

# Optical and NIR Polarimetric Monitoring of AA Tau in 2014-2017

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## 1 Introduction

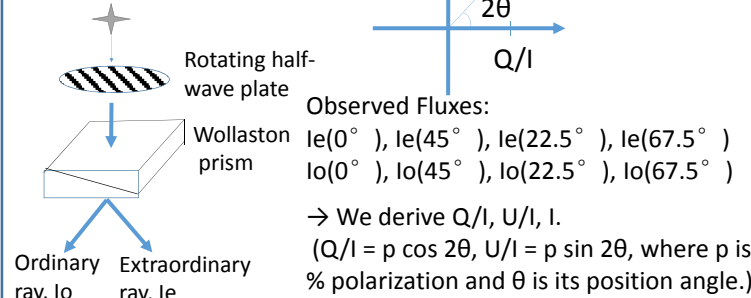
AA Tau is a classical T Tauri star. It irregularly shows short declining events, which could be explained by occultation by the inhomogeneous circumstellar medium. In 2011 AA Tau suddenly faded and the optical magnitude at its bright state became 2 magnitudes fainter in V-band compared with that in the previous 20 years. To investigate the geometry of its circumstellar medium, we have performed polarimetric monitoring of AA Tau since 2014 with HONIR (Hiroshima Optical and Near-Infrared camera) attached to the 1.5m Kanata telescope in Hiroshima Univ.. We found polarization variation correlated with the short declining events.

## 2 Telescope and instrument

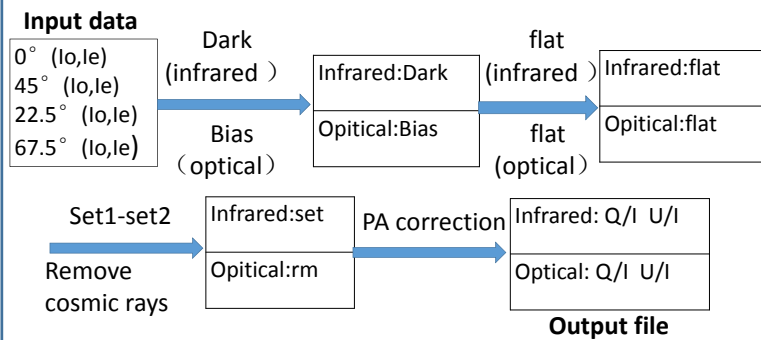


	Optical	Infrared
Detector pixel	2048x4096	2048x2048
Field of view	10' x 10'	10' x 10'
$\lambda(\mu\text{m})$	0.4-1.0	1.15-2.4
Band	V, Rc, Ic	J, H, Ks

HONIR on 1.5m Kanata Telescope



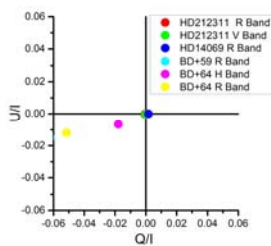
## 3 Reduction Procedure



## 4 Polarimetric Calibration

Unpolarized Standard Star	Polarized Standard Star
HD212311	BD+64d106
HD14069	BD+59d389

Referring catalogued position angle (PA) of polarized standard stars (Schmidt+ 1992), we derive the origin of the instrumental PA and correct it for AA Tau data.

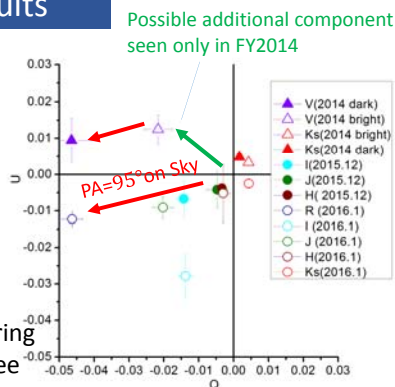


## 5 Observations and Results

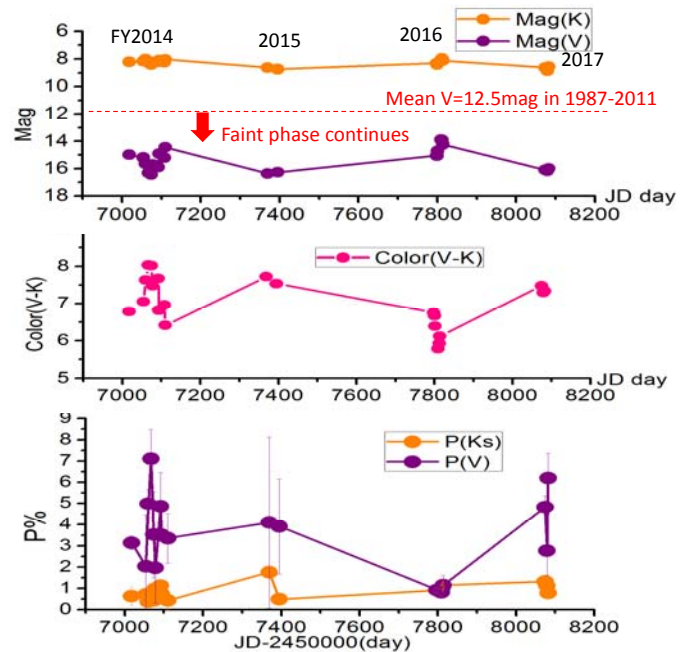
Season	Observation Date (JD-2450000)
FY2014	7017,7054,7060,7067,7074,7078,7091,7093,7108,7109
FY2015	7369, 7394
FY2016	7798,7800,7801,7809,7812,7814
FY2017	8074,8079,8082

In FY2014-15 (Takata 2016 広大修論)

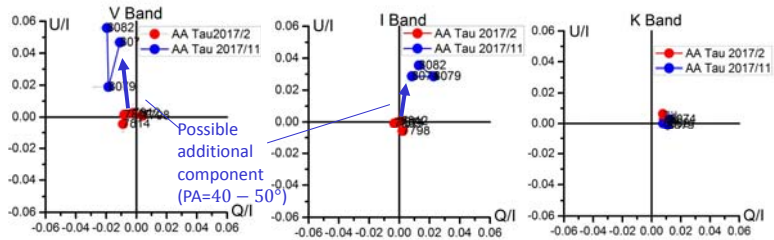
For shorter wavelength (and during declines), the polarization degree becomes larger with a constant PA ~95degrees. In 2014 a possible additional component exists.



## Magnitude, Color, Polarization VS. Observation Date

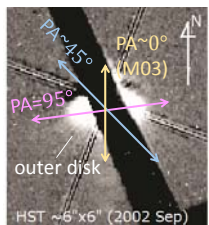


- Faint phase ( $\Delta V \sim 2\text{mag}$ ) still continues in 2014-2018
- Inverse correlation between in optical magnitude and color and optical polarization is still seen (i.e., redder and larger pol. in short decline phase), which was also seen in former bright phase (cf. Menard et al. 2003)
- Less variability in NIR (K) bands than in optical (V) bands.



## In FY2016-17

On fainter nights (FY2017) AA Tau shows large optical polarization (a few %), but its PA is  $40^\circ \sim 50^\circ$  on sky which is significantly apart from  $PA=95^\circ$  (FY2014-15) and also from  $PA=0^\circ$  in bright phase (Menard et al. 2003). These suggest an existence of polarization components not aligned with the outer disk elongation.



Pol. directions superimposed on HST image (Cox+ 2013)

## 6 Discussion and conclusion

The inverse correlation with flux and color/polarization would be explained by occultation of direct light from the central star by clumpy dust clouds in the inner disk and relative enhancements of scattered, polarized lights from the inner disk. However, the axis of polarization is not always aligned with the disk-jet geometry seen by HST, suggesting non-axisymmetric nature of the inner disk.