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SUPPLEMENTARY INFORMATION

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A new class of flares from accreting supermassive black holes

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Supplementary Information

"A new class of flares from accreting supermassive black holes"

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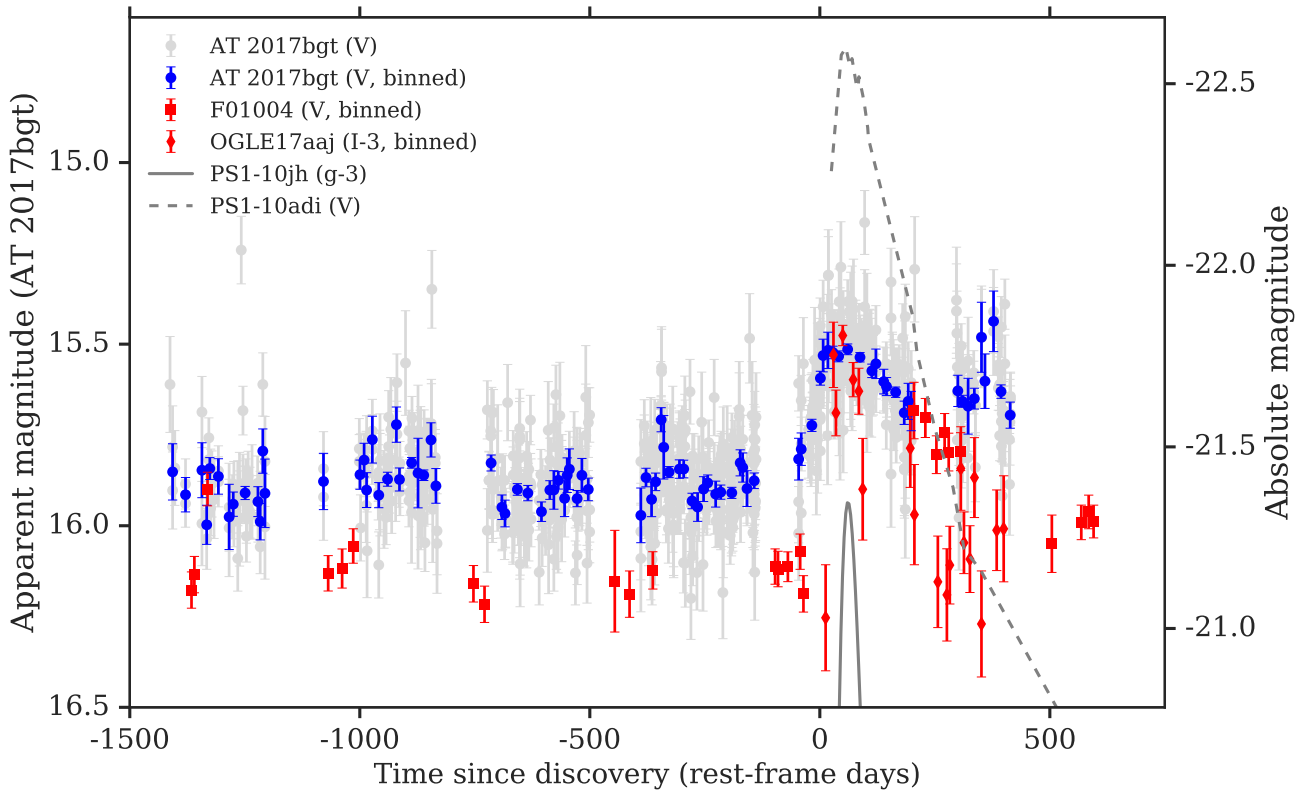
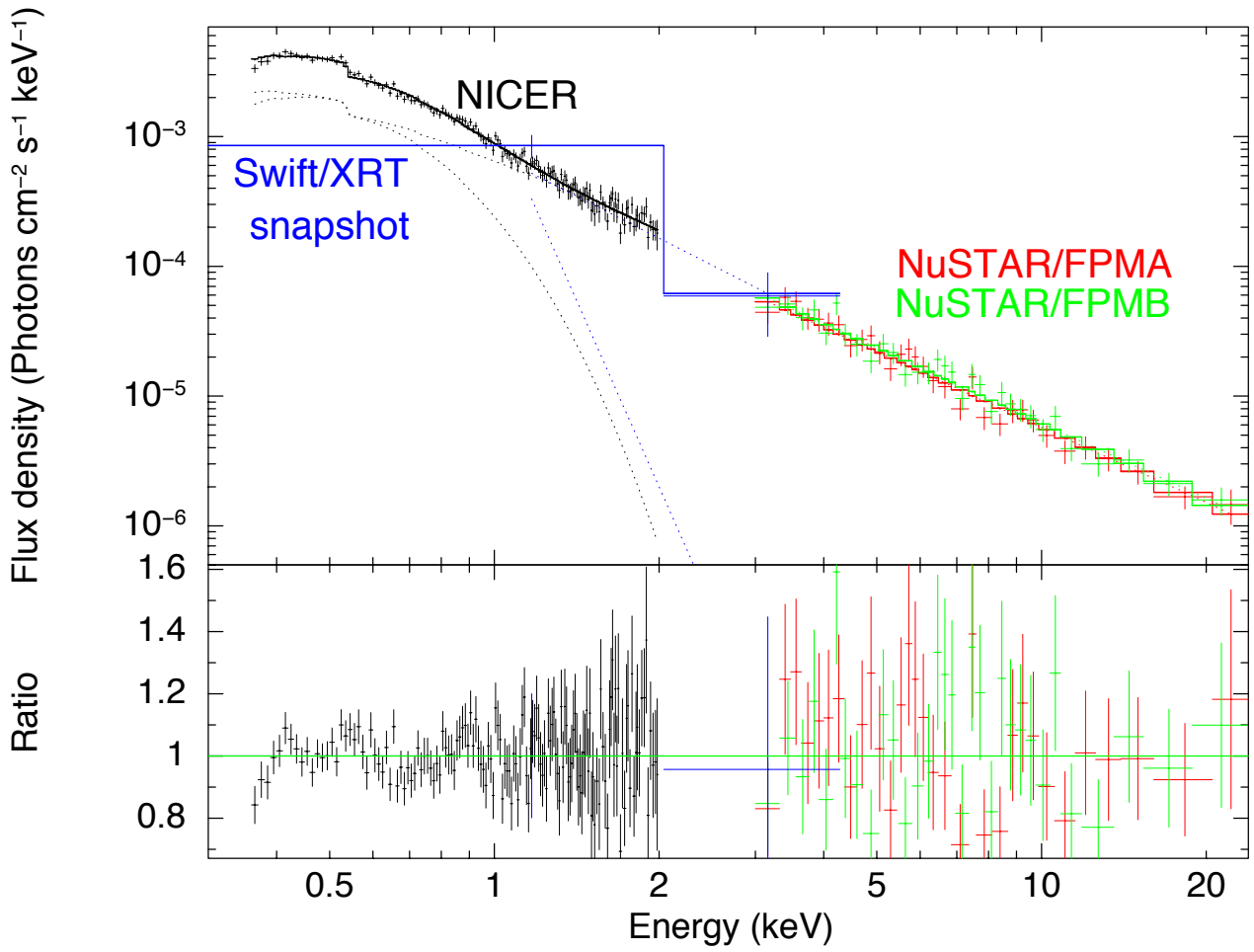
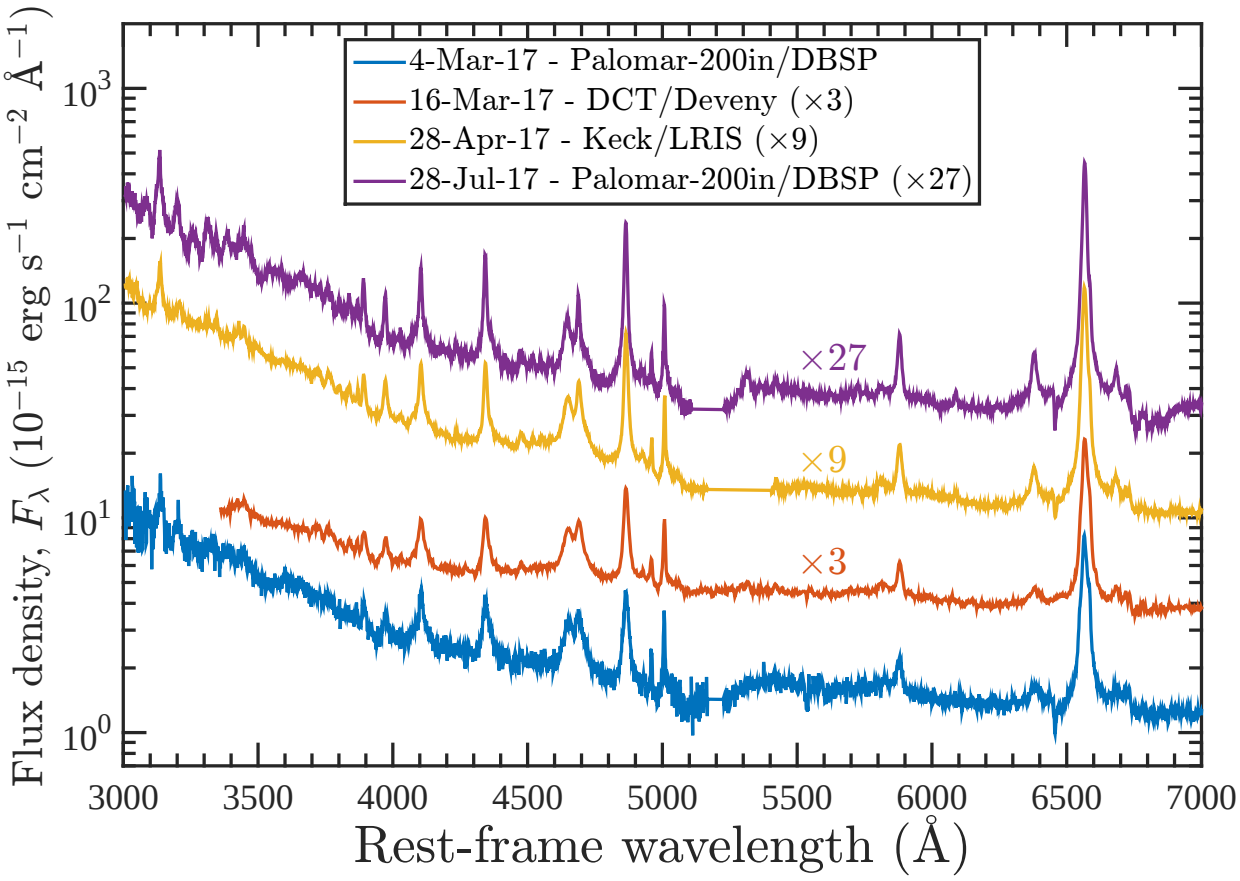


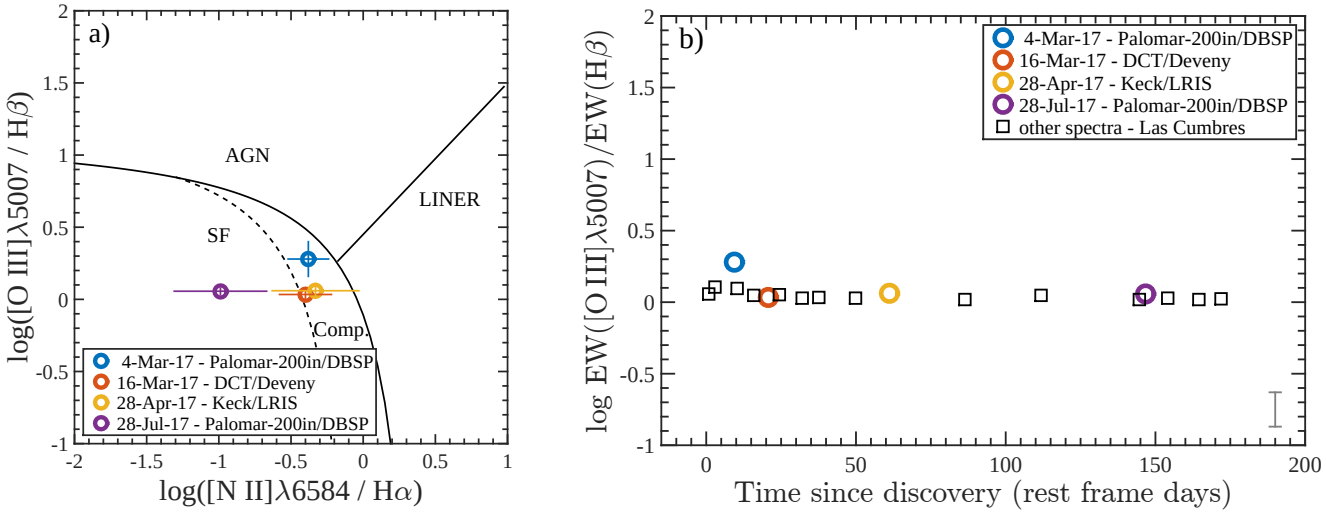
Supplementary Figure 1: **The transient nature and the long-term optical light-curve of AT 2017bgt and comparison objects.** We show both the raw ASAS-SN V-band data for AT 2017bgt (grey symbols), and a binned light-curve (blue symbols; binned in 4-day time spans, and cleaned from data points with errors $>$0.1 mag). We also show the binned optical V-band light-curves of the other two transients we associate with AT 2017bgt – the event reported in F01004-2237 (ref. 1), and the event OGLE17aaj (refs. 2, 3). In all three cases, the magnitudes are calibrated in the Vega system, and the error bars on the binned light-curves represent a combination of uncertainties on individual measurements and the scatter of data in each bin. For comparison, we present light-curves of two other recently reported events (PS1-10jh, solid line, ref. 4 and PS1-10adi, dashed line, ref. 5), which are markedly different than AT 2017bgt and the two source we associate with it. All magnitudes are in the AB system.



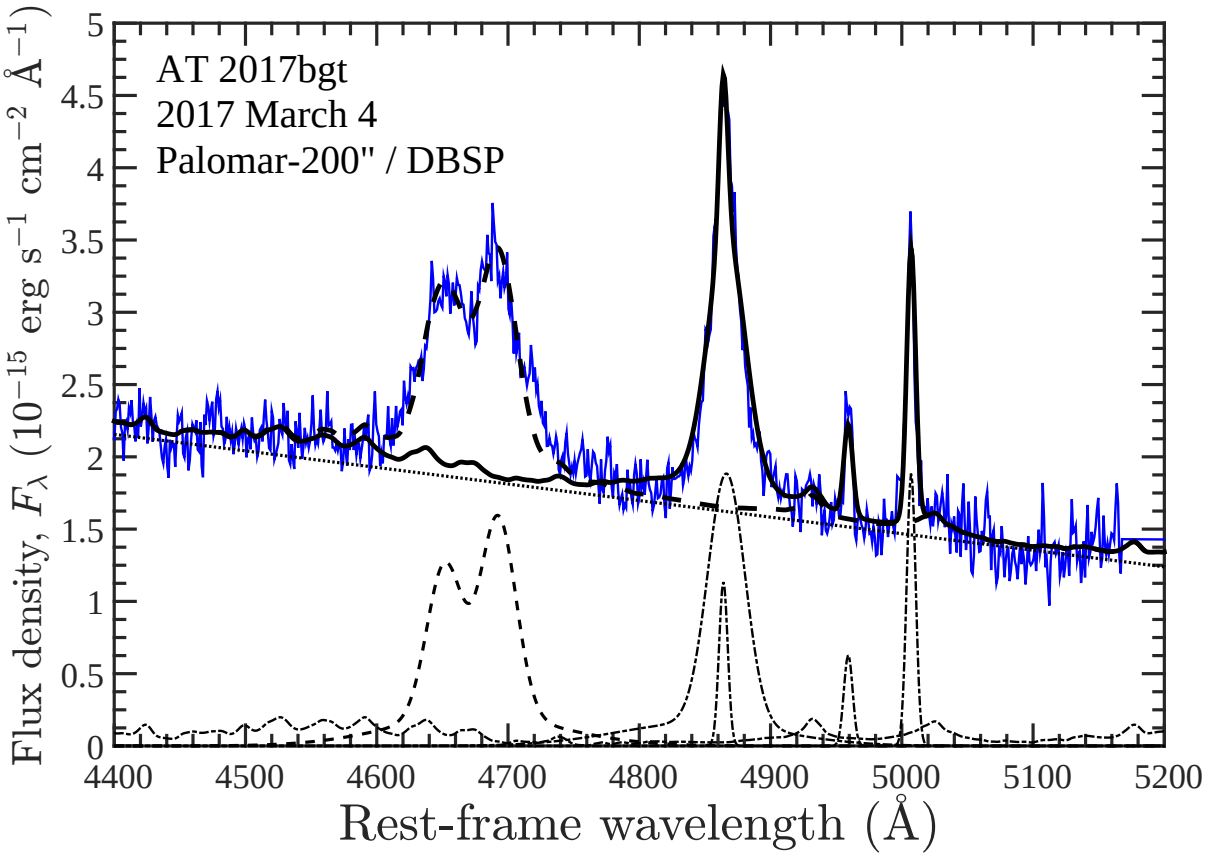
Supplementary Figure 2: **The X-ray spectral energy distribution of AT 2017bgt.** The blue, black, red and green data points (and uncertainties) correspond to the *NICER*, *Swift*/XRT, and *NuSTAR* FPMA/FPMB data, respectively, taken quasi-simultaneously starting 2018 June 25. All error bars indicate $1-\sigma$ uncertainties. The solid line traces the best-fit model, which consists of an absorbed power-law and a blackbody component. The bottom panel shows the residuals of the fit.



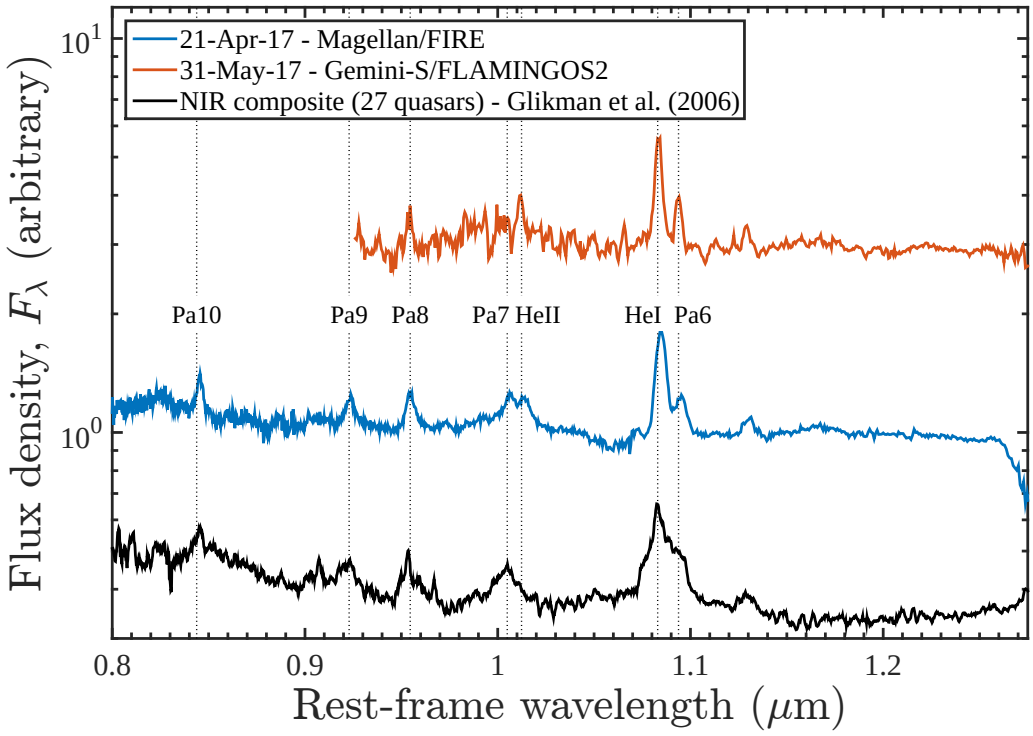
Supplementary Figure 3: **High-resolution optical spectra of AT 2017bgt.** We show four spectra taken on 2017 March 3, March 16, April 28, and July 28 (10, 23, 66, and 157 days after discovery; blue, orange, yellow, and purple lines, respecrively). The spectra were obtained using the DoubleSpec instrument on the Hale 200 inch telescope at the Palomar observatory (first and last spectra); the DeVeny instrument on the Discovery Channel Telescope at the Lowell Observatory; and the LRIS instrument on the W. M. Keck telescope at Mauna Kea. All spectra are presented un-binned and scaled by a multiplicative factor (consecutive steps of $\times 3$, as indicated). All spectra clearly show the emission features discussed in throughout this study, including broad Balmer lines, forbidden narrow lines, and the double-peaked broad feature near 4640 Å.



Supplementary Figure 4: **Strong emission line ratio diagnostics for AT 2017bgt.** In panel **a** we show the [O III] λ5007/Hβ vs. [N II] λ6584/Hα line ratios, as measured from the higher spectral resolution, high-S/N spectra presented in Supplementary Figure 3. The different black lines, taken from refs. 6–8, illustrate commonly used boundaries between sources classified as star forming regions/galaxies (SF), AGN, low ionization nuclear emission line regions (LINERs), and "composite" sources. Panel **b** shows the light-curve of the [O III] /Hβ line ratio, measured from all the available optical spectra for which this measurement was possible, with data from the four high-resolution spectra highlighted. The grey error bars at the bottom-right illustrates the typical (median) uncertainty on the line-ratio measurements (about 0.1 dex). Our earliest post-discovery optical spectra of AT 2017bgt suggest that the narrow emission lines are photoionized by a composite of continuum sources, which include both SF- and AGN-like emission.



Supplementary Figure 5: **Spectral decomposition of the optical spectrum of AT 2017bgt.** The 2017 March 4 optical spectrum of AT 2017bgt, taken with the DoubleSpec instrument mounted on the Hale 200-inch telescope at the Palomar observatory, is shown in blue. The dotted diagonal line traces the best-fit (linear) continuum emission. The lines at the bottom trace the different components of the spectral model. Dot-dashed lines trace the broad Hβ emission line, the narrow [O III] emission lines, and the broadened template of iron emission features. The combination of these components, typically seen in unobscured AGN, is shown in a solid heavy black line. The dashed lines highlight the two additional emission line profiles, which are used to decompose the broad, double-peaked emission feature near $\sim$4640 Å.



Supplementary Figure 6: **Near-infrared spectroscopy of AT 2017bgt.** The two spectra were obtained on 2017 April 21 and May 31 (59 and 99 days after the transient detection; blue and red lines, respectively), using the FIRE instrument on the Magellan-Baade telescope at the Las Campanas observatory, and the FLAMINGOS-2 instrument on the Gemini-South telescope. Here we show the J-band portion of the spectra, with annotated emission lines from hydrogen (Paschen series), He I, and He II, compared to a composite NIR quasar spectrum taken from ref. 9. All spectra are normalized at 1.15 μm, and then shifted by a multiplicative factor (consecutive steps of $\times 3$). Compared to normal unobscured AGN, AT 2017bgt exhibits strong helium emission lines, but no signature of double-peaked hydrogen emission features.

Supplementary Table 1: **Key measured and derived properties of AT 2017bgt**. The table lists the source of the data used, the date of the observation, and the value associated with the measurement.

	property	data source	date	value
Archival	νL_ν(NUV)	*GALEX*	2004 May 17	$1.2\times10^{43}\,\mathrm{erg\,s^{-1}}$
	$L(2-10\,\mathrm{keV})$	*ROSAT*	1990 Aug. 9	$5.3\times10^{42}\,\mathrm{erg\,s^{-1}}$
New, post-transient	νL_ν(NUV)	*Swift*/UVOT	2017 April 24	$8.9\times10^{44}\,\mathrm{erg\,s^{-1}}$
	$L(2-10\,\mathrm{keV})$	*Swift*/XRT	2017 April 24	$1.2\times10^{43}\,\mathrm{erg\,s^{-1}}$
	νL_ν(5100 Å)	Palomar spec.	2017 March 4	$7.3\times10^{43}\,\mathrm{erg\,s^{-1}}$
Derived	$L_{\rm bol}$ (from 2-10 keV)	*Swift*/XRT	2017 April 24	$2.2\times10^{44}\,\mathrm{erg\,s^{-1}}$
	$L_{\rm bol}$ (from 5100 Å)	Keck spec.	2017 March 4	$5.8\times10^{44}\,\mathrm{erg\,s^{-1}}$
	$M_{\rm BH}$	Palomar spec.	2017 March 4	$1.8\times10^{7}\,M_\odot$
	$L/L_{\rm Edd}$ (from 2-10 keV)	Palomar & XRT	$\cdots$	0.08
	$L/L_{\rm Edd}$ (from 5100 Å)	Palomar spec.	2017 March 4	0.21

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