Investigation of Herbig Ae /Be stars in the near -infrared with a long baseline interferometer

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Abstract

We have conducted the first systematic study of Herbig Ae/Be stars using the technique of long baseline spatial interferometry in the near-infrared, with the objective of characterizing the distribution and properties of the circumstellar dust responsible for the excess near-infrared fluxes observed in these systems. The observations for this work have been conducted at the Infrared Optical Telescope Array (IOTA). The interferometer resolves the source of infrared excess in 11 of the 15 systems surveyed. A new binary, MWC 361-A, has been detected interferometrically for the first time. The visibility data for all the sources has been interpreted within the context of four models which represent the range of plausible representations for the brightness distribution of the source of excess emission: a Gaussian distribution, a narrow uniform ring, an accretion disk, and an infrared companion. ^ We find that the sizes of the near-infrared emitting regions are larger than previously thought (0.5–5.9 AU). We also find that none of the sources (except the new binary) shows varying visibilities as the orientation of the interferometer baseline changes, indicative of circularly symmetric brightness distributions. ^ The observed symmetry of the sources of near-infrared excess strongly favors, for the data taken as an ensemble, models in which the circumstellar dust is distributed in spherical envelopes (the Gaussian model) or thin shells (the ring model). This interpretation is supported by the result that the measured sizes, combined with the excess near-infrared fluxes, imply optically thin emission, as required by the fact that the central stars are optically visible. We also find that the measured sizes and brightness do not correlate strongly with the luminosity of the central star. Moreover, the same excess results from circumstellar structures that differ in size by more than a factor of two, and surround essentially identical stars. Therefore, different physical mechanisms for the near-infrared emission may be at work in different cases, or alternatively, a single underlying mechanism with the property that the same infrared excess is produced on very different physical scales. ^ For this work, a new fringe detection system for near-infrared wavelengths based on a NICMOS3 array has been developed. The noise performance achieved is among the lowest known for this type of instrument, and results in magnitude limits for fringe detection at the IOTA of about 8 in J and H bands and 6.5 in K' band. ^

Subject Area

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