

**Core electron excitations in  $U^{4+}$ : modelling of the  $nd^{10}5f^2 \rightarrow nd^95f^3$  transitions with  $n = 3, 4$  and  $5$  by ligand field tools and density functional theory**

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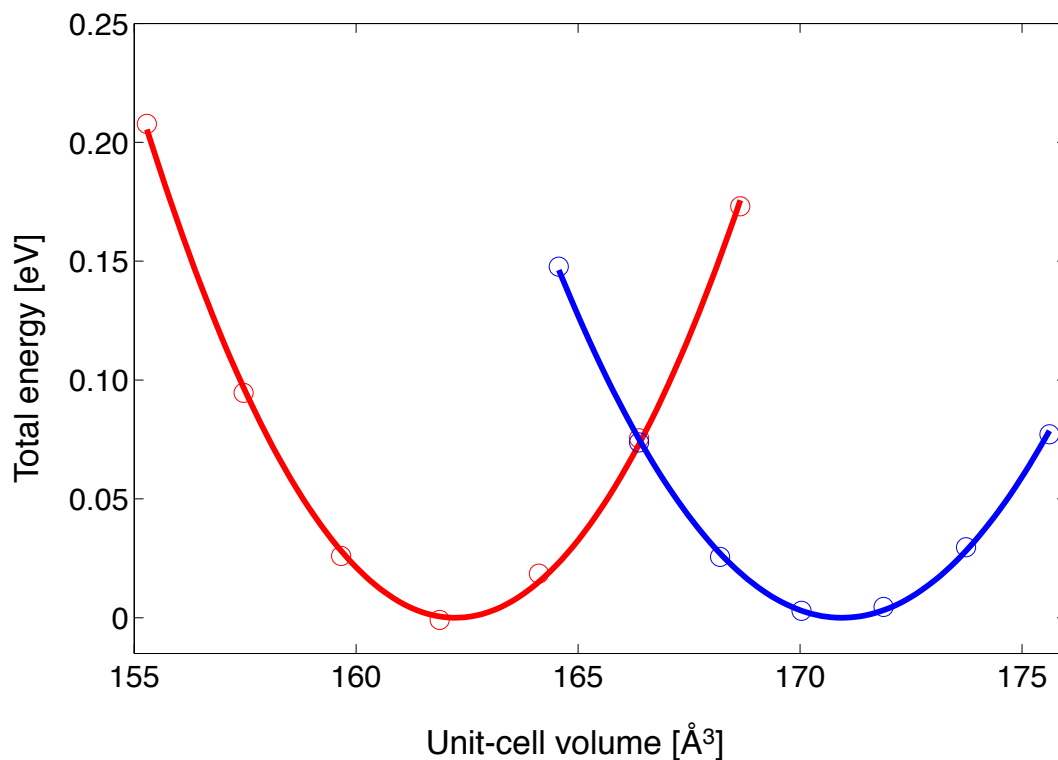
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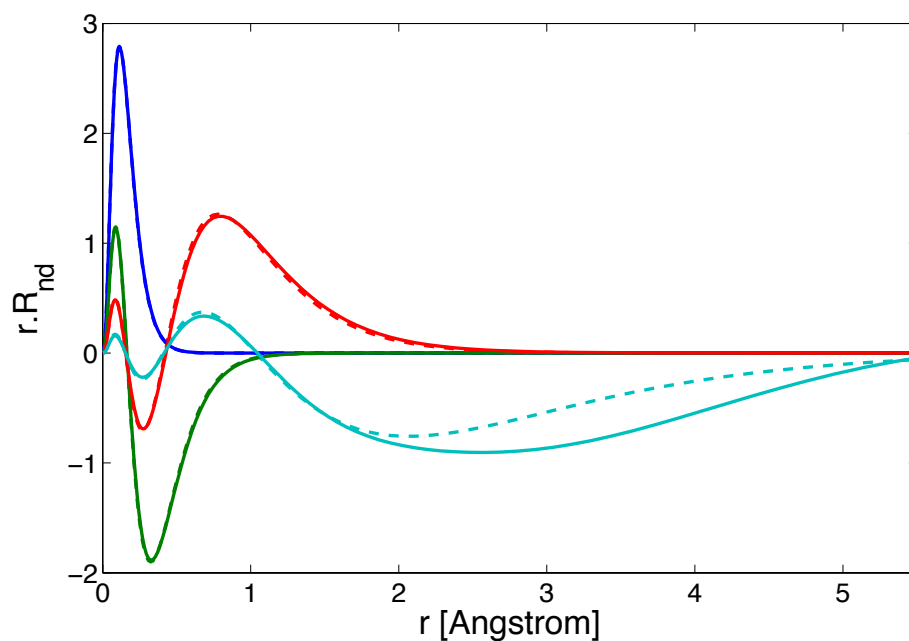
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**Electronic supplementary information (ESI): 63 pages**

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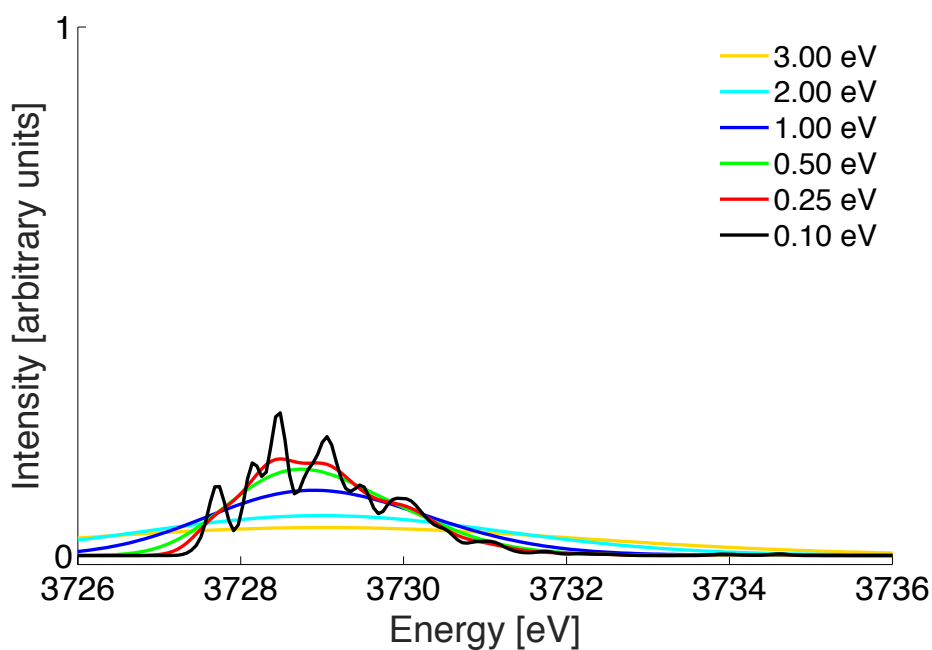
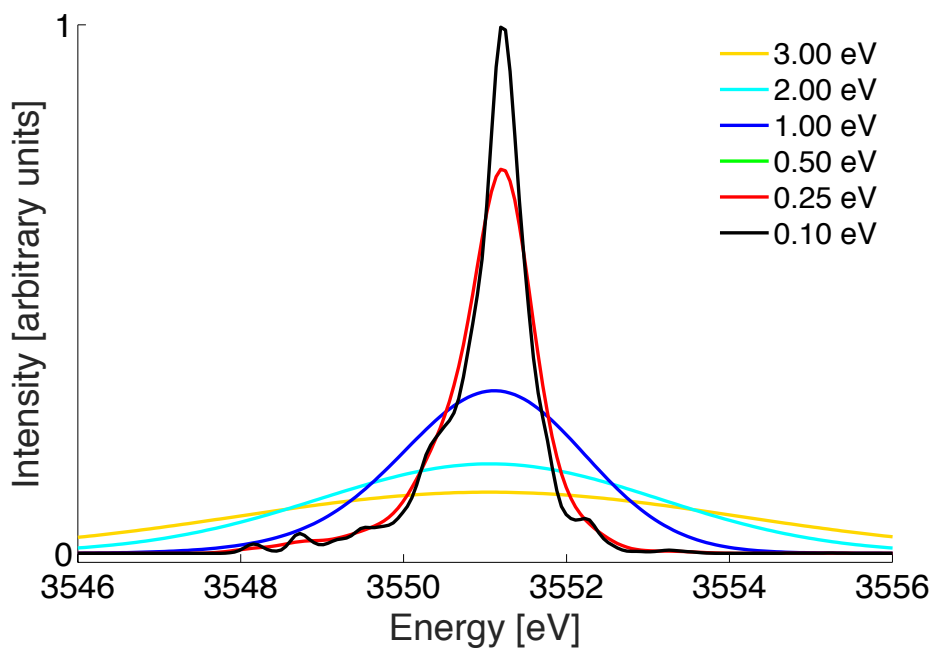
**Figure S1** Calculated total electronic energy with respect to the unit-cell volume of  $\text{UO}_2$  obtained at the LDA+ $U$  (in red colour) and the GGA+ $U$  levels of theory (in blue colour). The solid lines represent the fitting of the DFT results using the Birch-Murnaghan equation of state.



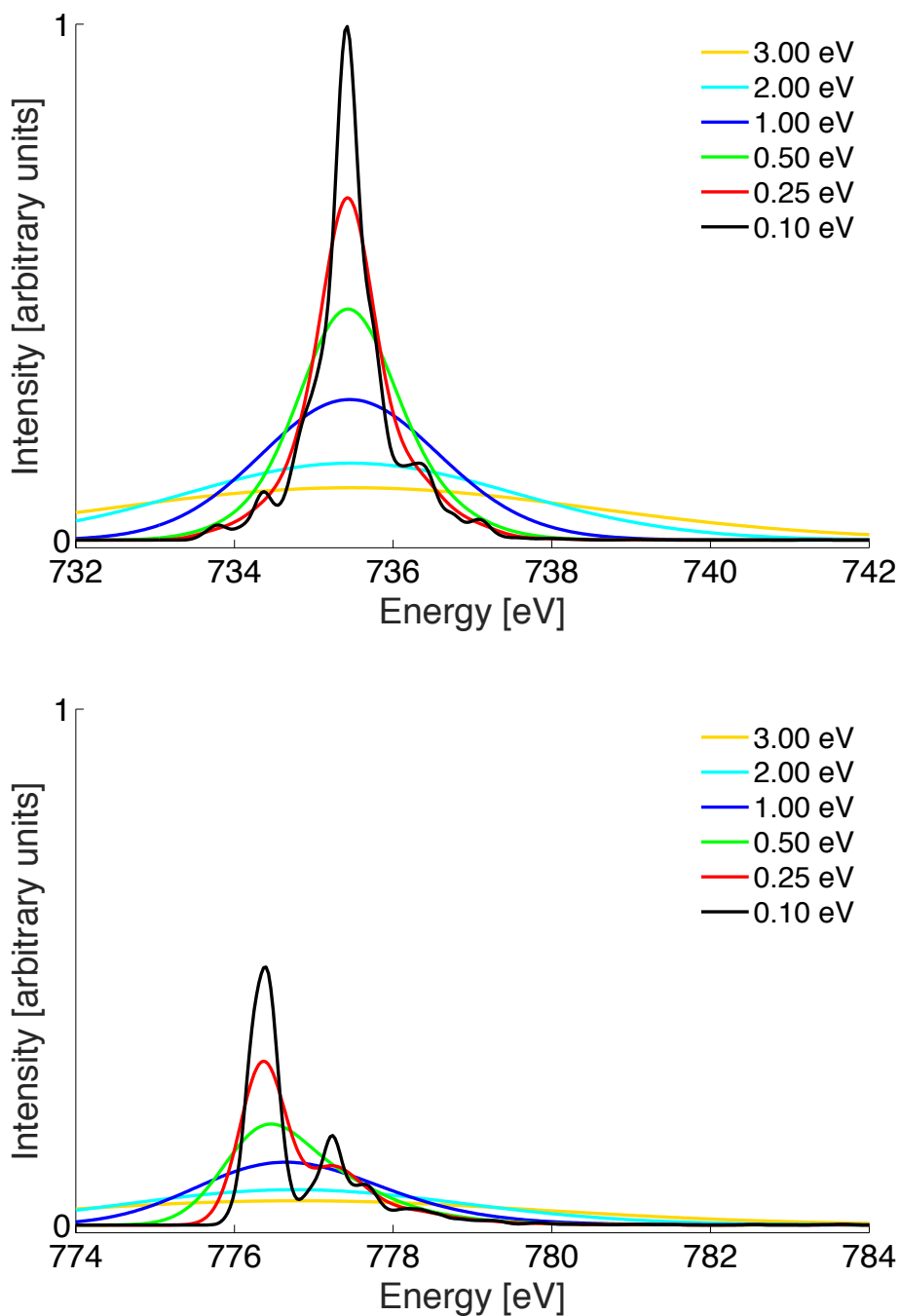
**Figure S2** Graphical representation of the change of the radial functions corresponding to the  $3d_{xy}$  (in blue),  $4d_{xy}$  (in green),  $5d_{xy}$  (in red) and  $6d_{xy}$  (in turquoise) Kohn-Sham orbitals of  $\text{U}^{4+}$  from the free ion (dashed lines) to the molecular cluster  $(\text{UO}_8)^{12-}$  embedded in  $\text{UO}_2$  (solid lines).

**Table S1** Numerical values for the multiplet energy levels (in eV) together with their degeneracy calculated for the ground  $5f^2$  configuration of  $U^{4+}$  in  $UO_2$  represented graphically in the right hand side of Figure 4.

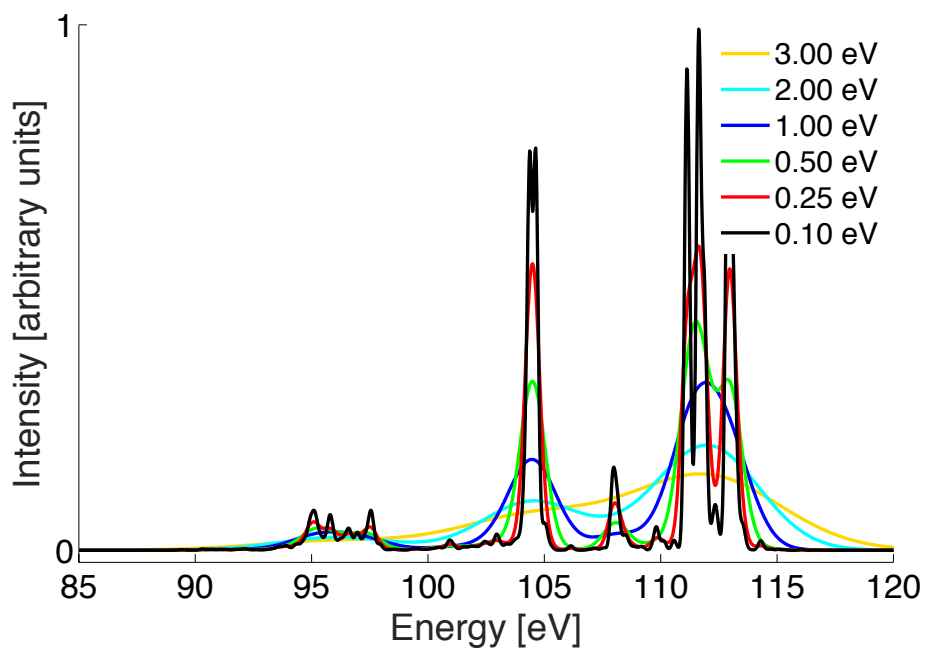
#	Multiplicity	Energy levels [eV]
1	3	0.0000
2	2	0.1805
3	3	0.2714
4	1	0.3195
5	3	0.6434
6	2	0.7484
7	3	0.7640
8	2	0.8518
9	3	0.9375
10	3	0.9979
11	3	1.1083
12	1	1.1708
13	3	1.2112
14	1	1.2153
15	3	1.2979
16	2	1.3080
17	3	1.5243
18	3	1.5330
19	1	1.5579
20	3	1.6116
21	2	1.6718
22	3	1.7143
23	1	2.0288
24	3	2.0789
25	2	2.1010
26	1	2.1403
27	3	2.1851
28	3	2.3437
29	2	2.3448
30	2	2.5572
31	3	2.5748
32	1	2.6165
33	1	2.6390
34	3	2.8978
35	3	3.0188
36	3	3.2063
37	2	3.2782
38	1	3.4251
39	3	3.5553
40	1	5.5041



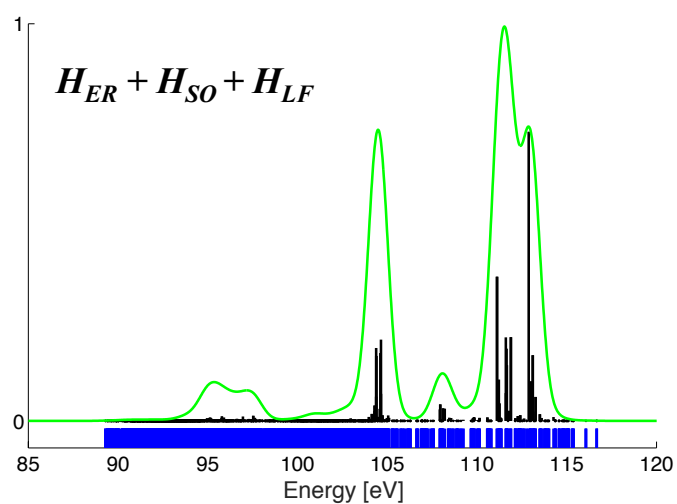
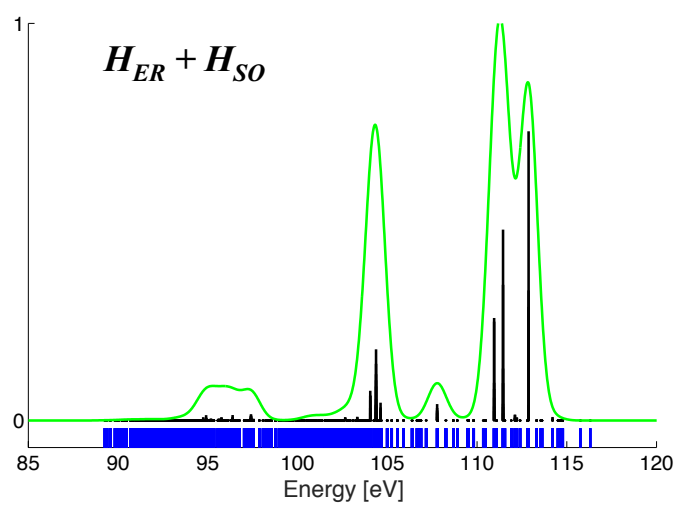
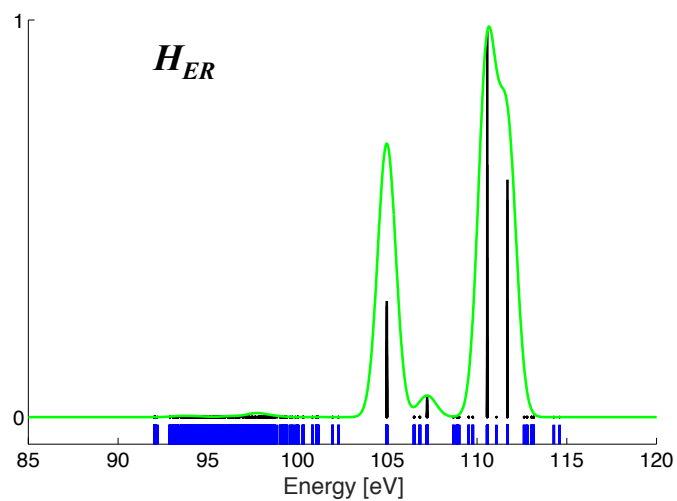
**Figure S3** Graphical representation showing the effect of Gaussian broadening of the oscillator strengths of the dipole allowed  $3d^{10}5f^2 \rightarrow 3d^95f^3$  transitions obtained from the LFDFT calculations of  $U^{4+}$  in  $UO_2$ . The energy values of the Gaussian half width parameter are given in the legend. The X-ray absorption profiles of  $UO_2$  at the uranium  $M_5$  and  $M_4$  edges are seen in the upper-panel and lower-panel of the figure, respectively.



**Figure S4** Graphical representation showing the effect of Gaussian broadening of the oscillator strengths of the dipole allowed  $4d^{10}5f^2 \rightarrow 4d^95f^3$  transitions obtained from the LFDFT calculations of  $U^{4+}$  in  $UO_2$ . The energy values of the Gaussian half width parameter are given in the legend. The X-ray absorption profiles of  $UO_2$  at the uranium  $N_5$  and  $N_4$  edges are seen in the upper-panel and lower-panel of the figure, respectively.



**Figure S5** Graphical representation showing the effect of Gaussian broadening of the oscillator strengths of the dipole allowed  $5d^{10}5f^2 \rightarrow 5d^95f^3$  transitions obtained from the LFDFT calculations of  $U^{4+}$  in  $UO_2$ . The figure represent the X-ray absorption profile of  $UO_2$  at the uranium  $O_{4,5}$  edge. The energy values of the Gaussian half width parameter are given in the legend.



**Figure S6** Calculated multiplet energy levels (in blue colour) of the  $5d^9 5f^2$  electron configuration of  $U^{4+}$  in  $UO_2$ ; together with the intensities of the absorption  $5d^{10} 5f^2 \rightarrow 5d^9 5f^3$  transitions, taking successively the effect of the inter-electron repulsion (top), the inter-electron repulsion plus the spin-orbit coupling (middle) and the inter-electron repulsion plus the spin-orbit coupling plus the ligand field interaction (bottom) into account.

**Table S2** Numerical values for the multiplet energy levels, degeneracies and oscillator strengths calculated for the  $3d^{10}5f^2 \rightarrow 3d^9 5f^3$  transitions of  $U^{4+}$  in  $UO_2$  represented graphically in the upper panel of Figure 5.

#	Multiplicity	Energy levels [eV]	Oscillator strength [-]
1	3	3547.9643	0.0000
2	2	3547.9778	0.0000
3	1	3547.9794	0.0001
4	3	3547.9927	0.0000
5	3	3548.0110	0.0001
6	1	3548.0598	0.0000
7	3	3548.0780	0.0000
8	2	3548.1081	0.0000
9	3	3548.1248	0.0011
10	3	3548.1325	0.0005
11	3	3548.1590	0.0004
12	2	3548.1661	0.0001
13	3	3548.1711	0.0000
14	3	3548.1788	0.0004
15	3	3548.1925	0.0000
16	1	3548.1932	0.0000
17	3	3548.2060	0.0000
18	2	3548.2111	0.0009
19	3	3548.2145	0.0001
20	1	3548.2261	0.0000
21	2	3548.3063	0.0000
22	3	3548.3140	0.0000
23	3	3548.3665	0.0000
24	3	3548.3866	0.0002
25	1	3548.4073	0.0002
26	3	3548.6010	0.0000
27	2	3548.6091	0.0000
28	3	3548.6169	0.0000
29	3	3548.6382	0.0000
30	3	3548.6486	0.0003
31	2	3548.6588	0.0004
32	3	3548.6640	0.0009
33	3	3548.6697	0.0004
34	3	3548.6781	0.0001
35	2	3548.6834	0.0000
36	1	3548.6842	0.0004
37	3	3548.6880	0.0000
38	1	3548.6887	0.0000
39	3	3548.6928	0.0000
40	3	3548.7014	0.0001
41	2	3548.7132	0.0004
42	3	3548.7138	0.0005
43	1	3548.7246	0.0000
44	1	3548.7348	0.0009
45	3	3548.7359	0.0026
46	1	3548.7894	0.0000
47	3	3548.8069	0.0001
48	2	3548.8122	0.0000
49	3	3548.8389	0.0001
50	3	3548.8465	0.0001
51	3	3548.8571	0.0000
52	1	3548.8616	0.0000
53	2	3548.8728	0.0006
54	3	3548.8866	0.0008
55	3	3548.9274	0.0005
56	1	3548.9625	0.0000
57	1	3548.9648	0.0000
58	3	3548.9687	0.0000
59	3	3548.9702	0.0002
60	2	3549.0107	0.0000
61	3	3549.0143	0.0001
62	3	3549.0266	0.0000
63	2	3549.0383	0.0002
64	3	3549.0595	0.0000
65	1	3549.0719	0.0000
66	3	3549.0721	0.0003
67	3	3549.0743	0.0000
68	3	3549.0802	0.0001
69	2	3549.0865	0.0001
70	3	3549.1079	0.0000
71	1	3549.1094	0.0001
72	3	3549.1118	0.0001
73	4	3549.1197	0.0001
74	2	3549.1402	0.0001
75	3	3549.1471	0.0010
76	3	3549.1547	0.0001
77	3	3549.1575	0.0004
78	3	3549.1664	0.0002
79	1	3549.1737	0.0000
80	2	3549.1742	0.0003
81	2	3549.1875	0.0001



82	3	3549.1899	0.0001
83	1	3549.2056	0.0000
84	3	3549.2198	0.0001
85	3	3549.2245	0.0001
86	3	3549.2247	0.0001
87	3	3549.2274	0.0000
88	2	3549.2284	0.0003
89	3	3549.2310	0.0000
90	3	3549.2327	0.0000
91	2	3549.2473	0.0002
92	3	3549.2483	0.0001
93	3	3549.2616	0.0004
94	1	3549.2621	0.0000
95	3	3549.2641	0.0001
96	1	3549.2756	0.0000
97	3	3549.2767	0.0001
98	3	3549.2788	0.0006
99	3	3549.2839	0.0002
100	1	3549.2885	0.0000
101	3	3549.3018	0.0000
102	2	3549.3083	0.0000
103	3	3549.3133	0.0000
104	2	3549.3222	0.0000
105	1	3549.3258	0.0001
106	5	3549.3263	0.0001
107	3	3549.3413	0.0000
108	1	3549.3490	0.0001
109	3	3549.3629	0.0003
110	3	3549.3803	0.0001
111	3	3549.3895	0.0000
112	3	3549.3910	0.0000
113	1	3549.3946	0.0000
114	3	3549.3990	0.0004
115	3	3549.4193	0.0000
116	2	3549.4195	0.0002
117	1	3549.4199	0.0000
118	3	3549.4250	0.0002
119	3	3549.4389	0.0003
120	2	3549.4392	0.0004
121	3	3549.4485	0.0000
122	3	3549.4494	0.0001
123	3	3549.4657	0.0019
124	1	3549.4660	0.0000
125	2	3549.4691	0.0000
126	3	3549.4740	0.0003
127	3	3549.4777	0.0003
128	2	3549.4806	0.0000
129	3	3549.4980	0.0007
130	3	3549.4984	0.0003
131	2	3549.5023	0.0002
132	3	3549.5121	0.0005
133	2	3549.5210	0.0007
134	1	3549.5227	0.0000
135	1	3549.5323	0.0000
136	3	3549.5454	0.0000
137	3	3549.5464	0.0000
138	5	3549.5487	0.0006
139	1	3549.5510	0.0000
140	3	3549.5549	0.0000
141	3	3549.5619	0.0004
142	3	3549.5624	0.0003
143	3	3549.5666	0.0000
144	5	3549.5678	0.0002
145	2	3549.5783	0.0001
146	1	3549.5954	0.0000
147	3	3549.5998	0.0003
148	3	3549.6006	0.0000
149	3	3549.6037	0.0001
150	3	3549.6068	0.0000
151	3	3549.6130	0.0001
152	1	3549.6196	0.0001
153	3	3549.6246	0.0004
154	3	3549.6248	0.0000
155	3	3549.6261	0.0000
156	2	3549.6295	0.0009
157	1	3549.6300	0.0000
158	2	3549.6403	0.0002
159	3	3549.6422	0.0000
160	1	3549.6501	0.0000
161	1	3549.6628	0.0003
162	3	3549.6638	0.0004
163	2	3549.6677	0.0000
164	1	3549.6684	0.0000
165	3	3549.6768	0.0000
166	3	3549.6785	0.0001
167	3	3549.6802	0.0002
168	3	3549.6895	0.0003

169	1	3549.6905	0.0000
170	3	3549.7002	0.0000
171	2	3549.7082	0.0000
172	3	3549.7155	0.0000
173	3	3549.7282	0.0003
174	2	3549.7319	0.0002
175	3	3549.7336	0.0000
176	3	3549.7344	0.0020
177	1	3549.7523	0.0001
178	2	3549.7554	0.0002
179	3	3549.7666	0.0014
180	2	3549.7681	0.0000
181	3	3549.7764	0.0007
182	1	3549.7791	0.0000
183	3	3549.7923	0.0003
184	3	3549.8058	0.0000
185	3	3549.8090	0.0001
186	1	3549.8139	0.0000
187	3	3549.8212	0.0002
188	3	3549.8257	0.0001
189	3	3549.8268	0.0003
190	2	3549.8323	0.0001
191	3	3549.8471	0.0000
192	3	3549.8497	0.0000
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194	2	3549.8538	0.0002
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202	3	3549.8833	0.0000
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204	3	3549.8971	0.0002
205	3	3549.9043	0.0007
206	1	3549.9074	0.0000
207	3	3549.9128	0.0001
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213	3	3549.9372	0.0003
214	1	3549.9441	0.0000
215	3	3549.9543	0.0004
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217	2	3549.9782	0.0020
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224	2	3550.0119	0.0000
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226	3	3550.0188	0.0004
227	3	3550.0242	0.0000
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230	1	3550.0437	0.0000
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232	3	3550.0501	0.0000
233	1	3550.0539	0.0000
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235	3	3550.0618	0.0002
236	2	3550.0643	0.0008
237	3	3550.0753	0.0000
238	3	3550.0767	0.0006
239	2	3550.0836	0.0001
240	3	3550.0894	0.0018
241	3	3550.0980	0.0014
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243	3	3550.1026	0.0003
244	1	3550.1053	0.0000
245	3	3550.1065	0.0004
246	3	3550.1142	0.0006
247	2	3550.1162	0.0006
248	3	3550.1192	0.0000
249	3	3550.1248	0.0000
250	1	3550.1298	0.0000
251	2	3550.1303	0.0000
252	1	3550.1311	0.0000
253	3	3550.1337	0.0003
254	3	3550.1413	0.0004
255	3	3550.1475	0.0000

256	3	3550.1486	0.0001
257	3	3550.1488	0.0003
258	3	3550.1515	0.0000
259	2	3550.1621	0.0004
260	1	3550.1685	0.0000
261	3	3550.1779	0.0001
262	3	3550.1781	0.0000
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265	1	3550.1852	0.0007
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267	2	3550.1913	0.0000
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273	1	3550.2129	0.0015
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275	2	3550.2203	0.0000
276	3	3550.2246	0.0000
277	3	3550.2270	0.0000
278	3	3550.2327	0.0009
279	3	3550.2338	0.0000
280	1	3550.2441	0.0023
281	3	3550.2444	0.0000
282	2	3550.2458	0.0001
283	3	3550.2506	0.0001
284	3	3550.2617	0.0000
285	2	3550.2618	0.0006
286	1	3550.2624	0.0000
287	3	3550.2720	0.0040
288	1	3550.2798	0.0002
289	3	3550.2829	0.0016
290	2	3550.2841	0.0003
291	1	3550.2877	0.0000
292	3	3550.2912	0.0001
293	3	3550.2928	0.0005
294	1	3550.2939	0.0000
295	2	3550.2969	0.0013
296	3	3550.3017	0.0015
297	3	3550.3056	0.0001
298	3	3550.3158	0.0002
299	2	3550.3160	0.0006
300	1	3550.3183	0.0000
301	3	3550.3215	0.0005
302	3	3550.3268	0.0060
303	1	3550.3328	0.0000
304	2	3550.3394	0.0003
305	3	3550.3397	0.0005
306	2	3550.3461	0.0004
307	6	3550.3472	0.0014
308	1	3550.3507	0.0000
309	3	3550.3515	0.0000
310	3	3550.3537	0.0002
311	3	3550.3579	0.0000
312	3	3550.3606	0.0004
313	2	3550.3695	0.0001
314	3	3550.3804	0.0003
315	2	3550.3820	0.0001
316	3	3550.3886	0.0000
317	3	3550.3903	0.0013
318	3	3550.3978	0.0005
319	1	3550.4034	0.0000
320	3	3550.4041	0.0002
321	2	3550.4087	0.0043
322	3	3550.4197	0.0008
323	2	3550.4230	0.0005
324	3	3550.4236	0.0003
325	1	3550.4297	0.0001
326	3	3550.4307	0.0019
327	3	3550.4425	0.0004
328	1	3550.4452	0.0005
329	3	3550.4541	0.0026
330	2	3550.4543	0.0000
331	3	3550.4546	0.0008
332	3	3550.4566	0.0003
333	4	3550.4699	0.0020
334	1	3550.4713	0.0000
335	3	3550.4741	0.0010
336	2	3550.4758	0.0000
337	1	3550.4839	0.0003
338	3	3550.4894	0.0003
339	3	3550.4905	0.0030
340	2	3550.4931	0.0002
341	3	3550.5028	0.0000
342	3	3550.5047	0.0008

343	3	3550.5127	0.0012
344	3	3550.5142	0.0002
345	3	3550.5284	0.0000
346	2	3550.5292	0.0008
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348	3	3550.5415	0.0008
349	1	3550.5431	0.0000
350	3	3550.5439	0.0015
351	3	3550.5467	0.0032
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362	2	3550.6013	0.0005
363	3	3550.6031	0.0006
364	3	3550.6059	0.0031
365	3	3550.6183	0.0001
366	1	3550.6239	0.0000
367	3	3550.6268	0.0002
368	1	3550.6287	0.0010
369	2	3550.6290	0.0004
370	1	3550.6320	0.0000
371	3	3550.6366	0.0001
372	3	3550.6377	0.0001
373	3	3550.6426	0.0006
374	3	3550.6503	0.0011
375	3	3550.6511	0.0008
376	2	3550.6545	0.0000
377	3	3550.6628	0.0000
378	3	3550.6629	0.0008
379	2	3550.6661	0.0003
380	3	3550.6703	0.0001
381	3	3550.6721	0.0014
382	2	3550.6730	0.0001
383	1	3550.6824	0.0000
384	3	3550.6870	0.0000
385	3	3550.6915	0.0036
386	1	3550.6965	0.0020
387	2	3550.7018	0.0040
388	1	3550.7030	0.0038
389	3	3550.7040	0.0013
390	3	3550.7051	0.0004
391	3	3550.7134	0.0000
392	3	3550.7168	0.0000
393	3	3550.7248	0.0012
394	2	3550.7350	0.0016
395	3	3550.7396	0.0000
396	3	3550.7409	0.0009
397	3	3550.7422	0.0003
398	3	3550.7549	0.0002
399	1	3550.7571	0.0000
400	2	3550.7607	0.0000
401	1	3550.7622	0.0000
402	3	3550.7704	0.0013
403	2	3550.7744	0.0016
404	3	3550.7763	0.0007
405	1	3550.7812	0.0000
406	3	3550.7813	0.0050
407	1	3550.7829	0.0003
408	2	3550.7858	0.0000
409	3	3550.7866	0.0026
410	3	3550.7888	0.0007
411	3	3550.7940	0.0000
412	2	3550.7979	0.0016
413	3	3550.7987	0.0009
414	3	3550.8121	0.0000
415	3	3550.8151	0.0008
416	1	3550.8197	0.0000
417	3	3550.8253	0.0000
418	3	3550.8273	0.0035
419	3	3550.8304	0.0046
420	2	3550.8336	0.0002
421	1	3550.8390	0.0063
422	3	3550.8395	0.0015
423	3	3550.8442	0.0003
424	2	3550.8466	0.0067
425	3	3550.8478	0.0000
426	3	3550.8487	0.0001
427	1	3550.8512	0.0000
428	1	3550.8568	0.0013
429	5	3550.8675	0.0005

430	3	3550.8678	0.0001
431	1	3550.8773	0.0000
432	2	3550.8805	0.0011
433	3	3550.8850	0.0042
434	2	3550.8893	0.0000
435	1	3550.8905	0.0000
436	3	3550.8913	0.0004
437	2	3550.8989	0.0023
438	3	3550.9007	0.0002
439	3	3550.9020	0.0001
440	3	3550.9055	0.0007
441	3	3550.9187	0.0007
442	2	3550.9197	0.0000
443	3	3550.9224	0.0010
444	1	3550.9246	0.0000
445	3	3550.9299	0.0020
446	3	3550.9326	0.0002
447	3	3550.9400	0.0000
448	1	3550.9405	0.0005
449	3	3550.9430	0.0039
450	3	3550.9457	0.0022
451	2	3550.9487	0.0002
452	3	3550.9522	0.0016
453	3	3550.9577	0.0010
454	3	3550.9609	0.0094
455	3	3550.9644	0.0021
456	3	3550.9696	0.0069
457	3	3550.9716	0.0014
458	2	3550.9764	0.0005
459	1	3550.9766	0.0010
460	3	3550.9777	0.0046
461	2	3550.9825	0.0035
462	3	3550.9893	0.0021
463	3	3550.9930	0.0000
464	2	3550.9977	0.0003
465	3	3550.9994	0.0000
466	1	3551.0038	0.0000
467	3	3551.0113	0.0023
468	3	3551.0114	0.0006
469	2	3551.0165	0.0023
470	1	3551.0212	0.0000
471	1	3551.0216	0.0008
472	3	3551.0244	0.0015
473	3	3551.0388	0.0000
474	3	3551.0480	0.0000
475	3	3551.0494	0.0005
476	3	3551.0563	0.0028
477	3	3551.0585	0.0021
478	2	3551.0635	0.0070
479	3	3551.0771	0.0001
480	3	3551.0856	0.0002
481	2	3551.0860	0.0029
482	1	3551.0973	0.0001
483	3	3551.0975	0.0003
484	3	3551.0979	0.0015
485	1	3551.1026	0.0000
486	1	3551.1046	0.0015
487	2	3551.1066	0.0009
488	3	3551.1075	0.0063
489	3	3551.1113	0.0012
490	2	3551.1150	0.0256
491	4	3551.1247	0.0004
492	1	3551.1330	0.0000
493	2	3551.1411	0.0045
494	3	3551.1447	0.0070
495	6	3551.1506	0.0361
496	3	3551.1577	0.0000
497	1	3551.1592	0.0000
498	3	3551.1612	0.0000
499	2	3551.1657	0.0035
500	3	3551.1743	0.0006
501	1	3551.1752	0.0000
502	3	3551.1773	0.0001
503	3	3551.1839	0.0007
504	2	3551.1854	0.0002
505	3	3551.1875	0.0033
506	3	3551.1938	0.0000
507	3	3551.2009	0.0121
508	3	3551.2085	0.0023
509	2	3551.2136	0.0007
510	3	3551.2242	0.0024
511	3	3551.2278	0.0125
512	1	3551.2285	0.0006
513	1	3551.2366	0.0000
514	2	3551.2370	0.0025
515	3	3551.2403	0.0000
516	3	3551.2453	0.0226

517	3	3551.2464	0.0004
518	2	3551.2465	0.0032
519	3	3551.2571	0.0004
520	1	3551.2627	0.0000
521	3	3551.2697	0.0011
522	2	3551.2700	0.0006
523	3	3551.2719	0.0001
524	1	3551.2744	0.0000
525	3	3551.2781	0.0179
526	3	3551.2825	0.0017
527	3	3551.2859	0.0018
528	3	3551.2985	0.0000
529	3	3551.3028	0.0012
530	3	3551.3033	0.0132
531	2	3551.3070	0.0047
532	3	3551.3140	0.0034
533	3	3551.3212	0.0098
534	2	3551.3251	0.0005
535	1	3551.3320	0.0000
536	3	3551.3354	0.0087
537	3	3551.3368	0.0008
538	3	3551.3425	0.0043
539	1	3551.3436	0.0013
540	2	3551.3453	0.0026
541	3	3551.3532	0.0001
542	2	3551.3544	0.0071
543	1	3551.3577	0.0000
544	1	3551.3604	0.0054
545	3	3551.3681	0.0014
546	3	3551.3705	0.0009
547	3	3551.3760	0.0024
548	2	3551.3792	0.0000
549	3	3551.3990	0.0004
550	1	3551.3992	0.0005
551	2	3551.4016	0.0001
552	3	3551.4031	0.0000
553	3	3551.4070	0.0008
554	3	3551.4111	0.0001
555	3	3551.4142	0.0003
556	2	3551.4167	0.0024
557	3	3551.4202	0.0002
558	1	3551.4206	0.0009
559	1	3551.4292	0.0000
560	3	3551.4329	0.0044
561	3	3551.4363	0.0038
562	3	3551.4373	0.0001
563	1	3551.4385	0.0066
564	1	3551.4422	0.0025
565	1	3551.4464	0.0008
566	3	3551.4525	0.0000
567	3	3551.4530	0.0050
568	2	3551.4595	0.0006
569	3	3551.4602	0.0038
570	5	3551.4670	0.0084
571	3	3551.4745	0.0012
572	3	3551.4812	0.0004
573	3	3551.4848	0.0005
574	2	3551.4894	0.0001
575	1	3551.4969	0.0000
576	3	3551.4990	0.0010
577	2	3551.5019	0.0011
578	3	3551.5053	0.0002
579	3	3551.5062	0.0031
580	3	3551.5091	0.0030
581	2	3551.5149	0.0027
582	3	3551.5208	0.0023
583	3	3551.5267	0.0013
584	3	3551.5275	0.0012
585	1	3551.5328	0.0000
586	3	3551.5365	0.0009
587	1	3551.5369	0.0028
588	2	3551.5446	0.0094
589	3	3551.5464	0.0019
590	3	3551.5478	0.0001
591	3	3551.5590	0.0001
592	3	3551.5598	0.0004
593	2	3551.5696	0.0020
594	6	3551.5752	0.0003
595	1	3551.5807	0.0000
596	2	3551.5875	0.0005
597	3	3551.5903	0.0000
598	3	3551.5939	0.0029
599	3	3551.5943	0.0017
600	2	3551.5974	0.0002
601	3	3551.6074	0.0035
602	3	3551.6078	0.0004
603	1	3551.6111	0.0009

604	2	3551.6177	0.0001
605	3	3551.6192	0.0001
606	3	3551.6248	0.0000
607	1	3551.6285	0.0000
608	1	3551.6452	0.0000
609	3	3551.6458	0.0001
610	3	3551.6472	0.0000
611	1	3551.6488	0.0003
612	2	3551.6521	0.0000
613	3	3551.6545	0.0016
614	2	3551.6564	0.0004
615	3	3551.6598	0.0017
616	3	3551.6604	0.0002
617	3	3551.6738	0.0000
618	3	3551.6807	0.0019
619	2	3551.6938	0.0002
620	3	3551.6944	0.0016
621	3	3551.6966	0.0044
622	3	3551.7001	0.0003
623	1	3551.7003	0.0002
624	3	3551.7049	0.0009
625	1	3551.7109	0.0000
626	3	3551.7246	0.0021
627	3	3551.7274	0.0001
628	3	3551.7296	0.0006
629	2	3551.7303	0.0008
630	3	3551.7407	0.0014
631	1	3551.7460	0.0068
632	3	3551.7525	0.0020
633	2	3551.7580	0.0001
634	2	3551.7610	0.0013
635	1	3551.7631	0.0000
636	3	3551.7660	0.0004
637	3	3551.7671	0.0008
638	3	3551.7762	0.0002
639	3	3551.7797	0.0018
640	3	3551.7871	0.0001
641	3	3551.7896	0.0001
642	2	3551.7920	0.0002
643	3	3551.7957	0.0001
644	3	3551.7982	0.0002
645	1	3551.7987	0.0000
646	1	3551.8015	0.0023
647	3	3551.8129	0.0006
648	2	3551.8195	0.0002
649	3	3551.8255	0.0005
650	3	3551.8311	0.0009
651	1	3551.8324	0.0009
652	2	3551.8348	0.0000
653	3	3551.8407	0.0007
654	3	3551.8482	0.0000
655	3	3551.8517	0.0000
656	1	3551.8558	0.0000
657	2	3551.8597	0.0005
658	3	3551.8607	0.0005
659	3	3551.8616	0.0000
660	1	3551.8649	0.0000
661	3	3551.8686	0.0002
662	2	3551.8699	0.0001
663	3	3551.8805	0.0001
664	3	3551.8879	0.0002
665	3	3551.8903	0.0000
666	3	3551.8982	0.0000
667	3	3551.9059	0.0003
668	3	3551.9138	0.0000
669	2	3551.9146	0.0000
670	3	3551.9239	0.0004
671	1	3551.9317	0.0000
672	2	3551.9354	0.0002
673	3	3551.9369	0.0003
674	1	3551.9446	0.0016
675	3	3551.9512	0.0002
676	3	3551.9564	0.0001
677	2	3551.9569	0.0001
678	1	3551.9687	0.0002
679	3	3551.9758	0.0000
680	3	3551.9805	0.0002
681	2	3551.9859	0.0000
682	1	3551.9891	0.0014
683	3	3551.9954	0.0015
684	3	3552.0057	0.0001
685	2	3552.0068	0.0001
686	2	3552.0191	0.0002
687	3	3552.0197	0.0001
688	3	3552.0304	0.0005
689	3	3552.0306	0.0000
690	4	3552.0324	0.0000

691	3	3552.0377	0.0000
692	2	3552.0503	0.0000
693	1	3552.0520	0.0008
694	3	3552.0557	0.0000
695	3	3552.0580	0.0016
696	3	3552.0642	0.0001
697	1	3552.0663	0.0000
698	3	3552.0671	0.0002
699	1	3552.0745	0.0000
700	3	3552.0813	0.0004
701	2	3552.0907	0.0001
702	1	3552.1036	0.0004
703	3	3552.1048	0.0000
704	2	3552.1095	0.0000
705	3	3552.1186	0.0002
706	3	3552.1285	0.0003
707	1	3552.1315	0.0000
708	2	3552.1319	0.0000
709	3	3552.1360	0.0000
710	1	3552.1440	0.0002
711	2	3552.1462	0.0000
712	3	3552.1477	0.0002
713	3	3552.1482	0.0006
714	3	3552.1687	0.0000
715	3	3552.1696	0.0003
716	3	3552.1753	0.0003
717	3	3552.1889	0.0001
718	3	3552.1921	0.0001
719	3	3552.1972	0.0001
720	2	3552.1979	0.0002
721	3	3552.1999	0.0003
722	1	3552.2104	0.0000
723	3	3552.2279	0.0004
724	3	3552.2317	0.0000
725	3	3552.2334	0.0001
726	1	3552.2365	0.0031
727	2	3552.2471	0.0000
728	3	3552.2513	0.0005
729	1	3552.2619	0.0000
730	6	3552.2691	0.0004
731	3	3552.2745	0.0000
732	2	3552.2850	0.0000
733	3	3552.2901	0.0011
734	3	3552.2950	0.0000
735	1	3552.2967	0.0018
736	3	3552.3075	0.0019
737	2	3552.3102	0.0002
738	3	3552.3331	0.0001
739	3	3552.3406	0.0001
740	1	3552.3447	0.0000
741	3	3552.3466	0.0002
742	1	3552.3605	0.0000
743	2	3552.3652	0.0001
744	3	3552.3781	0.0000
745	3	3552.3815	0.0000
746	2	3552.3885	0.0002
747	3	3552.3911	0.0000
748	3	3552.4078	0.0000
749	3	3552.4291	0.0007
750	1	3552.4341	0.0000
751	3	3552.4386	0.0000
752	3	3552.4501	0.0002
753	1	3552.4521	0.0004
754	2	3552.4596	0.0000
755	1	3552.4602	0.0000
756	3	3552.4735	0.0003
757	3	3552.4749	0.0001
758	3	3552.4833	0.0000
759	2	3552.4916	0.0000
760	3	3552.5116	0.0002
761	3	3552.5207	0.0000
762	3	3552.5223	0.0005
763	2	3552.5277	0.0000
764	1	3552.5427	0.0000
765	2	3552.5494	0.0000
766	3	3552.5640	0.0008
767	1	3552.5678	0.0000
768	3	3552.5700	0.0001
769	3	3552.5724	0.0000
770	3	3552.5903	0.0000
771	2	3552.5984	0.0001
772	1	3552.6145	0.0000
773	3	3552.6259	0.0000
774	3	3552.6438	0.0001
775	3	3552.6486	0.0000
776	1	3552.6766	0.0000
777	3	3552.6838	0.0001



778	2	3552.6853	0.0000
779	3	3552.7402	0.0000
780	2	3552.7432	0.0000
781	3	3552.7521	0.0000
782	3	3552.7544	0.0000
783	1	3552.7693	0.0000
784	3	3552.7880	0.0000
785	2	3552.7948	0.0000
786	3	3552.7979	0.0001
787	3	3552.8069	0.0000
788	1	3552.8086	0.0000
789	3	3552.8124	0.0000
790	3	3552.8275	0.0000
791	2	3552.8352	0.0000
792	3	3552.8429	0.0000
793	2	3552.8476	0.0001
794	3	3552.8581	0.0000
795	1	3552.8668	0.0001
796	3	3552.8748	0.0001
797	3	3552.8765	0.0000
798	1	3552.8989	0.0000
799	3	3552.8993	0.0000
800	3	3552.9002	0.0000
801	2	3552.9055	0.0000
802	1	3552.9224	0.0000
803	2	3552.9234	0.0000
804	1	3552.9358	0.0000
805	3	3552.9395	0.0000
806	3	3552.9440	0.0000
807	3	3552.9640	0.0000
808	3	3552.9858	0.0000
809	3	3552.9980	0.0000
810	3	3553.0061	0.0000
811	2	3553.0268	0.0000
812	1	3553.0298	0.0000
813	3	3553.0350	0.0000
814	3	3553.0375	0.0000
815	3	3553.0527	0.0000
816	3	3553.0552	0.0000
817	1	3553.0700	0.0002
818	3	3553.0766	0.0000
819	3	3553.0860	0.0000
820	2	3553.0968	0.0000
821	3	3553.1099	0.0000
822	3	3553.1554	0.0000
823	1	3553.1766	0.0000
824	3	3553.1818	0.0000
825	3	3553.1822	0.0000
826	2	3553.1884	0.0000
827	3	3553.1903	0.0000
828	1	3553.2100	0.0003
829	3	3553.2250	0.0000
830	2	3553.2321	0.0000
831	3	3553.2466	0.0001
832	3	3553.2552	0.0001
833	3	3553.2558	0.0000
834	2	3553.2582	0.0000
835	3	3553.2683	0.0000
836	1	3553.2789	0.0000
837	3	3553.2948	0.0002
838	3	3553.3031	0.0001
839	1	3553.3096	0.0002
840	3	3553.3290	0.0000
841	2	3553.3577	0.0000
842	3	3553.3722	0.0000
843	3	3553.3985	0.0001
844	3	3553.3991	0.0000
845	2	3553.4264	0.0000
846	3	3553.4448	0.0002
847	3	3553.4504	0.0000
848	1	3553.5074	0.0000
849	3	3553.5087	0.0000
850	1	3553.5272	0.0000
851	3	3553.5535	0.0001
852	1	3553.5561	0.0001
853	2	3553.6036	0.0000
854	3	3553.6438	0.0000
855	3	3553.6696	0.0000
856	2	3553.6800	0.0000
857	3	3553.6965	0.0000
858	3	3553.7329	0.0000
859	3	3553.7498	0.0000
860	3	3553.9872	0.0000
861	5	3554.3671	0.0000
862	3	3554.4163	0.0000
863	3	3554.4165	0.0000
864	1	3554.4195	0.0000

865	1	3554.4310	0.0000
866	3	3554.6409	0.0000
867	2	3554.6743	0.0000
868	3	3554.7321	0.0000
869	1	3554.7638	0.0000
870	3	3554.7688	0.0000
871	3	3554.7866	0.0000
872	3	3554.7950	0.0000
873	2	3554.8264	0.0000
874	3	3554.8484	0.0000
875	2	3554.8610	0.0000
876	1	3554.8657	0.0000
877	3	3554.8737	0.0000
878	3	3554.9454	0.0000
879	3	3555.0202	0.0000
880	1	3555.0238	0.0000
881	3	3555.0527	0.0000
882	2	3555.0676	0.0000
883	1	3555.1071	0.0000
884	3	3555.1305	0.0000
885	3	3555.1327	0.0000
886	3	3555.1792	0.0000
887	3	3555.2075	0.0000
888	2	3555.2152	0.0000
889	1	3555.2681	0.0000
890	3	3555.2708	0.0000
891	2	3555.2921	0.0000
892	3	3555.3028	0.0001
893	3	3555.3271	0.0000
894	3	3555.6171	0.0000

**Table S3** Numerical values for the multiplet energy levels, degeneracies and oscillator strength calculated for the  $3d^{10}5f^2 \rightarrow 3d^9 5f^3$  transitions of  $U^{4+}$  in  $UO_2$  represented graphically in the lower panel of Figure 5.

#	Multiplicity	Energy levels [eV]	Oscillator strength [-]
1	1	3727.3951	0.0000
2	1	3727.4010	0.0001
3	3	3727.4084	0.0002
4	3	3727.4116	0.0002
5	2	3727.5158	0.0025
6	3	3727.5268	0.0001
7	3	3727.6899	0.0177
8	2	3727.7629	0.0077
9	3	3727.7779	0.0001
10	3	3727.7876	0.0017
11	3	3727.9534	0.0002
12	3	3727.9572	0.0003
13	2	3727.9618	0.0001
14	3	3727.9731	0.0001
15	1	3727.9829	0.0014
16	3	3728.0264	0.0005
17	3	3728.0801	0.0000
18	3	3728.0813	0.0000
19	1	3728.0988	0.0043
20	1	3728.1051	0.0000
21	2	3728.1457	0.0062
22	3	3728.1505	0.0188
23	3	3728.1881	0.0004
24	3	3728.1993	0.0001
25	2	3728.2220	0.0001
26	3	3728.2427	0.0016
27	3	3728.2430	0.0031
28	1	3728.2721	0.0000
29	1	3728.2811	0.0000
30	3	3728.3075	0.0006
31	2	3728.3102	0.0001
32	1	3728.3405	0.0000
33	3	3728.3610	0.0006
34	3	3728.3938	0.0002
35	3	3728.3990	0.0036
36	2	3728.4026	0.0001
37	3	3728.4107	0.0001
38	3	3728.4457	0.0218
39	3	3728.4647	0.0121
40	2	3728.4998	0.0009
41	3	3728.5072	0.0025
42	2	3728.5101	0.0105
43	3	3728.5159	0.0008
44	1	3728.5265	0.0000
45	3	3728.5664	0.0003
46	1	3728.5703	0.0008
47	3	3728.5711	0.0001
48	1	3728.6153	0.0009
49	2	3728.6188	0.0001

50	1	3728.6384	0.0000
51	3	3728.6584	0.0000
52	3	3728.6628	0.0004
53	3	3728.6744	0.0000
54	3	3728.6798	0.0001
55	1	3728.6889	0.0000
56	3	3728.6932	0.0004
57	1	3728.6943	0.0001
58	3	3728.7152	0.0027
59	2	3728.7179	0.0002
60	3	3728.7291	0.0005
61	3	3728.7381	0.0006
62	3	3728.7413	0.0002
63	2	3728.7492	0.0010
64	1	3728.7545	0.0000
65	2	3728.7628	0.0002
66	3	3728.7693	0.0004
67	3	3728.7909	0.0004
68	3	3728.8040	0.0134
69	1	3728.8111	0.0015
70	2	3728.8184	0.0000
71	3	3728.8375	0.0000
72	3	3728.8444	0.0009
73	3	3728.8457	0.0007
74	2	3728.8598	0.0019
75	3	3728.8604	0.0000
76	3	3728.8686	0.0000
77	1	3728.8812	0.0000
78	3	3728.8857	0.0005
79	1	3728.8874	0.0005
80	1	3728.8896	0.0000
81	3	3728.9143	0.0000
82	3	3728.9256	0.0030
83	1	3728.9259	0.0005
84	3	3728.9280	0.0005
85	3	3728.9319	0.0000
86	2	3728.9362	0.0008
87	3	3728.9539	0.0038
88	3	3728.9561	0.0001
89	2	3728.9628	0.0024
90	1	3728.9821	0.0000
91	3	3728.9961	0.0015
92	3	3729.0043	0.0000
93	2	3729.0187	0.0001
94	1	3729.0306	0.0000
95	3	3729.0348	0.0001
96	3	3729.0351	0.0015
97	3	3729.0465	0.0016
98	2	3729.0561	0.0011
99	3	3729.0570	0.0078
100	3	3729.0628	0.0000
101	1	3729.0700	0.0055
102	3	3729.0718	0.0060
103	2	3729.0920	0.0016
104	3	3729.0951	0.0006
105	1	3729.1001	0.0053
106	3	3729.1069	0.0000
107	3	3729.1181	0.0002
108	3	3729.1249	0.0005
109	3	3729.1343	0.0001
110	2	3729.1446	0.0000
111	3	3729.1481	0.0000
112	2	3729.1533	0.0002
113	3	3729.1605	0.0001
114	1	3729.1640	0.0000
115	3	3729.1792	0.0000
116	2	3729.1887	0.0002
117	3	3729.1996	0.0001
118	3	3729.2019	0.0016
119	3	3729.2235	0.0081
120	3	3729.2317	0.0001
121	2	3729.2340	0.0001
122	3	3729.2427	0.0000
123	2	3729.2513	0.0000
124	3	3729.2520	0.0002
125	3	3729.2555	0.0003
126	3	3729.2672	0.0004
127	3	3729.2737	0.0015
128	2	3729.2768	0.0003
129	1	3729.2779	0.0000
130	3	3729.2975	0.0001
131	1	3729.3020	0.0006
132	3	3729.3131	0.0025
133	3	3729.3143	0.0001
134	2	3729.3174	0.0004
135	3	3729.3241	0.0010
136	1	3729.3347	0.0000

137	2	3729.3416	0.0011
138	3	3729.3488	0.0000
139	3	3729.3573	0.0011
140	3	3729.3693	0.0000
141	3	3729.3875	0.0000
142	2	3729.3921	0.0000
143	3	3729.3926	0.0000
144	3	3729.3951	0.0002
145	1	3729.3972	0.0000
146	1	3729.3993	0.0001
147	1	3729.4051	0.0000
148	3	3729.4223	0.0001
149	3	3729.4314	0.0003
150	3	3729.4341	0.0009
151	2	3729.4513	0.0004
152	1	3729.4534	0.0072
153	3	3729.4579	0.0004
154	1	3729.4650	0.0000
155	3	3729.4808	0.0001
156	3	3729.4859	0.0042
157	2	3729.4861	0.0008
158	2	3729.5006	0.0001
159	1	3729.5008	0.0000
160	3	3729.5049	0.0001
161	3	3729.5091	0.0000
162	2	3729.5146	0.0001
163	3	3729.5152	0.0006
164	3	3729.5181	0.0000
165	3	3729.5387	0.0002
166	3	3729.5390	0.0055
167	1	3729.5511	0.0001
168	3	3729.5530	0.0000
169	2	3729.5559	0.0001
170	3	3729.5565	0.0001
171	1	3729.5573	0.0000
172	3	3729.5626	0.0007
173	3	3729.5811	0.0005
174	3	3729.5873	0.0000
175	3	3729.5889	0.0001
176	2	3729.5920	0.0003
177	3	3729.6028	0.0011
178	2	3729.6134	0.0000
179	1	3729.6163	0.0000
180	1	3729.6167	0.0000
181	3	3729.6214	0.0000
182	3	3729.6242	0.0016
183	3	3729.6332	0.0003
184	5	3729.6350	0.0002
185	1	3729.6425	0.0000
186	3	3729.6486	0.0002
187	3	3729.6503	0.0002
188	1	3729.6716	0.0000
189	1	3729.6823	0.0000
190	3	3729.6868	0.0007
191	1	3729.6907	0.0000
192	3	3729.6916	0.0000
193	3	3729.6947	0.0005
194	2	3729.6965	0.0000
195	3	3729.7057	0.0001
196	3	3729.7156	0.0001
197	3	3729.7187	0.0010
198	1	3729.7218	0.0000
199	3	3729.7263	0.0001
200	3	3729.7365	0.0004
201	2	3729.7389	0.0003
202	3	3729.7488	0.0004
203	3	3729.7567	0.0001
204	2	3729.7593	0.0000
205	3	3729.7691	0.0005
206	1	3729.7719	0.0000
207	3	3729.7743	0.0003
208	3	3729.7881	0.0001
209	2	3729.7964	0.0001
210	3	3729.7967	0.0000
211	3	3729.8083	0.0007
212	3	3729.8091	0.0002
213	1	3729.8130	0.0000
214	2	3729.8176	0.0002
215	6	3729.8180	0.0001
216	2	3729.8224	0.0000
217	3	3729.8303	0.0001
218	3	3729.8386	0.0017
219	3	3729.8421	0.0000
220	3	3729.8507	0.0018
221	1	3729.8538	0.0071
222	3	3729.8564	0.0004
223	1	3729.8610	0.0000

224	3	3729.8753	0.0000
225	2	3729.8814	0.0001
226	3	3729.8866	0.0000
227	3	3729.8930	0.0001
228	3	3729.8983	0.0005
229	1	3729.9131	0.0003
230	3	3729.9175	0.0000
231	3	3729.9270	0.0002
232	3	3729.9281	0.0010
233	2	3729.9317	0.0000
234	2	3729.9447	0.0001
235	1	3729.9504	0.0000
236	1	3729.9529	0.0014
237	1	3729.9533	0.0000
238	5	3729.9588	0.0002
239	3	3729.9681	0.0001
240	3	3729.9799	0.0014
241	2	3729.9858	0.0001
242	1	3729.9894	0.0000
243	3	3729.9962	0.0000
244	2	3730.0100	0.0001
245	3	3730.0266	0.0012
246	1	3730.0307	0.0052
247	3	3730.0374	0.0005
248	2	3730.0416	0.0000
249	3	3730.0481	0.0002
250	3	3730.0484	0.0000
251	3	3730.0543	0.0001
252	2	3730.0715	0.0000
253	3	3730.0720	0.0022
254	3	3730.0906	0.0000
255	3	3730.0933	0.0004
256	2	3730.0952	0.0000
257	1	3730.0958	0.0001
258	3	3730.0974	0.0000
259	1	3730.1026	0.0000
260	1	3730.1071	0.0000
261	3	3730.1073	0.0002
262	3	3730.1095	0.0000
263	3	3730.1154	0.0007
264	1	3730.1177	0.0000
265	2	3730.1310	0.0001
266	1	3730.1326	0.0036
267	3	3730.1348	0.0003
268	3	3730.1378	0.0001
269	1	3730.1435	0.0000
270	3	3730.1484	0.0010
271	3	3730.1594	0.0001
272	2	3730.1633	0.0005
273	3	3730.1636	0.0001
274	2	3730.1654	0.0001
275	3	3730.1798	0.0005
276	3	3730.1822	0.0003
277	3	3730.1895	0.0001
278	3	3730.2007	0.0002
279	3	3730.2043	0.0000
280	2	3730.2076	0.0000
281	1	3730.2187	0.0001
282	3	3730.2195	0.0000
283	3	3730.2211	0.0006
284	1	3730.2474	0.0000
285	3	3730.2483	0.0005
286	2	3730.2486	0.0000
287	3	3730.2512	0.0003
288	3	3730.2624	0.0001
289	3	3730.2689	0.0012
290	1	3730.2693	0.0023
291	3	3730.2747	0.0001
292	3	3730.2802	0.0000
293	2	3730.2838	0.0000
294	3	3730.2945	0.0007
295	3	3730.3047	0.0001
296	1	3730.3059	0.0000
297	2	3730.3108	0.0001
298	3	3730.3166	0.0001
299	3	3730.3177	0.0015
300	3	3730.3225	0.0004
301	2	3730.3290	0.0000
302	1	3730.3373	0.0000
303	3	3730.3384	0.0002
304	3	3730.3406	0.0001
305	1	3730.3424	0.0001
306	3	3730.3499	0.0000
307	2	3730.3502	0.0001
308	3	3730.3552	0.0002
309	3	3730.3558	0.0001
310	1	3730.3667	0.0000

311	3	3730.3737	0.0001
312	3	3730.3883	0.0003
313	2	3730.3905	0.0001
314	1	3730.3949	0.0000
315	2	3730.3975	0.0001
316	3	3730.4056	0.0002
317	3	3730.4116	0.0000
318	3	3730.4225	0.0003
319	1	3730.4229	0.0001
320	2	3730.4233	0.0000
321	3	3730.4283	0.0001
322	3	3730.4366	0.0004
323	3	3730.4497	0.0003
324	2	3730.4506	0.0000
325	3	3730.4606	0.0000
326	1	3730.4637	0.0000
327	3	3730.4639	0.0001
328	1	3730.4680	0.0016
329	3	3730.4727	0.0009
330	3	3730.4819	0.0000
331	3	3730.4875	0.0002
332	3	3730.4902	0.0003
333	3	3730.5026	0.0001
334	2	3730.5054	0.0001
335	2	3730.5099	0.0000
336	3	3730.5210	0.0000
337	3	3730.5221	0.0014
338	2	3730.5297	0.0001
339	3	3730.5378	0.0001
340	1	3730.5428	0.0003
341	3	3730.5511	0.0001
342	3	3730.5518	0.0002
343	1	3730.5574	0.0000
344	3	3730.5590	0.0002
345	1	3730.5639	0.0002
346	3	3730.5689	0.0002
347	2	3730.5702	0.0000
348	3	3730.5792	0.0000
349	3	3730.5838	0.0001
350	3	3730.5840	0.0000
351	3	3730.5858	0.0001
352	2	3730.5925	0.0001
353	1	3730.5943	0.0000
354	2	3730.5998	0.0000
355	3	3730.6047	0.0002
356	3	3730.6106	0.0007
357	3	3730.6241	0.0001
358	3	3730.6308	0.0001
359	2	3730.6338	0.0001
360	1	3730.6396	0.0008
361	1	3730.6458	0.0000
362	3	3730.6549	0.0000
363	2	3730.6618	0.0000
364	3	3730.6623	0.0000
365	3	3730.6672	0.0000
366	1	3730.6679	0.0000
367	1	3730.6694	0.0000
368	3	3730.6743	0.0002
369	2	3730.6789	0.0000
370	1	3730.6938	0.0000
371	3	3730.6972	0.0000
372	3	3730.7006	0.0000
373	3	3730.7074	0.0000
374	3	3730.7129	0.0000
375	2	3730.7175	0.0000
376	3	3730.7199	0.0000
377	1	3730.7215	0.0000
378	3	3730.7241	0.0000
379	3	3730.7256	0.0000
380	3	3730.7379	0.0003
381	3	3730.7417	0.0001
382	2	3730.7527	0.0000
383	3	3730.7528	0.0000
384	1	3730.7545	0.0002
385	3	3730.7594	0.0000
386	2	3730.7605	0.0001
387	1	3730.7665	0.0000
388	3	3730.7735	0.0001
389	2	3730.7740	0.0000
390	3	3730.7800	0.0000
391	3	3730.8010	0.0002
392	3	3730.8044	0.0000
393	3	3730.8183	0.0000
394	2	3730.8192	0.0000
395	3	3730.8261	0.0005
396	3	3730.8410	0.0002
397	4	3730.8459	0.0000

398	1	3730.8469	0.0006
399	2	3730.8566	0.0000
400	2	3730.8692	0.0000
401	3	3730.8696	0.0007
402	3	3730.8702	0.0000
403	3	3730.8724	0.0000
404	2	3730.8942	0.0000
405	3	3730.8948	0.0001
406	3	3730.8949	0.0000
407	1	3730.8981	0.0000
408	3	3730.9173	0.0001
409	3	3730.9191	0.0000
410	1	3730.9239	0.0000
411	3	3730.9297	0.0008
412	1	3730.9344	0.0003
413	3	3730.9396	0.0000
414	1	3730.9420	0.0000
415	2	3730.9454	0.0000
416	2	3730.9496	0.0001
417	3	3730.9570	0.0002
418	1	3730.9580	0.0000
419	3	3730.9597	0.0002
420	3	3730.9668	0.0000
421	3	3730.9899	0.0000
422	2	3731.0035	0.0001
423	3	3731.0057	0.0000
424	3	3731.0117	0.0000
425	3	3731.0276	0.0007
426	2	3731.0293	0.0000
427	1	3731.0331	0.0002
428	3	3731.0343	0.0000
429	3	3731.0372	0.0000
430	3	3731.0391	0.0000
431	1	3731.0414	0.0000
432	3	3731.0472	0.0001
433	1	3731.0558	0.0000
434	2	3731.0716	0.0002
435	3	3731.0728	0.0000
436	3	3731.0818	0.0002
437	3	3731.0909	0.0006
438	3	3731.0979	0.0004
439	2	3731.1021	0.0001
440	3	3731.1120	0.0002
441	3	3731.1145	0.0000
442	2	3731.1165	0.0001
443	3	3731.1246	0.0000
444	3	3731.1309	0.0002
445	3	3731.1311	0.0000
446	1	3731.1461	0.0011
447	3	3731.1492	0.0001
448	1	3731.1540	0.0000
449	3	3731.1746	0.0000
450	3	3731.1749	0.0000
451	2	3731.1865	0.0001
452	3	3731.1893	0.0000
453	3	3731.1970	0.0000
454	3	3731.2187	0.0000
455	2	3731.2218	0.0000
456	1	3731.2239	0.0000
457	3	3731.2256	0.0000
458	3	3731.2311	0.0002
459	1	3731.2379	0.0000
460	2	3731.2392	0.0001
461	3	3731.2418	0.0001
462	3	3731.2485	0.0001
463	1	3731.2597	0.0000
464	3	3731.2689	0.0000
465	3	3731.2743	0.0001
466	3	3731.2832	0.0002
467	2	3731.2840	0.0000
468	1	3731.2978	0.0000
469	3	3731.3000	0.0000
470	3	3731.3044	0.0004
471	3	3731.3148	0.0000
472	1	3731.3238	0.0001
473	3	3731.3306	0.0000
474	1	3731.3364	0.0001
475	2	3731.3624	0.0000
476	3	3731.3636	0.0001
477	3	3731.3689	0.0000
478	2	3731.3799	0.0000
479	3	3731.3839	0.0000
480	3	3731.3885	0.0000
481	3	3731.4009	0.0000
482	3	3731.4012	0.0000
483	1	3731.4026	0.0000
484	1	3731.4119	0.0000

485	3	3731.4281	0.0001
486	3	3731.4323	0.0000
487	2	3731.4360	0.0001
488	3	3731.4430	0.0000
489	1	3731.4496	0.0000
490	2	3731.4542	0.0000
491	3	3731.4552	0.0001
492	3	3731.4694	0.0000
493	3	3731.4718	0.0000
494	1	3731.4736	0.0000
495	2	3731.4843	0.0000
496	2	3731.5005	0.0000
497	3	3731.5027	0.0000
498	3	3731.5233	0.0003
499	3	3731.5244	0.0000
500	2	3731.5318	0.0000
501	3	3731.5545	0.0000
502	3	3731.5871	0.0000
503	1	3731.5888	0.0002
504	3	3731.5908	0.0000
505	1	3731.5983	0.0000
506	3	3731.6080	0.0000
507	2	3731.6089	0.0000
508	3	3731.6126	0.0001
509	3	3731.6252	0.0000
510	1	3731.6317	0.0000
511	3	3731.6824	0.0000
512	2	3731.6870	0.0000
513	3	3731.6899	0.0000
514	3	3731.7125	0.0001
515	3	3731.7183	0.0000
516	3	3731.7313	0.0000
517	3	3731.7403	0.0002
518	3	3731.7452	0.0002
519	2	3731.7580	0.0001
520	1	3731.7623	0.0006
521	1	3731.7691	0.0000
522	3	3731.7715	0.0000
523	3	3731.7928	0.0000
524	1	3731.7946	0.0000
525	3	3731.8197	0.0000
526	3	3731.8288	0.0001
527	1	3731.8414	0.0000
528	2	3731.8427	0.0000
529	3	3731.8537	0.0000
530	2	3731.8595	0.0000
531	3	3731.8820	0.0001
532	3	3731.9094	0.0000
533	2	3731.9168	0.0000
534	3	3731.9289	0.0000
535	2	3731.9813	0.0000
536	3	3732.0008	0.0000
537	3	3732.0125	0.0000
538	3	3732.0362	0.0000
539	3	3732.0498	0.0001
540	1	3732.0582	0.0002
541	3	3732.0784	0.0000
542	3	3732.1496	0.0001
543	3	3732.1535	0.0000
544	1	3732.1778	0.0000
545	2	3732.1855	0.0000
546	3	3732.2099	0.0002
547	2	3732.2202	0.0000
548	3	3732.2603	0.0000
549	3	3732.2664	0.0000
550	1	3732.2999	0.0000
551	1	3732.3050	0.0000
552	3	3732.3057	0.0000
553	3	3732.3238	0.0000
554	3	3732.3240	0.0002
555	2	3732.3357	0.0000
556	3	3732.3510	0.0000
557	1	3732.3556	0.0000
558	3	3732.3589	0.0001
559	3	3732.3886	0.0000
560	2	3732.4045	0.0000
561	3	3732.4160	0.0000
562	3	3732.4212	0.0000
563	3	3732.4283	0.0001
564	1	3732.4374	0.0000
565	2	3732.4902	0.0000
566	1	3732.5411	0.0003
567	1	3732.5815	0.0000
568	3	3732.5835	0.0000
569	2	3732.5989	0.0000
570	3	3732.6011	0.0000
571	3	3732.6320	0.0000



572	3	3732.6422	0.0000
573	2	3732.6500	0.0000
574	3	3732.6797	0.0000
575	3	3732.6904	0.0000
576	3	3732.7143	0.0000
577	2	3732.7470	0.0000
578	3	3732.7625	0.0000
579	3	3732.8072	0.0000
580	3	3732.8094	0.0000
581	1	3732.8376	0.0000
582	1	3733.7130	0.0000
583	2	3733.7912	0.0000
584	3	3733.7914	0.0001
585	3	3733.8046	0.0000
586	3	3733.8823	0.0000
587	3	3733.9313	0.0004
588	2	3733.9637	0.0000
589	3	3733.9932	0.0000
590	3	3734.0488	0.0000
591	2	3734.0974	0.0000
592	3	3734.1214	0.0000
593	1	3734.1233	0.0002
594	3	3734.2153	0.0000
595	2	3734.2495	0.0000
596	3	3734.2680	0.0000
597	3	3734.4112	0.0000
598	2	3734.4522	0.0000
599	3	3734.4575	0.0001
600	1	3734.5430	0.0000
601	3	3734.5734	0.0001
602	1	3734.6119	0.0003
603	3	3734.6379	0.0002
604	3	3734.6965	0.0001

**Table S4** Numerical values for the multiplet energy levels, degeneracies and oscillator strength calculated for the  $4d^{10}5f^2 \rightarrow 4d^95f^3$  transitions of  $U^{4+}$  in  $UO_2$  represented graphically in the upper panel of Figure 6.

#	Multiplicity	Energy levels [eV]	Oscillator strength [-]
1	3	733.6088	0.0000
2	1	733.6167	0.0011
3	2	733.6514	0.0000
4	3	733.6535	0.0006
5	3	733.6642	0.0000
6	1	733.7270	0.0000
7	3	733.7272	0.0000
8	3	733.7694	0.0038
9	2	733.7753	0.0001
10	3	733.8135	0.0003
11	2	733.8591	0.0005
12	3	733.8622	0.0011
13	3	733.8930	0.0000
14	3	733.9045	0.0002
15	2	733.9089	0.0004
16	3	733.9282	0.0002
17	1	733.9410	0.0001
18	3	733.9681	0.0000
19	3	733.9684	0.0000
20	1	733.9926	0.0000
21	3	734.0227	0.0000
22	2	734.0347	0.0008
23	3	734.0630	0.0008
24	3	734.1131	0.0021
25	1	734.1510	0.0012
26	3	734.2549	0.0019
27	2	734.2674	0.0000
28	3	734.2711	0.0002
29	3	734.2801	0.0002
30	3	734.3062	0.0001
31	2	734.3173	0.0000
32	1	734.3228	0.0045
33	3	734.3307	0.0015
34	1	734.3387	0.0000
35	3	734.3490	0.0013
36	3	734.3495	0.0002
37	1	734.3617	0.0000
38	3	734.3755	0.0059
39	3	734.3811	0.0001
40	2	734.3909	0.0025
41	3	734.3917	0.0000
42	2	734.4308	0.0001
43	3	734.4411	0.0024
44	3	734.4413	0.0000
45	2	734.4521	0.0005
46	3	734.4534	0.0005

47	1	734.4825	0.0003
48	3	734.4907	0.0005
49	1	734.5020	0.0000
50	3	734.5037	0.0004
51	1	734.5195	0.0001
52	3	734.5207	0.0000
53	2	734.5459	0.0000
54	3	734.5679	0.0007
55	3	734.5697	0.0009
56	2	734.5809	0.0011
57	3	734.5996	0.0010
58	1	734.6160	0.0000
59	3	734.6237	0.0006
60	1	734.6270	0.0004
61	3	734.6392	0.0015
62	3	734.6443	0.0001
63	2	734.6536	0.0003
64	3	734.6674	0.0020
65	3	734.6744	0.0015
66	1	734.6960	0.0000
67	1	734.7300	0.0000
68	3	734.7317	0.0027
69	1	734.7375	0.0002
70	3	734.7383	0.0002
71	2	734.7509	0.0009
72	3	734.7623	0.0027
73	3	734.7670	0.0002
74	2	734.7776	0.0005
75	3	734.7778	0.0067
76	3	734.7806	0.0005
77	3	734.8006	0.0001
78	3	734.8007	0.0005
79	1	734.8045	0.0000
80	2	734.8270	0.0038
81	3	734.8280	0.0002
82	1	734.8300	0.0013
83	3	734.8326	0.0020
84	1	734.8361	0.0000
85	3	734.8470	0.0000
86	2	734.8562	0.0002
87	3	734.8579	0.0001
88	3	734.8606	0.0006
89	3	734.8711	0.0001
90	1	734.8769	0.0000
91	2	734.8782	0.0012
92	3	734.8797	0.0013
93	3	734.8948	0.0182
94	3	734.9224	0.0000
95	2	734.9293	0.0021
96	3	734.9304	0.0001
97	3	734.9320	0.0012
98	2	734.9342	0.0007
99	3	734.9479	0.0003
100	3	734.9489	0.0001
101	3	734.9613	0.0001
102	4	734.9647	0.0003
103	3	734.9730	0.0001
104	3	734.9779	0.0000
105	2	734.9825	0.0017
106	3	734.9851	0.0006
107	1	734.9892	0.0000
108	3	734.9925	0.0019
109	1	735.0100	0.0001
110	3	735.0149	0.0019
111	2	735.0201	0.0009
112	3	735.0265	0.0063
113	3	735.0321	0.0074
114	2	735.0333	0.0024
115	2	735.0469	0.0000
116	1	735.0477	0.0000
117	3	735.0507	0.0000
118	3	735.0511	0.0003
119	3	735.0586	0.0045
120	2	735.0821	0.0066
121	1	735.0933	0.0012
122	3	735.0948	0.0035
123	3	735.1053	0.0023
124	3	735.1109	0.0000
125	3	735.1114	0.0016
126	3	735.1167	0.0004
127	3	735.1305	0.0045
128	3	735.1307	0.0014
129	2	735.1382	0.0004
130	3	735.1550	0.0066
131	1	735.1644	0.0000
132	3	735.1701	0.0064
133	2	735.1705	0.0019

134	1	735.1851	0.0004
135	3	735.1966	0.0009
136	2	735.1982	0.0000
137	3	735.1985	0.0018
138	6	735.2027	0.0010
139	1	735.2149	0.0000
140	2	735.2179	0.0058
141	2	735.2248	0.0063
142	1	735.2317	0.0004
143	3	735.2344	0.0072
144	3	735.2446	0.0074
145	3	735.2464	0.0007
146	2	735.2521	0.0000
147	3	735.2594	0.0001
148	3	735.2719	0.0003
149	1	735.2785	0.0000
150	3	735.2790	0.0002
151	3	735.2959	0.0006
152	3	735.2964	0.0006
153	2	735.3002	0.0022
154	1	735.3066	0.0001
155	3	735.3129	0.0100
156	3	735.3157	0.0020
157	3	735.3191	0.0067
158	3	735.3282	0.0033
159	3	735.3305	0.0001
160	3	735.3369	0.0005
161	2	735.3388	0.0057
162	1	735.3415	0.0000
163	1	735.3486	0.0087
164	3	735.3516	0.0001
165	3	735.3539	0.0473
166	1	735.3582	0.0000
167	3	735.3655	0.0008
168	3	735.3664	0.0043
169	2	735.3679	0.0047
170	1	735.3727	0.0075
171	3	735.3743	0.0002
172	6	735.3862	0.0036
173	1	735.3992	0.0026
174	3	735.4122	0.0017
175	2	735.4127	0.0006
176	3	735.4143	0.0143
177	3	735.4183	0.0031
178	3	735.4241	0.0000
179	3	735.4291	0.0001
180	2	735.4311	0.0124
181	2	735.4413	0.0262
182	3	735.4527	0.0076
183	3	735.4618	0.0001
184	1	735.4632	0.0000
185	3	735.4649	0.0028
186	3	735.4702	0.0029
187	2	735.4725	0.0007
188	3	735.4775	0.0010
189	2	735.4811	0.0059
190	3	735.4910	0.0017
191	1	735.5009	0.0011
192	3	735.5013	0.0194
193	3	735.5025	0.0027
194	3	735.5039	0.0238
195	1	735.5094	0.0000
196	3	735.5101	0.0042
197	1	735.5136	0.0034
198	3	735.5244	0.0016
199	1	735.5343	0.0000
200	2	735.5369	0.0007
201	3	735.5377	0.0008
202	3	735.5413	0.0003
203	3	735.5421	0.0008
204	1	735.5590	0.0047
205	2	735.5591	0.0009
206	1	735.5658	0.0000
207	3	735.5677	0.0012
208	3	735.5697	0.0028
209	3	735.5828	0.0005
210	3	735.5830	0.0004
211	3	735.5904	0.0020
212	3	735.5916	0.0016
213	2	735.5947	0.0032
214	3	735.6018	0.0075
215	2	735.6057	0.0000
216	3	735.6117	0.0000
217	3	735.6146	0.0035
218	1	735.6164	0.0000
219	1	735.6273	0.0000
220	5	735.6403	0.0006

221	3	735.6451	0.0067
222	3	735.6702	0.0083
223	2	735.6706	0.0040
224	3	735.6756	0.0015
225	3	735.6852	0.0005
226	1	735.6903	0.0000
227	1	735.6944	0.0140
228	3	735.7038	0.0001
229	3	735.7103	0.0010
230	2	735.7126	0.0000
231	3	735.7153	0.0027
232	3	735.7282	0.0009
233	2	735.7341	0.0008
234	3	735.7359	0.0001
235	3	735.7369	0.0015
236	1	735.7480	0.0000
237	2	735.7504	0.0043
238	3	735.7545	0.0001
239	3	735.7566	0.0021
240	2	735.7610	0.0049
241	3	735.7616	0.0002
242	1	735.7663	0.0009
243	3	735.7712	0.0060
244	3	735.7727	0.0004
245	2	735.7781	0.0022
246	3	735.7833	0.0084
247	1	735.7872	0.0000
248	3	735.7883	0.0002
249	1	735.7919	0.0009
250	2	735.7922	0.0045
251	3	735.7943	0.0002
252	3	735.7971	0.0001
253	1	735.8033	0.0000
254	3	735.8150	0.0031
255	3	735.8189	0.0001
256	3	735.8259	0.0014
257	1	735.8264	0.0000
258	2	735.8305	0.0001
259	3	735.8336	0.0009
260	3	735.8361	0.0007
261	2	735.8407	0.0013
262	1	735.8471	0.0000
263	3	735.8499	0.0000
264	3	735.8578	0.0002
265	3	735.8581	0.0029
266	2	735.8620	0.0000
267	1	735.8628	0.0000
268	3	735.8657	0.0001
269	3	735.8699	0.0006
270	3	735.8843	0.0014
271	3	735.8876	0.0001
272	2	735.8884	0.0047
273	3	735.8906	0.0004
274	3	735.8969	0.0005
275	2	735.9038	0.0006
276	3	735.9067	0.0015
277	3	735.9122	0.0005
278	2	735.9156	0.0018
279	3	735.9162	0.0008
280	2	735.9245	0.0008
281	1	735.9268	0.0000
282	3	735.9322	0.0001
283	3	735.9366	0.0000
284	3	735.9431	0.0000
285	1	735.9457	0.0005
286	3	735.9487	0.0002
287	2	735.9488	0.0003
288	3	735.9506	0.0000
289	3	735.9563	0.0005
290	1	735.9575	0.0006
291	2	735.9592	0.0002
292	3	735.9619	0.0002
293	3	735.9666	0.0010
294	3	735.9738	0.0001
295	1	735.9748	0.0000
296	3	735.9768	0.0000
297	1	735.9788	0.0002
298	3	735.9971	0.0000
299	2	735.9975	0.0002
300	3	736.0018	0.0001
301	3	736.0057	0.0002
302	3	736.0069	0.0004
303	3	736.0093	0.0000
304	2	736.0151	0.0018
305	3	736.0207	0.0004
306	3	736.0219	0.0018
307	3	736.0263	0.0014

308	1	736.0303	0.0003
309	2	736.0369	0.0005
310	1	736.0373	0.0000
311	3	736.0442	0.0010
312	2	736.0498	0.0022
313	1	736.0507	0.0000
314	3	736.0521	0.0005
315	3	736.0579	0.0005
316	1	736.0705	0.0000
317	3	736.0721	0.0001
318	2	736.0723	0.0000
319	3	736.0750	0.0003
320	3	736.0808	0.0008
321	3	736.0865	0.0001
322	3	736.0889	0.0019
323	2	736.0902	0.0001
324	1	736.0969	0.0000
325	3	736.1011	0.0000
326	3	736.1043	0.0012
327	3	736.1095	0.0019
328	1	736.1114	0.0000
329	1	736.1153	0.0000
330	1	736.1169	0.0000
331	3	736.1202	0.0006
332	2	736.1219	0.0001
333	3	736.1253	0.0001
334	3	736.1317	0.0004
335	1	736.1366	0.0001
336	2	736.1387	0.0008
337	3	736.1421	0.0002
338	3	736.1448	0.0008
339	3	736.1536	0.0003
340	3	736.1591	0.0012
341	3	736.1732	0.0025
342	3	736.1750	0.0009
343	2	736.1779	0.0000
344	5	736.1906	0.0007
345	3	736.1914	0.0009
346	1	736.1963	0.0013
347	3	736.2042	0.0002
348	2	736.2089	0.0002
349	3	736.2098	0.0000
350	3	736.2142	0.0002
351	3	736.2163	0.0009
352	3	736.2229	0.0002
353	3	736.2259	0.0003
354	3	736.2264	0.0004
355	3	736.2355	0.0000
356	2	736.2386	0.0000
357	3	736.2393	0.0008
358	3	736.2461	0.0000
359	3	736.2532	0.0008
360	1	736.2534	0.0000
361	3	736.2567	0.0003
362	2	736.2613	0.0000
363	3	736.2654	0.0000
364	3	736.2717	0.0028
365	1	736.2727	0.0004
366	3	736.2791	0.0029
367	3	736.2875	0.0016
368	3	736.2917	0.0022
369	2	736.2975	0.0001
370	1	736.3006	0.0000
371	3	736.3083	0.0003
372	3	736.3084	0.0001
373	3	736.3100	0.0000
374	1	736.3117	0.0021
375	3	736.3260	0.0004
376	1	736.3274	0.0000
377	2	736.3279	0.0000
378	3	736.3314	0.0001
379	3	736.3366	0.0001
380	3	736.3517	0.0000
381	3	736.3539	0.0004
382	1	736.3580	0.0015
383	2	736.3597	0.0001
384	2	736.3631	0.0001
385	3	736.3657	0.0005
386	3	736.3662	0.0000
387	3	736.3725	0.0002
388	3	736.3785	0.0002
389	3	736.3806	0.0000
390	2	736.3822	0.0003
391	1	736.3907	0.0000
392	2	736.3916	0.0000
393	3	736.3982	0.0012
394	3	736.4036	0.0000

395	1	736.4120	0.0043
396	2	736.4131	0.0002
397	6	736.4190	0.0036
398	1	736.4241	0.0000
399	3	736.4273	0.0005
400	2	736.4310	0.0006
401	3	736.4373	0.0006
402	1	736.4386	0.0000
403	3	736.4431	0.0007
404	1	736.4462	0.0001
405	3	736.4493	0.0015
406	3	736.4500	0.0002
407	2	736.4515	0.0006
408	3	736.4619	0.0000
409	3	736.4630	0.0002
410	3	736.4637	0.0001
411	2	736.4641	0.0006
412	1	736.4674	0.0001
413	3	736.4697	0.0012
414	3	736.4776	0.0000
415	3	736.4790	0.0006
416	3	736.4836	0.0000
417	1	736.4858	0.0015
418	2	736.4868	0.0003
419	3	736.4874	0.0004
420	3	736.4919	0.0007
421	3	736.5013	0.0005
422	3	736.5029	0.0000
423	3	736.5101	0.0001
424	2	736.5128	0.0001
425	1	736.5169	0.0000
426	3	736.5173	0.0000
427	1	736.5179	0.0000
428	3	736.5364	0.0000
429	3	736.5371	0.0001
430	1	736.5400	0.0000
431	3	736.5445	0.0000
432	2	736.5453	0.0001
433	2	736.5484	0.0005
434	3	736.5499	0.0006
435	3	736.5527	0.0001
436	2	736.5570	0.0000
437	3	736.5611	0.0002
438	3	736.5630	0.0000
439	1	736.5675	0.0000
440	3	736.5701	0.0000
441	1	736.5714	0.0011
442	1	736.5816	0.0004
443	3	736.5834	0.0000
444	2	736.5862	0.0000
445	3	736.5912	0.0003
446	3	736.5916	0.0000
447	3	736.5970	0.0002
448	3	736.6021	0.0001
449	3	736.6085	0.0001
450	1	736.6102	0.0000
451	3	736.6144	0.0003
452	3	736.6147	0.0001
453	2	736.6157	0.0000
454	2	736.6207	0.0006
455	1	736.6229	0.0005
456	3	736.6255	0.0000
457	3	736.6290	0.0000
458	3	736.6330	0.0000
459	2	736.6387	0.0002
460	3	736.6454	0.0001
461	1	736.6476	0.0000
462	3	736.6578	0.0003
463	2	736.6591	0.0000
464	3	736.6595	0.0007
465	1	736.6635	0.0000
466	3	736.6757	0.0001
467	2	736.6847	0.0000
468	2	736.6860	0.0000
469	3	736.6865	0.0000
470	3	736.6900	0.0001
471	3	736.6915	0.0001
472	1	736.7102	0.0000
473	3	736.7131	0.0001
474	3	736.7144	0.0000
475	1	736.7181	0.0001
476	3	736.7200	0.0002
477	2	736.7214	0.0001
478	3	736.7261	0.0002
479	2	736.7327	0.0001
480	3	736.7386	0.0000
481	3	736.7394	0.0013

482	3	736.7416	0.0001
483	3	736.7458	0.0009
484	1	736.7487	0.0003
485	2	736.7497	0.0002
486	3	736.7500	0.0005
487	3	736.7543	0.0000
488	3	736.7596	0.0019
489	1	736.7633	0.0000
490	3	736.7699	0.0000
491	3	736.7750	0.0001
492	2	736.7829	0.0000
493	3	736.7864	0.0002
494	3	736.7914	0.0000
495	3	736.7933	0.0004
496	1	736.7954	0.0003
497	3	736.8071	0.0000
498	3	736.8098	0.0001
499	3	736.8166	0.0001
500	1	736.8173	0.0000
501	1	736.8198	0.0000
502	2	736.8203	0.0000
503	3	736.8240	0.0000
504	3	736.8243	0.0006
505	2	736.8361	0.0000
506	3	736.8362	0.0001
507	3	736.8404	0.0002
508	2	736.8417	0.0001
509	1	736.8505	0.0000
510	3	736.8540	0.0001
511	1	736.8550	0.0000
512	3	736.8594	0.0000
513	2	736.8605	0.0001
514	3	736.8628	0.0001
515	3	736.8708	0.0000
516	3	736.8755	0.0000
517	1	736.8809	0.0000
518	4	736.8832	0.0002
519	3	736.8866	0.0000
520	2	736.8927	0.0001
521	3	736.8979	0.0001
522	3	736.8987	0.0001
523	5	736.8995	0.0001
524	3	736.9108	0.0001
525	2	736.9149	0.0000
526	1	736.9196	0.0000
527	3	736.9210	0.0000
528	1	736.9270	0.0005
529	3	736.9296	0.0000
530	3	736.9422	0.0000
531	3	736.9488	0.0000
532	3	736.9507	0.0001
533	2	736.9535	0.0001
534	1	736.9539	0.0000
535	2	736.9598	0.0000
536	3	736.9614	0.0000
537	3	736.9708	0.0000
538	3	736.9728	0.0000
539	2	736.9783	0.0001
540	3	736.9828	0.0006
541	3	736.9831	0.0000
542	3	736.9966	0.0002
543	1	737.0018	0.0005
544	1	737.0054	0.0000
545	3	737.0087	0.0001
546	2	737.0117	0.0000
547	3	737.0128	0.0001
548	1	737.0132	0.0001
549	3	737.0184	0.0001
550	3	737.0248	0.0001
551	1	737.0355	0.0000
552	5	737.0377	0.0011
553	1	737.0448	0.0003
554	3	737.0491	0.0002
555	3	737.0494	0.0001
556	3	737.0518	0.0000
557	2	737.0534	0.0000
558	3	737.0543	0.0001
559	1	737.0549	0.0000
560	3	737.0626	0.0001
561	3	737.0635	0.0000
562	2	737.0667	0.0000
563	3	737.0689	0.0000
564	4	737.0831	0.0009
565	3	737.0846	0.0000
566	2	737.0991	0.0001
567	3	737.1003	0.0007
568	1	737.1028	0.0000

569	3	737.1095	0.0000
570	3	737.1206	0.0003
571	2	737.1222	0.0000
572	3	737.1237	0.0000
573	3	737.1343	0.0005
574	3	737.1376	0.0001
575	1	737.1410	0.0015
576	5	737.1452	0.0002
577	1	737.1502	0.0000
578	3	737.1566	0.0002
579	3	737.1610	0.0001
580	3	737.1619	0.0000
581	2	737.1653	0.0001
582	3	737.1664	0.0001
583	1	737.1702	0.0000
584	3	737.1823	0.0004
585	2	737.1908	0.0001
586	3	737.1948	0.0002
587	3	737.1972	0.0001
588	3	737.2000	0.0000
589	2	737.2037	0.0003
590	3	737.2213	0.0001
591	1	737.2217	0.0000
592	1	737.2359	0.0000
593	3	737.2419	0.0002
594	2	737.2507	0.0000
595	3	737.2595	0.0000
596	3	737.2655	0.0000
597	1	737.2708	0.0000
598	2	737.2757	0.0001
599	3	737.2764	0.0000
600	1	737.2773	0.0000
601	3	737.2833	0.0000
602	3	737.2950	0.0000
603	2	737.2958	0.0001
604	3	737.2991	0.0000
605	3	737.3004	0.0000
606	3	737.3180	0.0000
607	3	737.3234	0.0000
608	2	737.3239	0.0001
609	3	737.3322	0.0001
610	2	737.3362	0.0002
611	1	737.3384	0.0000
612	1	737.3399	0.0000
613	3	737.3449	0.0000
614	2	737.3508	0.0000
615	6	737.3533	0.0000
616	3	737.3600	0.0001
617	1	737.3603	0.0001
618	3	737.3652	0.0000
619	3	737.3709	0.0000
620	2	737.3734	0.0000
621	3	737.3742	0.0000
622	3	737.3785	0.0000
623	3	737.3933	0.0000
624	1	737.4107	0.0000
625	1	737.4147	0.0000
626	2	737.4182	0.0001
627	2	737.4241	0.0000
628	3	737.4269	0.0000
629	3	737.4292	0.0000
630	3	737.4320	0.0000
631	3	737.4435	0.0000
632	3	737.4474	0.0000
633	3	737.4481	0.0000
634	3	737.4555	0.0000
635	1	737.4561	0.0000
636	1	737.4670	0.0000
637	2	737.4708	0.0000
638	3	737.4715	0.0000
639	3	737.4748	0.0000
640	3	737.4828	0.0000
641	3	737.4856	0.0000
642	4	737.4906	0.0000
643	2	737.4935	0.0000
644	1	737.4963	0.0000
645	3	737.5114	0.0000
646	1	737.5117	0.0001
647	3	737.5128	0.0000
648	2	737.5131	0.0000
649	3	737.5255	0.0000
650	3	737.5256	0.0000
651	3	737.5319	0.0000
652	2	737.5323	0.0000
653	3	737.5356	0.0000
654	2	737.5430	0.0000
655	3	737.5434	0.0001



656	1	737.5507	0.0000
657	3	737.5550	0.0000
658	3	737.5562	0.0000
659	3	737.5678	0.0000
660	3	737.5687	0.0000
661	3	737.5838	0.0001
662	2	737.5862	0.0001
663	3	737.5869	0.0000
664	1	737.5954	0.0000
665	3	737.6033	0.0000
666	1	737.6081	0.0001
667	3	737.6147	0.0000
668	1	737.6161	0.0000
669	3	737.6255	0.0001
670	3	737.6278	0.0000
671	2	737.6378	0.0001
672	3	737.6421	0.0000
673	3	737.6496	0.0000
674	3	737.6551	0.0000
675	1	737.6642	0.0000
676	3	737.6671	0.0000
677	3	737.6691	0.0000
678	2	737.6695	0.0000
679	3	737.6908	0.0000
680	2	737.6937	0.0000
681	3	737.6954	0.0000
682	3	737.6973	0.0000
683	1	737.7037	0.0000
684	1	737.7082	0.0000
685	3	737.7115	0.0000
686	1	737.7119	0.0000
687	2	737.7189	0.0000
688	1	737.7272	0.0000
689	3	737.7322	0.0000
690	3	737.7360	0.0000
691	3	737.7382	0.0000
692	2	737.7442	0.0000
693	2	737.7601	0.0000
694	3	737.7613	0.0001
695	3	737.7853	0.0000
696	2	737.7877	0.0000
697	3	737.7949	0.0000
698	3	737.7971	0.0000
699	3	737.7985	0.0000
700	2	737.7995	0.0000
701	3	737.8144	0.0000
702	3	737.8165	0.0000
703	1	737.8332	0.0000
704	3	737.8373	0.0000
705	3	737.8392	0.0000
706	2	737.8545	0.0000
707	3	737.8581	0.0000
708	1	737.8586	0.0000
709	3	737.8616	0.0000
710	3	737.8697	0.0000
711	3	737.8905	0.0000
712	2	737.8983	0.0000
713	1	737.8997	0.0000
714	1	737.9047	0.0000
715	3	737.9078	0.0000
716	2	737.9106	0.0000
717	1	737.9153	0.0002
718	1	737.9211	0.0000
719	3	737.9218	0.0001
720	3	737.9373	0.0000
721	3	737.9462	0.0000
722	2	737.9500	0.0000
723	3	737.9610	0.0000
724	3	737.9701	0.0000
725	3	737.9736	0.0000
726	1	737.9747	0.0000
727	2	737.9868	0.0000
728	3	737.9896	0.0000
729	3	738.0004	0.0000
730	3	738.0083	0.0001
731	2	738.0111	0.0000
732	3	738.0312	0.0000
733	3	738.0374	0.0000
734	1	738.0379	0.0001
735	3	738.0397	0.0000
736	3	738.0420	0.0000
737	2	738.0477	0.0000
738	1	738.0616	0.0001
739	3	738.0624	0.0001
740	2	738.0690	0.0000
741	1	738.0723	0.0000
742	3	738.0725	0.0000

743	3	738.0736	0.0000
744	3	738.0890	0.0000
745	3	738.0964	0.0000
746	3	738.0992	0.0000
747	3	738.1119	0.0000
748	2	738.1161	0.0000
749	3	738.1255	0.0000
750	3	738.1382	0.0000
751	3	738.1431	0.0000
752	1	738.1440	0.0000
753	1	738.1607	0.0000
754	2	738.1622	0.0000
755	3	738.1660	0.0000
756	3	738.1771	0.0000
757	3	738.1899	0.0000
758	1	738.1910	0.0001
759	3	738.1983	0.0000
760	3	738.2018	0.0000
761	3	738.2137	0.0000
762	1	738.2139	0.0000
763	2	738.2153	0.0000
764	2	738.2193	0.0000
765	3	738.2206	0.0000
766	3	738.2315	0.0000
767	2	738.2483	0.0000
768	3	738.2487	0.0000
769	3	738.2629	0.0000
770	3	738.2746	0.0000
771	1	738.2795	0.0000
772	3	738.2819	0.0000
773	2	738.3181	0.0000
774	3	738.3208	0.0001
775	3	738.3214	0.0000
776	3	738.3332	0.0000
777	1	738.3362	0.0000
778	3	738.3366	0.0000
779	1	738.3372	0.0000
780	3	738.3527	0.0000
781	3	738.3534	0.0000
782	2	738.3659	0.0000
783	1	738.3728	0.0000
784	3	738.3804	0.0000
785	3	738.3834	0.0000
786	2	738.3882	0.0000
787	3	738.4179	0.0000
788	3	738.4182	0.0000
789	1	738.4242	0.0000
790	3	738.4245	0.0000
791	2	738.4365	0.0000
792	3	738.4606	0.0000
793	2	738.4629	0.0000
794	3	738.4884	0.0000
795	3	738.4891	0.0000
796	3	738.4956	0.0000
797	3	738.5248	0.0000
798	2	738.5295	0.0000
799	1	738.5322	0.0000
800	1	738.5413	0.0000
801	3	738.5648	0.0000
802	3	738.6264	0.0000
803	2	738.6277	0.0000
804	3	738.6420	0.0000
805	3	738.6702	0.0000
806	1	738.6825	0.0000
807	2	738.7003	0.0000
808	3	738.7006	0.0000
809	3	738.7202	0.0000
810	3	738.7306	0.0000
811	3	738.7544	0.0000
812	2	738.7742	0.0000
813	3	738.7938	0.0000
814	3	738.7951	0.0000
815	2	738.7952	0.0000
816	1	738.8131	0.0000
817	3	738.8201	0.0000
818	3	738.8290	0.0000
819	3	738.8497	0.0000
820	2	738.8559	0.0000
821	1	738.8901	0.0000
822	1	738.8905	0.0000
823	3	738.8918	0.0000
824	3	738.8926	0.0000
825	3	738.9303	0.0000
826	3	738.9364	0.0000
827	2	738.9458	0.0000
828	3	738.9880	0.0000
829	1	738.9923	0.0000

830	2	739.0066	0.0000
831	3	739.0399	0.0001
832	3	739.0493	0.0000
833	1	739.0558	0.0000
834	3	739.0692	0.0000
835	1	739.0761	0.0000
836	2	739.0762	0.0000
837	3	739.0789	0.0000
838	3	739.1026	0.0000
839	3	739.1232	0.0000
840	3	739.1263	0.0000
841	3	739.1379	0.0000
842	2	739.1456	0.0000
843	2	739.1724	0.0000
844	3	739.1731	0.0000
845	3	739.2059	0.0000
846	3	739.2143	0.0000
847	2	739.2285	0.0000
848	3	739.2306	0.0000
849	3	739.2329	0.0000
850	3	739.2481	0.0000
851	3	739.2598	0.0000
852	1	739.2638	0.0000
853	3	739.2648	0.0000
854	2	739.3054	0.0000
855	3	739.3075	0.0000
856	3	739.3545	0.0000
857	2	739.3551	0.0000
858	3	739.3847	0.0000
859	1	739.3968	0.0000
860	1	739.4440	0.0000
861	3	739.5838	0.0000
862	2	740.0413	0.0000
863	3	740.0563	0.0000
864	3	740.2251	0.0000
865	3	740.2553	0.0000
866	1	740.2595	0.0000
867	2	740.2641	0.0000
868	1	740.2805	0.0000
869	3	740.2917	0.0000
870	3	740.2922	0.0000
871	2	740.3075	0.0000
872	3	740.3495	0.0000
873	3	740.3957	0.0000
874	3	740.5760	0.0000
875	1	740.6600	0.0000
876	3	740.6839	0.0000
877	3	740.7180	0.0000
878	3	740.8500	0.0000
879	2	740.8777	0.0000
880	3	740.9242	0.0000
881	3	740.9817	0.0000
882	1	741.0143	0.0000
883	2	741.0166	0.0000
884	3	741.0612	0.0000
885	3	741.1462	0.0000
886	2	741.2004	0.0000
887	1	741.2141	0.0000
888	3	741.2353	0.0000
889	3	741.2666	0.0000
890	2	741.3627	0.0000
891	3	741.3938	0.0000
892	1	741.4199	0.0000
893	3	741.4449	0.0000
894	3	741.4450	0.0000

**Table S5** Numerical values for the multiplet energy levels, degeneracies and oscillator strength calculated for the  $4d^{10}5f^2 \rightarrow 4d^9 5f^3$  transitions of  $U^{4+}$  in  $UO_2$  represented graphically in the lower panel of Figure 6.

#	Multiplicity	Energy levels [eV]	Oscillator strength [-]
1	1	775.9705	0.0000
2	1	775.9712	0.0011
3	3	775.9831	0.0005
4	3	775.9846	0.0020
5	2	776.0778	0.0048
6	3	776.0958	0.0018
7	3	776.1820	0.0110
8	1	776.2134	0.0171
9	3	776.2238	0.0013
10	3	776.2337	0.0236
11	2	776.2674	0.0061
12	3	776.2949	0.0001
13	3	776.3190	0.0217
14	3	776.4093	0.0510

15	1	776.4439	0.0000
16	2	776.4531	0.0202
17	3	776.4975	0.0112
18	2	776.5422	0.0027
19	3	776.5453	0.0053
20	3	776.5568	0.0075
21	3	776.5676	0.0005
22	1	776.6105	0.0013
23	2	776.6158	0.0033
24	3	776.6284	0.0020
25	1	776.6456	0.0000
26	3	776.6613	0.0006
27	3	776.6617	0.0005
28	3	776.7066	0.0009
29	3	776.7217	0.0027
30	2	776.7320	0.0003
31	1	776.7758	0.0000
32	3	776.8234	0.0007
33	3	776.8491	0.0000
34	3	776.8565	0.0001
35	2	776.9006	0.0019
36	1	776.9035	0.0006
37	3	776.9103	0.0038
38	2	776.9607	0.0000
39	3	776.9616	0.0001
40	1	776.9646	0.0000
41	3	776.9659	0.0010
42	3	776.9729	0.0003
43	3	776.9750	0.0002
44	2	776.9807	0.0002
45	1	777.0050	0.0042
46	3	777.0116	0.0000
47	3	777.0230	0.0012
48	3	777.0737	0.0004
49	2	777.0800	0.0003
50	1	777.1060	0.0039
51	3	777.1077	0.0016
52	2	777.1079	0.0001
53	3	777.1198	0.0001
54	3	777.1345	0.0001
55	3	777.1425	0.0006
56	3	777.1618	0.0021
57	3	777.1766	0.0001
58	2	777.1798	0.0005
59	1	777.1934	0.0000
60	3	777.2030	0.0055
61	1	777.2241	0.0099
62	3	777.2433	0.0085
63	2	777.2482	0.0002
64	3	777.2539	0.0000
65	1	777.2578	0.0000
66	3	777.2636	0.0002
67	3	777.2644	0.0000
68	1	777.2735	0.0001
69	3	777.2762	0.0001
70	3	777.2771	0.0001
71	3	777.2980	0.0019
72	1	777.2988	0.0000
73	3	777.2998	0.0028
74	2	777.3026	0.0002
75	1	777.3062	0.0000
76	3	777.3207	0.0015
77	3	777.3256	0.0000
78	3	777.3284	0.0005
79	1	777.3347	0.0012
80	2	777.3368	0.0002
81	3	777.3436	0.0002
82	2	777.3451	0.0008
83	3	777.3725	0.0025
84	4	777.4054	0.0004
85	2	777.4061	0.0000
86	3	777.4141	0.0002
87	1	777.4143	0.0001
88	3	777.4239	0.0000
89	3	777.4293	0.0002
90	3	777.4441	0.0002
91	2	777.4539	0.0000
92	1	777.4577	0.0000
93	3	777.4664	0.0033
94	1	777.4669	0.0012
95	3	777.4759	0.0000
96	3	777.4890	0.0001
97	3	777.5004	0.0001
98	2	777.5020	0.0004
99	3	777.5114	0.0002
100	3	777.5224	0.0004
101	1	777.5252	0.0000

102	2	777.5287	0.0000
103	3	777.5373	0.0020
104	1	777.5437	0.0017
105	3	777.5486	0.0000
106	3	777.5586	0.0009
107	3	777.5698	0.0005
108	1	777.5760	0.0000
109	2	777.5790	0.0002
110	3	777.5956	0.0002
111	2	777.6137	0.0002
112	1	777.6160	0.0004
113	3	777.6195	0.0002
114	3	777.6196	0.0000
115	3	777.6221	0.0001
116	3	777.6366	0.0000
117	3	777.6428	0.0006
118	3	777.6452	0.0000
119	3	777.6761	0.0042
120	1	777.6802	0.0000
121	3	777.6841	0.0002
122	1	777.6918	0.0046
123	3	777.6954	0.0000
124	2	777.6964	0.0009
125	2	777.6983	0.0002
126	3	777.7032	0.0000
127	3	777.7332	0.0001
128	3	777.7355	0.0002
129	3	777.7439	0.0000
130	3	777.7521	0.0000
131	2	777.7607	0.0003
132	3	777.7654	0.0000
133	2	777.7797	0.0000
134	1	777.7829	0.0000
135	3	777.7831	0.0000
136	3	777.7873	0.0016
137	3	777.7882	0.0000
138	2	777.8031	0.0001
139	3	777.8083	0.0000
140	2	777.8178	0.0001
141	3	777.8202	0.0006
142	3	777.8292	0.0004
143	3	777.8360	0.0012
144	1	777.8394	0.0000
145	2	777.8400	0.0001
146	3	777.8545	0.0003
147	1	777.8554	0.0000
148	3	777.8672	0.0000
149	2	777.8734	0.0000
150	3	777.8824	0.0000
151	2	777.8935	0.0000
152	4	777.8999	0.0011
153	1	777.9098	0.0000
154	3	777.9110	0.0002
155	1	777.9116	0.0000
156	3	777.9305	0.0000
157	3	777.9338	0.0001
158	3	777.9375	0.0001
159	3	777.9523	0.0002
160	3	777.9615	0.0004
161	2	777.9630	0.0000
162	2	777.9841	0.0000
163	3	777.9926	0.0000
164	1	777.9940	0.0000
165	3	778.0055	0.0000
166	3	778.0131	0.0000
167	3	778.0224	0.0000
168	1	778.0270	0.0016
169	1	778.0344	0.0000
170	2	778.0353	0.0000
171	3	778.0425	0.0001
172	3	778.0469	0.0002
173	1	778.0615	0.0002
174	3	778.0641	0.0000
175	2	778.0649	0.0001
176	3	778.0691	0.0001
177	3	778.0769	0.0002
178	3	778.0778	0.0000
179	3	778.0914	0.0003
180	3	778.0968	0.0001
181	1	778.0983	0.0000
182	2	778.1033	0.0000
183	1	778.1074	0.0003
184	2	778.1147	0.0002
185	3	778.1220	0.0001
186	3	778.1248	0.0001
187	3	778.1397	0.0001
188	3	778.1407	0.0010

189	3	778.1512	0.0003
190	3	778.1540	0.0000
191	3	778.1587	0.0000
192	3	778.1653	0.0000
193	2	778.1783	0.0002
194	3	778.1788	0.0002
195	3	778.1817	0.0000
196	3	778.1906	0.0000
197	1	778.1907	0.0000
198	2	778.2010	0.0001
199	3	778.2019	0.0001
200	1	778.2052	0.0010
201	3	778.2130	0.0000
202	3	778.2209	0.0001
203	2	778.2238	0.0000
204	1	778.2242	0.0000
205	2	778.2340	0.0000
206	3	778.2417	0.0005
207	3	778.2455	0.0000
208	1	778.2477	0.0000
209	3	778.2656	0.0000
210	3	778.2720	0.0000
211	3	778.2737	0.0000
212	2	778.2778	0.0001
213	1	778.2791	0.0004
214	3	778.2802	0.0000
215	3	778.2818	0.0000
216	3	778.2944	0.0000
217	1	778.2958	0.0002
218	1	778.3018	0.0000
219	2	778.3068	0.0000
220	3	778.3127	0.0008
221	3	778.3207	0.0000
222	1	778.3233	0.0001
223	3	778.3301	0.0008
224	3	778.3388	0.0001
225	3	778.3428	0.0000
226	2	778.3430	0.0000
227	3	778.3605	0.0000
228	2	778.3610	0.0000
229	1	778.3612	0.0000
230	1	778.3664	0.0000
231	3	778.3691	0.0002
232	3	778.3705	0.0000
233	3	778.3872	0.0001
234	2	778.3922	0.0000
235	3	778.3954	0.0013
236	1	778.3972	0.0006
237	3	778.4013	0.0001
238	3	778.4023	0.0000
239	3	778.4113	0.0000
240	2	778.4158	0.0000
241	3	778.4200	0.0000
242	2	778.4382	0.0000
243	3	778.4384	0.0005
244	3	778.4495	0.0001
245	3	778.4623	0.0000
246	3	778.4707	0.0002
247	3	778.4880	0.0001
248	1	778.4901	0.0000
249	1	778.4929	0.0000
250	3	778.4966	0.0000
251	2	778.5037	0.0000
252	3	778.5155	0.0000
253	3	778.5159	0.0001
254	2	778.5262	0.0001
255	3	778.5286	0.0000
256	3	778.5291	0.0000
257	2	778.5452	0.0000
258	3	778.5660	0.0001
259	3	778.5707	0.0012
260	1	778.5733	0.0007
261	2	778.5819	0.0001
262	2	778.5986	0.0000
263	1	778.6003	0.0005
264	3	778.6023	0.0003
265	3	778.6061	0.0000
266	3	778.6172	0.0001
267	1	778.6195	0.0000
268	3	778.6233	0.0000
269	1	778.6356	0.0000
270	3	778.6379	0.0002
271	2	778.6459	0.0000
272	3	778.6489	0.0000
273	3	778.6541	0.0000
274	3	778.6571	0.0000
275	2	778.6572	0.0000

276	1	778.6625	0.0000
277	2	778.6639	0.0000
278	1	778.6690	0.0000
279	3	778.6696	0.0000
280	3	778.6803	0.0000
281	1	778.6952	0.0000
282	3	778.6962	0.0000
283	2	778.6968	0.0000
284	3	778.7001	0.0000
285	3	778.7060	0.0000
286	1	778.7156	0.0000
287	3	778.7206	0.0001
288	3	778.7219	0.0000
289	3	778.7243	0.0001
290	3	778.7312	0.0000
291	2	778.7483	0.0000
292	3	778.7529	0.0002
293	3	778.7556	0.0000
294	1	778.7559	0.0000
295	3	778.7583	0.0001
296	1	778.7610	0.0001
297	1	778.7648	0.0000
298	2	778.7698	0.0000
299	3	778.7718	0.0001
300	3	778.7732	0.0000
301	1	778.7823	0.0000
302	3	778.7884	0.0000
303	3	778.8000	0.0000
304	3	778.8020	0.0002
305	1	778.8044	0.0001
306	2	778.8054	0.0001
307	2	778.8095	0.0001
308	3	778.8167	0.0000
309	3	778.8213	0.0000
310	2	778.8370	0.0000
311	1	778.8372	0.0003
312	3	778.8403	0.0000
313	3	778.8420	0.0000
314	3	778.8428	0.0001
315	3	778.8457	0.0000
316	3	778.8622	0.0002
317	1	778.8673	0.0000
318	3	778.8686	0.0001
319	2	778.8718	0.0000
320	3	778.8797	0.0000
321	3	778.8902	0.0000
322	3	778.8937	0.0001
323	2	778.8948	0.0001
324	3	778.9060	0.0001
325	2	778.9138	0.0000
326	3	778.9167	0.0001
327	3	778.9187	0.0000
328	3	778.9357	0.0000
329	3	778.9373	0.0001
330	1	778.9381	0.0000
331	2	778.9419	0.0000
332	3	778.9424	0.0002
333	3	778.9481	0.0000
334	3	778.9633	0.0000
335	1	778.9656	0.0000
336	3	778.9739	0.0000
337	3	778.9761	0.0001
338	1	778.9796	0.0000
339	3	778.9867	0.0000
340	1	778.9980	0.0000
341	3	778.9993	0.0000
342	2	779.0027	0.0001
343	2	779.0147	0.0000
344	3	779.0257	0.0000
345	3	779.0319	0.0001
346	1	779.0409	0.0000
347	2	779.0437	0.0000
348	3	779.0442	0.0000
349	3	779.0471	0.0001
350	1	779.0478	0.0003
351	2	779.0489	0.0000
352	1	779.0590	0.0000
353	3	779.0803	0.0000
354	3	779.0858	0.0001
355	3	779.0924	0.0002
356	3	779.0985	0.0001
357	3	779.1020	0.0000
358	3	779.1171	0.0001
359	2	779.1173	0.0001
360	3	779.1260	0.0000
361	3	779.1334	0.0000
362	1	779.1440	0.0001

363	3	779.1458	0.0000
364	2	779.1478	0.0000
365	3	779.1597	0.0000
366	3	779.1628	0.0000
367	3	779.1651	0.0001
368	3	779.1671	0.0001
369	1	779.1721	0.0000
370	2	779.1731	0.0000
371	1	779.1841	0.0000
372	3	779.1956	0.0000
373	2	779.1988	0.0000
374	3	779.2066	0.0000
375	1	779.2175	0.0000
376	1	779.2225	0.0003
377	3	779.2232	0.0000
378	3	779.2298	0.0000
379	2	779.2353	0.0000
380	3	779.2378	0.0000
381	3	779.2465	0.0000
382	2	779.2529	0.0000
383	3	779.2609	0.0001
384	1	779.2695	0.0000
385	3	779.2709	0.0002
386	3	779.2721	0.0000
387	3	779.2745	0.0000
388	2	779.2748	0.0000
389	1	779.2917	0.0000
390	3	779.2920	0.0000
391	3	779.2935	0.0002
392	2	779.3075	0.0000
393	3	779.3134	0.0000
394	3	779.3235	0.0002
395	3	779.3296	0.0000
396	3	779.3322	0.0001
397	2	779.3380	0.0000
398	3	779.3483	0.0003
399	1	779.3501	0.0001
400	3	779.3614	0.0000
401	3	779.3827	0.0000
402	1	779.3838	0.0000
403	5	779.3862	0.0000
404	3	779.3867	0.0000
405	3	779.3939	0.0000
406	3	779.4081	0.0000
407	3	779.4281	0.0001
408	2	779.4291	0.0000
409	3	779.4325	0.0000
410	1	779.4460	0.0000
411	3	779.4475	0.0000
412	2	779.4581	0.0000
413	3	779.4609	0.0000
414	2	779.4634	0.0000
415	1	779.4661	0.0000
416	3	779.4699	0.0000
417	1	779.4726	0.0000
418	3	779.4934	0.0000
419	3	779.5035	0.0000
420	3	779.5065	0.0000
421	1	779.5257	0.0000
422	3	779.5421	0.0000
423	3	779.5479	0.0000
424	2	779.5499	0.0000
425	3	779.5555	0.0000
426	4	779.5576	0.0000
427	2	779.5809	0.0000
428	1	779.5991	0.0000
429	3	779.6024	0.0000
430	2	779.6092	0.0000
431	3	779.6221	0.0000
432	1	779.6358	0.0000
433	3	779.6424	0.0000
434	3	779.6566	0.0001
435	2	779.6665	0.0000
436	3	779.6706	0.0001
437	1	779.6731	0.0000
438	3	779.6736	0.0000
439	3	779.6932	0.0001
440	3	779.7036	0.0001
441	3	779.7141	0.0000
442	3	779.7244	0.0000
443	3	779.7364	0.0000
444	1	779.7410	0.0000
445	2	779.7443	0.0000
446	3	779.7515	0.0000
447	1	779.7565	0.0000
448	3	779.7625	0.0000
449	3	779.7819	0.0000



450	2	779.7981	0.0000
451	1	779.8025	0.0000
452	3	779.8033	0.0000
453	3	779.8087	0.0001
454	1	779.8284	0.0000
455	3	779.8291	0.0002
456	2	779.8334	0.0001
457	3	779.8441	0.0000
458	3	779.8462	0.0001
459	3	779.8606	0.0000
460	1	779.8645	0.0002
461	3	779.8648	0.0000
462	2	779.8776	0.0000
463	3	779.8842	0.0000
464	3	779.9046	0.0001
465	1	779.9105	0.0000
466	5	779.9141	0.0000
467	2	779.9308	0.0000
468	3	779.9312	0.0001
469	3	779.9354	0.0000
470	3	779.9427	0.0000
471	3	779.9665	0.0000
472	3	779.9782	0.0000
473	2	779.9820	0.0000
474	3	779.9987	0.0000
475	1	780.0129	0.0001
476	2	780.0217	0.0000
477	3	780.0280	0.0000
478	3	780.0378	0.0000
479	3	780.0492	0.0000
480	2	780.0496	0.0000
481	3	780.0543	0.0000
482	1	780.0829	0.0000
483	1	780.0915	0.0000
484	3	780.0958	0.0000
485	3	780.0994	0.0000
486	2	780.1098	0.0000
487	3	780.1115	0.0000
488	1	780.1257	0.0000
489	3	780.1391	0.0000
490	3	780.1484	0.0000
491	2	780.1490	0.0000
492	3	780.1613	0.0000
493	3	780.1782	0.0000
494	3	780.1796	0.0000
495	3	780.1943	0.0000
496	2	780.2097	0.0000
497	3	780.2164	0.0000
498	1	780.2197	0.0002
499	2	780.2214	0.0000
500	3	780.2418	0.0000
501	3	780.2450	0.0000
502	1	780.2514	0.0000
503	3	780.2534	0.0000
504	1	780.2722	0.0000
505	3	780.2763	0.0000
506	3	780.2774	0.0000
507	1	780.2923	0.0000
508	3	780.2953	0.0001
509	3	780.3069	0.0000
510	2	780.3071	0.0000
511	3	780.3213	0.0000
512	2	780.3290	0.0000
513	3	780.3385	0.0000
514	1	780.3514	0.0000
515	3	780.3536	0.0000
516	3	780.3572	0.0000
517	2	780.3799	0.0000
518	3	780.3885	0.0000
519	3	780.3959	0.0000
520	3	780.4007	0.0000
521	1	780.4117	0.0000
522	2	780.4322	0.0000
523	3	780.4403	0.0000
524	3	780.4426	0.0000
525	3	780.4632	0.0000
526	1	780.4679	0.0000
527	2	780.4852	0.0000
528	3	780.4993	0.0000
529	3	780.5092	0.0000
530	1	780.5206	0.0000
531	2	780.5282	0.0000
532	3	780.5335	0.0000
533	2	780.5520	0.0000
534	1	780.5572	0.0000
535	3	780.5583	0.0001
536	3	780.5727	0.0000

537	3	780.6047	0.0000
538	3	780.6350	0.0000
539	1	780.6465	0.0000
540	3	780.6626	0.0000
541	3	780.6757	0.0000
542	2	780.7222	0.0000
543	3	780.7228	0.0000
544	3	780.8358	0.0000
545	1	780.8604	0.0000
546	3	780.8640	0.0000
547	3	780.8919	0.0000
548	2	780.8980	0.0000
549	3	780.9364	0.0001
550	2	780.9577	0.0000
551	1	780.9757	0.0001
552	3	780.9840	0.0000
553	3	781.0568	0.0000
554	3	781.0679	0.0001
555	1	781.0868	0.0000
556	2	781.0913	0.0000
557	3	781.1057	0.0000
558	3	781.1156	0.0000
559	3	781.1170	0.0000
560	1	781.1329	0.0000
561	2	781.1640	0.0000
562	1	781.1739	0.0000
563	3	781.1883	0.0000
564	6	781.2118	0.0000
565	1	781.2121	0.0000
566	2	781.2432	0.0000
567	3	781.2511	0.0001
568	3	781.2762	0.0000
569	3	781.3110	0.0000
570	3	781.3128	0.0000
571	2	781.3615	0.0000
572	3	781.4246	0.0000
573	2	781.4424	0.0000
574	3	781.4491	0.0000
575	1	781.4669	0.0000
576	3	781.4741	0.0000
577	3	781.4787	0.0000
578	1	781.4918	0.0001
579	3	781.6059	0.0000
580	3	781.9718	0.0000
581	2	782.0432	0.0000
582	3	782.2533	0.0000
583	1	782.4217	0.0000
584	3	782.5189	0.0000
585	3	782.5274	0.0001
586	3	782.5655	0.0000
587	2	782.6053	0.0000
588	3	782.6320	0.0000
589	2	782.6468	0.0000
590	3	782.6511	0.0000
591	3	782.9640	0.0000
592	1	782.9735	0.0001
593	3	783.0554	0.0000
594	2	783.1852	0.0000
595	3	783.1907	0.0000
596	2	783.3680	0.0000
597	3	783.4177	0.0001
598	3	783.4250	0.0000
599	1	783.5722	0.0000
600	3	783.6528	0.0000
601	3	783.6697	0.0001
602	1	783.6750	0.0002

**Table S6** Numerical values for the multiplet energy levels, degeneracies and oscillator strength calculated for the  $5d^{10}5f^2 \rightarrow 5d^95f^3$  transitions of  $U^{4+}$  in  $UO_2$  represented graphically in Figure 7.

#	Multiplicity	Energy levels [eV]	Oscillator strength [-]
1	3	89.3016	0.0000
2	2	89.3950	0.0000
3	3	89.4139	0.0000
4	1	89.4212	0.0001
5	1	89.4595	0.0000
6	3	89.4926	0.0000
7	3	89.5334	0.0001
8	2	89.5924	0.0000
9	3	89.6226	0.0000
10	3	89.6384	0.0000
11	3	89.7013	0.0000
12	2	89.7694	0.0000
13	3	89.7784	0.0000

14	1	89.8803	0.0000
15	3	89.8940	0.0000
16	2	89.8992	0.0000
17	3	89.9065	0.0000
18	3	89.9098	0.0000
19	1	89.9575	0.0000
20	3	89.9908	0.0000
21	2	90.0138	0.0000
22	3	90.0267	0.0000
23	1	90.1196	0.0000
24	3	90.2260	0.0001
25	3	90.2334	0.0000
26	2	90.2753	0.0001
27	3	90.2797	0.0001
28	3	90.3305	0.0000
29	3	90.3452	0.0000
30	3	90.3580	0.0000
31	2	90.3639	0.0000
32	1	90.3893	0.0000
33	3	90.4069	0.0000
34	3	90.4072	0.0000
35	1	90.4109	0.0000
36	3	90.4423	0.0000
37	2	90.4429	0.0000
38	3	90.4554	0.0000
39	1	90.4729	0.0000
40	1	90.4747	0.0000
41	3	90.4971	0.0000
42	2	90.4974	0.0000
43	3	90.5080	0.0000
44	3	90.5363	0.0000
45	1	90.5966	0.0000
46	3	90.6089	0.0000
47	2	90.6188	0.0001
48	1	90.6378	0.0001
49	3	90.6774	0.0000
50	3	90.6799	0.0000
51	3	90.7030	0.0000
52	2	90.7092	0.0000
53	3	90.7318	0.0000
54	3	90.7463	0.0000
55	1	90.7480	0.0000
56	1	90.7588	0.0000
57	2	90.7746	0.0000
58	1	90.7817	0.0000
59	3	90.7839	0.0000
60	3	90.7864	0.0000
61	3	90.8003	0.0000
62	3	90.8193	0.0000
63	3	90.8202	0.0000
64	3	90.8232	0.0000
65	2	90.8314	0.0000
66	3	90.8379	0.0000
67	1	90.8460	0.0000
68	3	90.8537	0.0000
69	3	90.8755	0.0000
70	2	90.8772	0.0000
71	3	90.8974	0.0000
72	1	90.9000	0.0000
73	2	90.9013	0.0000
74	3	90.9167	0.0000
75	3	90.9252	0.0000
76	2	90.9299	0.0000
77	3	90.9310	0.0000
78	2	90.9337	0.0000
79	3	90.9343	0.0000
80	3	90.9423	0.0000
81	3	90.9629	0.0000
82	3	90.9665	0.0000
83	1	90.9731	0.0000
84	3	90.9901	0.0000
85	1	91.0297	0.0000
86	3	91.0358	0.0000
87	3	91.0426	0.0000
88	1	91.0611	0.0000
89	2	91.0686	0.0000
90	6	91.0730	0.0000
91	3	91.0782	0.0000
92	3	91.0906	0.0000
93	3	91.0912	0.0001
94	2	91.1082	0.0000
95	1	91.1099	0.0000
96	3	91.1169	0.0000
97	3	91.1229	0.0000
98	2	91.1238	0.0000
99	3	91.1540	0.0000
100	3	91.1572	0.0000

101	1	91.1613	0.0000
102	2	91.1771	0.0000
103	3	91.1828	0.0000
104	3	91.1978	0.0000
105	2	91.2073	0.0000
106	3	91.2208	0.0000
107	2	91.2267	0.0000
108	3	91.2308	0.0000
109	3	91.2387	0.0000
110	3	91.2520	0.0000
111	2	91.2607	0.0000
112	3	91.2654	0.0000
113	3	91.2679	0.0000
114	1	91.2738	0.0000
115	2	91.3053	0.0000
116	1	91.3076	0.0000
117	1	91.3133	0.0000
118	3	91.3240	0.0001
119	3	91.3317	0.0000
120	3	91.3473	0.0000
121	3	91.3551	0.0000
122	2	91.3609	0.0000
123	1	91.3714	0.0000
124	2	91.3755	0.0000
125	3	91.3774	0.0000
126	3	91.3867	0.0000
127	3	91.3991	0.0000
128	1	91.3994	0.0000
129	2	91.4084	0.0000
130	3	91.4140	0.0000
131	3	91.4345	0.0000
132	3	91.4349	0.0000
133	3	91.4442	0.0000
134	1	91.4557	0.0000
135	2	91.4566	0.0000
136	3	91.4694	0.0000
137	3	91.4793	0.0000
138	1	91.4846	0.0000
139	2	91.5188	0.0000
140	3	91.5294	0.0000
141	3	91.5475	0.0000
142	1	91.5512	0.0000
143	3	91.5602	0.0000
144	3	91.5694	0.0000
145	4	91.5791	0.0000
146	2	91.6045	0.0000
147	2	91.6085	0.0000
148	3	91.6146	0.0000
149	3	91.6244	0.0000
150	3	91.6382	0.0000
151	1	91.6388	0.0000
152	2	91.6445	0.0000
153	3	91.6593	0.0000
154	3	91.6618	0.0000
155	3	91.6835	0.0000
156	3	91.6880	0.0000
157	2	91.6982	0.0000
158	3	91.7206	0.0000
159	1	91.7356	0.0000
160	3	91.7399	0.0000
161	3	91.7428	0.0000
162	3	91.7487	0.0001
163	1	91.7605	0.0000
164	3	91.7721	0.0000
165	2	91.7773	0.0000
166	3	91.7982	0.0000
167	3	91.8024	0.0000
168	3	91.8098	0.0000
169	3	91.8380	0.0000
170	2	91.8469	0.0000
171	1	91.8483	0.0000
172	3	91.8532	0.0000
173	1	91.8575	0.0000
174	1	91.8631	0.0000
175	3	91.8665	0.0000
176	1	91.8692	0.0000
177	3	91.8700	0.0000
178	3	91.8733	0.0000
179	2	91.8746	0.0000
180	3	91.8913	0.0000
181	3	91.8999	0.0000
182	1	91.9074	0.0000
183	3	91.9077	0.0000
184	3	91.9116	0.0000
185	3	91.9235	0.0000
186	2	91.9285	0.0000
187	6	91.9340	0.0000

188	3	91.9524	0.0000
189	3	91.9594	0.0000
190	3	91.9625	0.0000
191	2	91.9646	0.0000
192	1	91.9734	0.0000
193	3	91.9777	0.0000
194	3	91.9854	0.0000
195	3	91.9908	0.0000
196	3	91.9972	0.0000
197	2	92.0065	0.0000
198	3	92.0153	0.0000
199	5	92.0183	0.0000
200	1	92.0256	0.0000
201	3	92.0343	0.0000
202	1	92.0347	0.0000
203	3	92.0387	0.0000
204	3	92.0450	0.0000
205	2	92.0461	0.0000
206	1	92.0621	0.0000
207	2	92.0636	0.0000
208	3	92.0656	0.0000
209	3	92.0671	0.0000
210	3	92.0754	0.0000
211	3	92.0799	0.0000
212	1	92.0807	0.0000
213	3	92.0996	0.0000
214	2	92.1052	0.0000
215	3	92.1077	0.0000
216	1	92.1158	0.0000
217	1	92.1168	0.0000
218	3	92.1172	0.0000
219	3	92.1225	0.0000
220	3	92.1293	0.0000
221	3	92.1391	0.0000
222	2	92.1403	0.0000
223	2	92.1467	0.0000
224	1	92.1543	0.0000
225	3	92.1639	0.0000
226	3	92.1700	0.0000
227	3	92.1716	0.0000
228	1	92.1753	0.0000
229	2	92.1838	0.0000
230	3	92.1938	0.0001
231	1	92.2033	0.0000
232	3	92.2067	0.0000
233	2	92.2135	0.0000
234	3	92.2208	0.0000
235	3	92.2249	0.0000
236	1	92.2288	0.0000
237	3	92.2472	0.0000
238	3	92.2502	0.0000
239	2	92.2513	0.0000
240	2	92.2616	0.0000
241	3	92.2645	0.0000
242	3	92.2679	0.0000
243	2	92.2897	0.0000
244	1	92.2923	0.0000
245	3	92.2938	0.0000
246	3	92.2951	0.0000
247	3	92.3008	0.0000
248	1	92.3024	0.0000
249	2	92.3171	0.0000
250	3	92.3183	0.0000
251	3	92.3262	0.0000
252	3	92.3285	0.0000
253	3	92.3360	0.0000
254	1	92.3369	0.0000
255	3	92.3370	0.0000
256	1	92.3391	0.0000
257	2	92.3603	0.0000
258	3	92.3641	0.0000
259	3	92.3754	0.0000
260	3	92.3936	0.0000
261	2	92.4005	0.0000
262	3	92.4210	0.0000
263	3	92.4274	0.0000
264	3	92.4324	0.0000
265	3	92.4393	0.0000
266	1	92.4409	0.0000
267	2	92.4415	0.0000
268	3	92.4530	0.0000
269	3	92.4540	0.0000
270	2	92.4552	0.0000
271	1	92.4625	0.0000
272	2	92.4771	0.0000
273	3	92.4780	0.0000
274	3	92.4794	0.0000

275	1	92.4864	0.0000
276	3	92.4931	0.0000
277	1	92.4965	0.0000
278	3	92.5014	0.0000
279	1	92.5048	0.0000
280	2	92.5132	0.0000
281	3	92.5160	0.0000
282	3	92.5213	0.0000
283	3	92.5227	0.0000
284	3	92.5289	0.0000
285	2	92.5469	0.0000
286	3	92.5516	0.0000
287	1	92.5531	0.0000
288	3	92.5593	0.0000
289	3	92.5671	0.0000
290	3	92.5803	0.0000
291	3	92.5909	0.0000
292	1	92.5918	0.0000
293	3	92.5951	0.0000
294	2	92.5960	0.0000
295	3	92.6043	0.0000
296	3	92.6087	0.0000
297	1	92.6169	0.0000
298	3	92.6171	0.0000
299	3	92.6212	0.0000
300	3	92.6270	0.0000
301	3	92.6352	0.0000
302	2	92.6356	0.0000
303	4	92.6362	0.0000
304	1	92.6467	0.0000
305	3	92.6514	0.0000
306	2	92.6553	0.0000
307	2	92.6670	0.0000
308	3	92.6744	0.0000
309	3	92.6801	0.0000
310	3	92.6958	0.0000
311	3	92.7039	0.0000
312	3	92.7086	0.0000
313	3	92.7158	0.0000
314	1	92.7217	0.0000
315	3	92.7296	0.0000
316	1	92.7388	0.0000
317	1	92.7477	0.0000
318	3	92.7537	0.0000
319	3	92.7550	0.0000
320	3	92.7616	0.0000
321	2	92.7645	0.0000
322	1	92.7727	0.0000
323	2	92.7838	0.0000
324	3	92.7896	0.0000
325	3	92.7939	0.0000
326	1	92.7950	0.0000
327	3	92.7978	0.0000
328	3	92.8065	0.0000
329	2	92.8153	0.0000
330	3	92.8178	0.0000
331	3	92.8209	0.0000
332	1	92.8270	0.0000
333	2	92.8274	0.0000
334	3	92.8432	0.0000
335	3	92.8523	0.0000
336	3	92.8601	0.0000
337	2	92.8637	0.0000
338	3	92.8915	0.0000
339	3	92.8986	0.0000
340	3	92.8991	0.0000
341	3	92.9048	0.0000
342	2	92.9056	0.0000
343	1	92.9096	0.0000
344	1	92.9145	0.0000
345	3	92.9213	0.0000
346	3	92.9366	0.0000
347	3	92.9467	0.0000
348	1	92.9483	0.0000
349	1	92.9507	0.0000
350	2	92.9539	0.0000
351	3	92.9572	0.0000
352	2	92.9853	0.0000
353	3	92.9868	0.0000
354	1	92.9925	0.0000
355	3	92.9973	0.0000
356	3	93.0088	0.0000
357	1	93.0143	0.0000
358	3	93.0207	0.0000
359	3	93.0256	0.0000
360	2	93.0368	0.0000
361	3	93.0407	0.0000

362	2	93.0489	0.0000
363	1	93.0573	0.0000
364	3	93.0630	0.0000
365	3	93.0672	0.0000
366	2	93.0694	0.0000
367	3	93.0768	0.0000
368	3	93.0805	0.0000
369	3	93.0939	0.0000
370	3	93.0944	0.0000
371	1	93.1029	0.0000
372	3	93.1127	0.0000
373	1	93.1257	0.0000
374	2	93.1386	0.0000
375	3	93.1420	0.0000
376	3	93.1432	0.0000
377	3	93.1505	0.0000
378	3	93.1518	0.0000
379	2	93.1644	0.0000
380	3	93.1872	0.0000
381	3	93.1926	0.0000
382	2	93.1945	0.0000
383	1	93.2061	0.0000
384	1	93.2072	0.0000
385	3	93.2163	0.0000
386	3	93.2255	0.0000
387	2	93.2345	0.0000
388	3	93.2386	0.0000
389	3	93.2397	0.0001
390	3	93.2590	0.0000
391	3	93.2701	0.0000
392	3	93.2781	0.0000
393	3	93.2799	0.0000
394	2	93.2883	0.0000
395	1	93.3057	0.0000
396	3	93.3066	0.0000
397	3	93.3081	0.0000
398	2	93.3094	0.0000
399	3	93.3131	0.0000
400	2	93.3338	0.0000
401	3	93.3401	0.0000
402	3	93.3492	0.0000
403	1	93.3559	0.0000
404	3	93.3616	0.0000
405	1	93.3820	0.0000
406	3	93.3838	0.0000
407	2	93.3854	0.0000
408	3	93.3873	0.0000
409	1	93.3987	0.0000
410	3	93.4002	0.0000
411	2	93.4077	0.0000
412	3	93.4188	0.0000
413	1	93.4230	0.0000
414	3	93.4302	0.0000
415	3	93.4328	0.0001
416	3	93.4372	0.0000
417	2	93.4401	0.0000
418	3	93.4565	0.0000
419	3	93.4731	0.0000
420	3	93.4771	0.0000
421	1	93.4851	0.0000
422	2	93.4872	0.0000
423	3	93.4977	0.0000
424	2	93.4984	0.0000
425	3	93.5050	0.0000
426	2	93.5193	0.0000
427	1	93.5257	0.0000
428	3	93.5317	0.0000
429	3	93.5324	0.0000
430	3	93.5410	0.0000
431	3	93.5429	0.0000
432	3	93.5471	0.0000
433	2	93.5524	0.0000
434	3	93.5678	0.0000
435	3	93.5726	0.0000
436	3	93.5863	0.0001
437	3	93.5865	0.0000
438	2	93.5954	0.0000
439	2	93.6041	0.0001
440	3	93.6085	0.0002
441	2	93.6133	0.0000
442	3	93.6192	0.0000
443	2	93.6198	0.0001
444	3	93.6401	0.0000
445	3	93.6465	0.0000
446	3	93.6495	0.0000
447	3	93.6537	0.0000
448	4	93.6678	0.0000

449	2	93.6686	0.0000
450	3	93.6707	0.0000
451	3	93.6731	0.0001
452	1	93.6778	0.0000
453	3	93.6806	0.0000
454	1	93.6863	0.0000
455	3	93.6946	0.0000
456	2	93.6949	0.0001
457	3	93.6980	0.0000
458	3	93.7113	0.0000
459	1	93.7133	0.0000
460	2	93.7146	0.0000
461	3	93.7260	0.0000
462	3	93.7382	0.0000
463	2	93.7401	0.0000
464	3	93.7416	0.0000
465	2	93.7503	0.0000
466	1	93.7510	0.0000
467	3	93.7530	0.0001
468	1	93.7553	0.0000
469	3	93.7761	0.0000
470	3	93.7898	0.0000
471	3	93.7905	0.0000
472	2	93.7933	0.0000
473	3	93.7988	0.0000
474	2	93.8014	0.0000
475	3	93.8103	0.0000
476	1	93.8109	0.0001
477	3	93.8190	0.0000
478	3	93.8288	0.0000
479	3	93.8326	0.0000
480	3	93.8470	0.0000
481	3	93.8524	0.0000
482	1	93.8536	0.0000
483	3	93.8607	0.0000
484	1	93.8710	0.0000
485	1	93.8894	0.0000
486	3	93.8977	0.0002
487	3	93.9039	0.0000
488	3	93.9087	0.0000
489	2	93.9109	0.0001
490	3	93.9179	0.0000
491	3	93.9208	0.0003
492	1	93.9358	0.0000
493	3	93.9383	0.0000
494	3	93.9484	0.0002
495	1	93.9675	0.0000
496	3	93.9884	0.0000
497	2	93.9885	0.0000
498	1	94.0010	0.0000
499	3	94.0035	0.0000
500	3	94.0067	0.0001
501	3	94.0099	0.0000
502	3	94.0215	0.0000
503	3	94.0275	0.0001
504	3	94.0411	0.0000
505	2	94.0462	0.0000
506	3	94.0506	0.0000
507	3	94.0609	0.0000
508	1	94.0614	0.0000
509	3	94.0859	0.0001
510	1	94.0865	0.0000
511	2	94.0885	0.0000
512	2	94.1081	0.0000
513	3	94.1158	0.0000
514	3	94.1185	0.0000
515	3	94.1250	0.0000
516	3	94.1385	0.0000
517	3	94.1425	0.0000
518	1	94.1551	0.0000
519	2	94.1626	0.0000
520	1	94.1710	0.0000
521	3	94.1765	0.0000
522	3	94.1846	0.0000
523	2	94.1954	0.0000
524	3	94.1960	0.0000
525	1	94.2089	0.0000
526	3	94.2218	0.0001
527	3	94.2229	0.0000
528	1	94.2400	0.0001
529	3	94.2413	0.0000
530	2	94.2492	0.0000
531	3	94.2502	0.0000
532	3	94.2702	0.0001
533	3	94.2741	0.0000
534	3	94.2935	0.0003
535	3	94.2998	0.0000



536	1	94.3021	0.0001
537	2	94.3033	0.0000
538	3	94.3168	0.0000
539	1	94.3172	0.0000
540	2	94.3187	0.0000
541	3	94.3203	0.0000
542	2	94.3217	0.0000
543	3	94.3307	0.0001
544	3	94.3390	0.0000
545	3	94.3582	0.0001
546	2	94.3588	0.0000
547	3	94.3614	0.0001
548	1	94.3685	0.0001
549	1	94.3852	0.0000
550	3	94.3854	0.0000
551	3	94.4004	0.0000
552	2	94.4059	0.0001
553	3	94.4155	0.0000
554	3	94.4191	0.0000
555	1	94.4259	0.0000
556	3	94.4294	0.0001
557	1	94.4309	0.0000
558	2	94.4363	0.0000
559	1	94.4476	0.0000
560	3	94.4484	0.0000
561	3	94.4677	0.0002
562	2	94.4782	0.0002
563	3	94.4835	0.0000
564	3	94.4934	0.0000
565	2	94.4937	0.0000
566	1	94.4991	0.0000
567	3	94.5065	0.0000
568	1	94.5103	0.0000
569	3	94.5139	0.0000
570	3	94.5166	0.0000
571	3	94.5231	0.0001
572	3	94.5247	0.0000
573	2	94.5421	0.0000
574	3	94.5550	0.0000
575	1	94.5577	0.0000
576	3	94.5630	0.0000
577	3	94.5712	0.0000
578	3	94.5738	0.0001
579	2	94.5793	0.0000
580	2	94.5921	0.0001
581	3	94.5924	0.0001
582	1	94.5930	0.0000
583	3	94.6027	0.0003
584	3	94.6220	0.0002
585	2	94.6238	0.0001
586	1	94.6263	0.0000
587	3	94.6269	0.0000
588	2	94.6369	0.0000
589	3	94.6702	0.0000
590	3	94.6745	0.0000
591	3	94.6901	0.0000
592	3	94.6950	0.0001
593	3	94.7015	0.0004
594	1	94.7081	0.0000
595	2	94.7152	0.0002
596	3	94.7218	0.0002
597	1	94.7241	0.0000
598	3	94.7448	0.0001
599	2	94.7521	0.0001
600	3	94.7617	0.0000
601	4	94.7718	0.0005
602	3	94.7783	0.0001
603	2	94.7842	0.0002
604	3	94.7876	0.0002
605	1	94.7914	0.0000
606	3	94.8006	0.0000
607	2	94.8246	0.0001
608	3	94.8262	0.0000
609	3	94.8286	0.0000
610	3	94.8381	0.0001
611	2	94.8504	0.0001
612	3	94.8675	0.0004
613	3	94.9030	0.0002
614	3	94.9050	0.0006
615	2	94.9190	0.0001
616	3	94.9242	0.0002
617	3	94.9288	0.0011
618	3	94.9442	0.0014
619	3	94.9555	0.0002
620	1	94.9561	0.0000
621	1	94.9596	0.0010
622	3	94.9676	0.0000

623	2	94.9679	0.0010
624	1	94.9697	0.0001
625	2	94.9934	0.0000
626	3	94.9969	0.0001
627	3	95.0079	0.0001
628	1	95.0433	0.0000
629	3	95.0521	0.0001
630	1	95.0531	0.0000
631	3	95.0602	0.0001
632	3	95.0832	0.0020
633	2	95.0882	0.0003
634	1	95.0946	0.0003
635	3	95.1043	0.0001
636	3	95.1103	0.0006
637	1	95.1136	0.0000
638	3	95.1173	0.0001
639	3	95.1264	0.0025
640	2	95.1452	0.0001
641	3	95.1469	0.0000
642	3	95.1640	0.0007
643	1	95.1670	0.0000
644	3	95.1734	0.0001
645	2	95.1853	0.0014
646	3	95.2012	0.0001
647	3	95.2069	0.0003
648	1	95.2194	0.0000
649	3	95.2228	0.0002
650	2	95.2278	0.0004
651	3	95.2315	0.0000
652	3	95.2423	0.0003
653	3	95.2569	0.0000
654	3	95.2680	0.0001
655	2	95.2718	0.0004
656	3	95.2777	0.0004
657	1	95.2968	0.0000
658	2	95.2976	0.0002
659	1	95.3002	0.0000
660	3	95.3022	0.0000
661	3	95.3052	0.0003
662	2	95.3364	0.0000
663	3	95.3371	0.0004
664	1	95.3432	0.0000
665	3	95.3593	0.0000
666	3	95.3608	0.0003
667	3	95.3655	0.0000
668	3	95.3820	0.0006
669	2	95.4051	0.0002
670	3	95.4077	0.0002
671	3	95.4186	0.0000
672	3	95.4337	0.0003
673	2	95.4412	0.0000
674	3	95.4534	0.0002
675	3	95.4680	0.0000
676	1	95.4730	0.0003
677	2	95.4815	0.0000
678	3	95.5049	0.0003
679	1	95.5083	0.0000
680	3	95.5157	0.0001
681	3	95.5323	0.0000
682	3	95.5454	0.0000
683	3	95.5544	0.0000
684	1	95.5643	0.0000
685	3	95.5763	0.0002
686	3	95.5776	0.0004
687	2	95.5814	0.0001
688	2	95.6039	0.0000
689	3	95.6193	0.0000
690	3	95.6239	0.0006
691	2	95.6278	0.0002
692	1	95.6313	0.0000
693	1	95.6440	0.0001
694	3	95.6445	0.0000
695	3	95.6673	0.0001
696	2	95.6703	0.0001
697	3	95.6709	0.0004
698	1	95.7206	0.0002
699	3	95.7224	0.0000
700	2	95.7406	0.0001
701	3	95.7594	0.0000
702	3	95.7805	0.0020
703	2	95.7860	0.0024
704	3	95.7895	0.0024
705	3	95.7906	0.0001
706	3	95.8149	0.0001
707	3	95.8323	0.0001
708	3	95.8336	0.0001
709	3	95.8437	0.0000

710	3	95.8593	0.0001
711	2	95.8602	0.0000
712	1	95.8704	0.0001
713	3	95.8719	0.0000
714	3	95.8733	0.0002
715	1	95.8758	0.0000
716	2	95.8995	0.0017
717	3	95.9097	0.0000
718	3	95.9209	0.0001
719	3	95.9438	0.0001
720	1	95.9464	0.0000
721	3	95.9604	0.0000
722	1	95.9608	0.0003
723	2	95.9845	0.0002
724	1	95.9855	0.0000
725	3	95.9874	0.0002
726	3	95.9894	0.0002
727	3	96.0024	0.0003
728	2	96.0245	0.0000
729	3	96.0278	0.0000
730	3	96.0359	0.0000
731	1	96.0424	0.0000
732	3	96.0483	0.0000
733	3	96.0503	0.0000
734	3	96.0785	0.0001
735	3	96.0820	0.0000
736	3	96.0930	0.0000
737	2	96.1055	0.0001
738	1	96.1081	0.0000
739	2	96.1136	0.0000
740	3	96.1295	0.0003
741	1	96.1351	0.0001
742	1	96.1462	0.0000
743	2	96.1489	0.0000
744	3	96.1561	0.0000
745	3	96.1628	0.0000
746	4	96.1768	0.0004
747	2	96.1850	0.0002
748	1	96.2165	0.0000
749	3	96.2173	0.0000
750	3	96.2239	0.0000
751	3	96.2304	0.0001
752	2	96.2432	0.0001
753	3	96.2510	0.0010
754	3	96.2574	0.0000
755	3	96.2853	0.0001
756	3	96.2935	0.0001
757	3	96.3048	0.0001
758	1	96.3088	0.0005
759	3	96.3254	0.0000
760	1	96.3382	0.0000
761	2	96.3430	0.0000
762	3	96.3779	0.0003
763	3	96.3795	0.0000
764	3	96.4171	0.0006
765	2	96.4226	0.0000
766	2	96.4254	0.0004
767	3	96.4256	0.0000
768	3	96.4530	0.0000
769	1	96.4811	0.0003
770	2	96.4874	0.0003
771	1	96.5052	0.0001
772	3	96.5083	0.0005
773	3	96.5148	0.0000
774	3	96.5235	0.0005
775	3	96.5783	0.0000
776	2	96.5808	0.0002
777	3	96.5876	0.0001
778	3	96.5942	0.0014
779	3	96.6056	0.0001
780	1	96.6117	0.0000
781	3	96.6247	0.0015
782	3	96.6361	0.0003
783	1	96.6591	0.0000
784	3	96.6705	0.0001
785	2	96.6794	0.0009
786	2	96.6890	0.0001
787	3	96.6933	0.0001
788	3	96.6987	0.0000
789	2	96.7269	0.0001
790	1	96.7347	0.0000
791	3	96.7373	0.0000
792	3	96.7702	0.0000
793	3	96.7930	0.0002
794	3	96.8120	0.0000
795	2	96.8184	0.0002
796	1	96.8195	0.0000

797	3	96.8238	0.0000
798	3	96.8422	0.0000
799	2	96.8476	0.0004
800	3	96.8563	0.0000
801	1	96.8630	0.0001
802	3	96.8635	0.0000
803	1	96.8774	0.0000
804	3	96.8883	0.0001
805	3	96.9019	0.0000
806	2	96.9582	0.0022
807	3	96.9671	0.0000
808	3	96.9762	0.0004
809	2	96.9819	0.0004
810	3	97.0078	0.0010
811	3	97.0182	0.0000
812	3	97.0276	0.0003
813	1	97.0884	0.0000
814	2	97.0945	0.0001
815	1	97.1113	0.0000
816	3	97.1273	0.0003
817	3	97.1546	0.0003
818	3	97.2016	0.0001
819	2	97.2247	0.0000
820	3	97.2325	0.0000
821	3	97.2669	0.0008
822	1	97.2697	0.0000
823	3	97.2923	0.0004
824	3	97.2931	0.0014
825	3	97.3347	0.0001
826	2	97.3924	0.0007
827	3	97.4036	0.0000
828	1	97.4069	0.0000
829	3	97.4127	0.0000
830	3	97.4302	0.0010
831	3	97.4509	0.0000
832	3	97.4524	0.0000
833	1	97.4655	0.0006
834	1	97.5002	0.0000
835	3	97.5005	0.0005
836	2	97.5056	0.0003
837	3	97.5302	0.0039
838	3	97.5345	0.0002
839	2	97.5348	0.0000
840	3	97.5433	0.0000
841	1	97.5446	0.0000
842	2	97.5594	0.0011
843	3	97.5695	0.0002
844	1	97.5762	0.0006
845	3	97.5957	0.0002
846	2	97.6255	0.0016
847	3	97.6272	0.0004
848	3	97.6373	0.0015
849	3	97.6575	0.0000
850	3	97.6750	0.0002
851	2	97.6937	0.0000
852	3	97.7056	0.0000
853	2	97.7058	0.0002
854	3	97.7571	0.0000
855	1	97.7591	0.0000
856	3	97.8216	0.0003
857	3	97.8512	0.0000
858	3	97.8734	0.0002
859	3	97.8975	0.0000
860	3	97.9290	0.0002
861	3	97.9441	0.0002
862	2	97.9488	0.0007
863	1	97.9798	0.0000
864	1	98.0329	0.0000
865	3	98.0459	0.0000
866	3	98.1512	0.0001
867	3	98.2058	0.0000
868	2	98.2176	0.0000
869	3	98.2833	0.0000
870	1	98.3091	0.0000
871	3	98.3390	0.0000
872	1	98.3998	0.0000
873	3	98.4053	0.0000
874	3	98.4292	0.0000
875	3	98.4480	0.0000
876	1	98.4583	0.0000
877	3	98.4700	0.0000
878	2	98.4963	0.0000
879	1	98.4984	0.0001
880	3	98.5316	0.0000
881	3	98.5381	0.0001
882	3	98.5823	0.0000
883	2	98.6127	0.0000

884	3	98.6365	0.0000
885	1	98.6699	0.0000
886	2	98.6713	0.0001
887	3	98.6828	0.0000
888	3	98.7021	0.0000
889	3	98.7362	0.0000
890	3	98.7524	0.0000
891	2	98.7574	0.0000
892	1	98.8438	0.0000
893	3	98.8795	0.0000
894	3	98.9197	0.0000
895	2	98.9216	0.0000
896	3	99.0060	0.0000
897	1	99.0666	0.0000
898	5	99.0710	0.0000
899	3	99.0714	0.0000
900	3	99.1344	0.0000
901	3	99.1990	0.0000
902	3	99.2024	0.0000
903	1	99.2061	0.0000
904	3	99.2067	0.0000
905	2	99.2075	0.0000
906	1	99.2414	0.0000
907	3	99.2658	0.0000
908	1	99.2698	0.0000
909	3	99.3147	0.0000
910	3	99.3254	0.0000
911	3	99.3444	0.0000
912	2	99.3458	0.0000
913	3	99.3699	0.0002
914	3	99.4126	0.0000
915	1	99.4155	0.0001
916	3	99.4244	0.0000
917	2	99.4375	0.0000
918	1	99.4525	0.0000
919	3	99.5010	0.0000
920	3	99.5354	0.0000
921	3	99.5654	0.0002
922	1	99.5846	0.0000
923	2	99.5889	0.0000
924	1	99.6093	0.0000
925	3	99.6166	0.0001
926	3	99.6297	0.0000
927	3	99.6444	0.0000
928	3	99.6552	0.0000
929	2	99.6686	0.0000
930	3	99.6809	0.0000
931	2	99.6915	0.0000
932	3	99.7047	0.0000
933	3	99.7209	0.0000
934	1	99.7458	0.0000
935	3	99.7831	0.0000
936	3	99.7908	0.0000
937	2	99.7984	0.0000
938	3	99.8324	0.0000
939	3	99.8344	0.0000
940	2	99.8621	0.0000
941	2	99.8920	0.0001
942	3	99.8944	0.0001
943	3	99.9000	0.0000
944	1	99.9011	0.0000
945	3	99.9045	0.0000
946	1	99.9046	0.0000
947	1	99.9693	0.0000
948	3	99.9723	0.0000
949	3	99.9792	0.0000
950	2	99.9832	0.0000
951	1	100.0034	0.0000
952	3	100.0117	0.0000
953	1	100.0176	0.0000
954	3	100.0212	0.0000
955	3	100.0401	0.0000
956	1	100.0724	0.0000
957	1	100.0731	0.0000
958	3	100.0840	0.0000
959	3	100.0929	0.0000
960	3	100.1063	0.0001
961	2	100.1418	0.0000
962	2	100.1527	0.0000
963	3	100.1546	0.0000
964	3	100.1658	0.0000
965	3	100.1761	0.0001
966	2	100.1830	0.0000
967	3	100.1943	0.0000
968	1	100.2099	0.0000
969	1	100.2113	0.0000
970	3	100.2127	0.0000

971	3	100.2143	0.0000
972	3	100.2341	0.0000
973	2	100.2404	0.0000
974	3	100.2458	0.0000
975	3	100.2711	0.0000
976	1	100.2978	0.0000
977	3	100.2979	0.0000
978	2	100.2992	0.0000
979	3	100.3012	0.0000
980	3	100.3076	0.0000
981	3	100.3291	0.0001
982	2	100.3308	0.0000
983	3	100.3344	0.0000
984	3	100.3371	0.0000
985	3	100.3623	0.0000
986	1	100.3635	0.0000
987	3	100.3706	0.0000
988	3	100.3926	0.0000
989	1	100.3960	0.0000
990	1	100.3991	0.0000
991	3	100.4043	0.0001
992	2	100.4098	0.0002
993	3	100.4137	0.0000
994	2	100.4349	0.0001
995	3	100.4397	0.0000
996	2	100.4434	0.0001
997	3	100.4581	0.0000
998	3	100.4693	0.0000
999	3	100.4802	0.0000
1000	3	100.5091	0.0000
1001	3	100.5107	0.0000
1002	3	100.5215	0.0000
1003	1	100.5371	0.0000
1004	2	100.5405	0.0000
1005	3	100.5474	0.0000
1006	1	100.5506	0.0000
1007	3	100.5769	0.0000
1008	3	100.5867	0.0000
1009	3	100.6028	0.0002
1010	1	100.6170	0.0000
1011	2	100.6214	0.0000
1012	1	100.6220	0.0000
1013	2	100.6335	0.0000
1014	3	100.6459	0.0001
1015	1	100.6573	0.0000
1016	3	100.6583	0.0000
1017	3	100.6956	0.0000
1018	3	100.7038	0.0000
1019	3	100.7207	0.0000
1020	1	100.7308	0.0000
1021	3	100.7386	0.0000
1022	3	100.7478	0.0001
1023	2	100.7559	0.0000
1024	2	100.7721	0.0000
1025	1	100.7770	0.0000
1026	3	100.7842	0.0000
1027	3	100.7848	0.0000
1028	1	100.8082	0.0000
1029	3	100.8111	0.0000
1030	3	100.8155	0.0000
1031	1	100.8178	0.0000
1032	3	100.8381	0.0001
1033	2	100.8397	0.0000
1034	3	100.8432	0.0001
1035	3	100.8683	0.0001
1036	3	100.8689	0.0002
1037	1	100.8860	0.0000
1038	3	100.8920	0.0000
1039	3	100.9029	0.0000
1040	3	100.9192	0.0000
1041	1	100.9195	0.0003
1042	3	100.9293	0.0002
1043	2	100.9369	0.0005
1044	2	100.9412	0.0005
1045	1	100.9419	0.0000
1046	3	100.9457	0.0002
1047	2	100.9628	0.0000
1048	3	100.9658	0.0001
1049	3	100.9714	0.0000
1050	3	100.9866	0.0001
1051	1	100.9940	0.0000
1052	3	101.0049	0.0000
1053	2	101.0229	0.0000
1054	4	101.0409	0.0000
1055	3	101.0553	0.0001
1056	3	101.0560	0.0000
1057	2	101.0607	0.0001

1058	2	101.0746	0.0000
1059	3	101.0888	0.0004
1060	3	101.0891	0.0001
1061	3	101.0926	0.0001
1062	1	101.0988	0.0000
1063	3	101.1040	0.0002
1064	2	101.1165	0.0000
1065	1	101.1182	0.0000
1066	3	101.1259	0.0000
1067	2	101.1357	0.0000
1068	3	101.1433	0.0000
1069	2	101.1449	0.0000
1070	3	101.1480	0.0000
1071	3	101.1483	0.0000
1072	1	101.1546	0.0000
1073	1	101.1710	0.0000
1074	3	101.1761	0.0000
1075	3	101.1890	0.0000
1076	3	101.2062	0.0000
1077	2	101.2150	0.0000
1078	3	101.2206	0.0000
1079	3	101.2273	0.0000
1080	1	101.2333	0.0000
1081	3	101.2434	0.0000
1082	3	101.2468	0.0000
1083	3	101.2685	0.0000
1084	3	101.2869	0.0000
1085	3	101.3013	0.0000
1086	2	101.3094	0.0000
1087	3	101.3132	0.0000
1088	3	101.3275	0.0000
1089	3	101.3299	0.0000
1090	1	101.3343	0.0000
1091	2	101.3381	0.0000
1092	3	101.3537	0.0000
1093	1	101.3559	0.0000
1094	3	101.3694	0.0000
1095	3	101.3908	0.0000
1096	1	101.3990	0.0000
1097	2	101.4042	0.0000
1098	3	101.4251	0.0000
1099	1	101.4364	0.0000
1100	3	101.4427	0.0000
1101	2	101.4499	0.0000
1102	3	101.4534	0.0000
1103	3	101.4565	0.0000
1104	3	101.4633	0.0000
1105	2	101.4933	0.0000
1106	3	101.4947	0.0000
1107	2	101.5087	0.0000
1108	3	101.5108	0.0002
1109	1	101.5164	0.0000
1110	3	101.5297	0.0000
1111	2	101.5368	0.0000
1112	3	101.5424	0.0000
1113	3	101.5444	0.0001
1114	3	101.5465	0.0002
1115	3	101.5606	0.0000
1116	1	101.5616	0.0000
1117	3	101.5780	0.0001
1118	2	101.5851	0.0000
1119	2	101.6009	0.0000
1120	1	101.6043	0.0000
1121	3	101.6133	0.0000
1122	1	101.6252	0.0000
1123	3	101.6437	0.0000
1124	2	101.6471	0.0001
1125	3	101.6539	0.0000
1126	1	101.6657	0.0000
1127	3	101.6686	0.0000
1128	3	101.6707	0.0000
1129	2	101.6765	0.0000
1130	3	101.6925	0.0000
1131	3	101.7065	0.0000
1132	3	101.7071	0.0000
1133	2	101.7398	0.0000
1134	1	101.7440	0.0000
1135	3	101.7521	0.0002
1136	2	101.7526	0.0000
1137	3	101.7533	0.0000
1138	3	101.7654	0.0000
1139	3	101.7890	0.0002
1140	3	101.8039	0.0000
1141	1	101.8056	0.0000
1142	1	101.8234	0.0000
1143	2	101.8388	0.0000
1144	3	101.8439	0.0000

1145	1	101.8473	0.0000
1146	3	101.8496	0.0000
1147	3	101.8532	0.0002
1148	3	101.8823	0.0000
1149	2	101.8917	0.0003
1150	3	101.8985	0.0000
1151	3	101.9136	0.0001
1152	3	101.9188	0.0000
1153	1	101.9453	0.0000
1154	3	101.9557	0.0000
1155	2	101.9598	0.0000
1156	3	101.9609	0.0000
1157	3	101.9790	0.0001
1158	3	101.9890	0.0000
1159	1	102.0012	0.0000
1160	3	102.0018	0.0000
1161	3	102.0077	0.0000
1162	2	102.0318	0.0000
1163	4	102.0520	0.0000
1164	3	102.0577	0.0002
1165	3	102.0674	0.0000
1166	2	102.0678	0.0000
1167	3	102.0834	0.0001
1168	3	102.0957	0.0000
1169	1	102.0960	0.0000
1170	1	102.0984	0.0000
1171	3	102.1061	0.0000
1172	2	102.1098	0.0001
1173	3	102.1336	0.0000
1174	3	102.1383	0.0000
1175	3	102.1608	0.0000
1176	2	102.1647	0.0002
1177	3	102.1670	0.0000
1178	2	102.1694	0.0000
1179	1	102.2013	0.0000
1180	3	102.2032	0.0000
1181	3	102.2084	0.0000
1182	2	102.2163	0.0000
1183	3	102.2323	0.0000
1184	1	102.2328	0.0000
1185	1	102.2472	0.0000
1186	3	102.2498	0.0000
1187	3	102.2594	0.0000
1188	3	102.2668	0.0001
1189	1	102.2856	0.0000
1190	3	102.2903	0.0000
1191	1	102.2995	0.0000
1192	3	102.3000	0.0000
1193	2	102.3123	0.0004
1194	3	102.3133	0.0000
1195	2	102.3156	0.0000
1196	3	102.3504	0.0001
1197	3	102.3665	0.0000
1198	2	102.3928	0.0001
1199	3	102.3986	0.0003
1200	3	102.3998	0.0000
1201	3	102.4190	0.0003
1202	2	102.4348	0.0002
1203	1	102.4358	0.0000
1204	3	102.4612	0.0000
1205	3	102.4683	0.0001
1206	1	102.4786	0.0000
1207	3	102.4917	0.0004
1208	3	102.5014	0.0000
1209	2	102.5034	0.0004
1210	1	102.5041	0.0000
1211	3	102.5093	0.0000
1212	2	102.5268	0.0000
1213	3	102.5270	0.0000
1214	3	102.5583	0.0002
1215	3	102.5588	0.0000
1216	3	102.5857	0.0002
1217	1	102.5883	0.0000
1218	2	102.6238	0.0001
1219	3	102.6281	0.0000
1220	3	102.6469	0.0002
1221	3	102.6481	0.0000
1222	1	102.6591	0.0000
1223	1	102.6862	0.0000
1224	3	102.6913	0.0000
1225	2	102.6994	0.0004
1226	3	102.7093	0.0000
1227	1	102.7482	0.0000
1228	3	102.7679	0.0000
1229	3	102.7696	0.0000
1230	2	102.7751	0.0000
1231	3	102.7932	0.0000



1232	3	102.7968	0.0001
1233	3	102.8104	0.0000
1234	2	102.8568	0.0000
1235	4	102.8668	0.0001
1236	3	102.8879	0.0000
1237	2	102.8961	0.0010
1238	3	102.9237	0.0000
1239	3	102.9256	0.0005
1240	3	102.9486	0.0001
1241	3	102.9628	0.0018
1242	3	102.9649	0.0000
1243	1	102.9689	0.0000
1244	3	103.0045	0.0000
1245	2	103.0239	0.0008
1246	3	103.0251	0.0000
1247	2	103.0480	0.0001
1248	3	103.0661	0.0003
1249	3	103.0890	0.0000
1250	3	103.0975	0.0000
1251	1	103.1049	0.0000
1252	2	103.1073	0.0001
1253	3	103.1092	0.0001
1254	3	103.1387	0.0000
1255	3	103.1453	0.0000
1256	1	103.1651	0.0000
1257	2	103.1816	0.0001
1258	3	103.1832	0.0000
1259	3	103.1950	0.0000
1260	3	103.2196	0.0001
1261	2	103.2214	0.0001
1262	3	103.2346	0.0000
1263	1	103.2398	0.0000
1264	1	103.2623	0.0000
1265	3	103.2711	0.0001
1266	2	103.2717	0.0003
1267	1	103.2861	0.0000
1268	3	103.3349	0.0001
1269	1	103.3609	0.0000
1270	3	103.3771	0.0000
1271	2	103.3881	0.0007
1272	1	103.4035	0.0000
1273	3	103.4099	0.0004
1274	3	103.4240	0.0000
1275	1	103.4392	0.0000
1276	3	103.4433	0.0001
1277	2	103.4534	0.0000
1278	3	103.4896	0.0002
1279	2	103.4991	0.0000
1280	3	103.5065	0.0000
1281	3	103.5380	0.0000
1282	3	103.5520	0.0000
1283	3	103.5811	0.0000
1284	1	103.5894	0.0000
1285	3	103.5922	0.0000
1286	2	103.6135	0.0003
1287	3	103.6264	0.0000
1288	3	103.6339	0.0005
1289	3	103.6387	0.0000
1290	1	103.6414	0.0000
1291	2	103.6629	0.0000
1292	1	103.6649	0.0000
1293	3	103.6850	0.0005
1294	3	103.6912	0.0000
1295	3	103.7055	0.0000
1296	3	103.7067	0.0001
1297	2	103.7304	0.0005
1298	2	103.7530	0.0000
1299	3	103.7697	0.0000
1300	1	103.7714	0.0000
1301	3	103.7872	0.0001
1302	3	103.7928	0.0000
1303	3	103.8083	0.0010
1304	2	103.8349	0.0001
1305	1	103.8362	0.0001
1306	3	103.8451	0.0003
1307	1	103.8609	0.0000
1308	3	103.8626	0.0001
1309	3	103.9023	0.0000
1310	3	103.9291	0.0000
1311	3	103.9354	0.0000
1312	2	103.9423	0.0000
1313	3	103.9557	0.0000
1314	2	103.9712	0.0020
1315	3	103.9770	0.0000
1316	3	103.9989	0.0000
1317	1	104.0162	0.0000
1318	3	104.0464	0.0000

1319	3	104.0485	0.0007
1320	3	104.0583	0.0000
1321	2	104.1035	0.0001
1322	3	104.1103	0.0000
1323	3	104.1238	0.0007
1324	1	104.1369	0.0000
1325	3	104.1406	0.0000
1326	3	104.1436	0.0053
1327	2	104.1456	0.0016
1328	1	104.1543	0.0000
1329	3	104.1774	0.0000
1330	3	104.1812	0.0047
1331	1	104.1885	0.0000
1332	2	104.1900	0.0012
1333	3	104.2165	0.0000
1334	3	104.2184	0.0004
1335	3	104.2768	0.0000
1336	2	104.2905	0.0049
1337	3	104.2990	0.0116
1338	3	104.3109	0.0031
1339	3	104.3308	0.0000
1340	1	104.3712	0.0000
1341	2	104.3792	0.0366
1342	3	104.3844	0.0490
1343	3	104.4593	0.0000
1344	1	104.4676	0.0000
1345	3	104.4806	0.0030
1346	1	104.5026	0.0000
1347	3	104.5725	0.0001
1348	2	104.5845	0.0000
1349	3	104.5913	0.0091
1350	3	104.6272	0.0511
1351	3	104.6436	0.0000
1352	2	104.6484	0.0408
1353	1	104.6685	0.0000
1354	3	104.6807	0.0000
1355	3	104.7323	0.0042
1356	3	104.7336	0.0000
1357	2	104.7539	0.0012
1358	1	104.7628	0.0000
1359	3	104.7727	0.0008
1360	3	104.8354	0.0000
1361	3	104.8633	0.0009
1362	2	104.9154	0.0008
1363	3	104.9453	0.0000
1364	3	104.9845	0.0021
1365	3	105.0058	0.0000
1366	1	105.0351	0.0000
1367	2	105.0494	0.0028
1368	3	105.0927	0.0022
1369	2	105.2592	0.0003
1370	1	105.2791	0.0000
1371	3	105.2911	0.0007
1372	3	105.3731	0.0000
1373	1	105.4326	0.0000
1374	3	105.5033	0.0000
1375	3	105.5588	0.0000
1376	3	105.7489	0.0000
1377	1	105.7741	0.0000
1378	3	105.8767	0.0000
1379	2	105.9733	0.0000
1380	3	106.1359	0.0007
1381	2	106.1511	0.0005
1382	3	106.2127	0.0001
1383	3	106.2870	0.0000
1384	3	106.6377	0.0000
1385	3	106.7024	0.0000
1386	1	106.8850	0.0001
1387	2	106.8879	0.0000
1388	3	106.9245	0.0000
1389	1	106.9338	0.0000
1390	3	106.9591	0.0000
1391	3	106.9681	0.0000
1392	2	107.0841	0.0000
1393	3	107.0953	0.0000
1394	1	107.1067	0.0002
1395	2	107.1272	0.0000
1396	3	107.1911	0.0003
1397	3	107.2428	0.0000
1398	1	107.4113	0.0001
1399	1	107.4199	0.0000
1400	3	107.5190	0.0001
1401	3	107.5866	0.0005
1402	1	107.9291	0.0043
1403	3	107.9485	0.0013
1404	3	107.9493	0.0124
1405	3	107.9993	0.0001

1406	2	108.0341	0.0000
1407	3	108.0415	0.0000
1408	3	108.0481	0.0009
1409	3	108.1067	0.0094
1410	1	108.2025	0.0046
1411	3	108.3959	0.0011
1412	2	108.4513	0.0016
1413	3	108.5502	0.0021
1414	3	108.6792	0.0007
1415	3	108.8654	0.0007
1416	2	108.8716	0.0001
1417	3	108.9363	0.0001
1418	1	108.9796	0.0000
1419	3	109.1085	0.0007
1420	2	109.2349	0.0006
1421	3	109.6666	0.0003
1422	1	109.6749	0.0001
1423	3	109.6892	0.0004
1424	3	109.7224	0.0002
1425	2	109.7265	0.0000
1426	3	109.7651	0.0000
1427	3	109.7835	0.0022
1428	3	109.8345	0.0028
1429	1	109.8616	0.0010
1430	2	109.9909	0.0004
1431	3	110.0769	0.0001
1432	3	110.1381	0.0023
1433	1	110.5638	0.0000
1434	3	110.5750	0.0026
1435	3	110.6335	0.0000
1436	2	110.6526	0.0001
1437	3	110.7160	0.0000
1438	3	110.7870	0.0000
1439	3	111.1143	0.1088
1440	1	111.1996	0.0000
1441	2	111.2156	0.0208
1442	1	111.2297	0.0005
1443	3	111.2443	0.0132
1444	3	111.3133	0.0024
1445	3	111.3476	0.0018
1446	2	111.6076	0.0420
1447	3	111.6337	0.0544
1448	3	111.6598	0.0420
1449	1	111.7235	0.0000
1450	2	111.7824	0.0051
1451	3	111.8854	0.0631
1452	3	112.1252	0.0007
1453	3	112.1388	0.0020
1454	1	112.2441	0.0004
1455	3	112.2752	0.0036
1456	3	112.3524	0.0024
1457	2	112.3551	0.0014
1458	3	112.3663	0.0016
1459	1	112.3957	0.0000
1460	3	112.4091	0.0043
1461	2	112.4141	0.0000
1462	3	112.5126	0.0000
1463	3	112.6246	0.0017
1464	2	112.7681	0.0000
1465	1	112.8777	0.1090
1466	1	112.9170	0.0000
1467	3	112.9628	0.0011
1468	3	113.0028	0.0298
1469	3	113.1042	0.0495
1470	1	113.1385	0.0036
1471	3	113.1683	0.0001
1472	2	113.1879	0.0000
1473	3	113.2633	0.0181
1474	3	113.5009	0.0050
1475	2	113.5359	0.0000
1476	3	113.5935	0.0022
1477	1	113.7587	0.0000
1478	3	113.7687	0.0001
1479	3	113.8226	0.0000
1480	2	113.8672	0.0001
1481	3	113.9382	0.0000
1482	3	114.0030	0.0000
1483	1	114.2643	0.0014
1484	3	114.3454	0.0013
1485	3	114.3695	0.0000
1486	3	114.5694	0.0000
1487	3	114.5838	0.0001
1488	3	114.7270	0.0002
1489	3	114.7738	0.0000
1490	2	114.8320	0.0000
1491	3	114.8538	0.0000
1492	1	114.8872	0.0000

1493	2	114.9567	0.0000
1494	3	115.0139	0.0000
1495	2	115.0598	0.0001
1496	3	115.0804	0.0001
1497	1	115.0940	0.0000
1498	3	115.0956	0.0001
1499	1	115.2799	0.0000
1500	3	115.3152	0.0001
1501	3	115.3747	0.0000
1502	3	116.0688	0.0002
1503	3	116.6717	0.0001

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