Probing local density inhomogeneities in the circumstellar disk of a Be star using the new spectro-astrometry mode at the Keck interferometer

J.-U. Pott1,2,3, J. Woillez2, S. Ragland2, P. L. Wizinowich2, J. A. Eisner4, J. D. Monnier5, R. L. Akeson6, A. M. Ghez3,7, J. R. Graham8, L. A. Hillenbrand9, R. Millan-Gabet6, E. Appleby2, B. Berkey2, M. M. Colavita10, A. Cooper2, C. Felizardo6, J. Herstein6, M. Hrynevych2, D. Medeiros2, D. Morrison2, T. Panteleeva2, B. Smith2, K. Summers2, K. Tsubota2, C. Tyau2, E. Wetherell2

1Max-Planck-Institut fÂ¨ur Astronomie, KÂ¨onigstuhl 17, D-69117 Heidelberg, Germany
jpott@mpia.de
2W. M. Keck Observatory, California Association for Research in Astronomy, Kamuela, HI 96743
3Div. of Astronomy & Astrophysics, University of California, Los Angeles, CA 90095-1547
4Steward Observatory, University of Arizona, Tucson, AZ 85721
5Astronomy Department, University of Michigan, Ann Arbor, MI 48109
6NASA Exoplanet Science Institute, Caltech, Pasadena, CA 91125
7Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095-1565
8Astronomy Department, University of California Berkeley, CA 94720, USA
9California Institute of Technology, Pasadena, CA 91125, USA
10Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA

We report on the successful science verification phase of a new observing mode at the Keck interferometer, which provides a line-spread function width and sampling of 150 km/s at Kâ€²-band, at a current limiting magnitude of Kâ€² = 7 mag with spatial resolution of lambda / 2B = 2.7 mas and a measured differential phase stability of unprecedented precision (3 mrad at K = 5mag, which represents 3 Î¼as on sky or a centroiding precision of 10^âˆ'3). The scientific potential of this mode is demonstrated by the presented observations of the circumstellar disk of the evolved Be-star 48 Lib. In addition to indirect methods such as multi-wavelength spectroscopy and polaritmetry, the here described spectro-interferometric astrometry provides a new tool to directly constrain the radial density structure in the disk. We resolve for the first time several Pfund emission lines, in addition to Br Gam, in a single interferometric spectrum, and with adequate spatial and spectral resolution and precision to analyze the radial disk structure in 48 Lib. The data suggest that the continuum and Pf-emission originates in significantly more compact regions, inside of the Br Gam emission zone. Thus, spectro-interferometric astrometry opens the opportunity to directly connect the different observed line profiles of Br Gam and Pfund in the total and correlated flux to different disk radii. The gravitational potential of a rotationally flattened Be star is expected to induce a one-armed density perturbation in the circumstellar disk. Such a slowly rotating disk oscillation has been used to explain the well known periodic V/R spectral profile variability in these stars, as well as the observed V/R cycle phase shifts between different disk emission lines. The differential line properties and linear constraints set by our data are consistent with theoretical models and lend direct support to the existence of a radius-dependent disk density perturbation. The data also shows decreasing gas rotation velocities at increasing stello-centric radii as expected for Keplerian disk rotation, assumed by those models.

Reference: ApJ in press
Status: Manuscript has been accepted

Weblink: http://de.arxiv.org/abs/1008.1727

Comments: 28 pages, 4 figures, Accepted for publication by ApJ

Email: jpott@mpia.de