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

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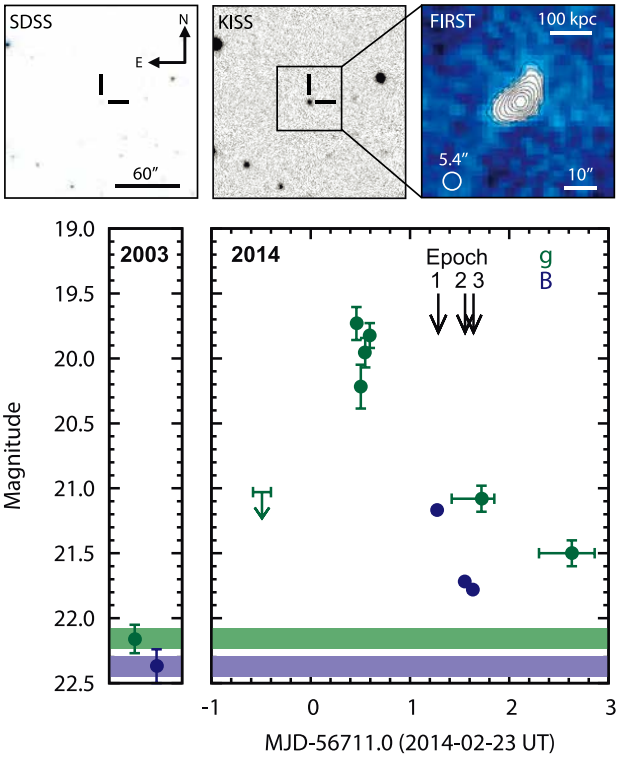

Figure 1: *Upper*: Discovery image of SDSS J1100+4421 taken on 2014 Feb 23 UT (middle), compared with the SDSS image (left) and the FIRST 1.4 GHz radio image (right). *Lower*: Light curves of SDSS J1100+4421 around the discovery epoch.

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 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 $R \simeq 4\times10^2 - 3\times10^3$, which implies the presence of relativistic jets. In addtion, 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.

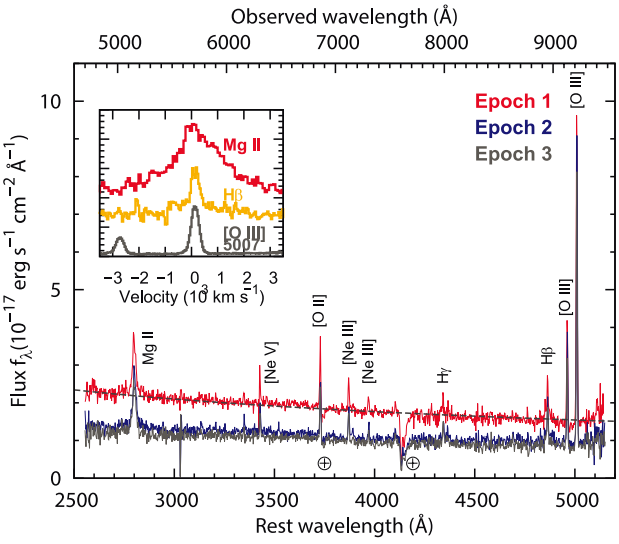

Figure 2: Optical spectra of SDSS J1100+4421 taken with Subaru/FOCAS.

References

[1] Morokuma, T., et al.: 2014, *PASJ*, **66**, 114.
[2] Tanaka, M., et al.: 2014, *ApJ*, **793**, L26.