COSMOGRAIL: the COSmological MOnitoring of GRAVitational Lenses

New results on HE0435-1223

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ABSTRACT

We present the brand new results of the COSMOGRAIL Collaboration, gathering scientists from five countries and using telescopes located around the globe. The ultimate aim is to measure the Hubble constant through optical light curves of gravitationally-lensed quasars obtained from long-term monitoring. This poster concerns the quadruply imaged quasar HE0435-1223. It shows intrinsic variations and therefore it has been monitored by three telescopes during four years. Moreover Hubble Space Telescope images are used to accurately determine the relative position of the source images and the shape parameters of the lensing galaxy. The team is now working on the next steps of the process which will eventually lead to a measurement of H₀.

1. Ground-based Monitoring

- **Object**: HE0435-1223 = quadruply imaged quasar (Wiziotzki et al., 2000 & 2002)
- **Monitoring**: 4 years (January 2004 to February 2008) using 3 telescopes
  - the Swiss 1.2m Euler telescope (La Silla)
  - the Belgian-Swiss 1.2m Mercator telescope (La Palma)
  - the 1.5m telescope at Maidanak Observatory (Uzbekistan)
- **Reduction** (method by Vuissoz et al., 2007 & 2008):
  - reference frame = image with the best seeing in the Euler data set
  - application of a spatial scale factor to Mercator and Maidanak images
  - alignment of all the images on the reference frame through the calculation of a geometrical transformation based on several reference stars in the field which are also used to measure the flux factor
  - fit of the Point Spread Function for each frame on 4 neighbouring stars
- **Extra material**: 2 years of monitoring by Kochanek et al. (2006) from August 2003 to April 2005 obtained with the 1.3m SMARTS telescope (Cerro Tololo)

2. Photometric Light Curves

- **Data**: flux of the 4 sources in each frame
- **Reference**: Euler telescope (arbitrarily chosen)
- **Flux scale of SMARTS data**: comparison to the fluxes obtained during common nights with Euler
- **One point in the graph**: mean per epoch (= per night)
- **Error bars**:
  - statistical noise = standard deviation of the mean of an epoch
  - systematic errors = estimated thanks to the deconvolution of a star in the field

3. Near-IR Imaging

- **Instrument**: camera 2 of HST/NICMOS (Near-Infrared Camera and Multi-Object Spectrometer)
- **Material**: 4 dithered frames through the F160W filter
- **Total exposure time**: 55 minutes
- **Method**: iterative process using the MCS deconvolution algorithm (see Chantry & Magain, 2007 for details)
- **Final reduced χ²**: 1.66
- **Final pixel scale**: 0.038"

4. Next Steps

- **Time delay measurement**: numerical fit (Burud et al., 2001; see poster of E. Elbers) + polynomial fit (Kochanek et al., 2006) of the light curves + the minimum dispersion method (Petit et al., 2006)
- **Parametric modelling**: Lensmodel (Keeton et al., 1997) and Semilinear Inversion (Warren & Dye, 2003)
- **Non-Parametric modelling**: PixeLens (Williams & Saha, 2000)
- **Measurement of H₀**: see the paper (Chantry et al., in preparation) for details

Related Papers

- Keeton et al., in prep.