New windows on massive stars: asteroseismology, interferometry, and spectropolarimetry
Proceedings IAU Symposium No. 307, 2014
G. Meynet, C. Georgy, J. H. Groh & Ph. Stee, eds.

doi:10.1017/S1743921314006437

Study of environment and photosphere of 51 Oph

N. Jamialahmadi, Ph. Berio, B. Lopez, A. Meilland and Ph. Stee

Laboratoire D.-L. Lagrange, UMR 7293 UNS-CNRS-OCA, Boulevard de l'Observatoire, CS 34229, 06304 NICE Cedex 4, France
email: jami@oca.eu

Abstract. The main objective of this work is to improve our understanding of young fast-rotating stars evolving from the Herbig Ae/Be class to the Vega-like one. We observed with the VEGA instrument on CHARA one object so-called 51 Oph that is probably in such an evolutionary phase, allowing us to measure a mean stellar radius for the first time for this star and to show that the Hα emission was produced in a Keplerian rotating disc. However, additional observations are needed to improve our (u,v) plan coverage in order to measure the flattening of this close-to-critically rotating star and to probe the inner region of its circumstellar gaseous disc. These studies will help to disentangle the gas and dust emission around this late young star and will finally improve our understanding of the planet formation conditions in the inner regions of protoplanetary discs.

Keywords. stars: atmospheres, stars: fundamental parameters, stars: emission-line, stars: Be, stars: kinematics

1. Introduction

51 Ophiuchi (51 Oph) is a rapidly rotating B9.5 Ve star located at 131 pc (Perryman *et al.* 1997) with V magnitude of 4.83 (Mendigutía *et al.* 2012) and age of 0.3×10^6 years (van den Ancker *et al.* 1998) with mass of $\sim 4\,M_\odot$. It appears to be a peculiar source in an unusual transitional state. However, many uncertainties remain on 51 Oph classification in the HR diagram. The spatial structure of the 51 Oph dust disk also remains puzzling. So, this star would be an interesting object for us to figure out because, the gas has not dissipated and may still allow the on going formation and growth of gaseous giant planets.

2. Interferometric observations

51 Oph was observed at medium spectral resolution (R = 5000) with the VEGA instrument (Mourard *et al.* 2009), on CHARA array at Mount Wilson Observatory (California, USA, ten Brummelaar *et al.* 2005). We observed this star in both the continuum and chromospheric spectral line. We selected Hα Balmer line (656.2 nm). We select the calibrators using the SearchCal tool developed at JMMC (Bonneau *et al.* 2006), providing an estimate of the limb-darkened (LD) angular diameter ($\theta_{\rm LD}$).

3. Fundamental parameter and gaseous disk

3.1. *Angular diameter as a fundamental parameter*

The squared visibilities in the continuum around Hα are fitted with a model of UD disk (see Fig.1). We estimated the angular diameter of 0.39 ± 0.001 mas for the first time for this star.

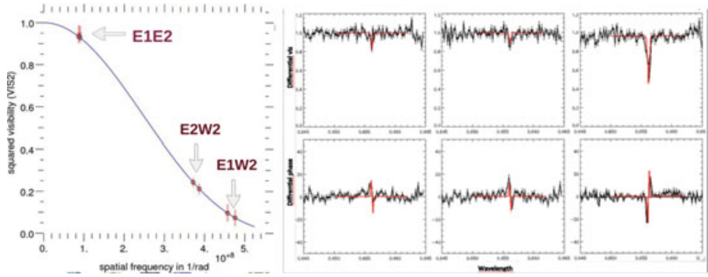

Figure 1. Left: The squared visibility to estimate the angular diameter. The top two points correspond to baseline E1E2, the middle points E2W2 and the down points E1W2. Right: The best fit model for differential visibilities and phase. The red line is model and black line is observational data for Hα line. Clear jumps in the differential phase and differential visibility at the center of the Hα 656.5 nm line are revealed for this star observed at medium spectral resolution.

3.2. *Gaseous disk*

Information related to the position of the photocenter of the gaseous disk can be deduced by measuring the phase of the differential visibility in the narrow spectral bands. This observable has been intensively used to study the kinematic of circumstellar environments. According to Fig.1 (Right), using a keplerian disk model, we succeed to fit our VEGA data. With this fitting, we derived some information for the gaseous disk such as: 1) The gaseous disk is keplerian according to Thi *et al.* (2005) 2) The inclination of the disk is 88° according to Tatulli *et al.* (2008) 3) FWHM in the continuum is 3 stellar diameter and in the line is 10 stellar diameter.

4. Conclusion

By analyzing interferometric measurements derived from CHARA/VEGA data, we have determined the physical extents of the gaseous disk of 51 Oph star. For the first time, we measured the position of the area in the disk where Hα line formed. In addition to this study, we have derived the angular diameter of this star for the first time. More observations with a more complete (u, v) coverage are needed to see whether we can confirm flattening for this fast-rotating star.

References

Bonneau, D., Clausse, J.-M., Delfosse, X., *et al.* 2006, *A&A* 456, 789
Mendigutía, I., Mora, A., Montesinos, B., *et al.* 2012, *A&A* 543, A59
Mourard, D., Clausse, J. M., Marcotto, A., *et al.* 2009, *A&A* 508, 1073
Perryman, M. A. C., Lindegren, L., Kovalevsky, J., *et al.* 1997, *A&A* 323, L49
Tatulli, E., Malbet, F., Ménard, F., *et al.* 2008, *A&A* 489, 1151
ten Brummelaar, T. A., McAlister, H. A., Ridgway, S. T., *et al.* 2005, *ApJ* 628, 453
Thi, W.-F., van Dalen, B., Bik, A., & Waters, L. B. F. M. 2005, *A&A* 430, L61
van den Ancker, M. E., de Winter, D., & Tjin A Djie, H. R. E. 1998, *A&A* 330, 145

https://doi.org/10.1017/S1743921314006437 Published online by Cambridge University Press