

## A Microwave Assisted Tandem Synthesis of Quinazolinones using Ionic Liquid Supported Copper (II) Catalyst with Mechanistic Insights

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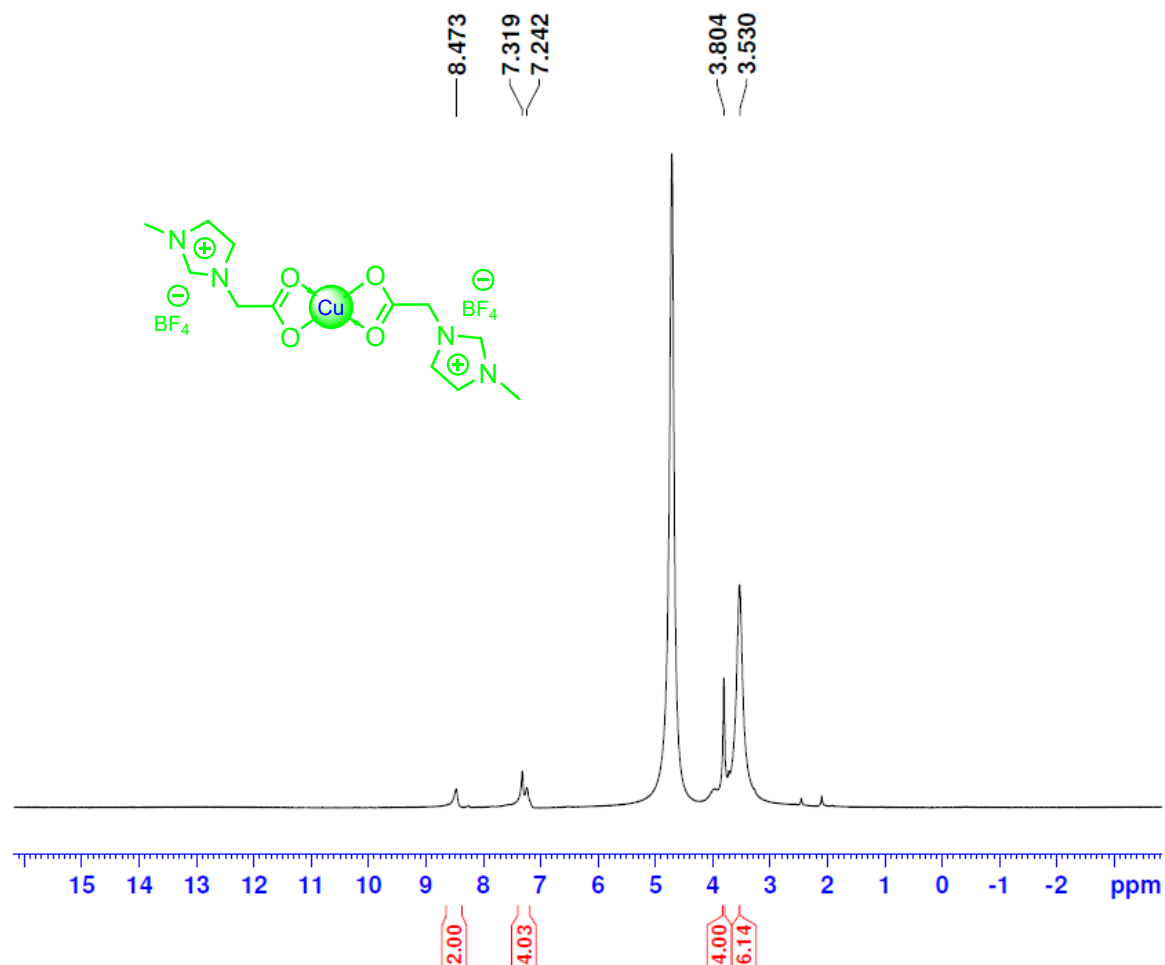
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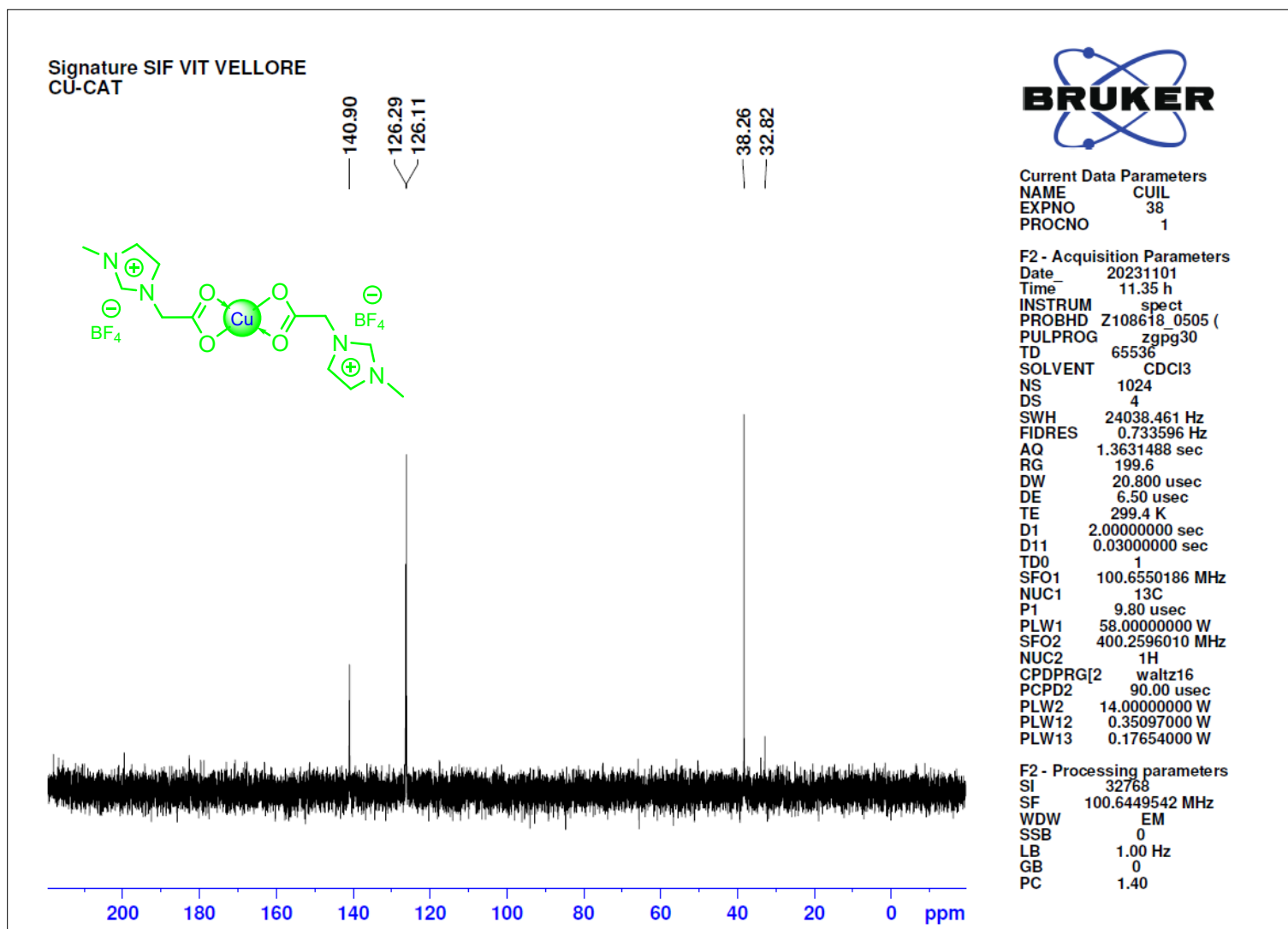
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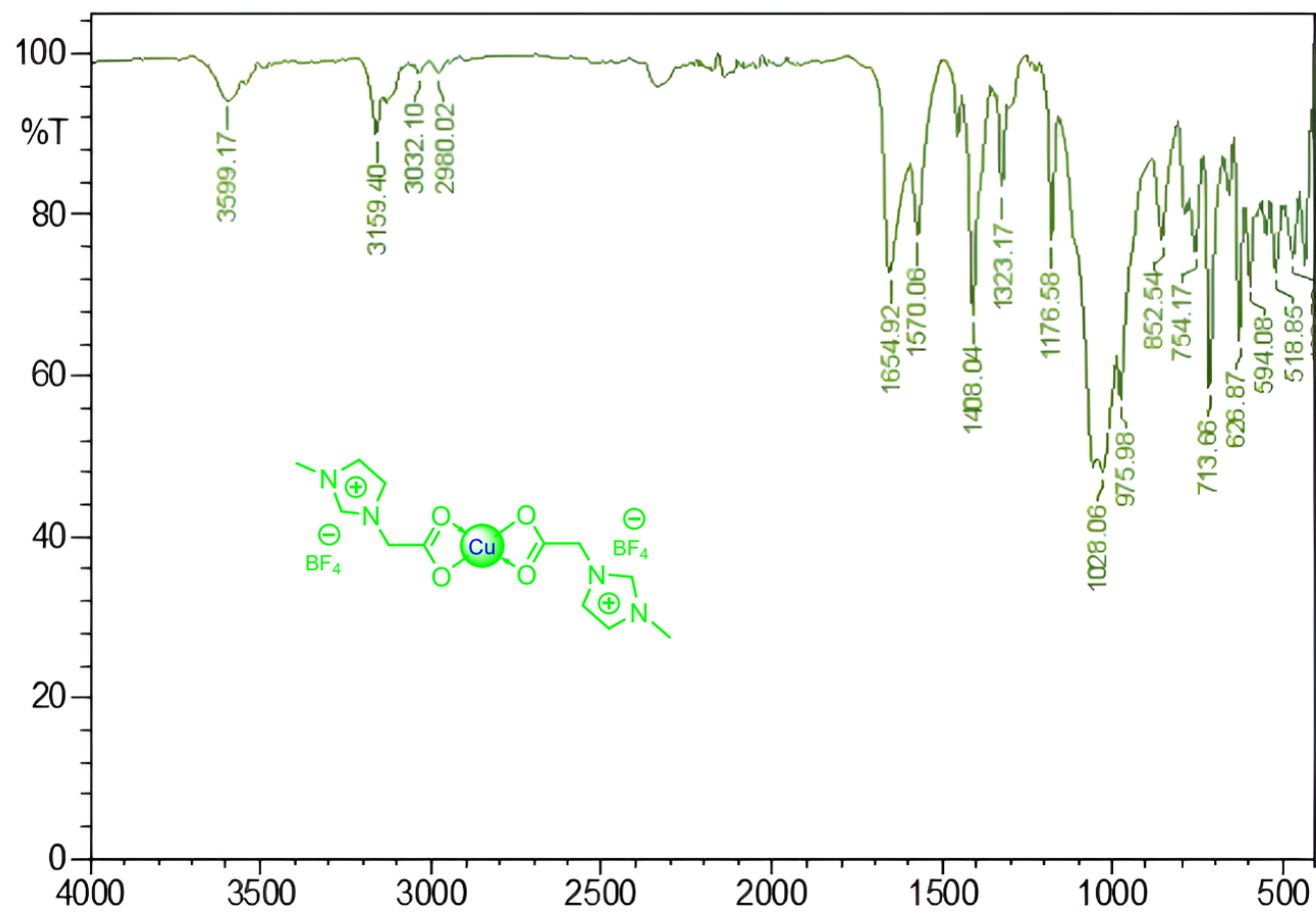
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2



**Figure 2:**  $^{13}\text{C}$  NMR spectrum of the ionic liquid supported copper catalyst 4.



**Figure 3:** FT-IR spectrum of the ionic liquid supported copper catalyst 4.

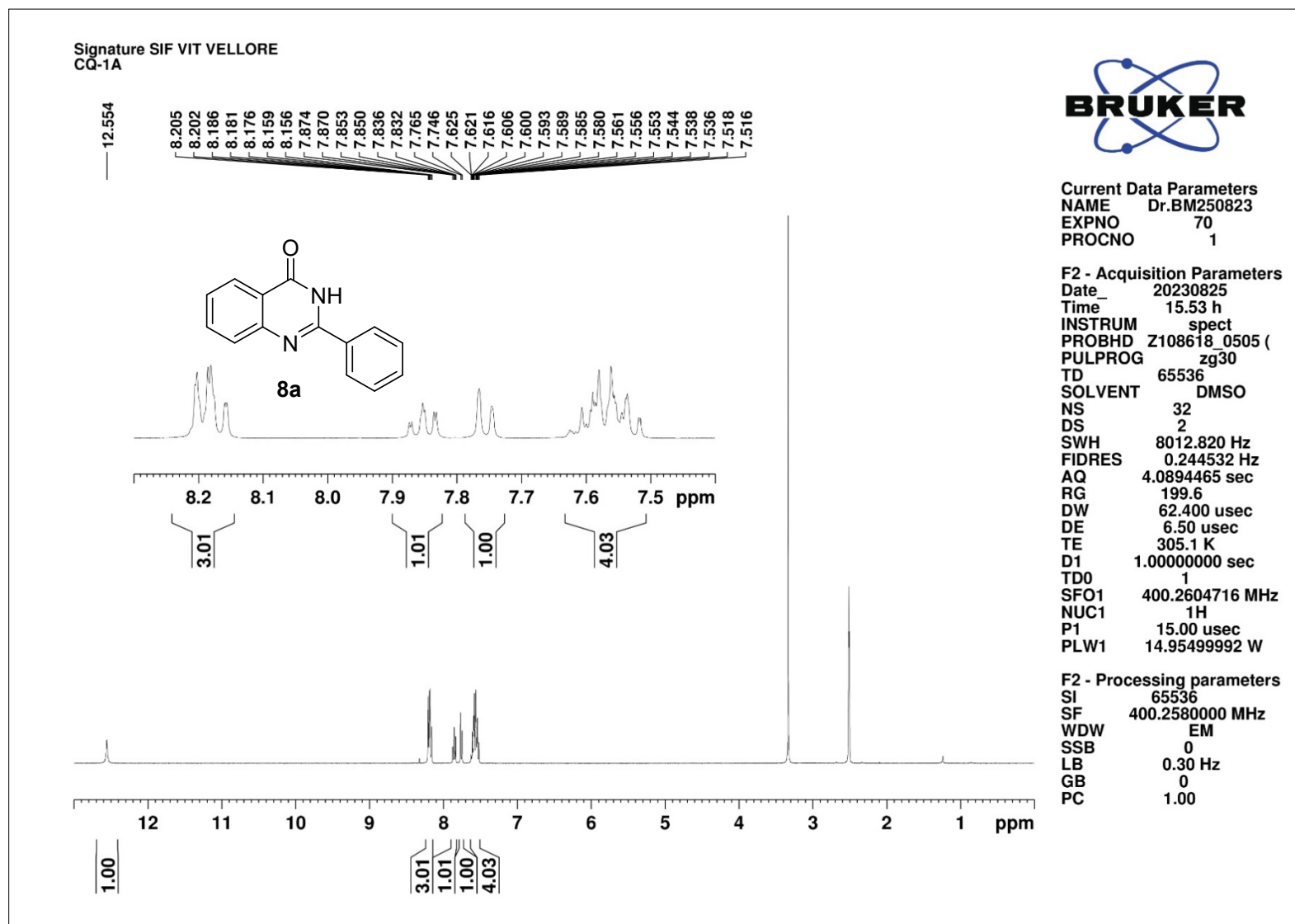


Figure 4:  $^1\text{H}$  NMR spectrum of the compound **8a**.

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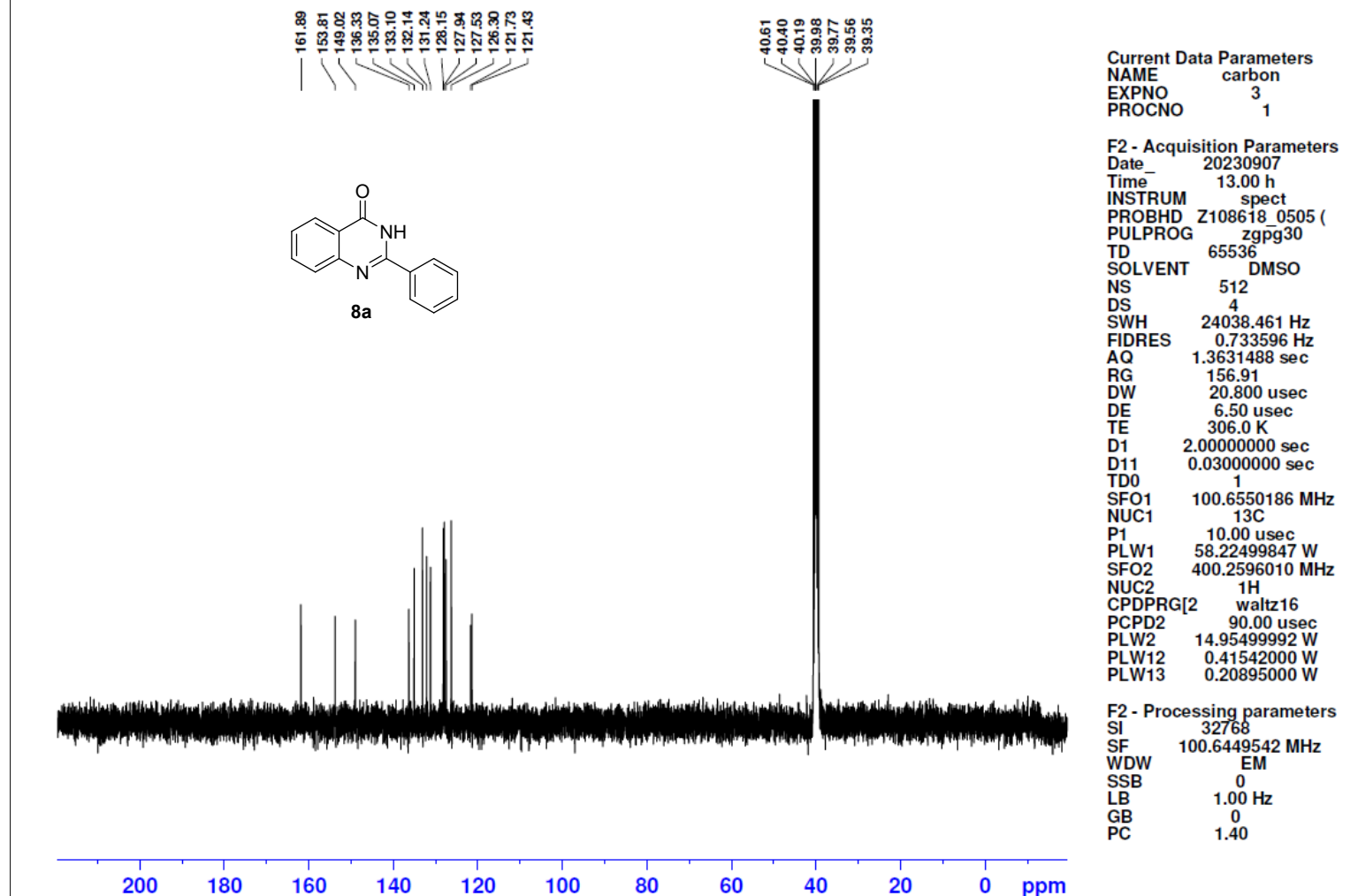
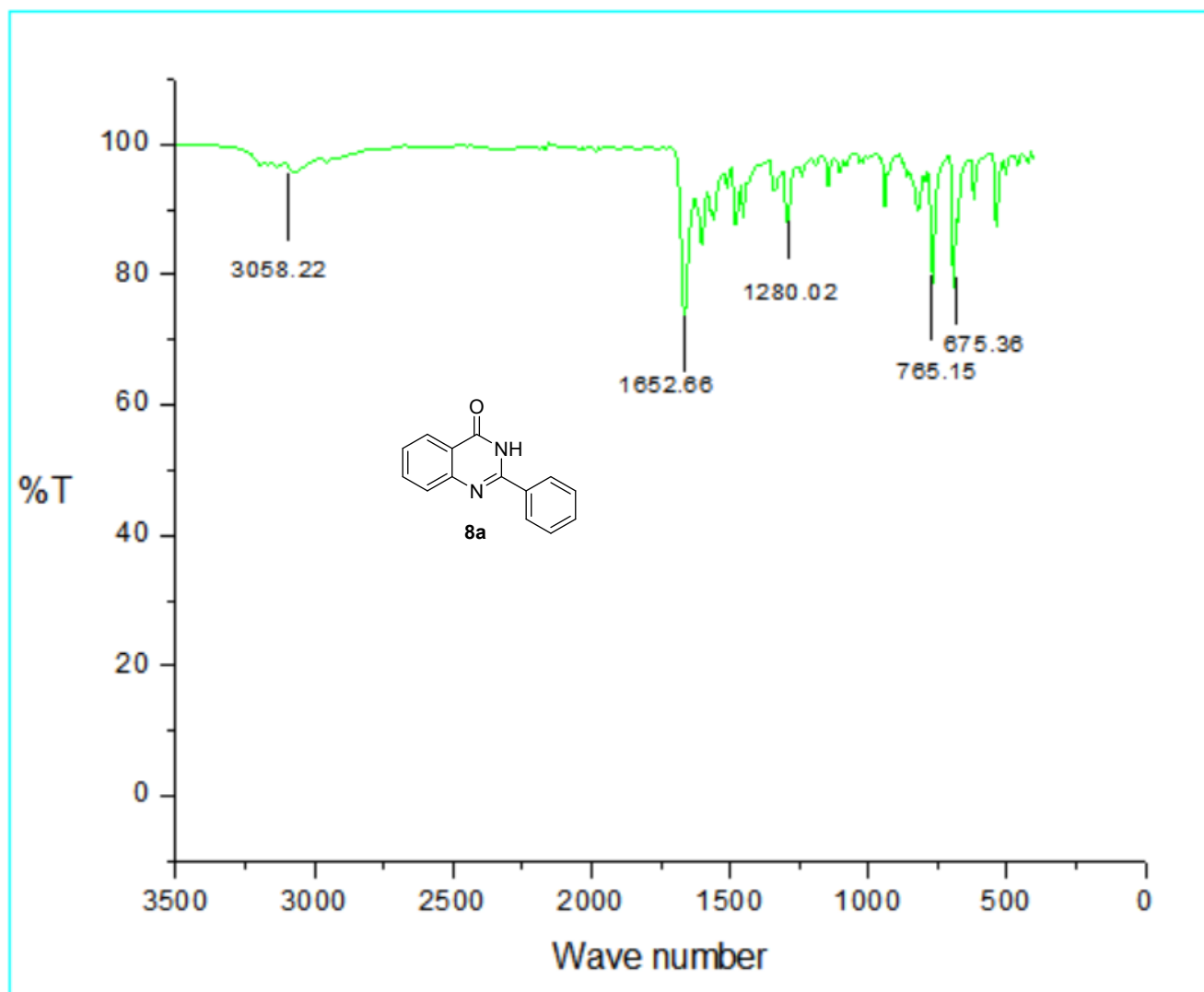


Figure 5: <sup>13</sup>C NMR spectrum of the compound **8a**.



**Figure 6:** FT-IR spectrum of the compound **8a**.

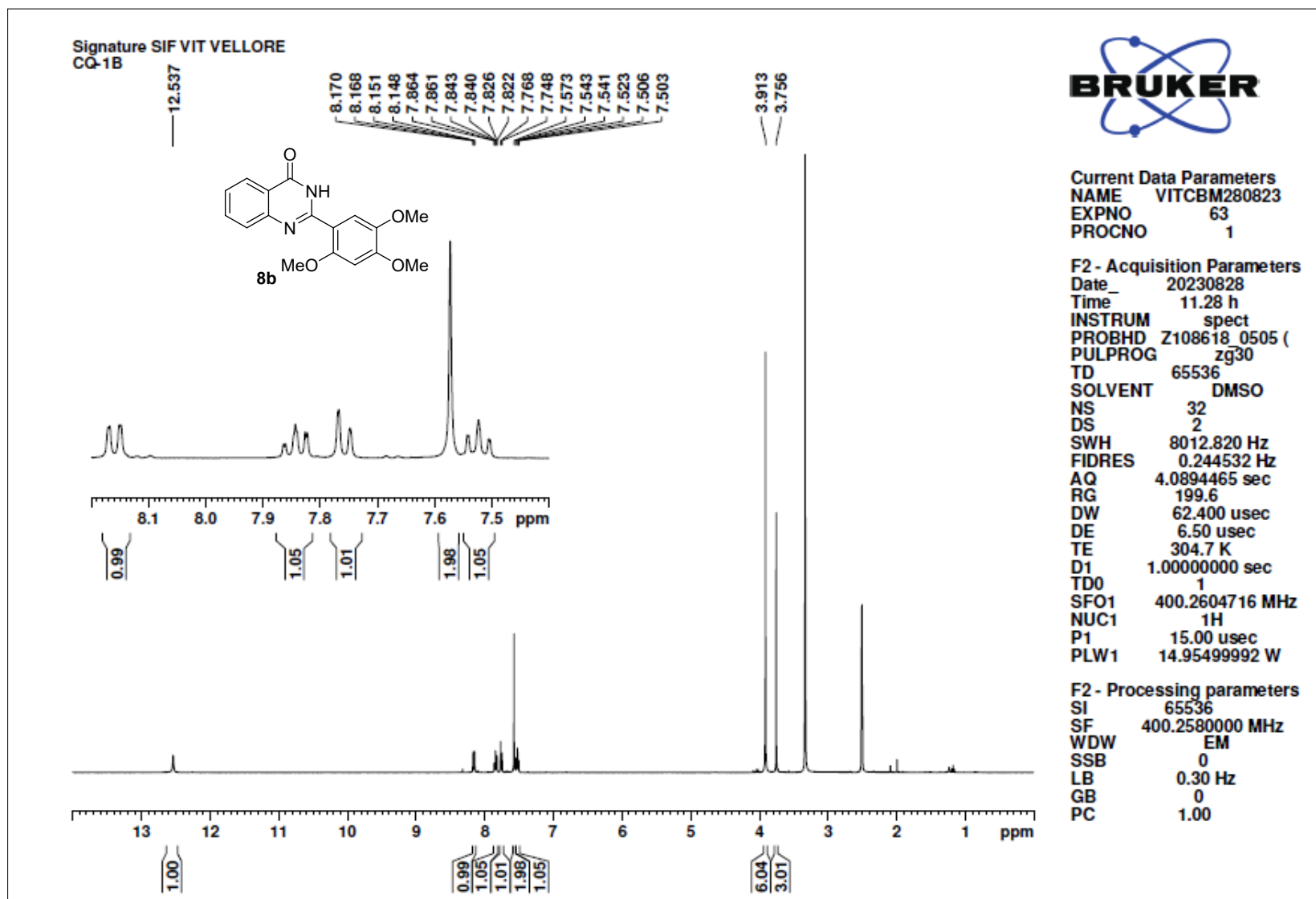
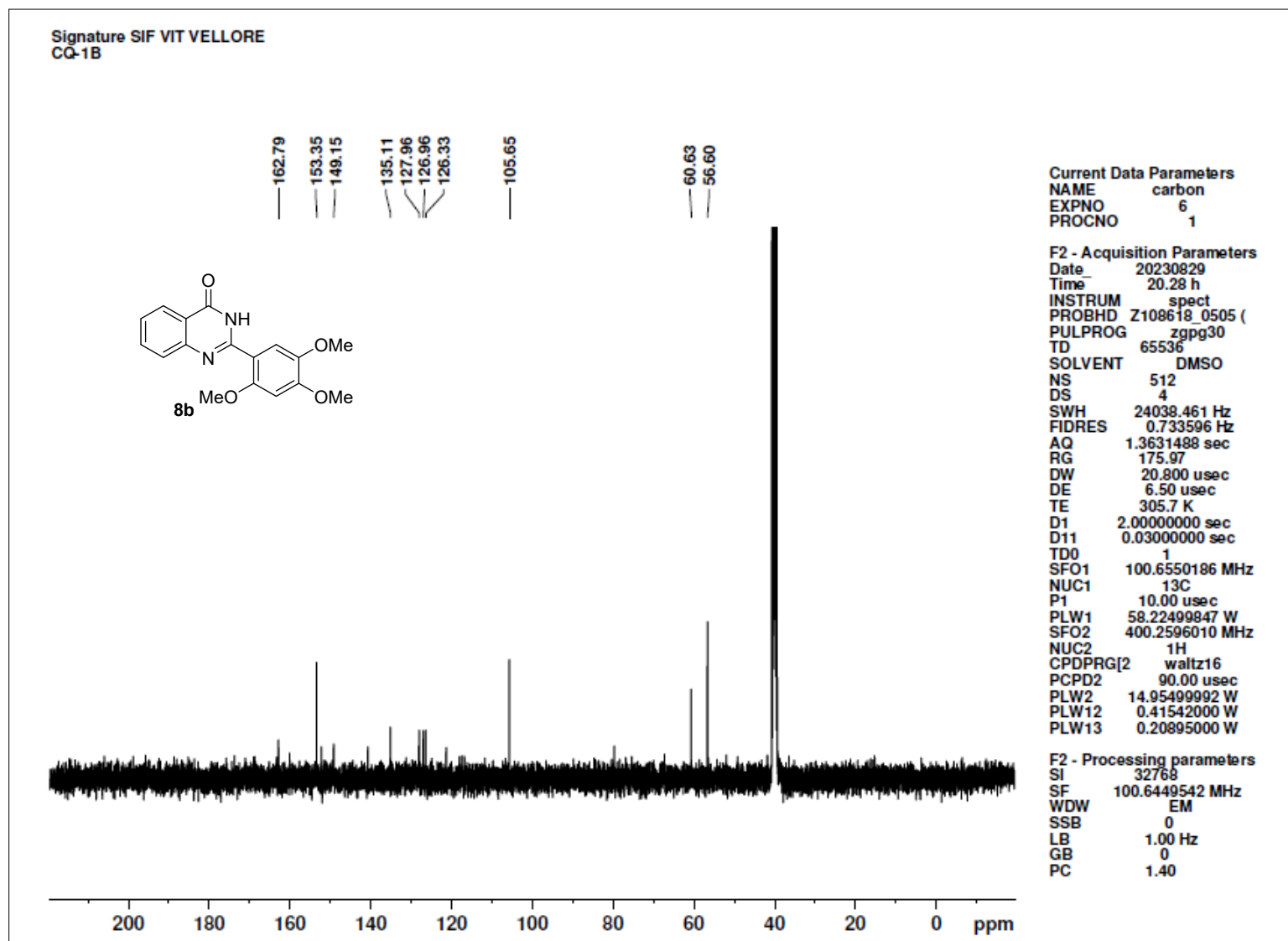
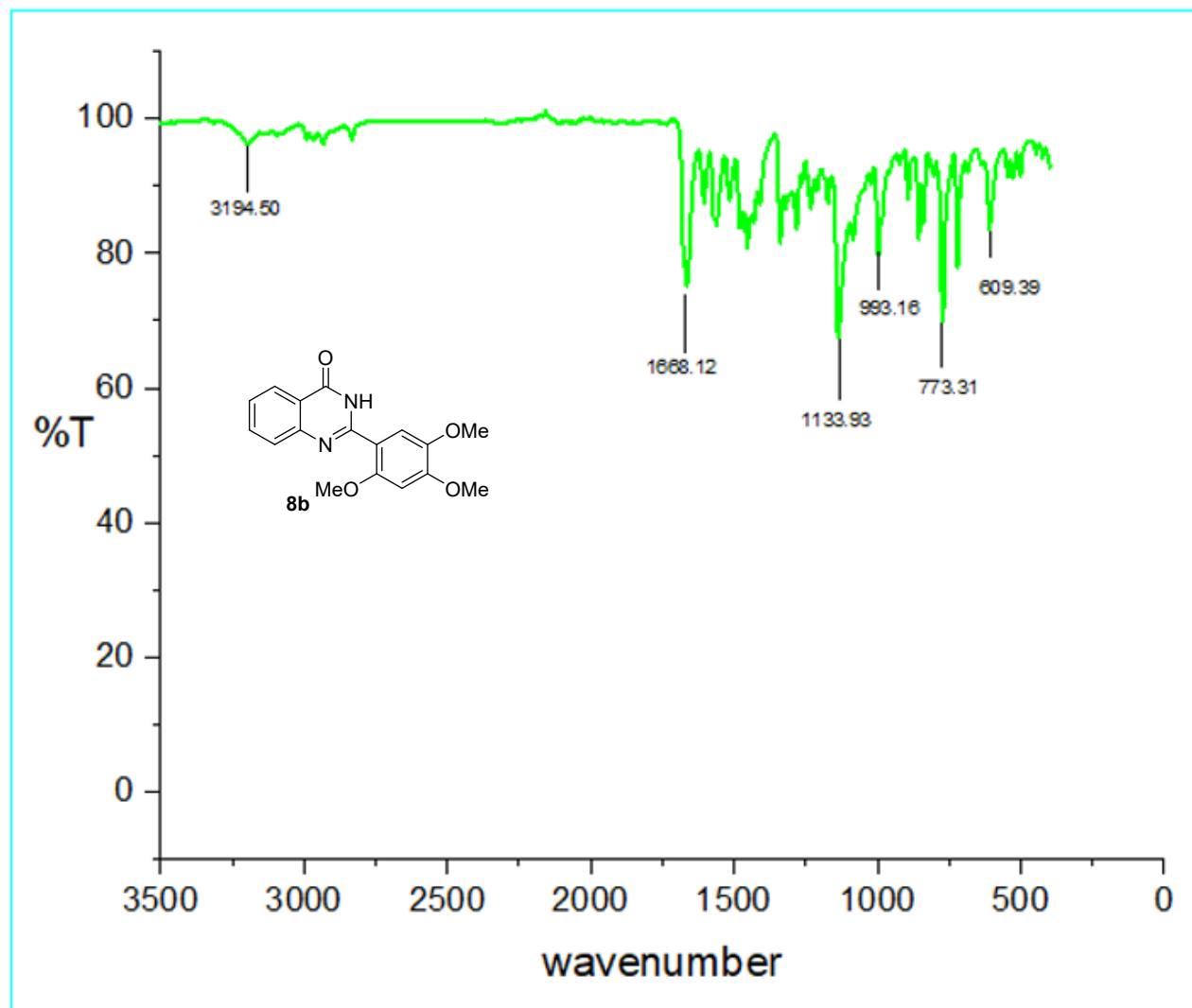


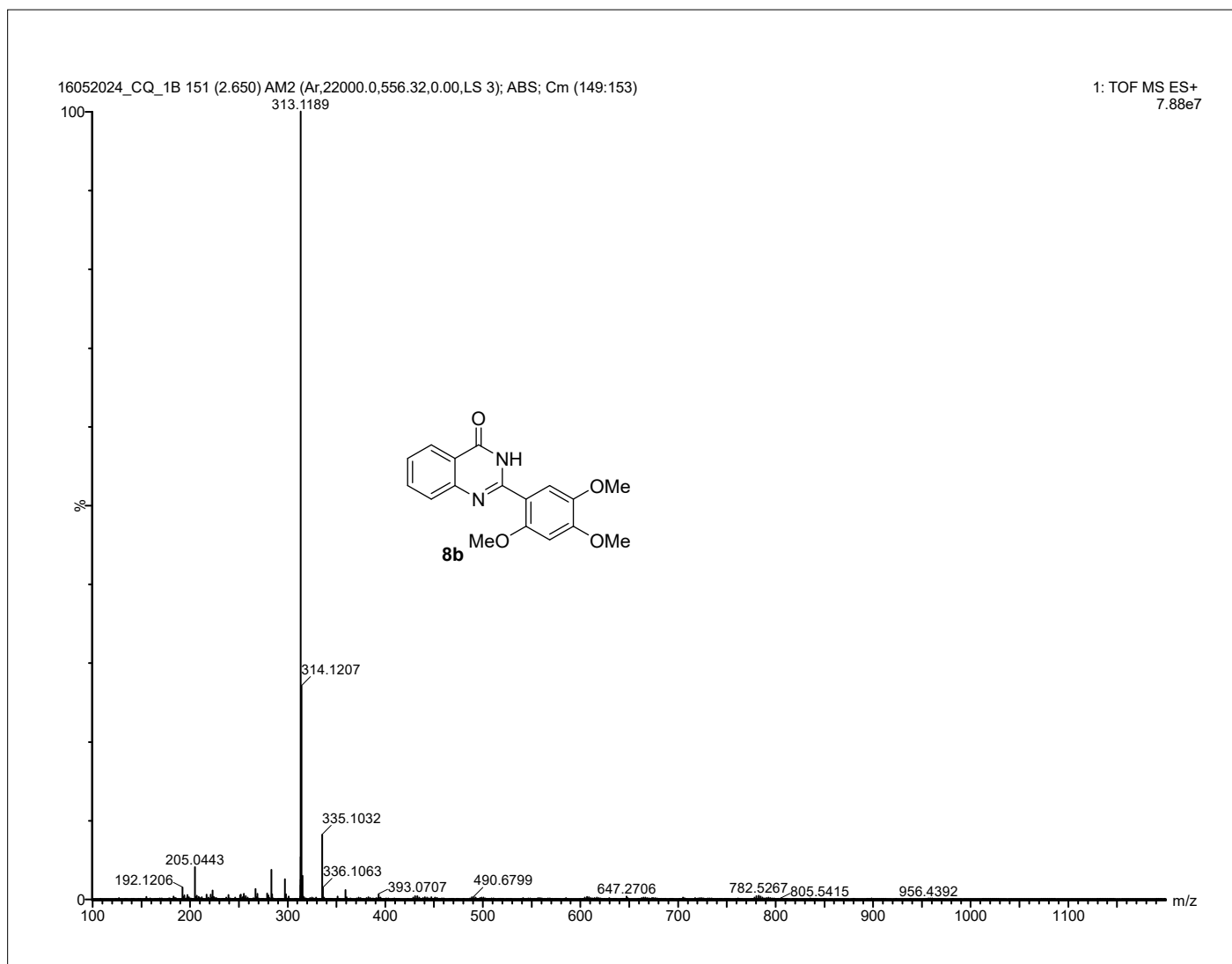
Figure 7: <sup>1</sup>H NMR spectrum of the compound **8b**.



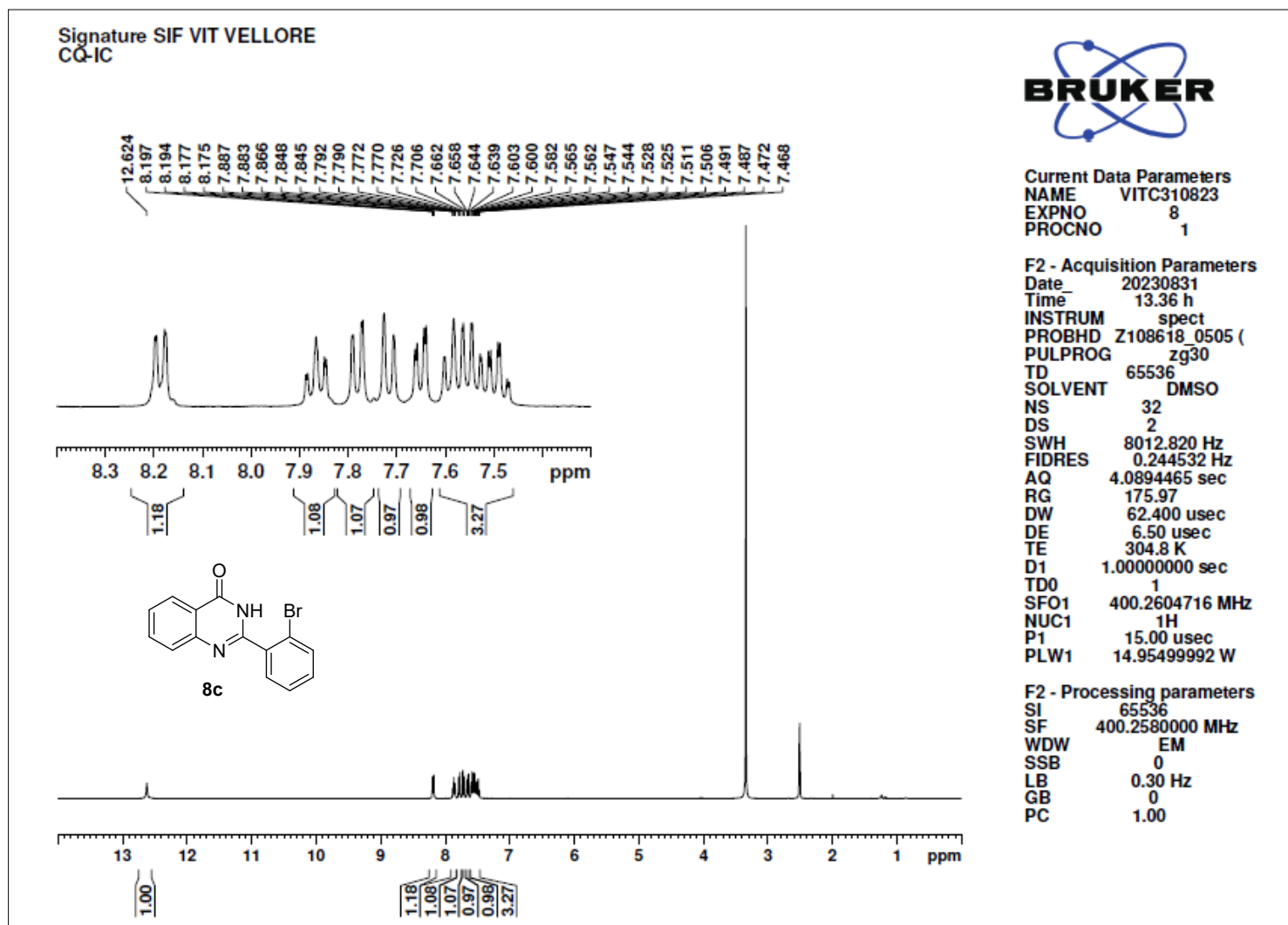
**Figure 8:** <sup>13</sup>C NMR spectrum of the compound **8b**.



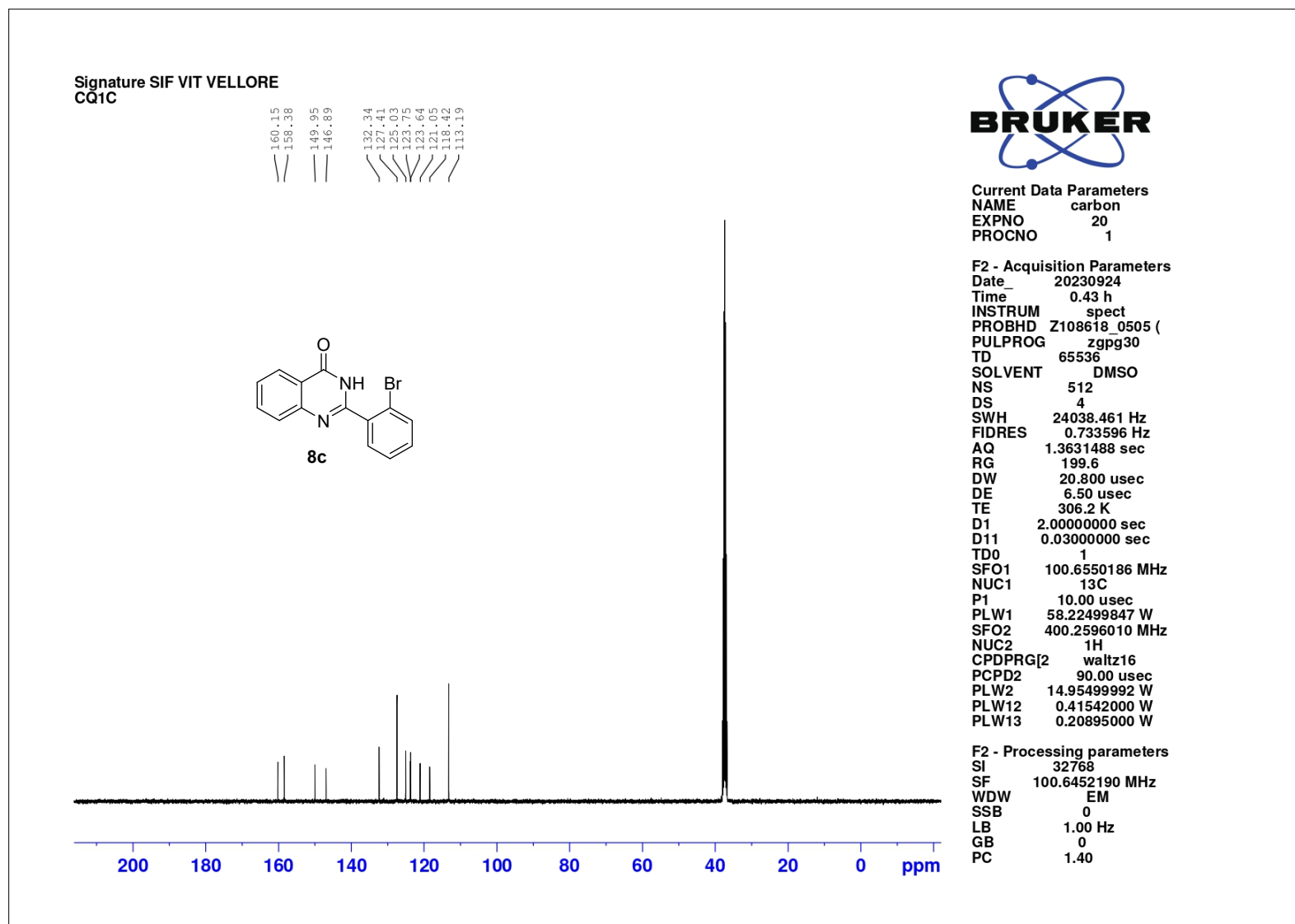
**Figure 9:** FT-IR spectrum of the compound **8b**.



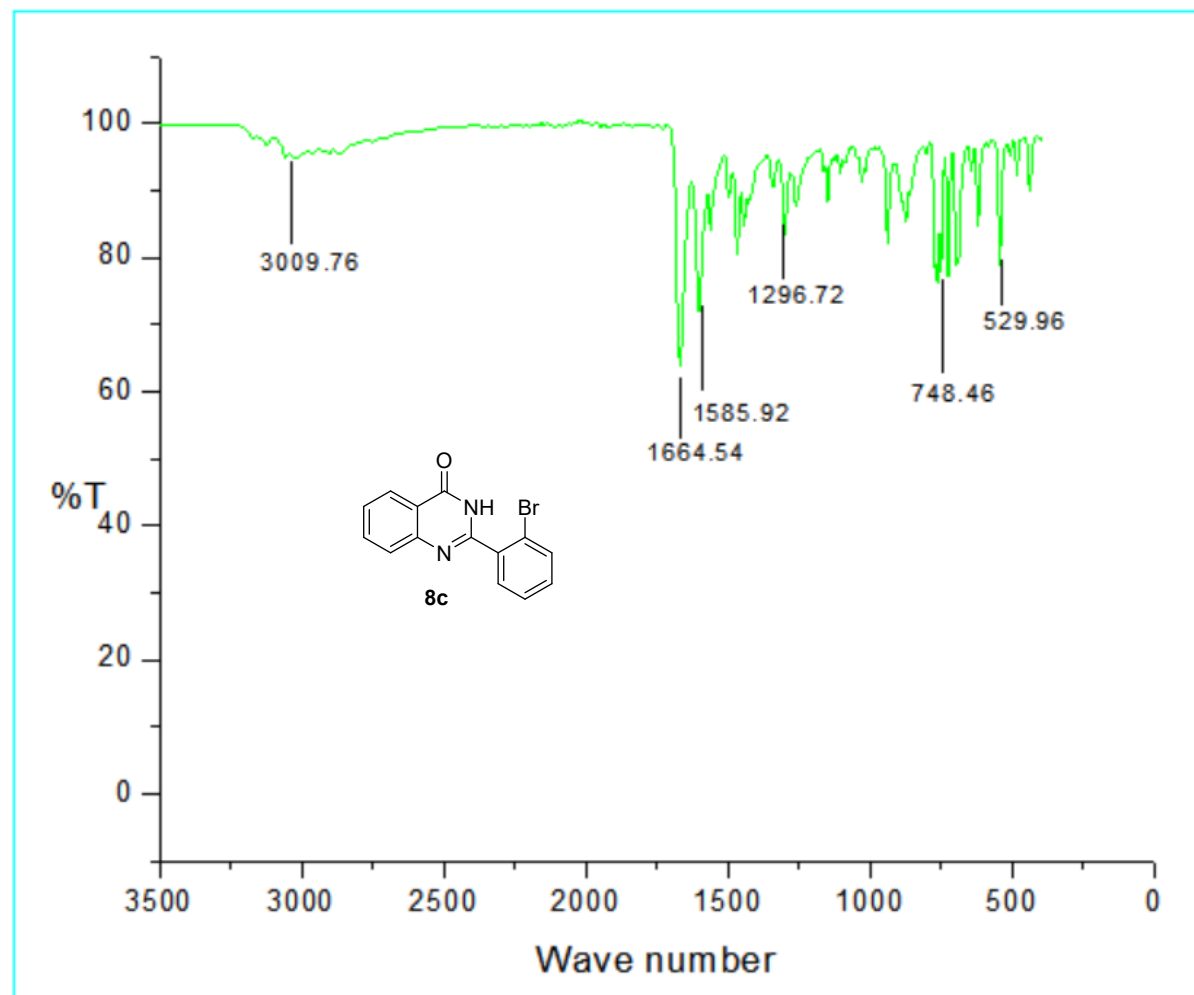
**Figure 10:** HRMS spectrum of the compound **8b**.



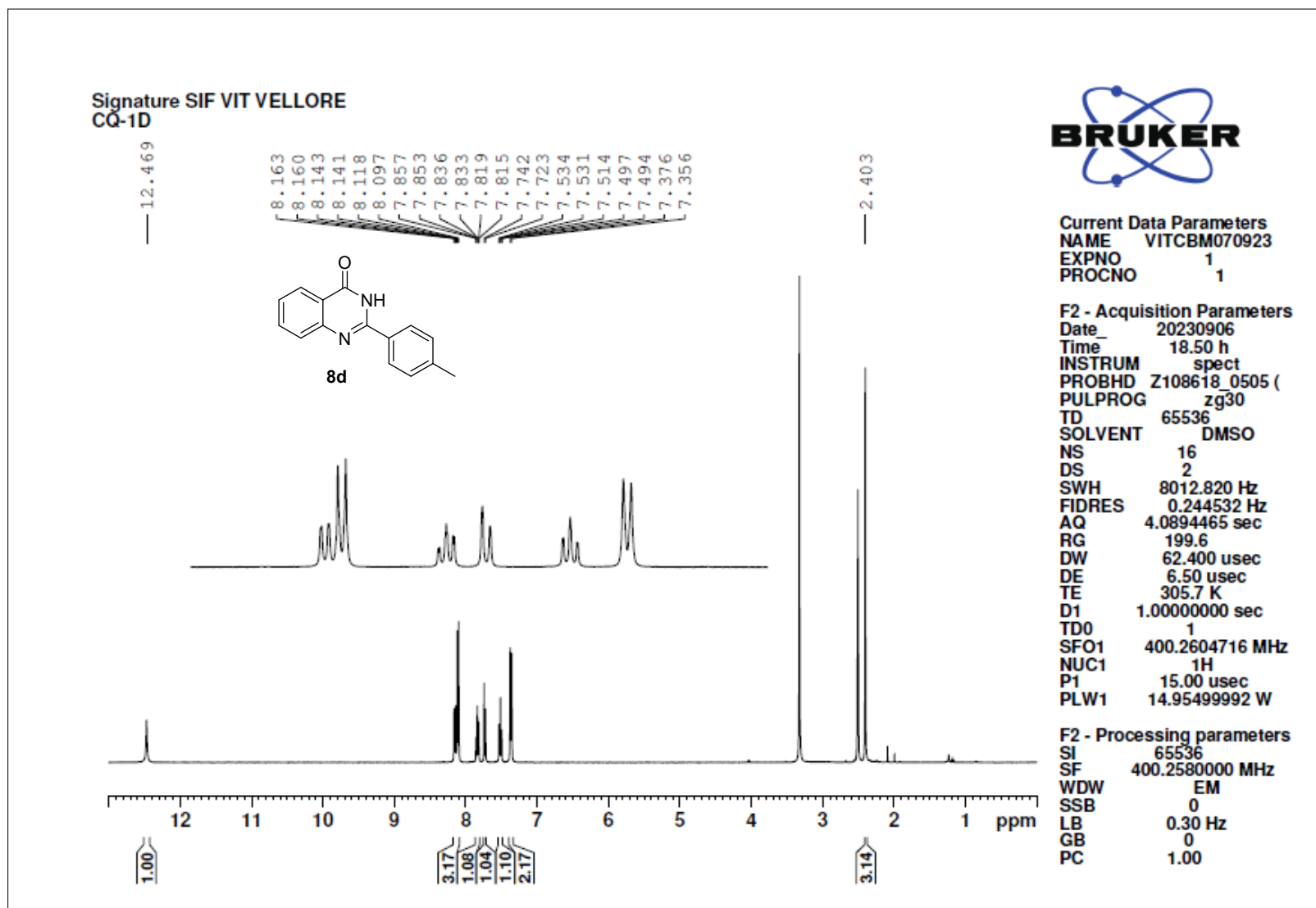
**Figure 11:**  $^1\text{H}$  NMR spectrum of the compound **8c**.



**Figure 12:**  $^{13}\text{C}$  NMR spectrum of the compound **8c**.



**Figure 13:** FT-IR spectrum of the compound **8c**.



**Figure 14:**  $^1\text{H}$  NMR spectrum of the compound **8d**.

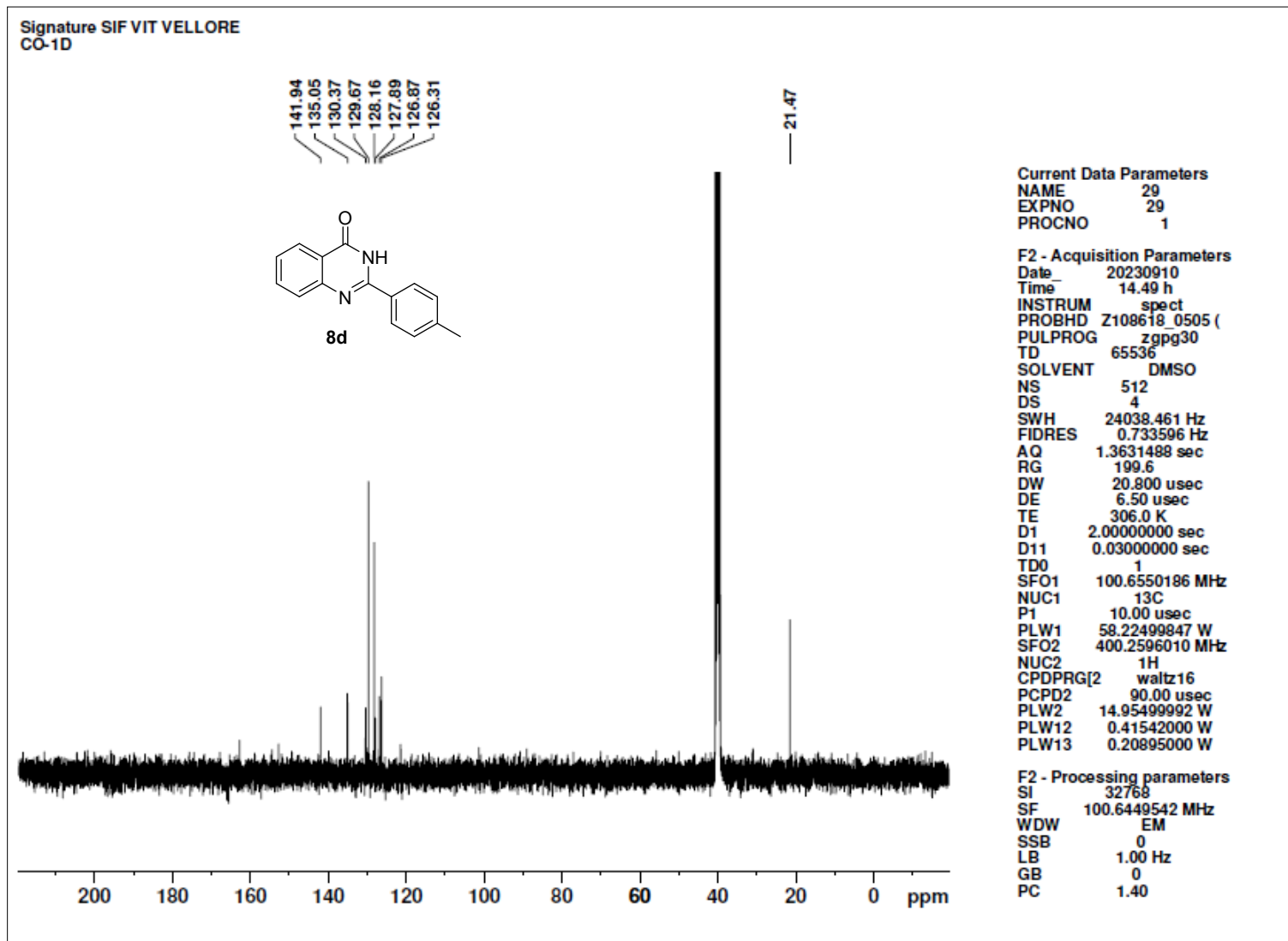
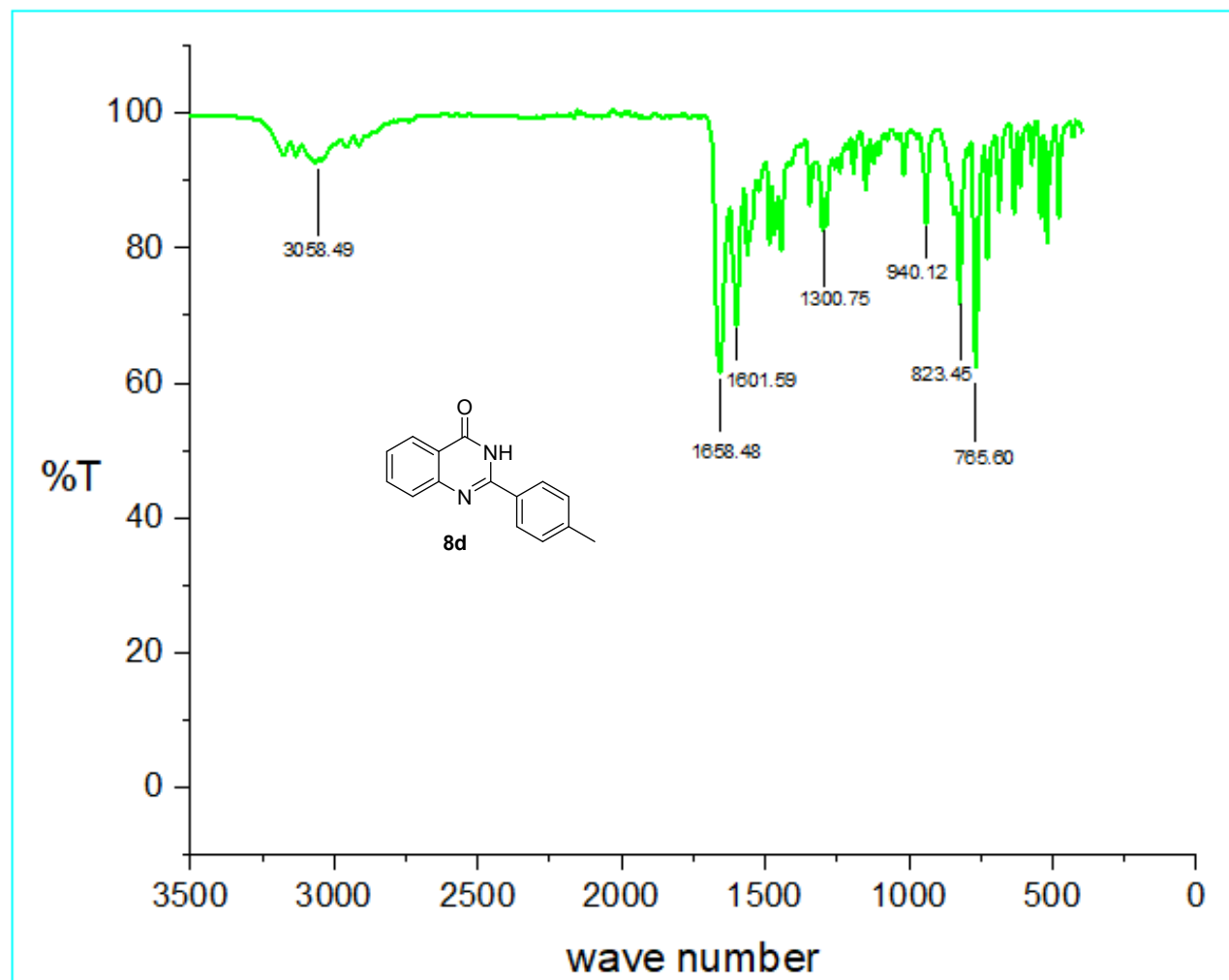
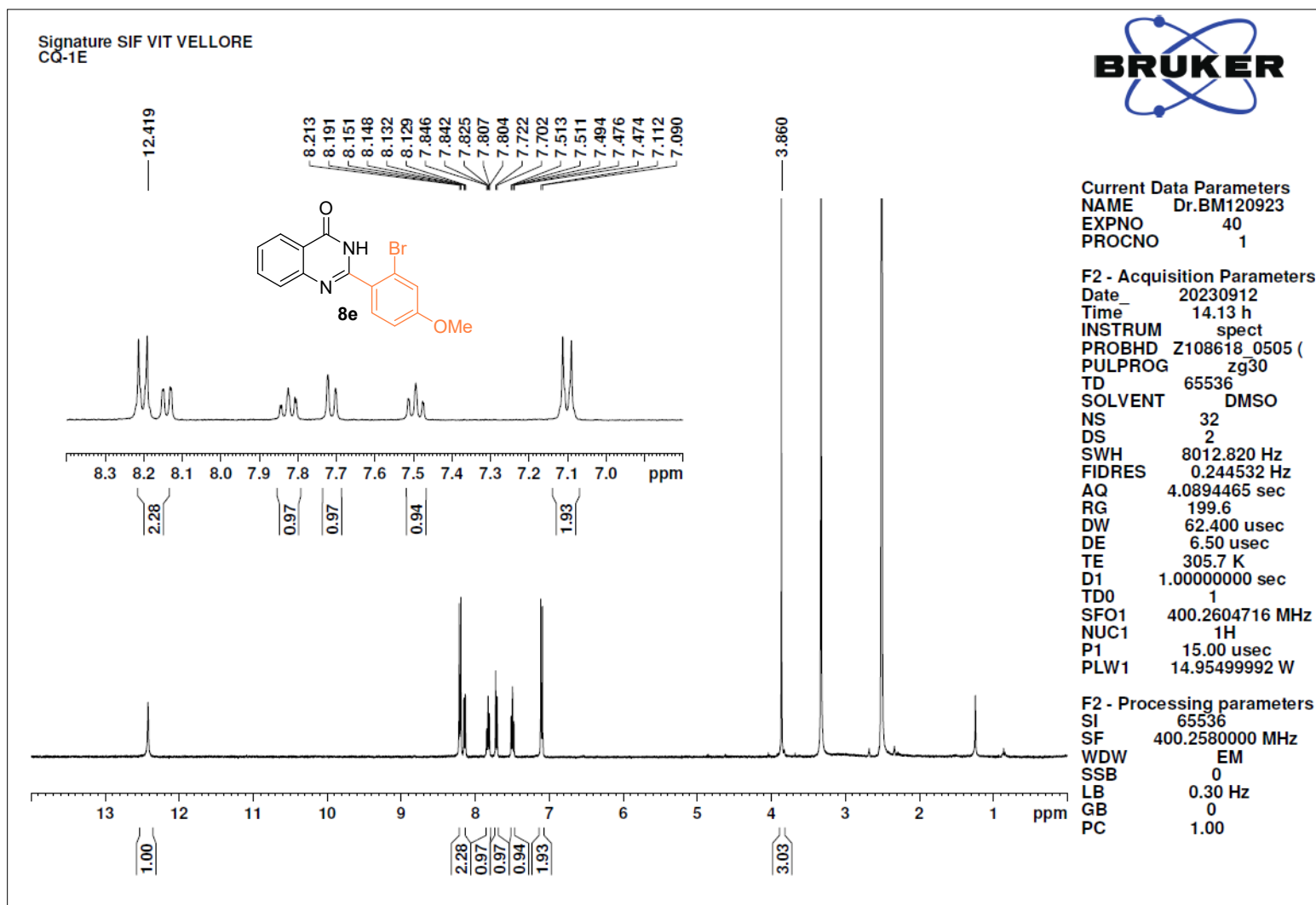


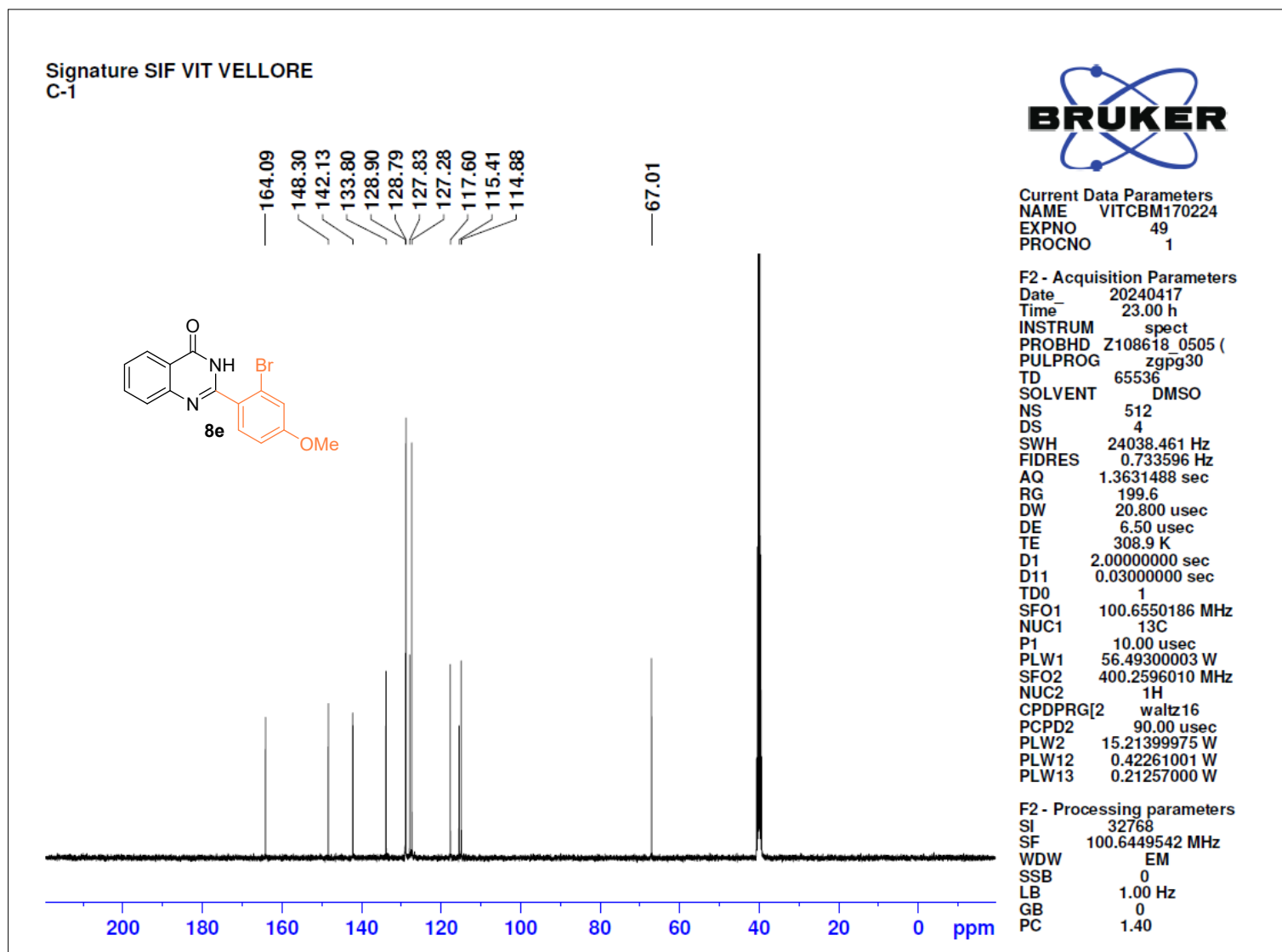
Figure 15:  $^{13}\text{C}$  NMR spectrum of the compound 8d.



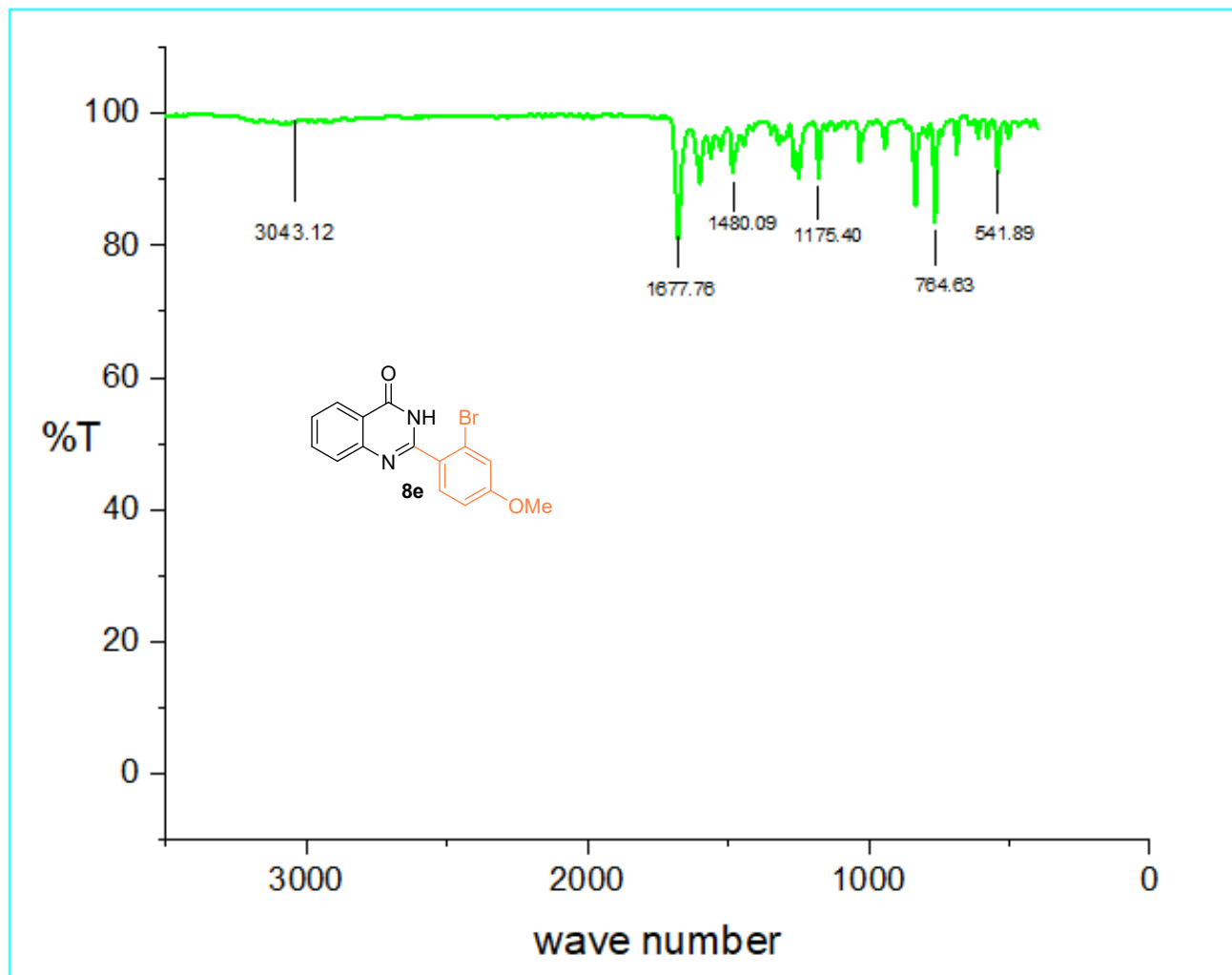
**Figure 16:** FT-IR spectrum of the compound **8d**.



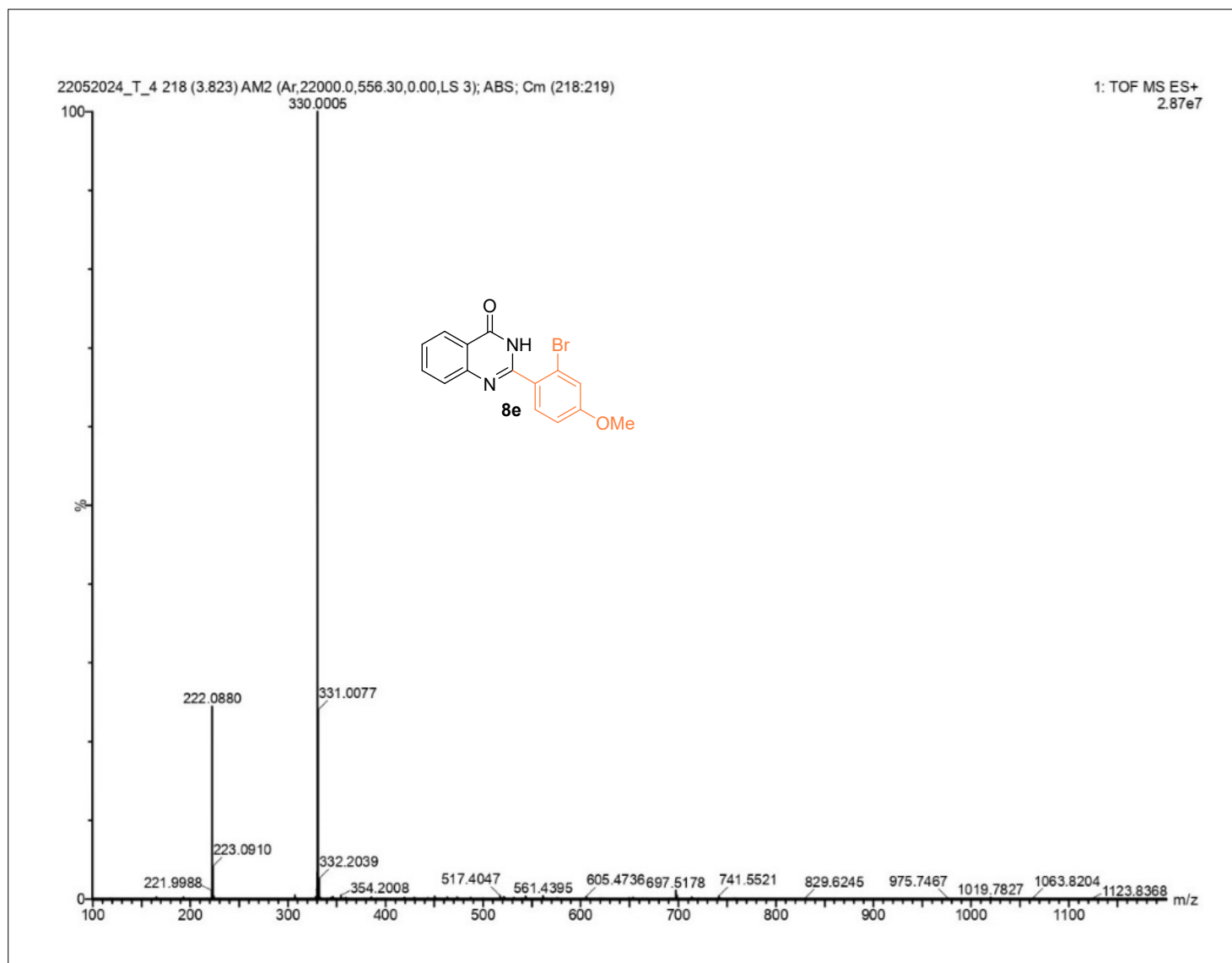
**Figure 17:** <sup>1</sup>H NMR spectrum of the compound **8e**.



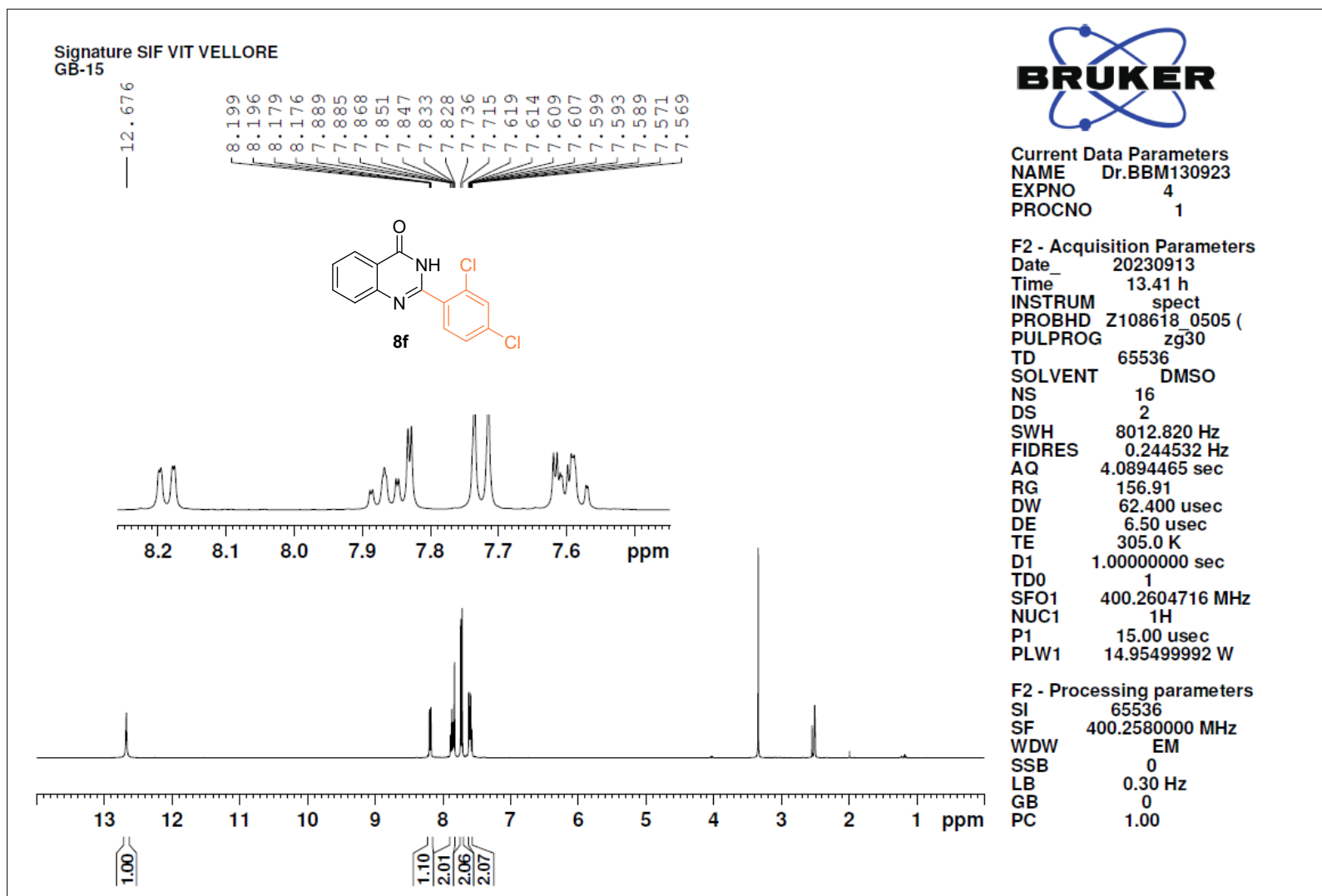
**Figure 18:** <sup>13</sup>C NMR spectrum of the compound **8e**.



**Figure 19:** FT-IR spectrum of the compound **8e**.



**Figure 20:** HRMS spectrum of the compound **8e**.



**Figure 21:**  $^1\text{H}$  NMR spectrum of the compound **8f**.

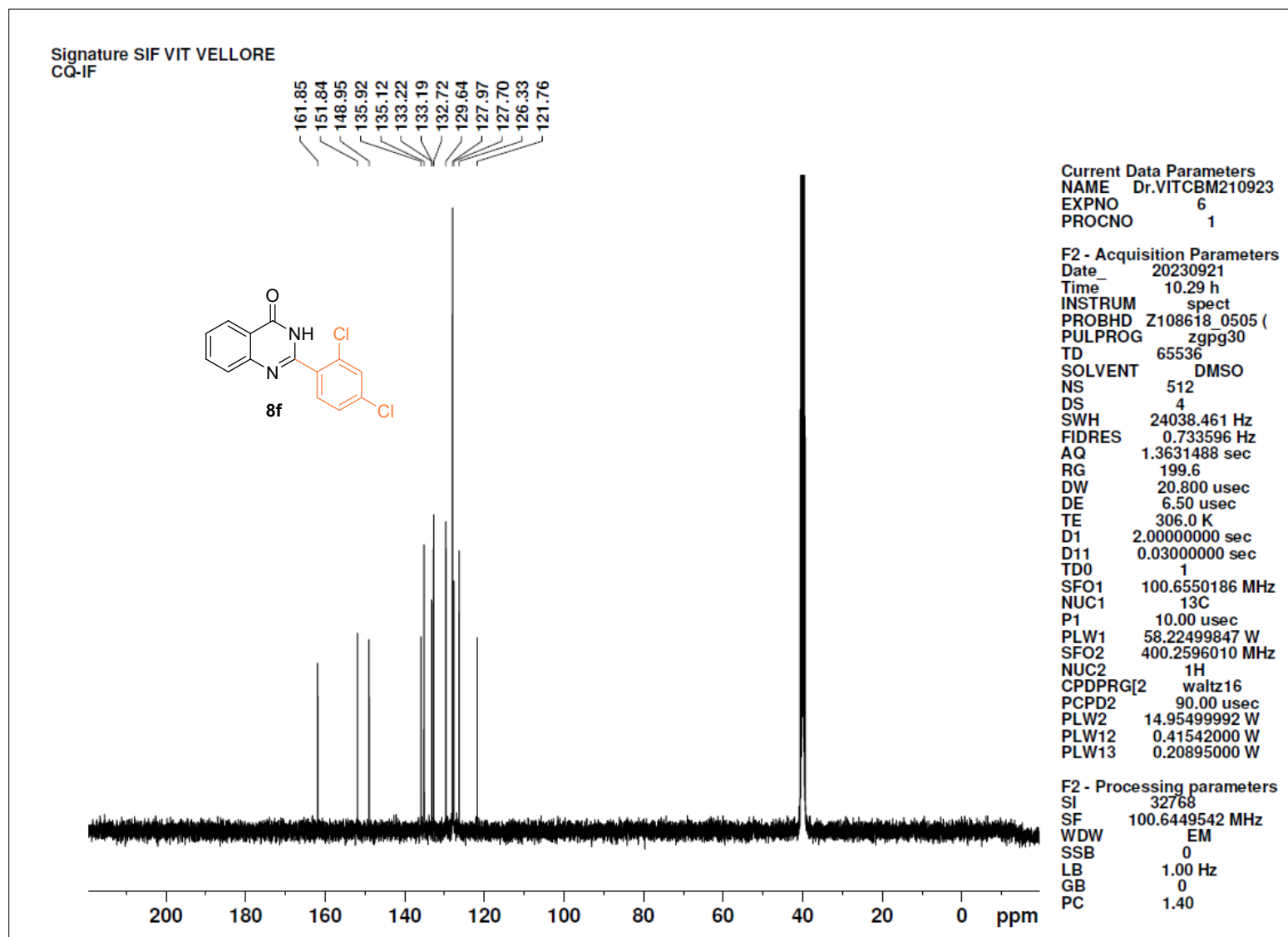
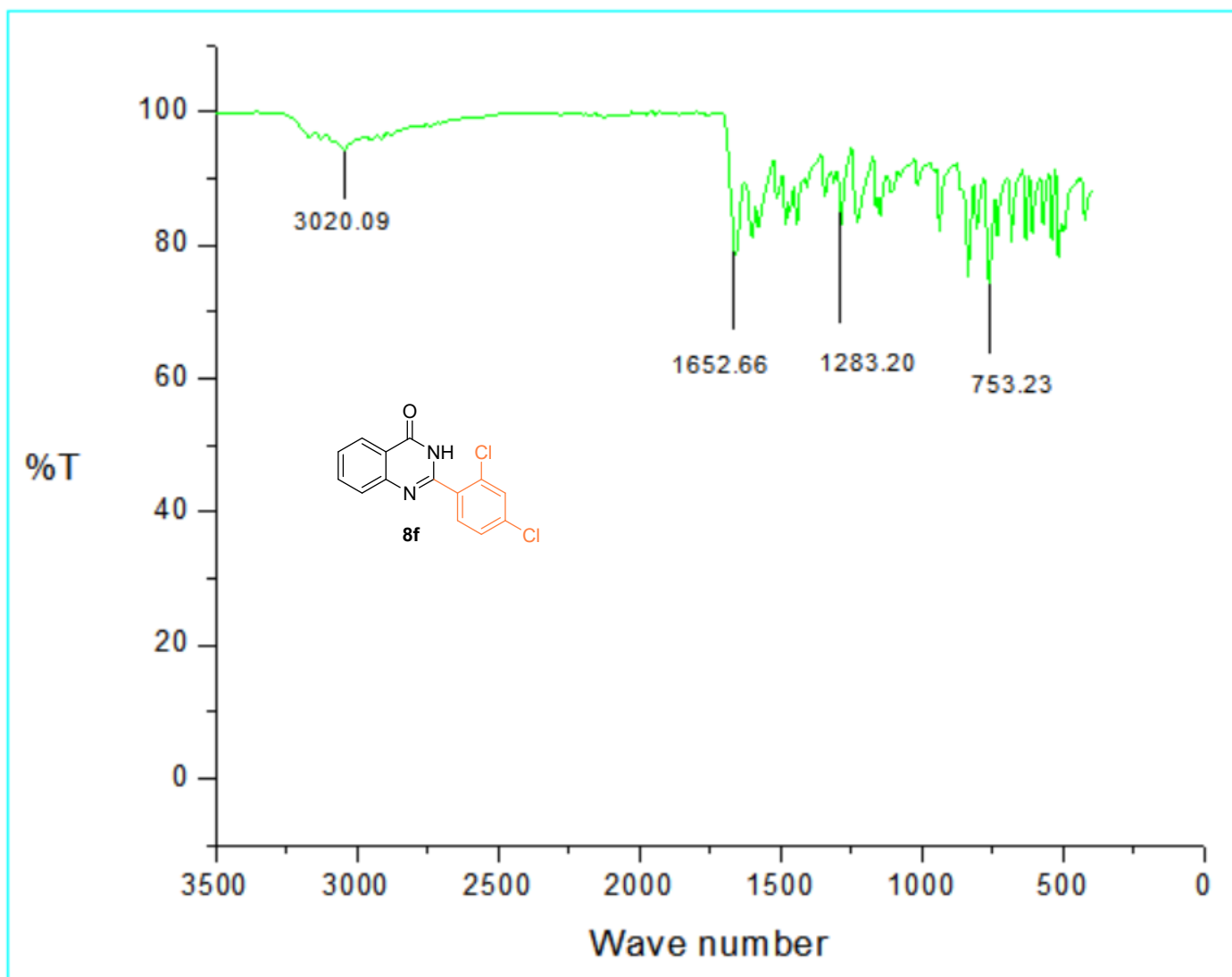


Figure 22:  $^{13}\text{C}$  NMR spectrum of the compound **8f**.



**Figure 23:** FT-IR spectrum of the compound **8f**.

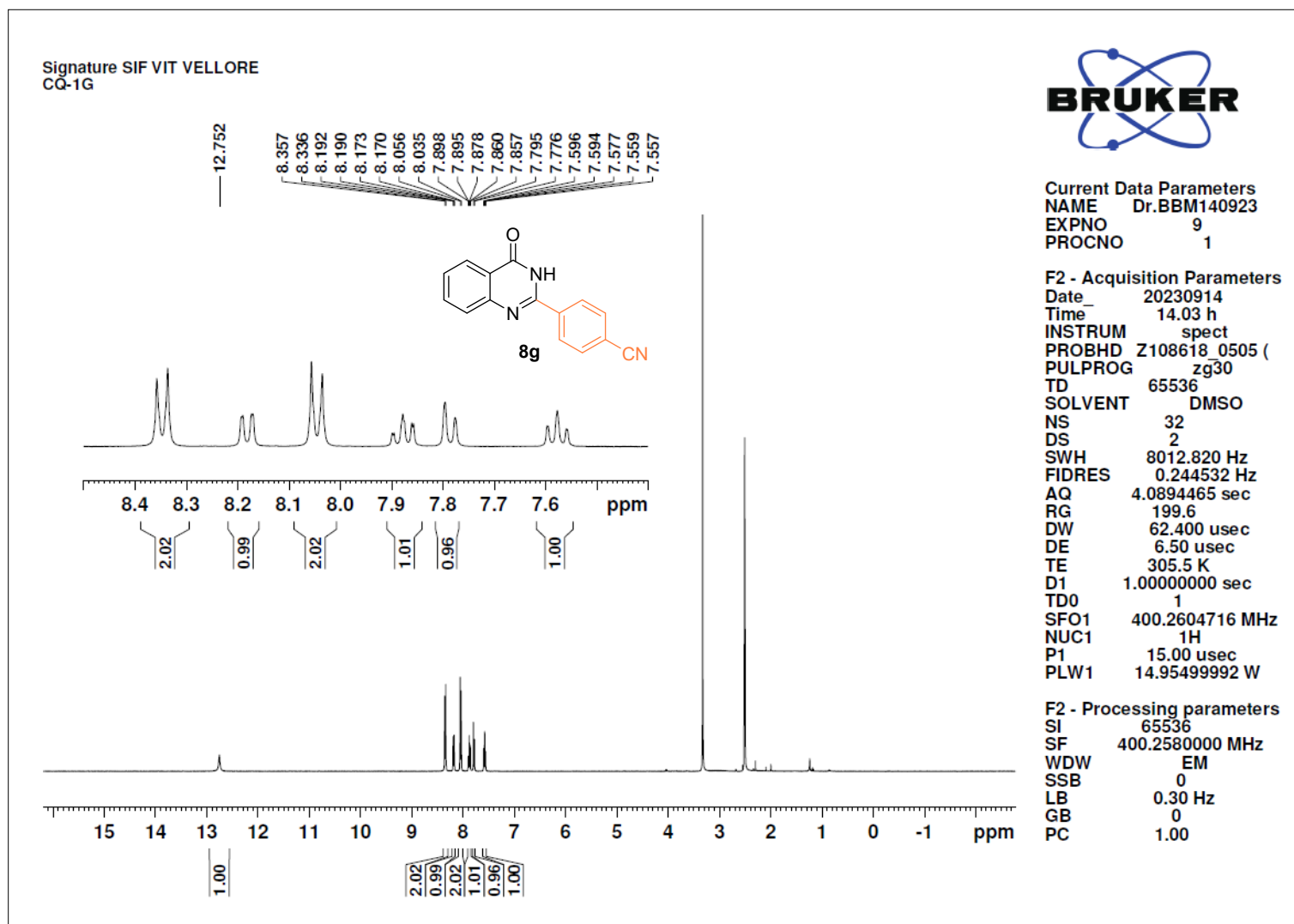


Figure 24:  $^1\text{H}$  NMR spectrum of the compound **8g**.

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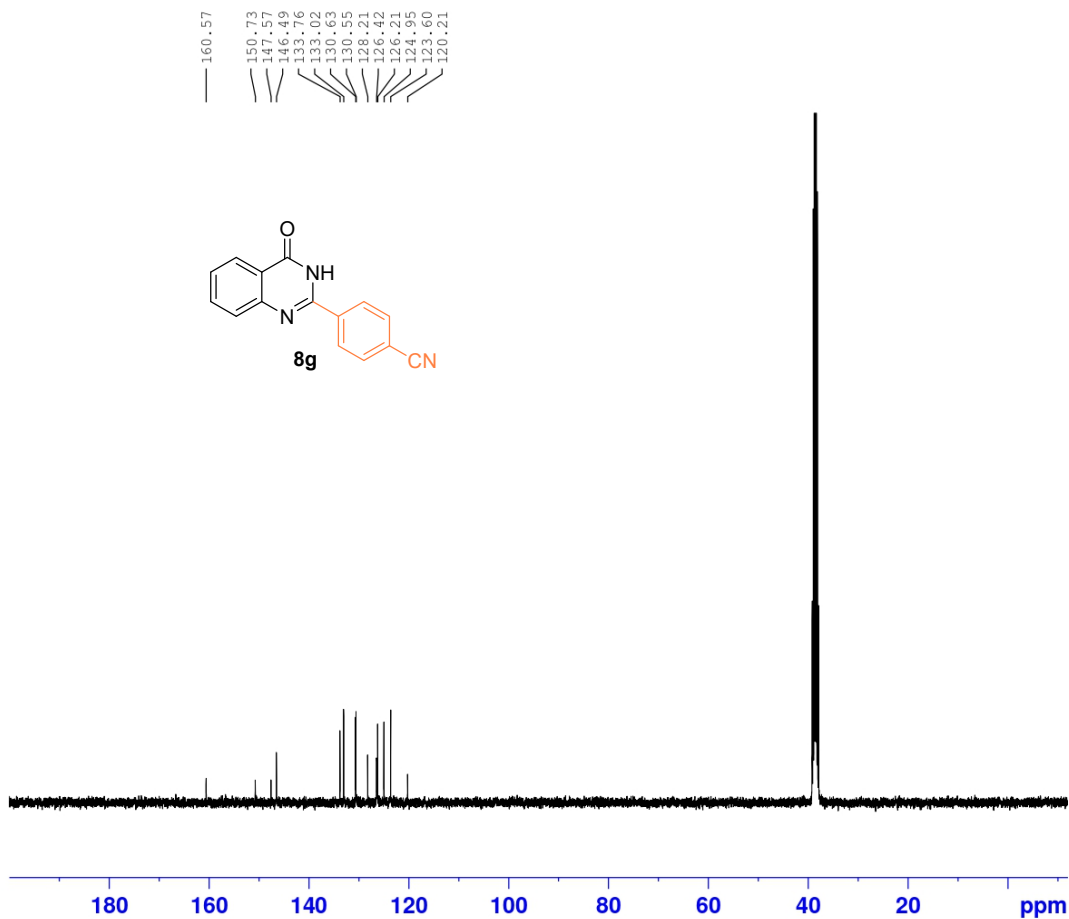
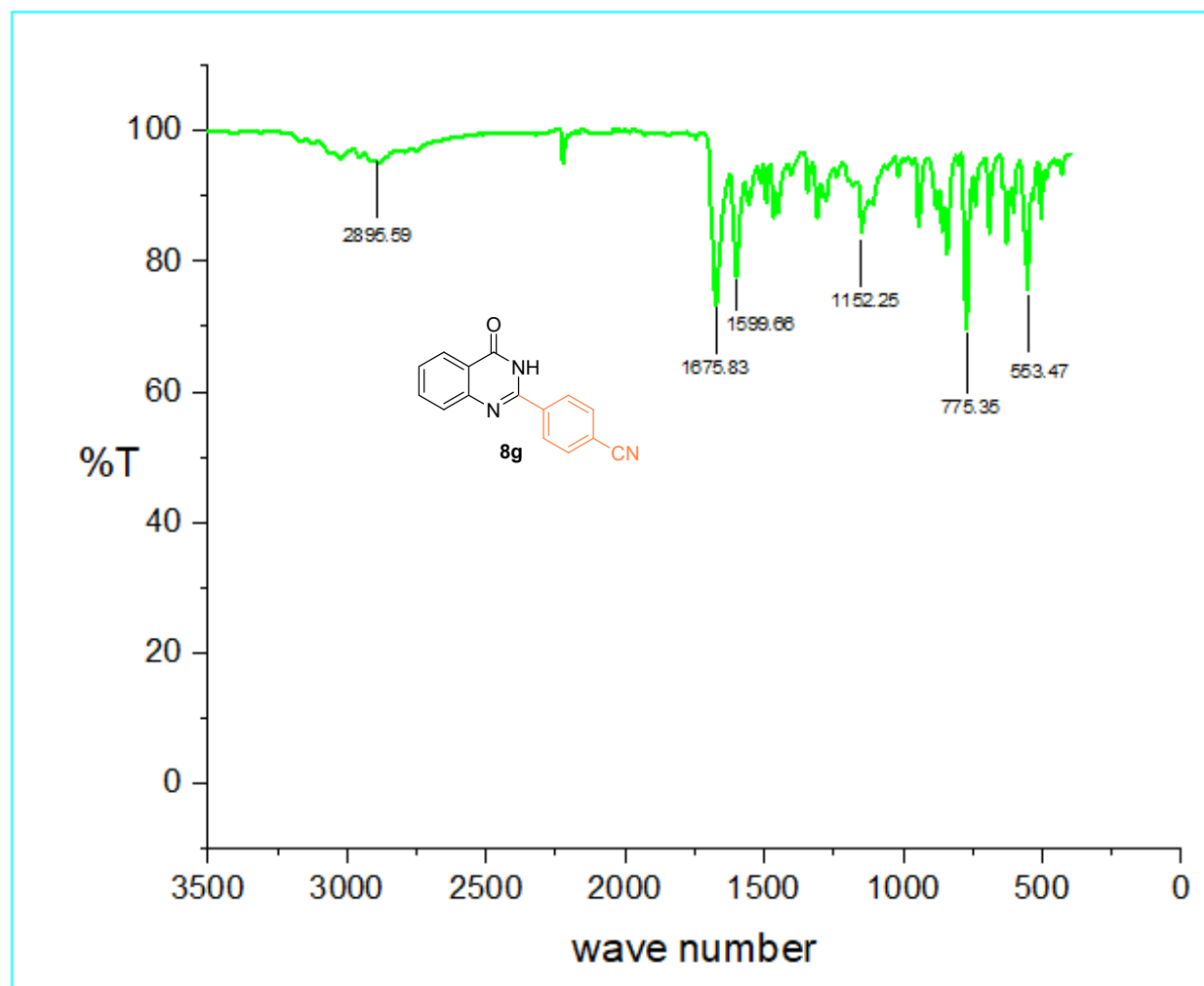
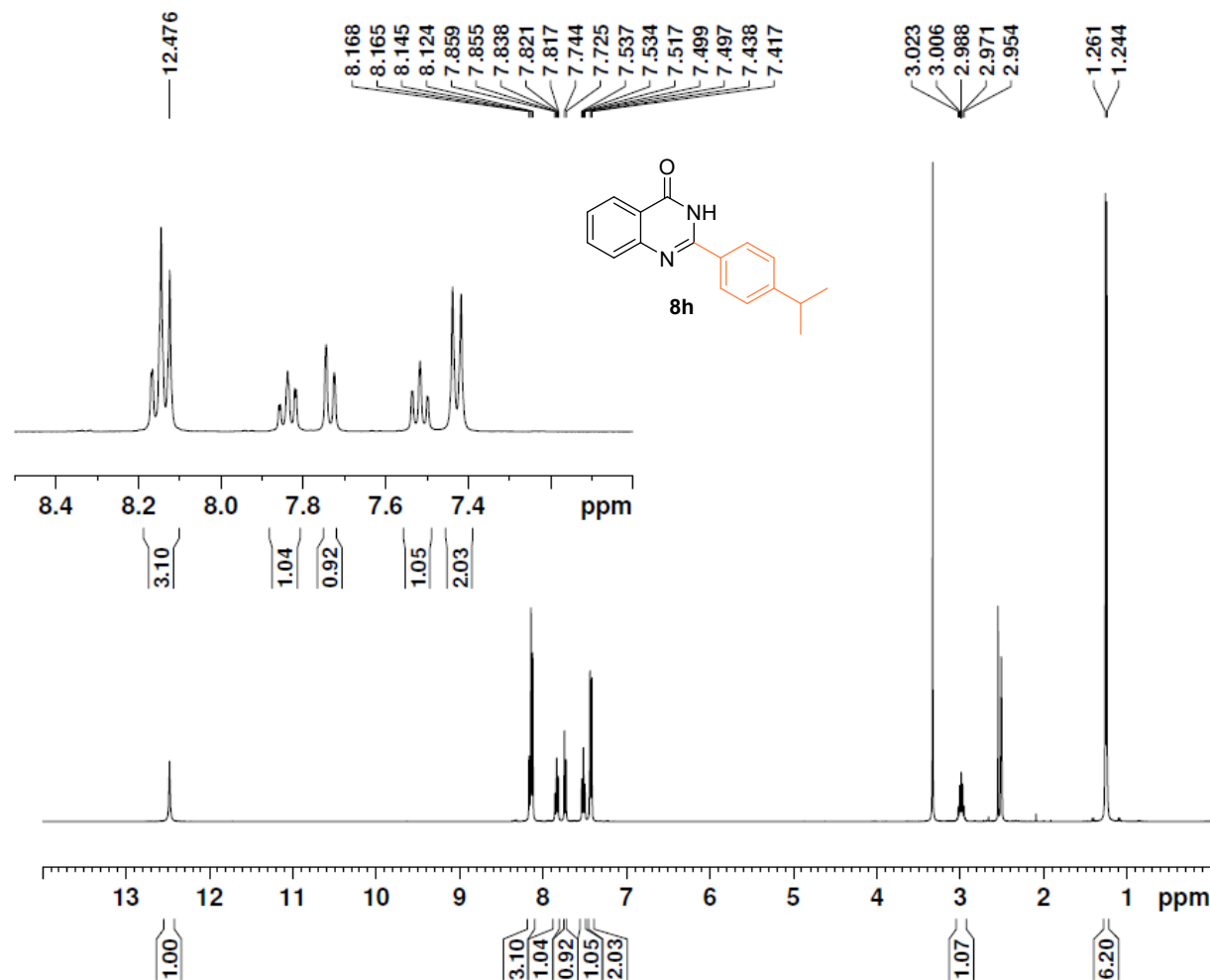


Figure 25:  $^{13}\text{C}$  NMR spectrum of the compound 8g.



**Figure 26:** FT-IR spectrum of the compound **8g**.

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TE 305.8 K  
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PLW1 14.95499992 W

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Figure 27: <sup>1</sup>H NMR spectrum of the compound **8h**.

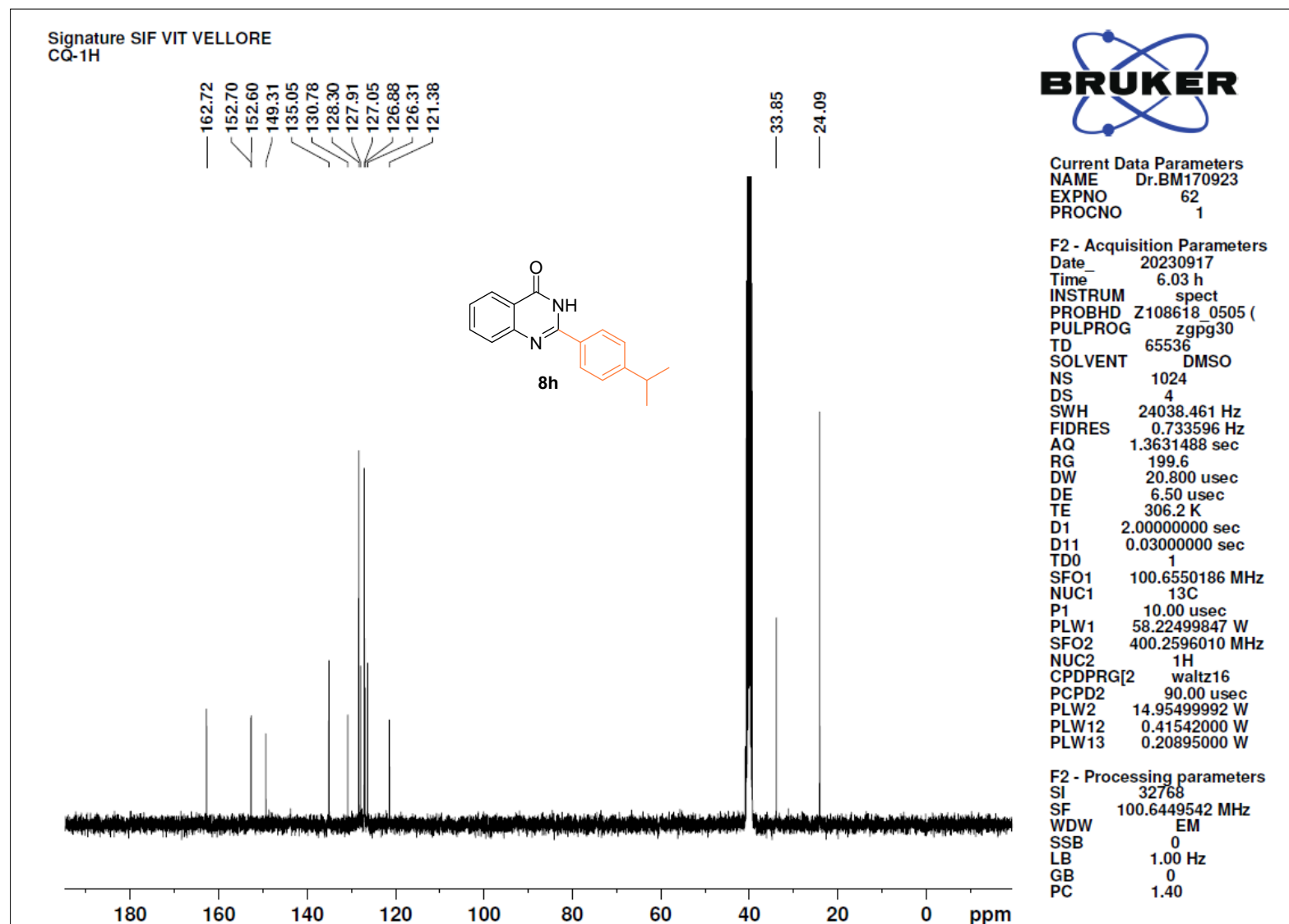
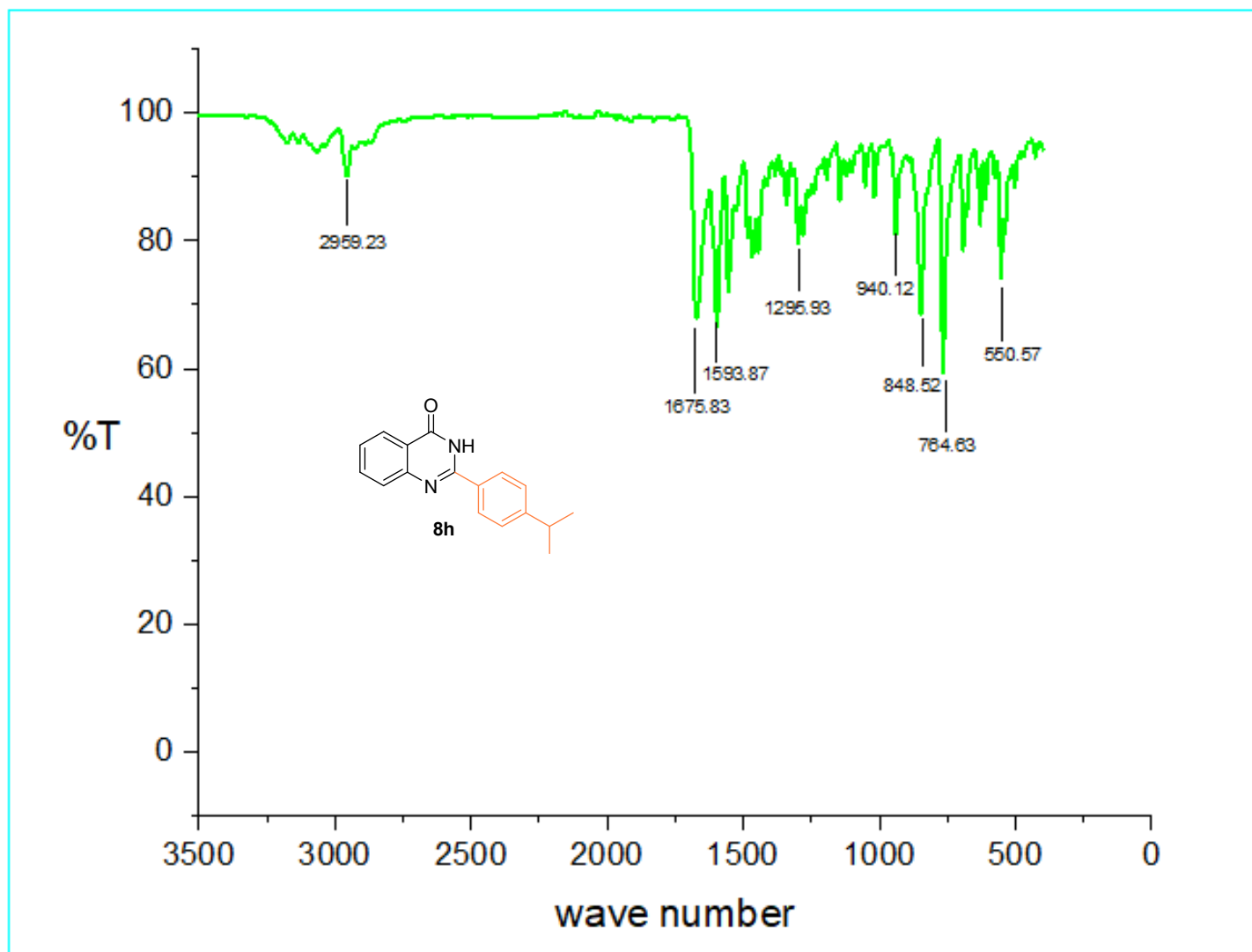
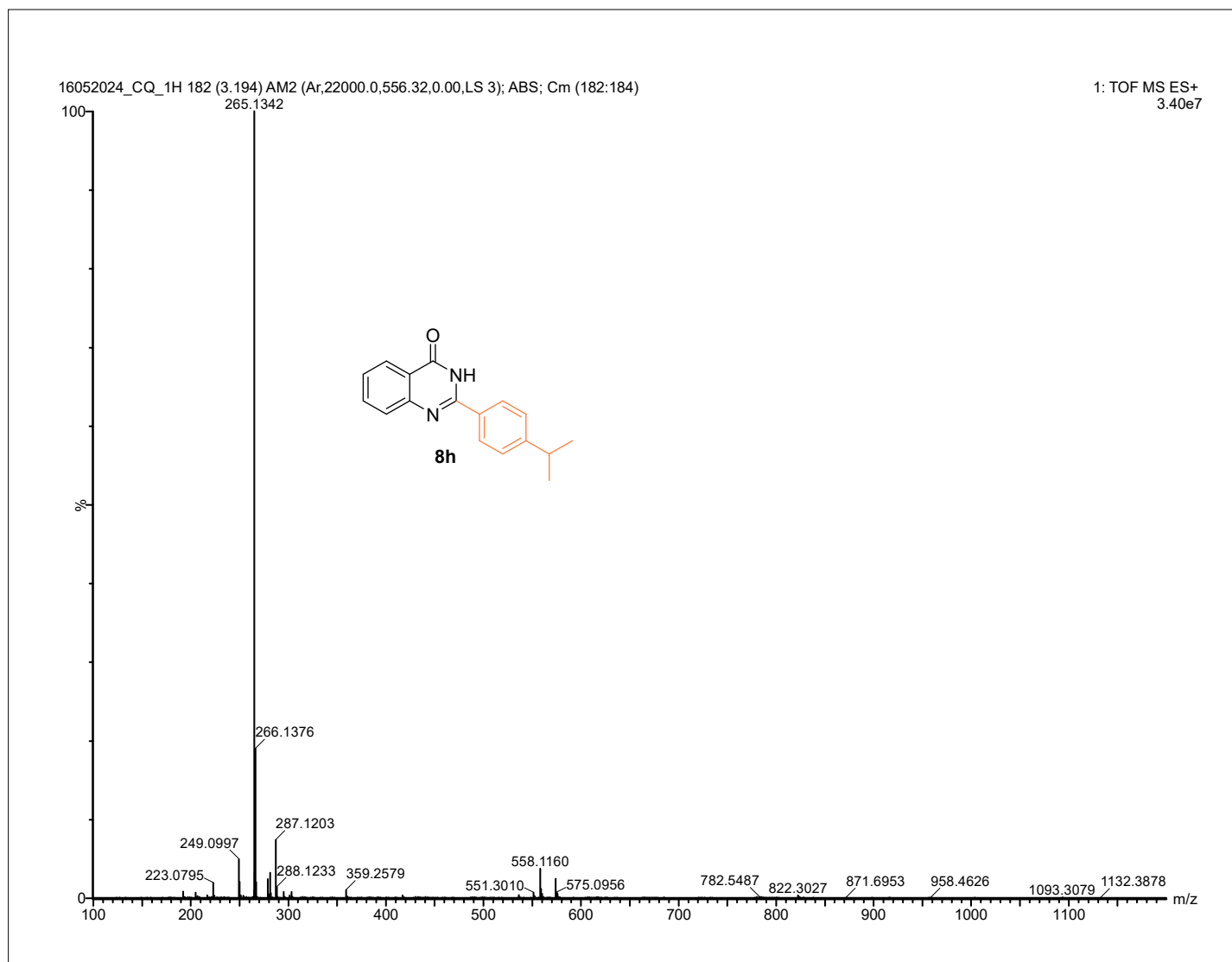


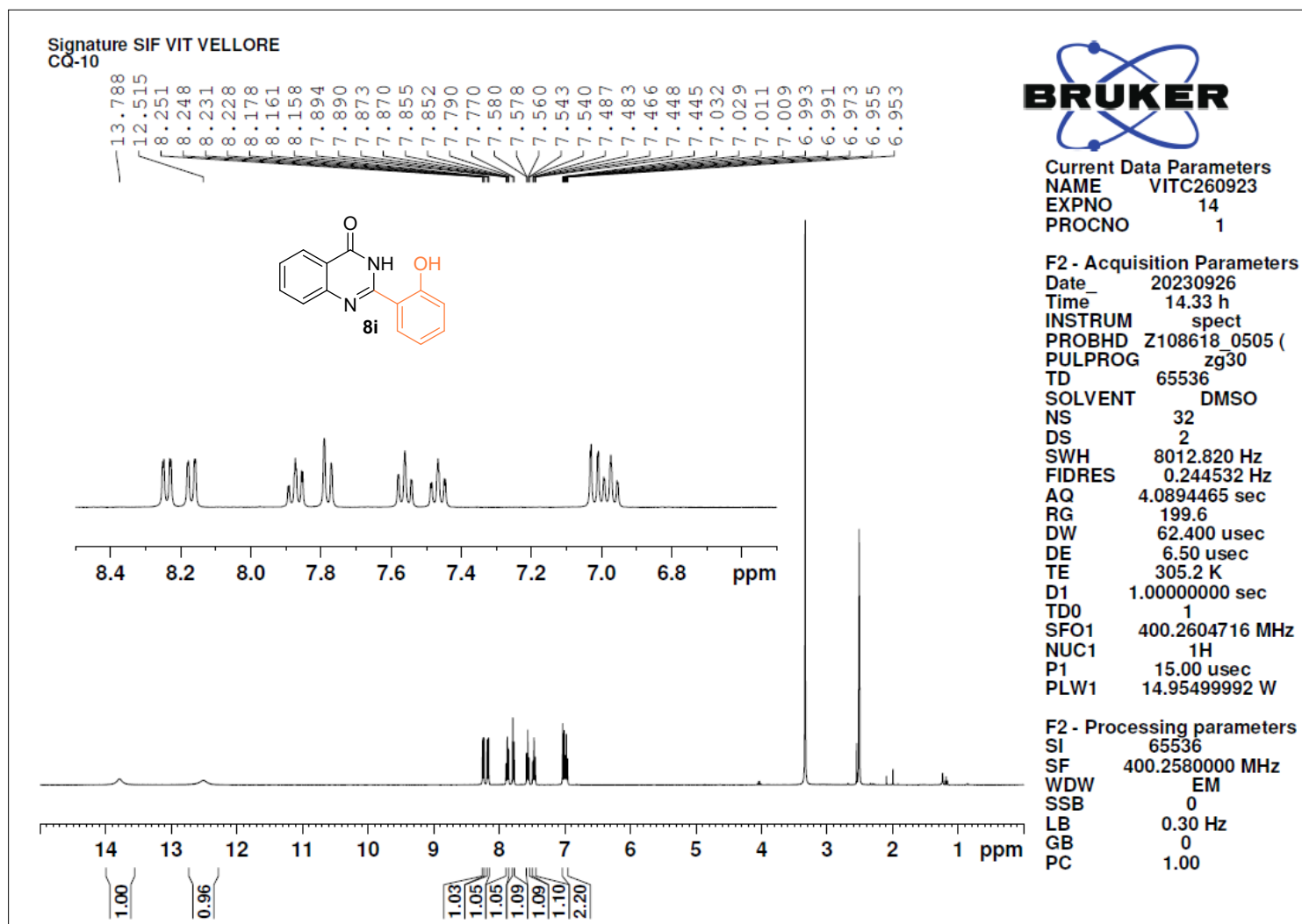
Figure 28:  $^{13}\text{C}$  NMR spectrum of the compound **8h**.



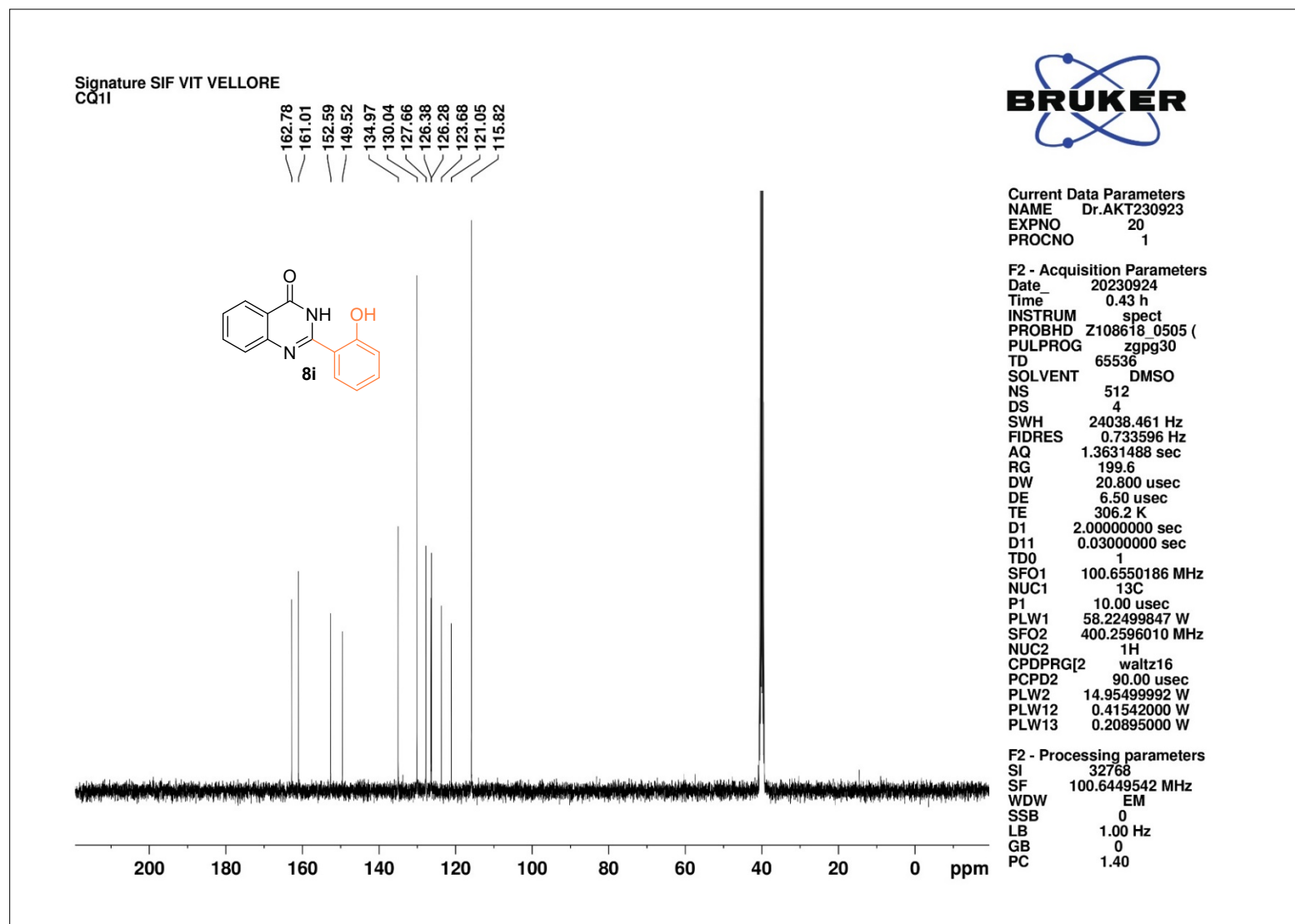
**Figure 29:** FT-IR spectrum of the compound **8h**.



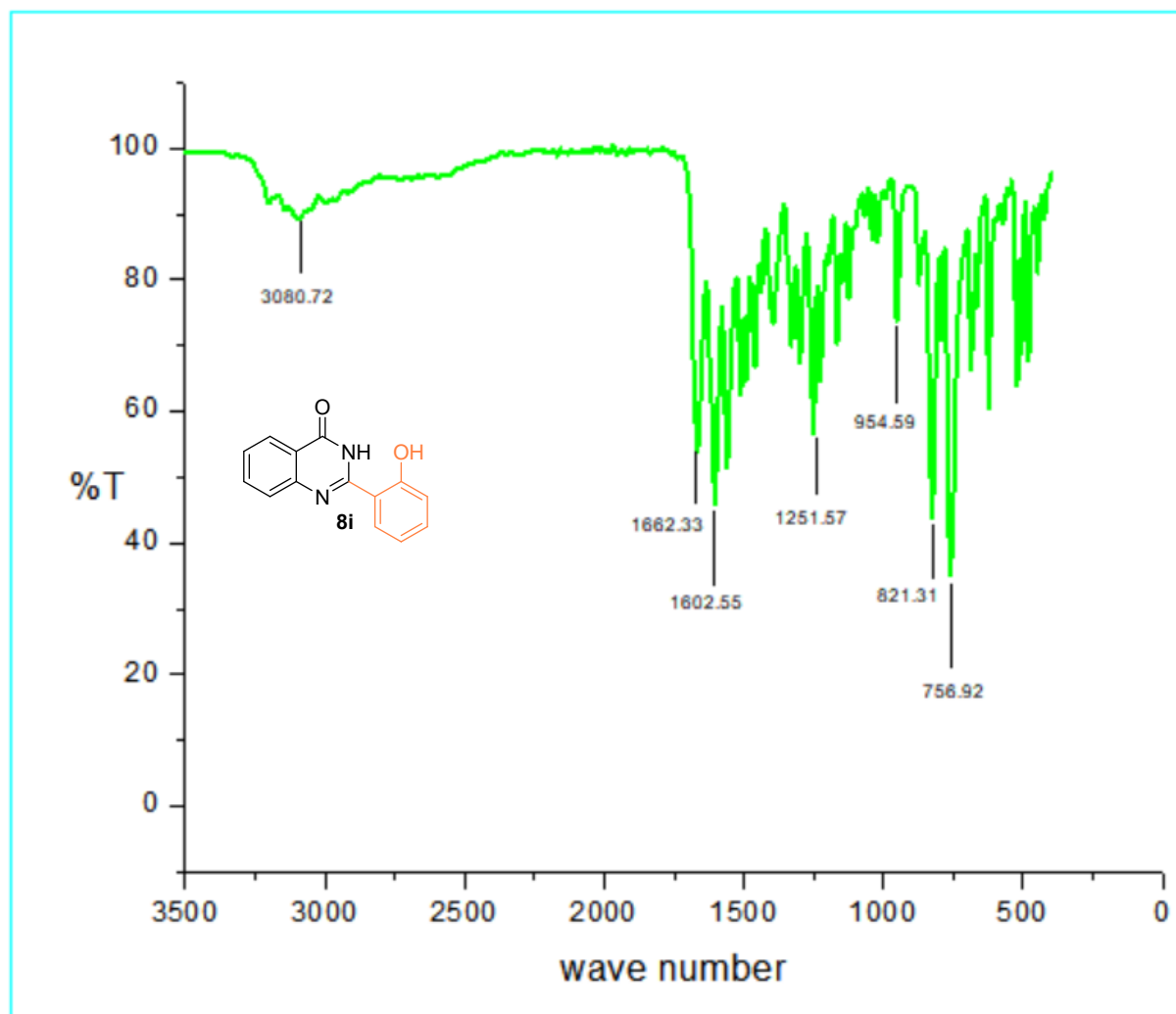
**Figure 30:** HRMS spectrum of the compound **8h**.



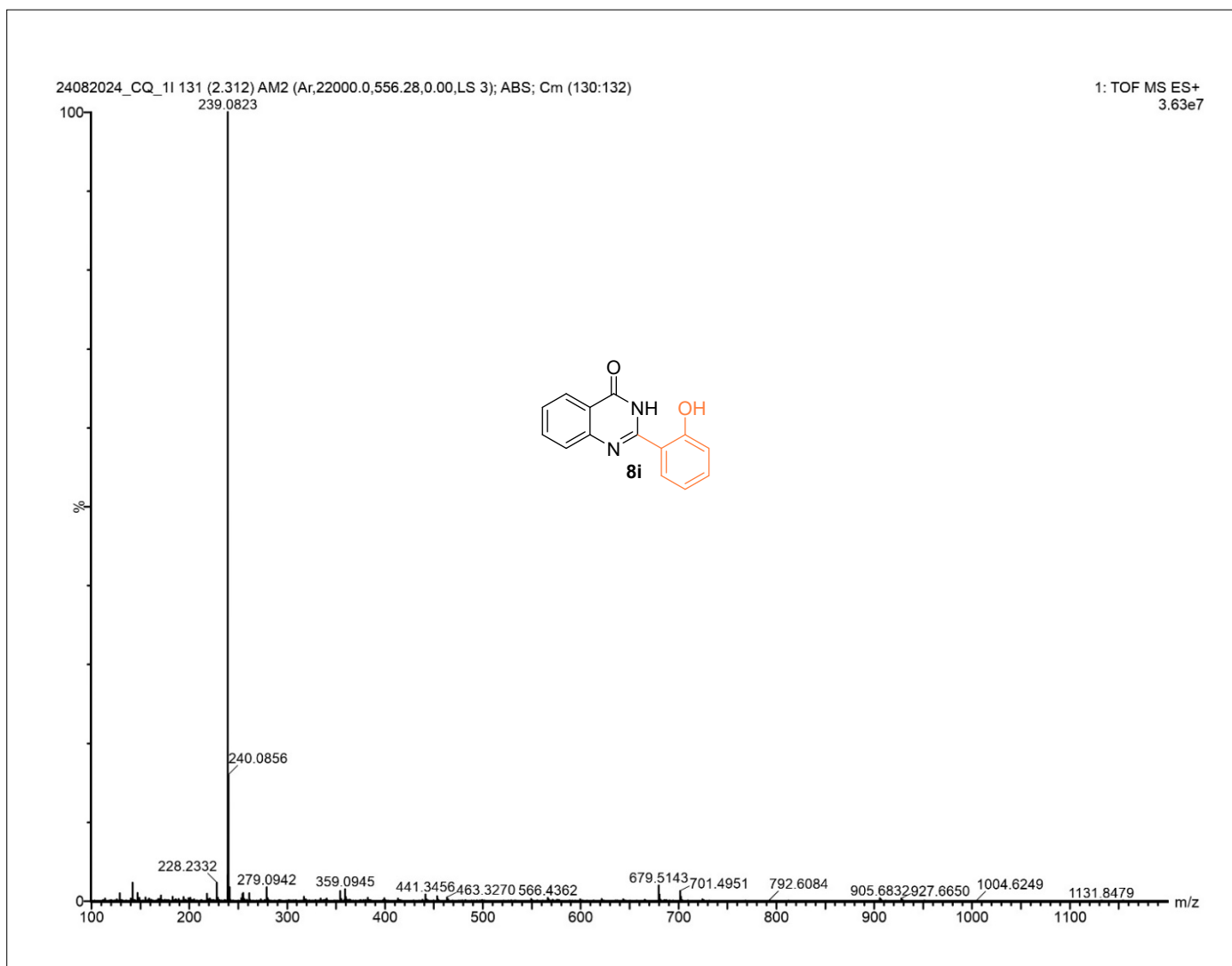
**Figure 31:** <sup>1</sup>H NMR spectrum of the compound **8i**.



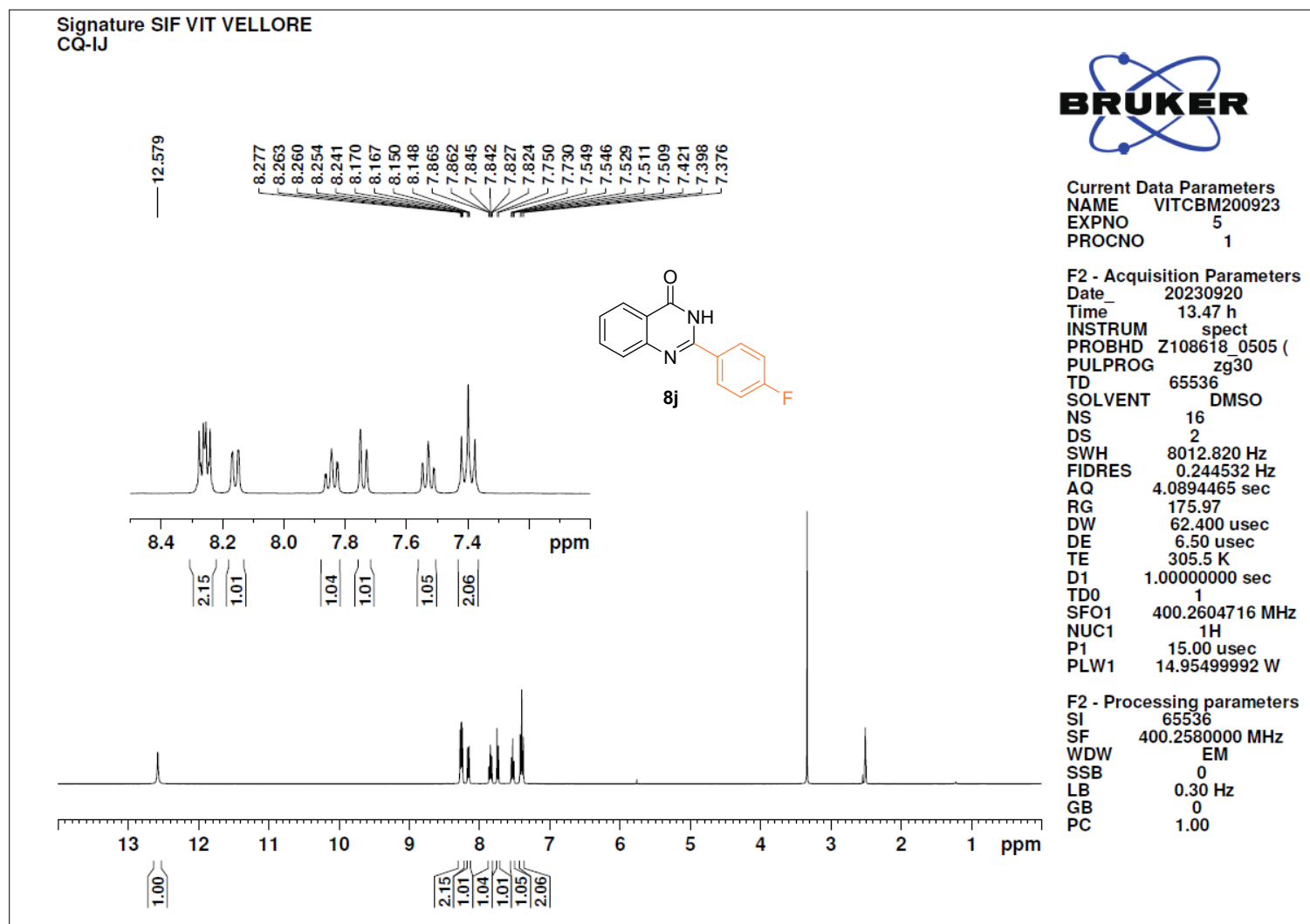
**Figure 32:**  $^{13}\text{C}$  NMR spectrum of the compound **8i**.



**Figure 33:** FT-IR spectrum of the compound **8i**.



**Figure 34:** FT-IR spectrum of the compound **8i**.



**Figure 35:**  $^1\text{H}$  NMR spectrum of the compound **8j**.

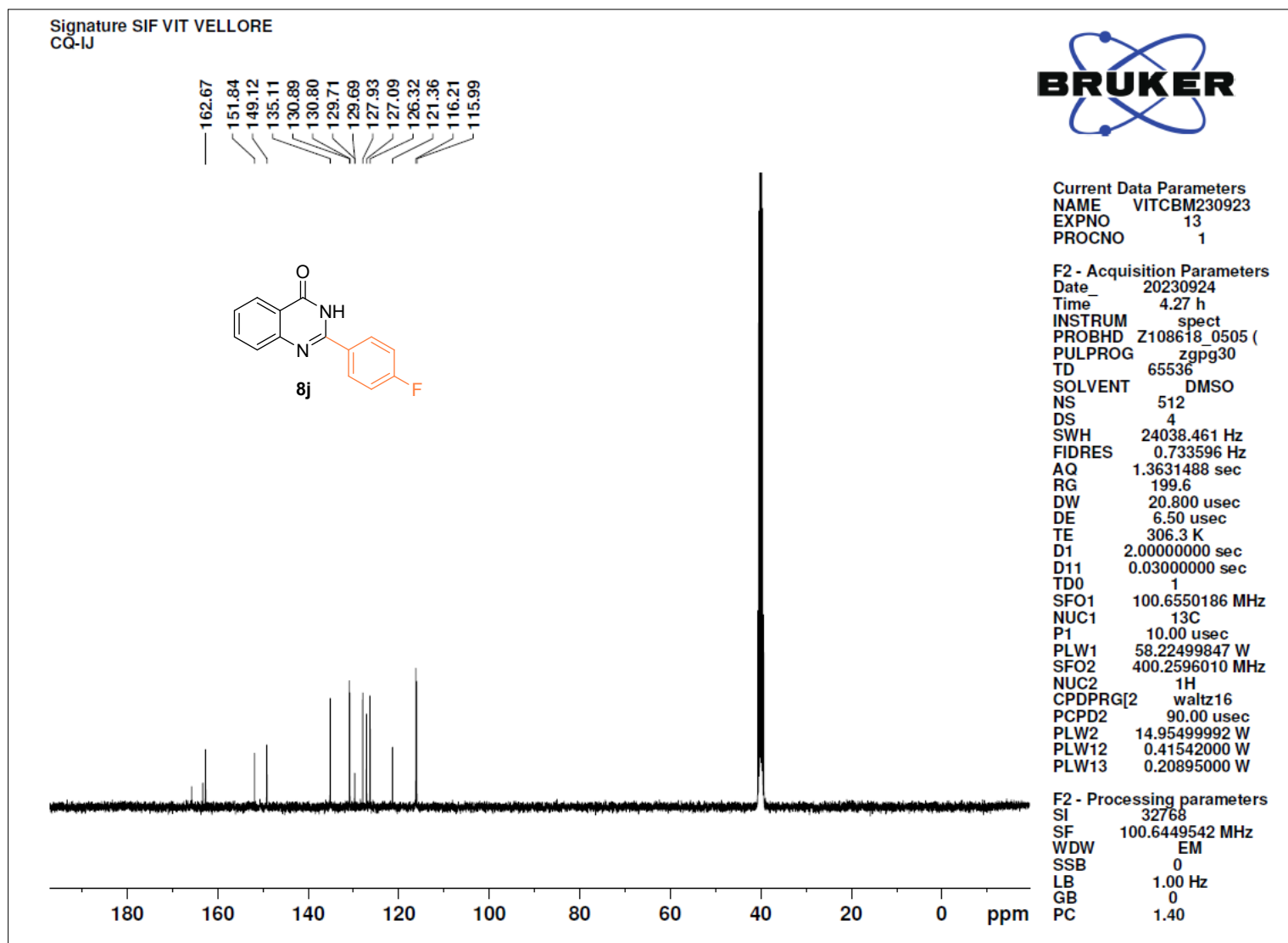
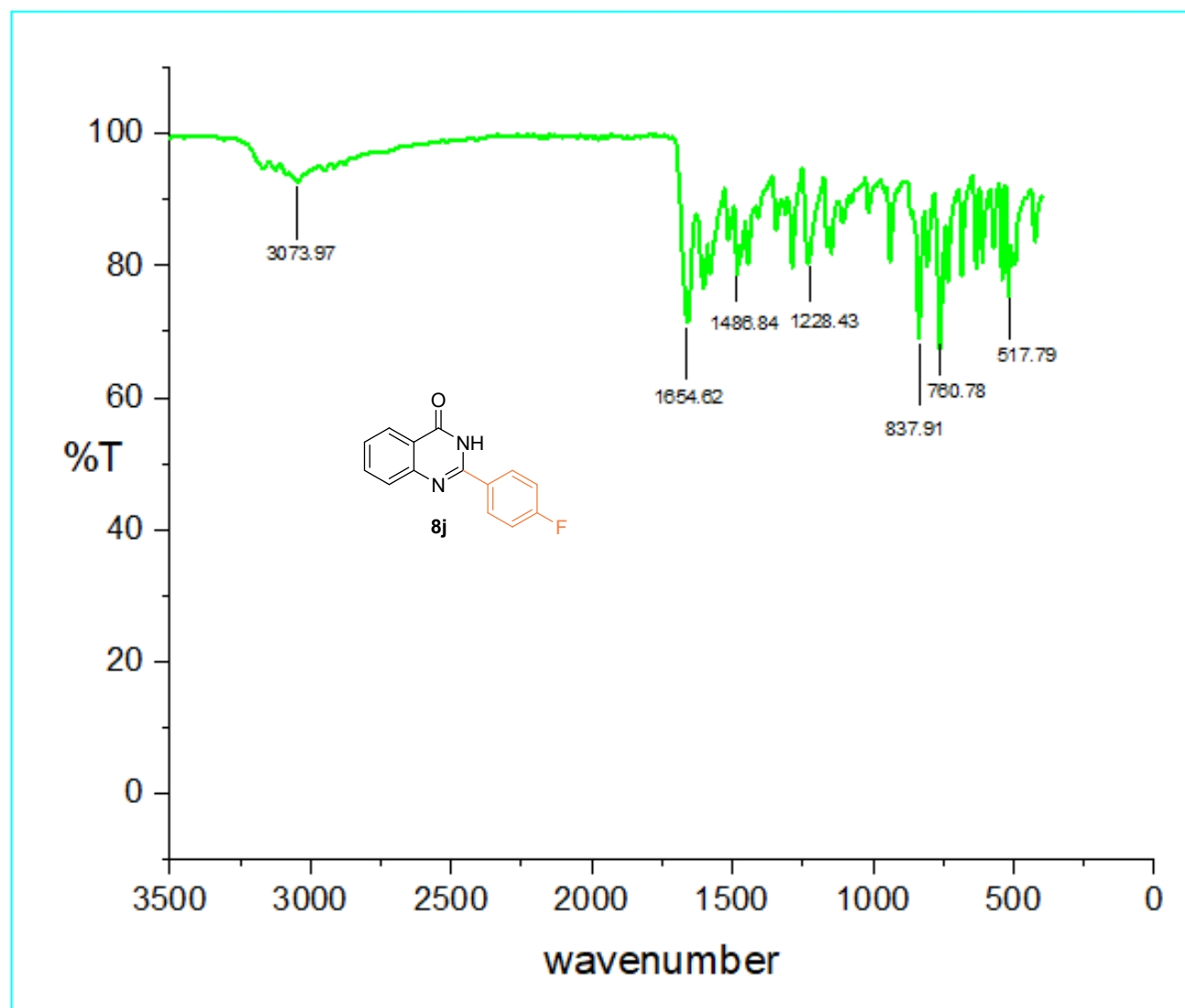
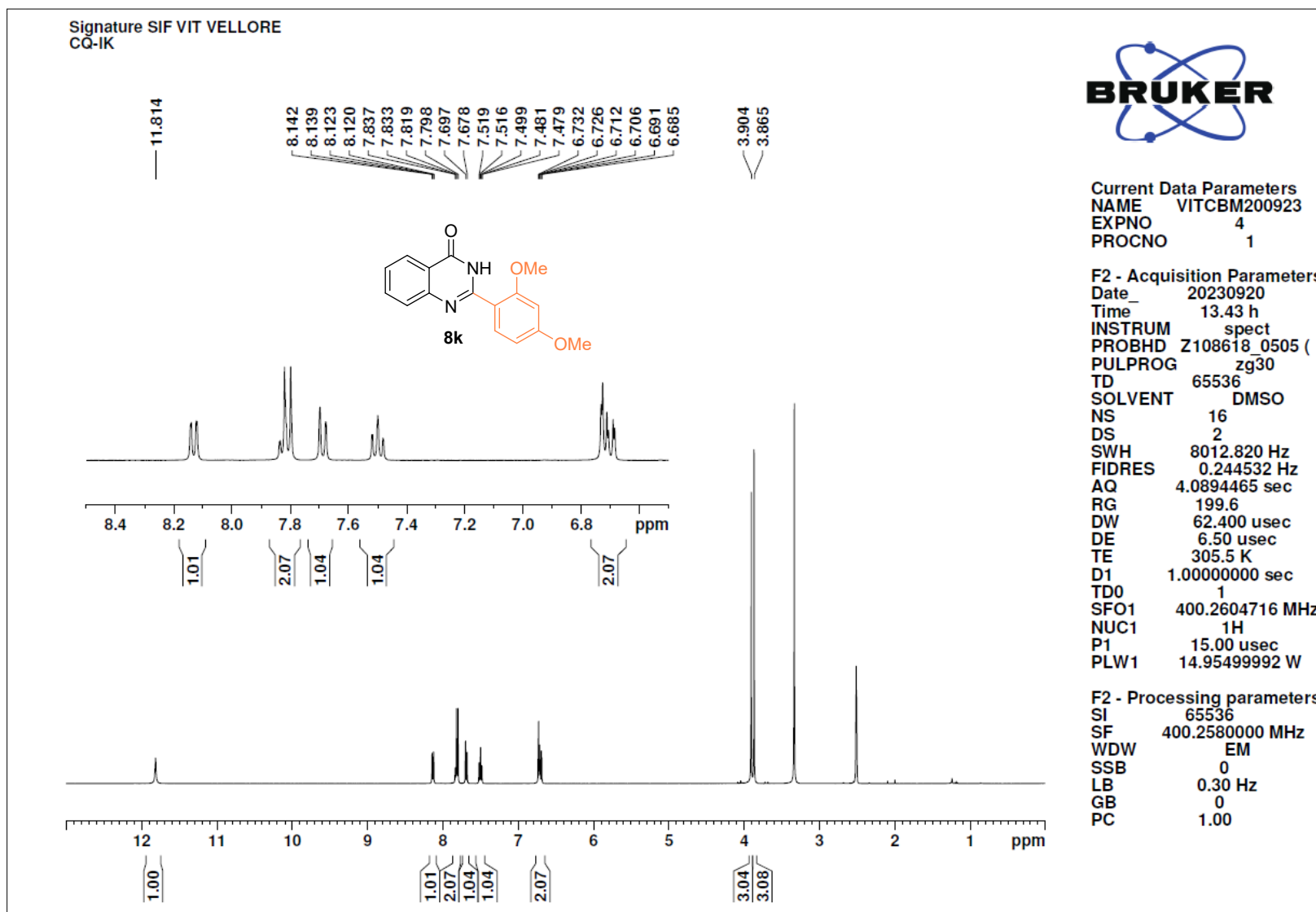


Figure 36:  $^{13}\text{C}$  NMR spectrum of the compound **8j**.



**Figure 37:** FT-IR spectrum of the compound **8j**.



**Figure 38:** <sup>1</sup>H NMR spectrum of the compound **8k**.

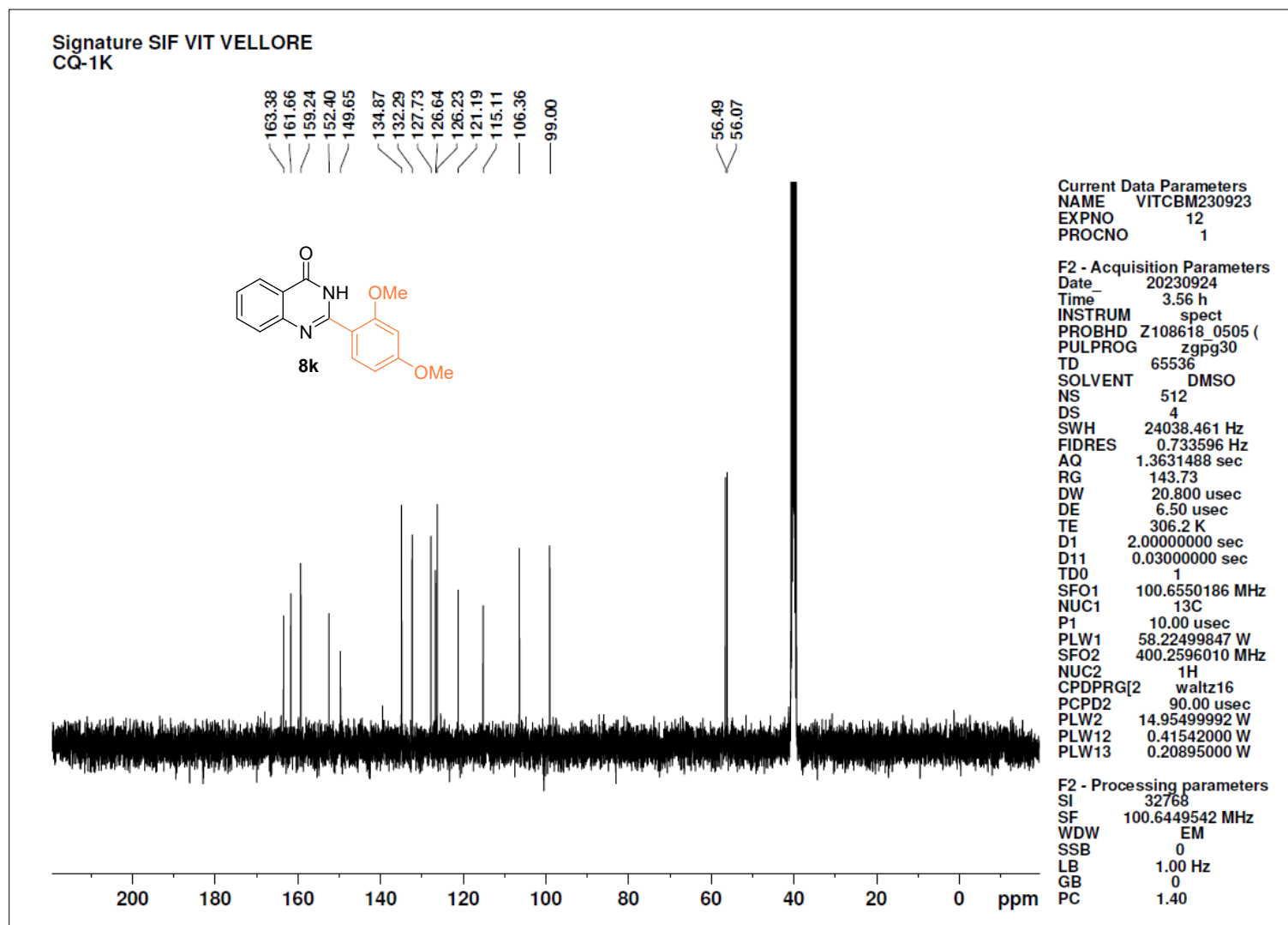
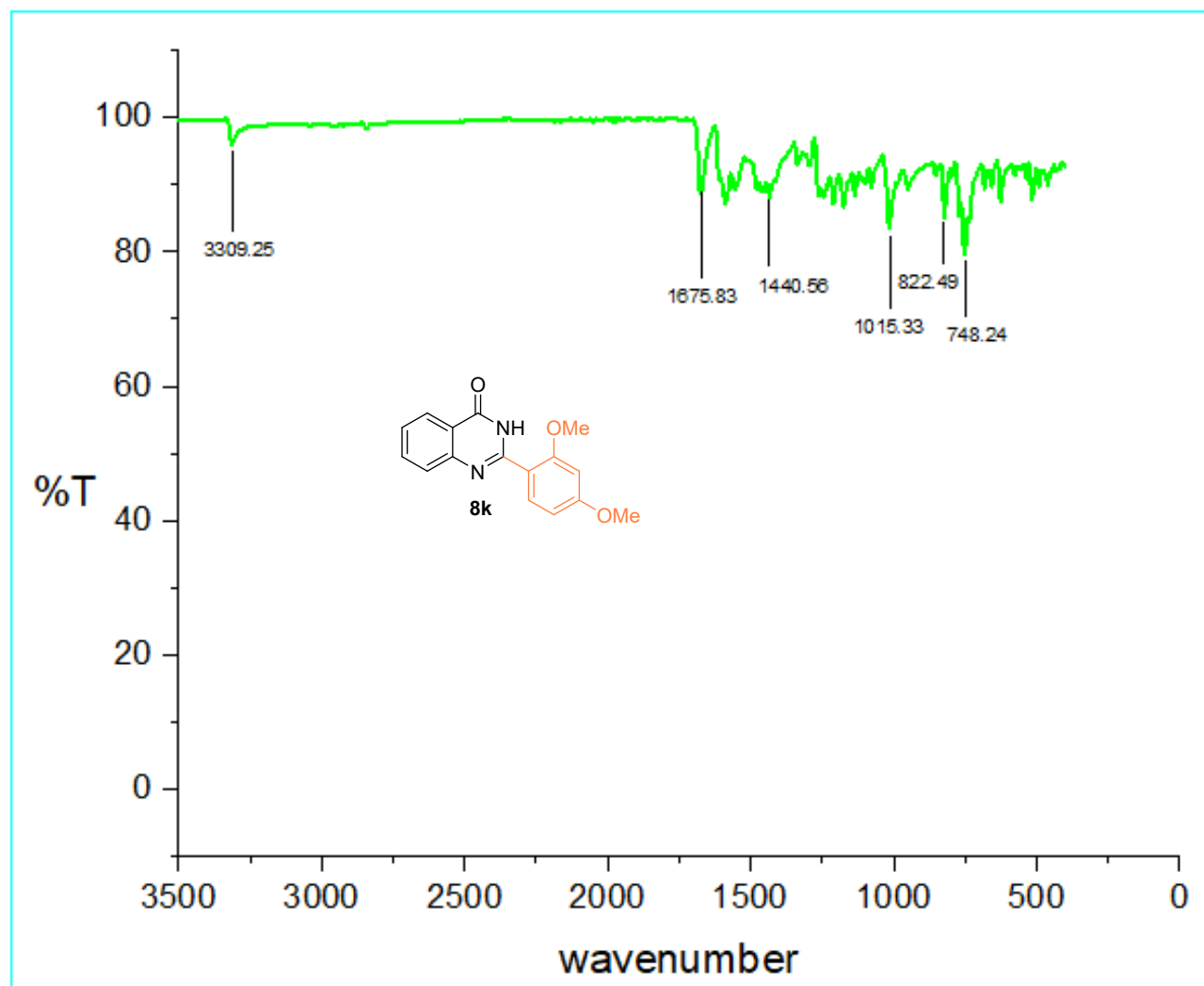
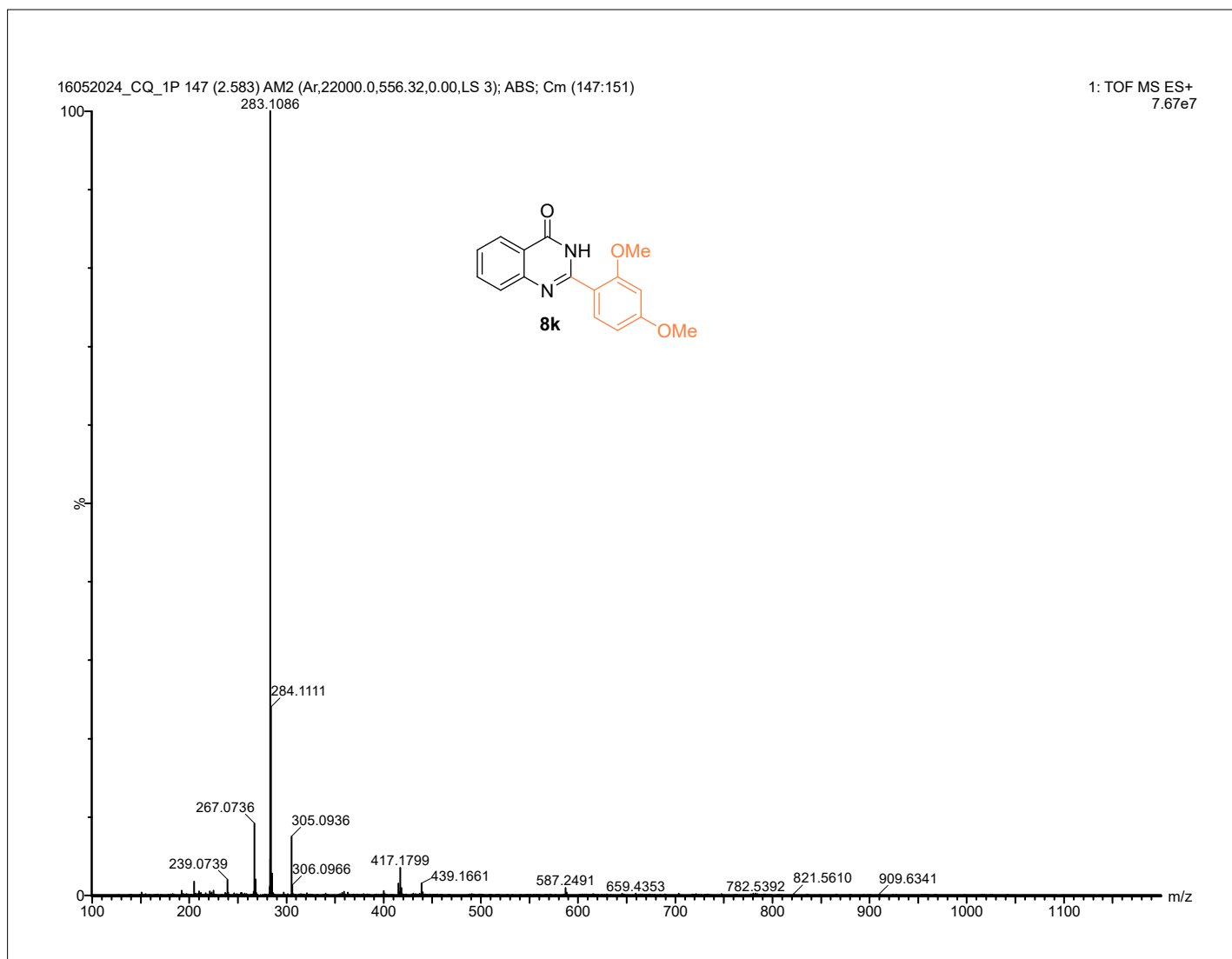


Figure 39:  $^{13}\text{C}$  NMR spectrum of the compound **8k**.



**Figure 40:** FT-IR spectrum of the compound **8k**.



**Figure 41:** HRMS of the compound **8k**.

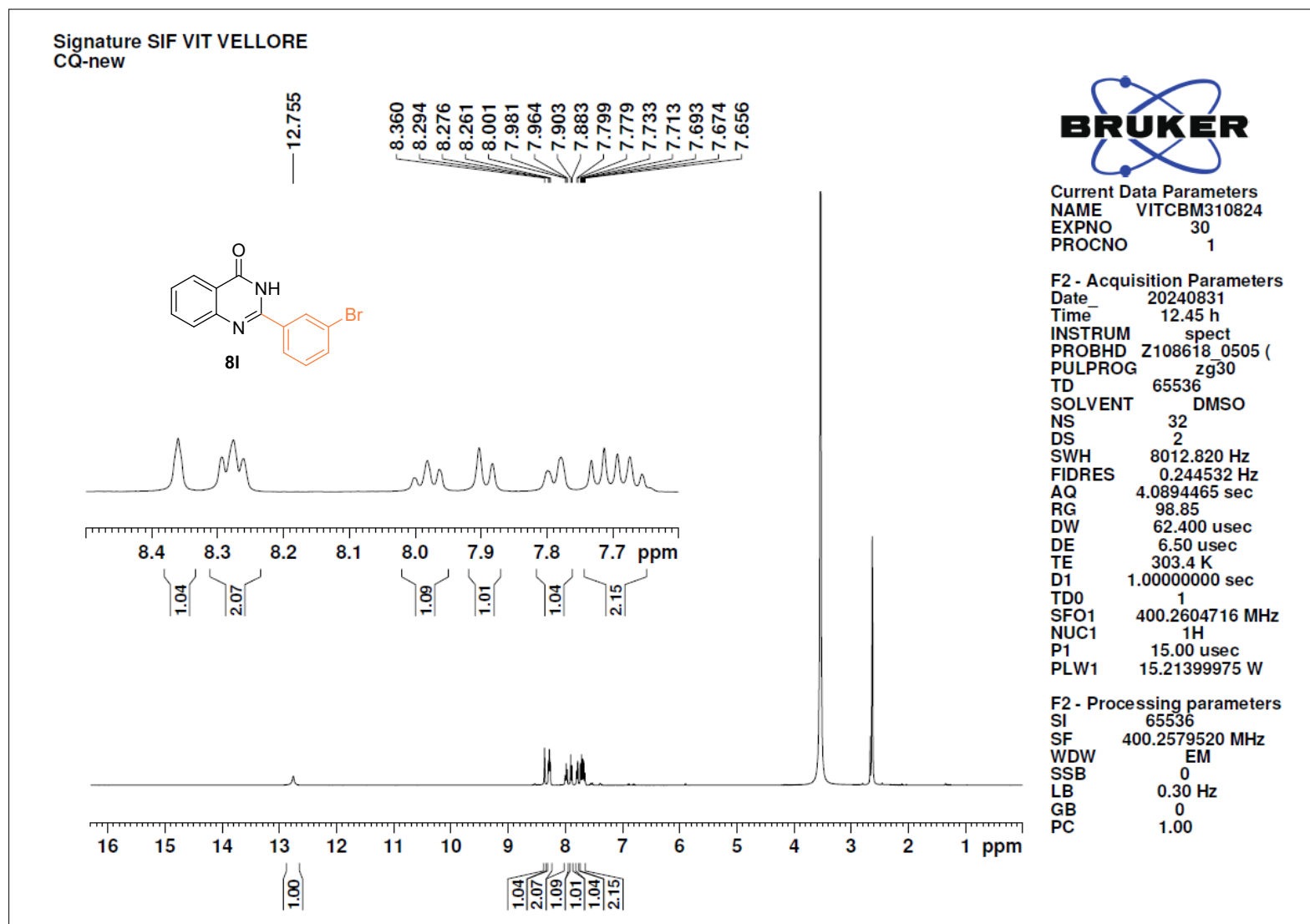
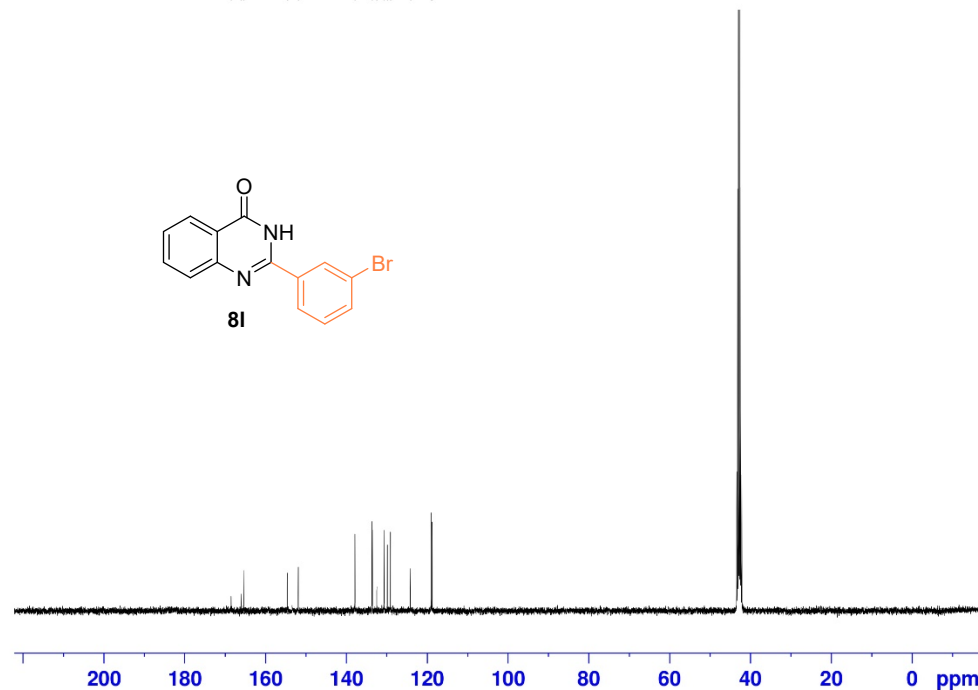
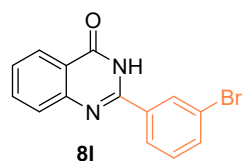


Figure 42: <sup>1</sup>H NMR spectrum of the compound **8I**.

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168.49  
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165.41  
154.58  
151.86  
137.85  
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132.45  
130.68  
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129.06  
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118.95  
118.73

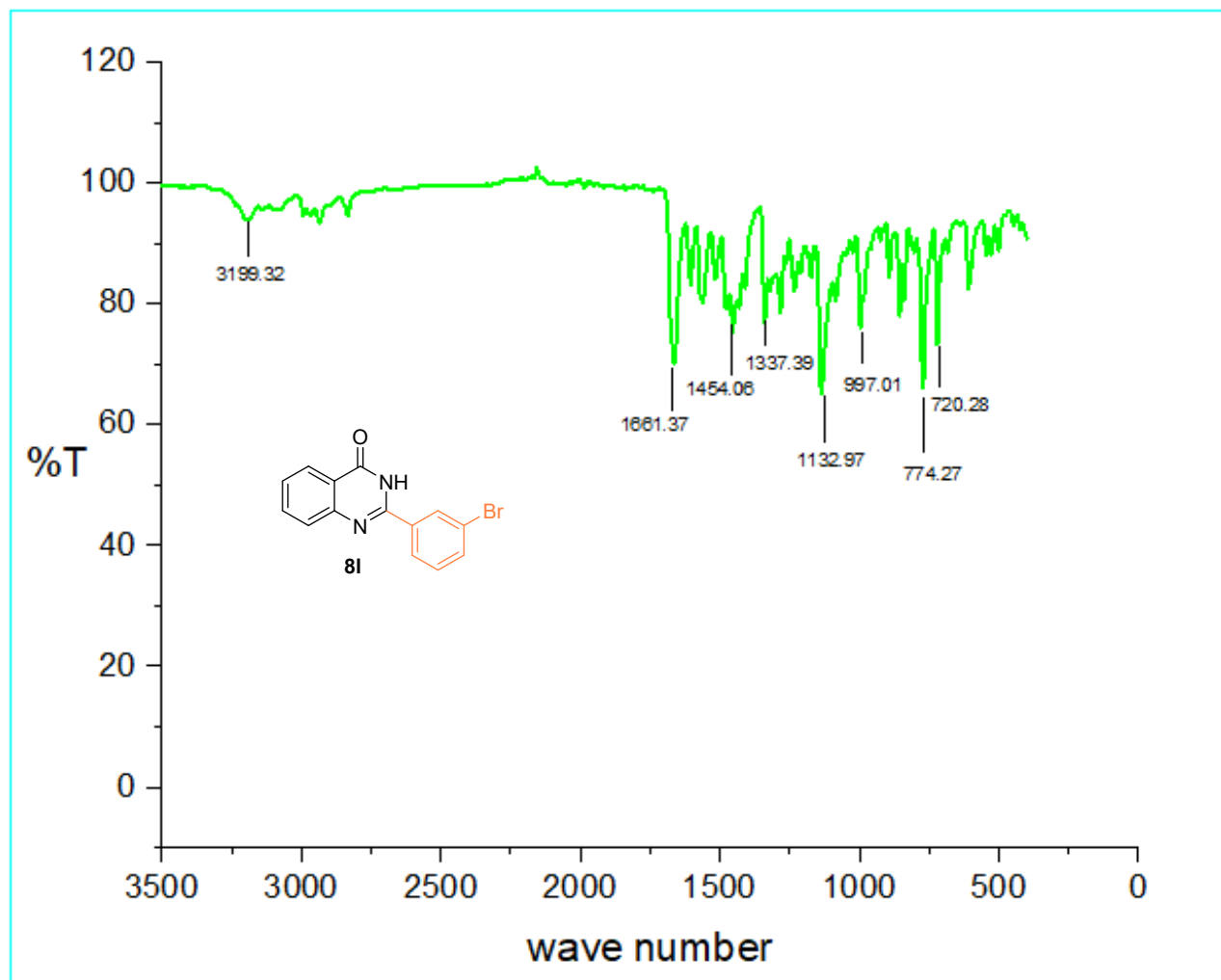


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SFO1 100.6550186 MHz  
NUC1 13C  
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Figure 43:  $^{13}\text{C}$  NMR spectrum of the compound **8l**.



**Figure 44:** FT-IR spectrum of the compound **8l**.

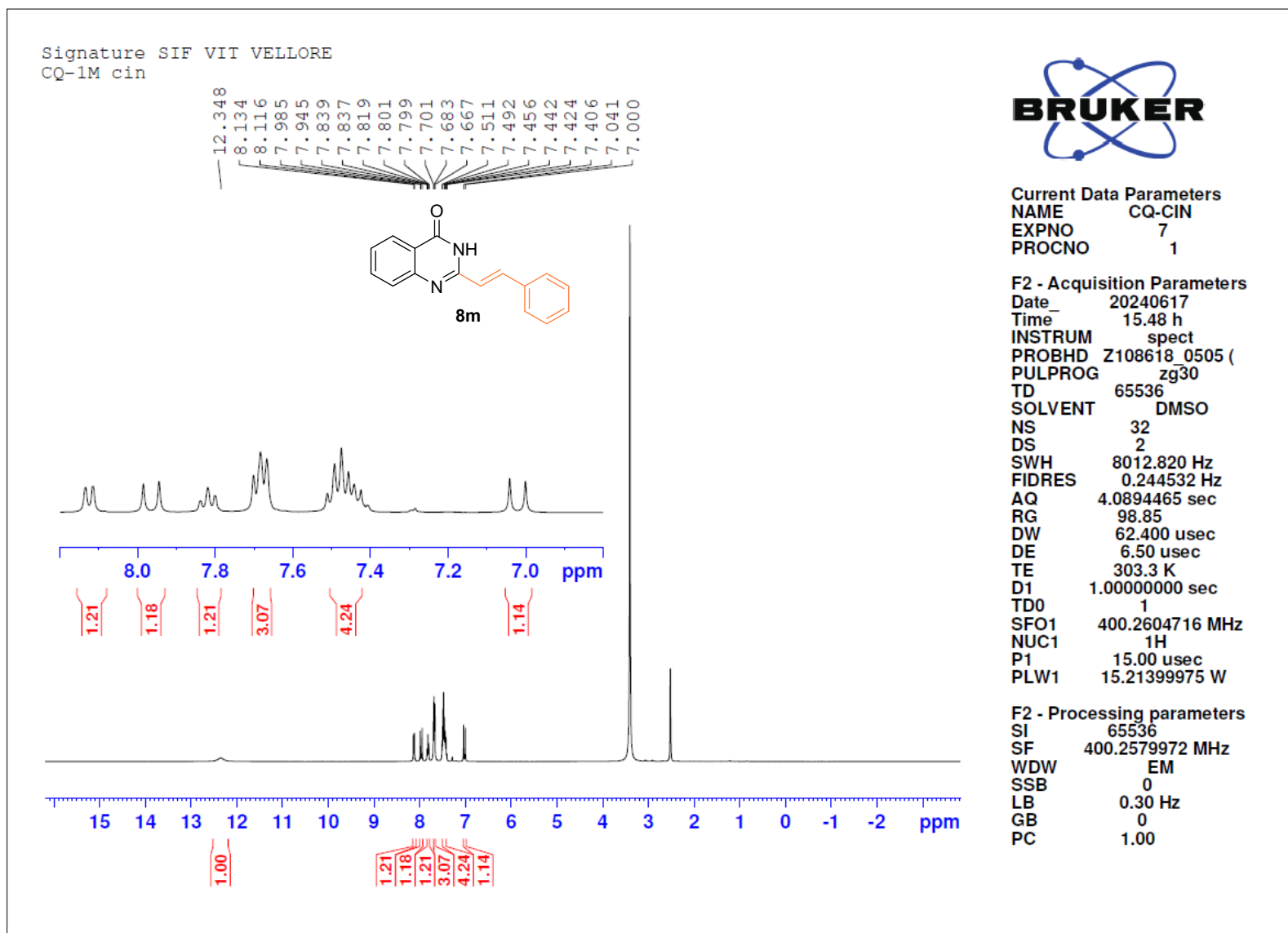
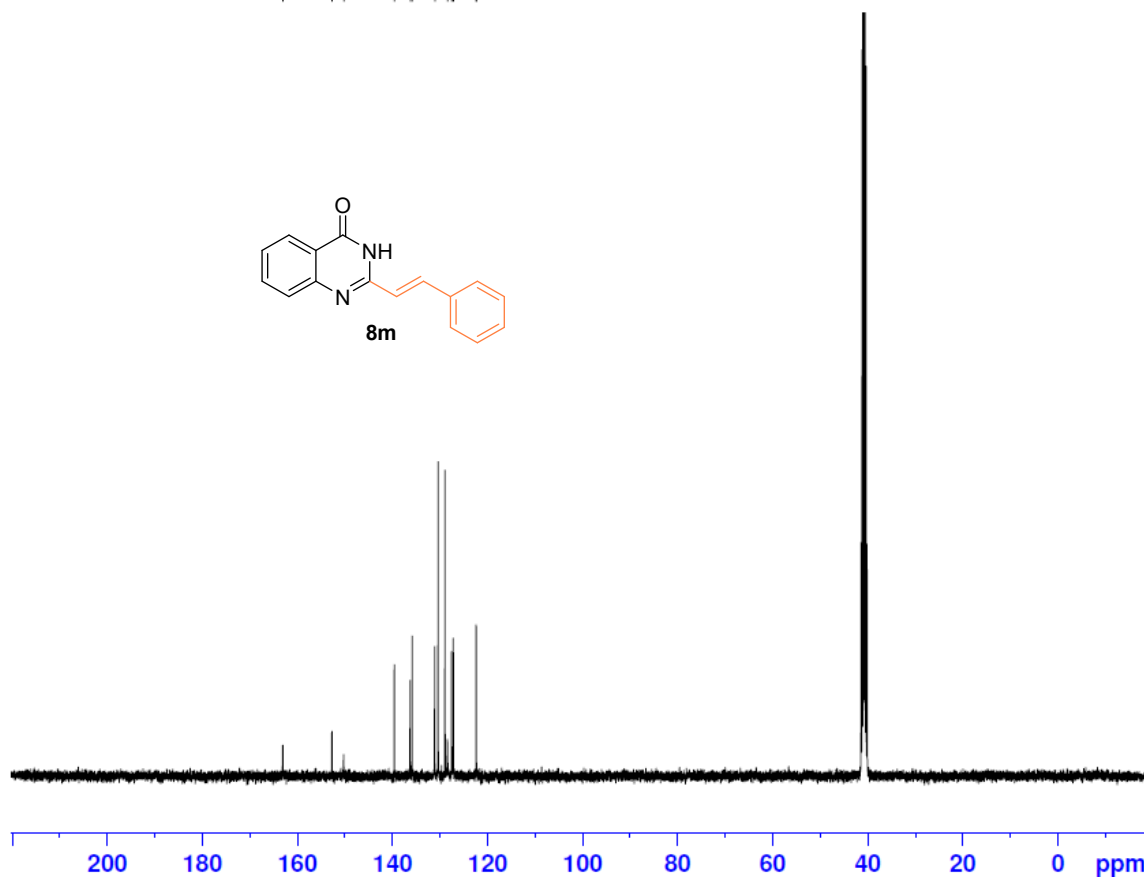
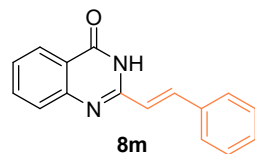


Figure 45:  $^1\text{H}$  NMR spectrum of the compound **8m**.

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135.81  
131.07  
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127.14  
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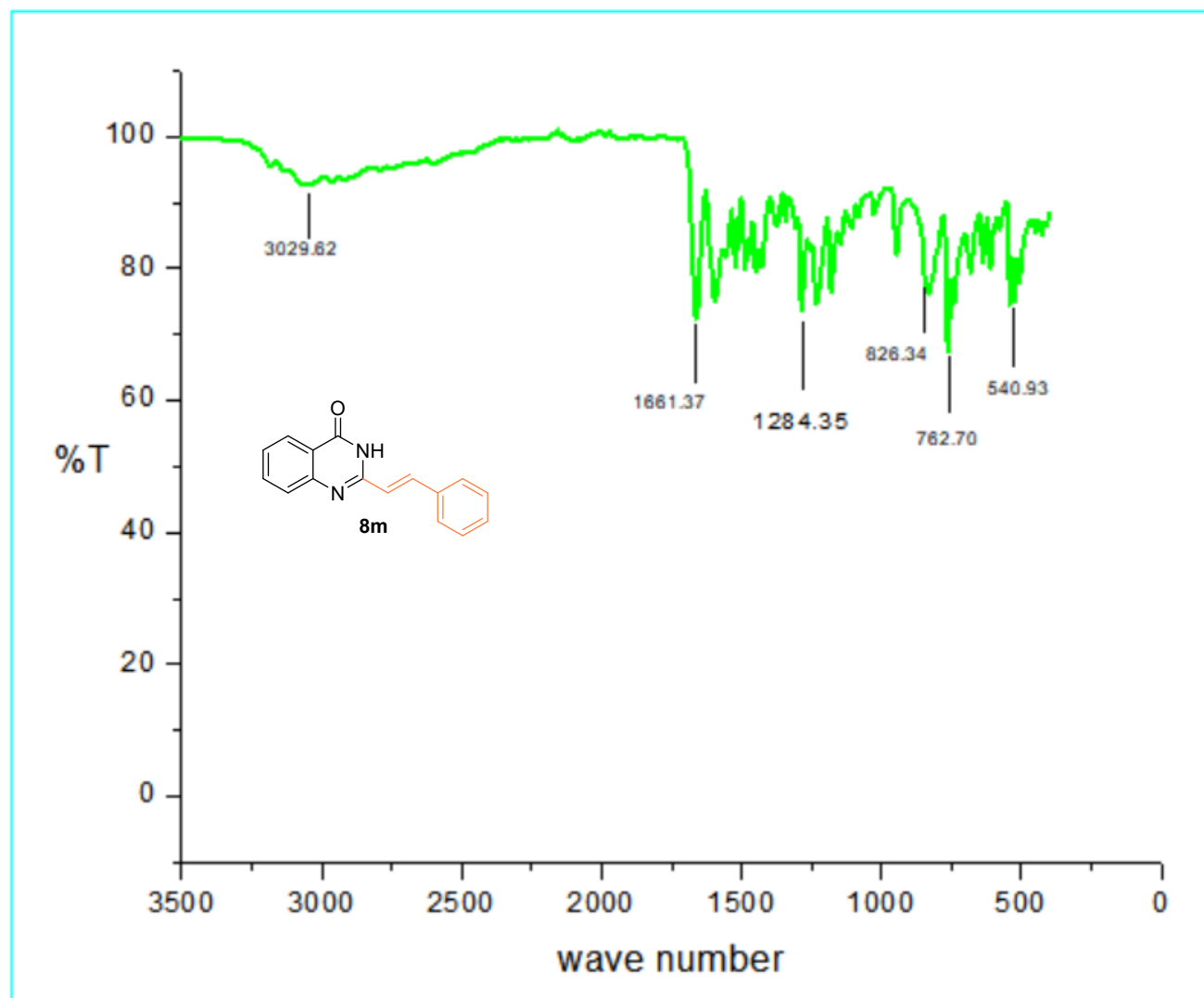


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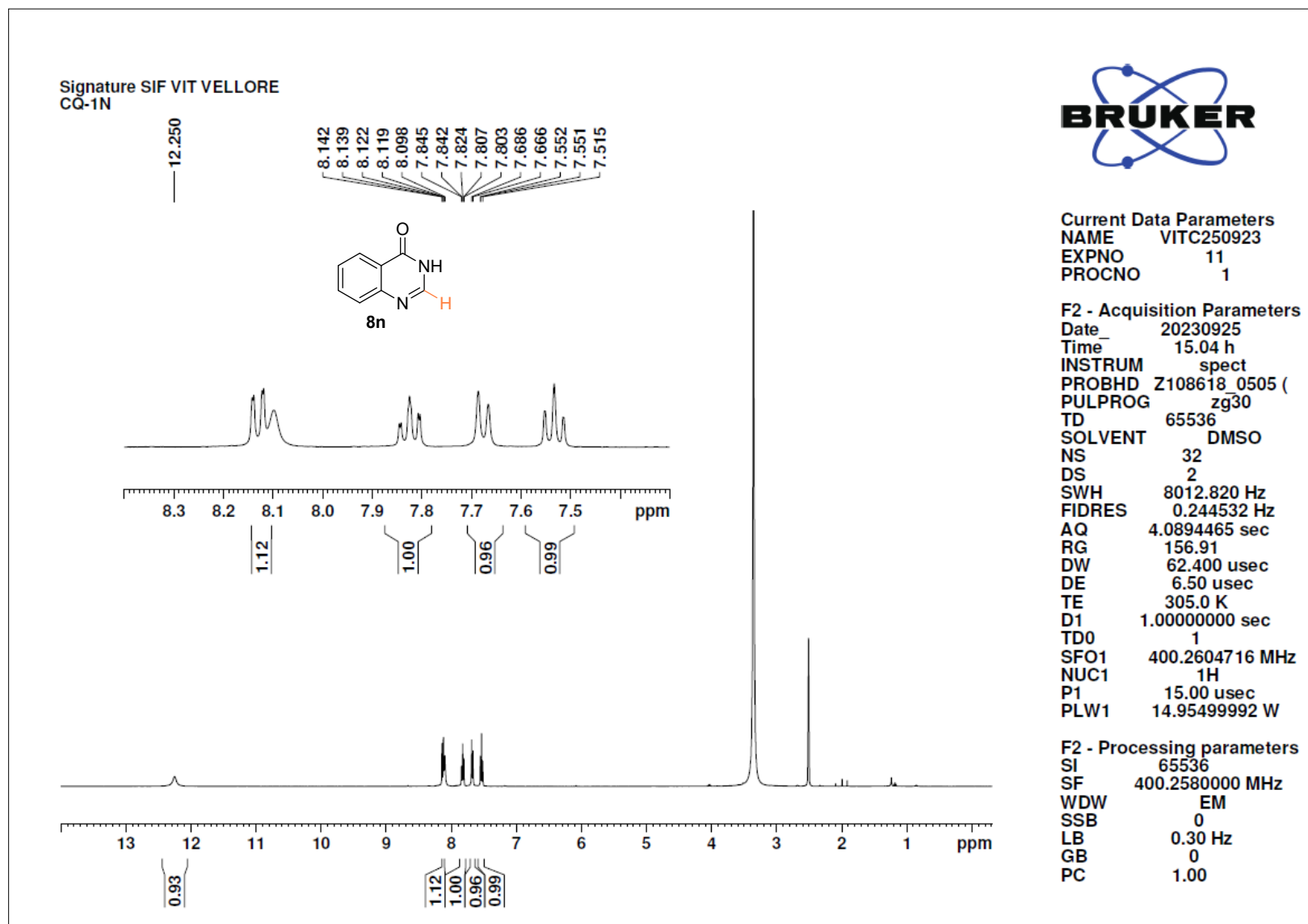
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P1 10.00 usec  
PLW1 56.49300003 W  
SFO2 400.2596010 MHz  
NUC2 1H  
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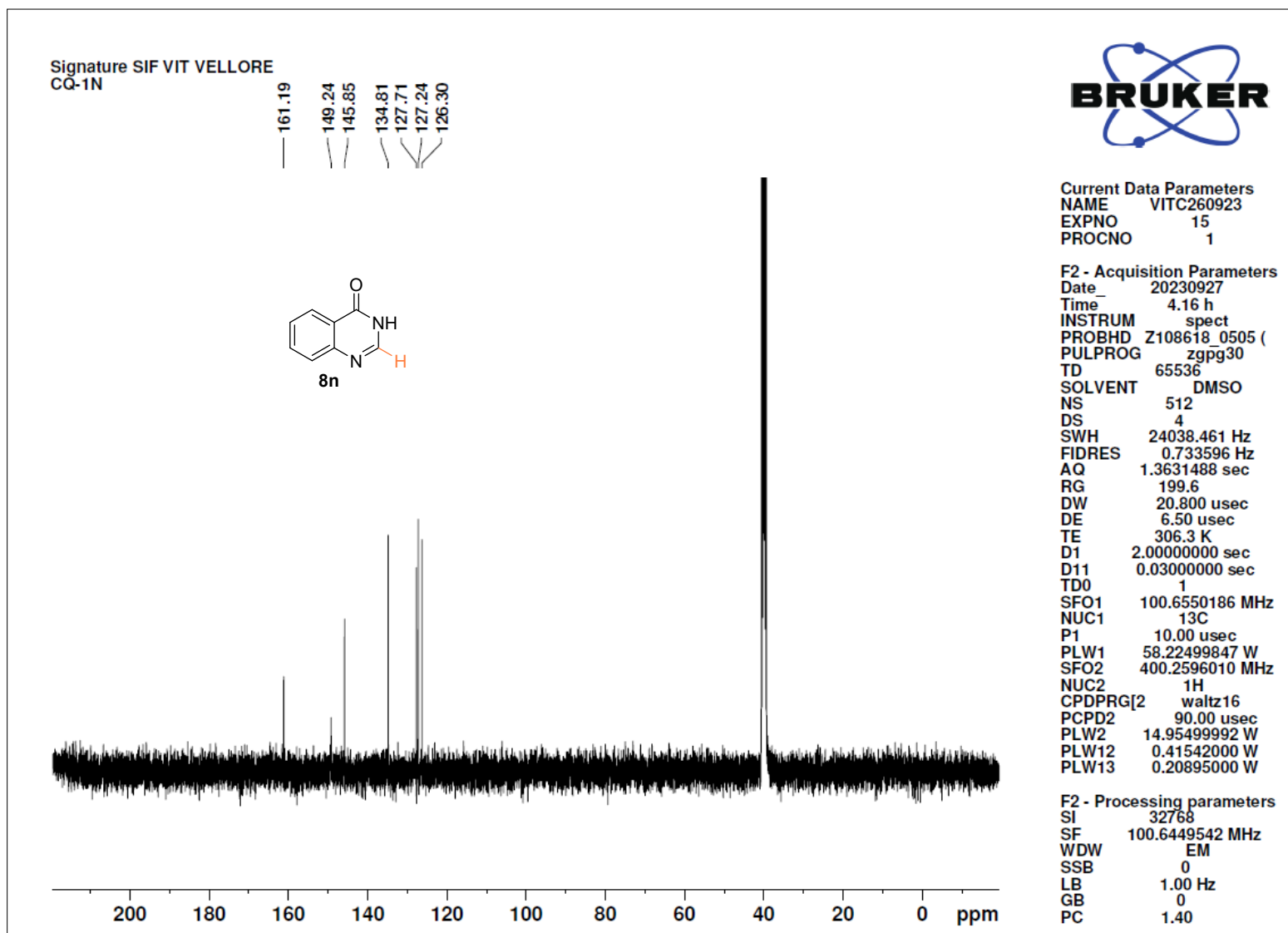
Figure 46:  $^{13}\text{C}$  NMR spectrum of the compound 8m.



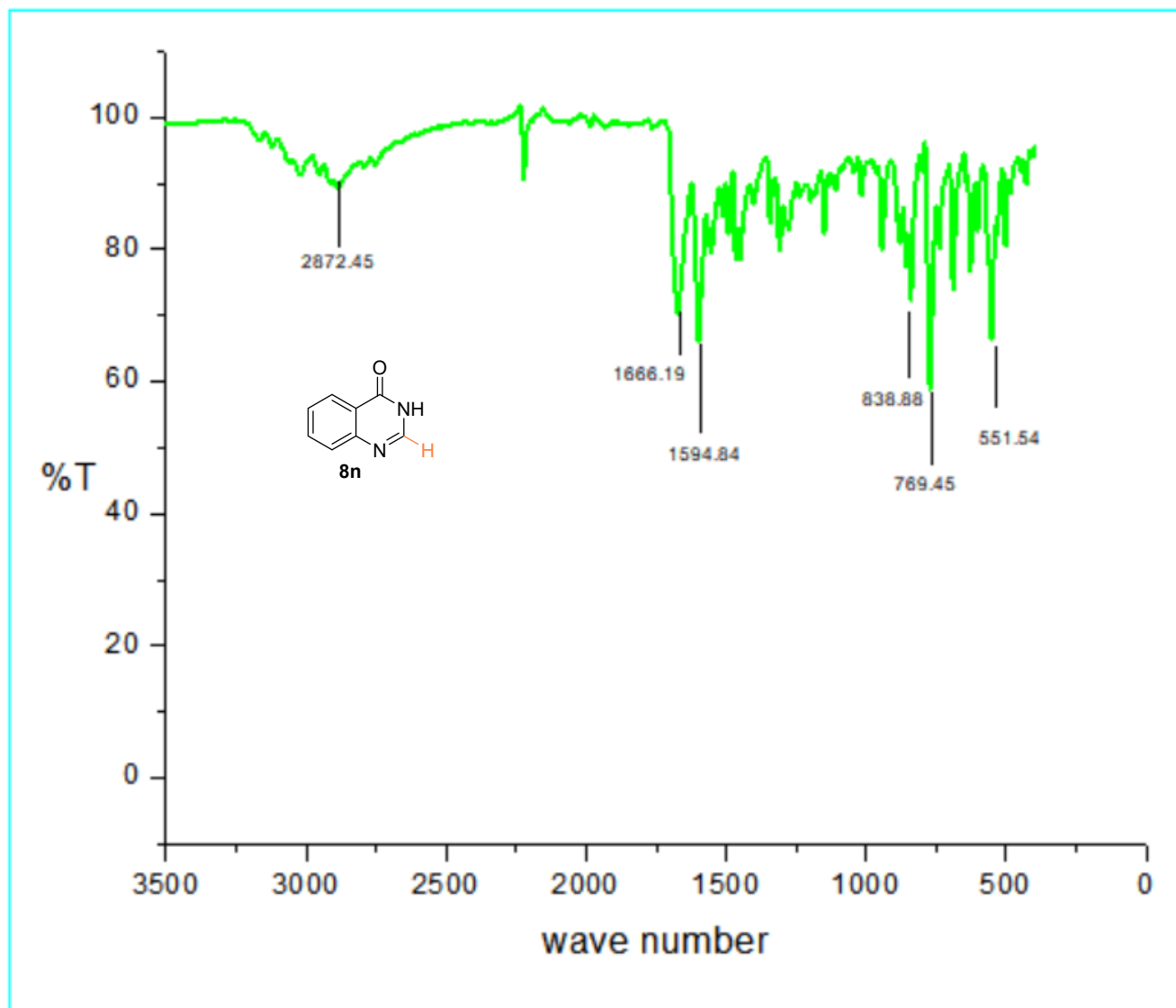
**Figure 47:** FT-IR spectrum of the compound **8m**.



**Figure 48:**  $^1\text{H}$  NMR spectrum of the compound **8n**.



**Figure 49:**  $^{13}\text{C}$  NMR spectrum of the compound **8n**.



**Figure 50:** FT-IR spectrum of the compound **8n**.

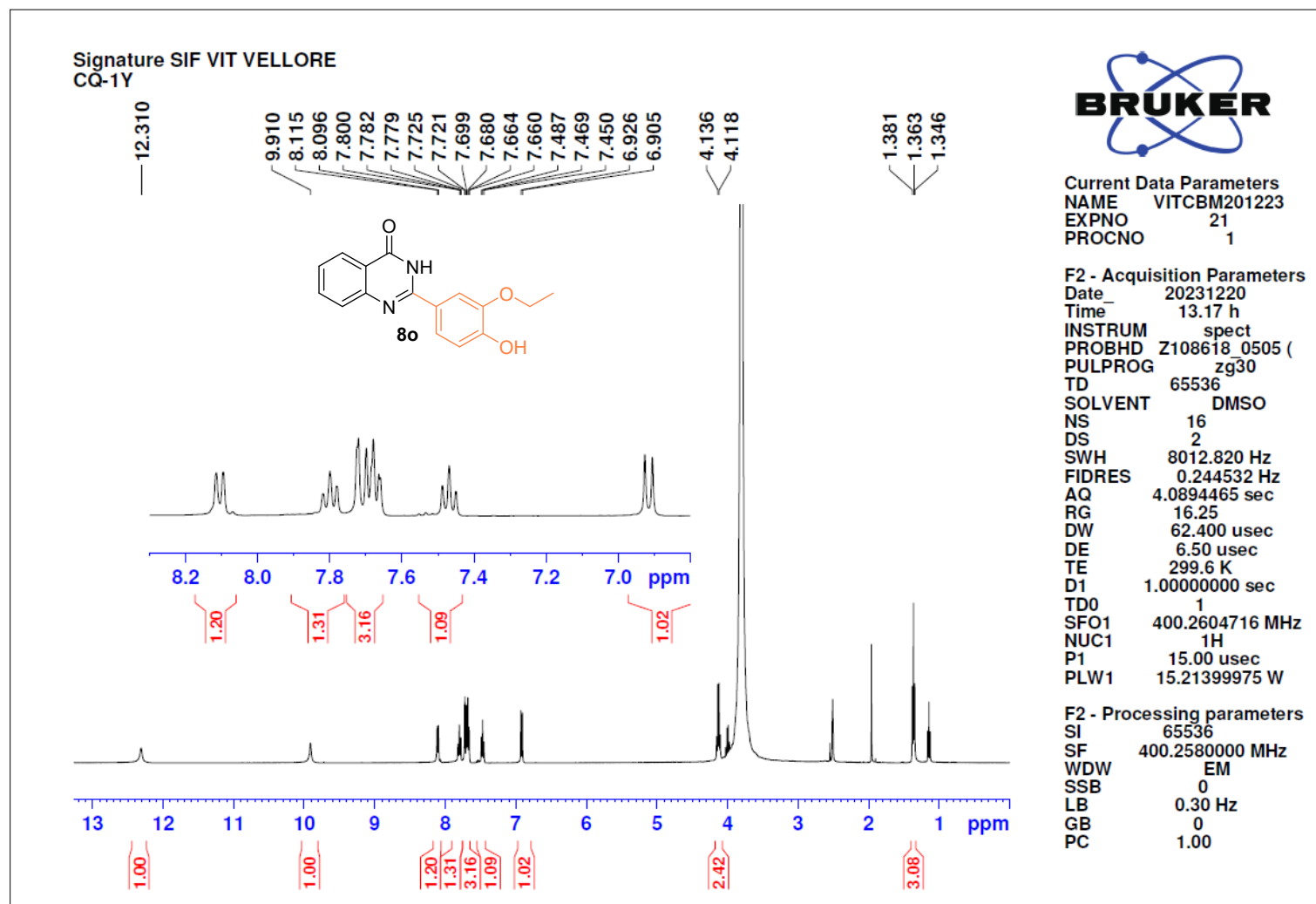
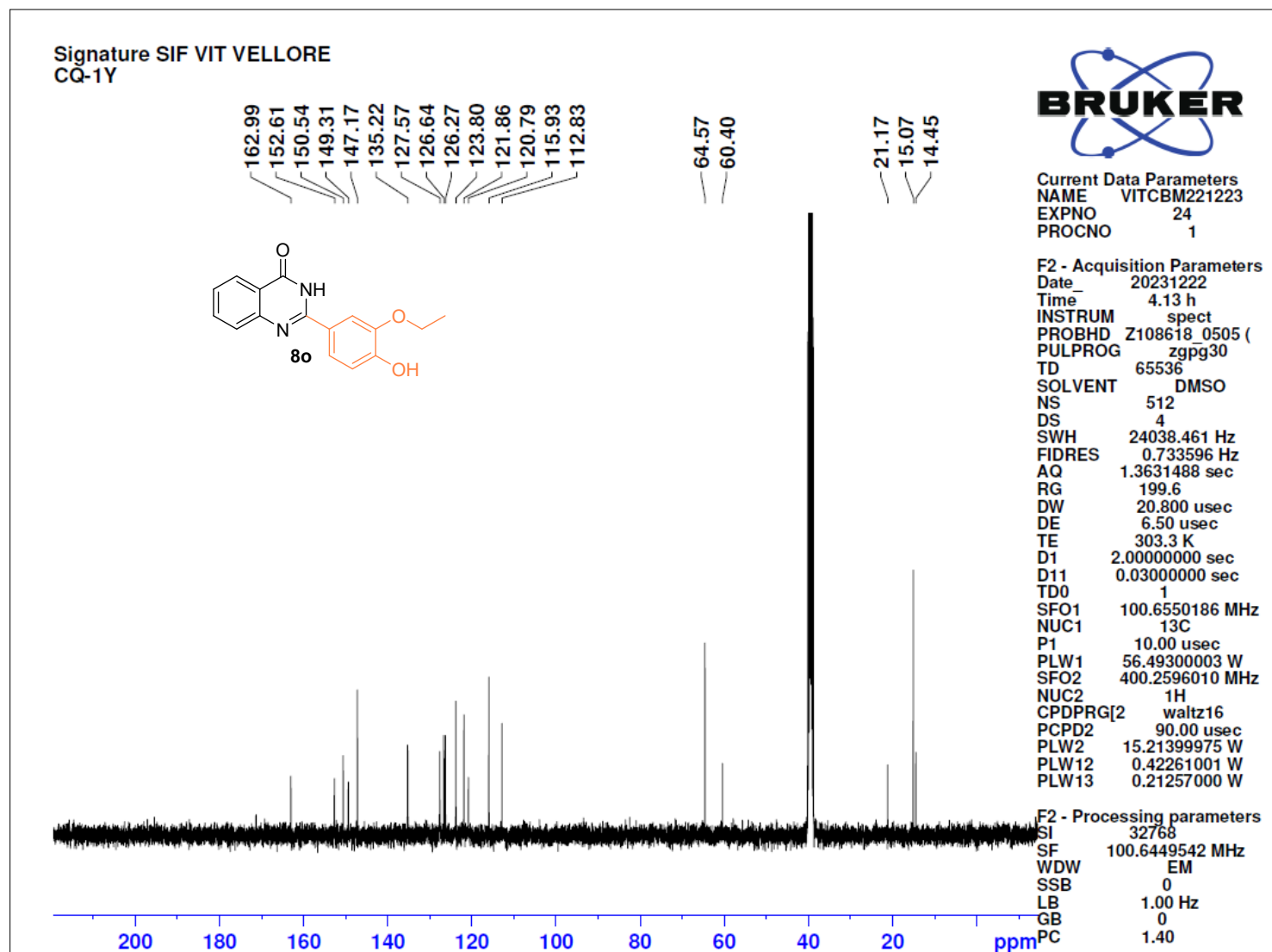
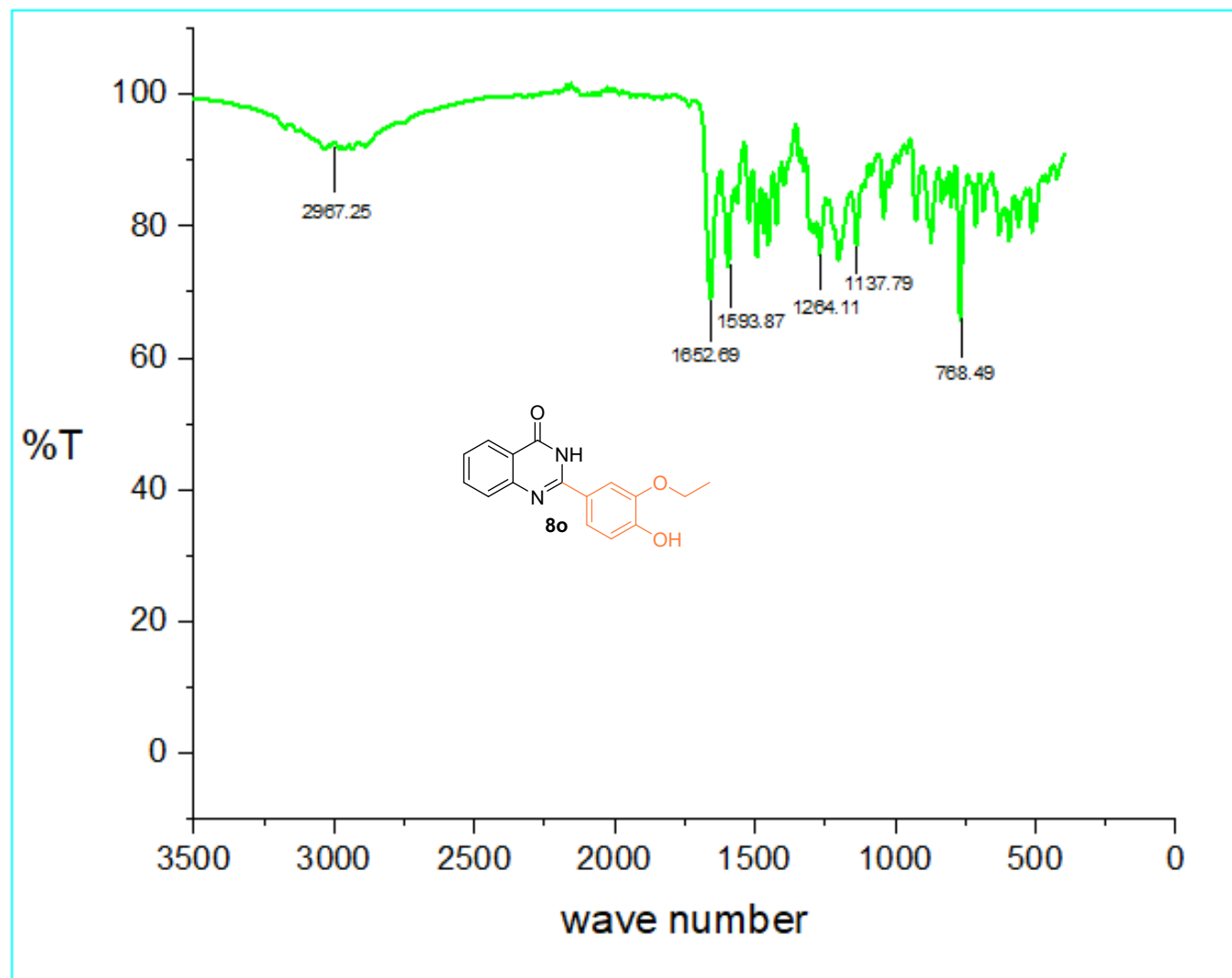


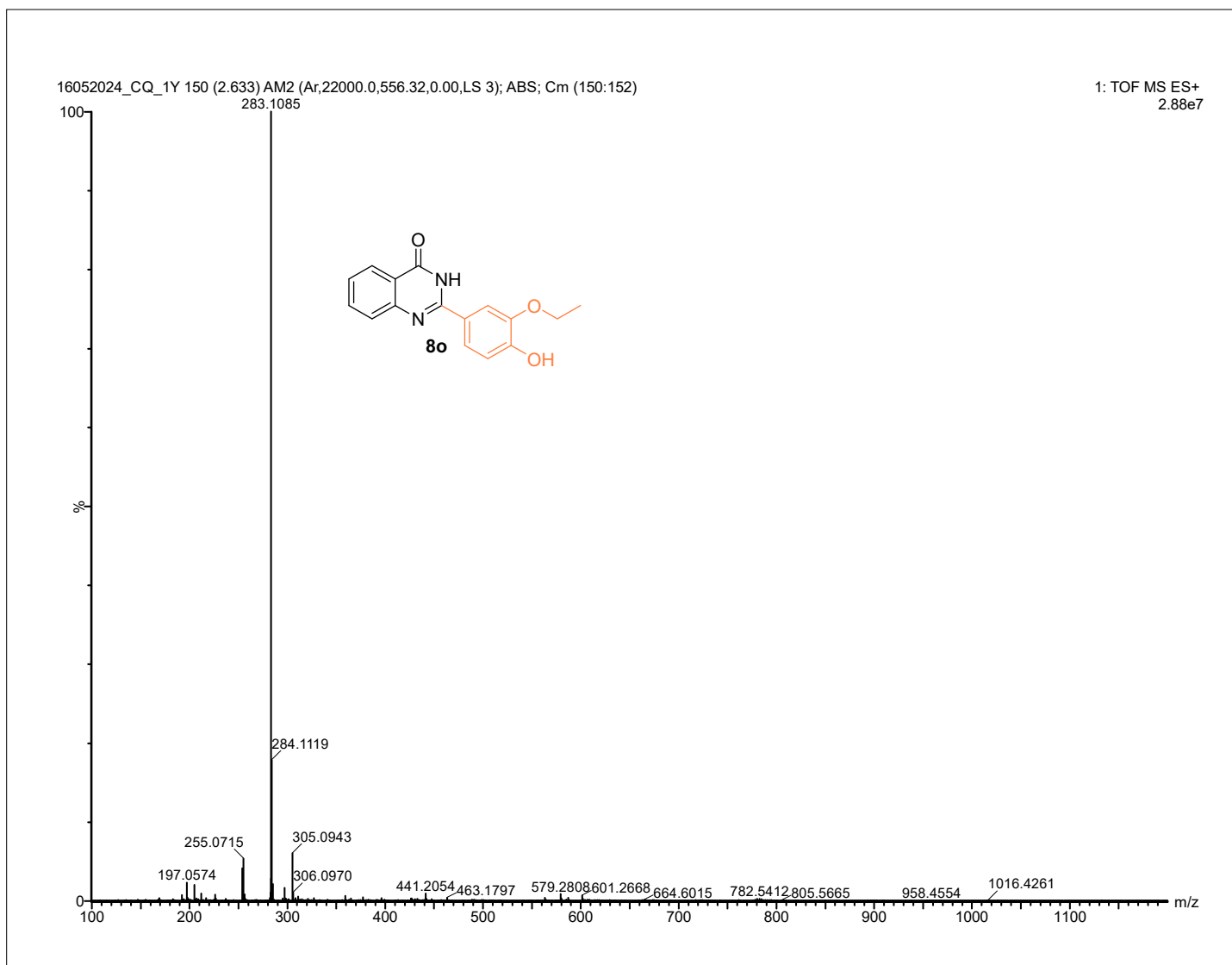
Figure 51:  $^1\text{H}$  NMR spectrum of the compound **8o**.



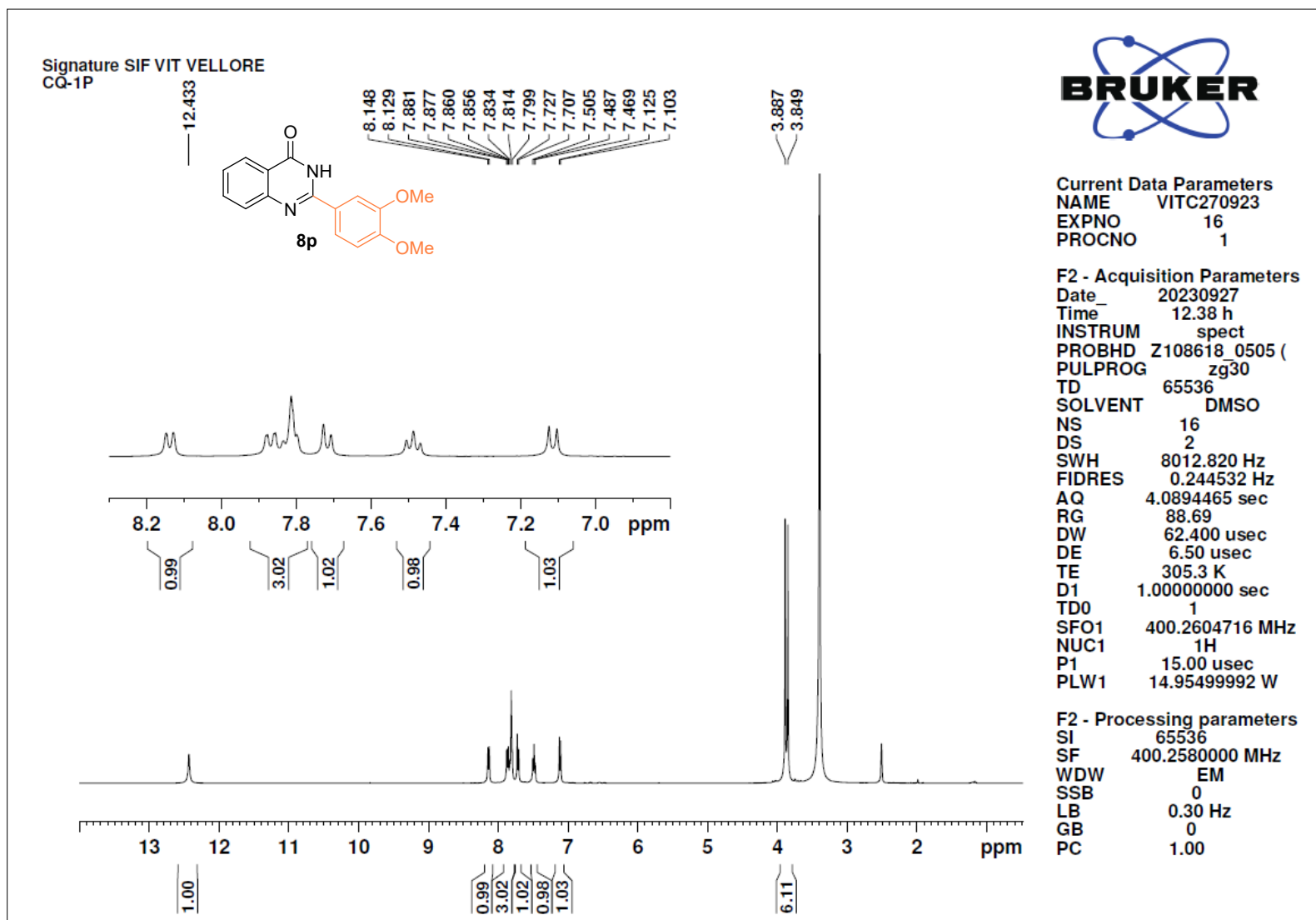
**Figure 52:**  $^{13}\text{C}$  NMR spectrum of the compound **80**.



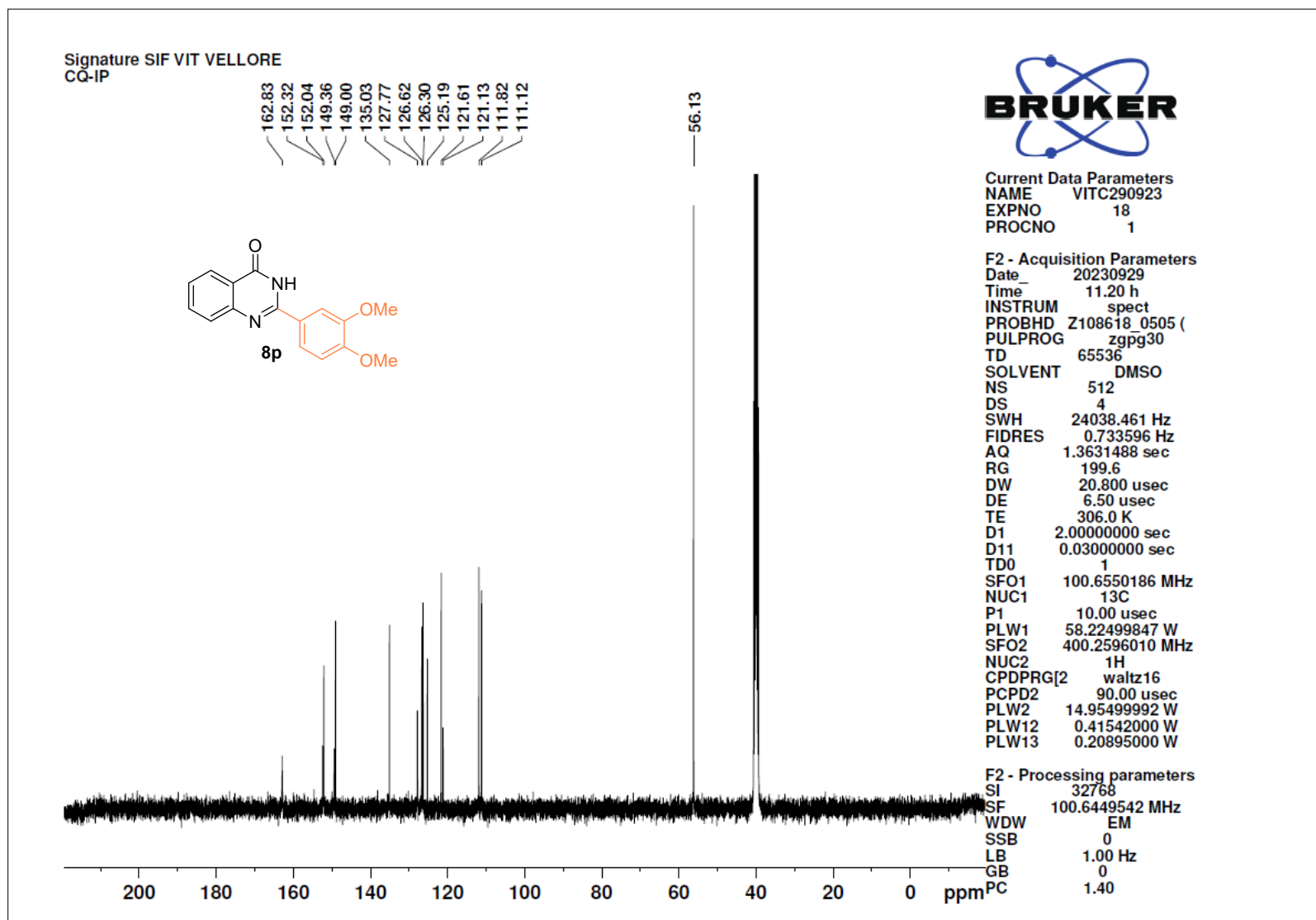
**Figure 53:** FT-IR spectrum of the compound **8o**.



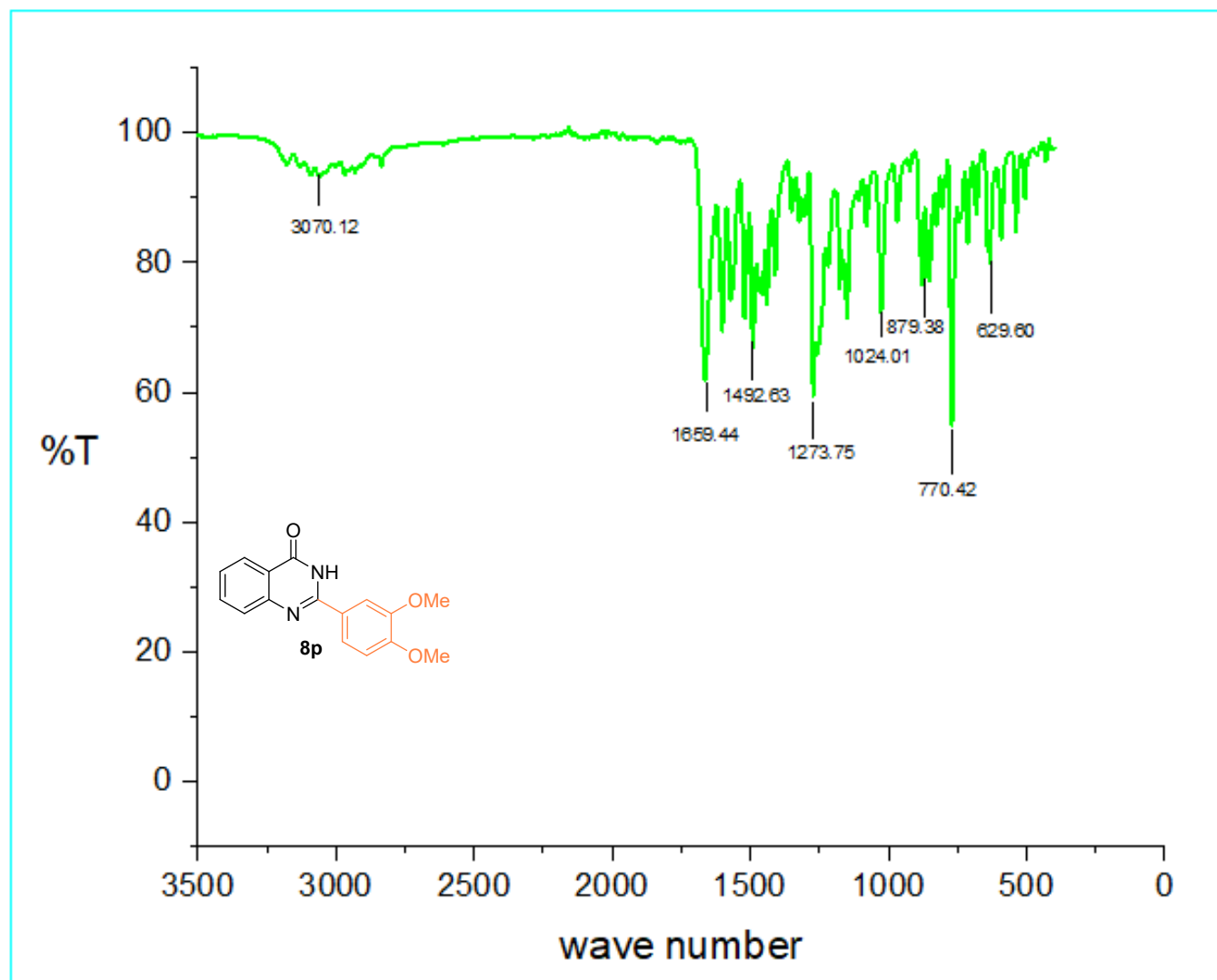
**Figure 54:** HRMS of the compound **8o**.



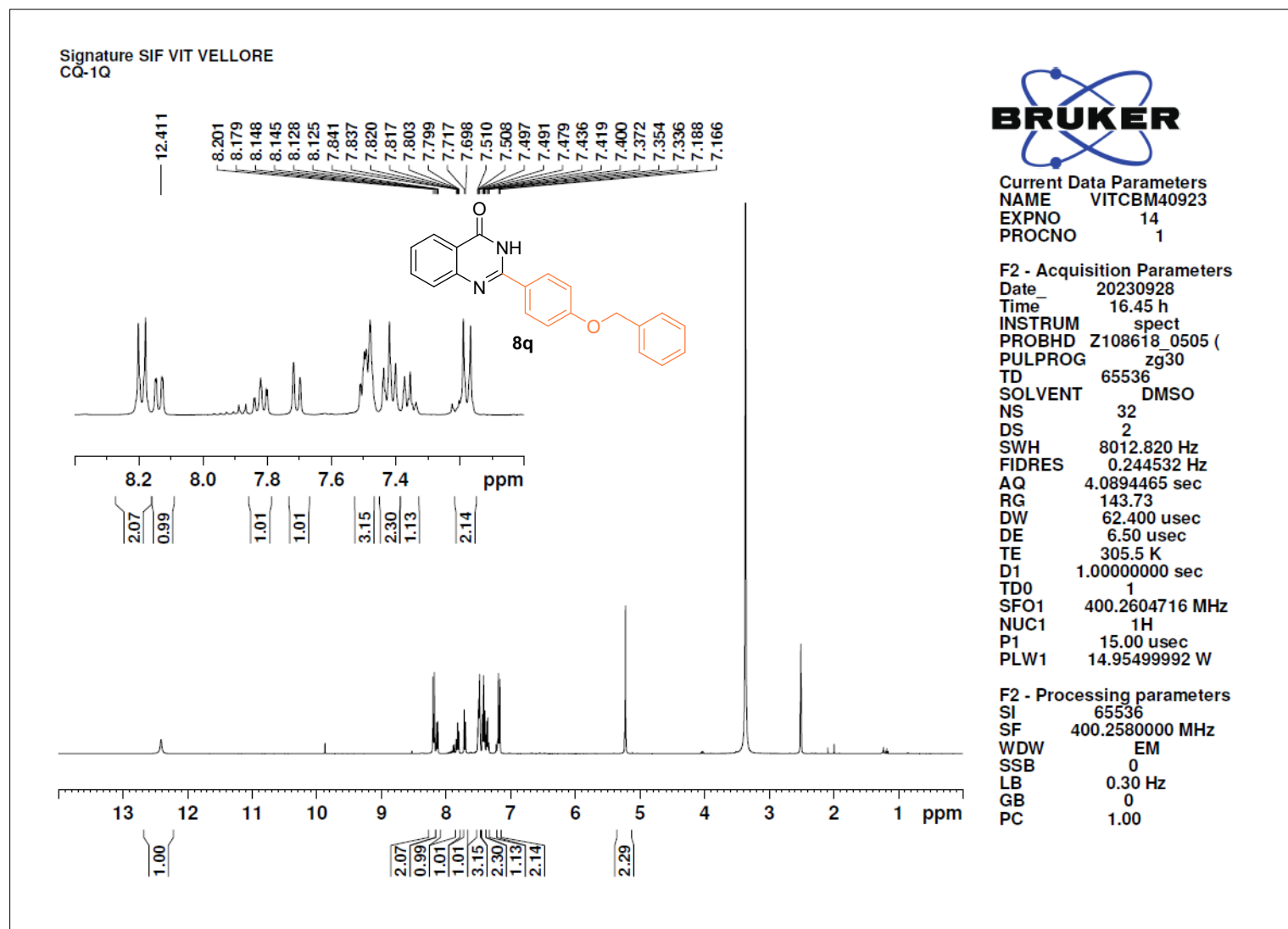
**Figure 55:** <sup>1</sup>H NMR spectrum of the compound **8p**.



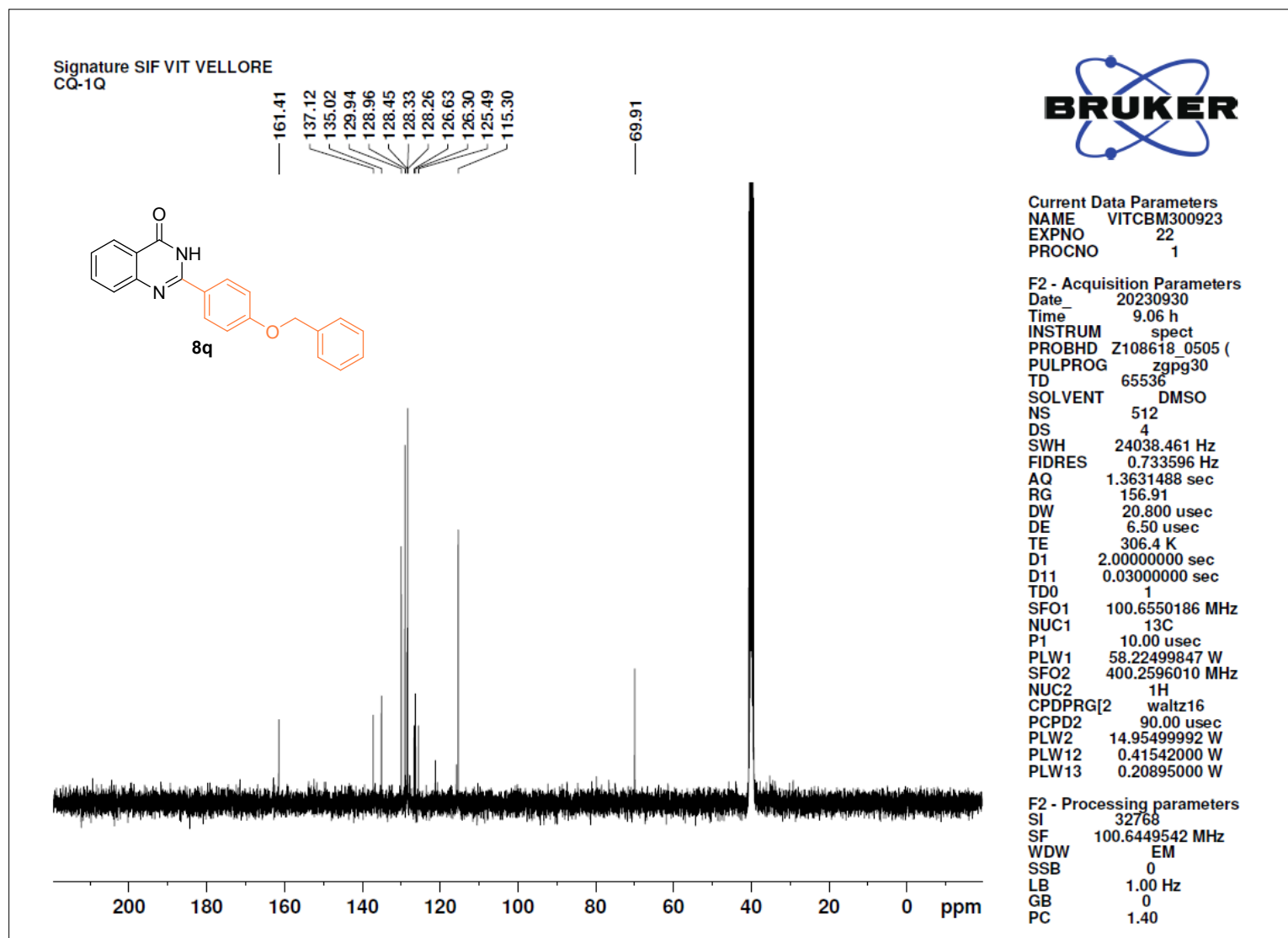
**Figure 56:**  $^{13}\text{C}$  NMR spectrum of the compound **8p**.



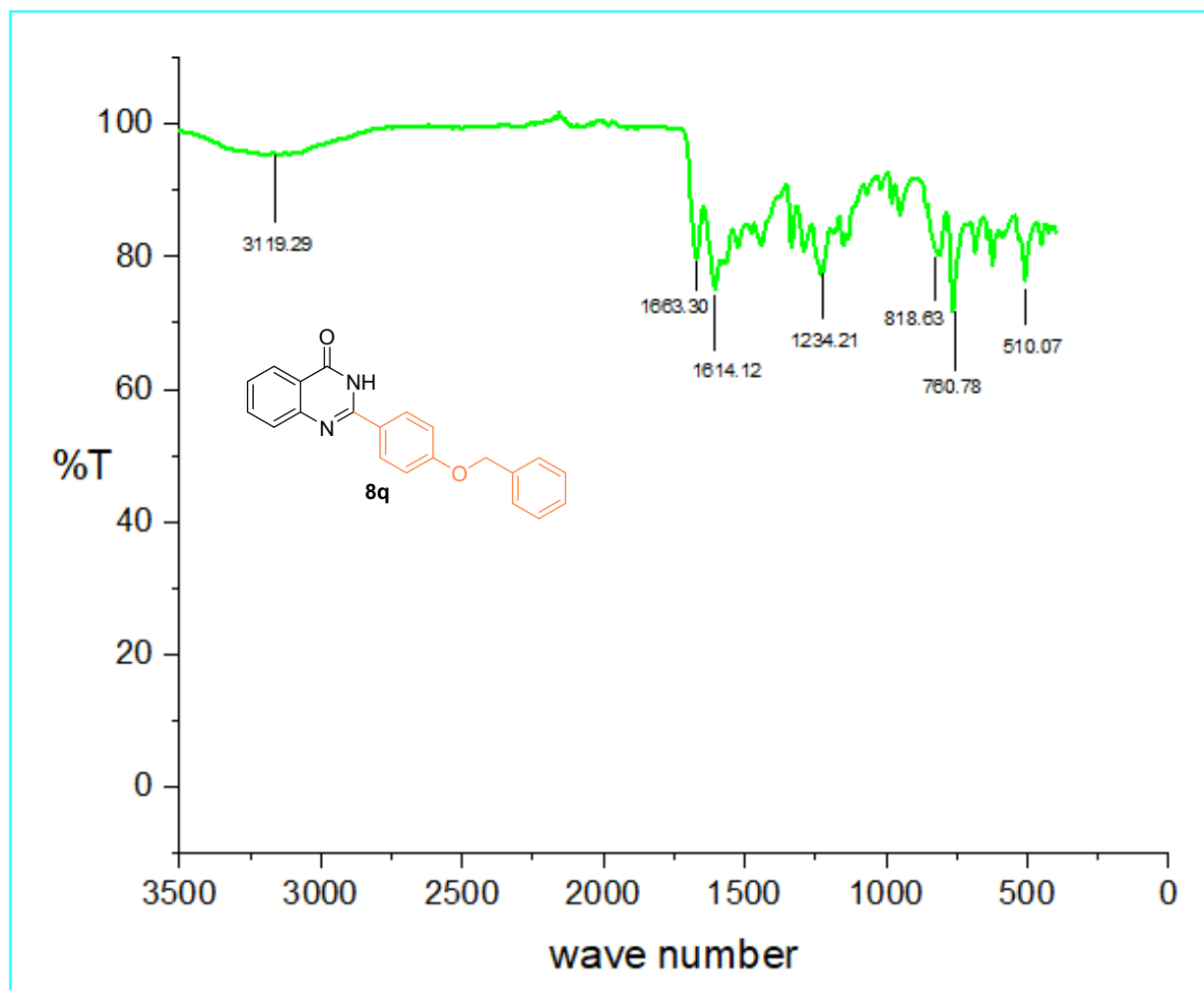
**Figure 57:** FT-IR spectrum of the compound **8p**.



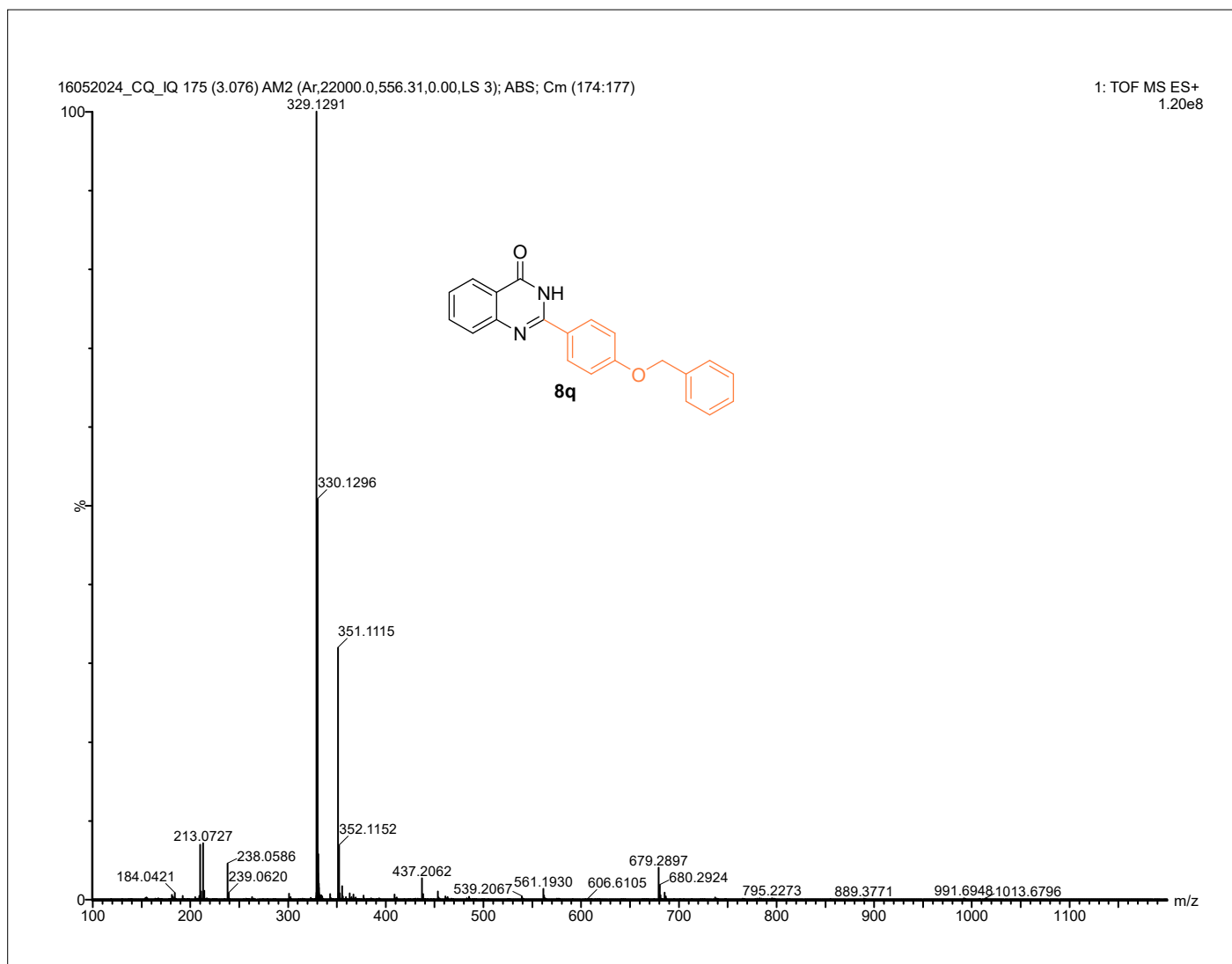
**Figure 58:**  $^1\text{H}$  NMR spectrum of the compound **8q**.



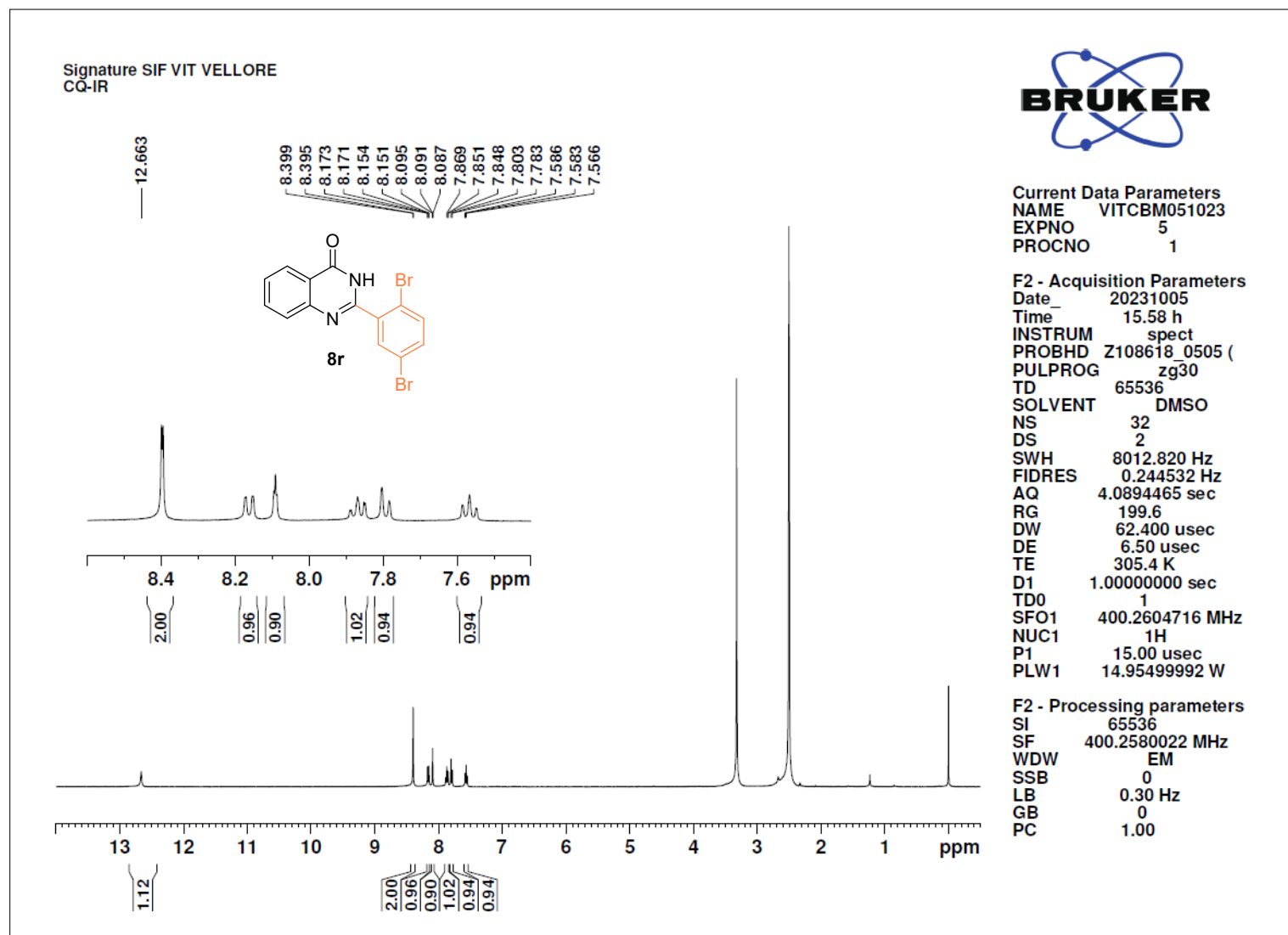
**Figure 59:** <sup>13</sup>C NMR spectrum of the compound **8q**.



**Figure 60:** FT-IR spectrum of the compound **8q**.



**Figure 61:** HRMS spectrum of the compound **8q**.



**Figure 62:**  $^1\text{H}$  NMR spectrum of the compound **8r**.

Signature SIF VIT VELLORE  
CQ-1R



Current Data Parameters  
NAME CQ-CIN  
EXPNO 8  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20240619  
Time 0.33 h  
INSTRUM spect  
PROBHD Z108618\_0505 (  
PULPROG zgpg30  
TD 65536  
SOLVENT DMSO  
NS 512  
DS 4  
SWH 24038.461 Hz  
FIDRES 0.733596 Hz  
AQ 1.3631488 sec  
RG 199.6  
DW 20.800 usec  
DE 6.50 usec  
TE 302.8 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 100.6550186 MHz  
NUC1 13C  
P1 10.00 usec  
PLW1 56.49300003 W  
SFO2 400.2596010 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 90.00 usec  
PLW2 15.21399975 W  
PLW12 0.42261001 W  
PLW13 0.21257000 W

F2 - Processing parameters  
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SF 100.6446724 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

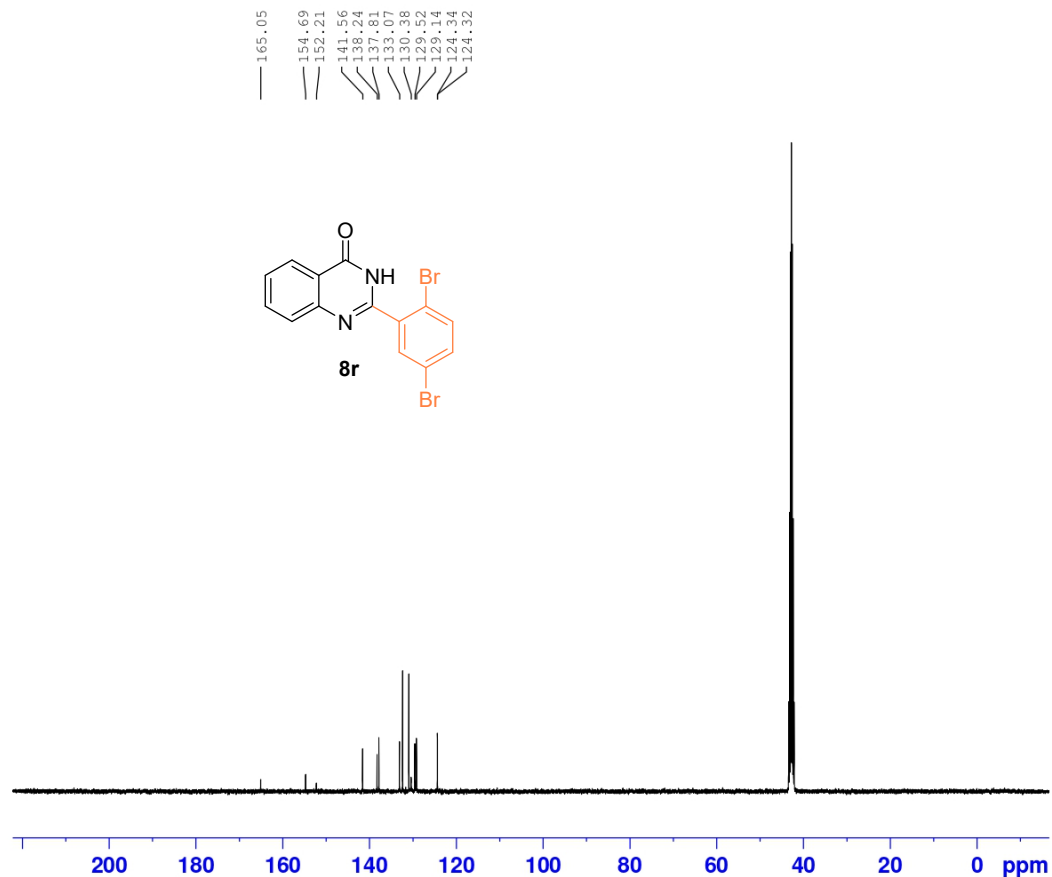
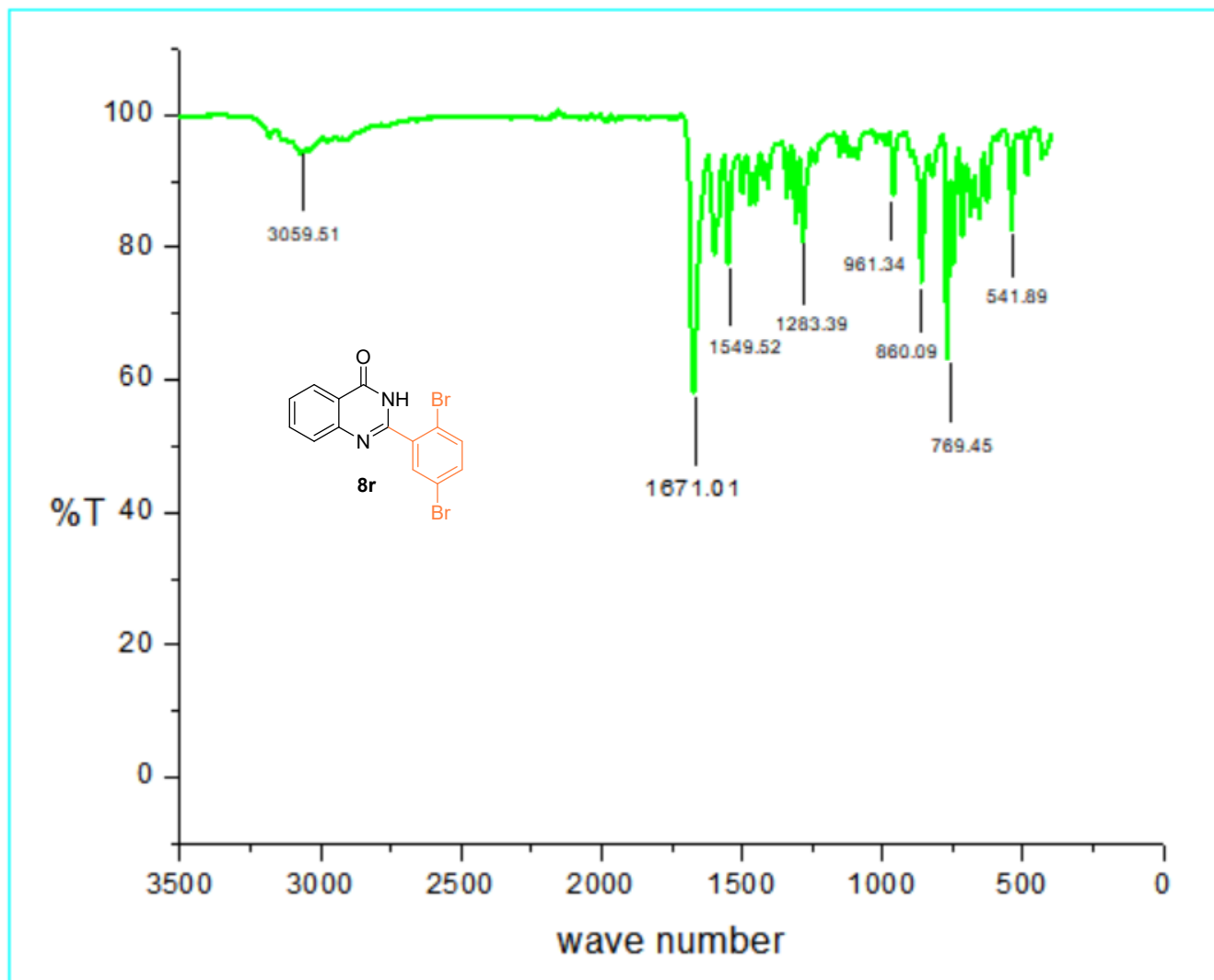
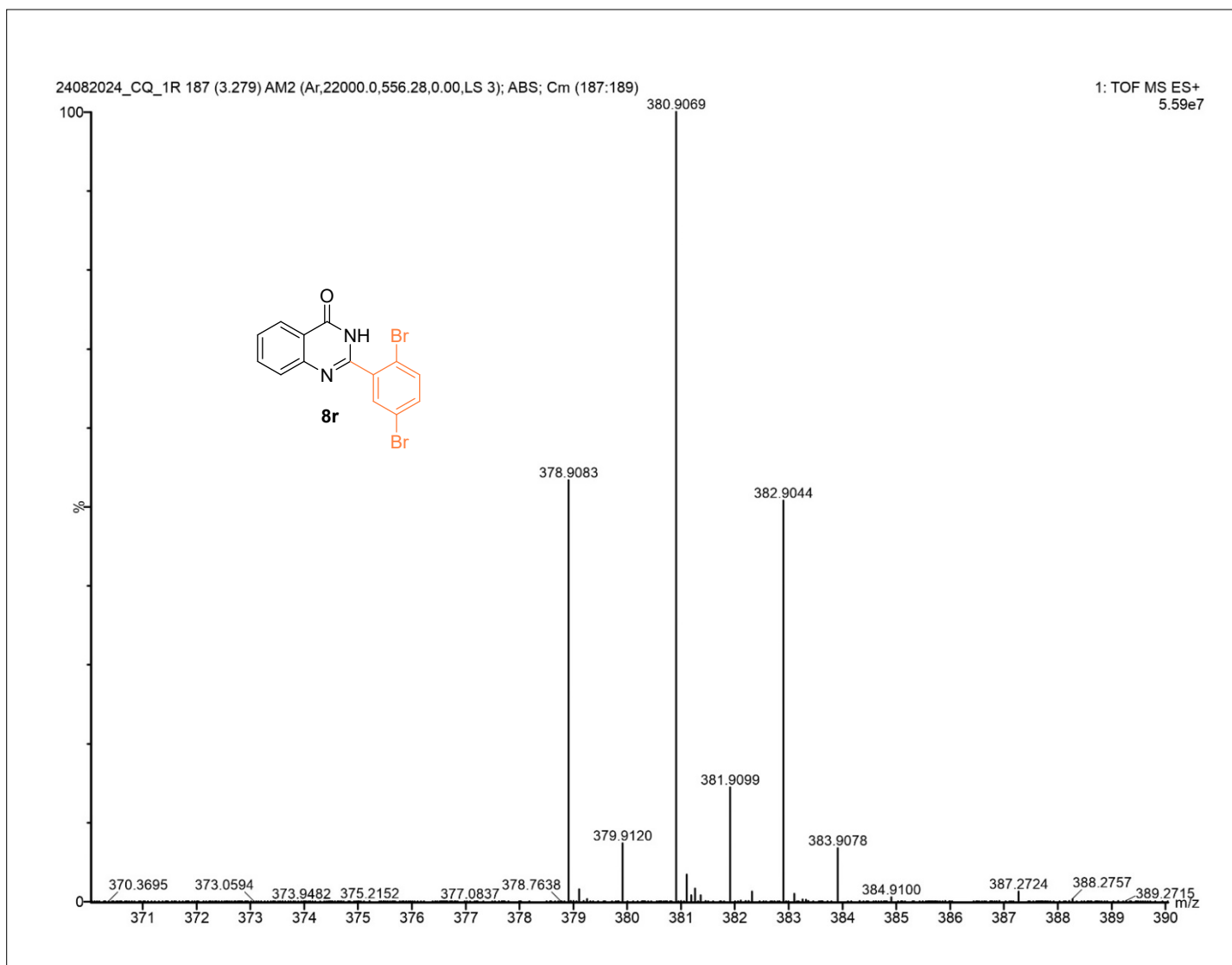


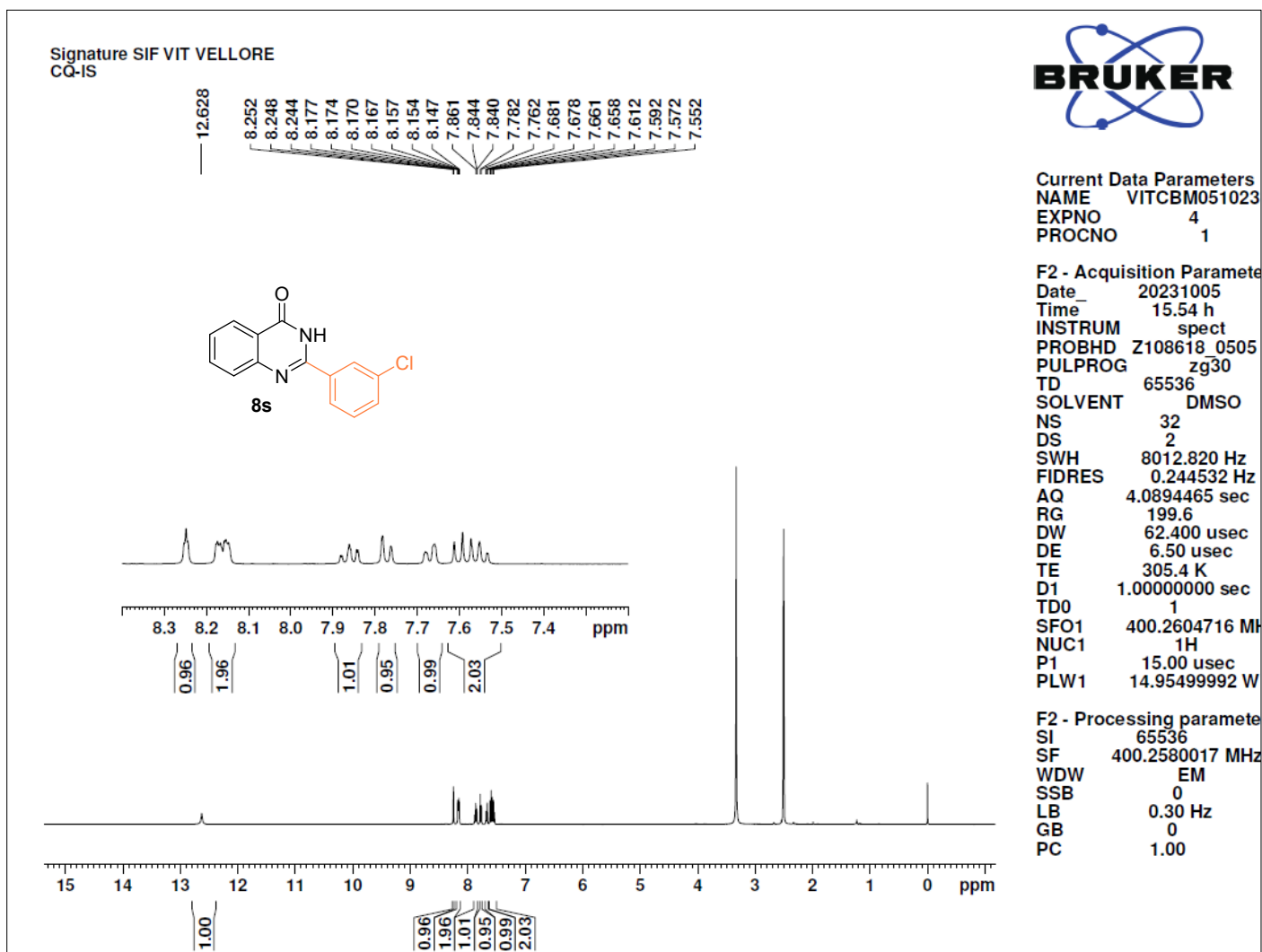
Figure 63:  $^{13}\text{C}$  NMR spectrum of the compound 8r.



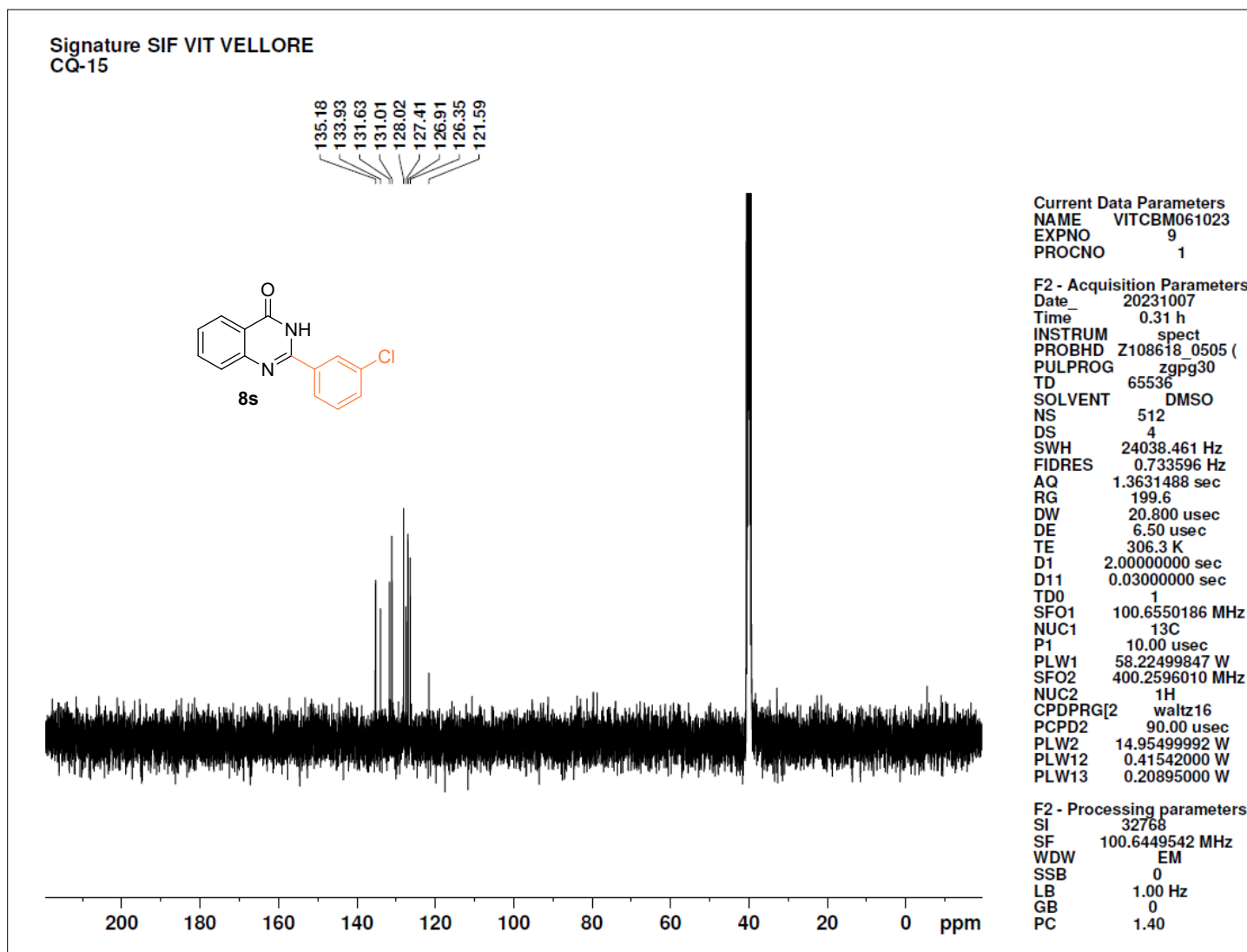
**Figure 64:** FT-IR spectrum of the compound **8r**.



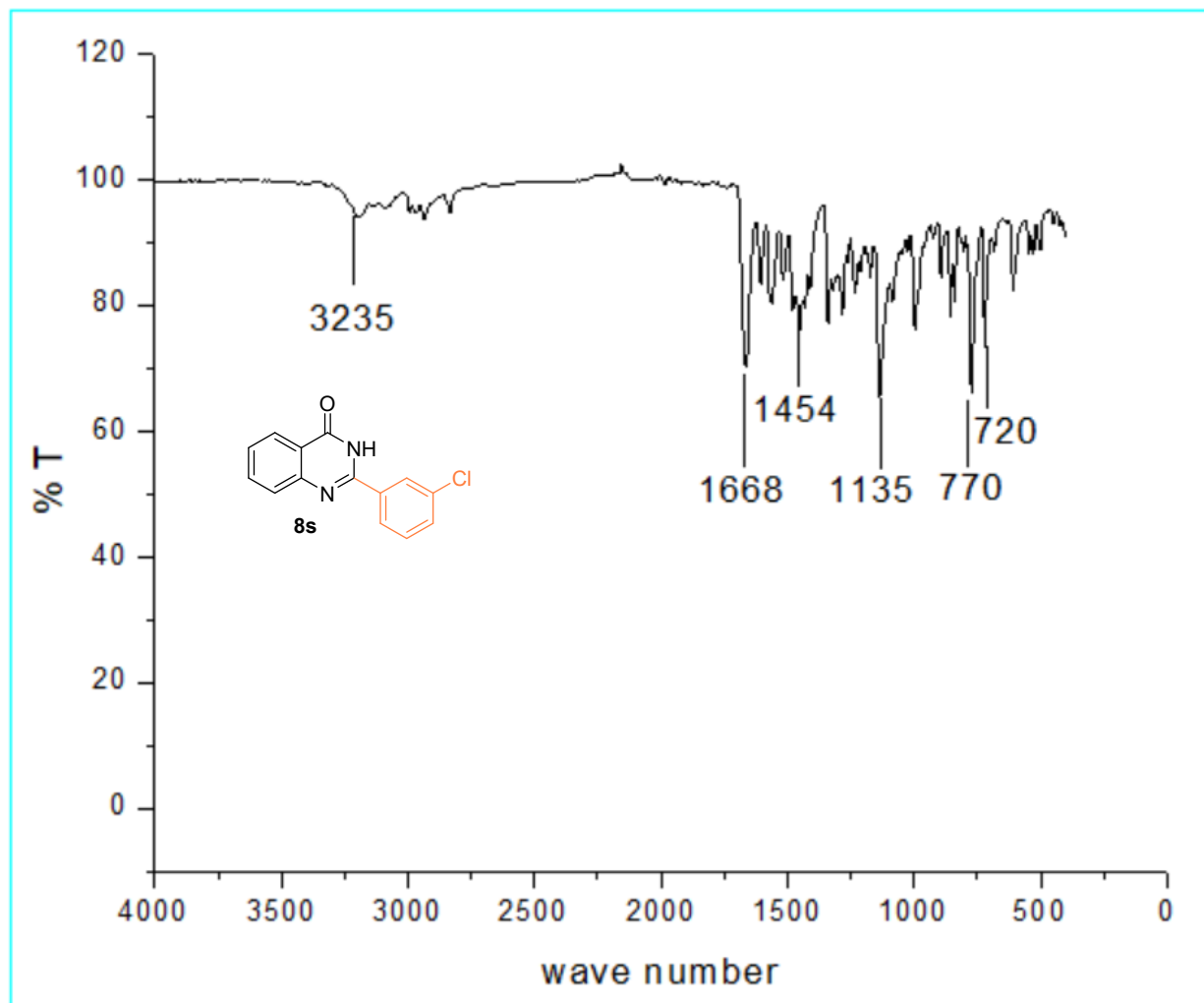
**Figure 65:** HRMS of the compound **8r**.



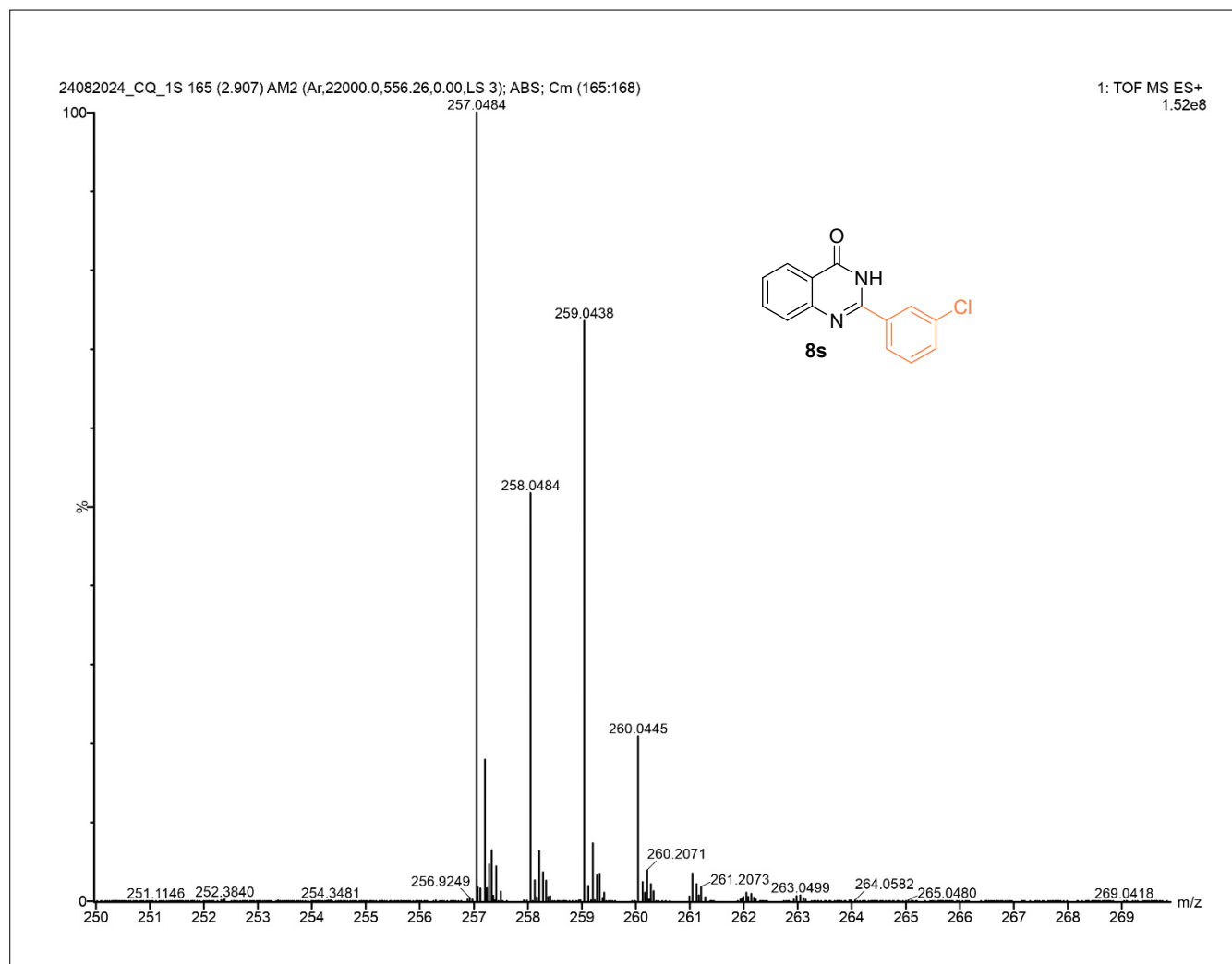
**Figure 66:**  $^1\text{H}$  NMR spectrum of the compound **8s**.



**Figure 67:**  $^{13}\text{C}$  NMR spectrum of the compound **8s**.



**Figure 68:** FT-IR spectrum of the compound 8s.



**Figure 69:** HRMS of the compound **8s**.

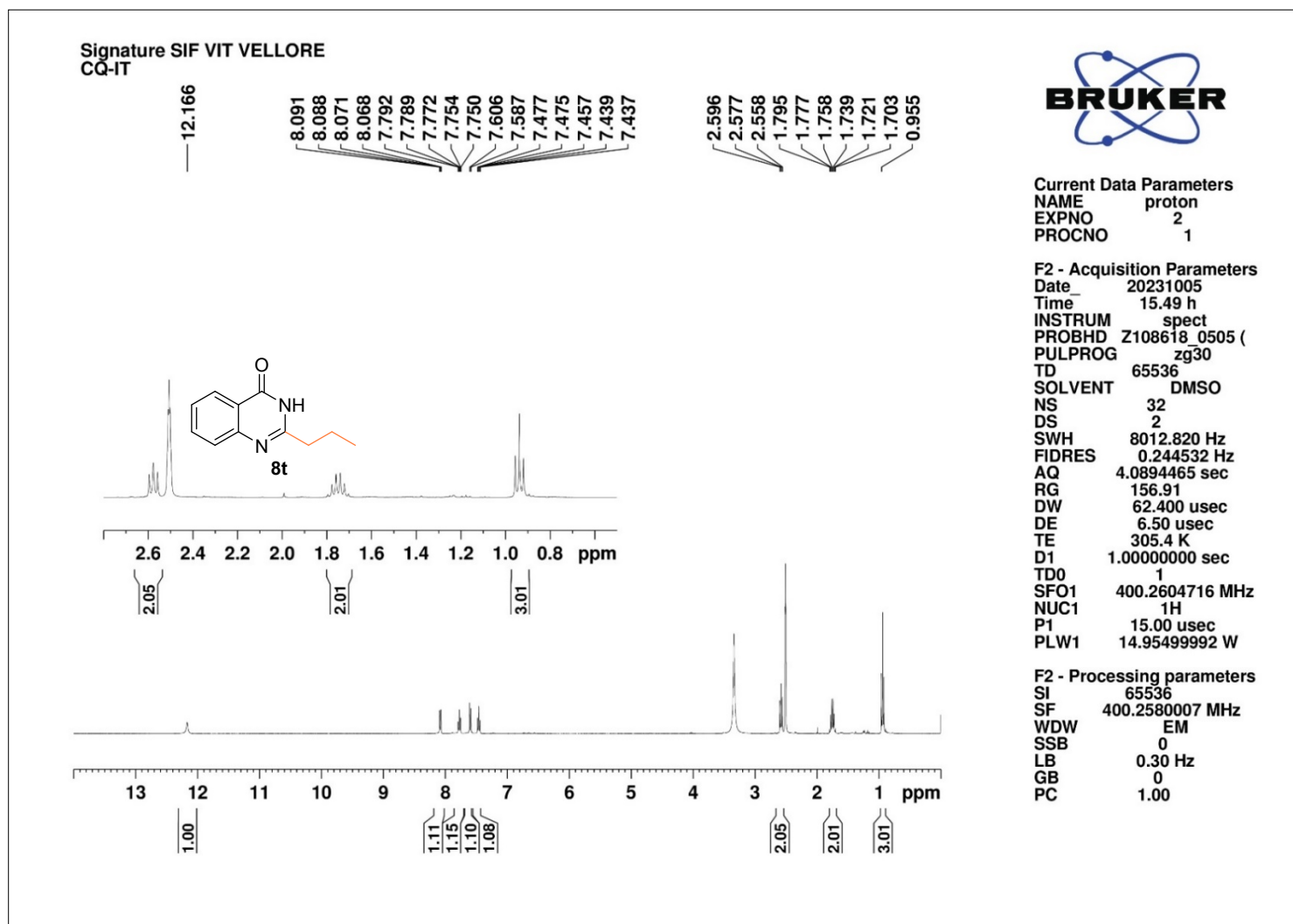


Figure 70:  $^1\text{H}$  NMR spectrum of the compound **8t**.

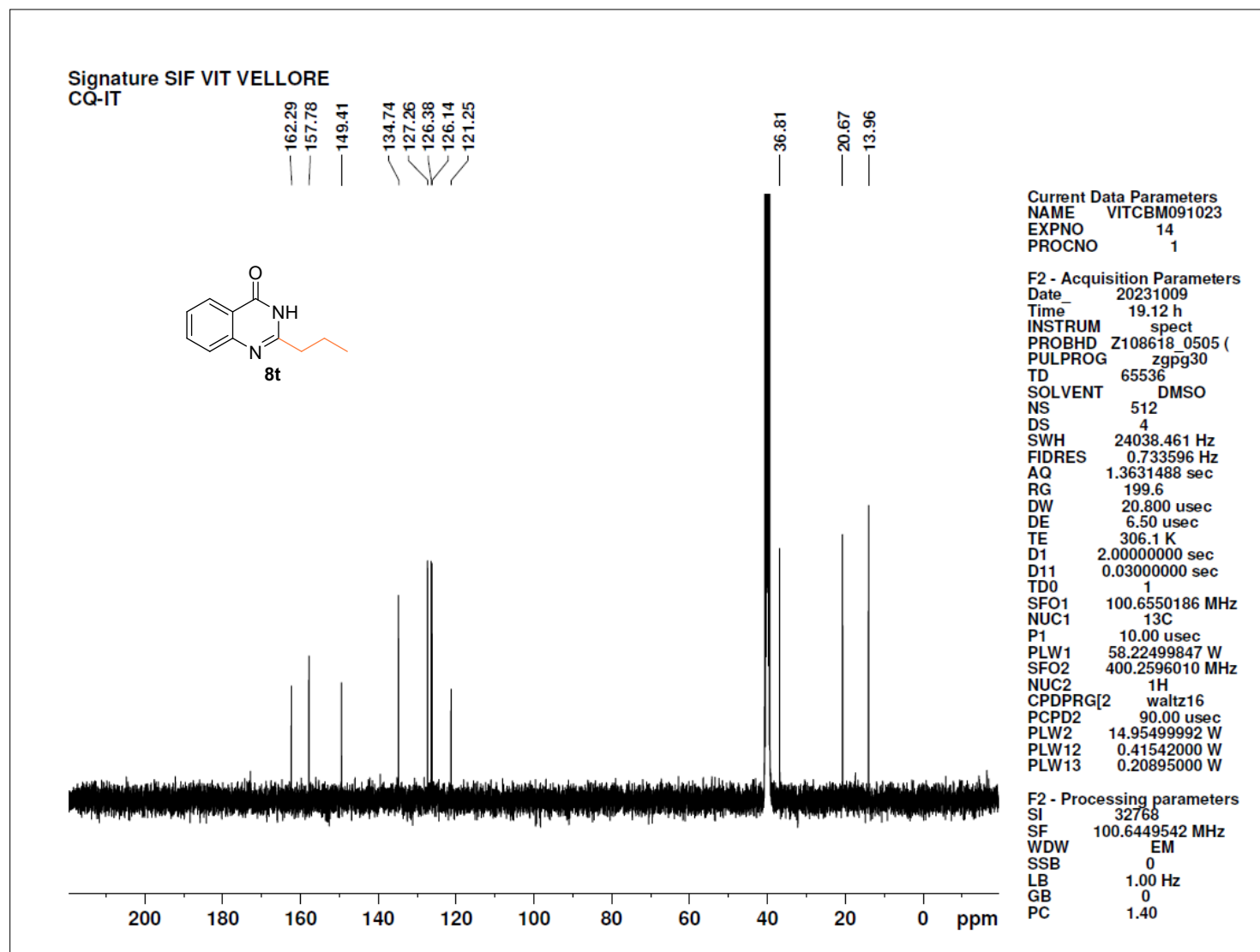
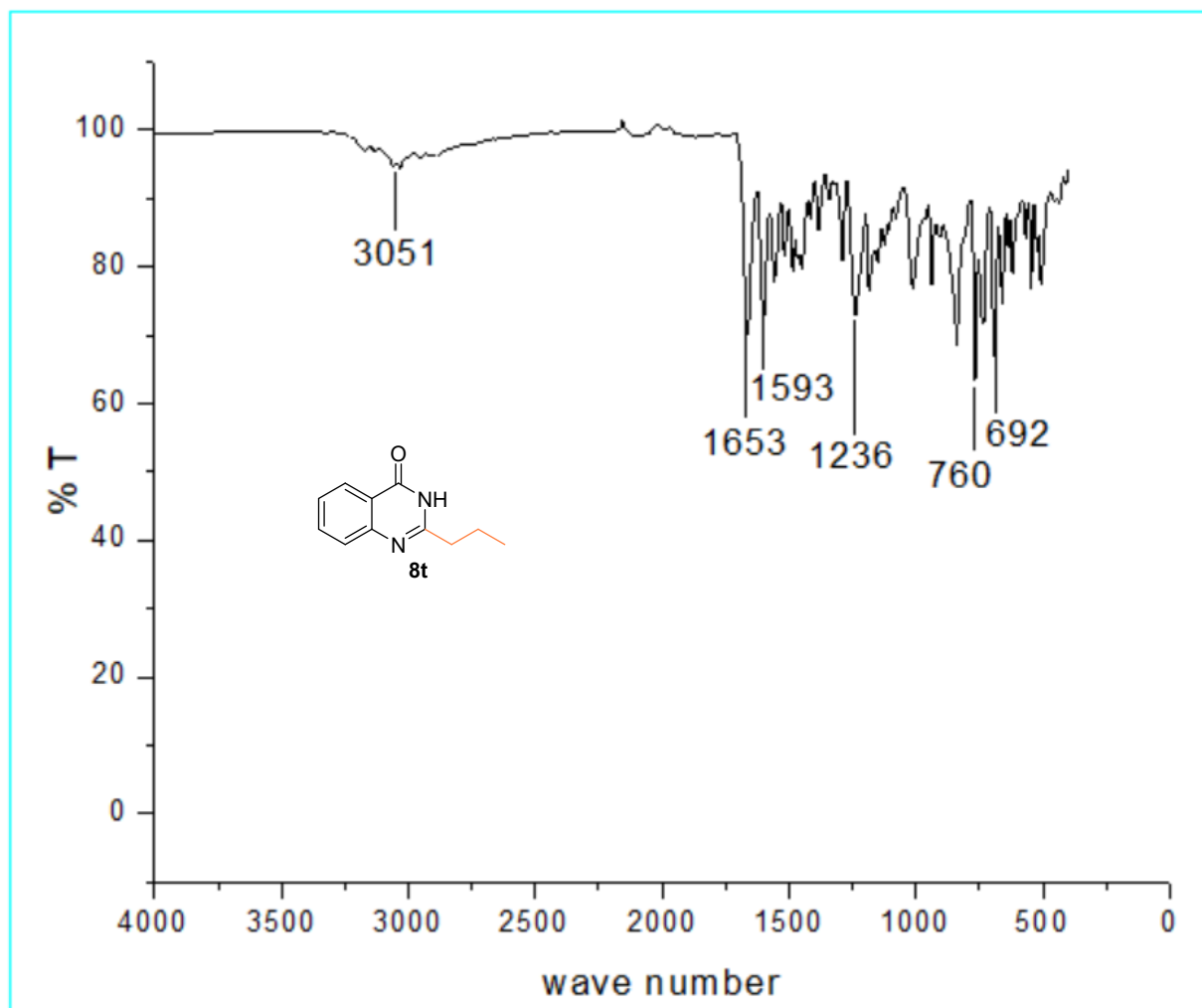


Figure 71:  $^{13}\text{C}$  NMR spectrum of the compound **8t**.



**Figure 72:** FT-IR spectrum of the compound **8t**.

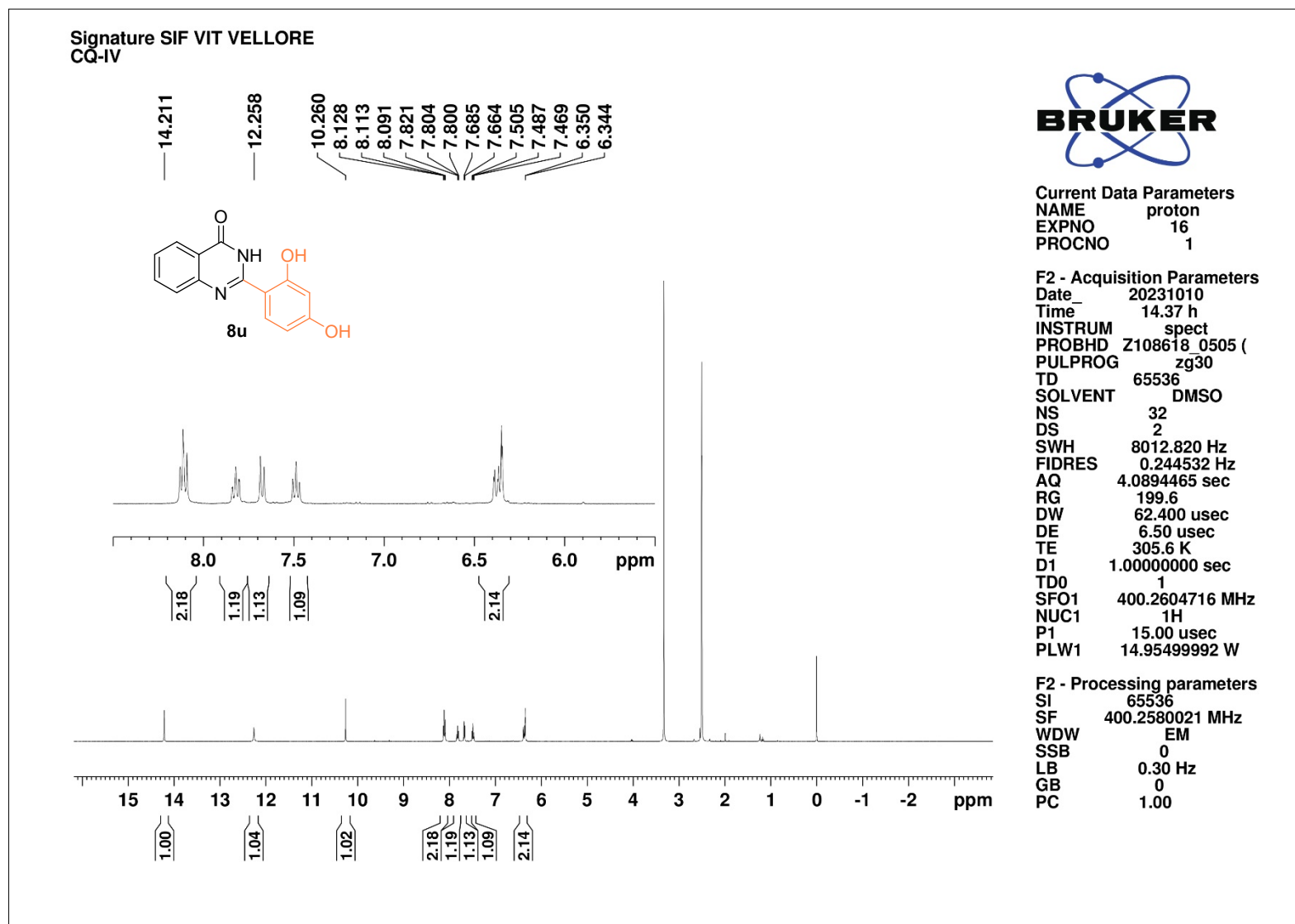


Figure 73: <sup>1</sup>H NMR spectrum of the compound **8u**.

Signature SIF VIT VELLORE  
CQ-IV



Current Data Parameters  
NAME VITC221123  
EXPNO 23  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20231122  
Time\_ 20.53 h  
INSTRUM spect  
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PULPROG zgpg30  
TD 65536  
SOLVENT DMSO  
NS 512  
DS 4  
SWH 24038.461 Hz  
FIDRES 0.733596 Hz  
AQ 1.3631488 sec  
RG 199.6  
DW 20.800 usec  
DE 6.50 usec  
TE 302.5 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 100.6550186 MHz  
NUC1 13C  
P1 10.00 usec  
PLW1 56.49300003 W  
SFO2 400.2596010 MHz  
NUC2 1H  
CPDPRG[2] waltz16  
PCPD2 90.00 usec  
PLW2 15.21399975 W  
PLW12 0.42261001 W  
PLW13 0.21257000 W

F2 - Processing parameters  
SI 32768  
SF 100.6449542 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

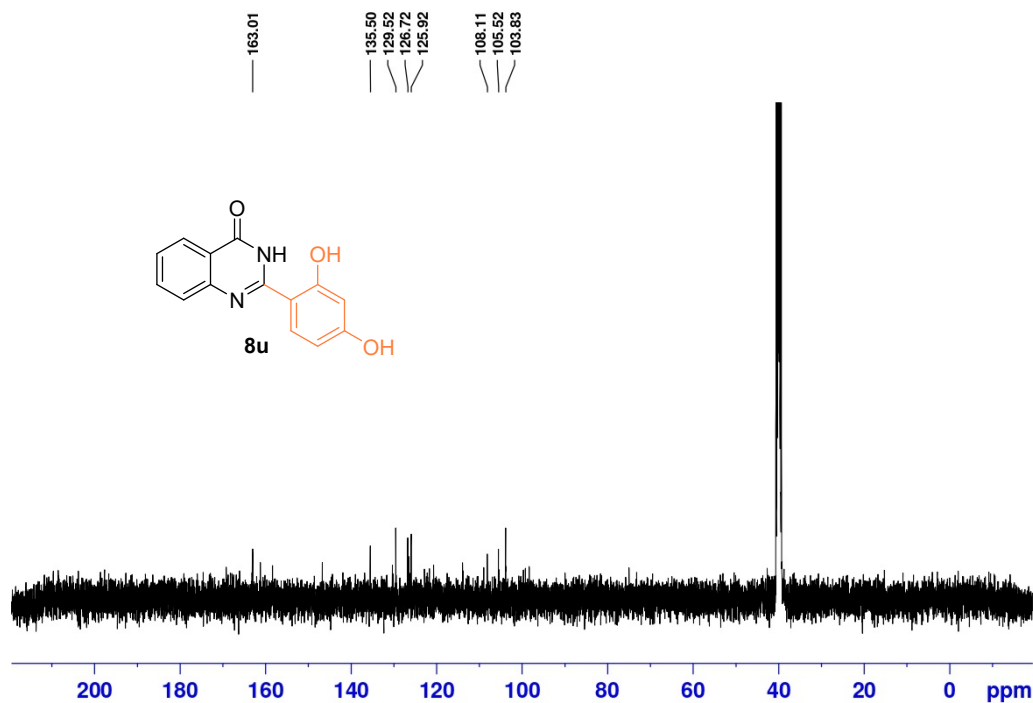
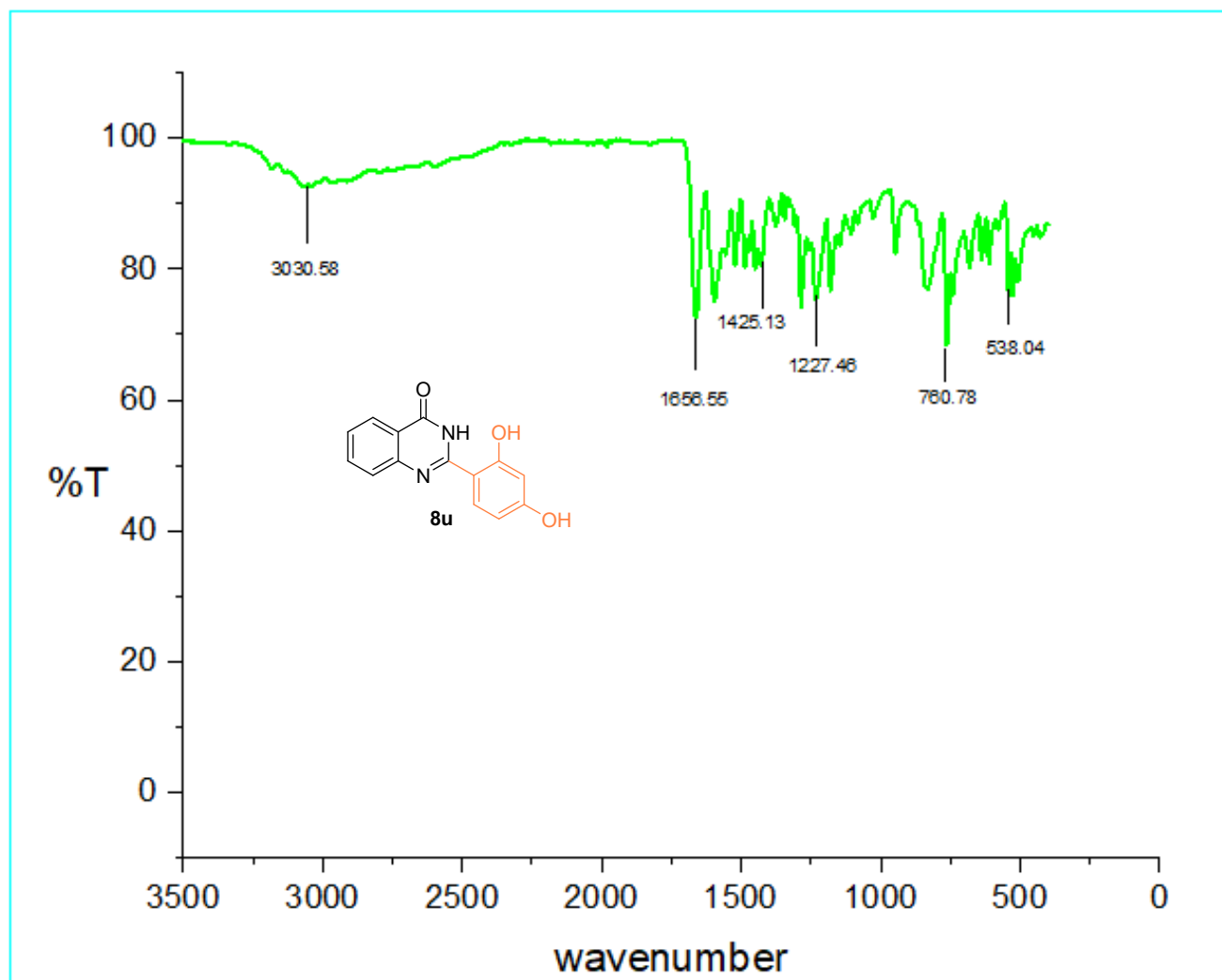
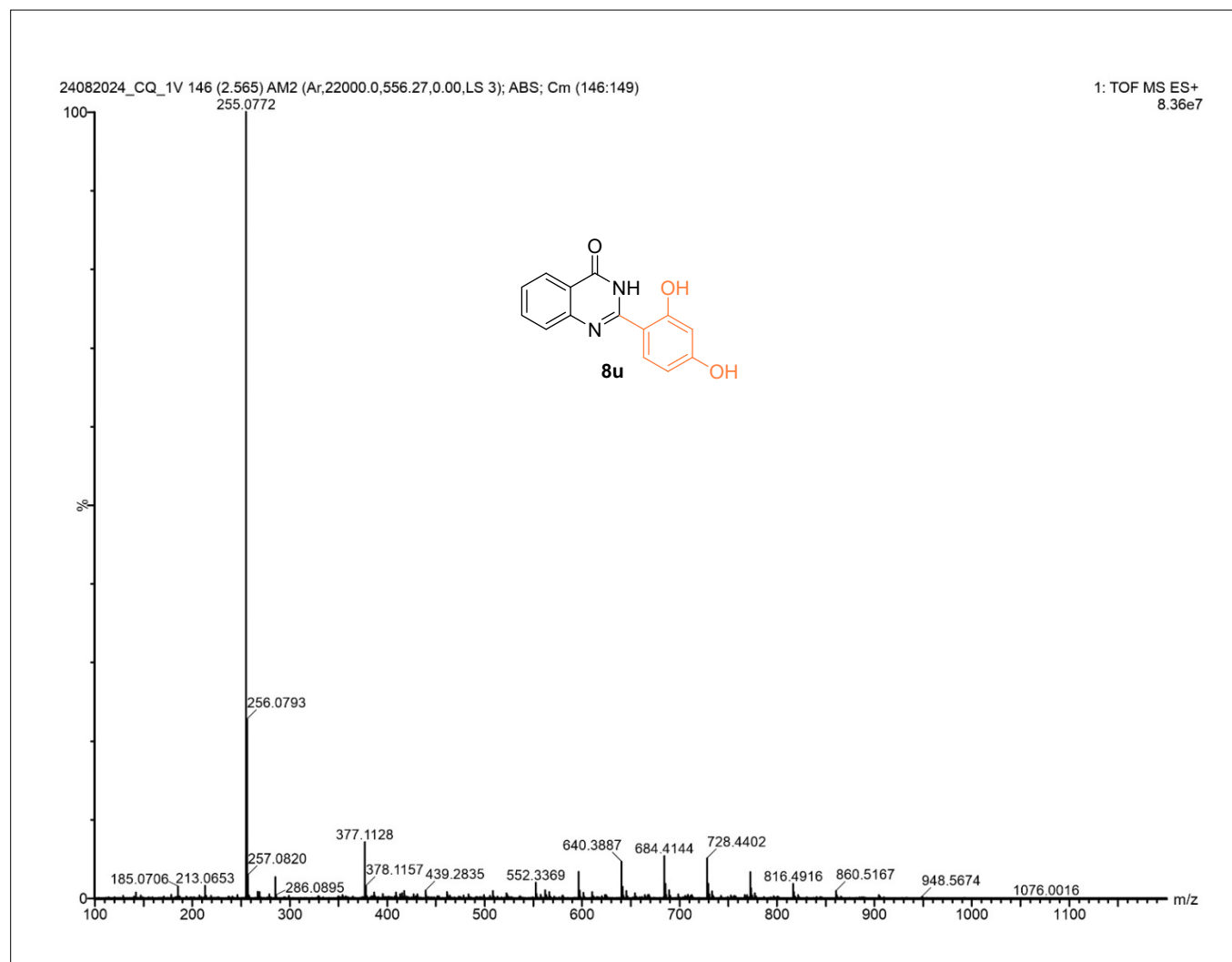


Figure 74:  $^{13}\text{C}$  NMR spectrum of the compound **8u**.



**Figure 75:** FT-IR spectrum of the compound **8u**.



**Figure 76:** HRMS of the compound **8u**.

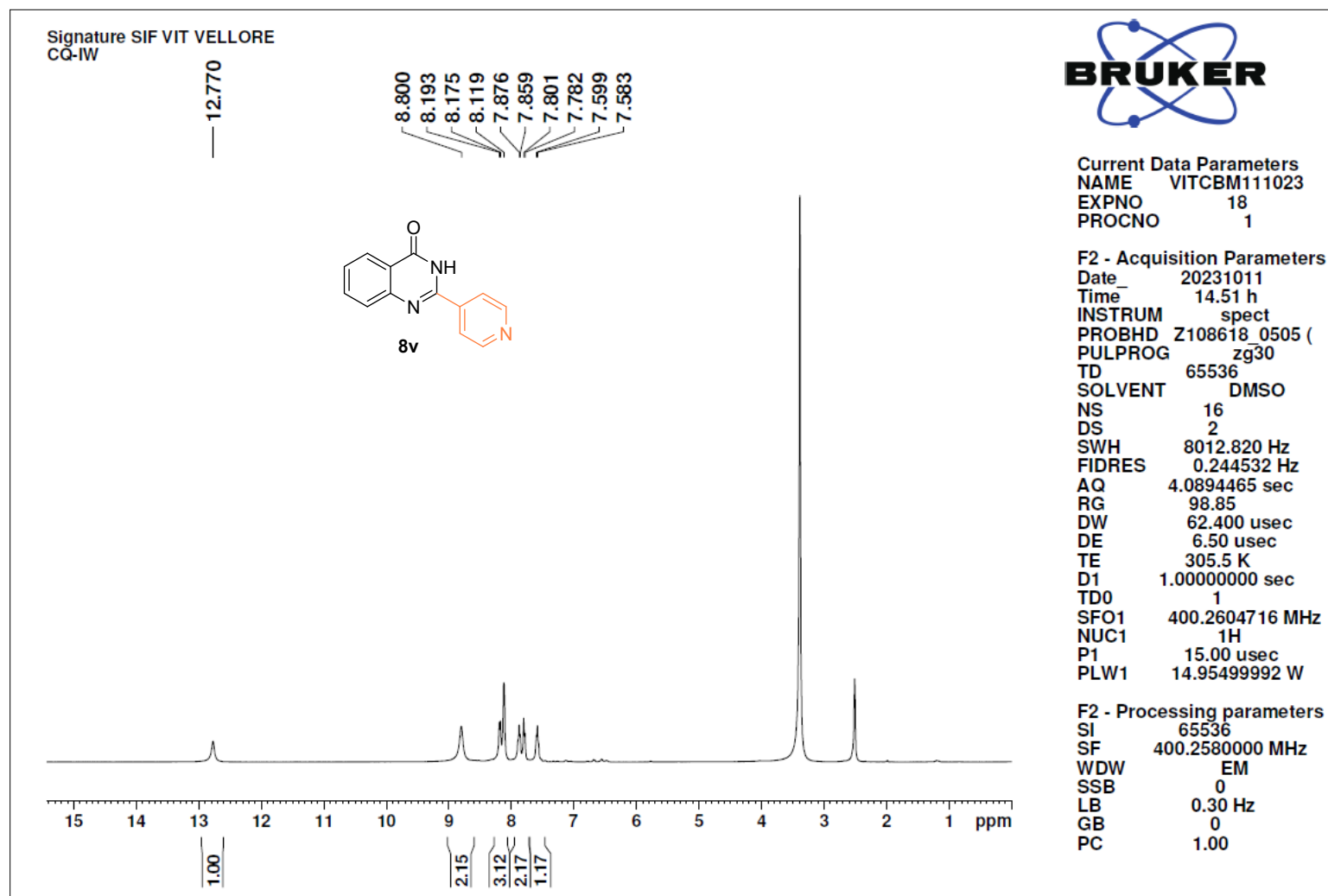


Figure 77:  $^1\text{H}$  NMR spectrum of the compound 8v.

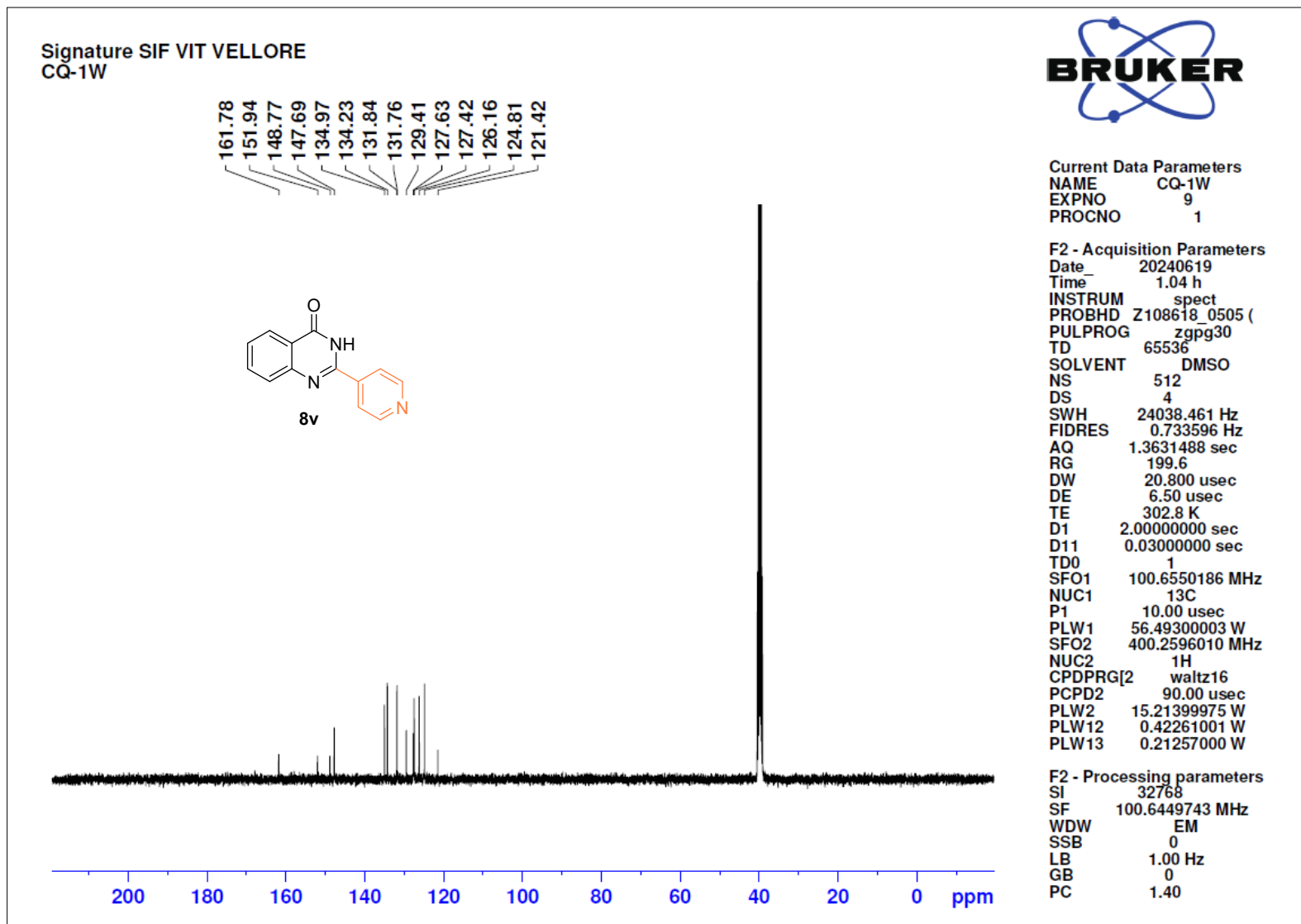
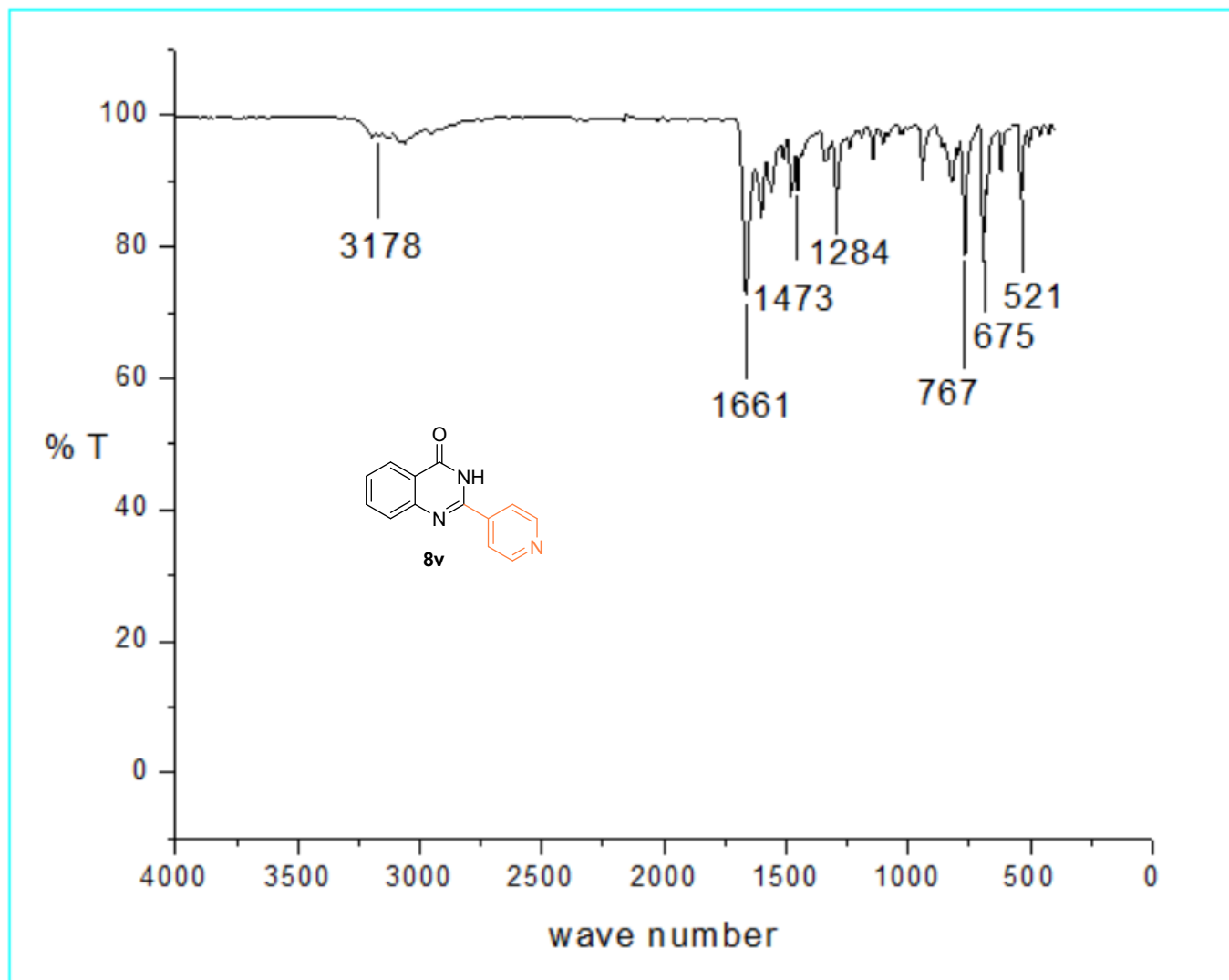
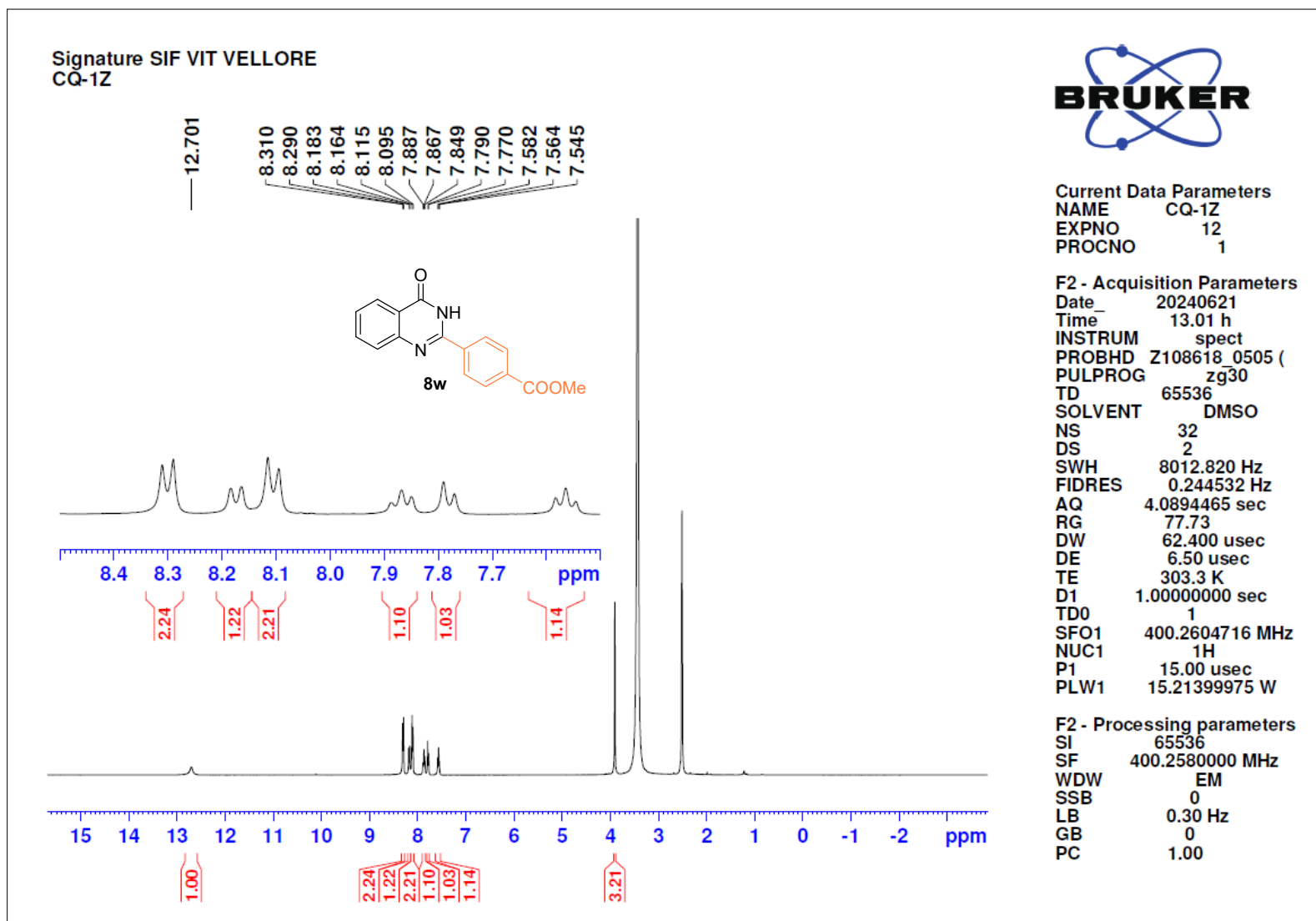


Figure 78:  $^{13}\text{C}$  NMR spectrum of the compound **8v**.



**Figure 79:** FT-IR spectrum of the compound **8v**.



**Figure 80:** <sup>1</sup>H NMR spectrum of the compound **8w**.

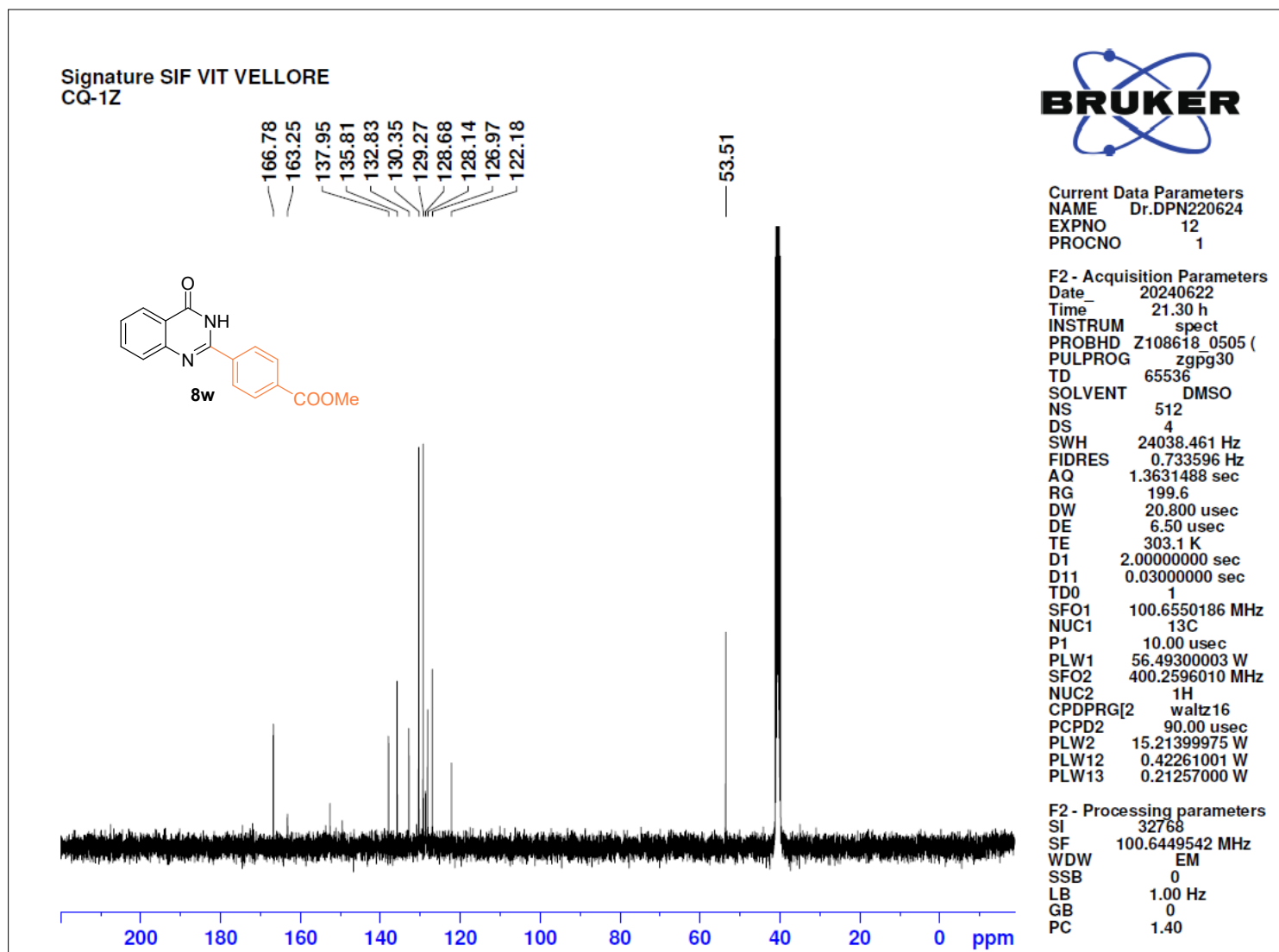
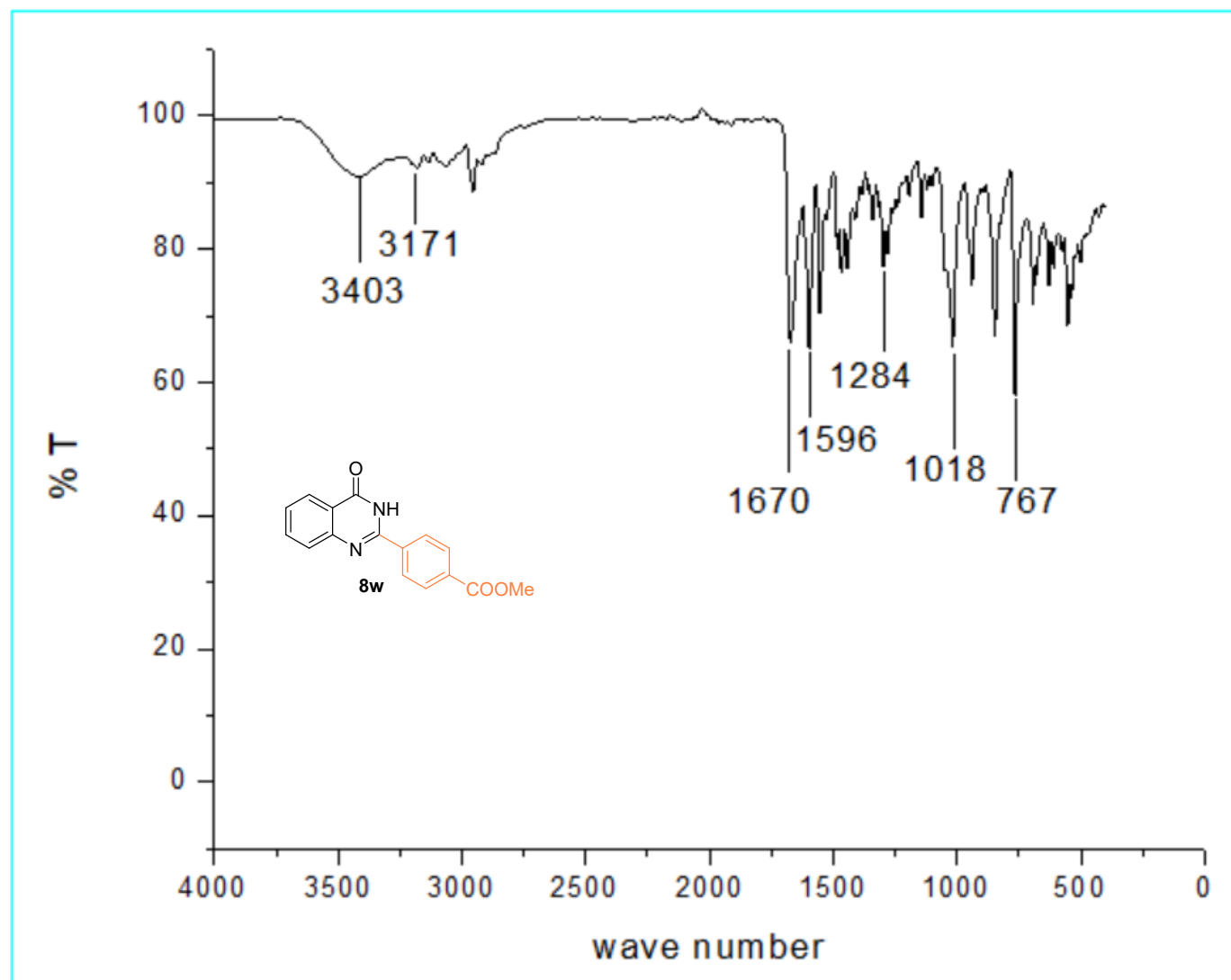
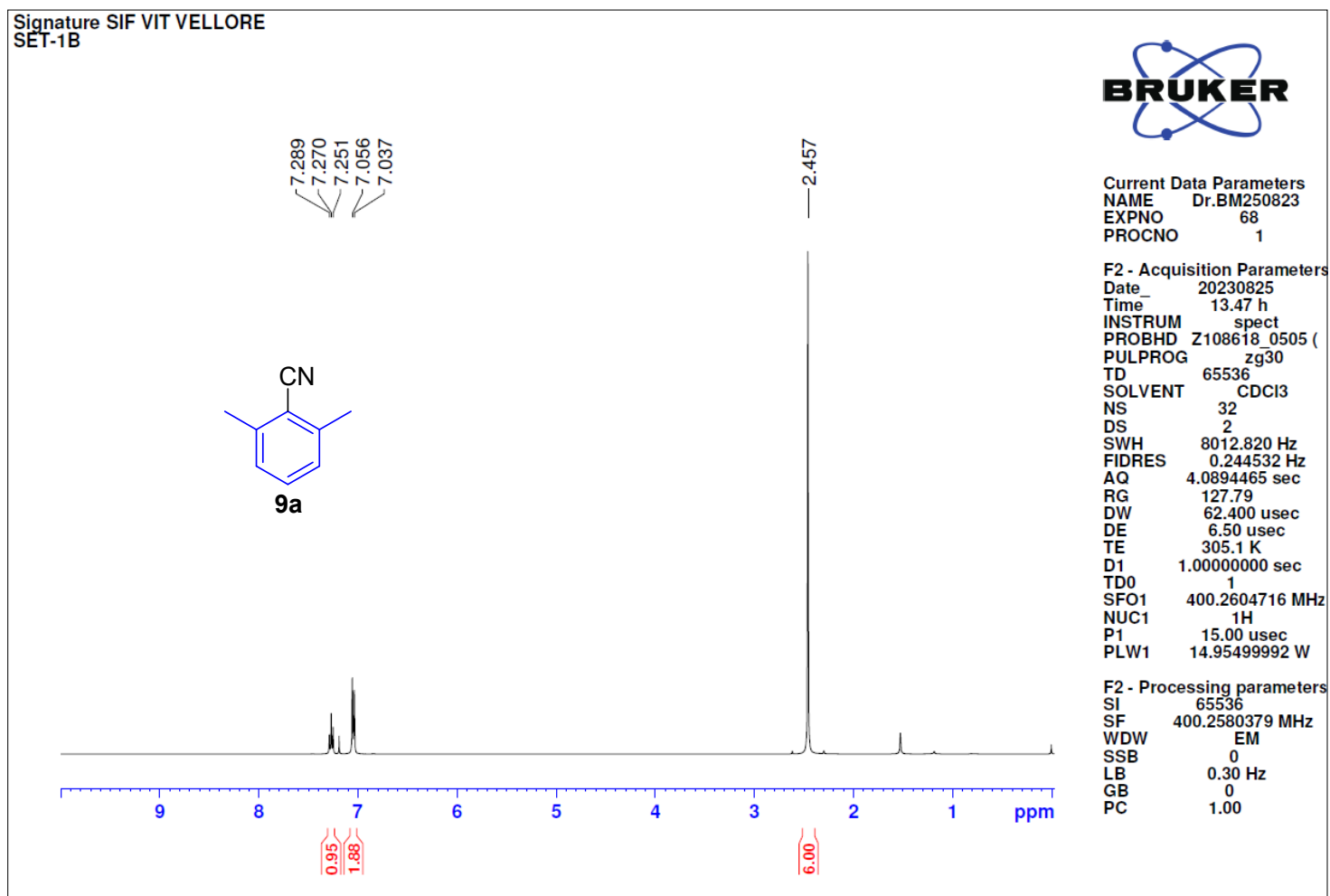


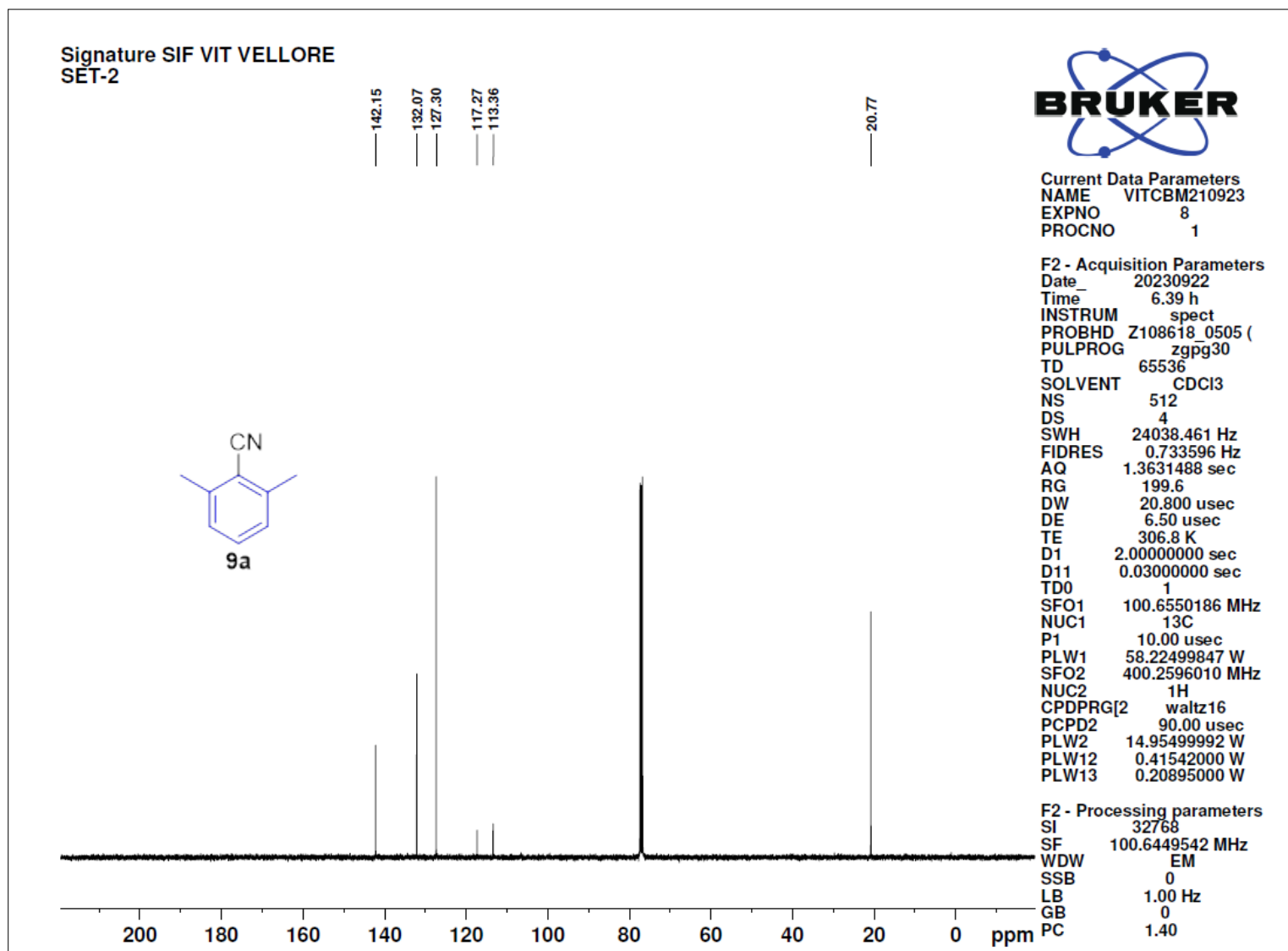
Figure 81: <sup>13</sup>C NMR spectrum of the compound **8w**.



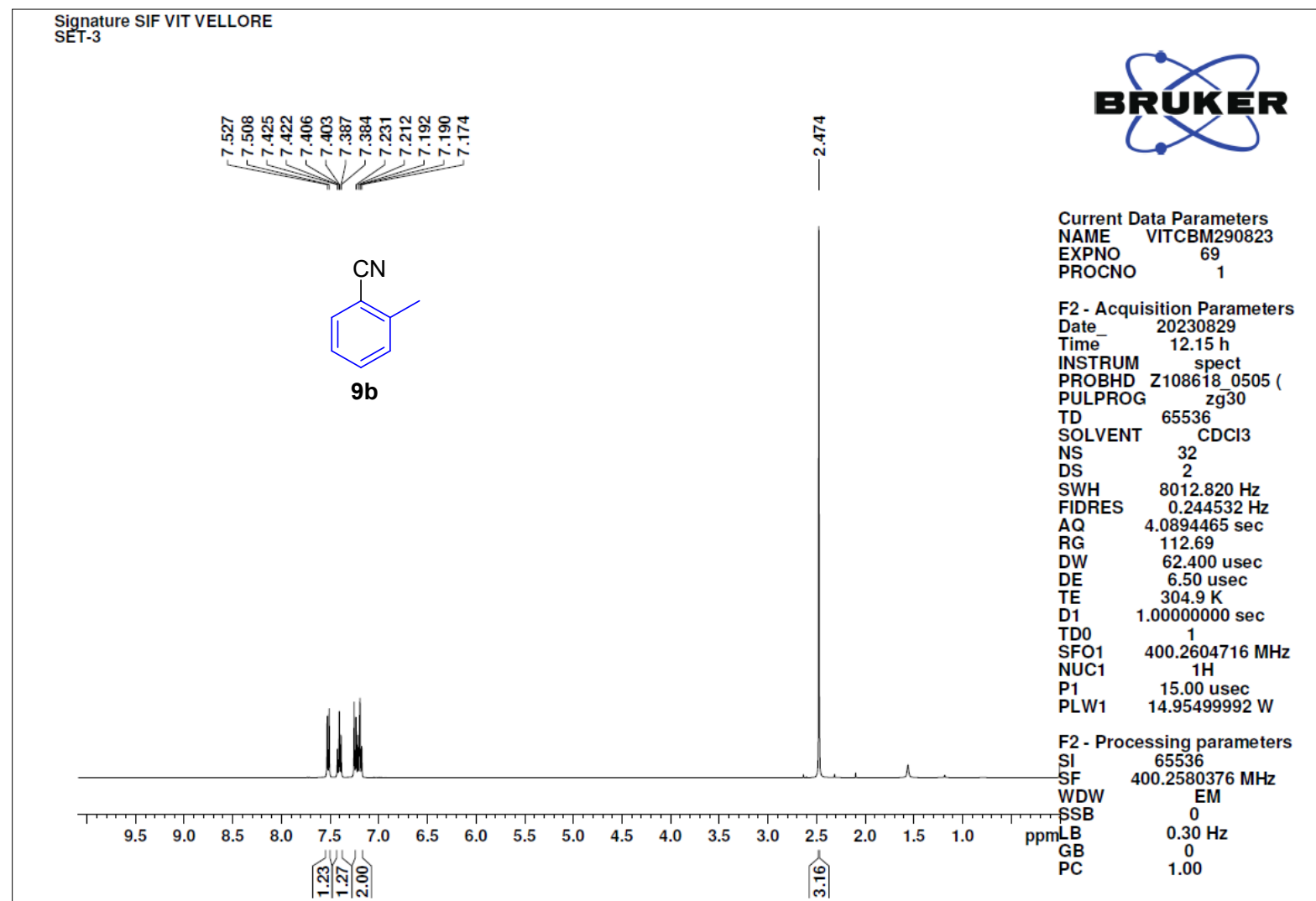
**Figure 82:** FT-IR spectrum of the compound **8w**.



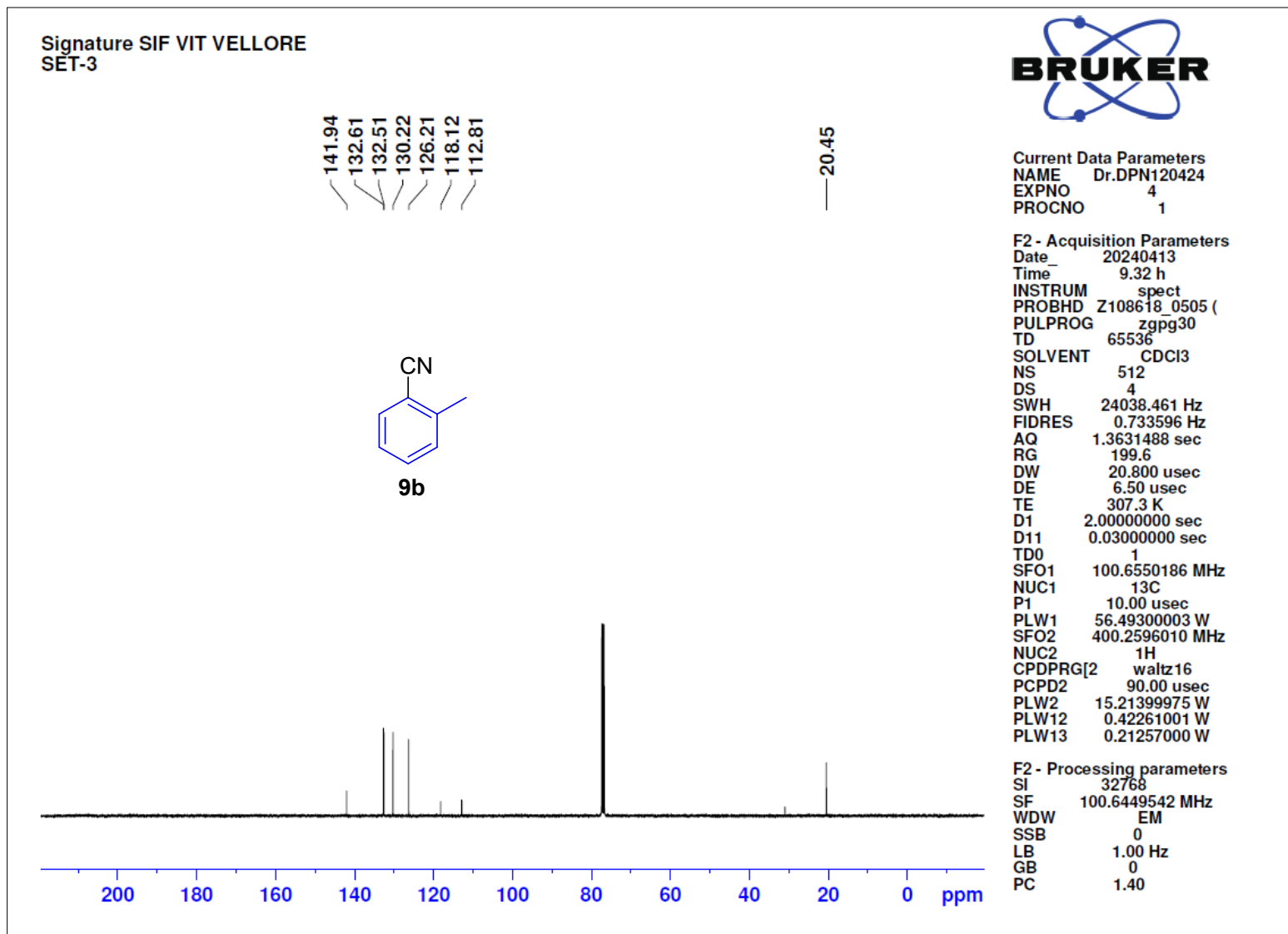
**Figure 83:**  $^1\text{H}$  NMR spectrum of the compound **9a**.



**Figure 84:**  $^{13}\text{C}$  NMR spectrum of the compound 9a.



**Figure 85:**  $^1\text{H}$  NMR spectrum of the compound **9b**.



**Figure 86:**  $^{13}\text{C}$  NMR spectrum of the compound **9b**.

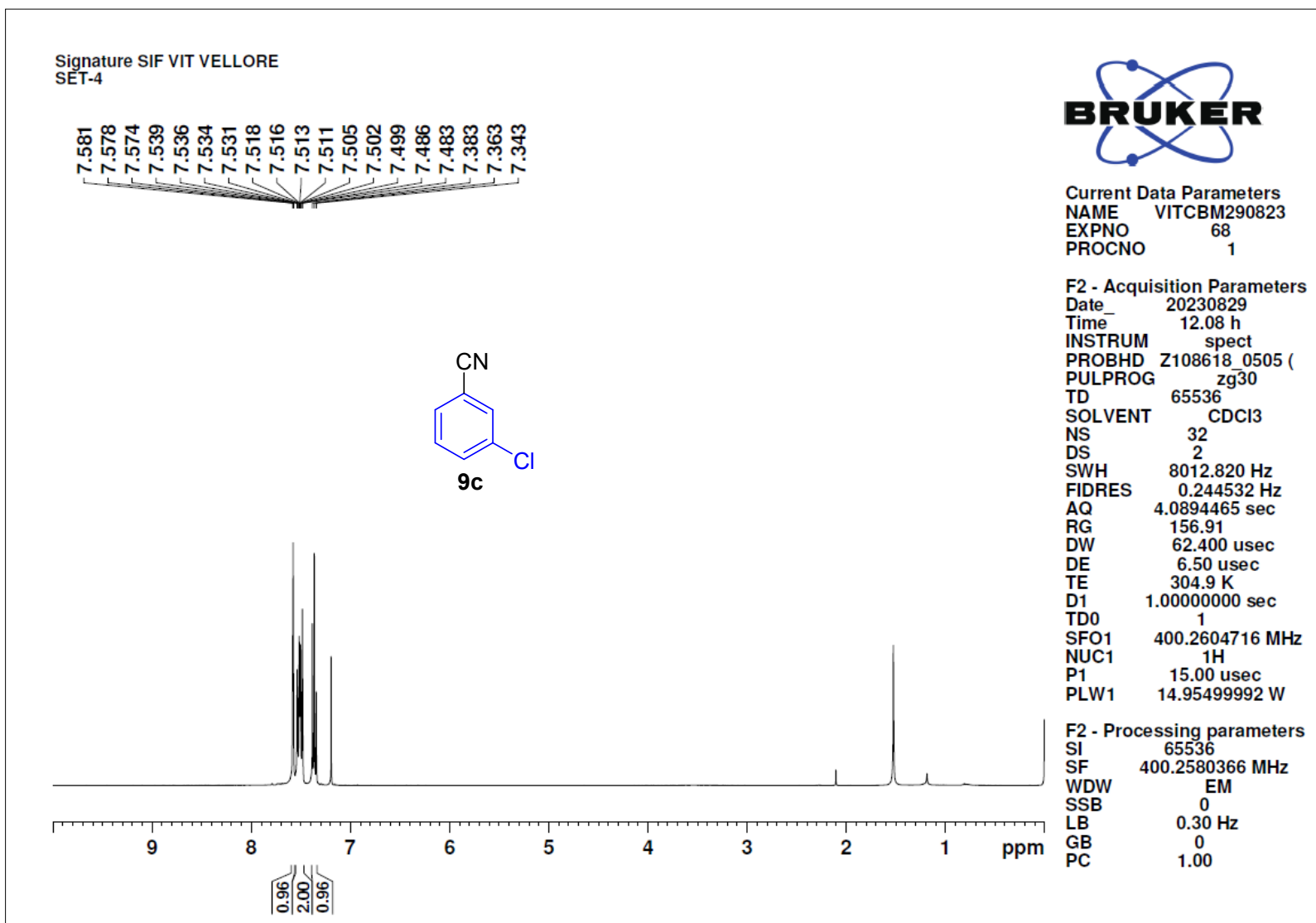
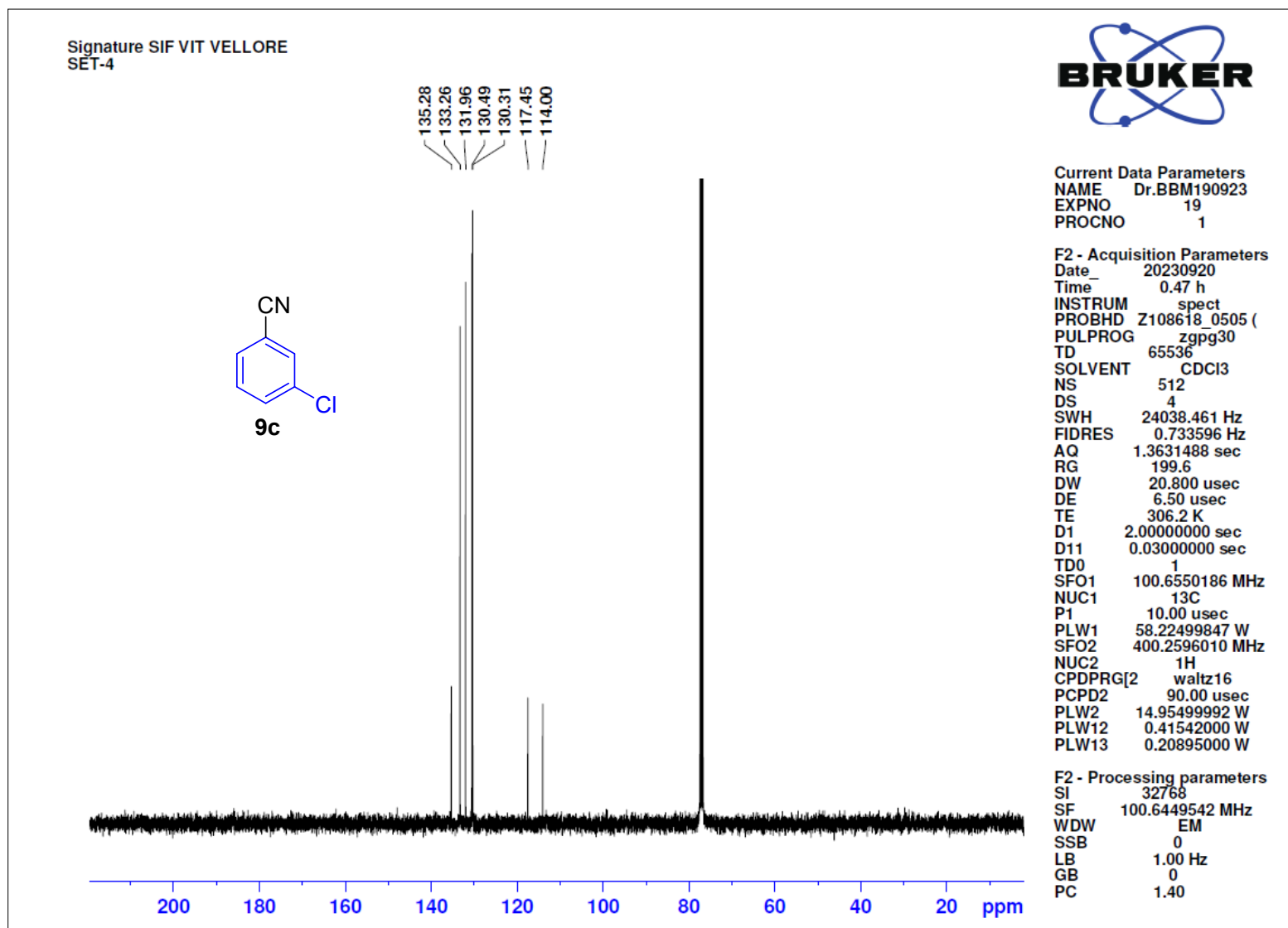


Figure 87:  $^1\text{H}$  NMR spectrum of the compound 9c.



**Figure 88:**  $^{13}\text{C}$  NMR spectrum of the compound **9c**.

Signature SIF VIT VELLORE  
SET-5



Current Data Parameters  
NAME VITCBM280823  
EXPNO 62  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20230828  
Time 11.23 h  
INSTRUM spect  
PROBHD Z108618\_0505 (  
PULPROG zg30  
TD 65536  
SOLVENT CDCl3  
NS 32  
DS 2  
SWH 8012.820 Hz  
FIDRES 0.244532 Hz  
AQ 4.0894465 sec  
RG 199.6  
DW 62.400 usec  
DE 6.50 usec  
TE 304.8 K  
D1 1.00000000 sec  
TD0 1  
SFO1 400.2604716 MHz  
NUC1 1H  
P1 15.00 usec  
PLW1 14.95499992 W

F2 - Processing parameters  
SI 65536  
SF 400.2580360 MHz  
WDW EM  
SSB 0  
LB 0.30 Hz  
GB 0  
PC 1.00

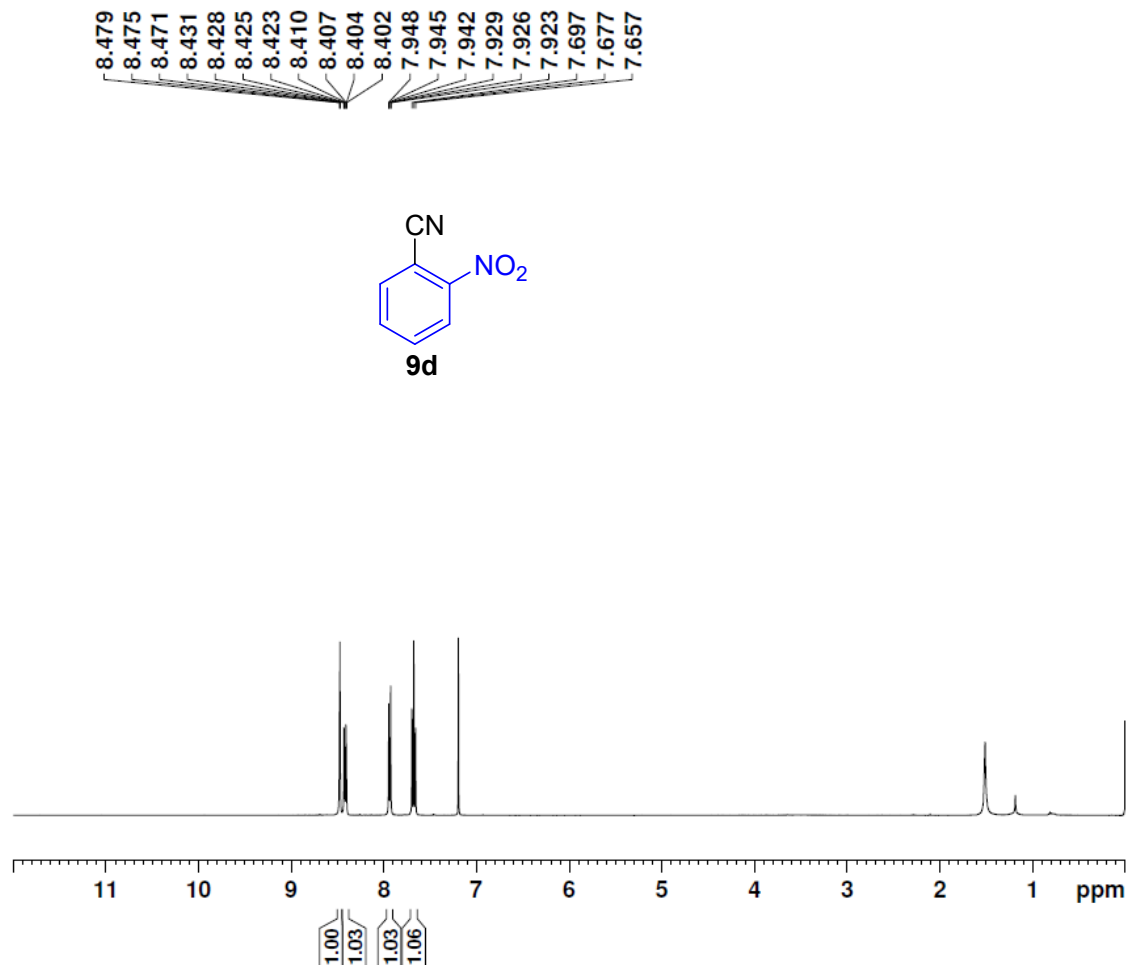
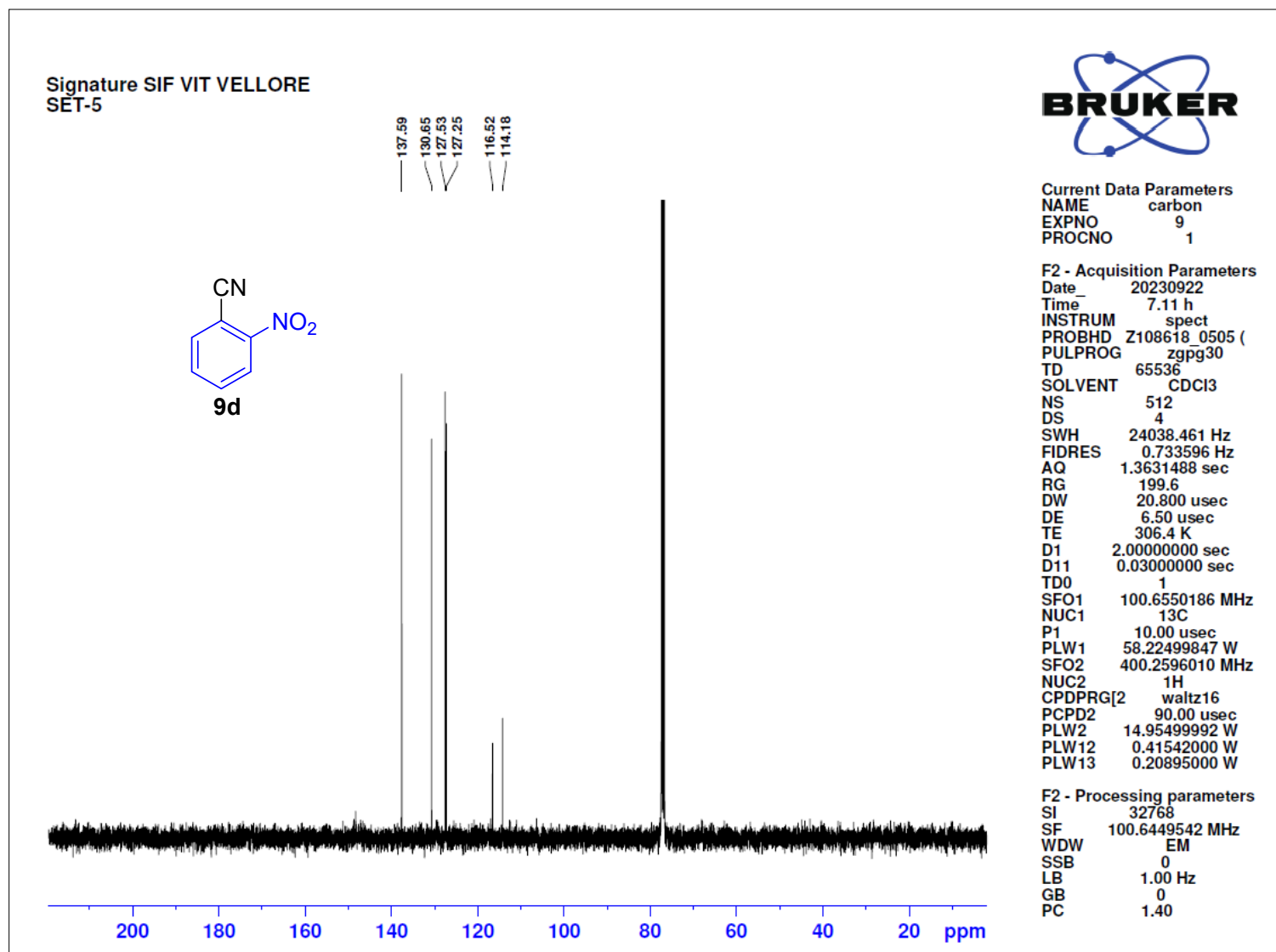
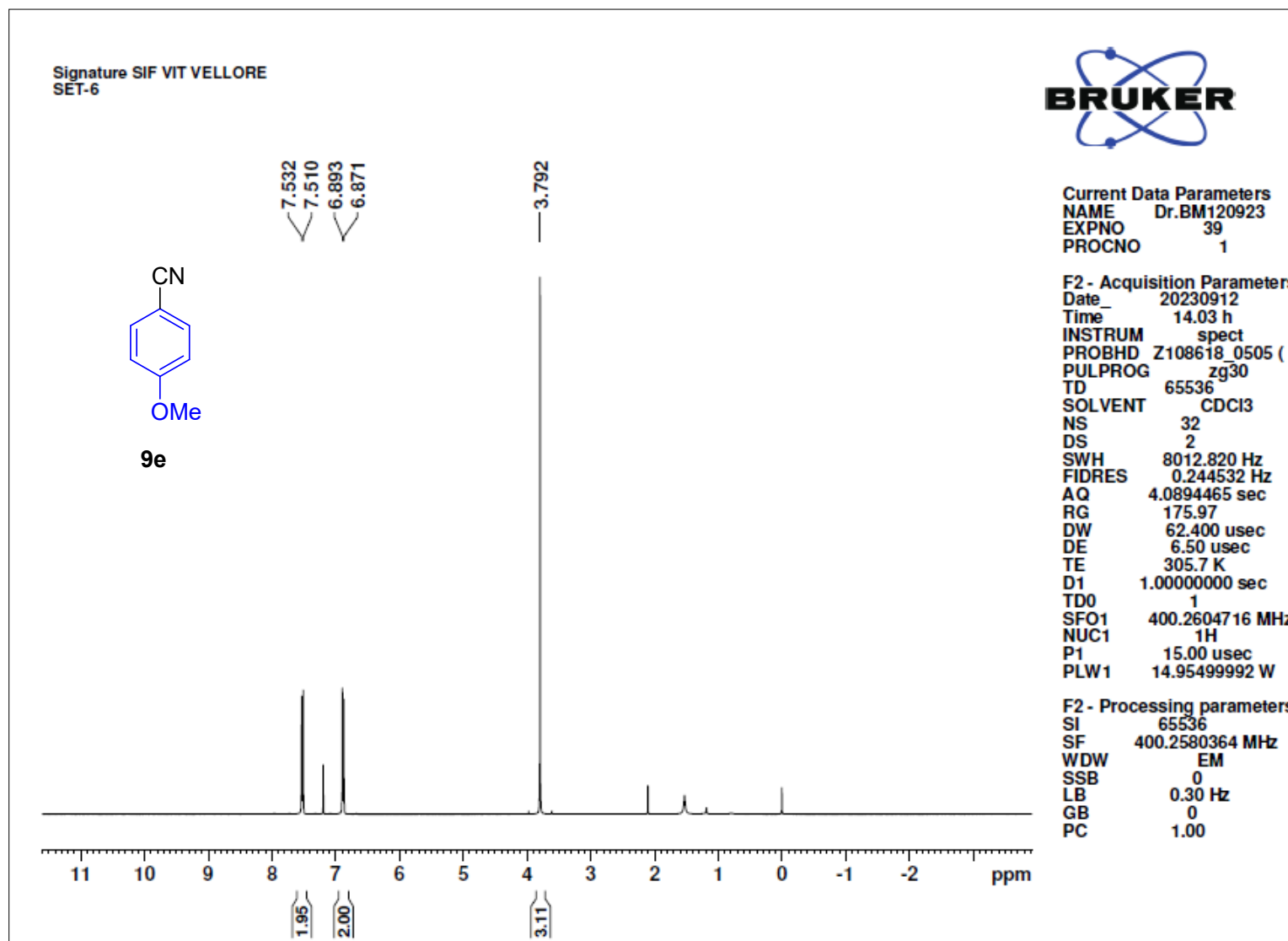


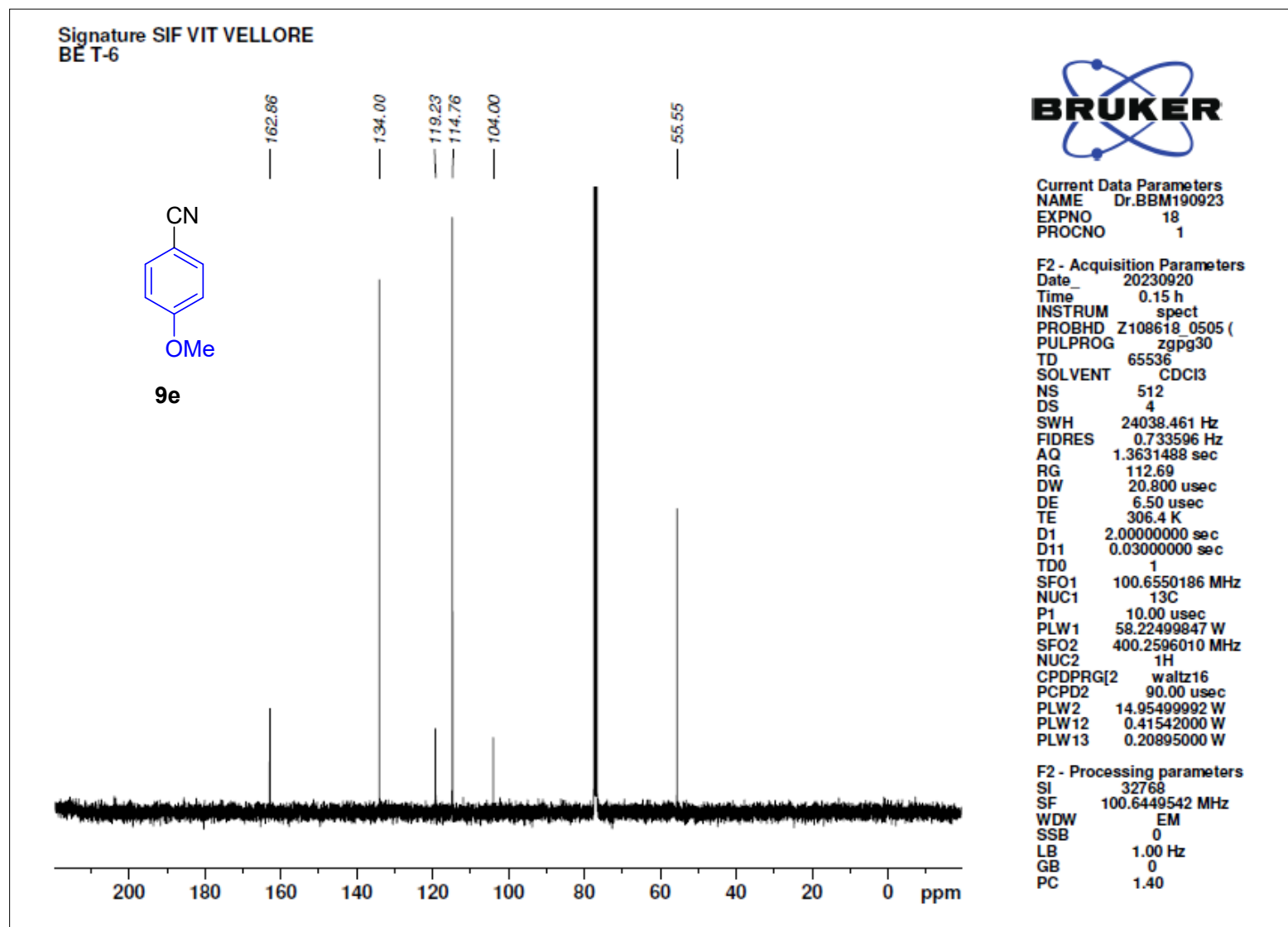
Figure 89:  $^1\text{H}$  NMR spectrum of the compound 9d.



**Figure 90:**  $^{13}\text{C}$  NMR spectrum of the compound **9d**.



**Figure 91:** <sup>1</sup>H NMR spectrum of the compound **9e**.



**Figure 92:**  $^{13}\text{C}$  NMR spectrum of the compound **9e**.

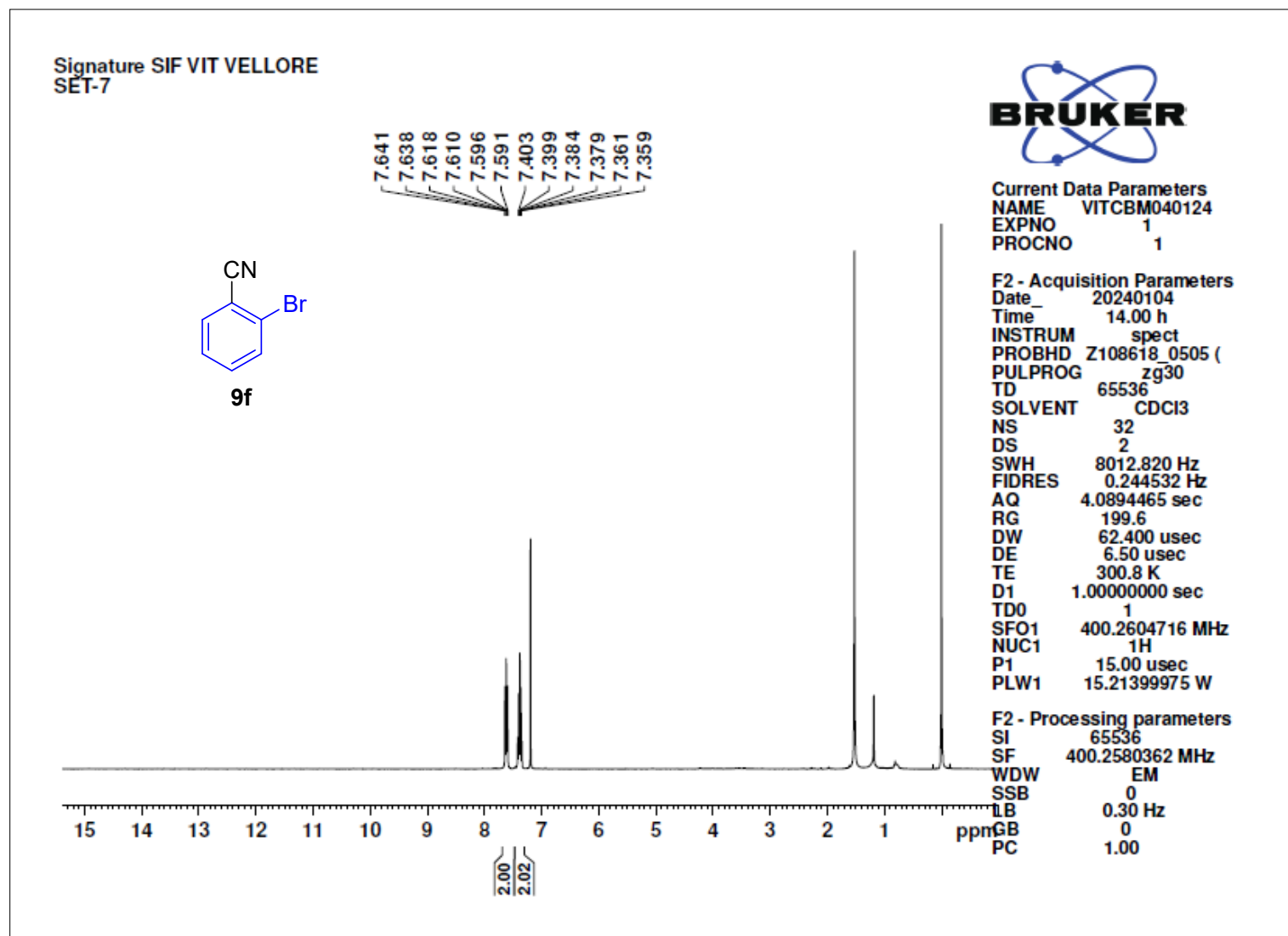


Figure 93:  $^1\text{H}$  NMR spectrum of the compound **9f**.

Signature SIF VIT VELLORE  
SET-7



Current Data Parameters  
NAME carbon  
EXPNO 19  
PROCNO 1

F2 - Acquisition Parameters  
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Time 0.47 h  
INSTRUM spect  
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PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 512  
DS 4  
SWH 24038.461 Hz  
FIDRES 0.733596 Hz  
AQ 1.3631488 sec  
RG 199.6  
DW 20.800 usec  
DE 6.50 usec  
TE 306.2 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 100.6550186 MHz  
NUC1 13C  
P1 10.00 usec  
PLW1 58.22499847 W  
SFO2 400.2596010 MHz  
NUC2 1H  
CPDPRG[2] waltz16  
PCPD2 90.00 usec  
PLW2 14.95499992 W  
PLW12 0.41542000 W  
PLW13 0.20895000 W

F2 - Processing parameters  
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GB 0  
PC 1.40

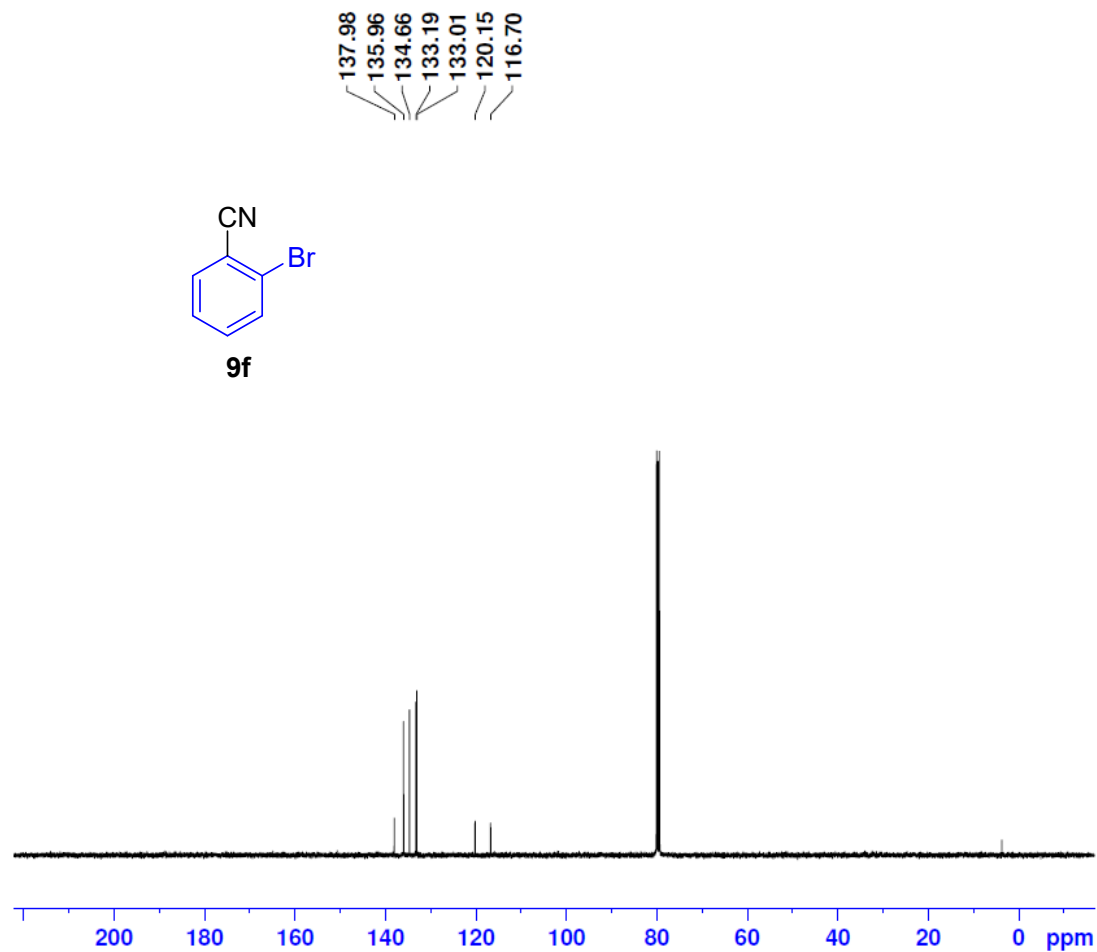
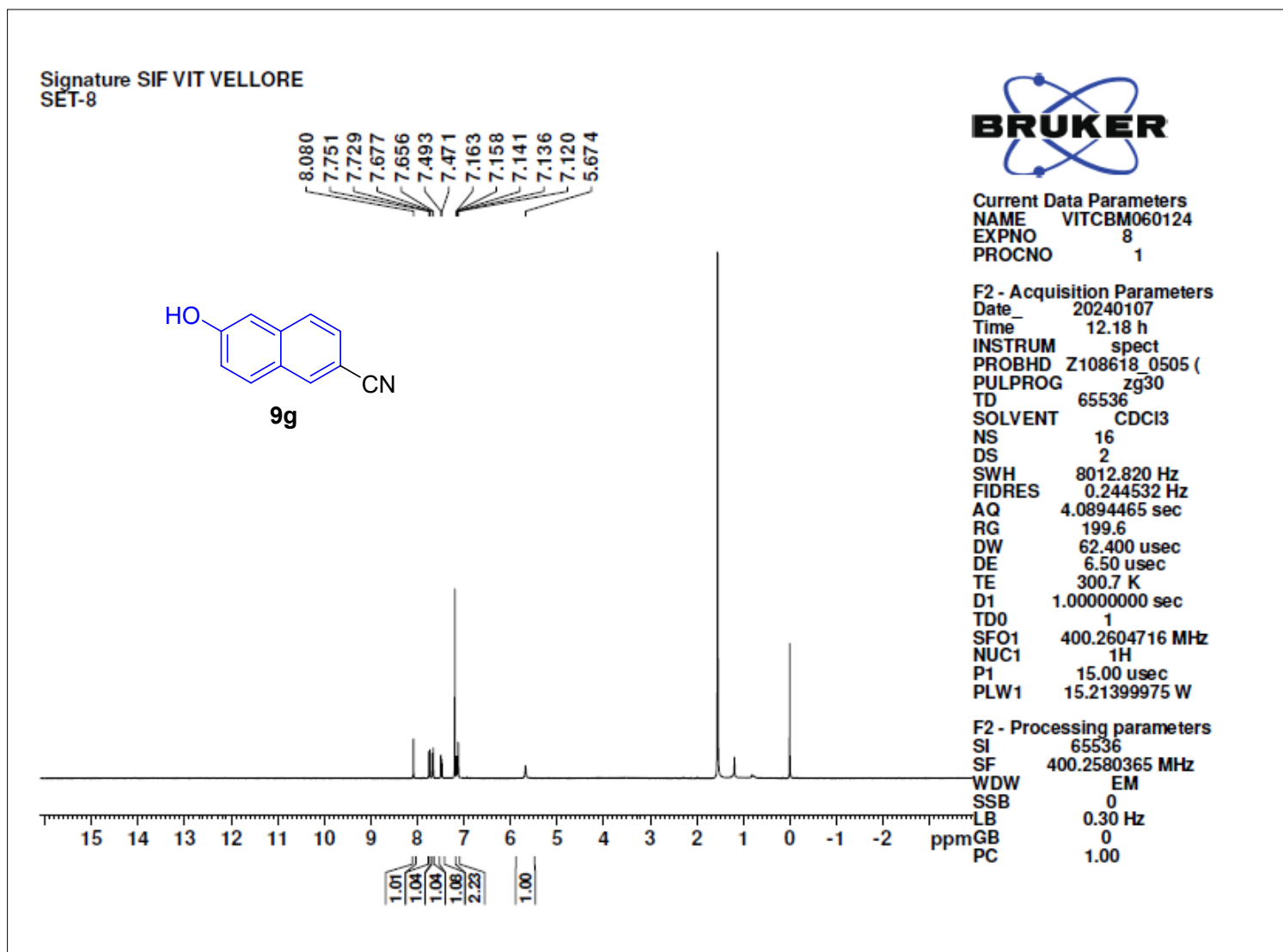
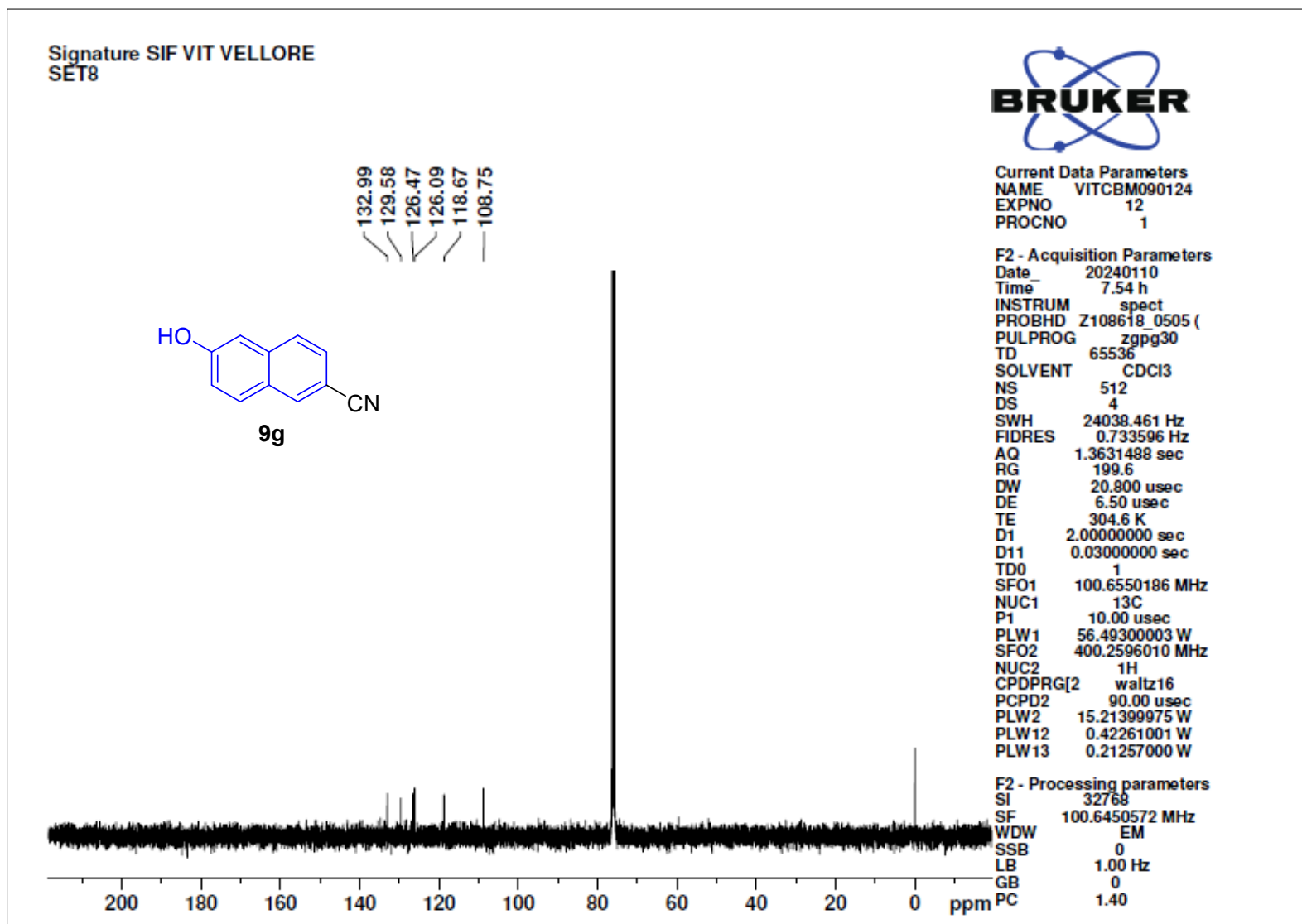


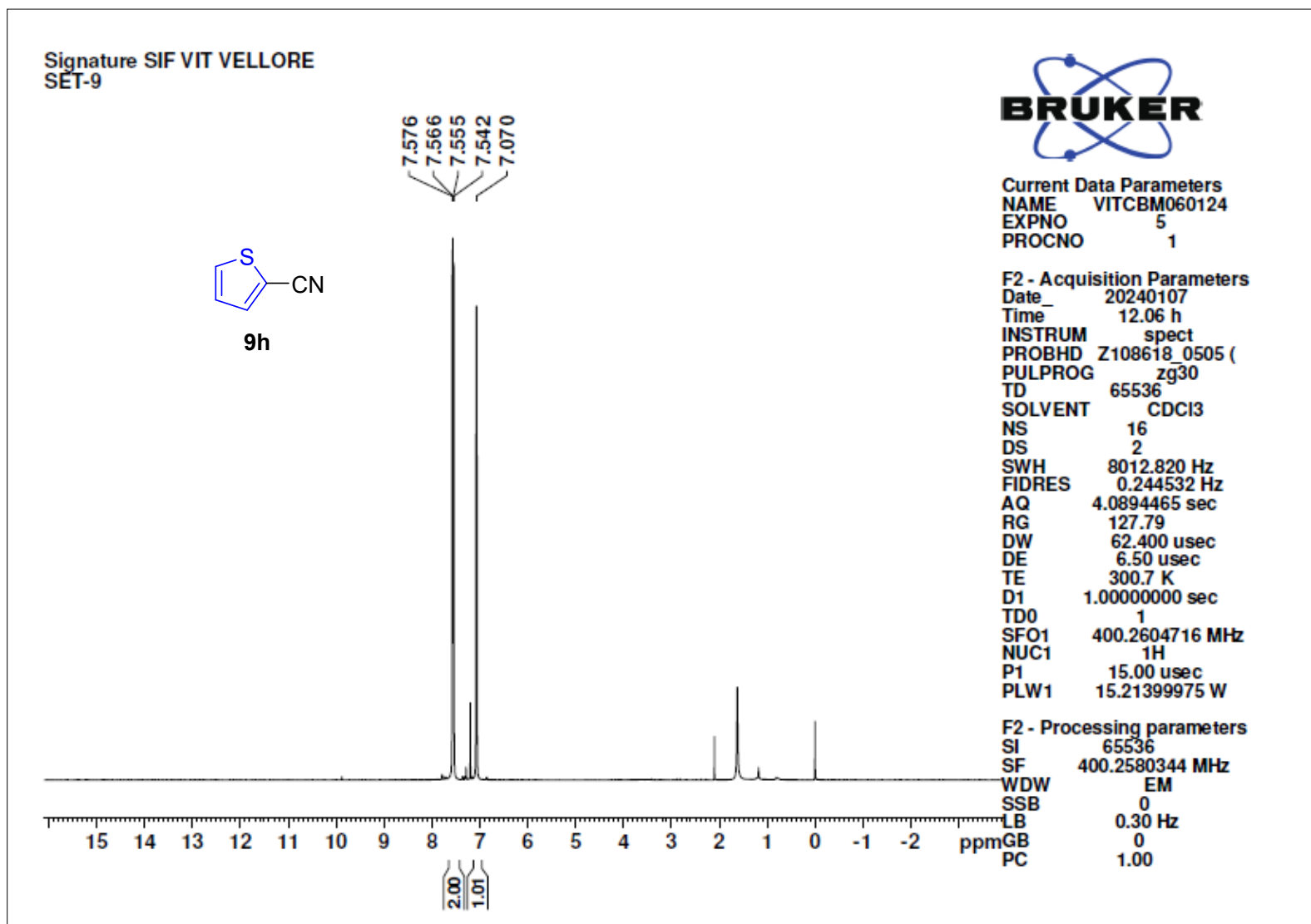
Figure 94:  $^{13}\text{C}$  NMR spectrum of the compound **9f**.



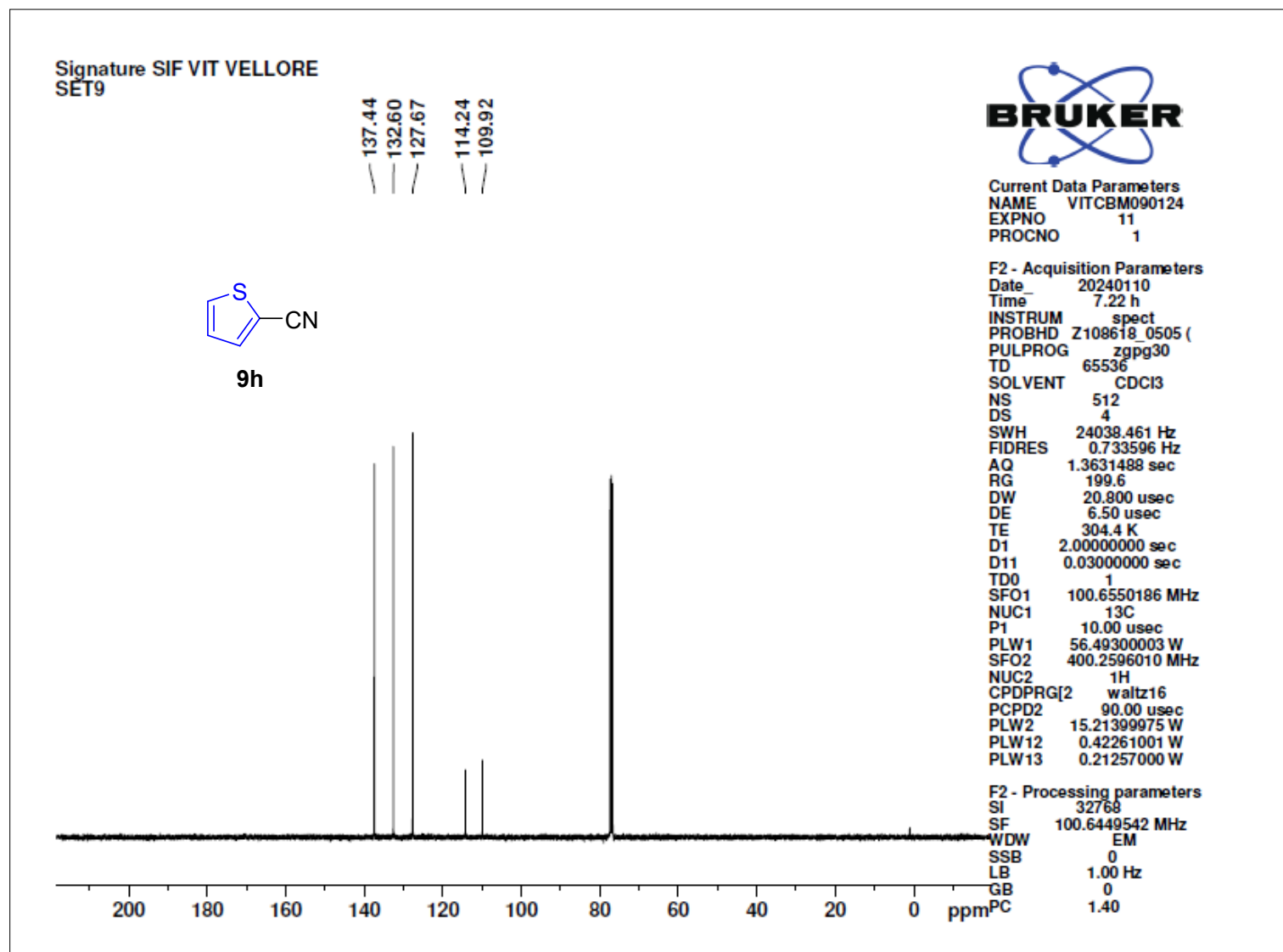
**Figure 95:**  $^1\text{H}$  NMR spectrum of the compound **9g**.



**Figure 96:**  $^{13}\text{C}$  NMR spectrum of the compound **9g**.



**Figure 97:**  $^1\text{H}$  NMR spectrum of the compound **9h**.



**Figure 98:**  $^{13}\text{C}$  NMR spectrum of the compound **9h**.

Signature SIF VIT VELLORE  
SET-10



Current Data Parameters  
NAME VITCBM060124  
EXPNO 6  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20240107  
Time 12.10 h  
INSTRUM spect  
PROBHD Z108618\_0505 (   
PULPROG zg30  
TD 65536  
SOLVENT CDCl3  
NS 16  
DS 2  
SWH 8012.820 Hz  
FIDRES 0.244532 Hz  
AQ 4.0894465 sec  
RG 156.91  
DW 62.400 usec  
DE 6.50 usec  
TE 300.7 K  
D1 1.00000000 sec  
TD0 1  
SFO1 400.2604716 MHz  
NUC1 1H  
P1 15.00 usec  
PLW1 15.21399975 W

F2 - Processing parameters  
SI 65536  
SF 400.2580366 MHz  
WDW EM  
SSB 0  
LB 0.30 Hz  
GB 0  
PC 1.00

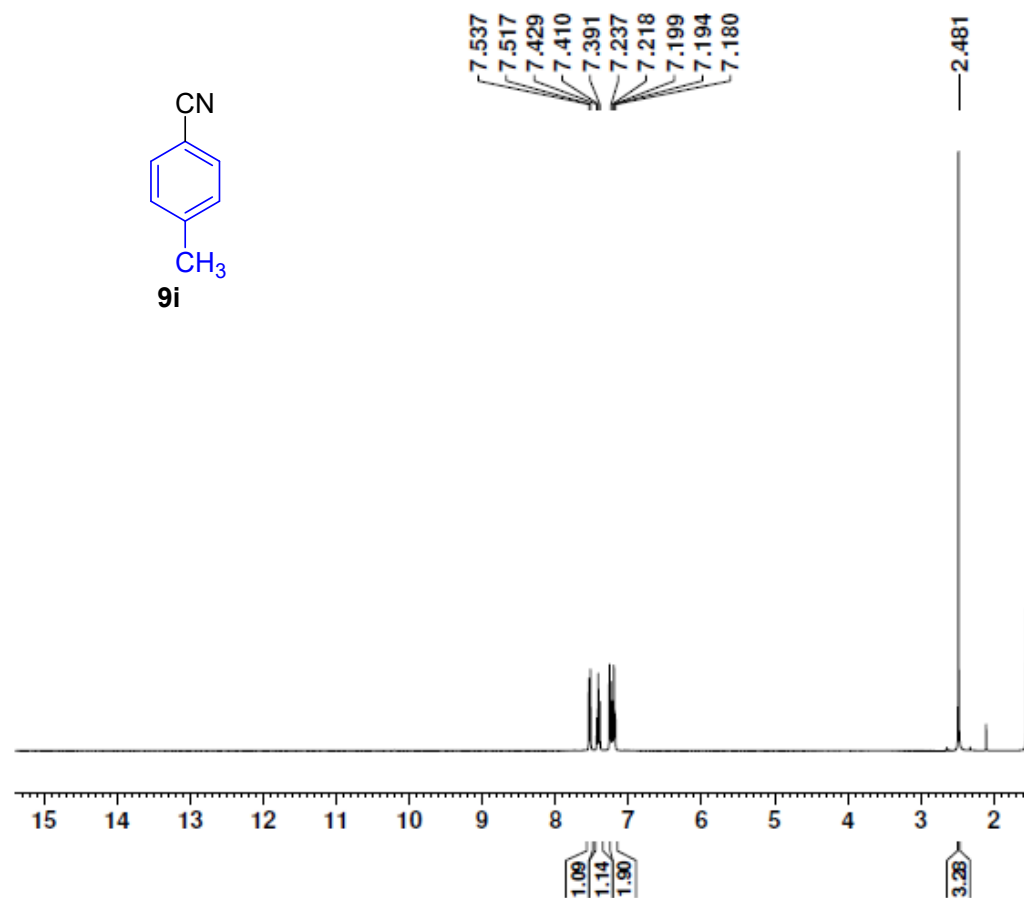
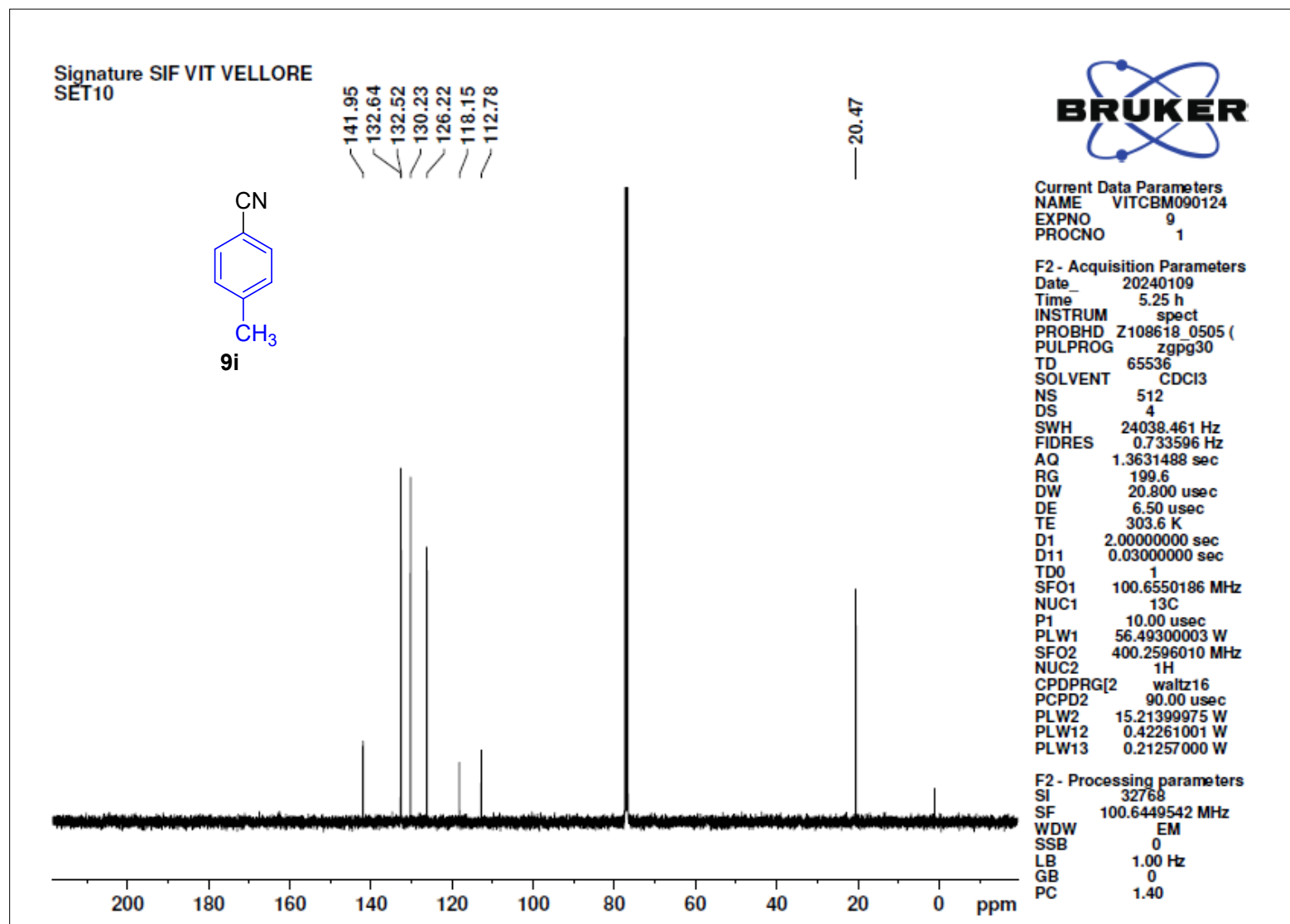


Figure 99:  $^1\text{H}$  NMR spectrum of the compound **9i**.



**Figure 100:**  $^{13}\text{C}$  NMR spectrum of the compound **9i**.

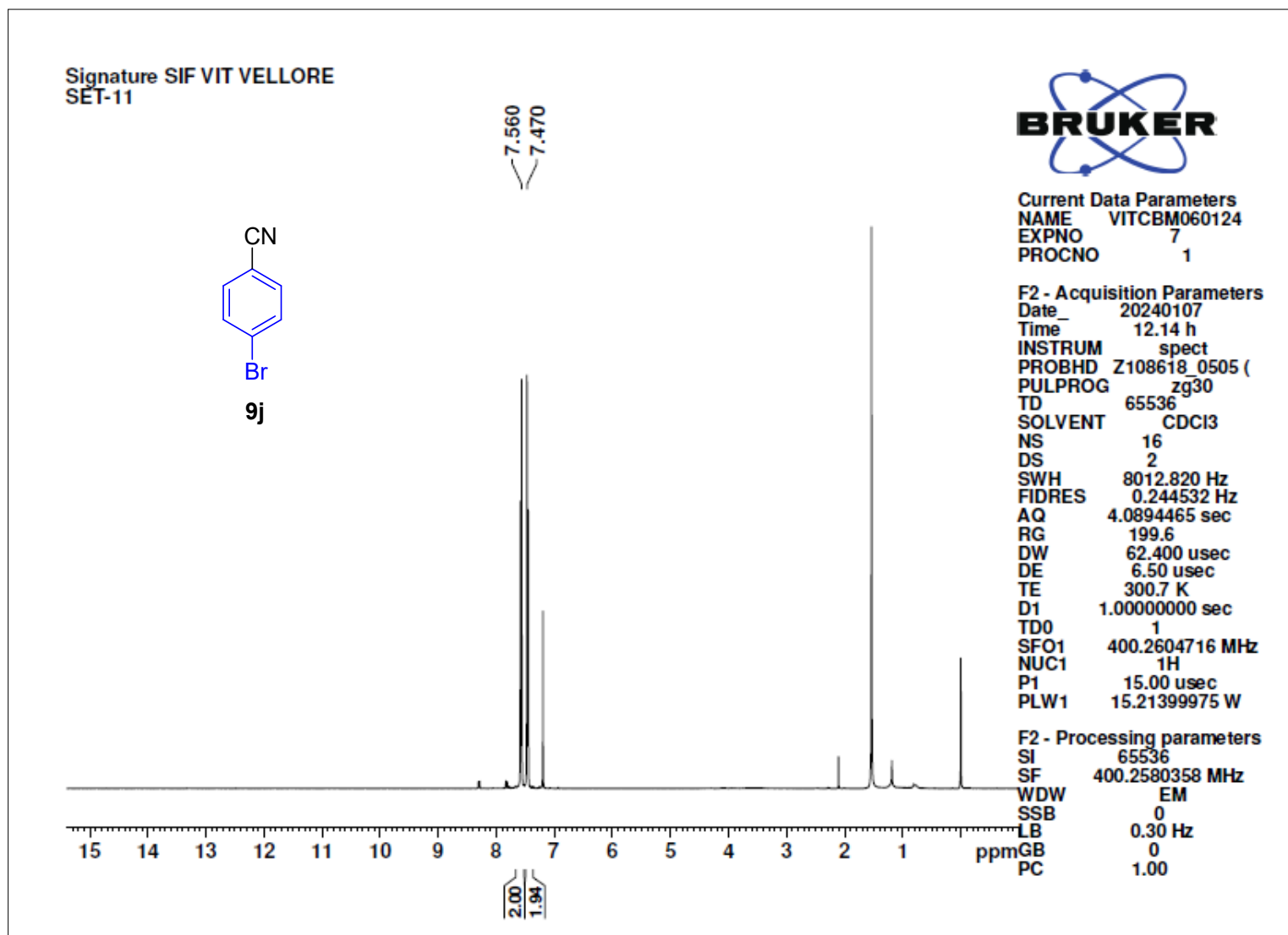


Figure 101:  $^1\text{H}$  NMR spectrum of the compound **9j**.

Signature SIF VIT VELLORE  
SET11



Current Data Parameters

NAME carbon  
EXPNO 10  
PROCNO 1

F2 - Acquisition Parameters

Date\_ 20240109  
Time 5.57 h  
INSTRUM spect  
PROBHD Z108618\_0505 (   
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 512  
DS 4  
SWH 24038.461 Hz  
FIDRES 0.733596 Hz  
AQ 1.3631488 sec  
RG 199.6  
DW 20.800 usec  
DE 6.50 usec  
TE 303.4 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 100.6550186 MHz  
NUC1 13C  
P1 10.00 usec  
PLW1 56.49300003 W  
SFO2 400.2596010 MHz  
NUC2 1H  
CPDPRG2 waltz16  
PCPD2 90.00 usec  
PLW2 15.21399975 W  
PLW12 0.42261001 W  
PLW13 0.21257000 W

F2 - Processing parameters

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SF 100.6449542 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

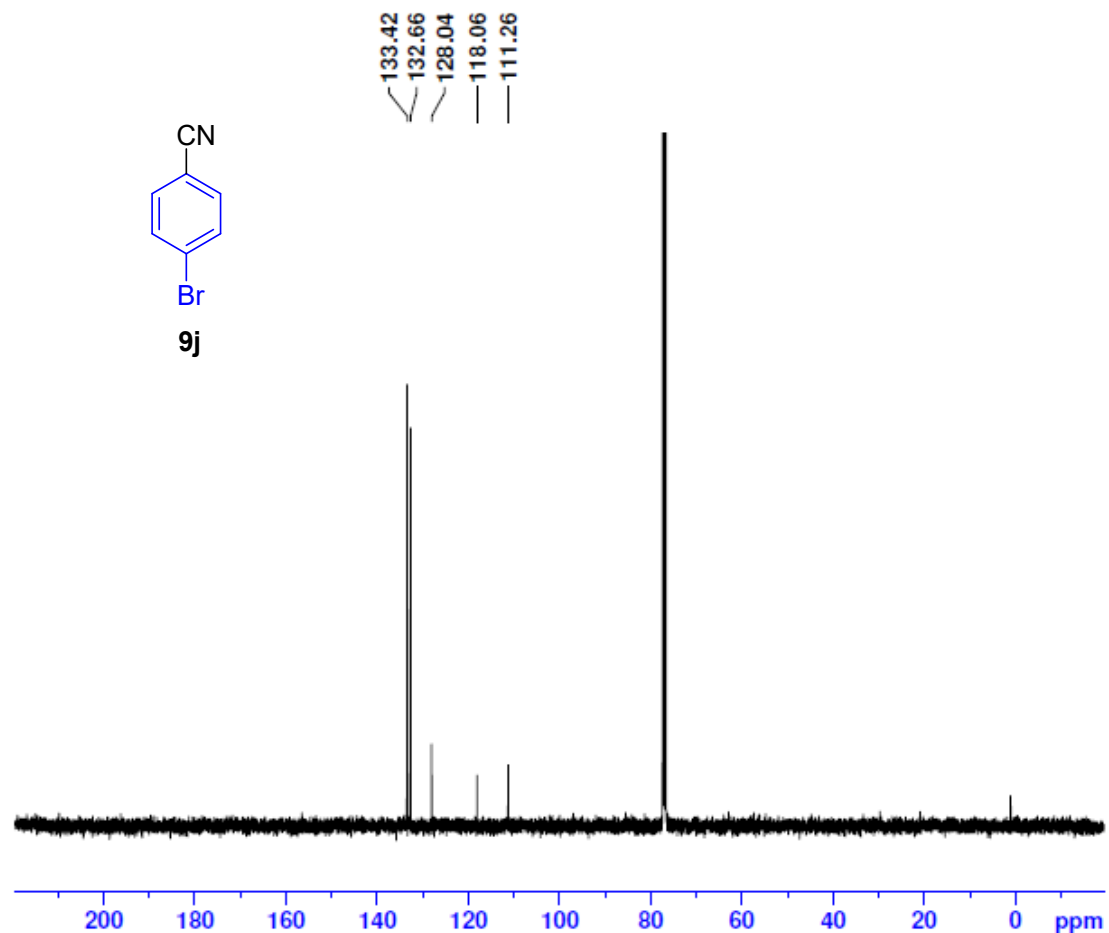
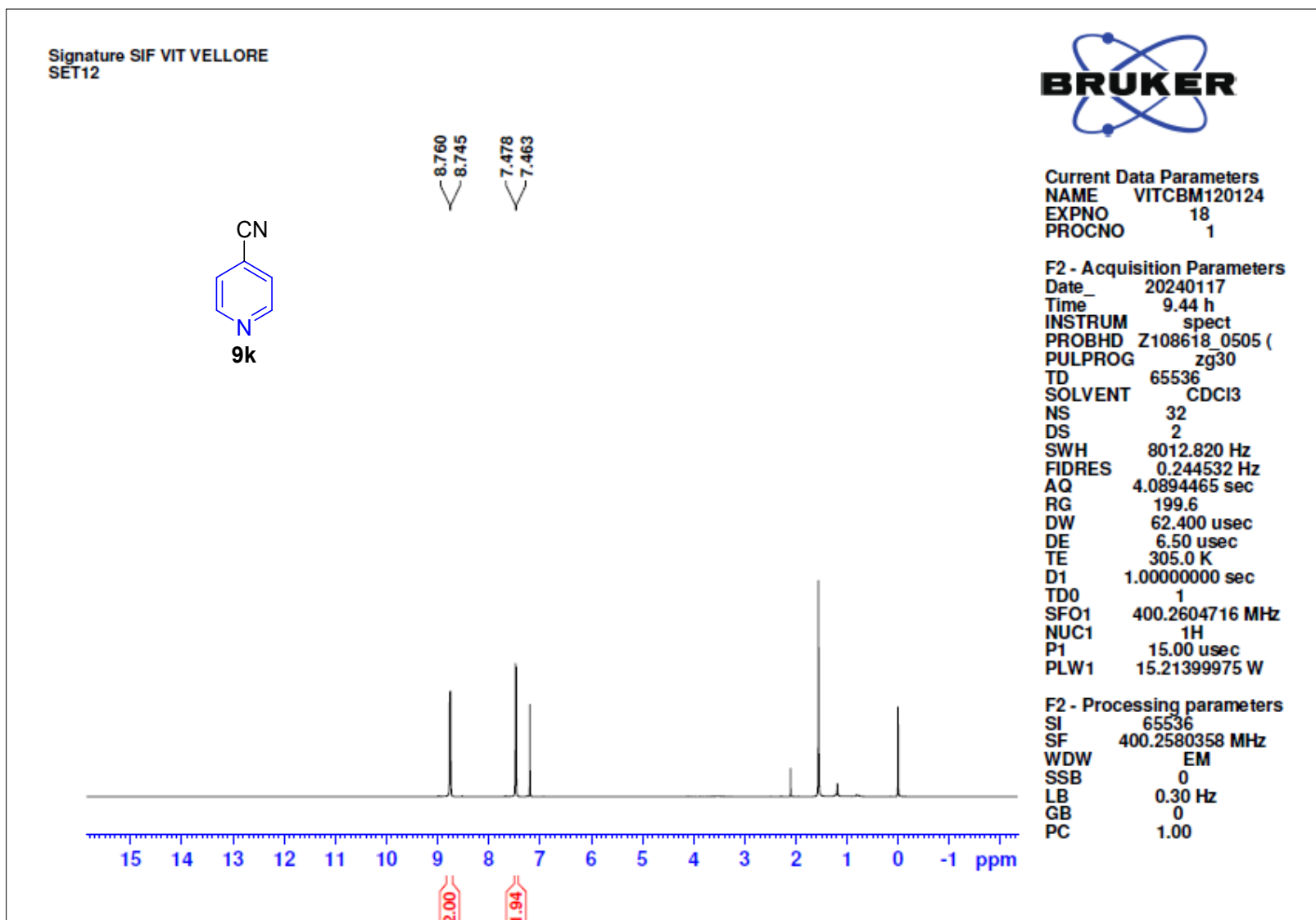
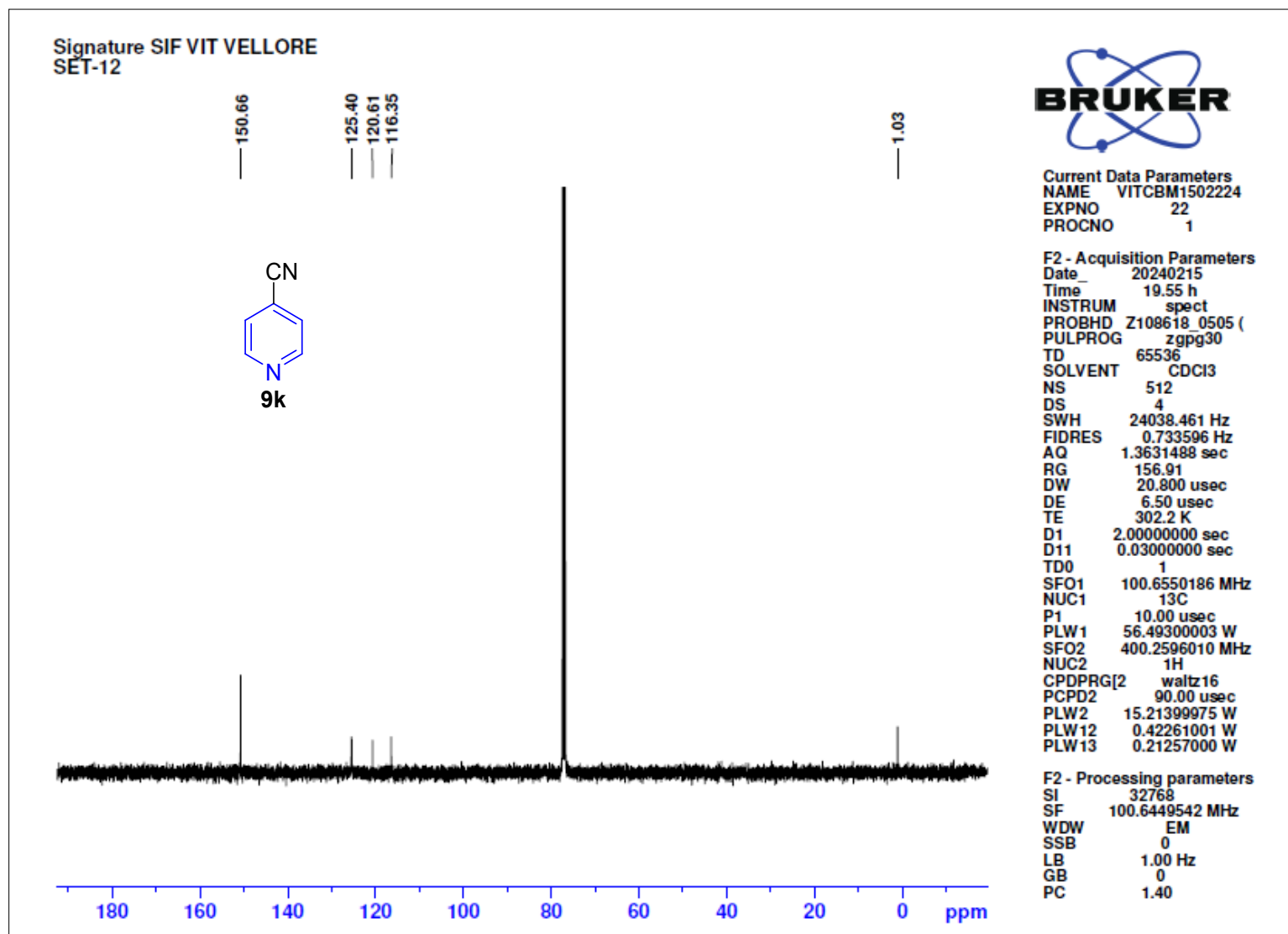


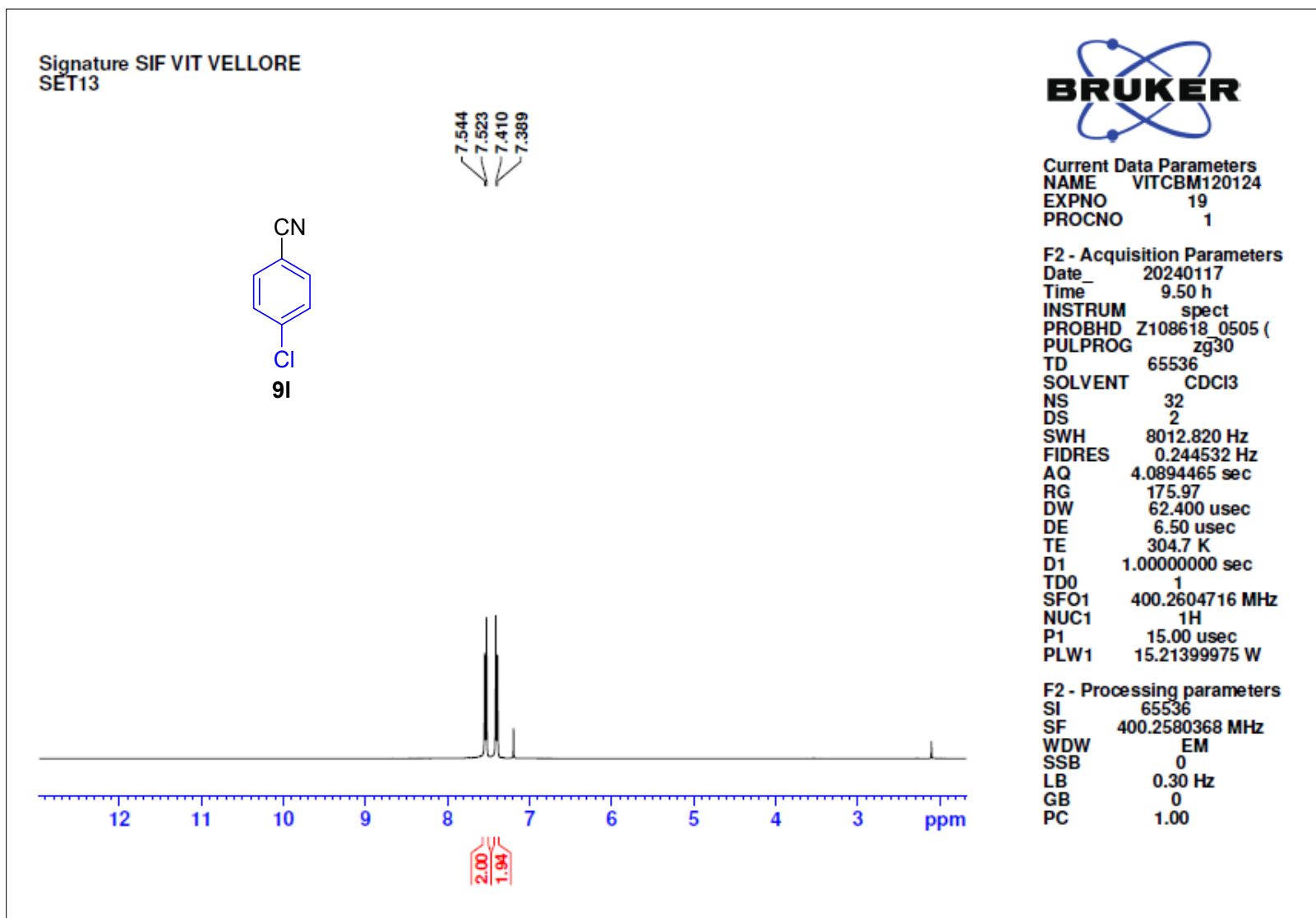
Figure 102:  $^{13}\text{C}$  NMR spectrum of the compound 9j.



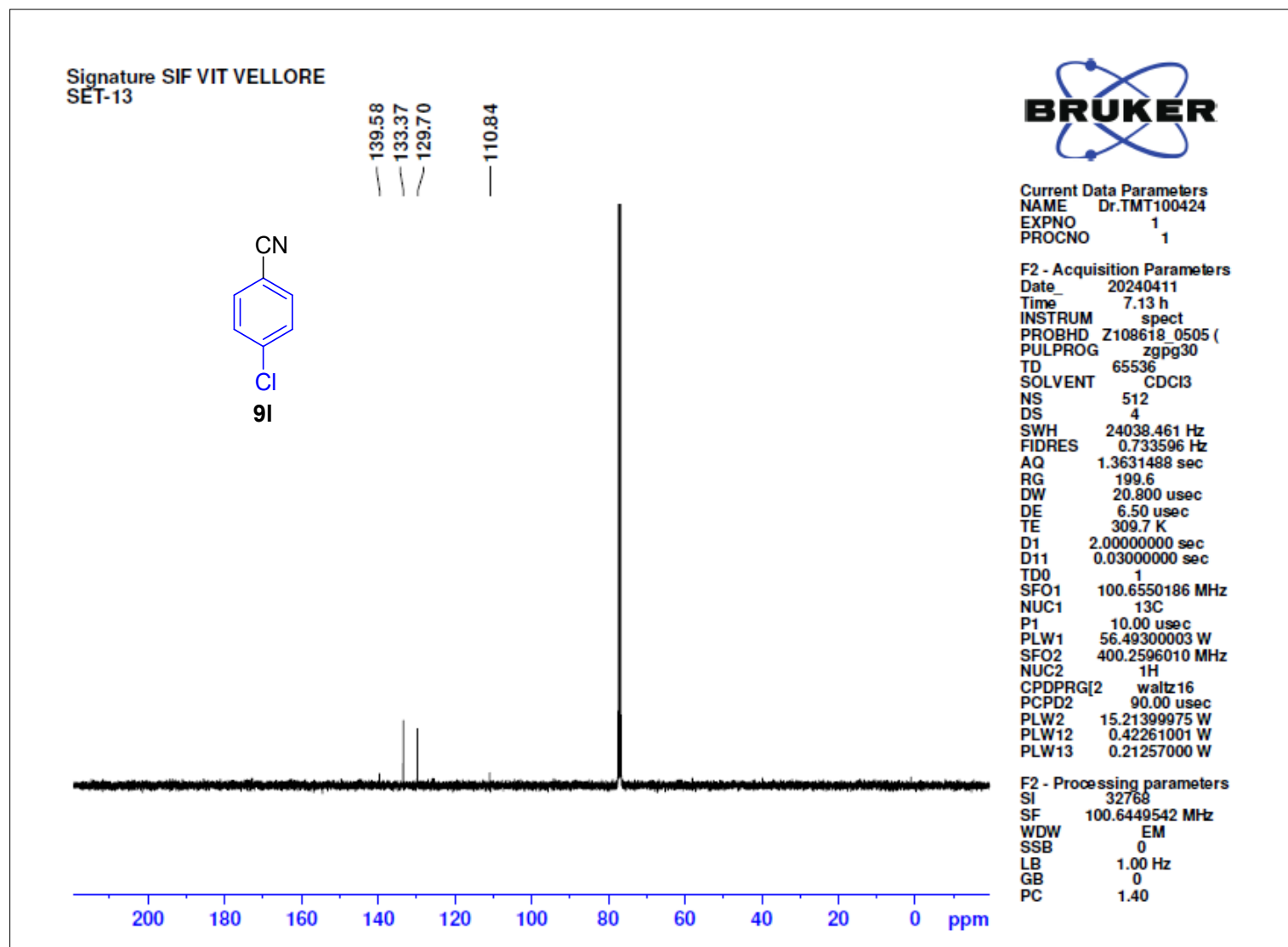
**Figure 103:**  $^1\text{H}$  NMR spectrum of the compound **9k**.



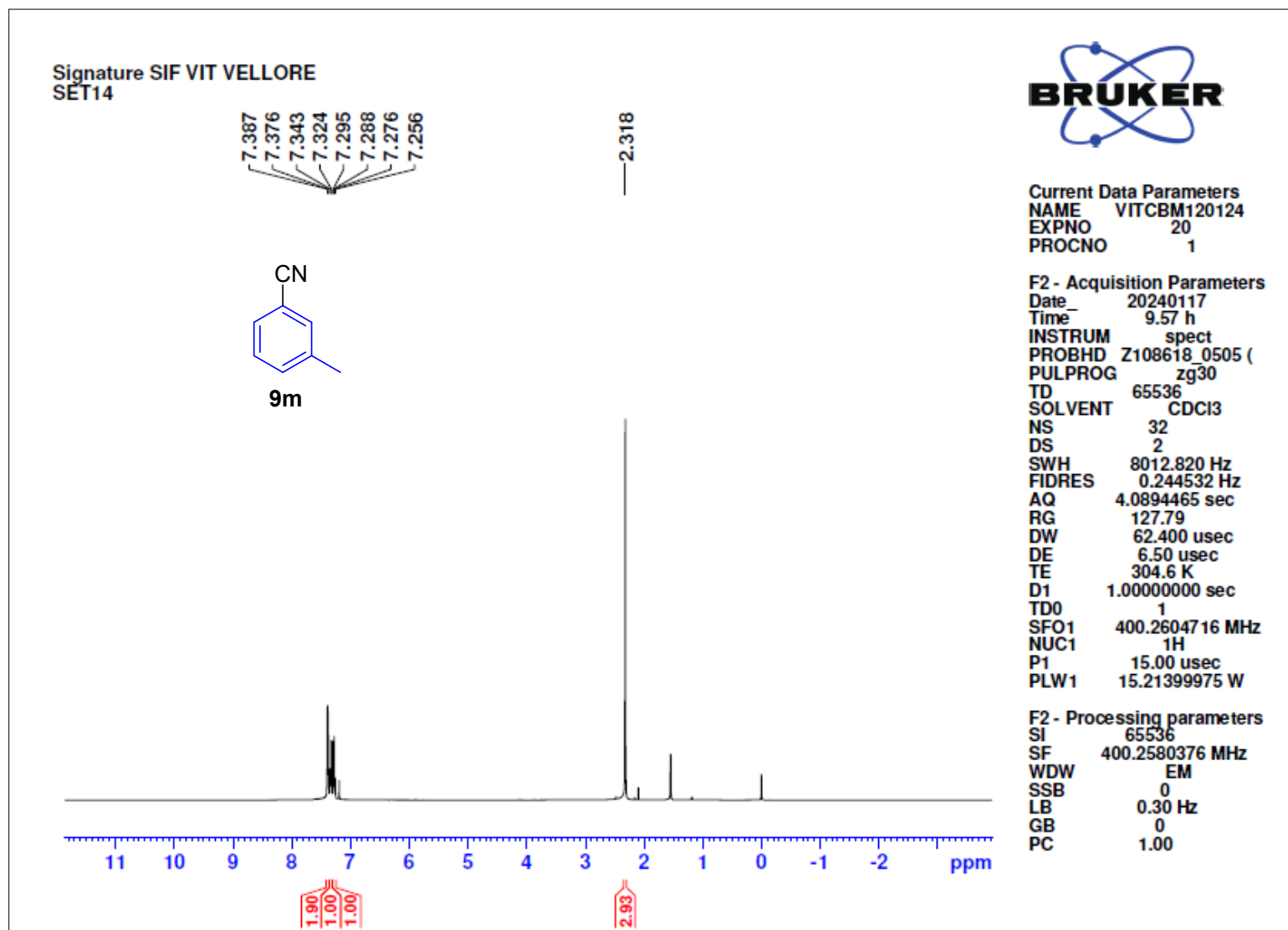
**Figure 104:**  $^{13}\text{C}$  NMR spectrum of the compound **9k**.



**Figure 105:**  $^1\text{H}$  NMR spectrum of the compound **9l**.



**Figure 106:**  $^{13}\text{C}$  NMR spectrum of the compound **9I**.



**Figure 107:**  $^1\text{H}$  NMR spectrum of the compound **9m**.

Signature SIF VIT VELLORE  
SET14



Current Data Parameters  
NAME Dr.AKT170424  
EXPNO 34  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20240418  
Time 3.28 h  
INSTRUM spect  
PROBHD Z108618\_0505 (  
PULPROG zgpg30  
TD 65536  
SOLVENT CDCl3  
NS 512  
DS 4  
SWH 24038.461 Hz  
FIDRES 0.733596 Hz  
AQ 1.3631488 sec  
RG 199.6  
DW 20.800 usec  
DE 6.50 usec  
TE 310.0 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 100.6550186 MHz  
NUC1 13C  
P1 10.00 usec  
PLW1 56.49300003 W  
SFO2 400.2596010 MHz  
NUC2 1H  
CPDPRG[2] waltz16  
PCPD2 90.00 usec  
PLW2 15.21399975 W  
PLW12 0.42261001 W  
PLW13 0.21257000 W

F2 - Processing parameters  
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WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

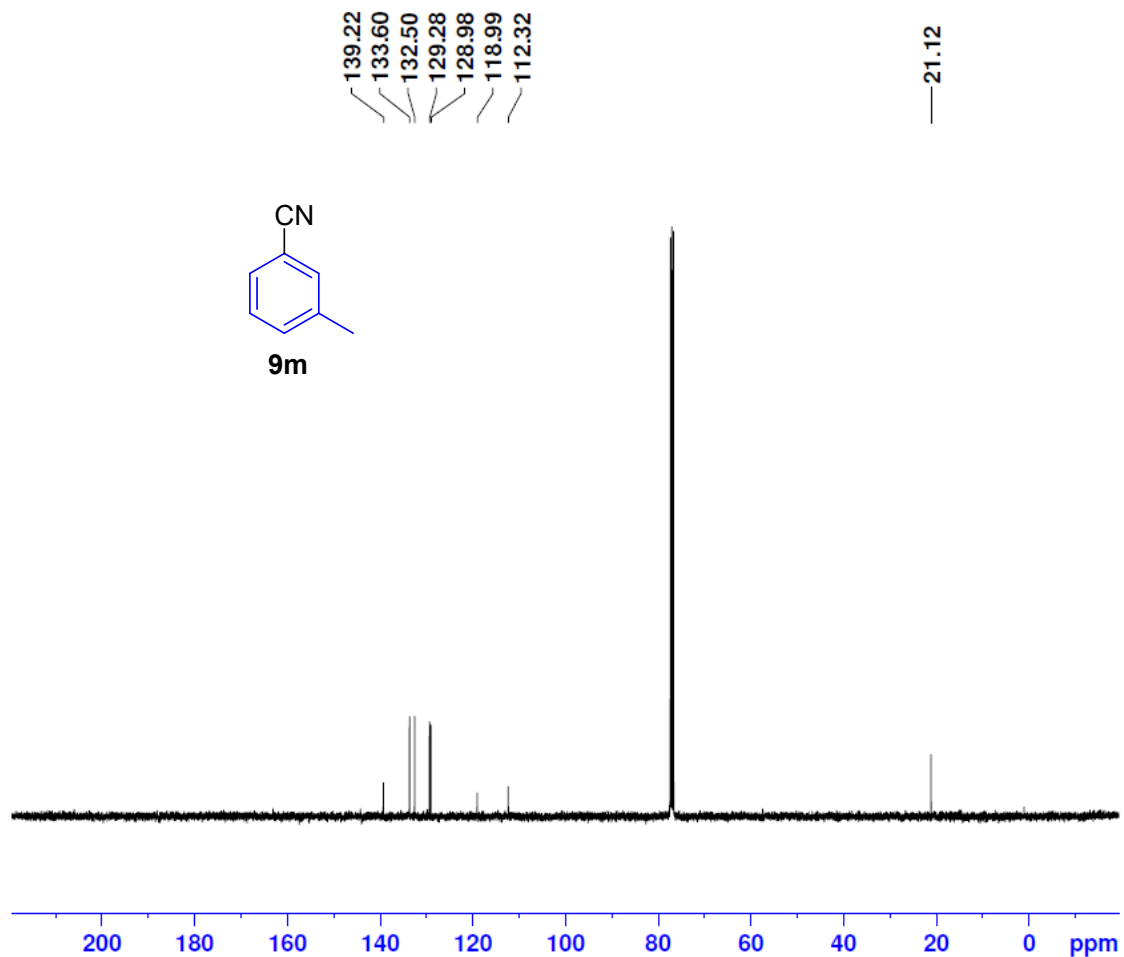


Figure 108:  $^{13}\text{C}$  NMR spectrum of the compound **9m**.

Signature SIF VIT VELLORE  
SET-15



Current Data Parameters  
NAME VITCBM040424  
EXPNO 16  
PROCNO 1

F2 - Acquisition Parameters  
Date\_ 20240404  
Time 16.07 h  
INSTRUM spect  
PROBHD Z108618\_0505 (  
PULPROG zg30  
TD 65536  
SOLVENT CDCl3  
NS 32  
DS 2  
SWH 8012.820 Hz  
FIDRES 0.244532 Hz  
AQ 4.0894465 sec  
RG 199.6  
DW 62.400 usec  
DE 6.50 usec  
TE 304.4 K  
D1 1.00000000 sec  
TD0 1  
SFO1 400.2604716 MHz  
NUC1 1H  
P1 15.00 usec  
PLW1 15.21399975 W

F2 - Processing parameters  
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GB 0  
PC 1.00

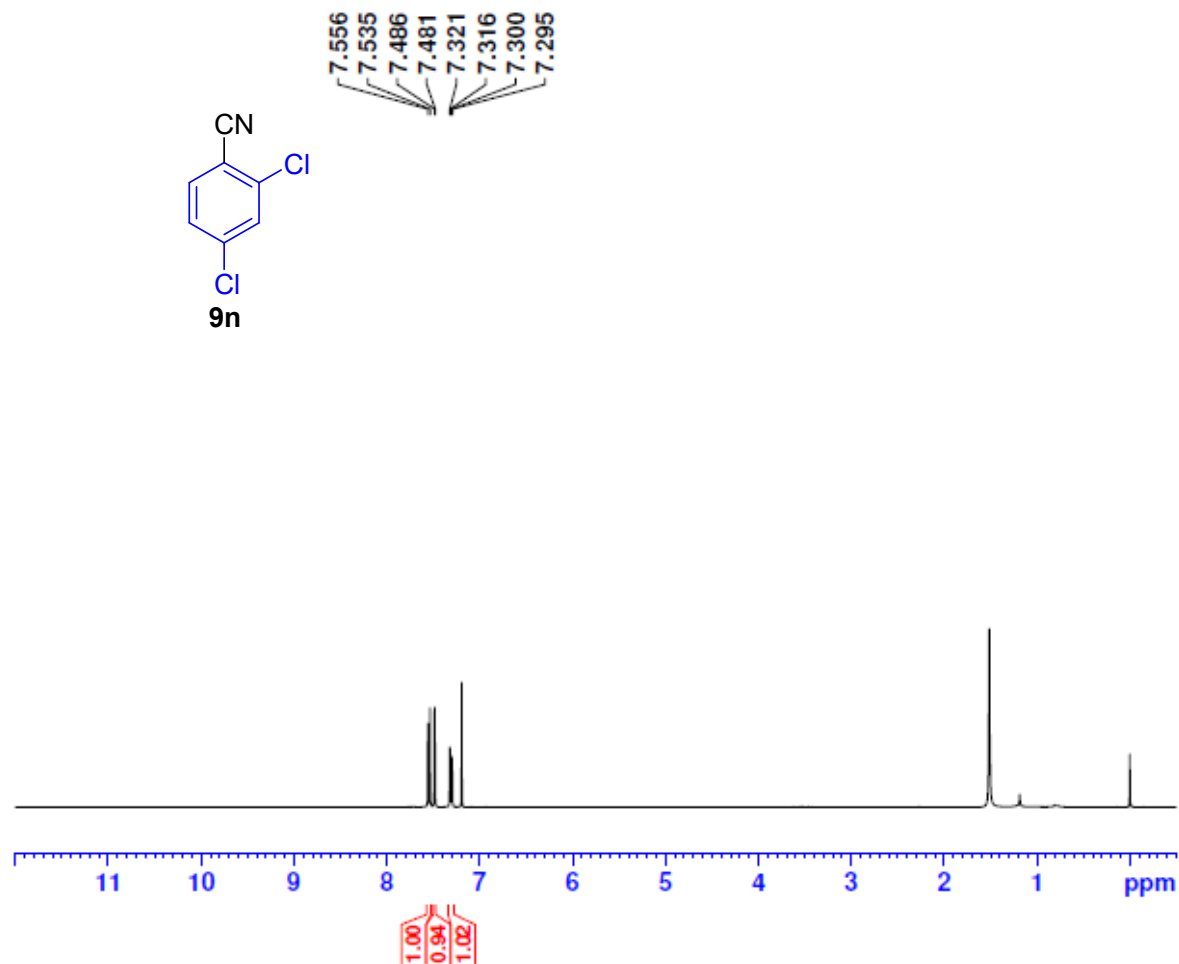


Figure 109: <sup>1</sup>H NMR spectrum of the compound **9n**.

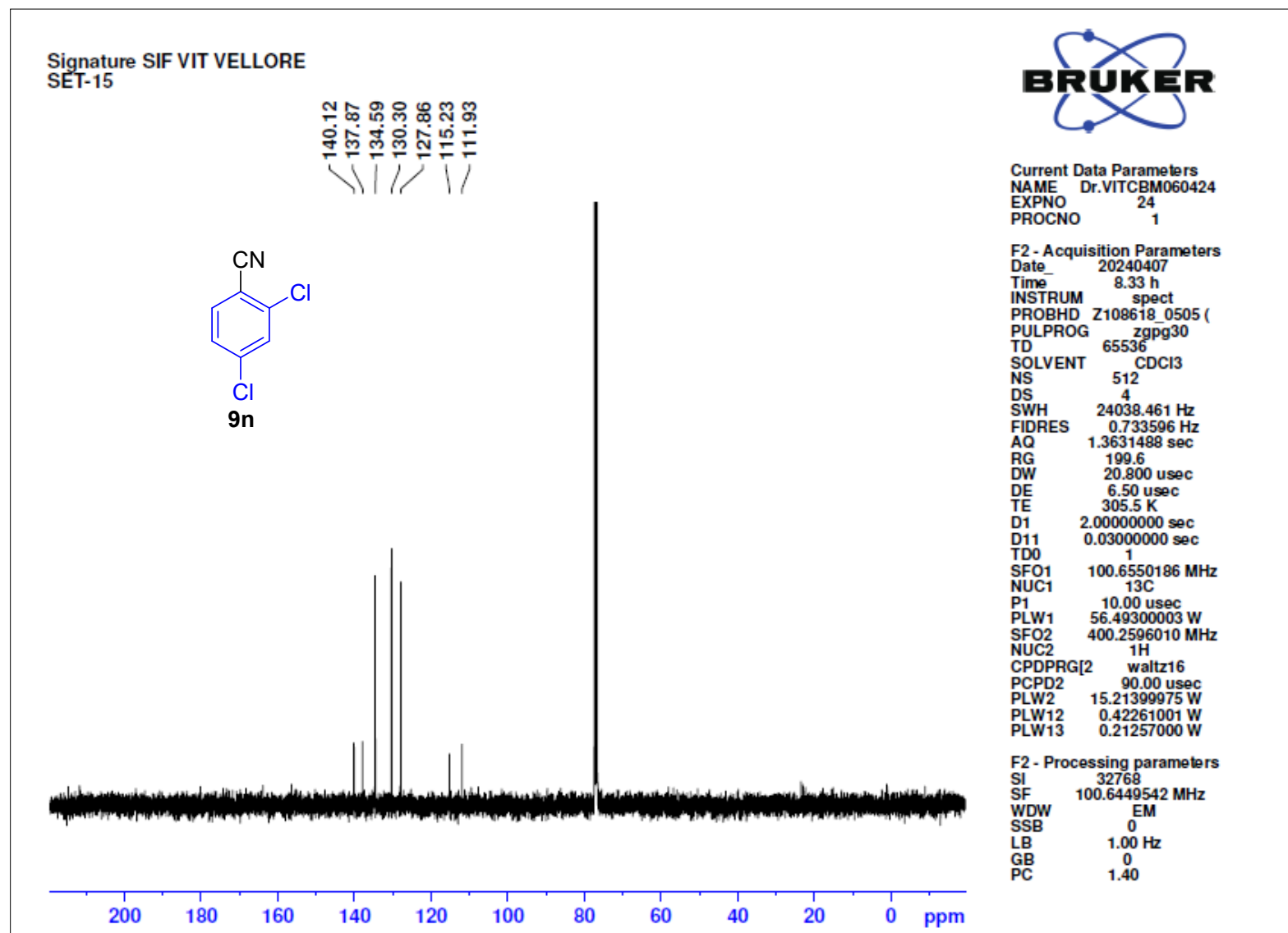
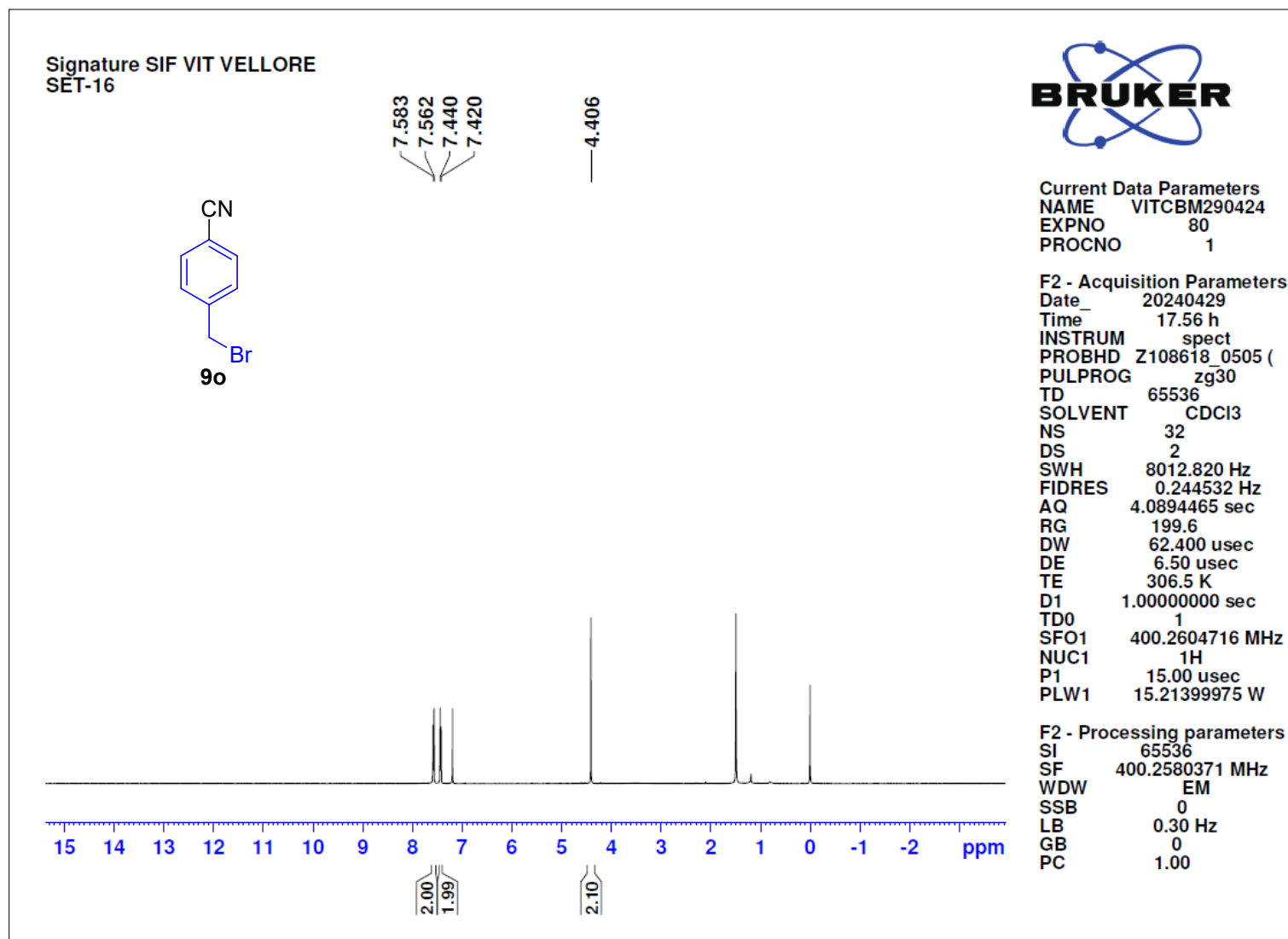
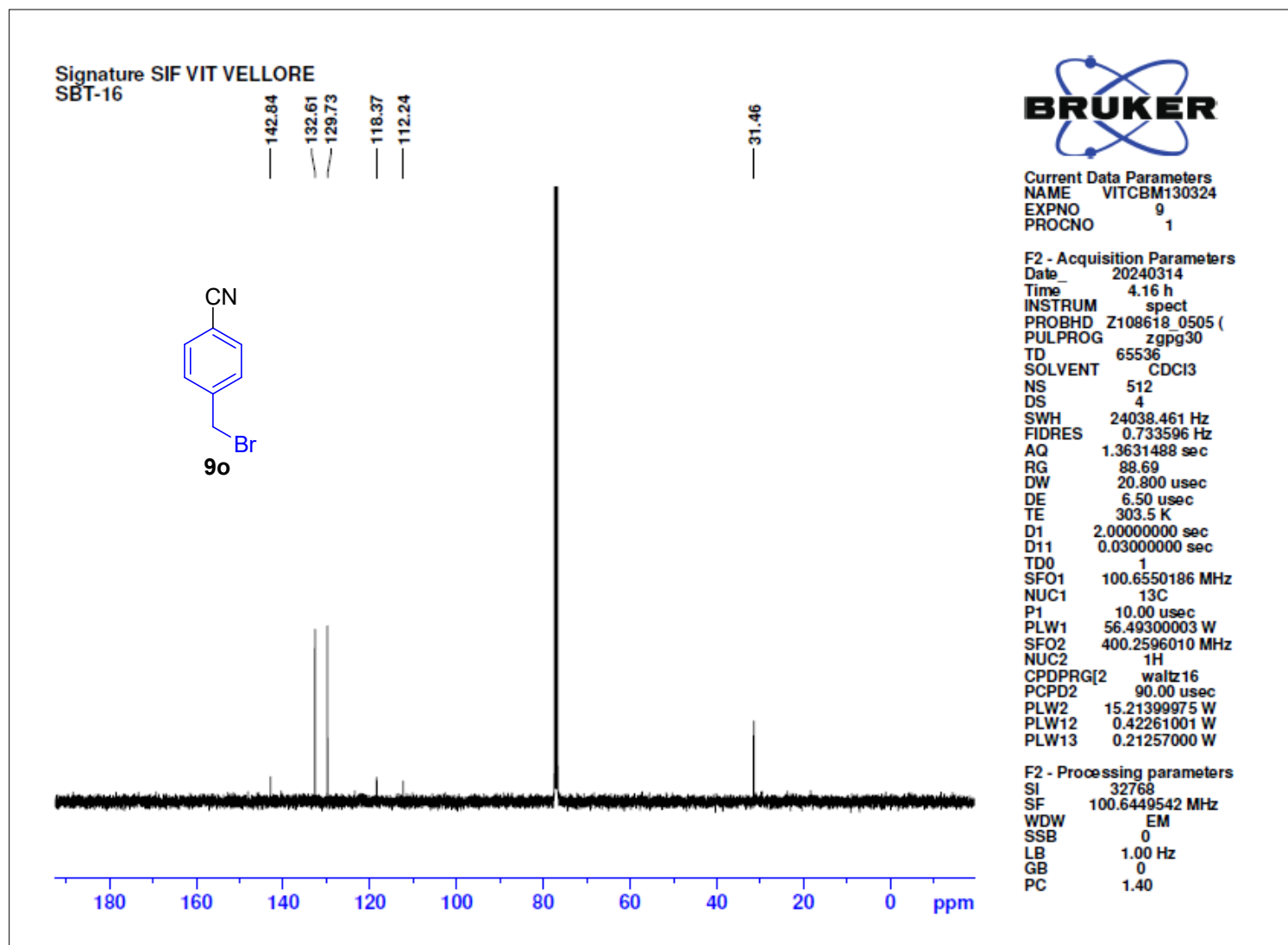


Figure 110:  $^{13}\text{C}$  NMR spectrum of the compound **9n**.



**Figure 111:**  $^1\text{H}$  NMR spectrum of the compound **9o**.



**Figure 112:**  $^{13}\text{C}$  NMR spectrum of the compound **9o**.

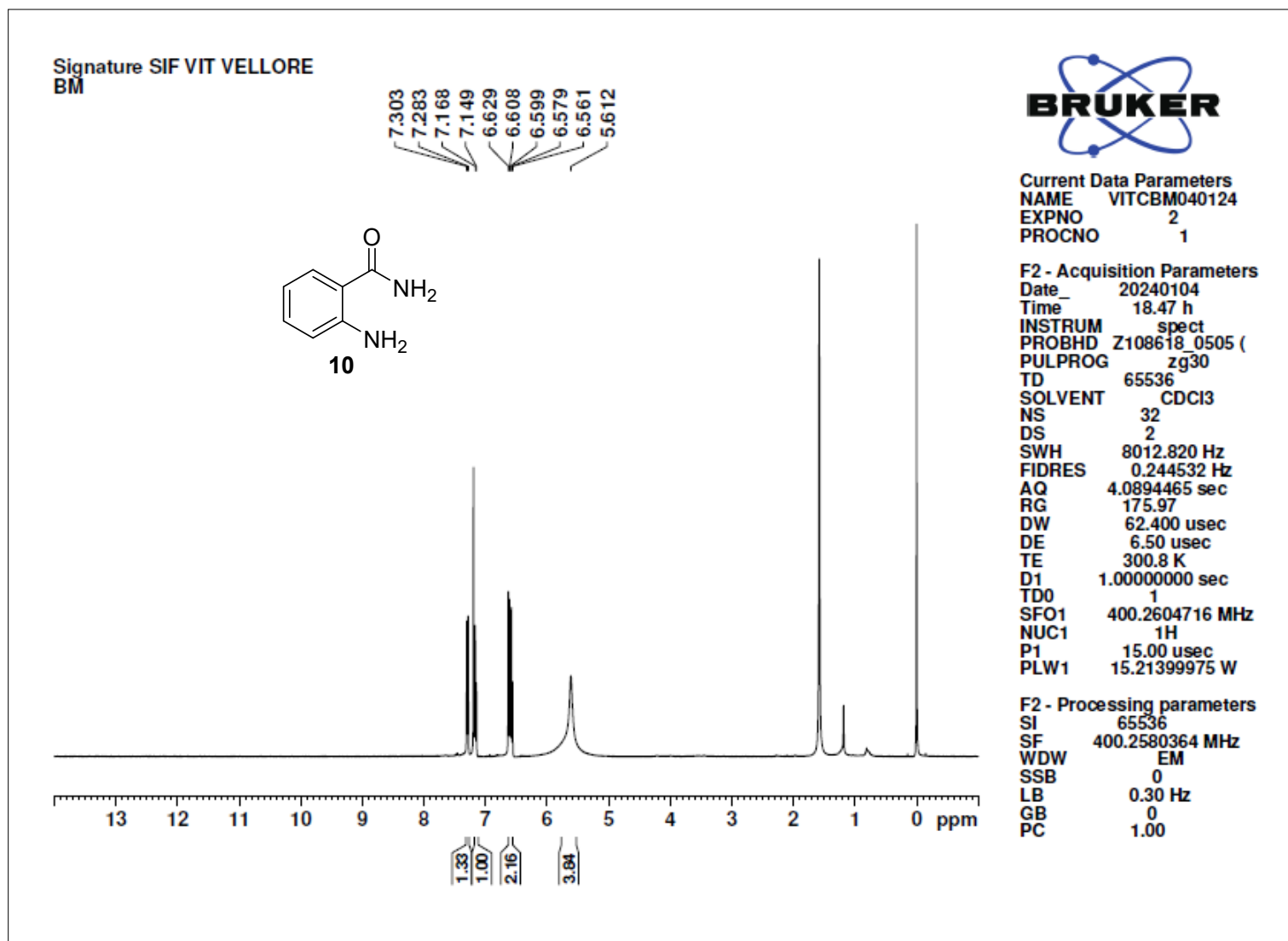
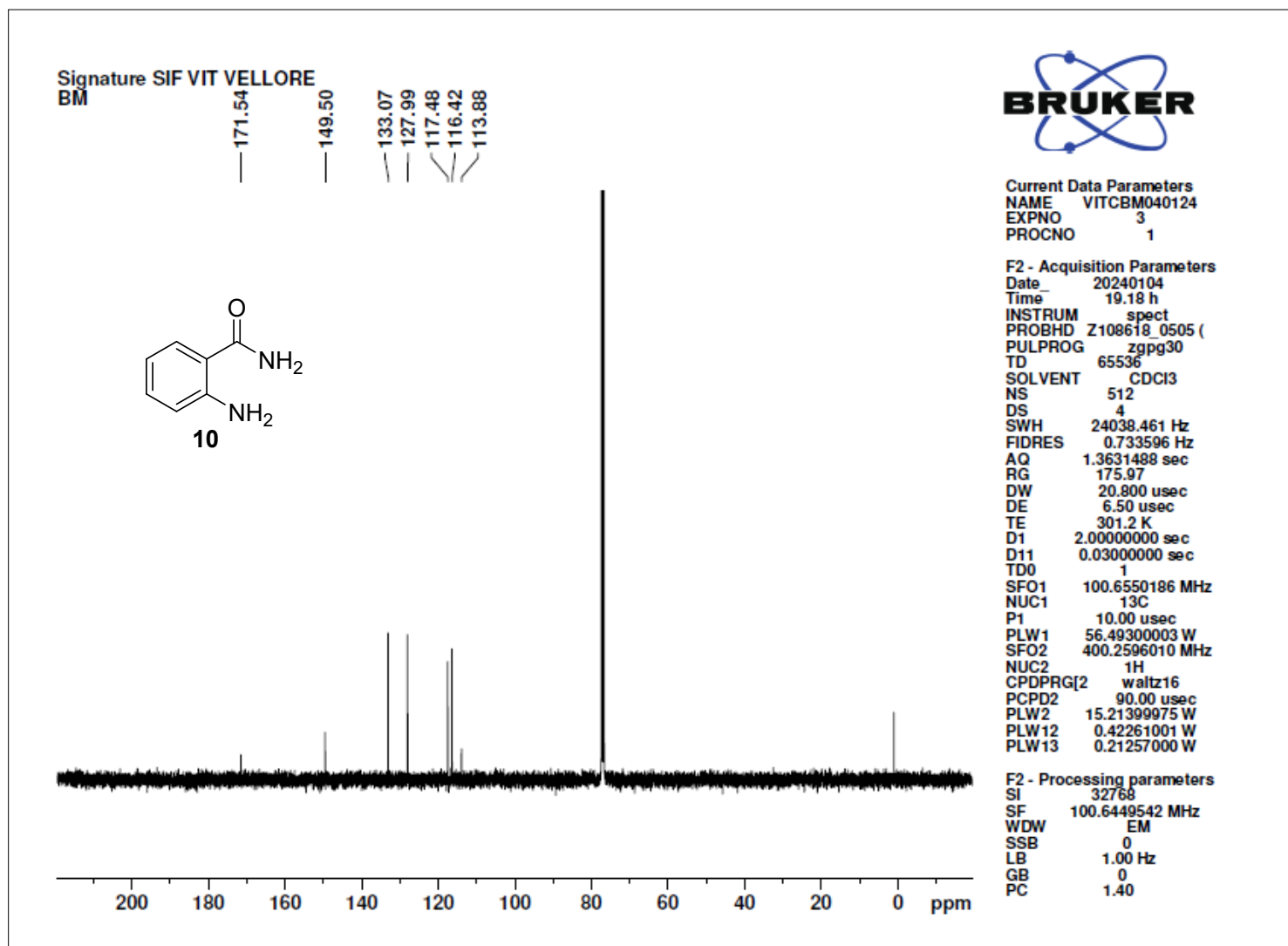
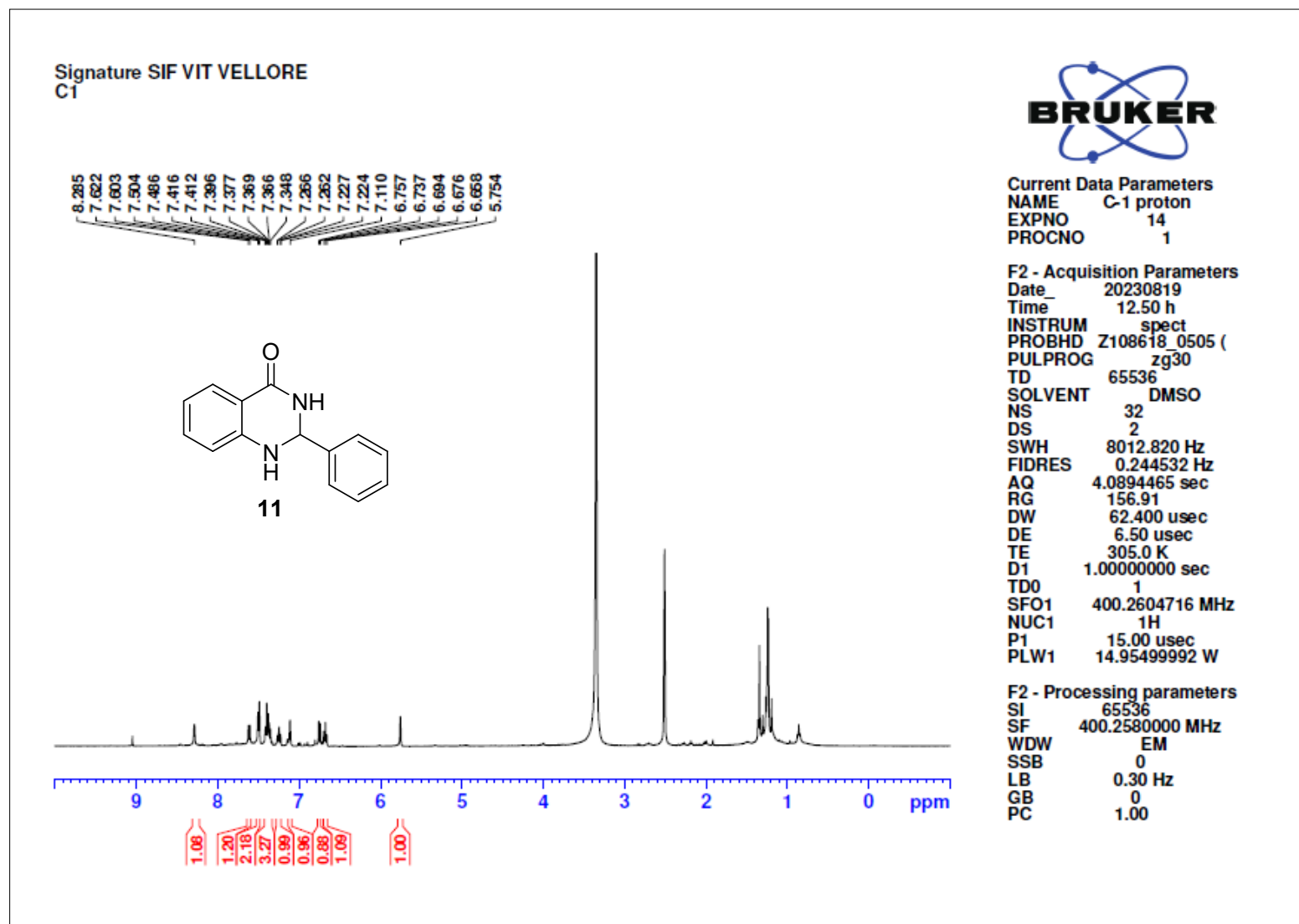


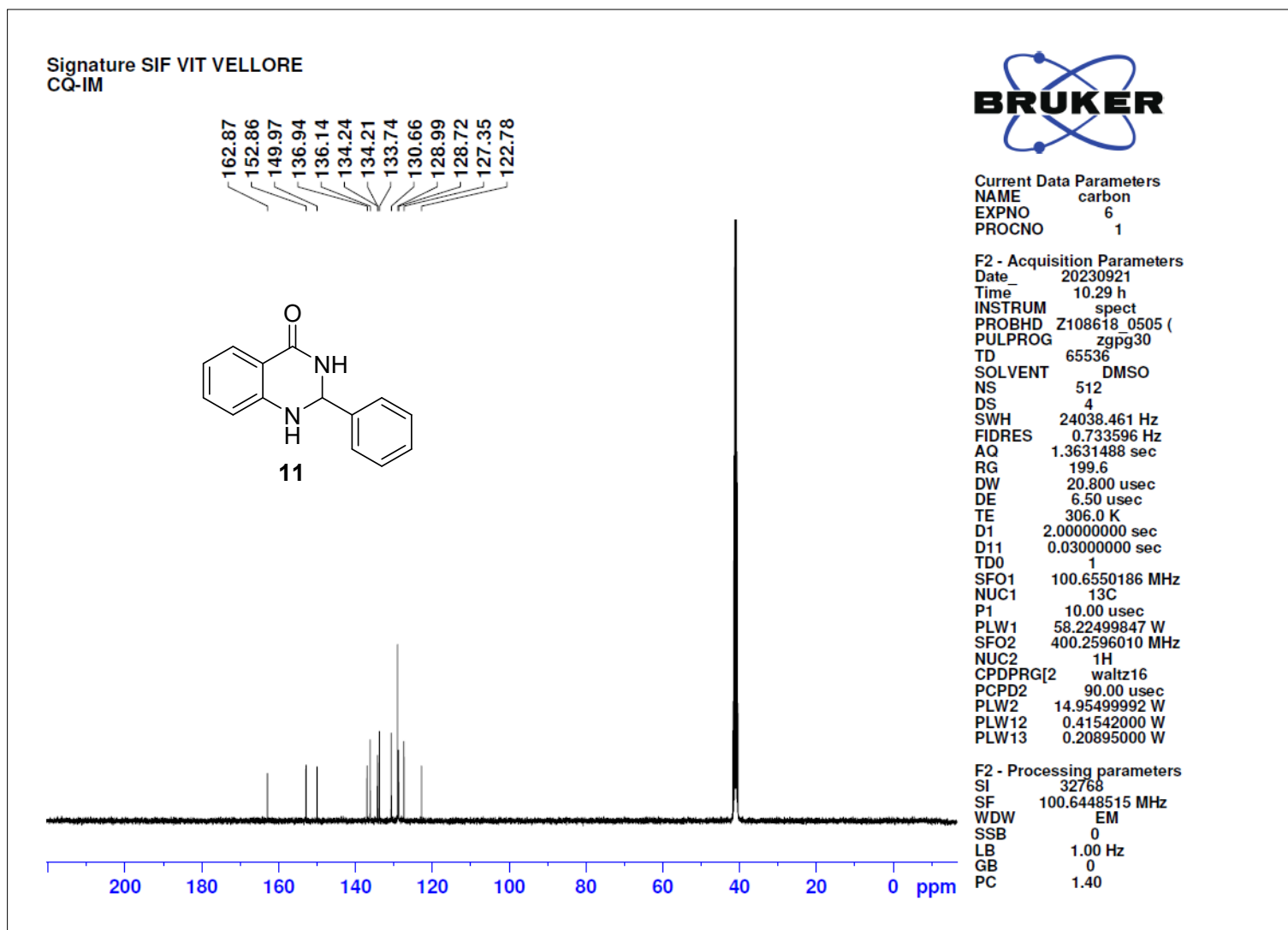
Figure 113:  $^1\text{H}$  NMR spectrum of the compound **10**.



**Figure 114:**  $^{13}\text{C}$  NMR spectrum of the compound **10**.



**Figure 115:**  $^1\text{H}$  NMR spectrum of the compound **11**.



**Figure 116:**  $^{13}\text{C}$  NMR spectrum of the compound **11**.

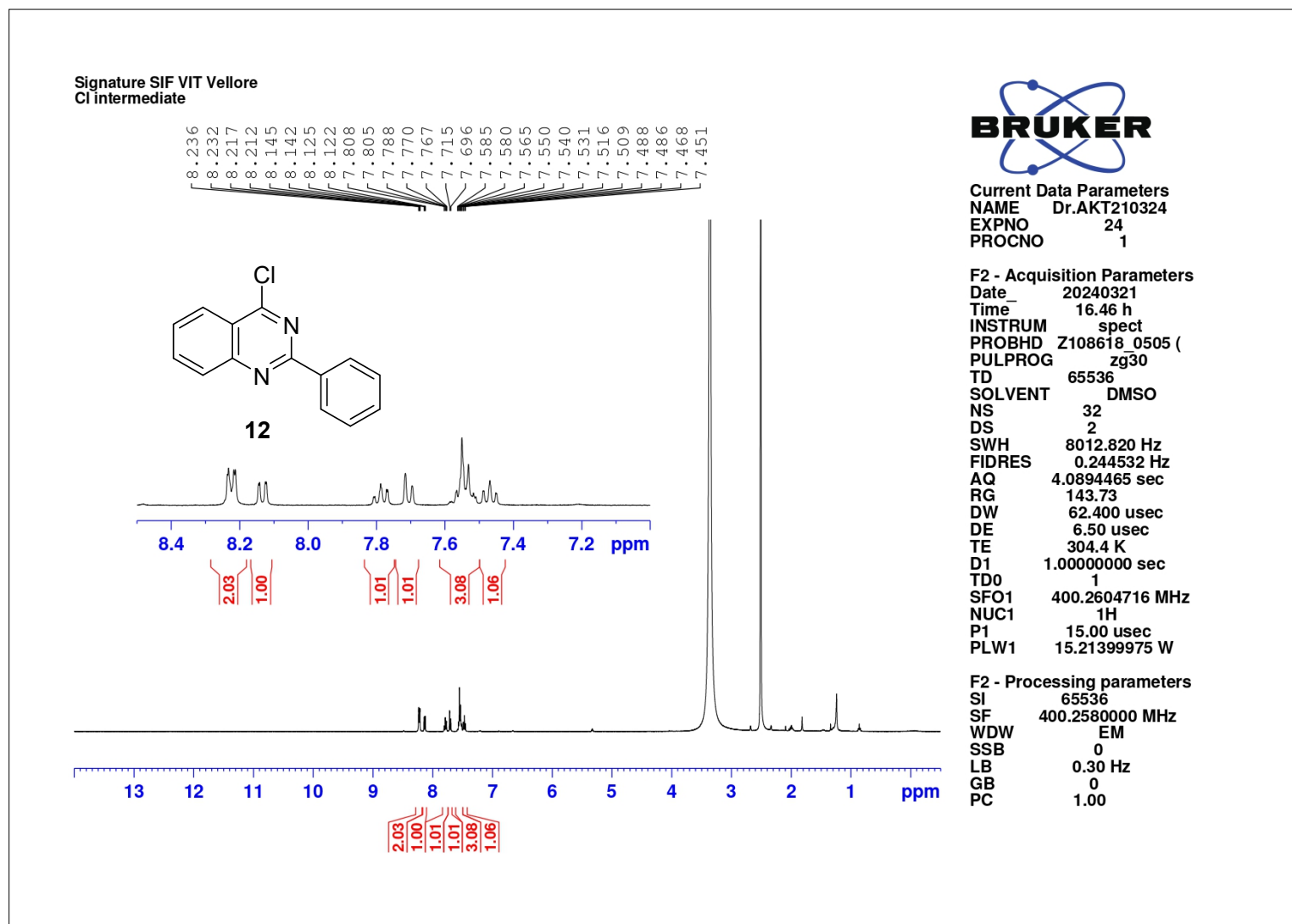
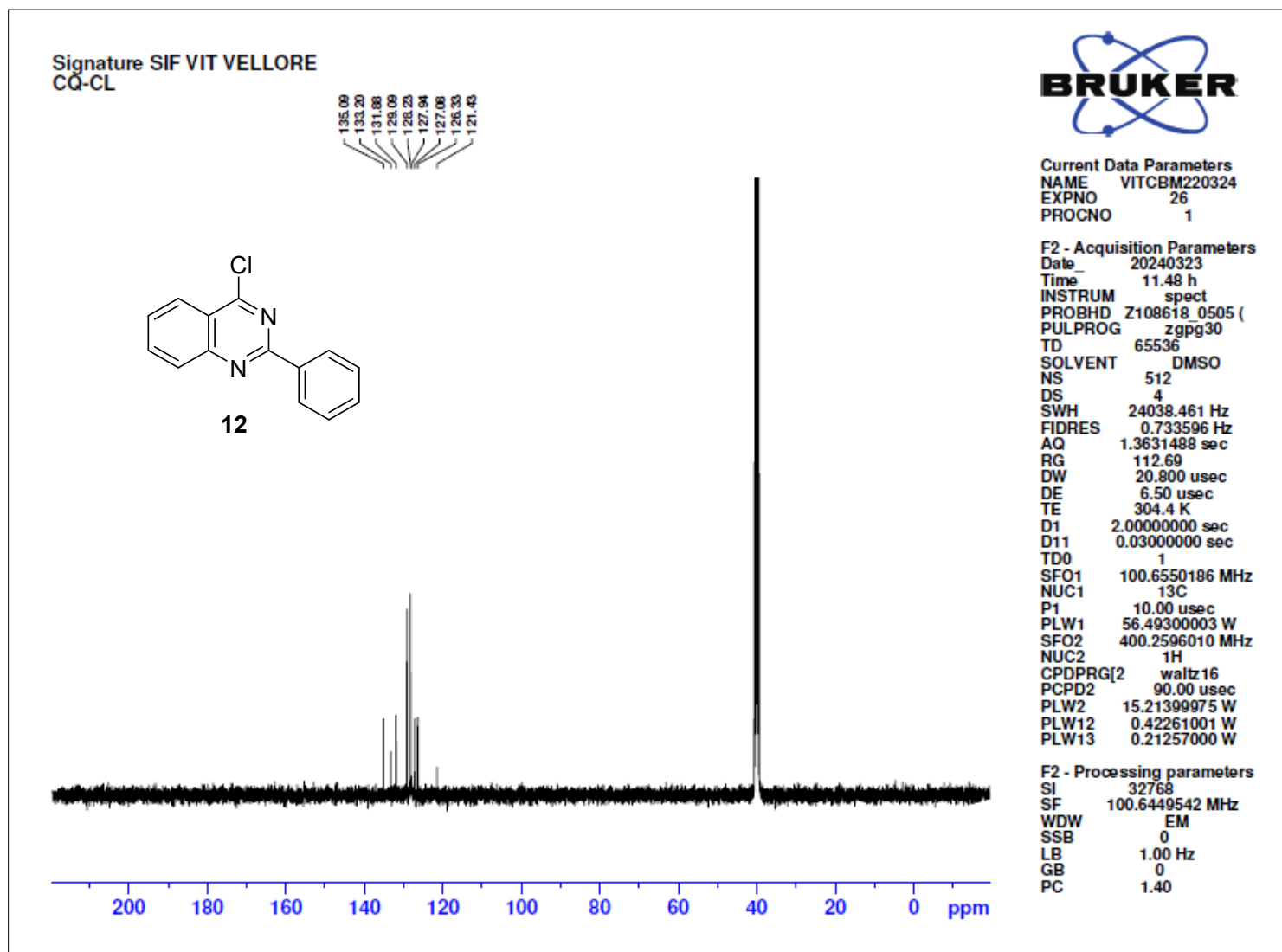


Figure 117: <sup>1</sup>H NMR spectrum of the compound 12.



**Figure 118:**  $^{13}\text{C}$  NMR spectrum of the compound **12**.

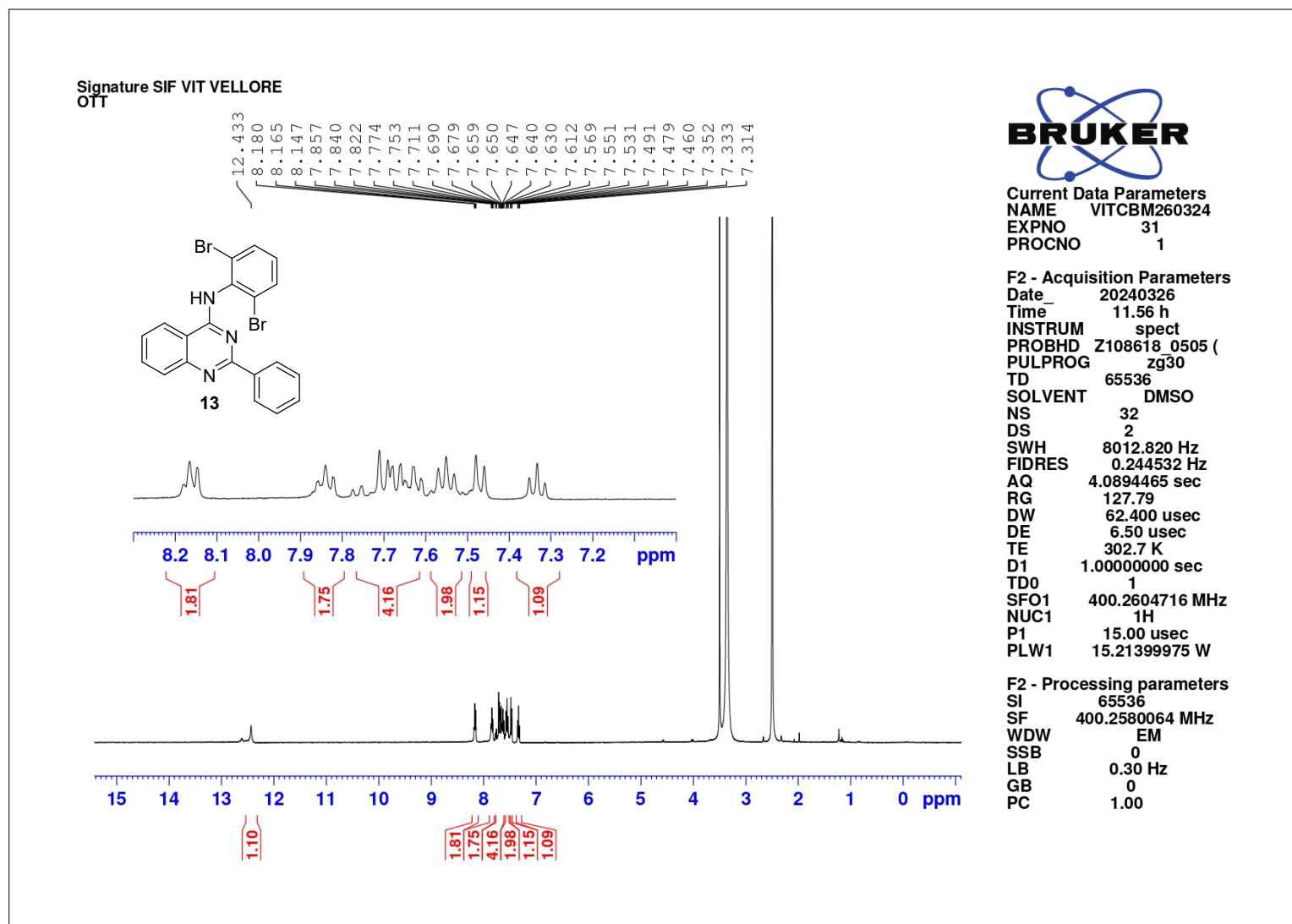
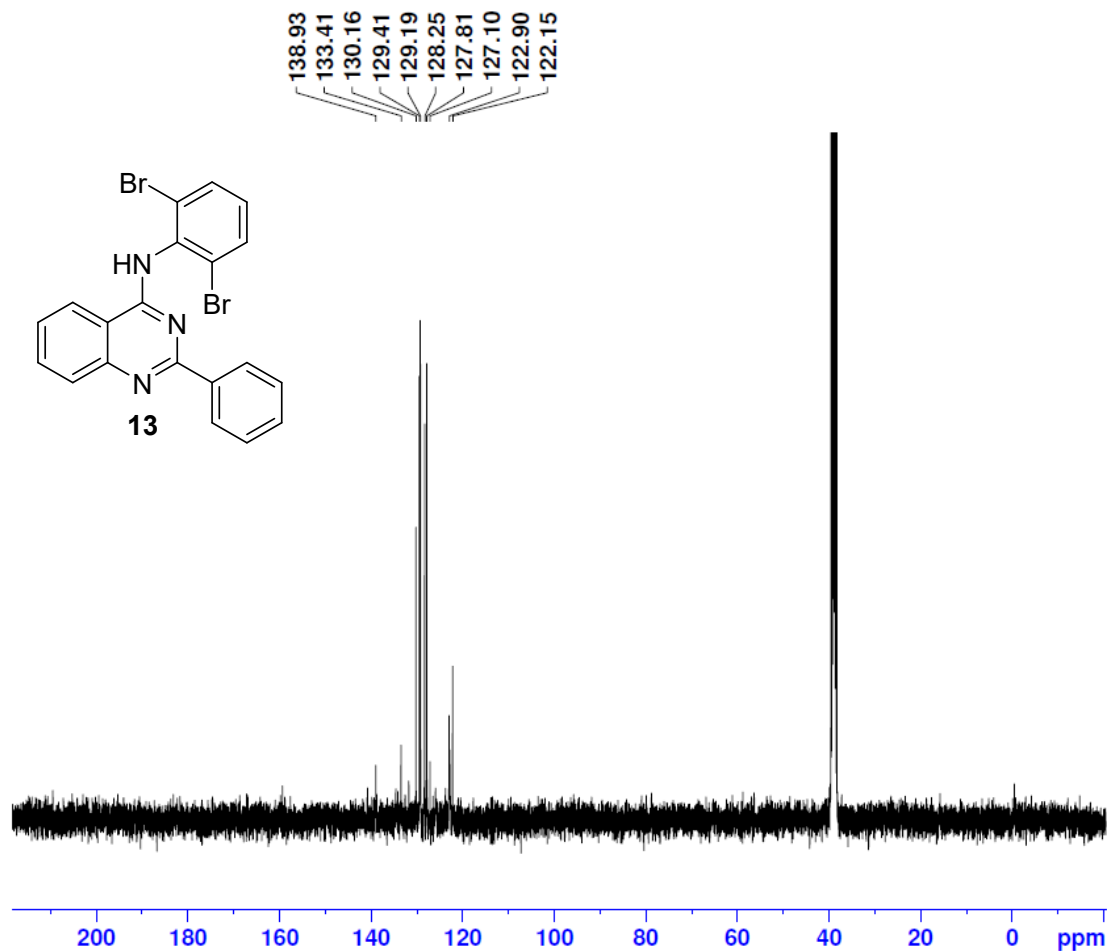


Figure 119: <sup>1</sup>H NMR spectrum of the compound 13.

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#### Current Data Parameters

NAME Dr.BM180624  
EXPNO 55  
PROCNO 1

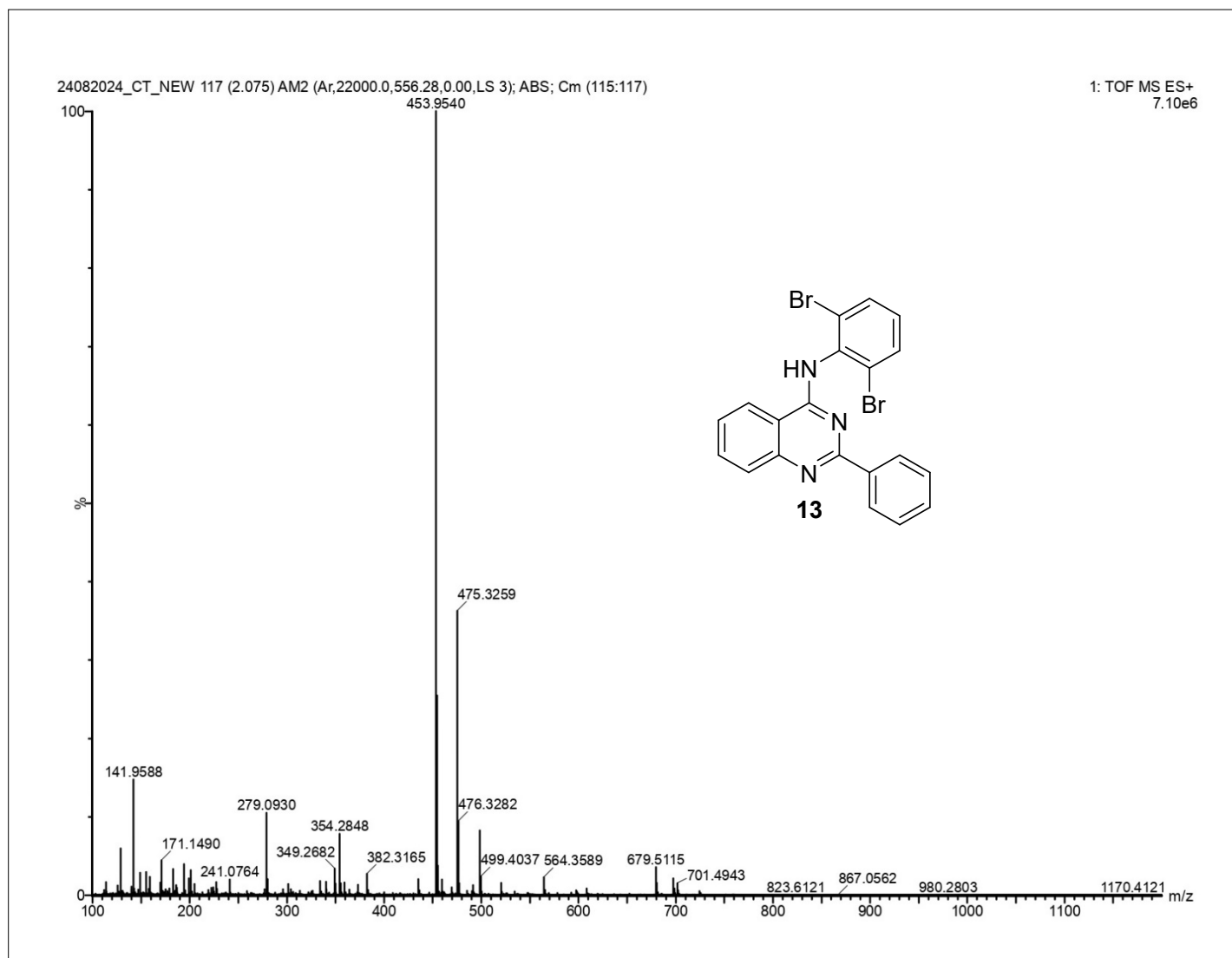
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Time 0.02 h  
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PULPROG zgpg30  
TD 65536  
SOLVENT DMSO  
NS 512  
DS 4  
SWH 24038.461 Hz  
FIDRES 0.733596 Hz  
AQ 1.3631488 sec  
RG 199.6  
DW 20.800 usec  
DE 6.50 usec  
TE 302.8 K  
D1 2.00000000 sec  
D11 0.03000000 sec  
TD0 1  
SFO1 100.6550186 MHz  
NUC1 13C  
P1 10.00 usec  
PLW1 56.49300003 W  
SFO2 400.2596010 MHz  
NUC2 1H  
CPDPRG[2] waltz16  
PCPD2 90.00 usec  
PLW2 15.21399975 W  
PLW12 0.42261001 W  
PLW13 0.21257000 W

#### F2 - Processing parameters

SI 32768  
SF 100.6449542 MHz  
WDW EM  
SSB 0  
LB 1.00 Hz  
GB 0  
PC 1.40

Figure 120:  $^{13}\text{C}$  NMR spectrum of the compound 13.



**Fig 121:** HRMS of the compound 13.

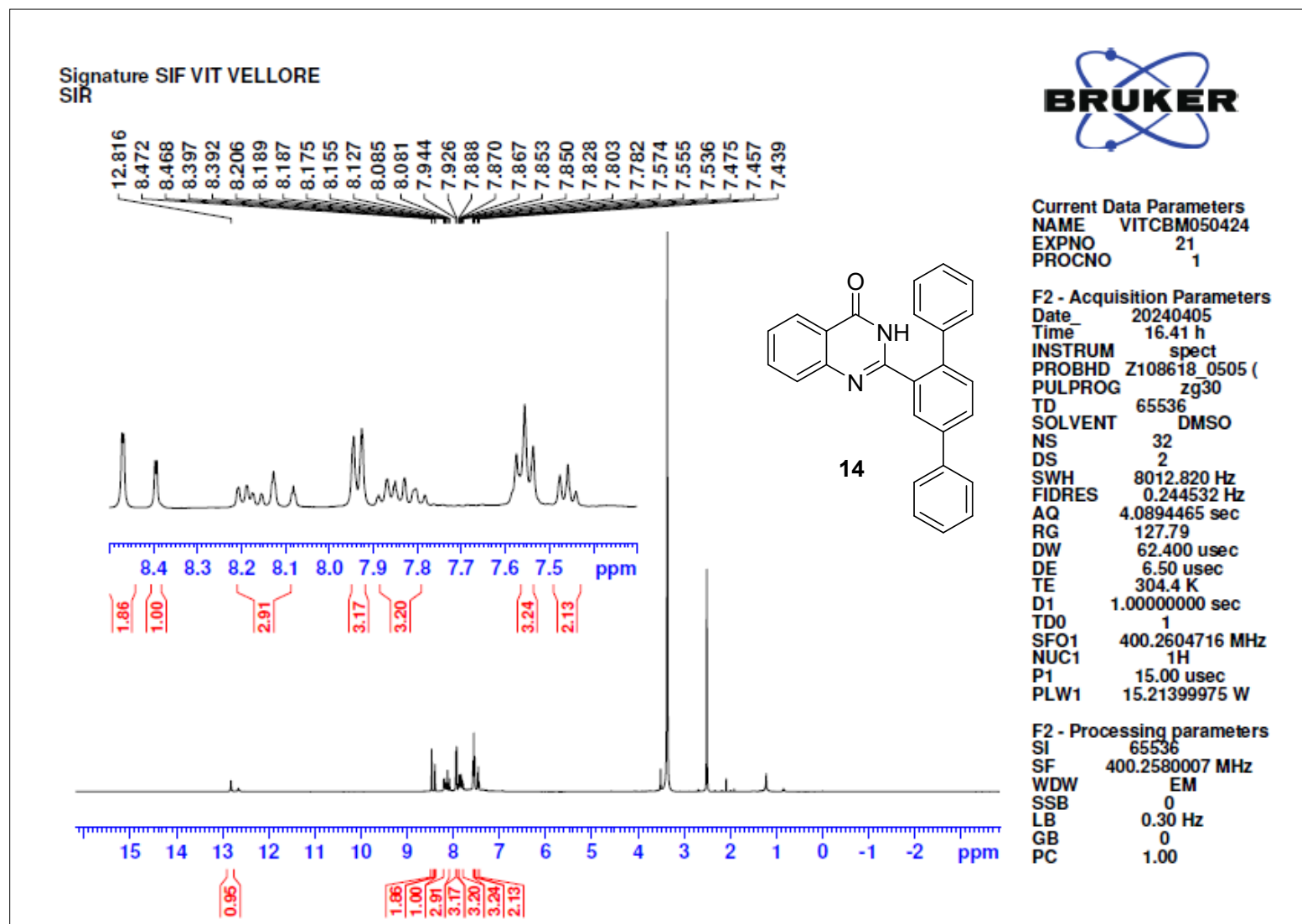
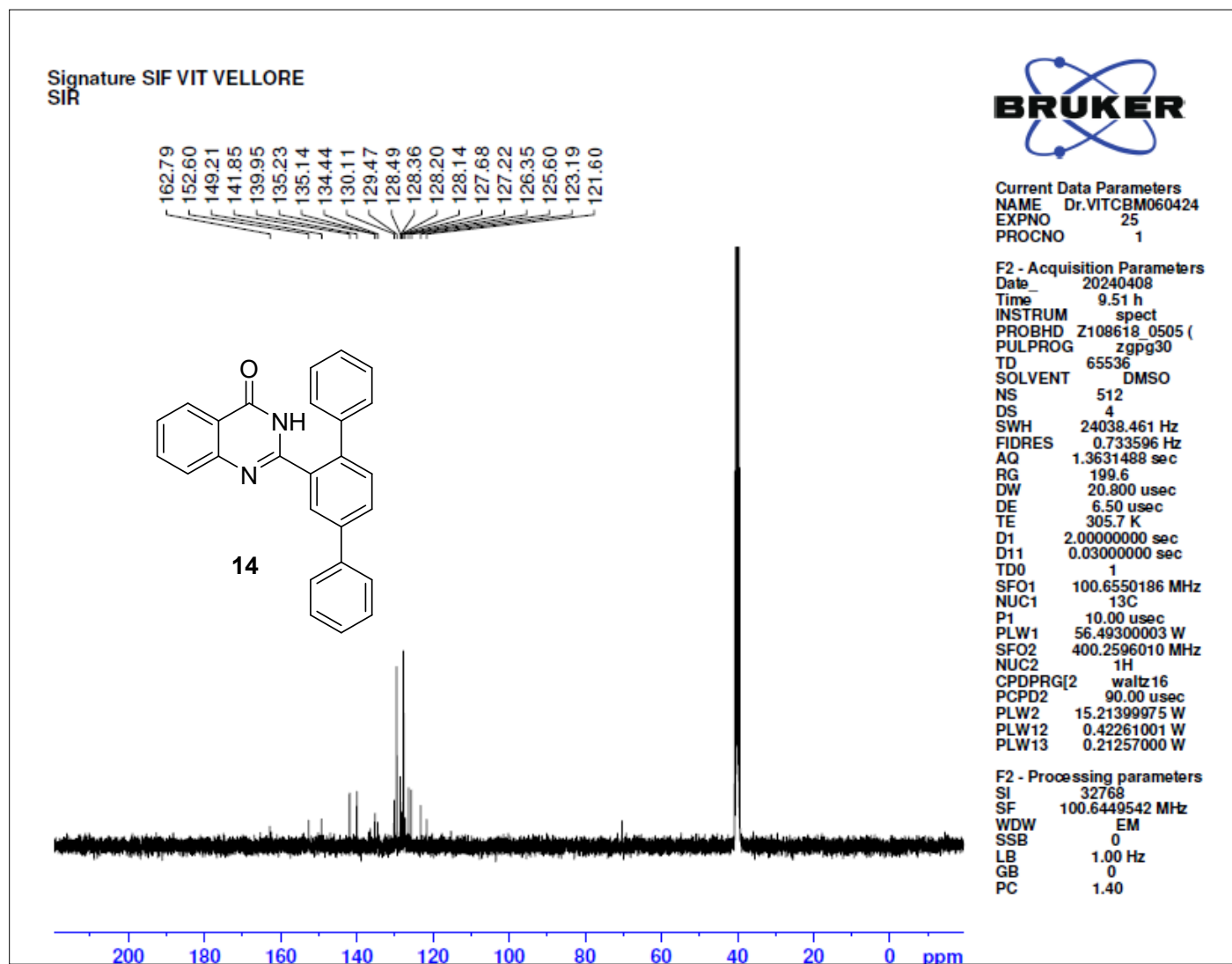
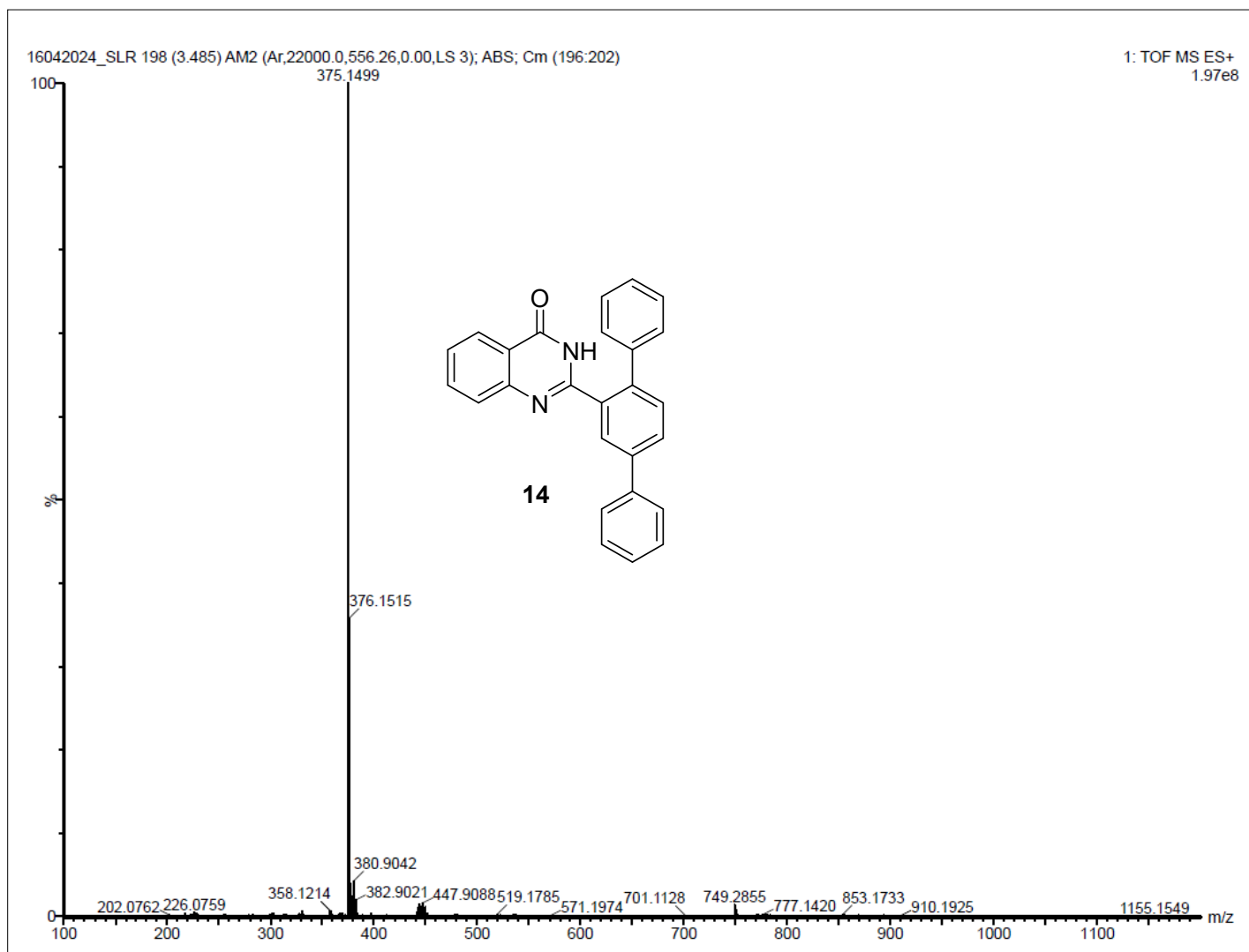


Figure 122: <sup>1</sup>H NMR spectrum of the compound 14.



**Figure 123:**  $^{13}\text{C}$  NMR spectrum of the compound 14.



**Figure 124:** HRMS of the compound **14**.