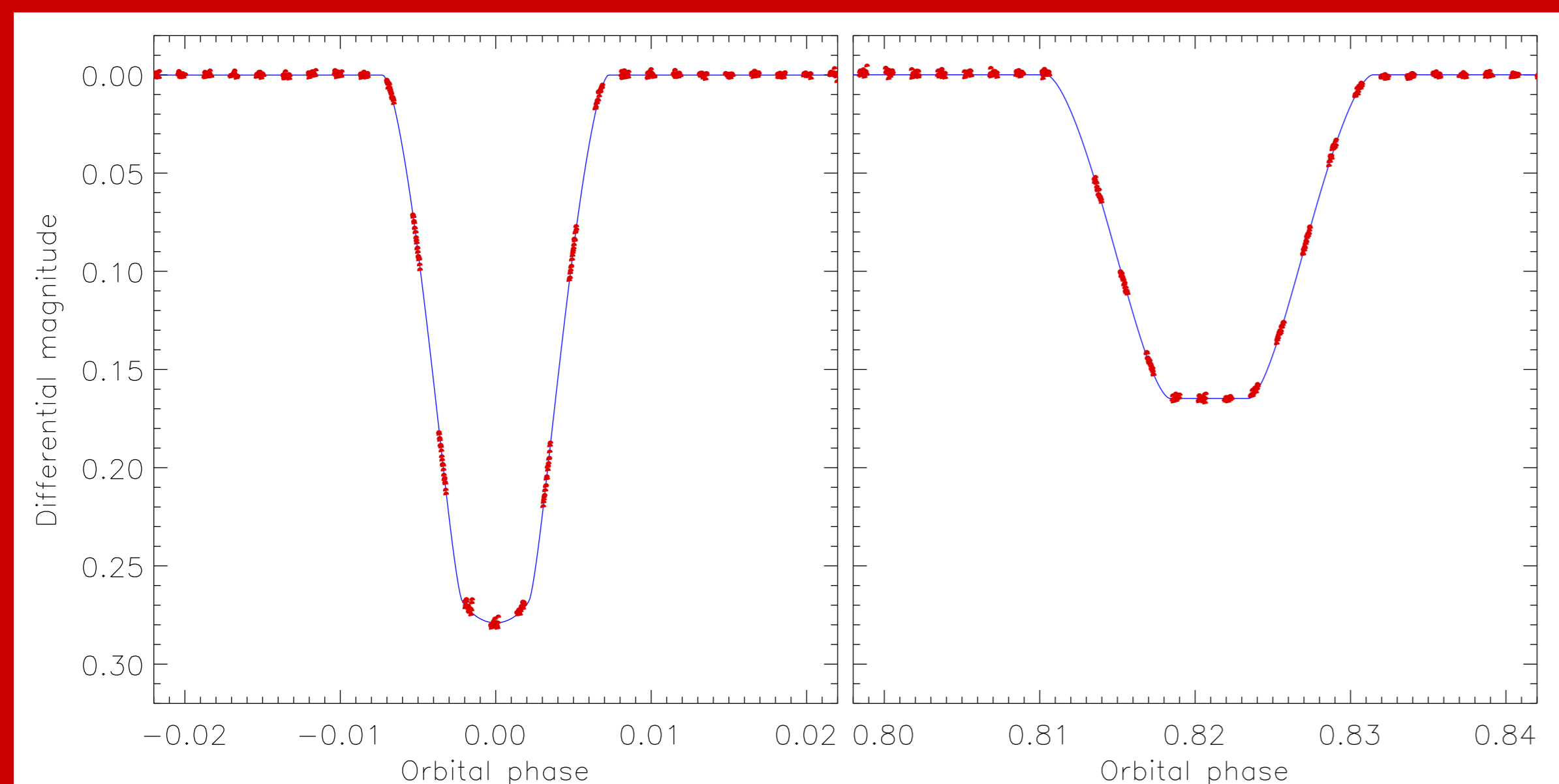


# SPACE OBSERVATIONS OF ECLIPSING BINARY STARS

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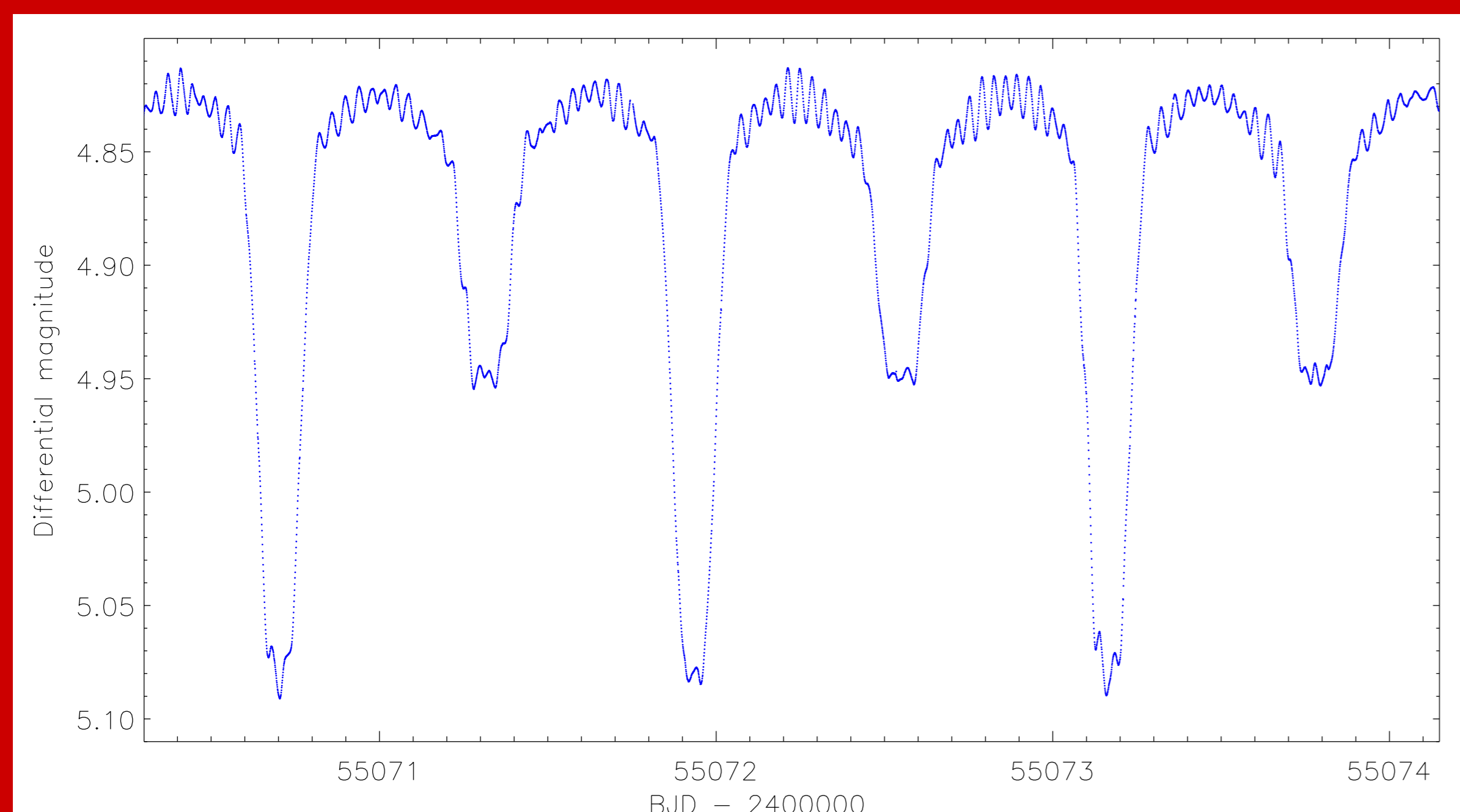
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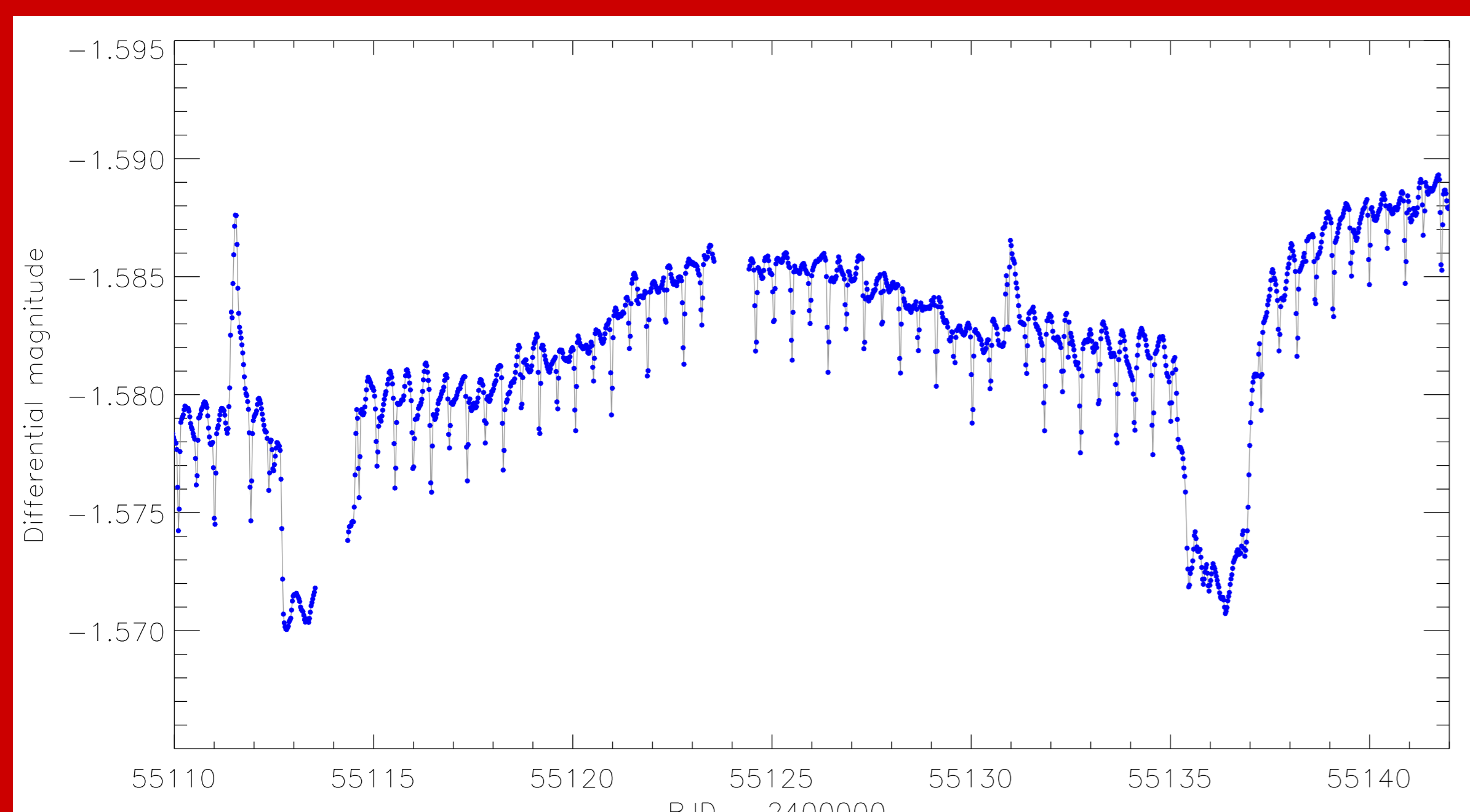
WIRE satellite light curve of  $\psi$  Centauri, a totally-eclipsing binary system with an orbital period of 38.8 d and A-type component stars (Bruntt et al., 2006).

The WIRE satellite was launched into a polar orbit in March 1999 in order to obtain infrared photometry of galaxies, but an early failure of the coolant system rendered it unable to attempt its primary mission. WIRE was also equipped with a 5cm-aperture star tracker, which was used as a high-speed photometer until October 2006 when communications with the satellite were lost (Bruntt & Southworth, 2008). The science targets included the eclipsing binary systems  $\psi$  Centauri (see above) and  $\beta$  Aurigae (see right), which were each observed for more than one month.



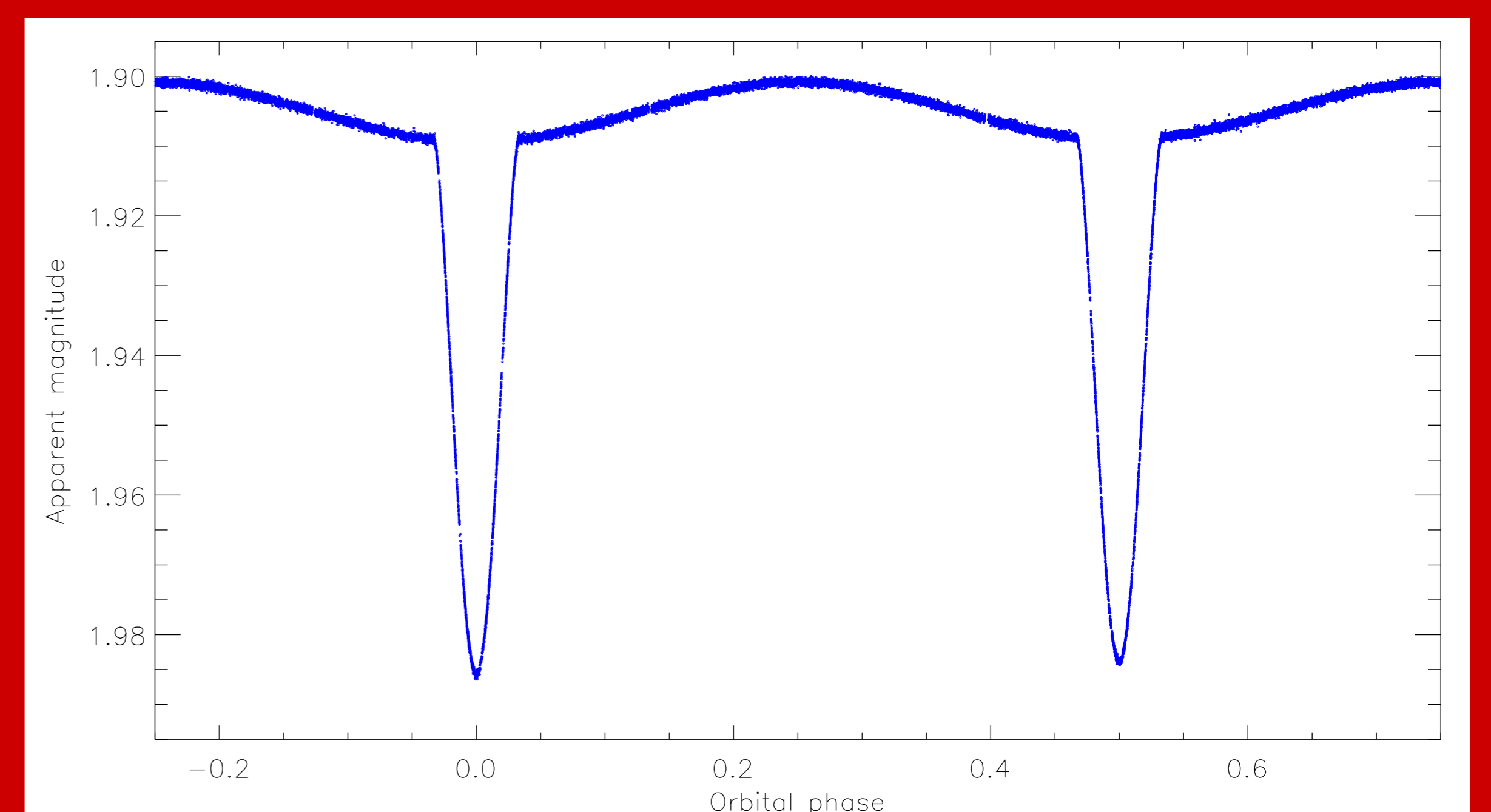
Kepler satellite light curve of KIC 10661783, a totally-eclipsing binary showing 58 individual  $\delta$  Scuti oscillation frequencies (Southworth et al., 2011).

KASC (The Kepler Asteroseismic Consortium) is a European-led effort to use *Kepler* satellite data to perform asteroseismology on large numbers of stars (Gilliland et al., 2010). Within this consortium, Working Group 9 is responsible for over 100 binary stars systems on the KASC target list. These systems comprise detached, semi-detached and contact eclipsing binaries both with and without pulsations. Several of these are giant-star systems such as KIC 8410638 (see right) and KIC 5952403 (see below).



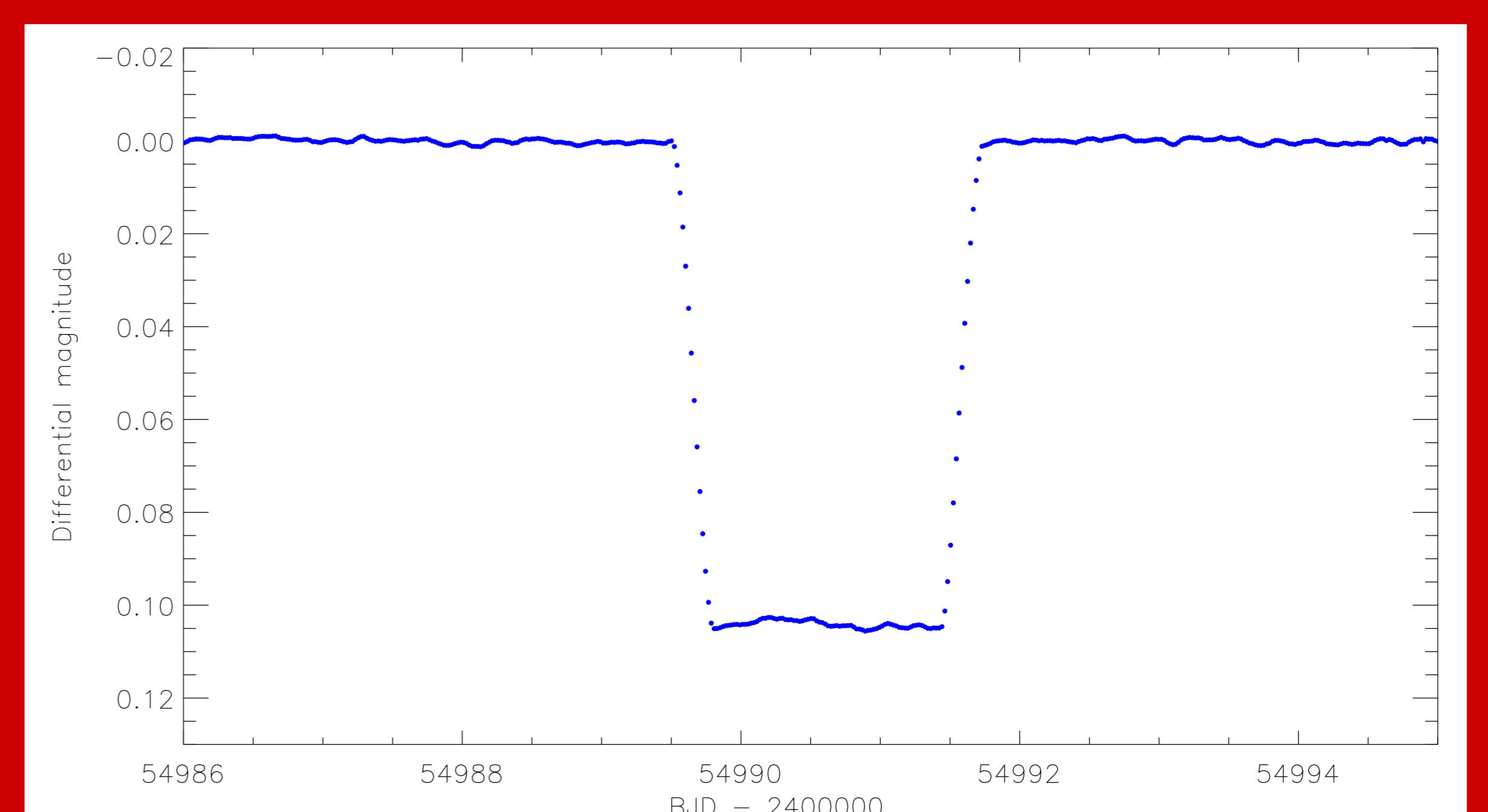
Kepler satellite light curve of KIC 5952403, a doubly-eclipsing triple system. It contains an G-type giant in a 45 d eclipsing orbit with a 0.9 d eclipsing binary composed of two late-type dwarfs (Derekas et al., 2011).

The study of eclipsing binary stars benefits from extensive high-precision photometry. They are therefore natural candidates to be observed from space, where telescopes are free of the Earth's atmospheric scintillation, extinction, diurnal variations and weather. Several of the earlier generations of space satellites observed eclipsing binaries, including *Voyager*, IUE and OAO-II. *Hipparcos* discovered 343 new ones, but obtained only a modest number of epochs for each of them. Since then, the WIRE, MOST, CoRoT and *Kepler* missions have obtained extensive observations of an increasing number of eclipsing binaries. The future holds the enticing prospect of PLATO, which will obtain even more sizeable and higher-precision data.



WIRE satellite light curve of the 3.96 d period  $\beta$  Aurigae, the first known eclipsing binary with a double-lined spectrum (Southworth et al., 2007).

The *Kepler* satellite was launched in March 2009 and is dedicated to finding new extra-solar planets by the transit method (Borucki et al., 2010). The high-quality photometry it obtains is also excellent for studying eclipsing binaries. Short-cadence photometry of KIC 10661783 (see left) showed it to be an oEA system: a semi-detached binary in which the primary star exhibits  $\delta$  Scuti oscillations (Southworth et al., 2011). We were able to extract 58 oscillation frequencies from the available data, at which point we ran out of frequency resolution. Further observations have been obtained by *Kepler* and will certainly reveal a multitude of new pulsation modes in this system.



Kepler satellite light curve of the long-period eclipsing binary system KIC 8410637, which contains an oscillating giant star (Hekker et al., 2011).

## References

- Borucki W., et al., 2010, *Science*, 327, 977
- Bruntt H., Southworth J., 2008, *JPhys. Conf. Ser.* 118, 012012
- Bruntt H., et al., 2006, *A&A*, 456, 651
- Derekas A., et al., 2011, *Science*, 332, 216
- Gilliland R. L., et al., 2010, *PASP*, 122, 131
- Hekker S., et al., 2010, *ApJ Letters*, 713, L187
- Southworth J., Bruntt H., Buzasi D. L., 2007, *A&A*, 461, 1077
- Southworth J., et al., 2011, *MNRAS*, 414, 2413