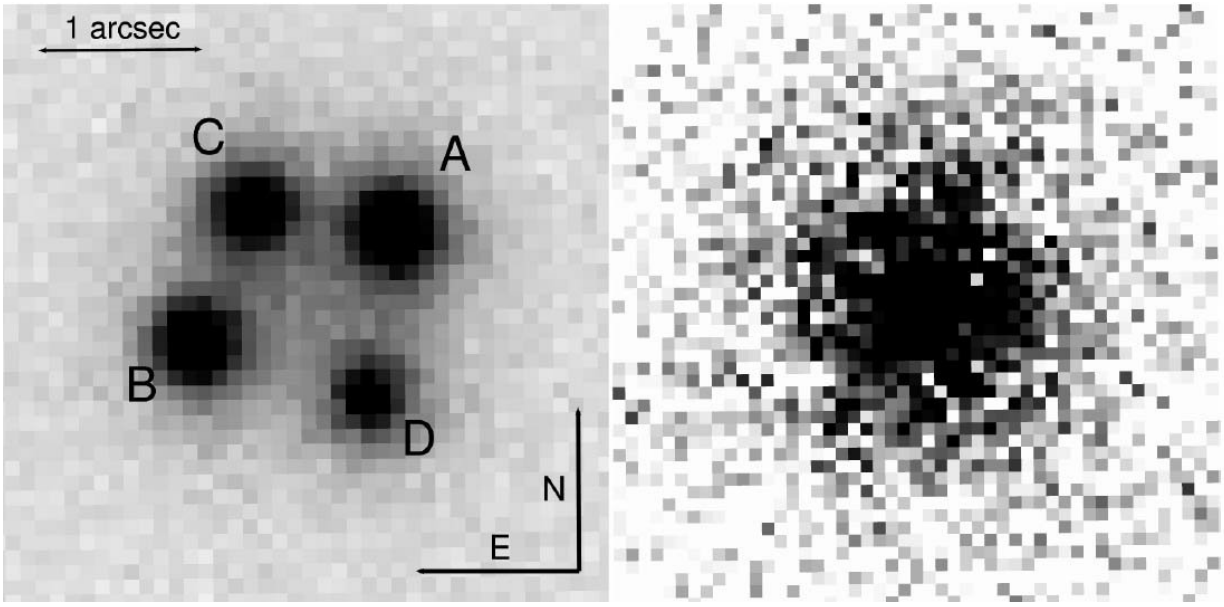
Gravitationally lensed quasars

November 19 2018



(left) A near-infrared image of a quasar whose light has been traveling for about 10 billion years and which has been distorted by an intervening galaxy into a reimaged (gravitationally lensed) set of four images of the same quasar. The right frame shows the faint intervening galaxy after subtraction of the four quasar images. Credit: Anguita et al. 2018

The path of light is bent by mass, an effect predicted by Einstein's theory of gravity, and when a massive galaxy or cluster lies along our line-of-sight to a more distant galaxy its matter will act as a lens to image the light from that object. So-called strong gravitational lensing creates highly distorted, magnified and often multiple images of a single source.

(Strong lensing is distinct from weak lensing which results in modestly deformed shapes of background galaxies.)

Quasars are galaxies with massive black holes at their cores around which vast amounts of energy are being radiated, more than from the rest of the entire host galaxy. Their luminosities allow quasars to be seen at cosmological distances and they are therefore likely candidates for strong lensing, with a few hundred gravitationally lensed quasars known so far. They have provided valuable information not only about quasars and lensing but also on cosmology since the distorted light paths of the distant objects have traveled across cosmological distances.

CfA astronomer David James was a member of a large international team systematically searching for new gravitationally lensed quasars. They used the WISE infrared all-sky survey to search for candidates whose infrared colors suggested they were galaxies with active nuclei (like quasars). They processed images of these candidates with a sophisticated algorithm looking for evidence of their being multiple components, such as would be expected from a lensed system, and then followed up this subset with spectroscopic and ground-based imaging observations using higher spatial resolution than WISE.

Of the original set of fifty-four candidates, they found two whose spectra confirmed that they were gravitationally lensed quasars, one with four sub-images and one with two, each of whose light has been traveling towards us for about ten billion years. The images in these two cases also showed traces of the lensing galaxy, an important verification of the lensing effect, although the galaxies were too faint to obtain measurements of their distances. The scientists also identified another seven objects that are likely to be doubled-quasars, but further research is needed to confirm those results.

More information: T Anguita et al. The STRong lensing Insights into

the Dark Energy Survey (STRIDES) 2016 follow-up campaign. II. New quasar lenses from double component fitting., *Monthly Notices of the Royal Astronomical Society* (2018). DOI: 10.1093/mnras/sty2172