ANOTHER QUADRUPLY LENSED QUASAR FROM THE VST-ATLAS SURVEY

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SEARCH, FOLLOWUP AND MODELLING

Gravitational lenses producing four images of a quasar are prized for four distinct purposes. Time delay measurements yield direct measurements of distances (Treu and Marshall 2016). Flux ratio anomalies are used both to measure surface stellar mass densities in the lensing galaxies (Schechter et al 2014; Jimenez-Vicente et al 2015) and to measure the sizes of quasar continuum emitting regions (Kochanek 2004; Pooley et al 2007). They also provide multiple lines of sight through intervening absorption line systems (Zahedy et al 2016). But quadruply lensed quasars are scarce, with only several dozen known.

We report here the quadruple nature of the source WISE 025942.9 -163543 as observed in the VST-ATLAS survey. Followup spectra obtained with IMACS (Dressler et al 2011) on the Baade 6.5 m telescope show two of the four images to be components of a lensed quasar system with source redshift $z = 2.16$, referred henceforth at ATLAS 0259-1635.

Our original search of the VST-ATLAS images for lensed quasars among WISE sources with colors $W1 - W2 > 0.7$ is described by Schechter et al (2017). Since then we have begun splitting sources into three components, when possible, rather than just two. Similar flux ratios in the 5 filters are used to isolate lensed quasars. In our original search ATLAS 0259-1635 was split into two extended components, and consequently, was passed over. But when split into

![Figure 1](image-url)

**Figure 1.** Left: Sloan $i$ 120s exposure of ATLAS0259-1635 at 0′′.111 per pixel. Coordinates are given in parentheses. Sloan $i$ magnitudes and $g - i$ colors are given in brackets. Right: Combined spectrum of images A and B.

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three components, two were pointlike and one was extended, all with similar colors. Figure 1 shows a direct image of ATLAS 0259-1635 taken in Sloan $i$ with IMACS, along with positions for the four images measured in arcseconds from the brightest component, image A, at position $\alpha = 02^{h}59^{m}42^{s}91$, $\delta = 16^{\circ}35'43''3$ on the ATLAS $r$ image.

PSF fitting photometry was obtained from 120 s $i$ and $g$ exposures with IMACS using a star at $\alpha = 02^{h}59^{m}38^{s}90$, $\delta = -16^{\circ}36'22''4$ as the template for the four quasar images. There was no convincing evidence of a lensing galaxy in the residuals. The $i$ magnitudes and $g-i$ colors (with no adjustment for the difference in color between the template and the quasar) are given in Figure 1. Note that the quasar is quite red for its redshift (Richards et al 2001).

Long slit spectroscopy was carried out with the 200l/mm grism on the f/2 camera at PA 0$^\circ$. Spectra for images A and B, shown in Figure 1, have typical quasar emission lines at $z_s = 2.16$. An absorption line system is seen at $z_{abs} = 0.905$.

Keeton’s (2001) lensmodel program was used to fit the positions but not the fluxes of the four images to a singular isothermal sphere with external shear. The best fitting model (with 7 free parameters) gave a scatter of roughly 0.01 in the eight position coordinates. The galaxy is predicted to lie at (0.690, 0.319). The signed magnifications of images A, B, C and D are 10.5, -6.7, 6.4 and -8.1, respectively. The shear, $\gamma = 0.068$, points 19.7$^\circ$ east of north. The strength of the isothermal is $0''.733$.

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