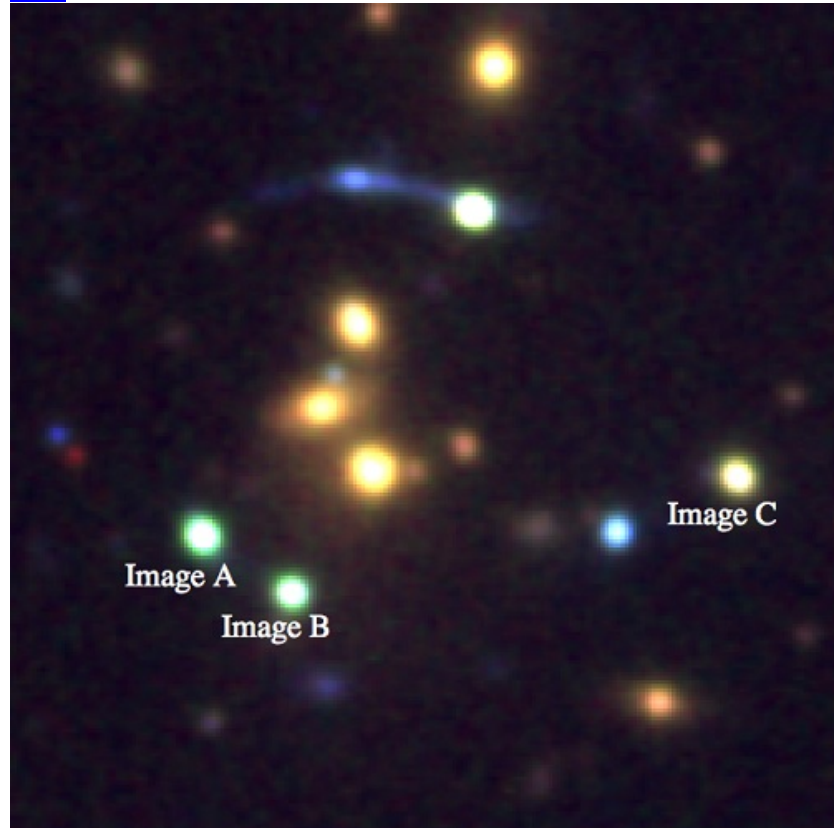


## Time Delay in Lensed Quasar: First Fast Turnaround Result

October 29, 2015

[Tweet](#)



30"x30" color composite g+r+i image using data from both Gemini and the NOT, highlighting the three brighter lensed quasar images for which time delays have now been measured. Image C leads all other images of the quasar by several years, and hence predicts the future behaviour. Lensing of quasars is achromatic, but the NOT data (r,i) and Gemini data (g) were taken at different times, and hence image C appears in this composite to be a different color than images A and B.

*A team of Norwegian and US astronomers, using data from Gemini North and the Nordic Optical Telescope (NOT), have measured the time delay in images of a quasar lensed by a foreground cluster of galaxies. The Gemini observations are the first published result obtained with the innovative Fast Turnaround (FT) mode of observing.*

A distant quasar may have its light split into multiple images by a foreground galaxy cluster that acts as a gravitational lens. The light travels along different paths of differing lengths to form each of these images. Quasars themselves are intrinsically variable, so the observed fading and brightening of each image happens at different observed times. Measuring these "time delays" yields tight constraints on the mass distribution in the lensing cluster, as well as the lensing geometry, and hence cosmology.

The team monitored the redshift  $z=2.82$  quasar SDSS J2222+2745 over the course of three years, using the NOT and Gemini+GMOS-N. They found a time delay of 48 and 722 days for two pairs of the quasar's lensed images. The Gemini data were instrumental in refining the time delay measurements for the quasar image that leads the other image by  $\sim 2$  years and hence predicts the behavior of other images of the quasar; continuing monitoring of the system will now allow further observations that take advantage of that 2 year peek into the future.

Under Gemini's FT mode, users can submit proposals every month and (if accepted) receive data 1-4 months after their initial proposal idea. The mode can be used for any kind of scientifically valuable project that needs just a few hours of observing time. Since the program's launch in January, it has been used to follow up discoveries of new solar system objects, obtain data sets needed to complete projects, and also for short, self-contained programs. For more information, see the FT web pages: <http://www.gemini.edu/sciops/observing-gemini/observing-modes/fast-turnaround>.

This work is available on Astro-ph at: <http://arxiv.org/abs/1505.06187>.

### Paper Abstract:

We report first results from an ongoing monitoring campaign to measure time delays between the six images of the quasar SDSS J2222+2745, gravitationally lensed by a galaxy cluster. The time delay between A and B, the two most highly magnified images, is measured to be  $\tau_{AB}=47.7\pm 6.0$  days (95% confidence interval), consistent with previous model predictions for this lens system. The strong intrinsic variability of the quasar also allows us to derive a time delay value of  $\tau_{CA}=722\pm 24$  days between image C and A, in spite of modest overlap between their light curves in the current data set. Image C, which is predicted to lead all the other lensed quasar images, has undergone a sharp, monotonic flux increase of 60-75% during 2014. A corresponding brightening is firmly predicted to occur in images A and B during 2016. The amplitude of this rise indicates that time delays involving all six known images in this system, including those of the demagnified central images D-F, will be obtainable from further ground-based monitoring of this system during the next few years.

Gemini Observatory Participants



*Gemini's mission is to advance our knowledge of the Universe by providing the international Gemini Community with forefront access to the entire sky.*

*The Gemini Observatory is an international collaboration with two identical 8-meter telescopes. The Frederick C. Gillett Gemini Telescope is located on Mauna Kea, Hawai'i (Gemini North) and the other telescope on Cerro Pachón in central Chile (Gemini South); together the twin telescopes provide full coverage over both hemispheres of the sky. The telescopes incorporate technologies that allow large, relatively thin mirrors, under active control, to collect and focus both visible and infrared radiation from space.*

*The Gemini Observatory provides the astronomical communities in five participant countries with state-of-the-art astronomical facilities that allocate observing time in proportion to each country's contribution. In addition to financial support, each country also contributes significant scientific and technical resources. The national research agencies that form the Gemini partnership include: the US National Science Foundation (NSF), the Canadian National Research Council (NRC), the Chilean Comisión Nacional de Investigación Científica y Tecnológica (CONICYT), the Brazilian Ministério da Ciência, the Argentinean Ministerio de Ciencia, Tecnología e Innovación Productiva, Tecnología e Inovação and the Korea Astronomy and Space Institute (KASI). The observatory is managed by the Association of Universities for Research in Astronomy, Inc. (AURA) under a cooperative agreement with the NSF. The NSF also serves as the executive agency for the international partnership.*

*Last Modified: October 31, 2017, jsilva*

*[Sitemap](#) | [Website Chilean Mirror](#)*