AMBER+FINITO+UT Science Demonstration Proposal

Title: Resolving Circumbinary Disks

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Abstract:

With the improved magnitude limits only possible with the FINITO fringe tracker, we propose to observe pre-Main Sequence spectroscopic binaries – AK Sco, UZ Tau E and GW Ori – to spatially resolve their circumbinary disks, providing a unique direct test of the leading model for binary-disk interactions. We will also search for evidence of the predicted accretion flows at different orbital phases.

Scientific Case:

Accretion Disks around Young Binary Stars: Numerical simulations (Artymowicz & Lubow 1994, 1996) of disks around binary stars predict a size for the inner edge of the circumbinary disk depending on the binary eccentricity, mass ratio and disk Reynolds number. The proposed AMBER observations will resolve the circumbinary disks, providing the first direct tests of the model. In addition to the gap sizes, the models predict periodic flow at or near periaston. With the detailed 3-D hydrodynamical code TORUS (Harries et al. 2004), we have simulated a circumbinary disk with an accretion flow and, when the material flows onto the central binary, the brightest region occurs at the sublimation radius of the binaries, while the flux originates from the inner edge of the circumbinary diskwhen the gap is relatively clear, since there is no shadowing. These differences in the spatial scale of the emitting regions cause measurable differences in the visibilities. Oct. 12-14 covers periastron (12th) and two subsequent nights.

Targets and Proposed Observations: Given the eccentricities, mass ratios, semimajor axes, and distances the systems have predicted inner edge diameters of ∼1-6mas. To estimate the expected visibilities we have used CalVis with disk sizes corresponding to the range of predicted inner edge sizes. The V^2 for GW Ori should be above 0.75 on all baselines; the V^2 for the other sources may include nulls, but 1-2 baselines should be high enough to measure (especially AK Sco). The size will be determined by the values of V^2 on different baselines. Observations near transit are best for GW Ori/UZ Tau, while AK Sco is only reachable at the start of the night on two baselines. For UZ Tau, only K-band data is expected.

Calibration strategy:

The target data will be calibrated with CalVin sources. The standard 3% absolute calibration is sufficient to distinguish between the different disk sizes predicted by the models. K-band data is sufficient.

Targets and number of visibility measurements

Target	**RA**	**DEC**	**V** mag	**H** mag	**K** mag	**Size** (mas)	**Vis.**	**Mode**	**# of** Vis.
GW Ori	05 29 08	+11 52 13	13.0	7.1	6.6	1.3	1.0/0.9/0.9	LR	1
AK Sco	16 54 45	-36 53 19	13.0	7.1	6.5	4.0	0.8/0.4/0.0	LR	2
UZ Tau E	04 32 43	+25 52 31	13.0	7.6	7.3	2.0	1.0/0.9/0.8	LR	2

Time Justification:

For GW Ori, one V^2 (70min) is requested since the accretion bursts are not expected. For the others, we request one visibility sequence on two separate nights (140min total), ideally the first and last. We list three targets not knowing when time will be available; a subset of observations is worthwhile.