Discovery of Dramatic Optical Variability in a Possible Radio-Loud Narrow-Line Seyfert 1 Galaxy

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SDSS J1100+4421 (Figure 1) is likely a NLS1 at $z = 0.840$ (Figure 2), however with unusually strong narrow emission lines. The estimated black hole mass of $\sim 10^7 M_\odot$ implies bolometric nuclear luminosity close to the Eddington limit.

Interestingly, SDSS J1100+4421 is also found to be an extremely radio-loud object, with a radio loudness parameter of $R \approx 4 \times 10^2 - 3 \times 10^3$, which implies the presence of relativistic jets. In addition, the 1.4 GHz radio image of the source shows an extended structure with a linear size of about 100 kpc (Figure 1). If SDSS J1100+4421 is a genuine NLS1, this radio structure would then be the largest ever discovered in this type of active galaxies. Our discovery demonstrates that high-cadence surveys are potentially useful to search for such a rare class of AGNs and to study the jet production/duty cycle in the growing BHs.

Figure 1: Upper: Discovery image of SDSS J1100+4421 taken on 2014 Feb 23 UT (middle), compared with the SDSS image (left) and the FIRST 1.4 GHz radio image (right). Lower: Light curves of SDSS J1100+4421 around the discovery epoch.

Figure 2: Optical spectra of SDSS J1100+4421 taken with Subaru/FOCAS.

References

It is widely accepted that active galactic nuclei (AGNs) are powered by supermassive black holes (BHs) accreting at high rates. Among AGNs, narrow-line Seyfert 1 galaxies (NLS1s) are of a particular interest, since AGNs of this peculiar type are believed to have relatively small BH masses ($10^6-10^8 M_\odot$) and very high accretion rates. By these properties, it had been inferred that NLS1s are a radio-quiet class of AGNs, and that young BHs in NLS1s that undergo rapid growth via high-rate accretion do not produce relativistic jets.

We discovered dramatic variability in SDSS J1100+4421 (Figure 1) by the high-cadence optical transient survey Kiso Supernova Survey (KISS, [1,2]). The source brightened in the optical by at least a factor of three within about half a day (Figure 1). Spectroscopic observations with Subaru/FOCAS suggest that this object