AMBER+FINITO+UT Science Demonstration Proposal

Triple star Sigma Orionis: a Helium rich star in Orion

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Abstract:

We propose observations of the close pair in the triple system σ Orionis A, excluding the tertiary component by means of the fiber. The latter component has caused poor data quality when observed with the NPOI array, and therefore SDT with AMBER was used to observe it in 2004. However, the data quality was again poor, and in view of the recent success with FINITO we would like to demonstrate that good results and especially useful closure phase data can be extracted for this binary. The separation is on the order of 8 mas (phase 0.24) or less, and the system magnitude, $H = 4.6$, while in the range of capability with the ATs, would require absolutely perfect conditions when using FINITO. The close pair is predicted to be close to periastron (phase 0.14) in the middle of October, requiring long baselines to resolve it.

Scientific Case:

Several fields of stellar astrophysics suffer from poor distance estimates. A major source of trigonometric parallaxes, Hipparcos distances to O-type stars are notoriously unreliable, leading to overestimation of absolute magnitudes of up to 5 (Schröder et al. 2004). σ Orionis is a (visual) quintuple system who's members include the original archetype He-rich star, σ Orionis E, around which has been found an extremely compact (several arcminutes) and rich cluster of very young pre-main sequence stars. The A and B components are only 0.25 arcseconds apart. Component A (O9.5) is a spectroscopic binary, announced by T. Bolton (U. of Toronto). The orbital parallax of the binary σ Orionis A would help to constrain fundamental stellar parameters not only of these late O-type binary components, but also of the "underluminous" Helium-rich E component. High Helium abundance in a fully mixed stellar interior would lower the luminosity, but the Helium-rich star phenomenon has been linked surface effects due to diffusion. σ Orionis has been observed extensively using spectroscopy in a collaboration with T. Bolton and an orbital period has been established at 150 days.

With the proposed observations, we plan to do the following. (1) Demonstrate fringe tracking of a bright, yet tricky target under average conditions. (2) Add important information to a growing body of spectroscopic and existing set of interferometric data. (3) Provide feasibility check of an astrophysically valuable target for subsequent open time proposals.

Calibration strategy:

We require good absolute calibration, and therefore propose to observe a CAL-SCI-CAL sequence.

Targets and number of visibility measurements

Target	**RA**	**DEC**	**V** mag	**H** mag	**K** mag	**Size** (mas)	**Vis.**	**Mode**	**# of** Vis.
HD 37468	05 38 44.77	-02 36 00.25	3.8	4.6	4.5	3.0	0.6/0.2/0.1	LR-JHK	1

Time Justification:

A single calibrated observation is sufficient. With a good absolute calibration and good data quality in the JHK bands, an image can be made.