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RXJ 1745+398: Detection of the first AGN acting as a gravitational lens

J. HEIDT¹, S.J. WAGNER¹, A. SILLANPÄÄ², L.O. TAKALO², K. NILSSON²,
T. PURSIMO², K. JÄGER³, and W. BRINKMANN⁴

¹Landessternwarte Heidelberg, D-69117 Heidelberg, Germany

²Tuorla Observatory, F-21500 Piikkiö, Finland

³Universitätssternwarte Göttingen, Geismarlandstr. 11, D-37083 Göttingen, Germany

⁴Max-Planck-Institut für Extraterrestrische Physik, Giessenbachstrasse, D-85740 Garching, Germany

Studies of gravitational lenses are one major tool of observational cosmology. Due to the strong magnification, it is possible to study the distribution and evolution of galaxies at high redshifts. Furthermore, they allow to investigate the mass function and distribution of galaxies in clusters as well as the nature of the dark matter in galaxy clusters. Finally, the geometry of the Universe and values of the cosmological parameters can also be derived.

During the course of an identification program of BL Lac objects from the ROSAT All-Sky Survey we detected a new gravitational arc around the BL Lac object RXJ 1745+398. This is the first AGN ever detected acting as a gravitational lens.

Here we report on high-resolution imaging of the field around RXJ 1745+398 in B, V, R, I and K' using the Nordic Optical Telescope on La Palma, the 3.5m telescope on Calar Alto as well as wide-field R band imaging using the 2.2m telescope on Calar Alto. The observations were supplemented by spectroscopy of the gravitational arc and the lense also using the Nordic Optical Telescope and the Calar Alto 2.2m telescope.

RXJ 1745+398 shows a striking similarity to the well studied gravitational lense A370. The gravitational arc has a length of $\approx 15''$, a diameter of $\approx 3''$ and is located $\approx 8''$ southeast of RXJ 1745+398. Within the arc several subcomponents can be identified. The integrated magnitude in V is ≈ 21 . The spectrum shows two emission lines which, if identified with H_β and [O III], sets the redshift of the gravitational arc to $z = 0.58$. The lense itself has a redshift of $z = 0.267$. Its brightness and morphology is typical for BL Lac host galaxies. Further away from the lense, several galaxies with an unusual morphology can be seen, which may be arclet candidates. Finally, RXJ 1745+398 is located in a rich cluster of galaxies.

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