

KIC2696703, A Kepler Eclipsing Binary System

with Gamma Dor Pulsations

Aunia Samadi Gh^{1,2}, Timothy Van Reeth¹, Andrew Tkachenko¹

¹ Institute for Astronomy, KU Leuven· Leuven, Belgium

²Astrophysics Department, Physics Faculty, University of Tabriz, Tabriz, Iran

KU LEUVEN

samadi.aunia@tabrizu.ac.ir
samadi.aunia@gmail.com

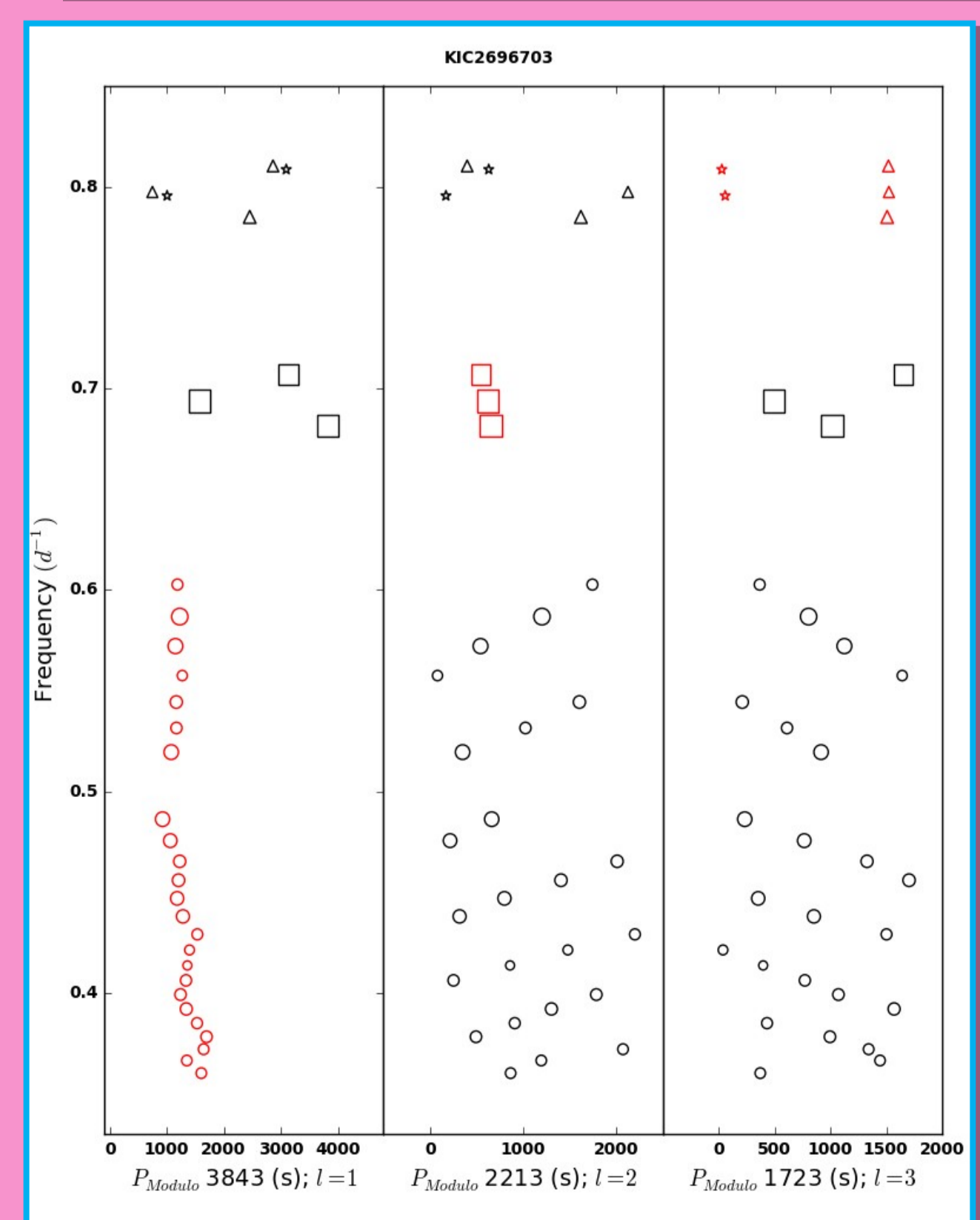
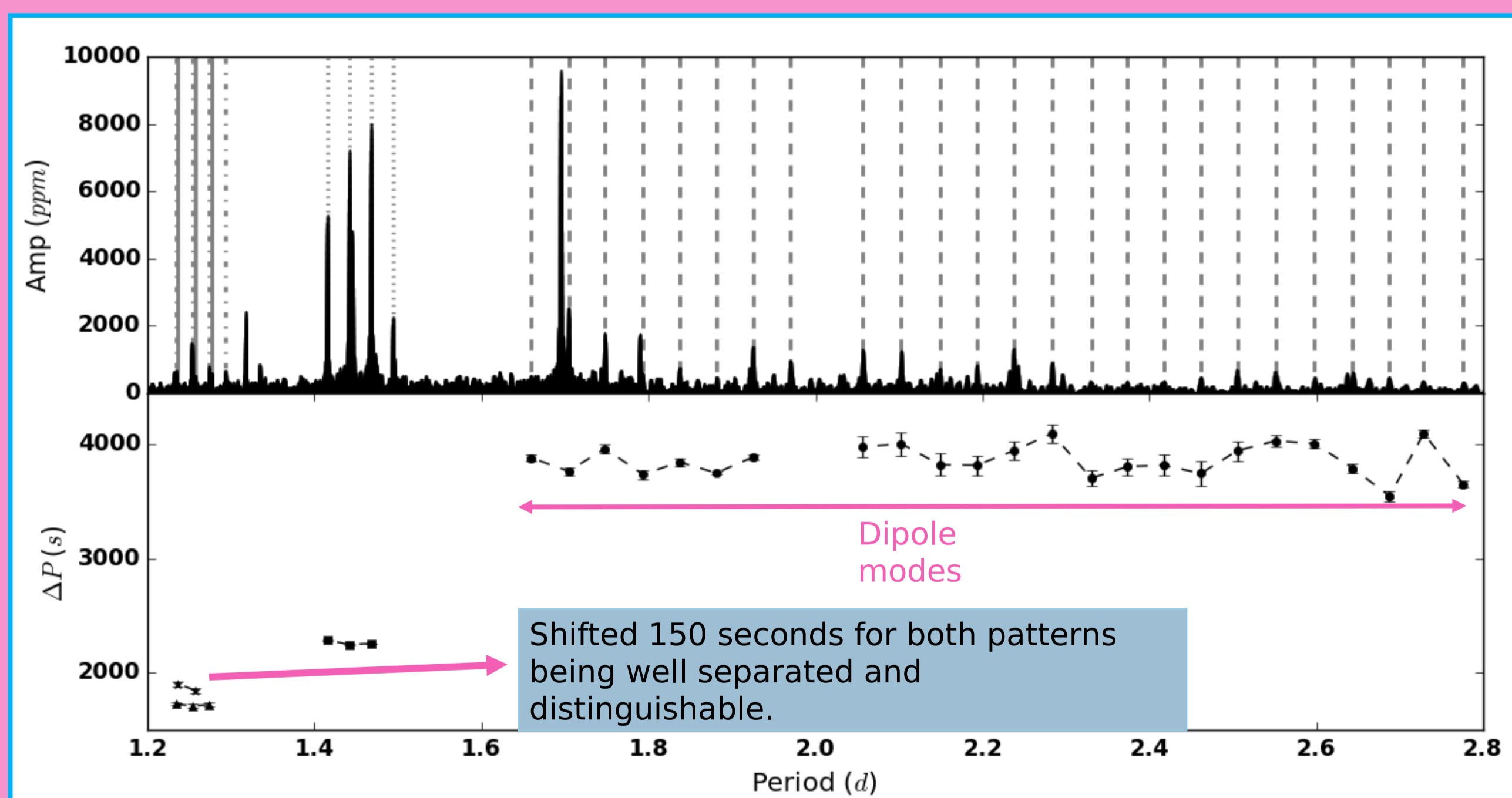
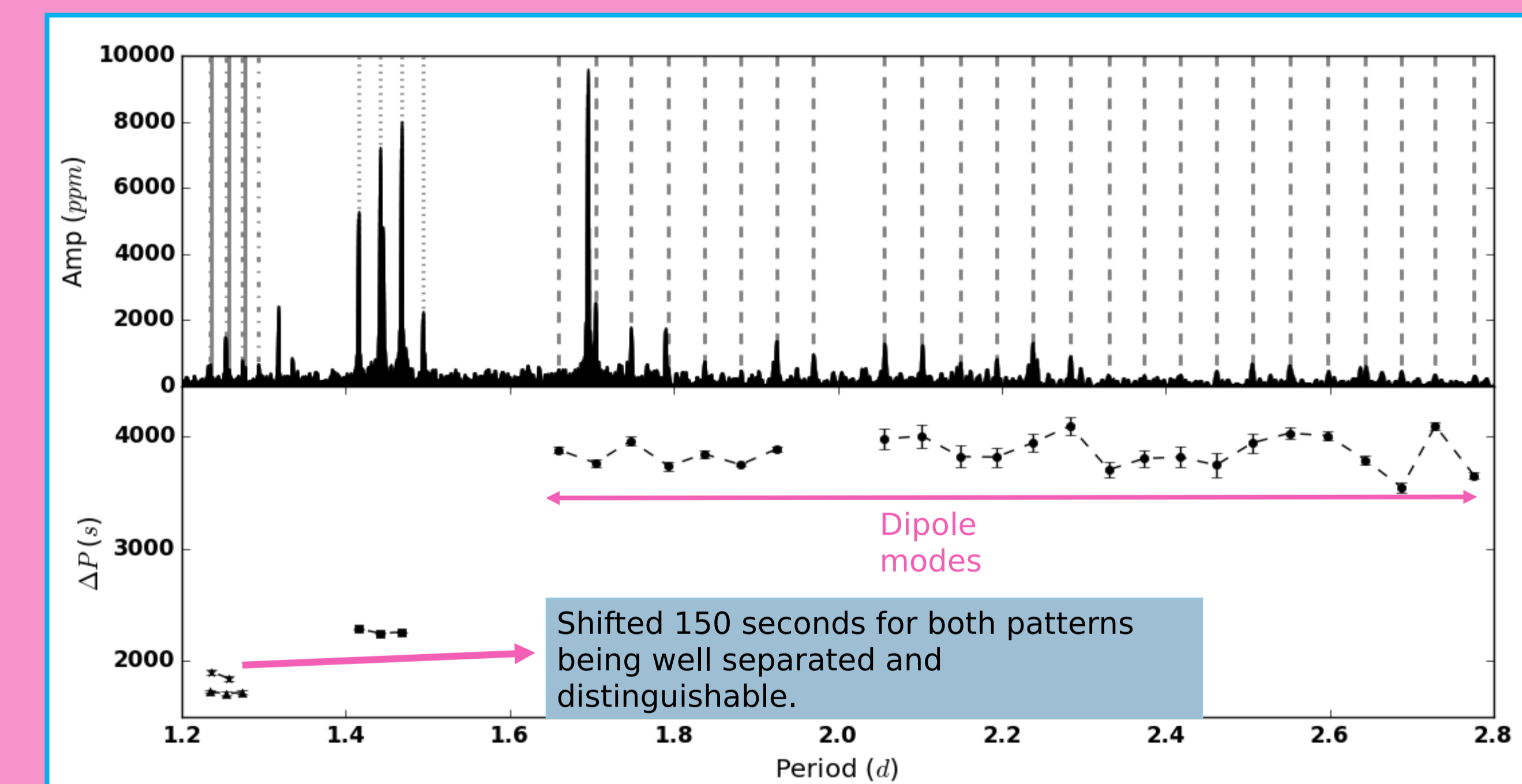
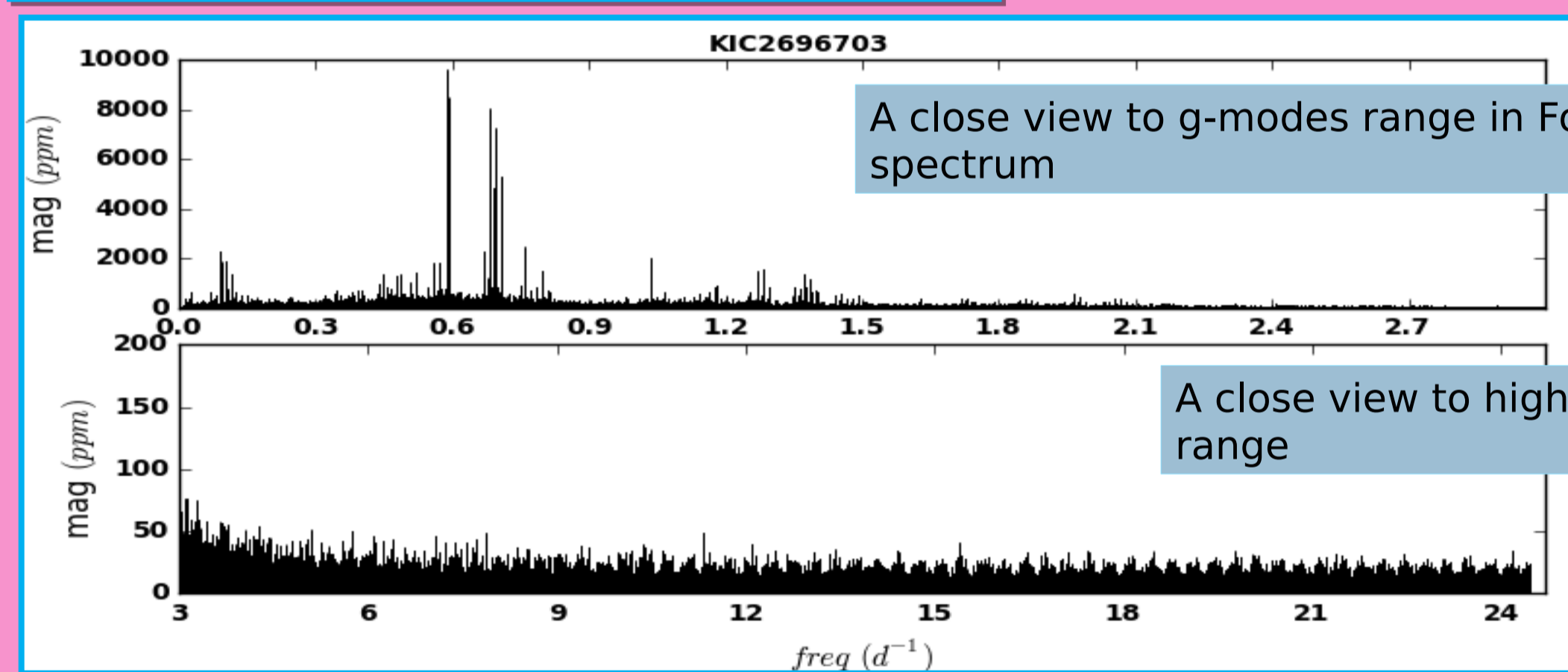
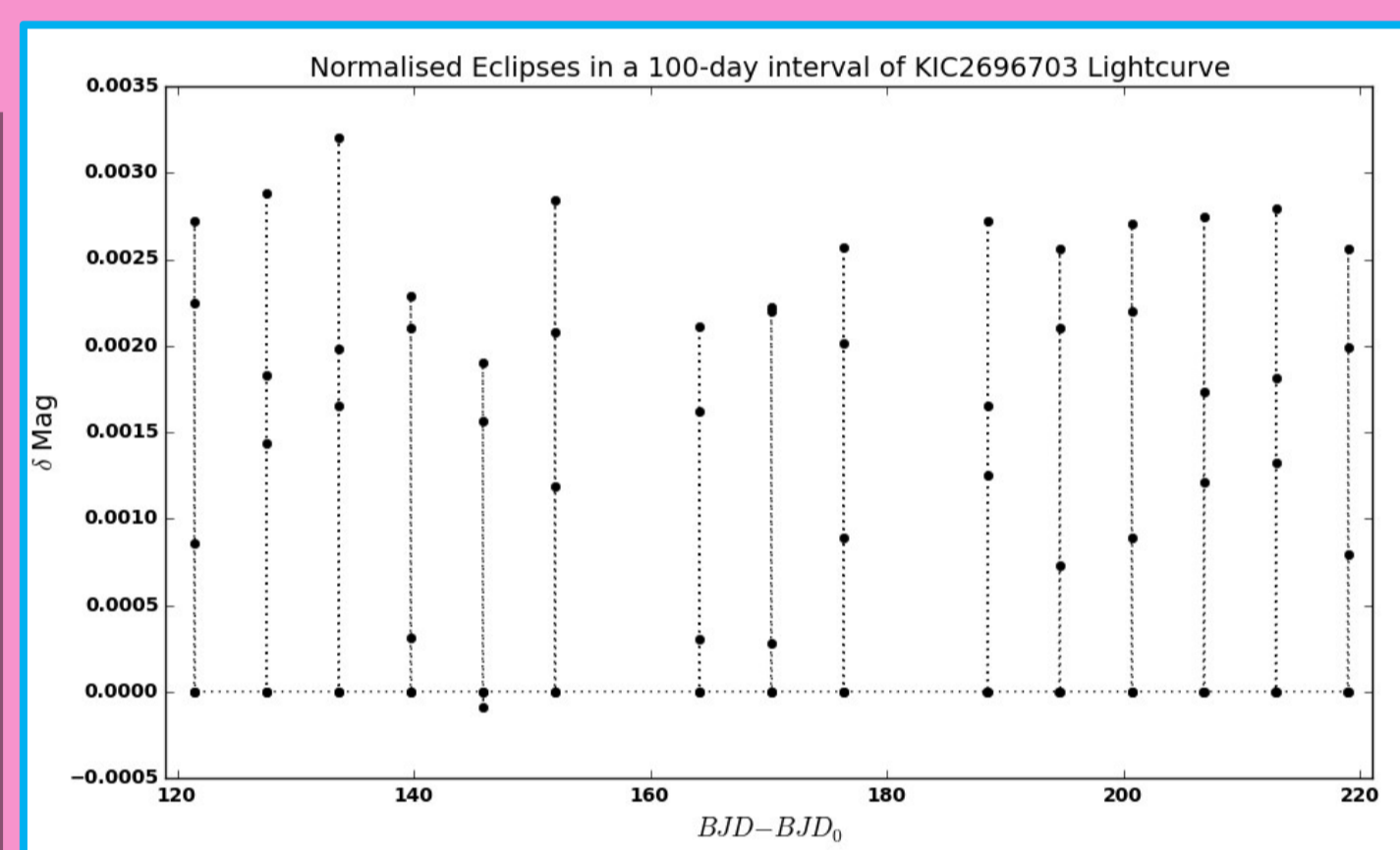
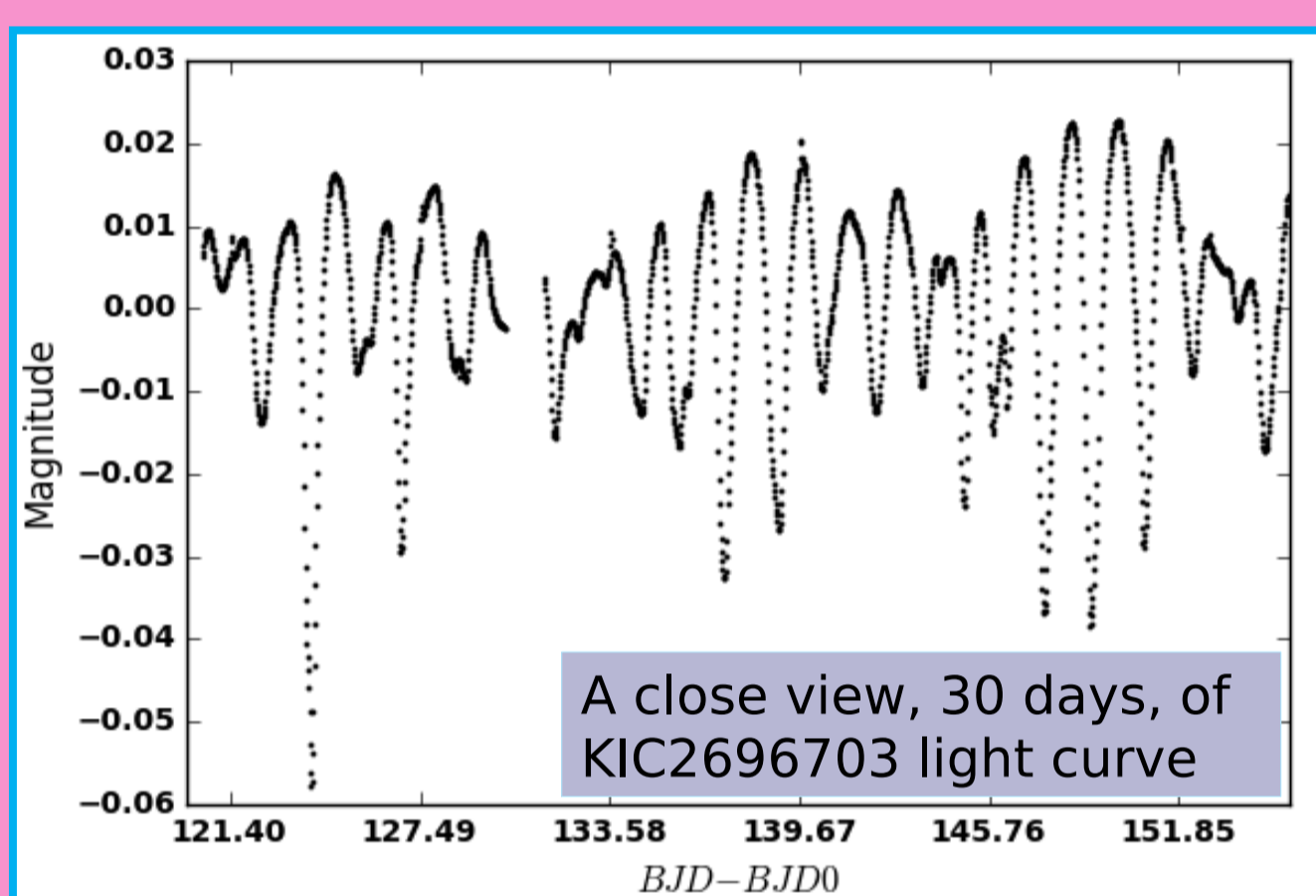
Why Asteroseismology of Binary stars?!

- Binary systems: The main source of precise fundamental properties of stars (masses, radii, chemical compositions ...).
- Key ingredients in many applications in stellar astrophysics (internal structure and evolution of stars)
- The theories of stellar structure and evolution: Best probed with asteroseismology
- Asteroseismology + Binary stars → To test and improve the current theoretical models.

Overview

- Observations:
- Kepler space-based photometry + HERMES High-resolution ground-based spectroscopy
- Investigating:
- KIC2696703: A short-period ($P \sim 6.0945$ d) eclipsing binary system
- Two nearly twin F-type stars ($m_1/m_2 \sim R_1/R_2 \sim 1$)
- Intrinsic variability in terms of gamma Dor-type g-mode oscillations
- A series of consecutive low-order harmonics of orbital frequency, $f_{orb} = 0.1641$ per day were detected which can't impose tidal effects on pulsations.
- The two stars are found to rotate synchronously with the orbit of the binary system
- Four series of pulsation periods. These may originate from the same star or both and can be identified as one dipole series, one quadrupole series and two octopole series, where one may originate from primary and the other for secondary.

Pulsation study



BD+373347
Kepler mag 9.580



Spectroscopy

Model independent Methods For extracting stellar atmospheric and dynamic parameters



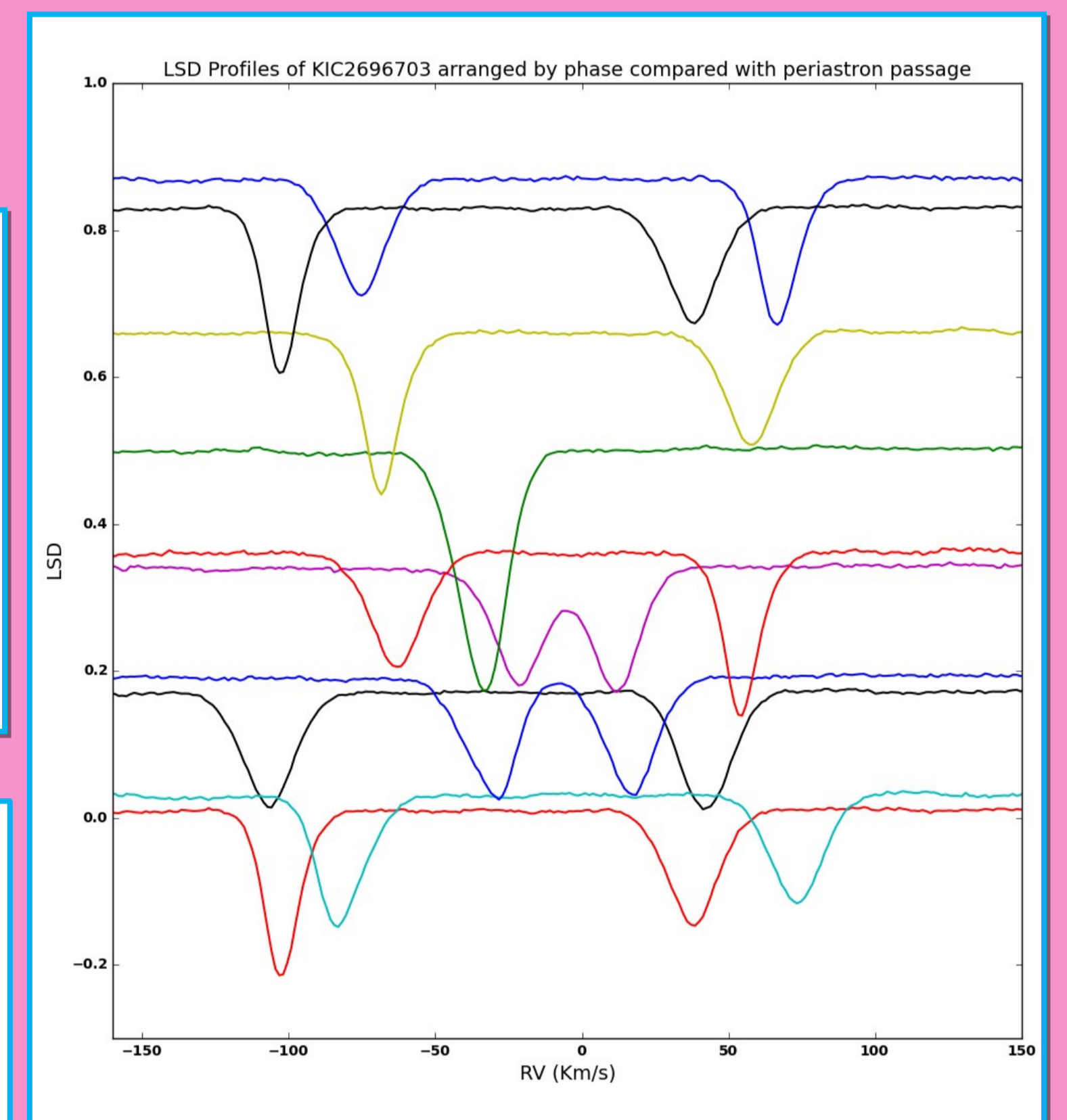
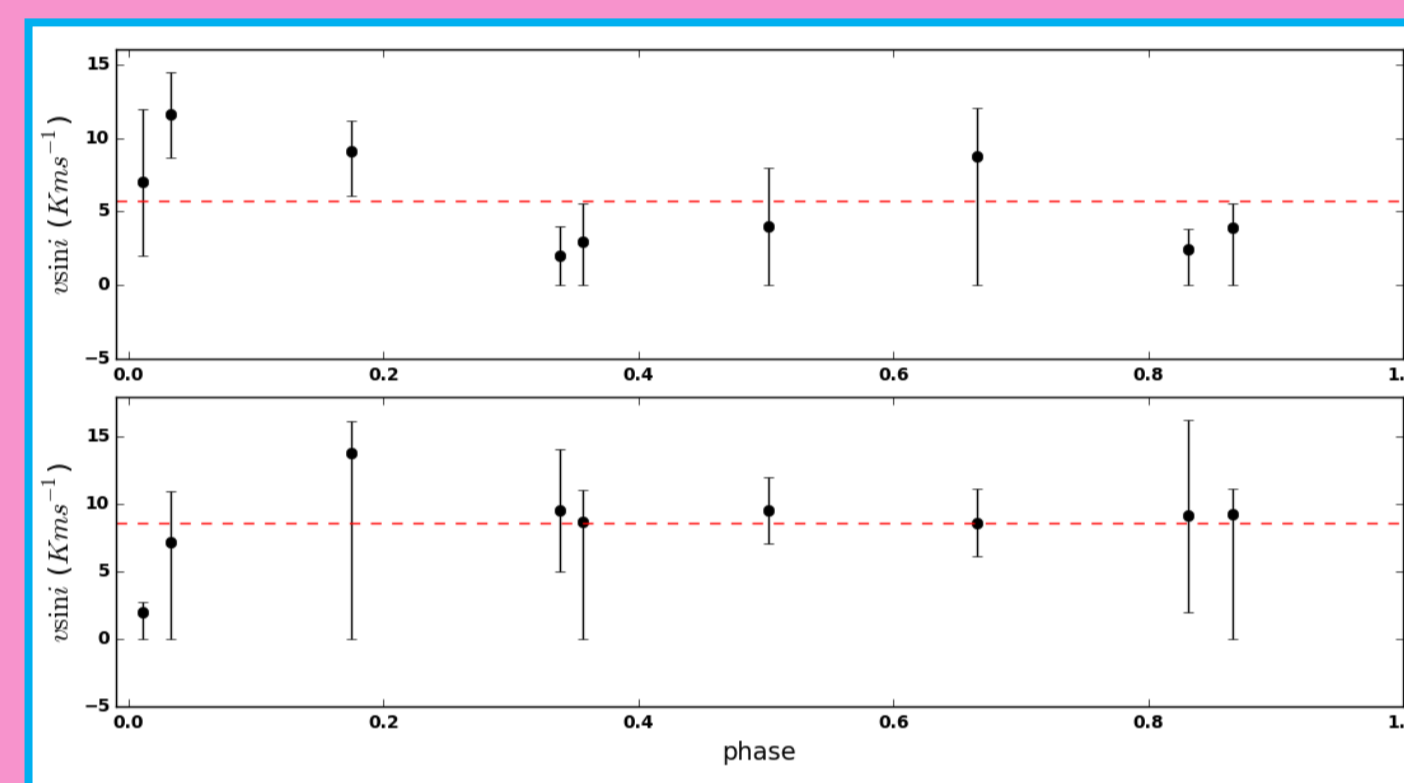
HERMES @ 1.2 m. Mercator Telescope
 • Wavelength range from 380 to 900 nm
 • spectral resolution of $R = 85000$

1. Grid Search in Stellar Parameters

(Tkachenko 2015)
 Done by two high resolution Spectra out of 3 which was observed in 2015, iteratively. The rest 7 spectra were observed in 2013.

2. LSD Profiles and Stellar Parameters

(Van Reeth et al. 2013)



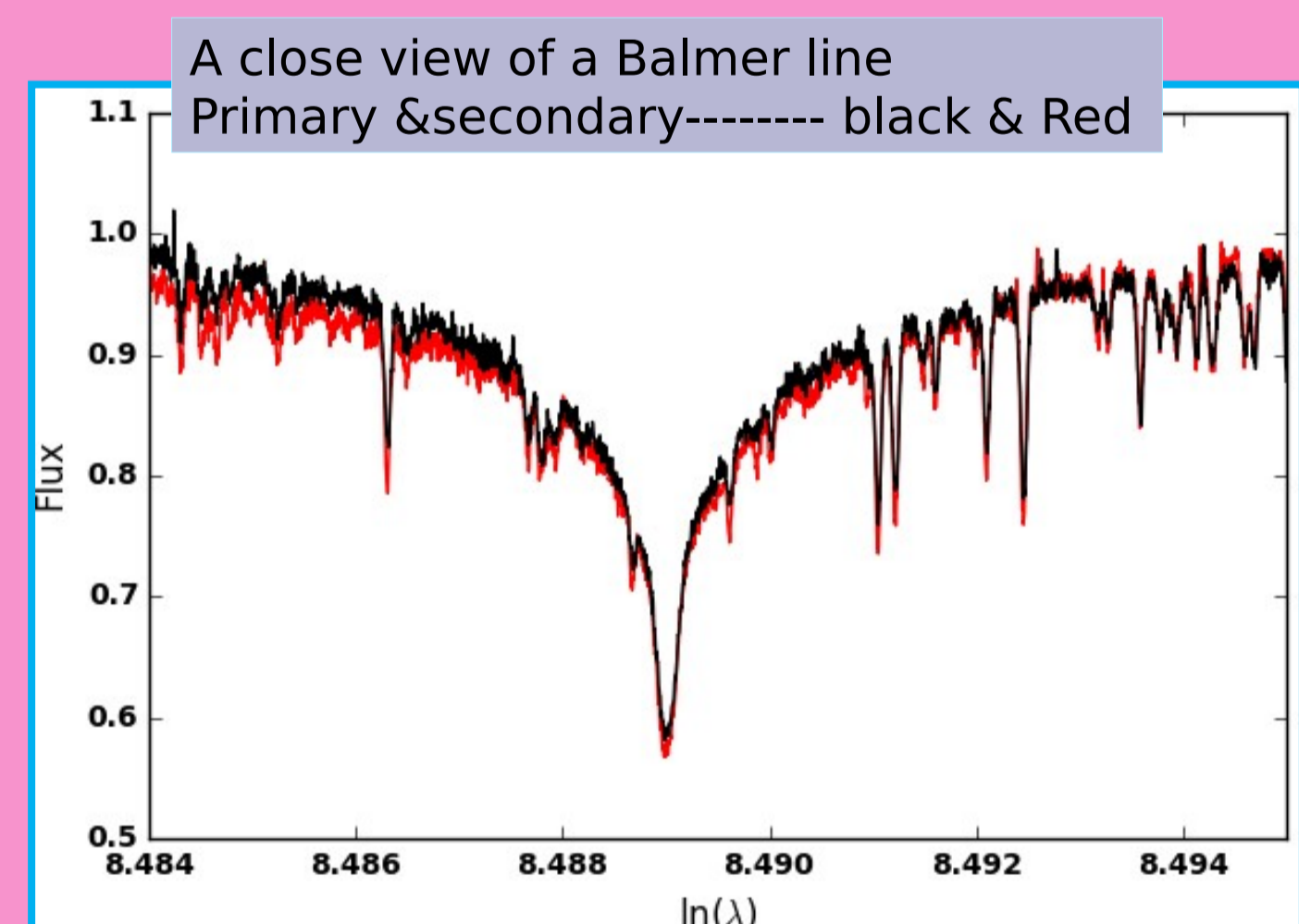
From bottom to top
 496337:red,
 497181:cyan,
 641369:black, 497479:blue,
 496571:magenta, 497745:red,
 641502:green,
 496876:yellow,
 641640:black, 496007:blue.

Parameter	Primary	Secondary
e	0.0223 ± 0.0007	
K (km s^{-1})	84.47 ± 0.89	83.73 ± 0.7
γ (km s^{-1})	-20.17 ± 0.25	

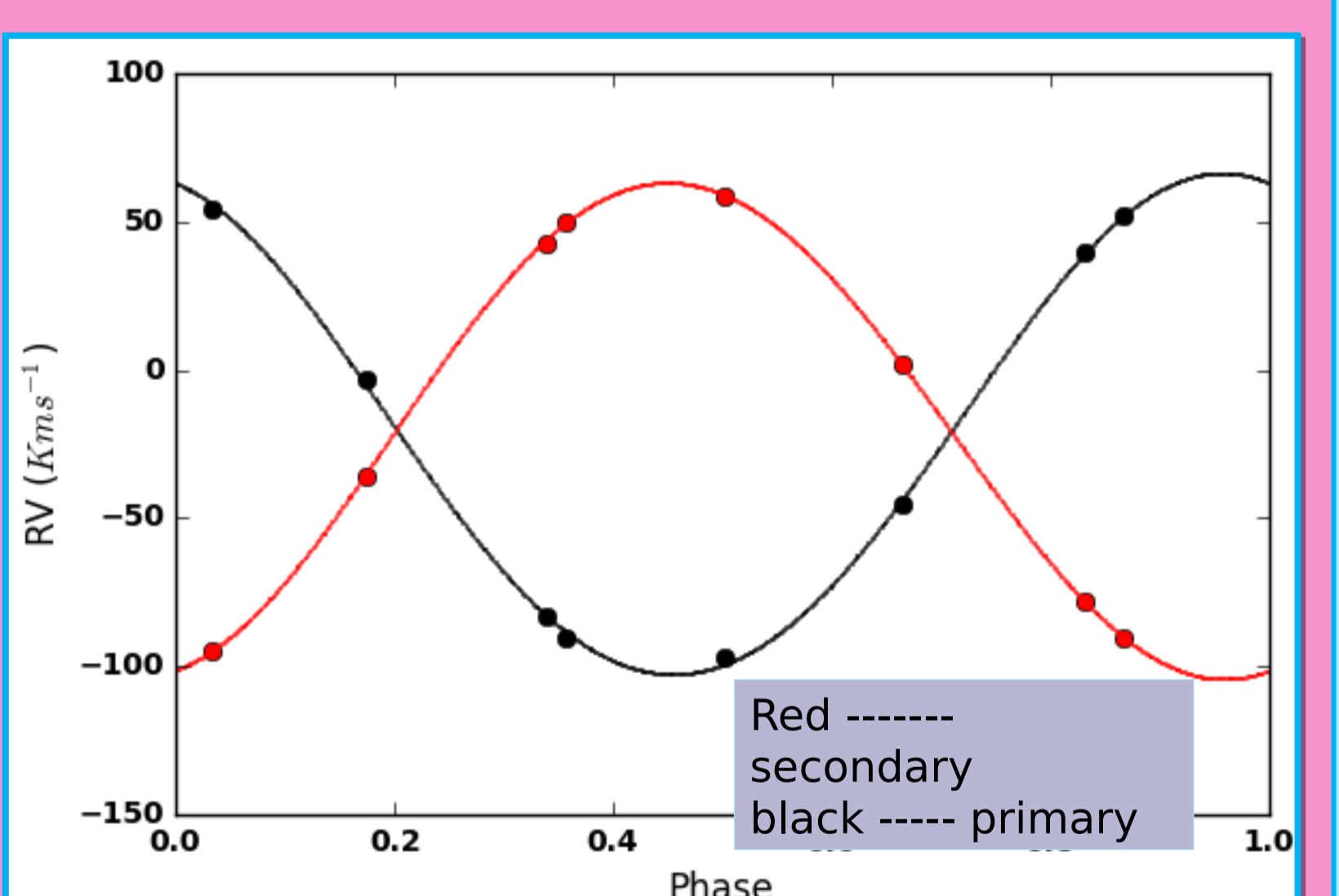
Parameter	Primary	Secondary
e	0.025 ± 0.002	
K (km s^{-1})	84.5 ± 0.2	83.9 ± 0.2
γ (km s^{-1})	-20.17 ± 0.25	
ω (deg)	15.7 ± 3.3	
t_0 (JD)	2457165.43 ± 0.06	
q ($\frac{m_2}{m_1}$)	1.0073 ± 0.0004	
v_2/v_1	0.992 ± 0.003	
$a_{1,2} \sin i$ (R_\odot)	10.17 ± 0.01	
$m_{1,2} \sin^3 i$ (M_\odot)	1.501 ± 0.001	

4. FDBinary code and Orbital Parameters

- (Ilijic et al. 2004)
- Nine composite spectra (excluding 641502) as input



3. Fitting a Keplerian orbit and orbital parameters



Acknowledgement

This research is based on the data gathered with NASA's Discovery mission Kepler with the HERMES spectrograph, installed at the Mercator telescope, operated on the island of La Palma by the Flemish Community, of the spanish observatorio del Roque de Los Muchachos of the Instituto de Astrofísica de Canarias and supported by the Fund for Scientific Research of Flanders (FWO), Belgium, the research Council of KU Leuven, Belgium, The Fonds National de Recherche Scientifique (F.R.S.-FNRS), Belgium, The Royal Observatory of Belgium, the Observatoire de Genève, Switzerland, and the Thueringer Landessternwarte, Tautenburg, Germany.

- Special Thanks to "Exploitation of Space Data for Innovative Helio- and Asteroseismology", Space Inn project; European Helio- and Asteroseismology Network
- Special Thanks to Prof. Conny Aerts, KU LEUVEN and Prof. D. M. Jassur University of Tabriz

References

- Aerts, C., Christensen-Dalsgaard, J., Kurtz, D. W. 2010, Asteroseismology, Astronomy and Astrophysics Library, Springer Berlin Heidelberg
- Ilijic, S., Hensberg, H., Pavlovski, K., Freyhammer, L. M. 2004, ASP Conf. Ser., 318, 111
- Tkachenko, A. 2015, A&A, 581, A129
- Tsymbal, V. 1996, ASP Conf. Ser., 108, 198
- Van Reeth, T., Tkachenko, A., Tsymbal, V. 2013, EAS Publications Series, 64, 237-244
- Van Reeth, T., et al. 2015a, A&A, 574, A17