A Quasar caught in the act of turning off

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Quasars are some of the most luminous objects in our Universe and are believed to play an important role in galaxy formation and the growth of the largest black holes. While variability has long been recognized as a characteristicÂăfeature of quasars, astronomers have only recently identified extreme quasar variability; dramatic changes in either the brightness or spectral characteristics of sources.Âă In particular, a new class of "changing-look quasarsâĂŹ' have recently been identified where the strong UV continuum and broad hydrogen emission lines associated with "unobscured" quasarsÂăeither appear or disappear on timescales of several years.Âă The physical processes, responsible for such changes are still debated, but fundamental changes in the quasar, such as the black hole accretion rate appear more likely than changes in obscuration, at least for quasars showing extreme mid-infrared variability.Âă Here we report on three epochs of spectroscopy of SDSS J110057.70-005304.5, an extreme mid-infrared variable quasar at $z = 0.378$ whose UV continuum and broad hydrogen emission lines have dramatically faded over the past 20 years.Âă Uniquely, an archival spectrum of this quasar from 2010 shows an intermediate phase of the transition, when the flux below rest-frame ~ 3400 Å has collapsed, suggestive of dramatic changes in the innermost regions of the accretion disk. This provides not only important clues to the physics of changing-look quasars, but also a prediction that the HÎš flux will increase in the next few months.

Shortly after their initial identification (**??**), quasars were seen to vary photometrically. This placed strict limits on the size of the central engine power source and gave credence to the idea that a supermassive black hole powers AGN.

From e.g., Lawerence (2016, ASPC):: If the accretion disc is in a stable steady state, we expect it to evolve gradually on the inward drift timescale set by viscosity, which is of the order 10,000 years (see e.g. Netzer (2013)). However, instabilities of various kinds could give much faster changes. The 'light crossing' timescale $t_{\rm lt} = R/c$, is the shortest timescale set by radiation heating or reflection. This is of the order hours, days, and years for disc, BLR, and torus respectively. The 'dynamical timescale', $t_{\rm dyn} = R^3/GM$, is the shortest timescale on which we are likely to see significant physical changes in a region, and is of the order of days, years, and thousands of years for disc, BLR, and torus respectively. (The 'free-fall' timescale is roughly the same and orbital timescale is 2π times longer.) More realistically, perturbations may transmit across a region on the sound crossing timescale $t_{\rm snd} = R/v_{\rm snd}$. This is somewhat model dependent but is of the order of years for the accretion disc. This is the global time to cross the whole region; local hot spots could grow on the timescale it takes sound to cross the vertical height of the disc, which can be 1âĂŞ3 orders of magnitude faster. The "thermal" timescale $t_{\rm therm}$ which is roughly the time it takes for for energy to dissipate within the disc, i.e. the response timescale to a spike of energy input. It is of the order of days for the inner disc and years for the optical disc. The analogous "response" timescale for the BLR and for the obscuring region is actually the light-crossing time - the local response time to a change in photo-ionisation or heating is very short, but is smeared out by the range of light travel delays.

Although the observed variability of quasars has been known since shortly after their discovery, only recently,

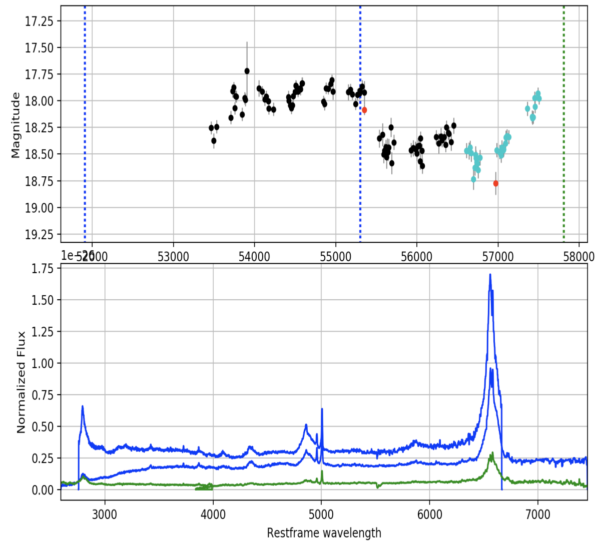

Figure 1 The light curve of J110057. SDSS, DECaLS and PanSTARRS give the optical photometery. The WISE IR light curves are shown and their dramatic decrease led to the identification of J110057. The three spectral epochs are shown by the vertical lines.

with the advent of extensive imaging surveys and the associated, repeat spectroscopy, has given actual evidence for these key physical mechanisms.

In this article we present the $z = 0.378$ quasar SDSS J110057.70-005304.5 that we have observed transitioning from a blue continuum sloped object to become a regular galaxy. However, along with the changes in the BELs, we see a major change to the disk interior to $150R_g$.

1 Results

Figure **??** gives the optical light curve of J110057. Figure **??** shows the three optical spectra of J110057. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam porta sodales est, vel cursus risus porta non. Vivamus vel pretium velit. Sed fringilla suscipit felis, nec iaculis lacus convallis ac. Fusce pellentesque condimentum dolor, quis vehicula tortor hendrerit sed. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Etiam interdum tristique diam eu blandit. Donec in lacinia libero.

Checking the data archives we found there was no source within 30 arcsec in the VLA FIRST, i.e., at 21 cm radio frequencies.

None of the *Hubble Space Telescope*, the *Spitzer Space Telescope* or the *Kepler* Mission has observed J110057 patch of sky. It is also not in the HSC DR1 footprint.

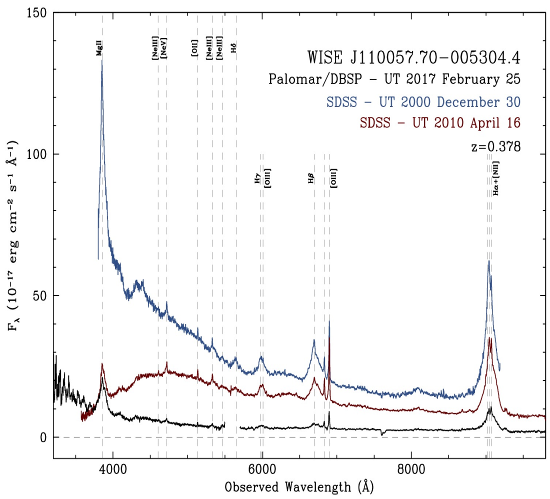

Figure 2 Three spectra of J110057.

There is a detection in ROSAT, using the 2nd all-sky survey (2RXS; Boller et al. 2016, A&A, 588, 103) as 2RXS J110058.1-005259 with 27.00 counts (count error 6.14), count rate= 0.06±0.01 and an exposure time of = 431.95 seconds. The NED gives J110057 as $1.27 \pm 0.28 \times^{-12}$ erg/cm^2/s in the 0.1-2.4 keV range (unabsorbed flux). J110057Neither *Chandra* or *XMM-Newton*.

2 Discussion

Using Ford et al and Sirko & Goodman 2003, Figure **??** shows a model for a $M_{\rm BH} = 3 \times 10^8 M_\odot$, radiative efficiency of $\varepsilon = 0.1$, accretion rate in units of Eddington accretion, $\dot{M} = 0.032$, inner and outer disk radii in units of r_g of SMBH of radius$_{\rm in}$=6.0, radius$_{\rm out}$=1.0$\times$10^4.

3 Method

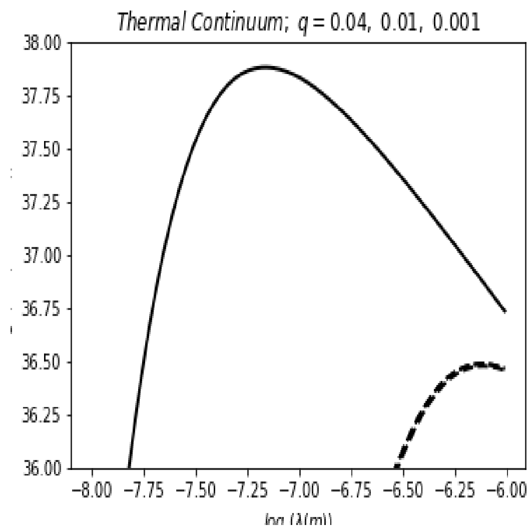

Figure 3 Model spectra of J110057.