Supplementary Information

Slow and fast absorption saturation of black phosphorus: experiment and modelling

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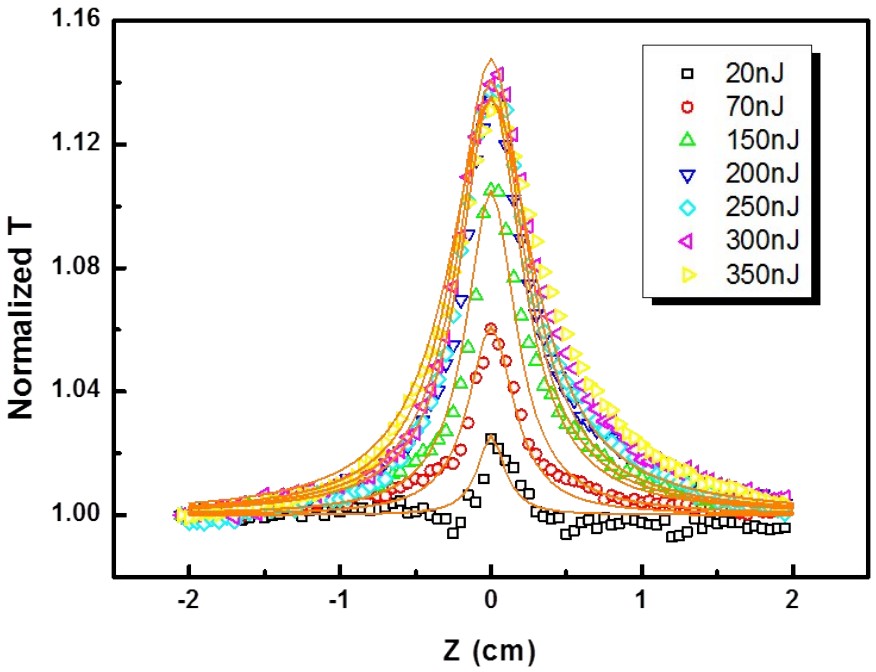

Figure S1 The Z-scan data of BP at 515 nm. The orange lines are the fitting results.

The Z-scan data of BP was fitted according to the propagating equation:

$$dI/dz = -(\alpha 0 + \beta I)I,$$

where $\alpha 0$ is the linear absorption coefficient, β is the nonlinear absorption coefficient.

Table S1 The parameters used in the fitting of Z-scan data of BP at 515 nm

BP 515 nm					

T0=0.799					
Pulse energy (nJ)	β (cm/GW)	Z0 (cm)	ω0 (μm)	Imχ（3）(esu, $\times10^{-14}$)	FOM (esu cm, $\times10^{-15}$)
20	0.027	0.11	13.4284	0.989292	4.40872
70	0.0305	0.19	17.6484	1.11753	4.98022
150	0.026	0.21	18.554	0.952652	4.24543
200	0.0315	0.27	21.0383	1.15417	5.1435
250	0.028	0.29	21.8036	1.02593	4.572
300	0.026	0.31	22.5429	0.952652	4.24543
350	0.0245	0.37	24.628	0.897691	4.0005

It was found that the Z-scan curves cannot be fitted well with a constant nonlinear absorption coefficient and a fixed beam radius. Actually, at 515 nm, the beam radius in our experiment is about 16 μm.

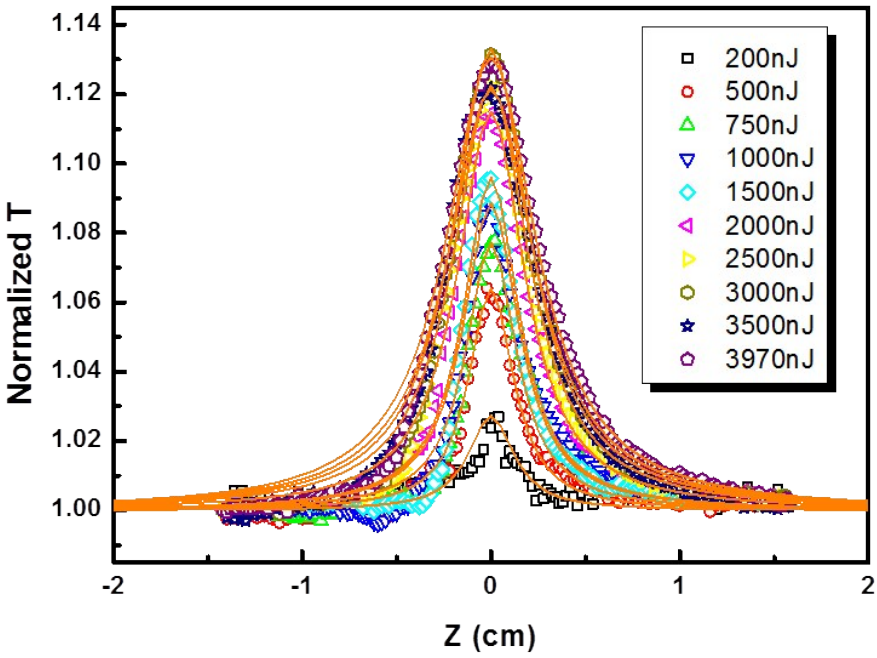

Figure S2 The Z-scan data of BP at 1030 nm. The orange lines are the fitting results.

Table S2 The parameters used in the fitting of Z-scan data of BP at 1030 nm

BP 1030 nm T0=0.812					
Pulse energy (nJ)	β (cm/GW)	Z0 (cm)	ω0 (μm)	Imχ（3）(esu, $\times10^{-14}$)	FOM (esu cm, $\times10^{-15}$)
200	0.0077	0.15	22.1763	0.564263	2.70948
500	0.007	0.15	22.1763	0.512966	2.46316
750	0.0063	0.17	23.6085	0.46167	2.21685

1000	0.006	0.19	24.9586	0.439685	2.11128
1500	0.0043	0.19	24.9586	0.315108	1.51309
2000	0.0046	0.23	27.4604	0.337092	1.61865
2500	0.0044	0.26	29.1965	0.322436	1.54827
3000	0.0041	0.27	29.7526	0.300452	1.44271
3500	0.0036	0.3	31.362	0.263811	1.26677
3970	0.0035	0.31	31.8805	0.256483	1.23158

It was found that the Z-scan curves cannot be fitted well with a constant nonlinear absorption coefficient and a fixed beam radius. At 1030 nm, the beam radius in our experiment is about 32 μm.