



Exploring asymmetries in the dusty shell of the semi-regular variable V CVn with CHARA

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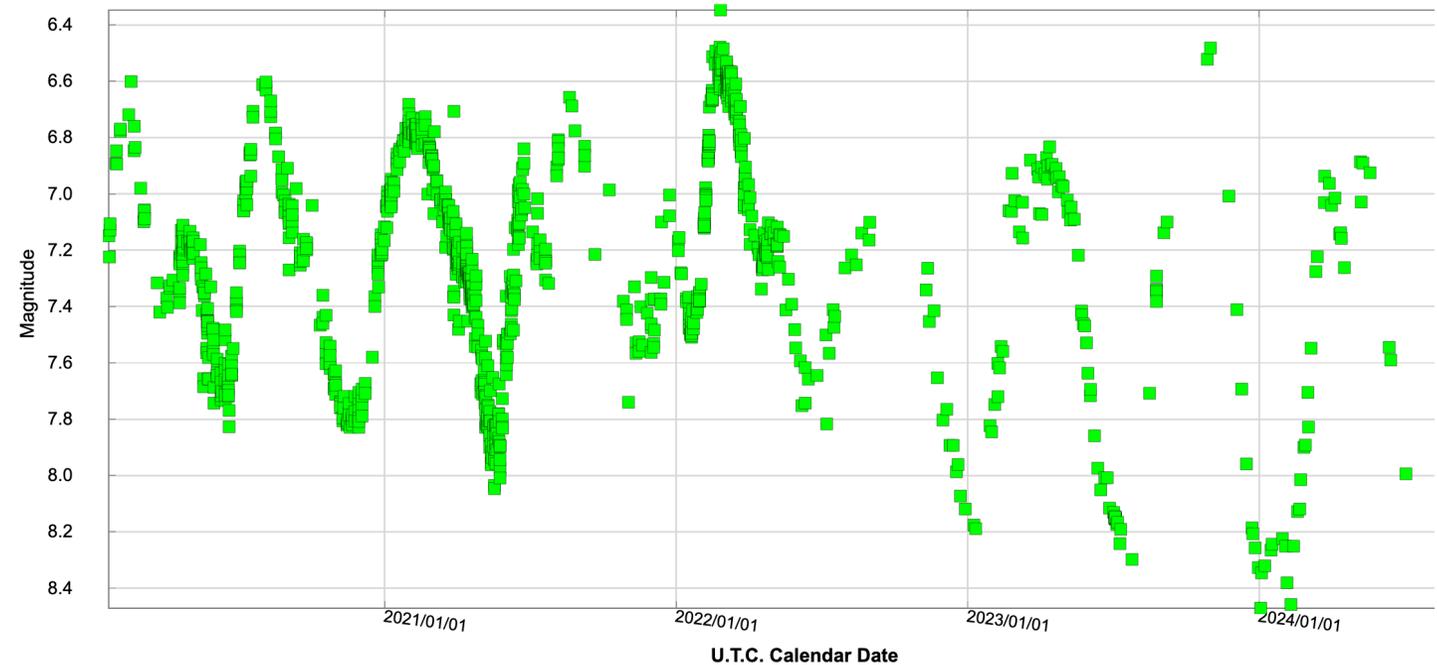
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V Canum Venaticorum - V CVn - HD 115898



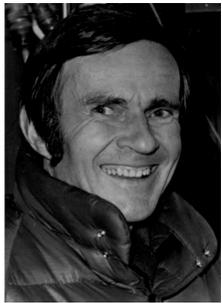
Atmospheric model of AGB star B. Freytag, S. Lijjgren, and S. Höfner, A&A, 2017



- M4e - M6e late AGB star
- 500 pc*
- High tangential velocity of 97 km/sec*
- High galactic latitude (70 deg.)
- Semi-Regular Mira Variable (SRVb)
- Radial pulsations with period of about 192 days
- Complex pulsating behavior not yet fully understood
 - > Secondary and/or extra long secondary period?



V CVn polarimetry milestones 1966 - 2019



Krzysztof Serkowski

1966

V CVn with highest optical polarization of Mira Variables.

V CVn polarization apparently of stellar or circumstellar origin



Antonio M. Magalhães

1986

Time-Dependent Spectro-polarimetry of V CVn

„...photospheric origin for most of the optical polarization ...existence of an intermediate scattering layer in the stellar photosphere.“



HPOL Team

1989-2004

15 years of observations Half-wave Spectro-Polarimeter Pine Bluff Observatory



Hilding Neilson



Richard Ignace

2014

Position angle measured for V CVn has been constant over 40 years

V CVn: Evidence of a Mira-like tail and bow shock*



Pierre Kervella

2015

Dust disk and companion of the nearby AGB star L² Puppis with SPHERE/ ZIMPOL



Susanne Höfner

2017

Detailed modelling of polarized light from dust shells surrounding AGB stars



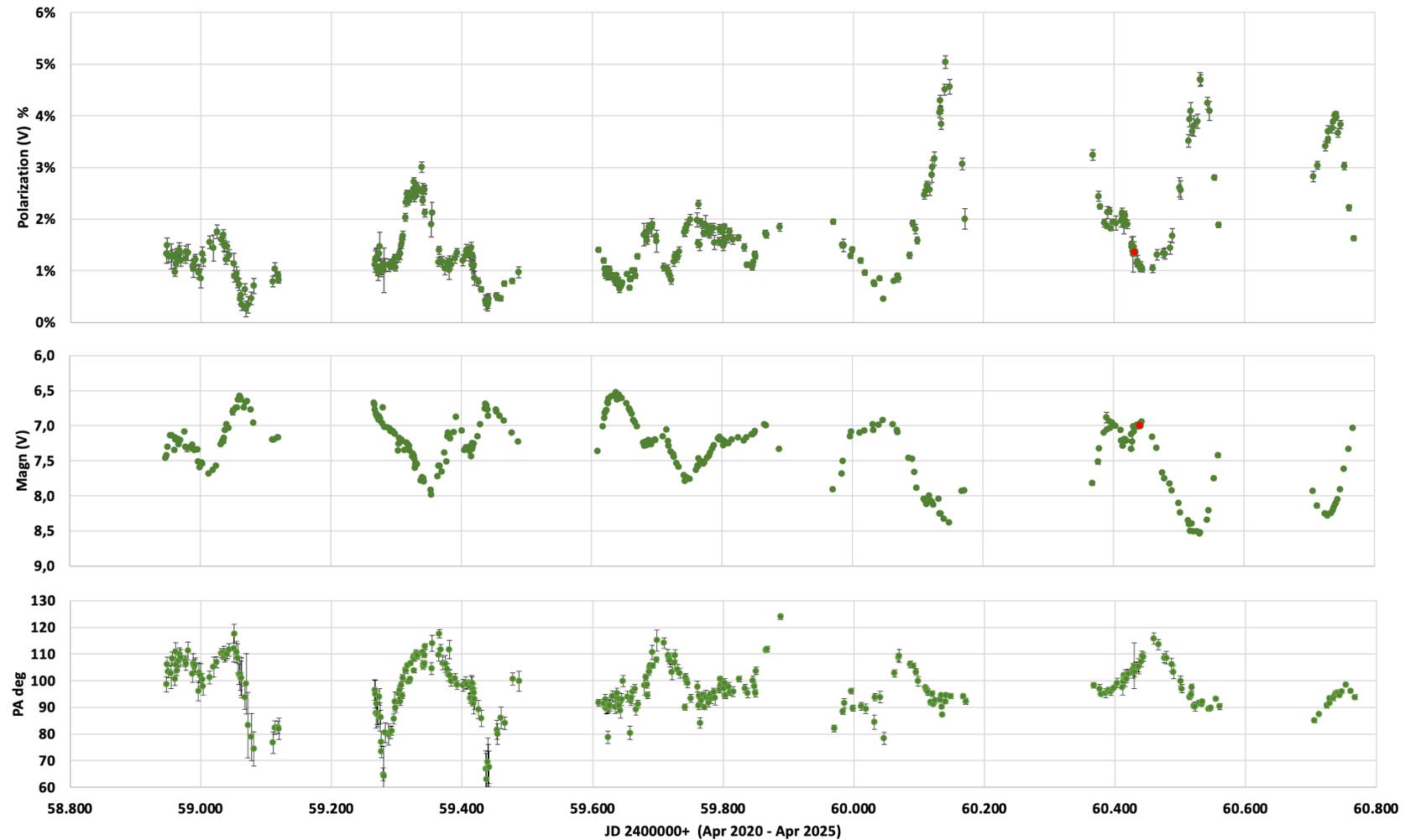
Boris Safonov

2019

Speckle Polarimeter observations of V CVn with 2.5-m telescope

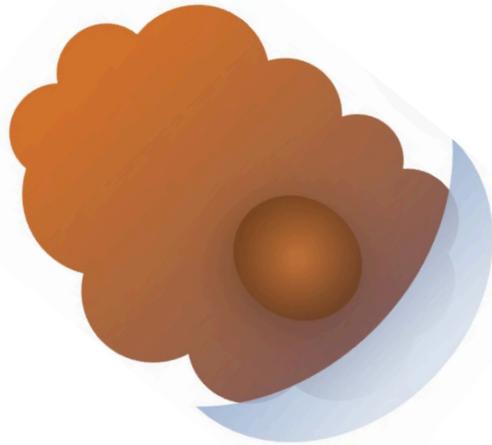
Asymmetric reflection nebula consisting of three regions surrounding V CVn at distance of 35 mas

A multiyear photopolarimetric study of the semi-regular variable V CVn



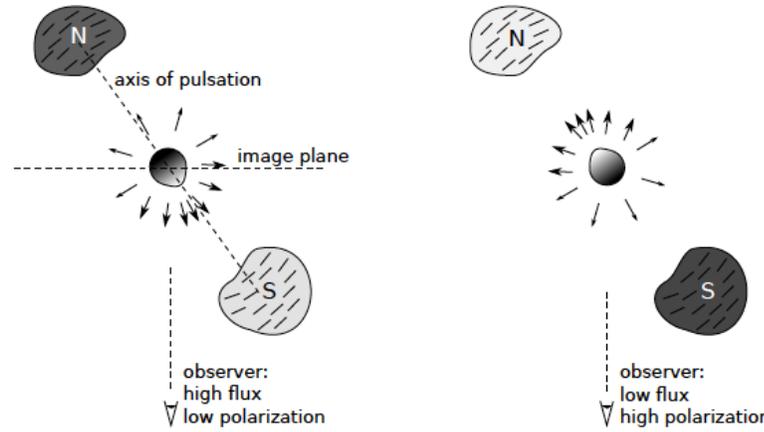
Reference: H. Neilson, N. Steenken, J. Simpson R. Ignace, M. Shrestha, C. Erba and G. Henson. *A&A* Volume 677, September 2023

After sixty years of research no consensus model for dusty shell



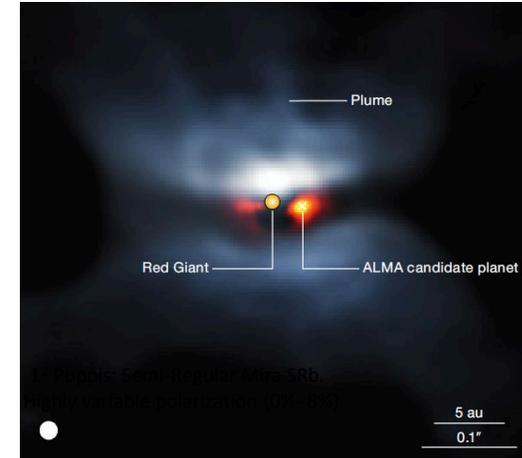
Neilson (2014)

Bow shock?



Safonov (2019)

Bipolar clouds?



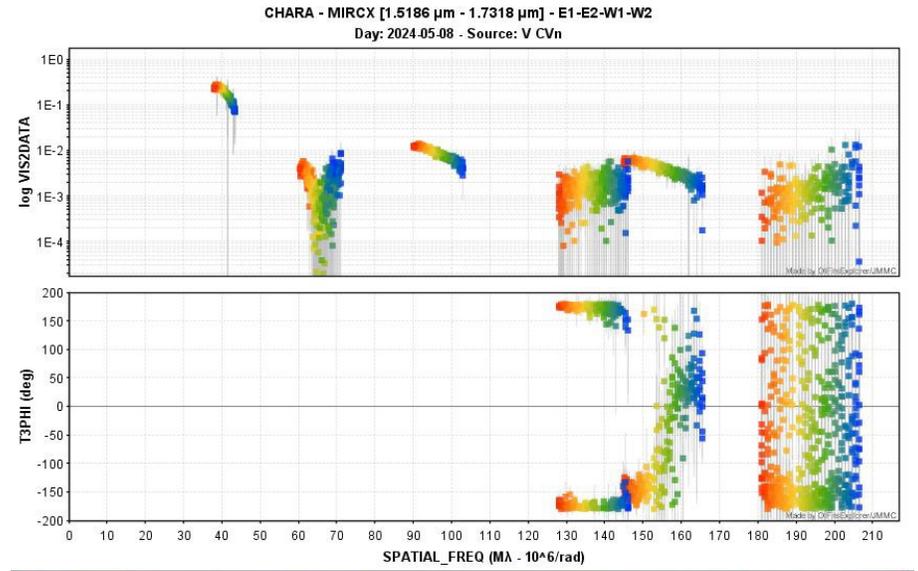
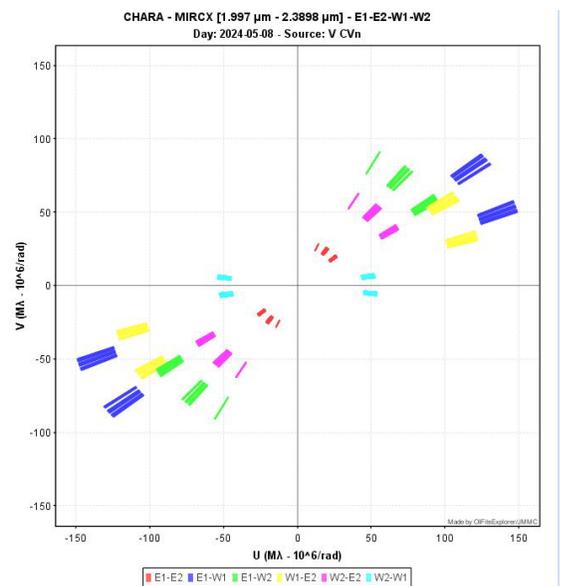
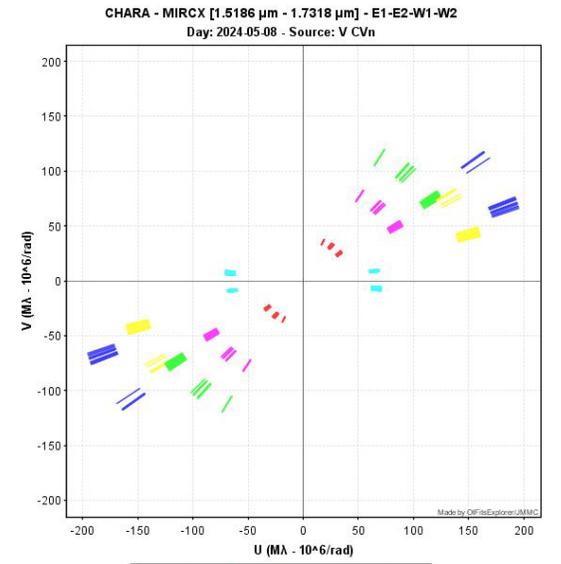
Dusty disk?

2023/11/03

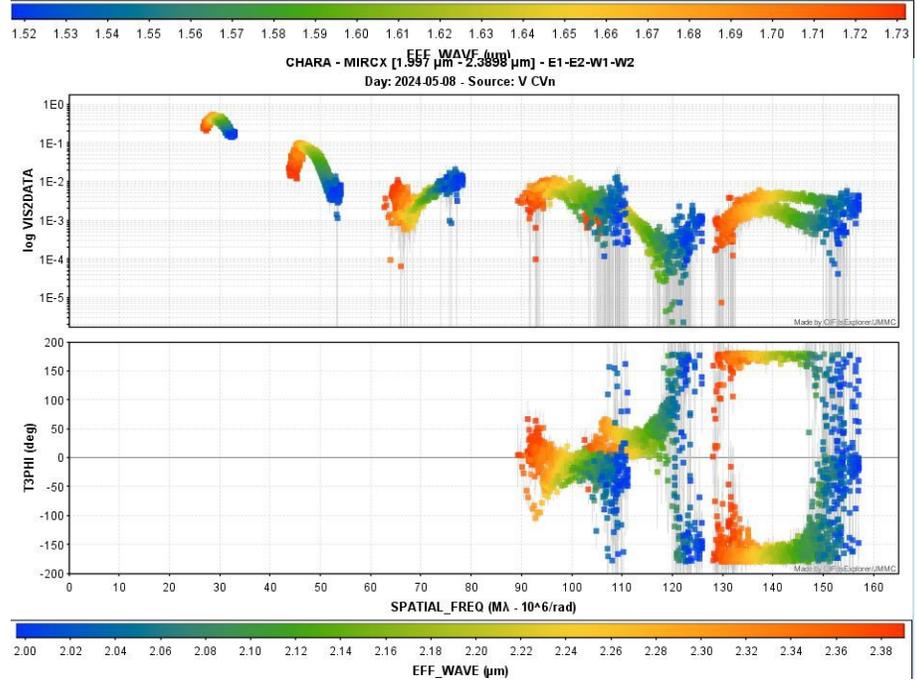
Positive reaction from CHARA Team on proposal for test observation!



**CHARA
Snapshot
May 8**



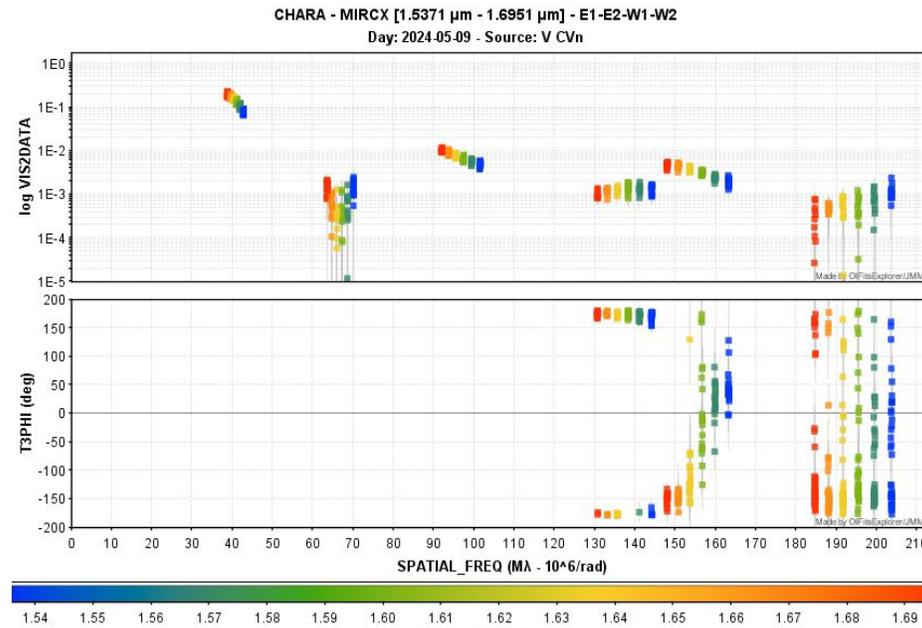
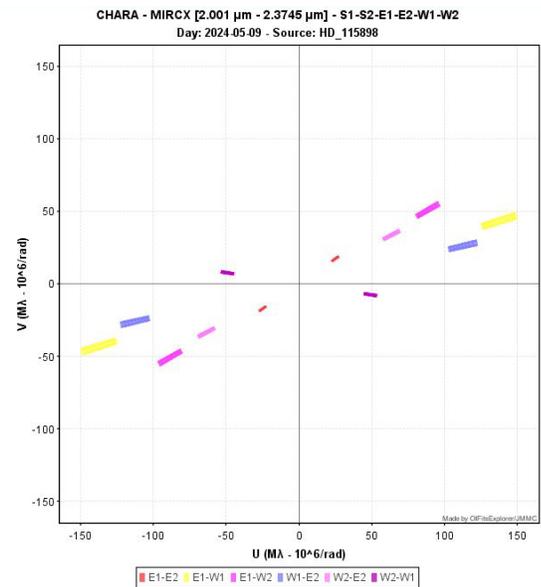
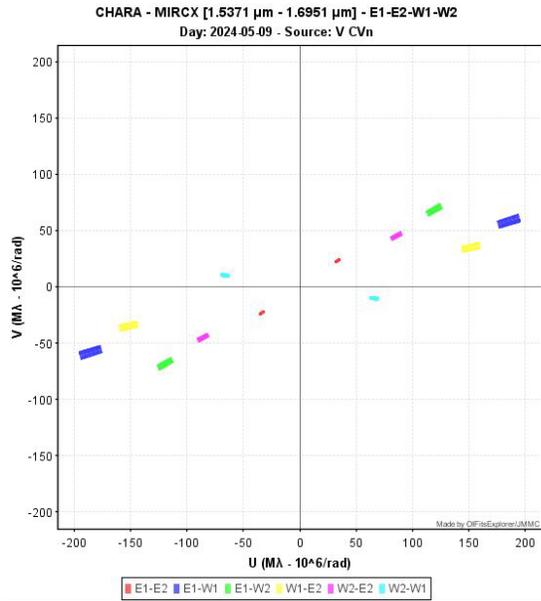
H band



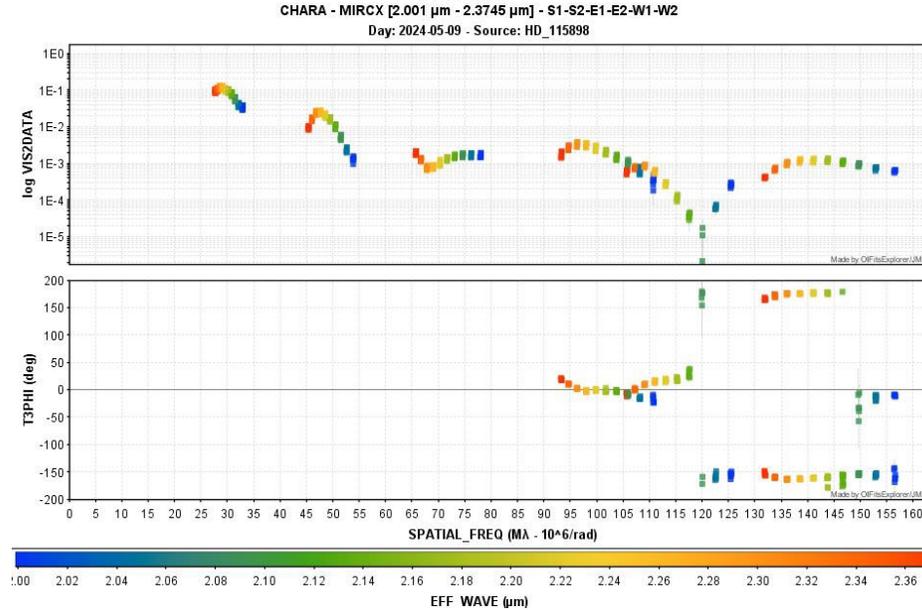
K band



CHARA
Snapshot
May 9



H band

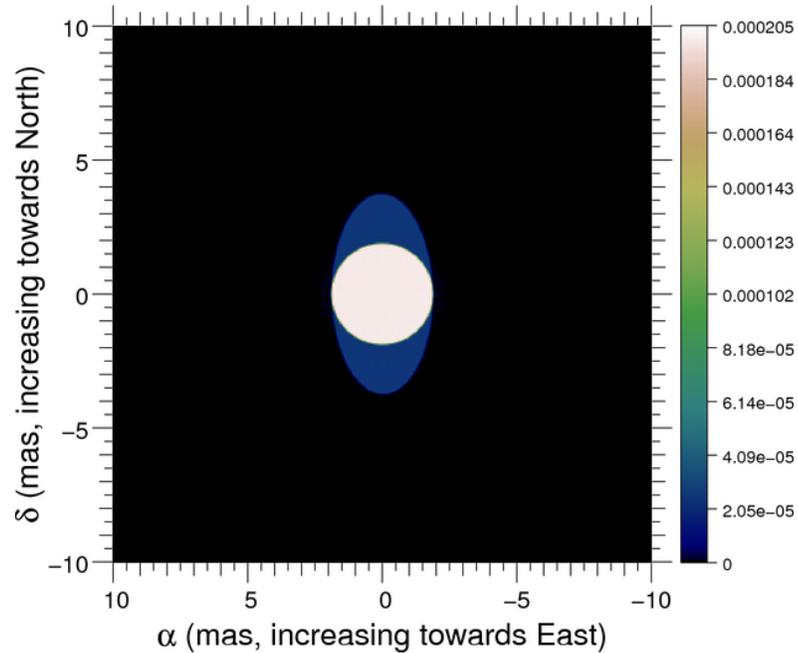


K band

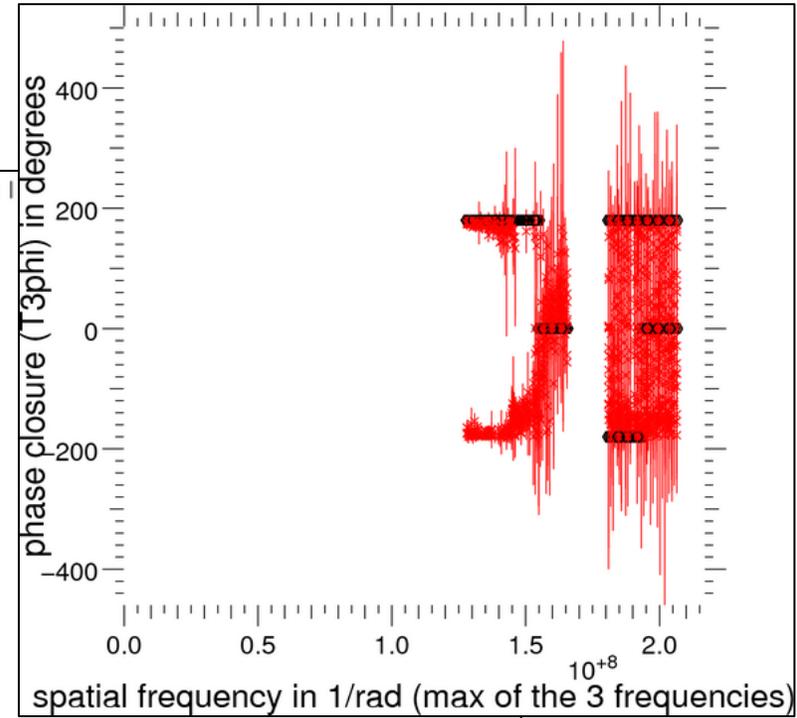
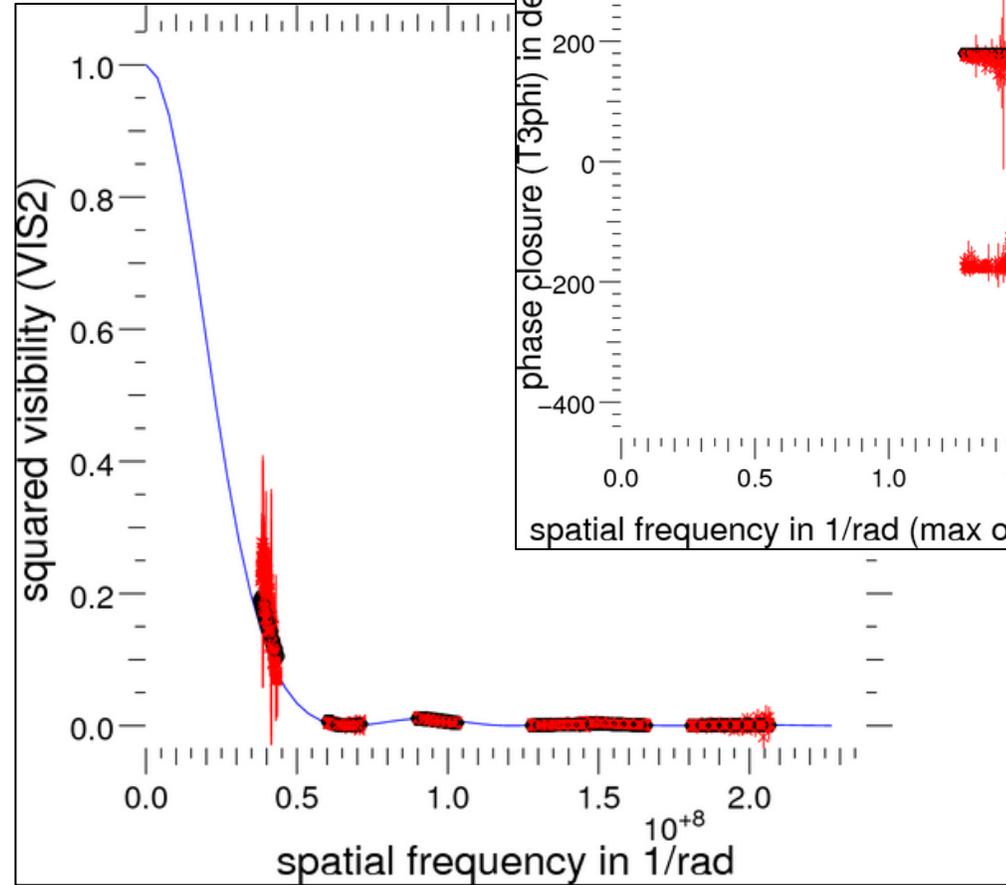
LitPro best fit model: 3.8 mas disk + elongated disk

Model:	
Diameter disk 1	3.8 mas
Flux weight disk 1	78.5%
Minor axis disk 2	3.7 mas
Elong_ratio	2.1
Flux weight disk 2	21.5%

H band
May 8+9



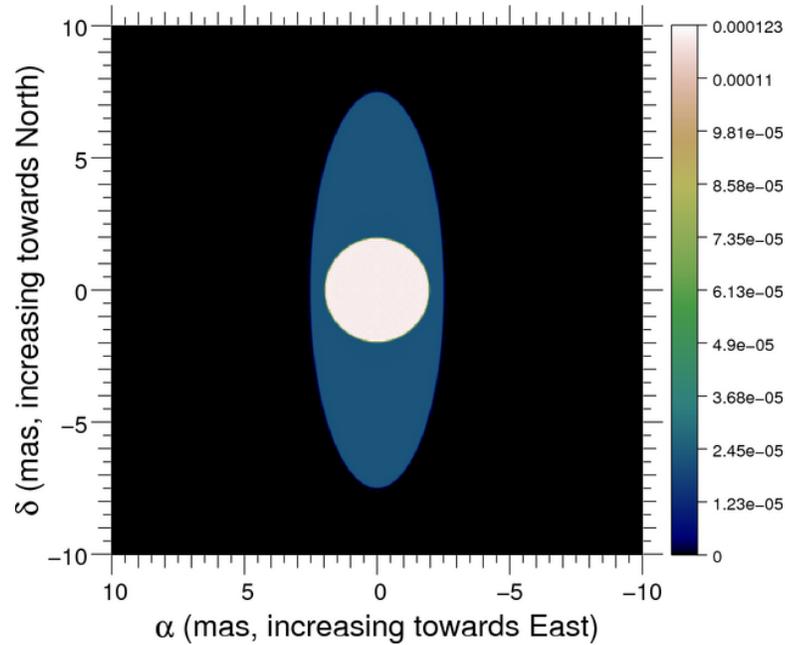
Fit analysis Model vs. data
Reduced Chi2: 2.8



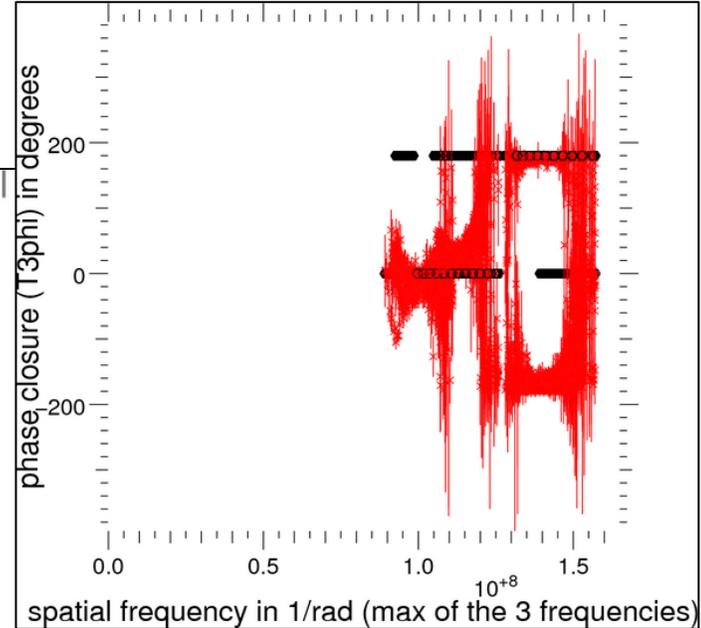
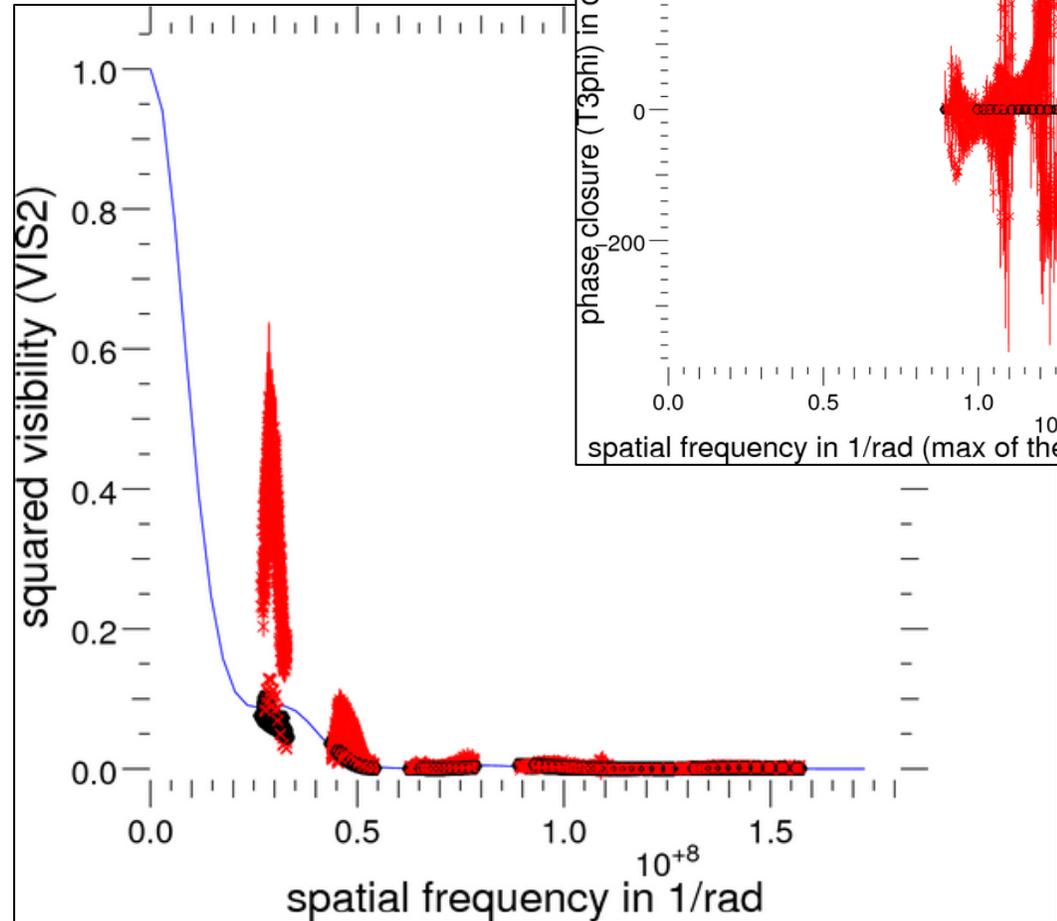
LitPro best fit model: 3.9 mas disk + elongated disk

Model:	
Diameter disk 1	3.9 mas
Flux weight disk 1	47.7%
Minor axis disk 2	5mas
Elong_ratio	2.9
Flux weight disk 2	52.3%

K band
8+9 May

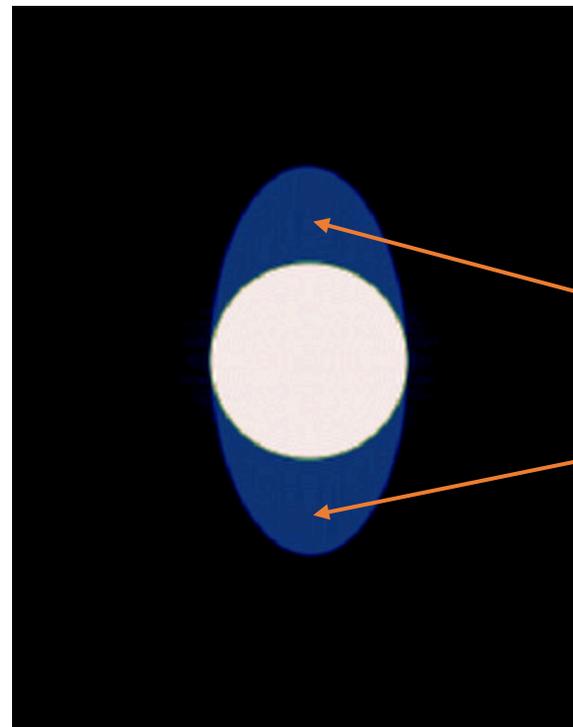
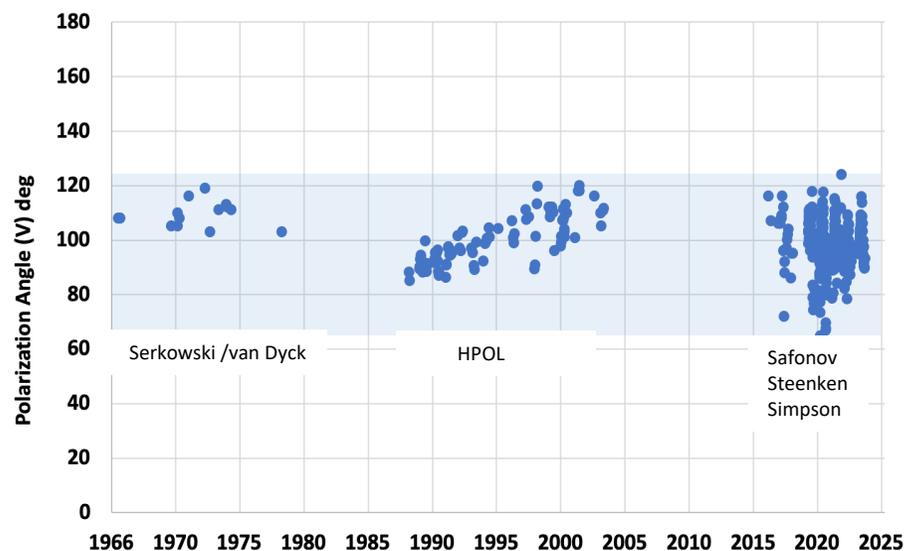


Fit analysis Model vs. data
Reduced Chi2: 93



Elliptical structure could explain the long-term stable PA of optical polarization

- 3.8 mas = radius disk of 200 R_{\odot} at a distance of 500 pc
- Elliptical structure/dusty shell semi-major axis of about 400 R_{\odot}
- PA long axis of elliptical structure seems to be orthogonal to the longterm polarization position angle (PA) range

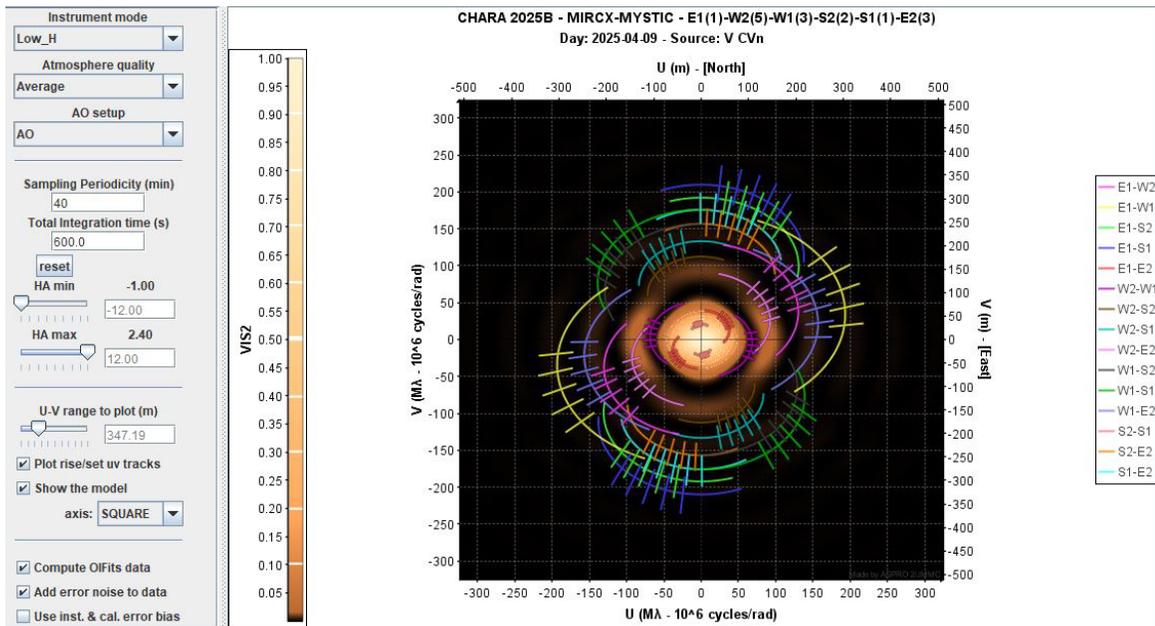


Preliminary hypothesis:

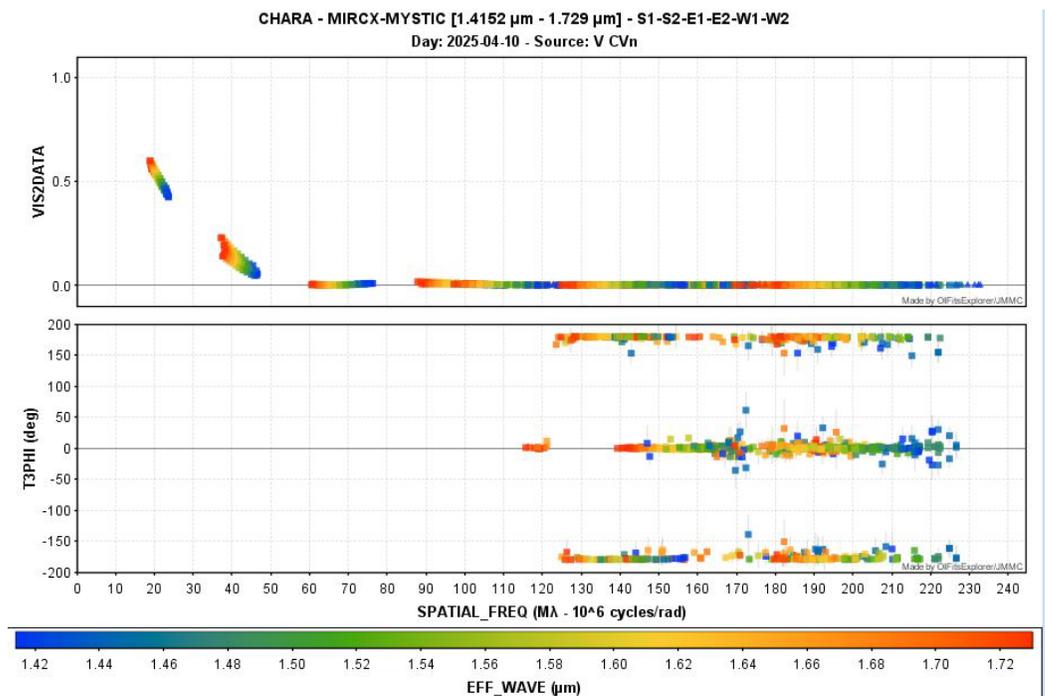
Main dust scattering in polar regions of elliptical structure

Request for guest observing time at the CHARA Array March 1 – July 31, 2026

Simulation of full observation with ASPRO2



Expected results for Model with 3.8 mas disk + 2 x elongated disk



V CVn minimum around mid of March 2026
 Visibility period of V CVn for CHARA starts in January
 Proposal deadline 9/2025

New CHARA Polarimetry mode available?