The Disk and Jet of the Classical T Tauri Star AA Tau

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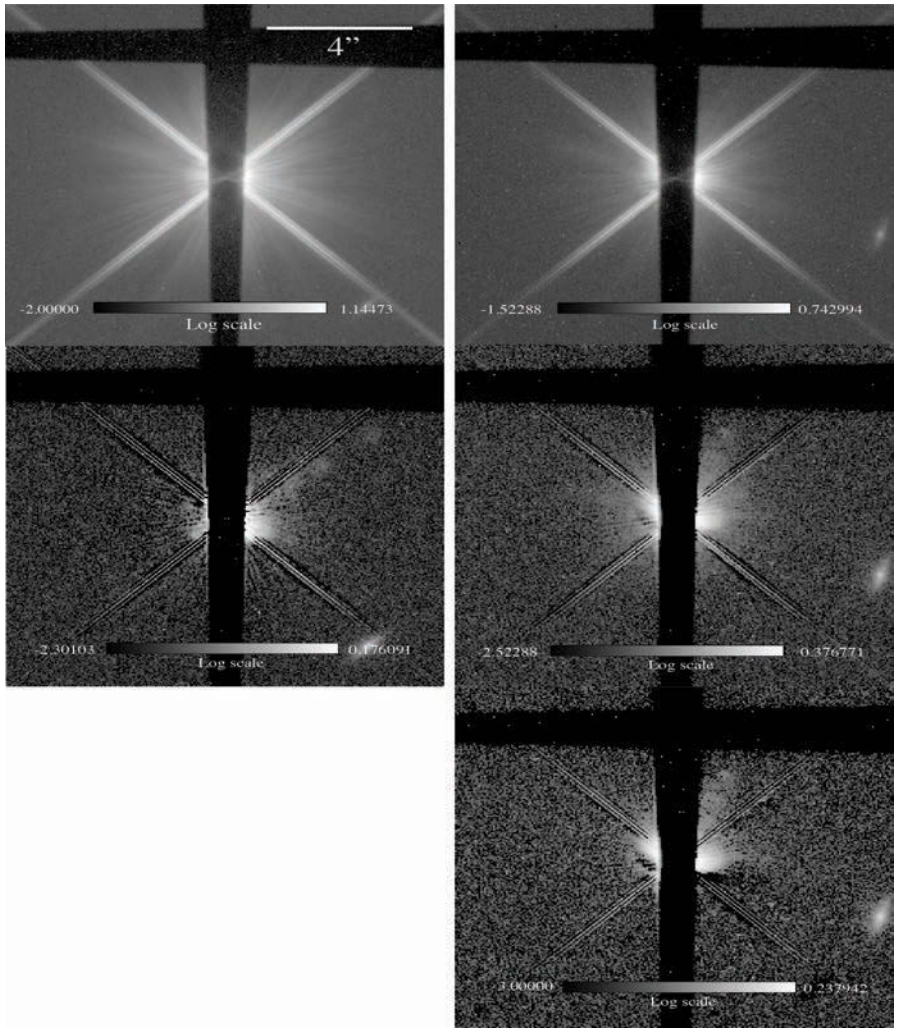
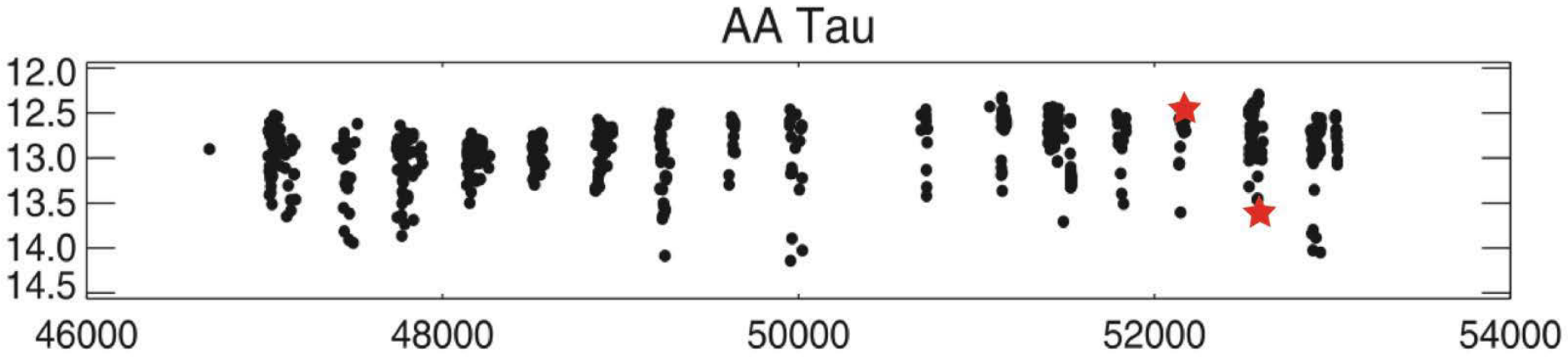
Credit: NASA/JPL-Caltech/ T. Pyle (SCC)

PSF Subtraction of Disk



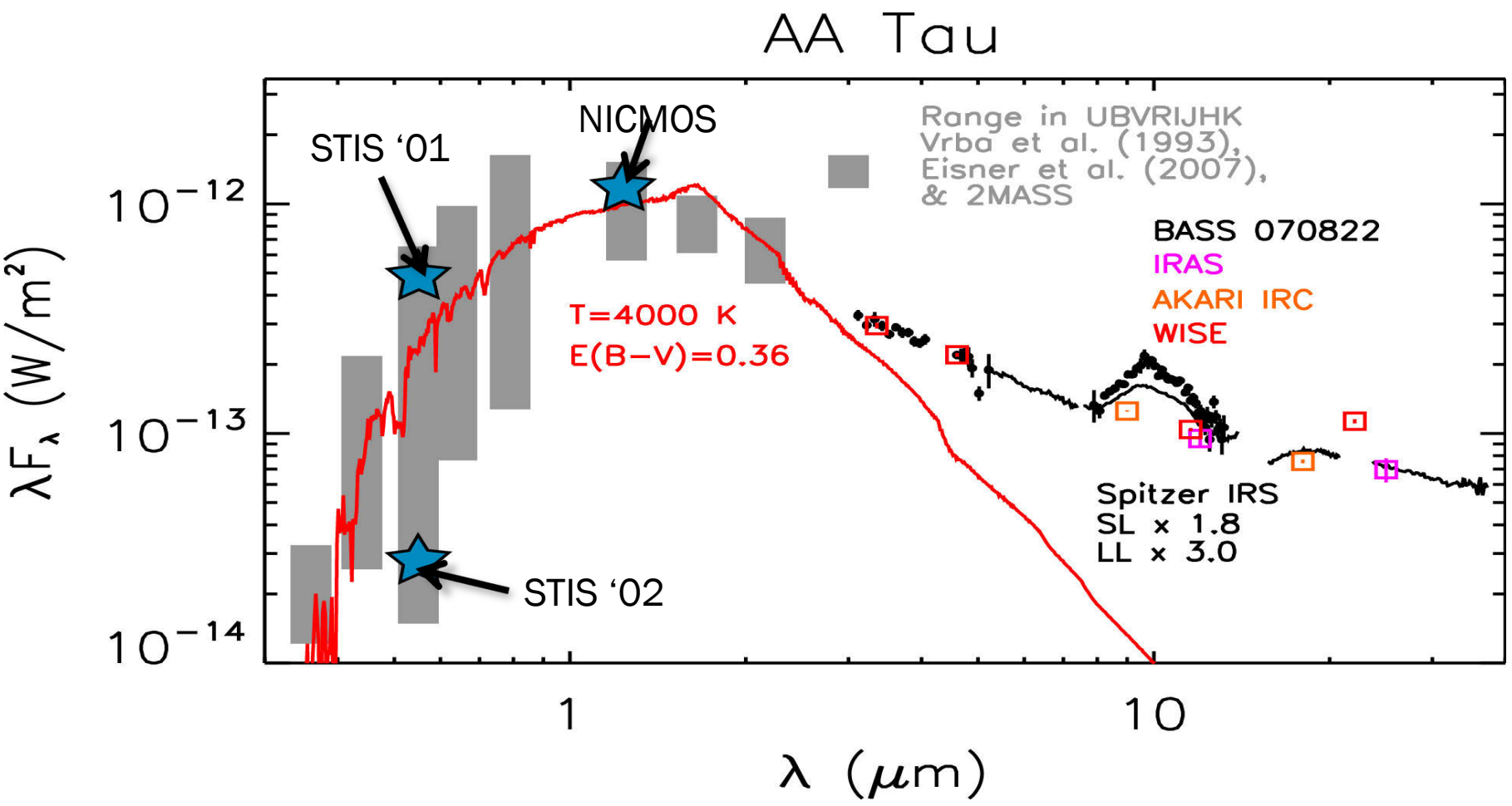
- PSF subtraction was used to remove diffraction spikes and instrumentally scattered starlight from STIS coronagraphic data taken on Sept. 2001 and Aug. 2002
- After subtraction, the disk and a chain of Herbig-Haro knots are visible in the 2001 data (left), but better revealed in the 2002 data (right). The field of view is 12” on a side in the detector frame.
- A roll-difference image provides the best imaging of the disk.
- We detect the jet of AA Tau in both STIS observations & most clearly image the disk in the second observation

Photons are the Key

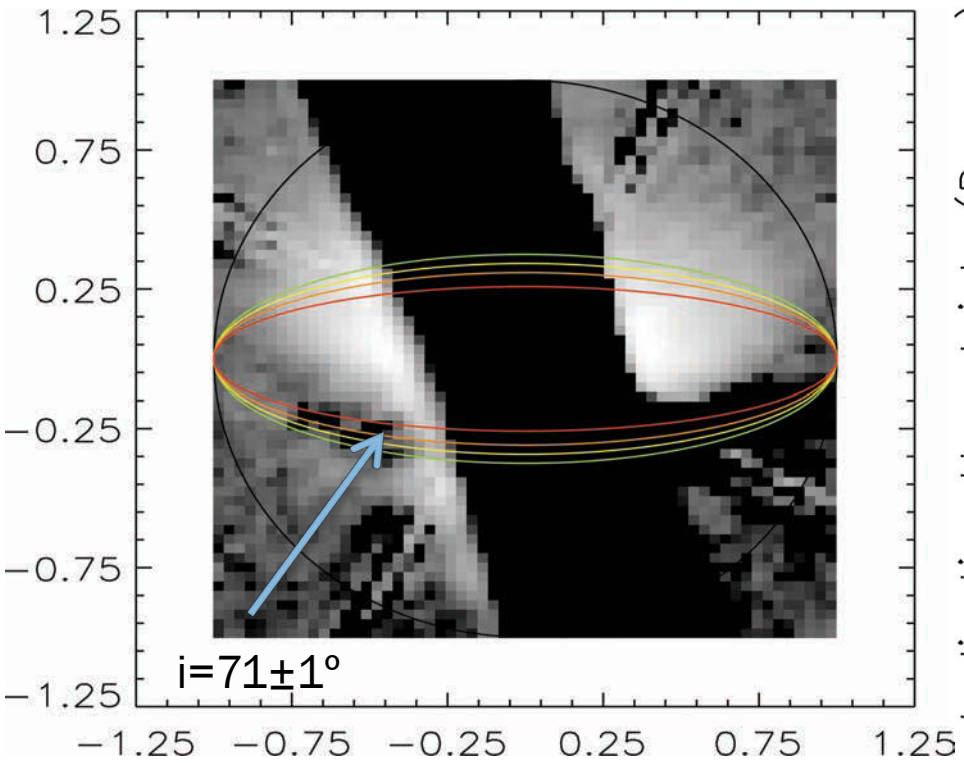


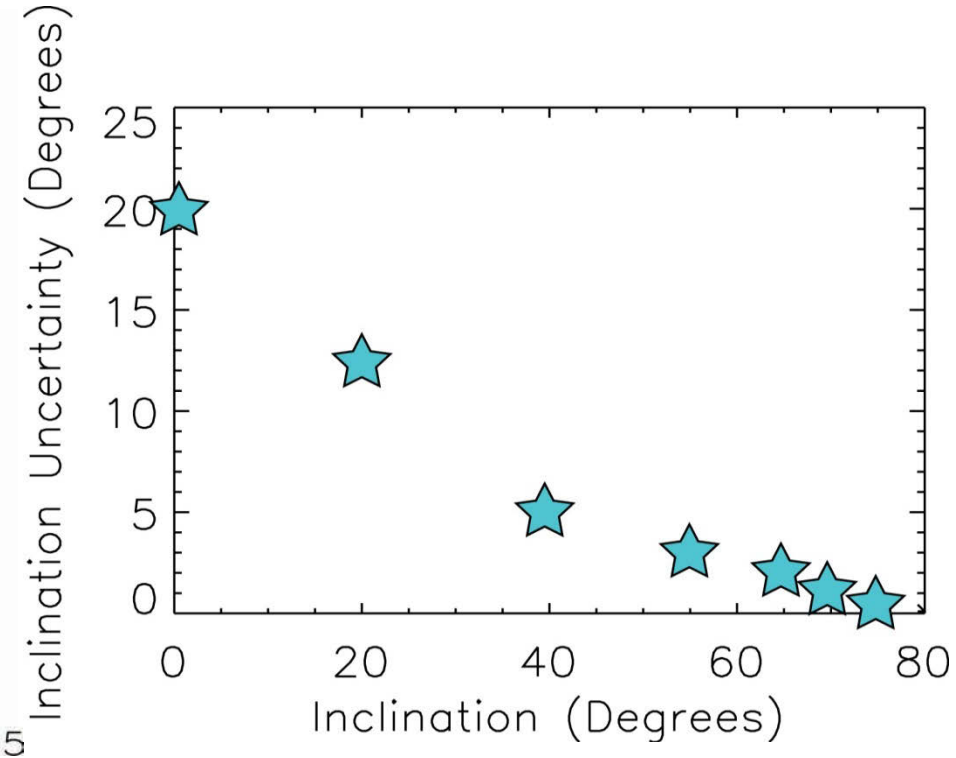
- Left star) Maximum light – disk barely visible
- Right star) Minimum light – disk most visible

SED of AA Tau


AA Tau
STIS '01
NICMOS
STIS '02
Range in UBVRIJHK
Vrba et al. (1993),
Eisner et al. (2007),
& 2MASS
BASS 070822
IRAS
AKARI IRC
WISE
T=4000 K
E(B−V)=0.36
Spitzer IRS
SL × 1.8
LL × 3.0
10^{-12}
10^{-13}
10^{-14}
λF_λ (W/m^2)
1
10
λ (μm)

Fitting The Disk



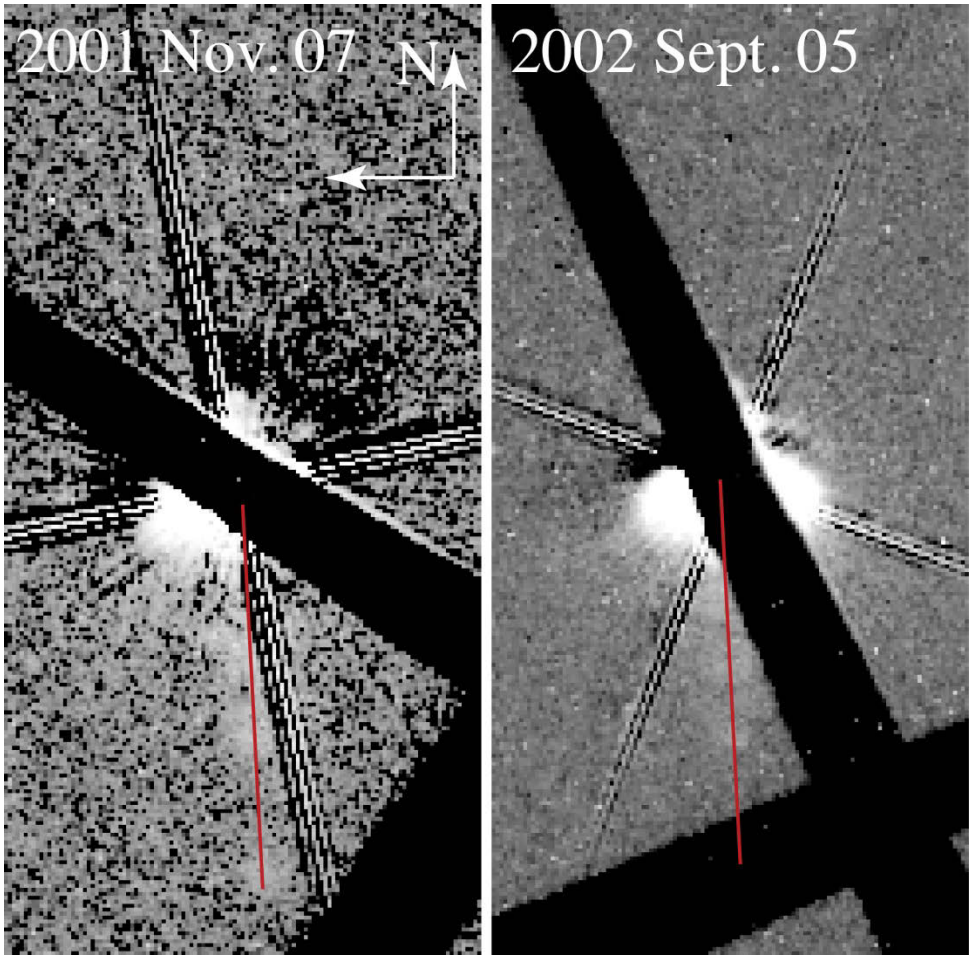


Left) circles depict approximation of disk inclination. Right) Uncertainty of measurement as function of inclination

i = 71±1° (yellow circle, left) is best approximation of inclination as seen from pole on.

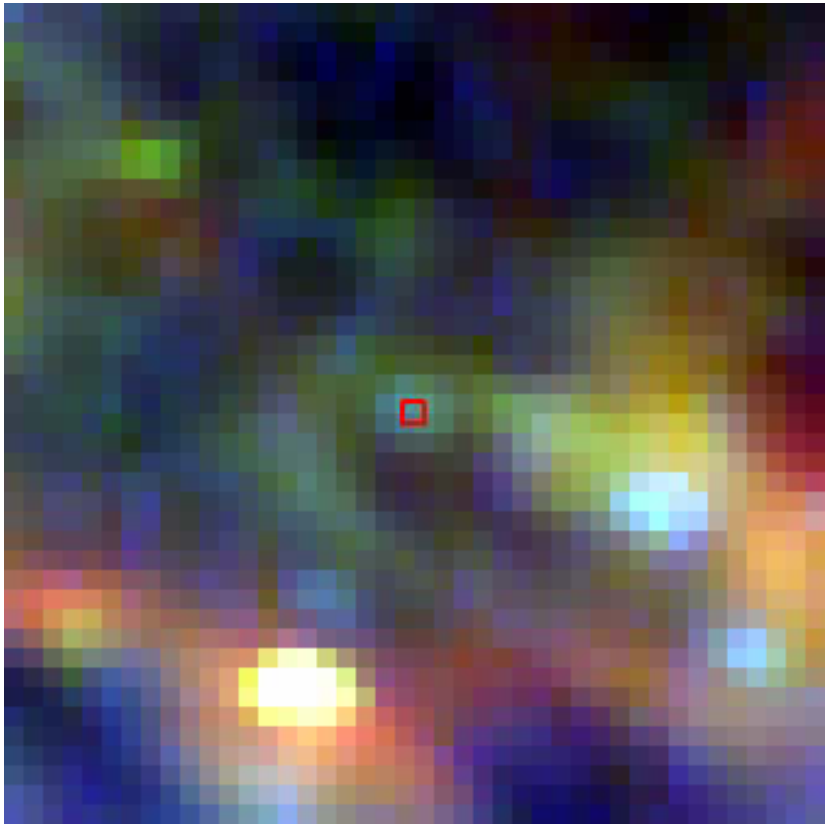
Disk separation estimated to be at 1.15” (156 AU)

Pinning the Position Angle



- Jet-driving PMS stars typically have the jet PA 90° from the disk semi-major axis. The Jet PA in AA Tau is along 183□1□, 86° from the disk semi-major axis. The jet is poorly collimated with an opening half angle of 17° within 3” of the star.
- We do not clearly see a counterjet, either in the STIS images or in Goddard Fabry-Pérot data.

And the Counterjet….



- AA Tau is on the southern end of a molecular cloud as seen in false-color composite image from IRAS (left)

Results

- AA Tau has a disk extending 1.15” (156 AU) and viewed at +/-1° from pole-on. The outer disk is misaligned with respect to the inner disk by 4° (O’Sullivan et al. 2005), providing independent verification of the warp in the disk.

- AA Tau is an UXOR. The best disk visibility is at minimum optical/ NIR light, when the inner disk partially occults the star. Given the periodic nature of optical minima for this object, future high-contrast imaging should be scheduled for minimum light.

- The jet is poorly collimated compared to other single T Tauri stars and is also slightly misaligned with respect to predictions based on polarimetric data (Ménard et al. 2003). The absence of an extended counter-jet may reflect an extinction gradient to the north of AA Tau.