Resolving the circumstellar environment of the B[e] star V921 Sco with VLTI/AMBER

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Introduction
The southern emission-line star V921 Sco (CD-42°11721, MWC 865, He 3-1300) is an intermediate-mass object with M★ = 8 ± 10 M⊙ (Borges Fernandes et al. 2007). The existence of a strong Hβ line was first reported by Merrill & Burwell (1949), who also noted the peculiar spectrum of this object. Surrounded by a small nebulosity (Glass & Allen 1975), V921 Sco resembles objects belonging to the class of intermediate-mass young stellar objects, the Herbig Ae/Be stars (Herbig 1960). While Finkenzeller & Mundt (1984) classified V921 Sco as a Herbig-B[e] star, Hutsemekers & van Drom (1990) pointed out its similarity to the β Doradians. The main uncertainties concerning the true nature of V921 Sco are the not well-known stellar parameters and the rough distance estimate.

New OPD correction method

V921 Sco was observed with the VLTI/AMBER instrument (Petrov et al. 2007) on three nights in May 2007. The observations were carried out using three of the auxiliary 1.8 m telescopes (ATs) of the VLTI, arranged in line-configuration (B = 31.2mas, B = 62.6mas, B = 93.8mas). The AMBER data were taken in the low-spectral resolution mode (R = 35), allowing us to observe in the H and K bands simultaneously.

Since the coherence length of AMBER LR observations is only approximately 60 to 80 µm, while the atmospheric piston in our data is of the order of 20 µm, we cannot neglect the influence of the optical path differences (OPDs) between the beams on the visibility calibration. To take care of this effect, we developed a method which is able to partially correct systematic differences between OPD errors of the target and calibrator data.

The circumstellar environment of V921 Sco

To characterize the size of V921 Sco’s circumstellar environment, we fit a ring model to the observed visibilities. In the size-luminosity relation (Fig. 3), the fitted ring radius (inner radius of a ring with a width of 20% of the inner radius) of V921 Sco is plotted using the stellar parameters given by Borges Fernandes et al. (2007). If we assume that these stellar parameters are correct, the position of V921 Sco in the size-luminosity diagram suggests that the K band ring-fit radius (2.10 mas / 2.41 AU) is nearly equal or only slightly smaller (<1.5 times) than the theoretical dust sublimation radius expected in the absence of radiation-shielding material between the star and the disk.

In addition to the geometrical modeling described above, a temperature-gradient model of a disk with an inner cavity is also able to reproduce the wavelength-dependent visibilities and the SED of V921 Sco (see parameters in Fig. 2).

References