W SERPENTIS STARS

GEORGIA STATE UNIVERSITY

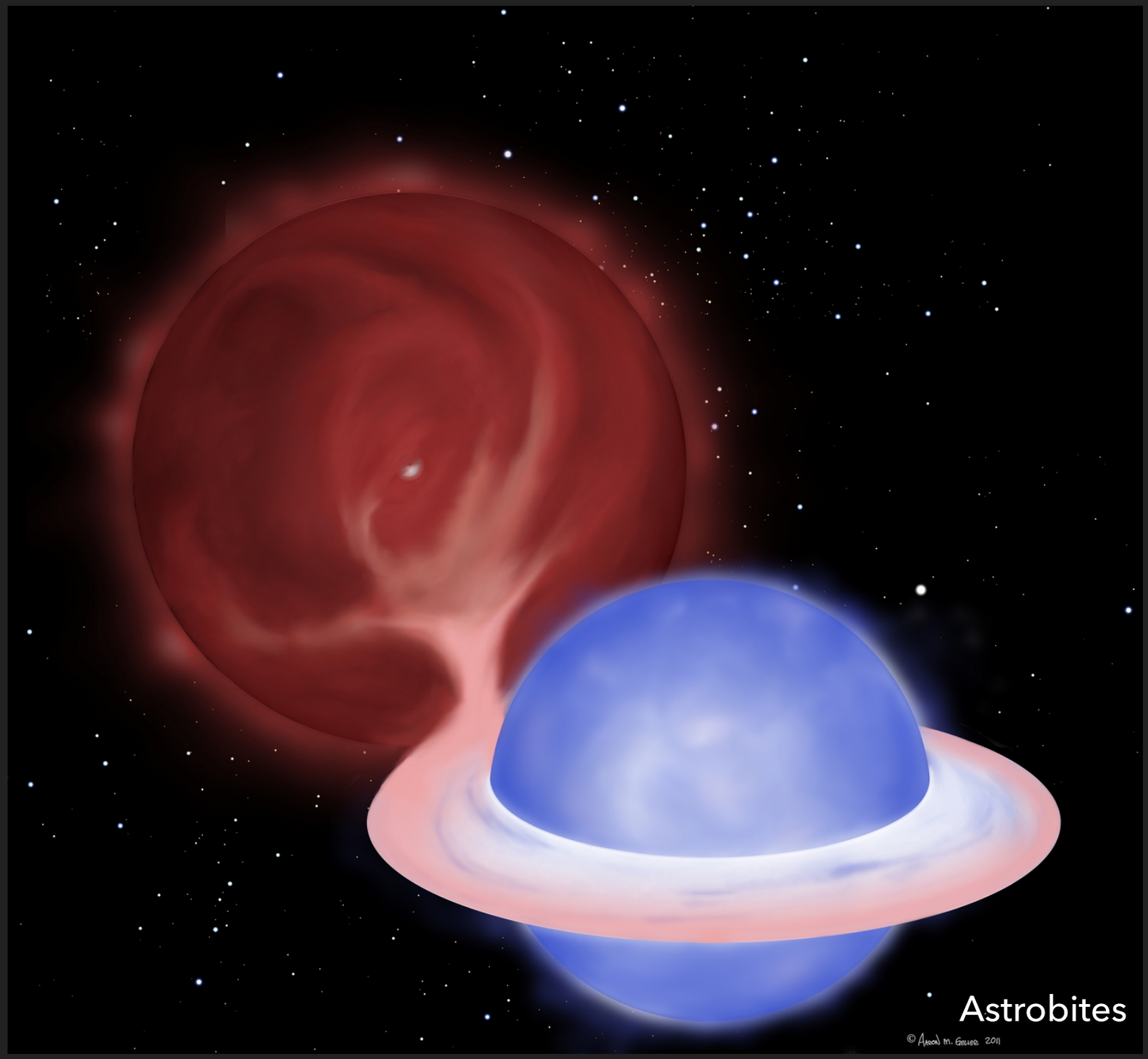
ADVISOR: DR. DOUGLAS GIES

KATHERINE SHEPARD

NASA/Casey Reed

WHAT ARE THEY?

- Rare Binary Systems



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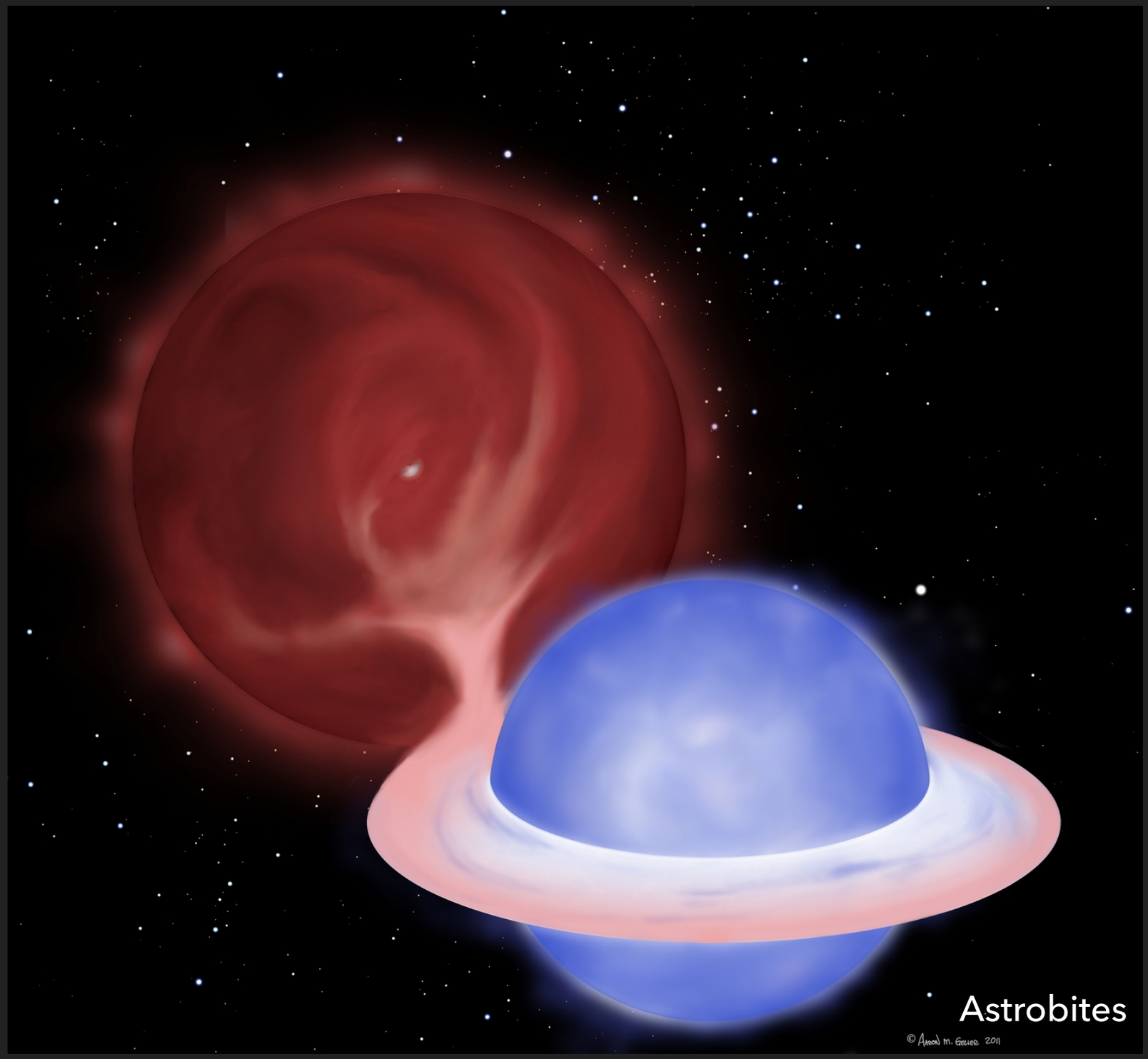

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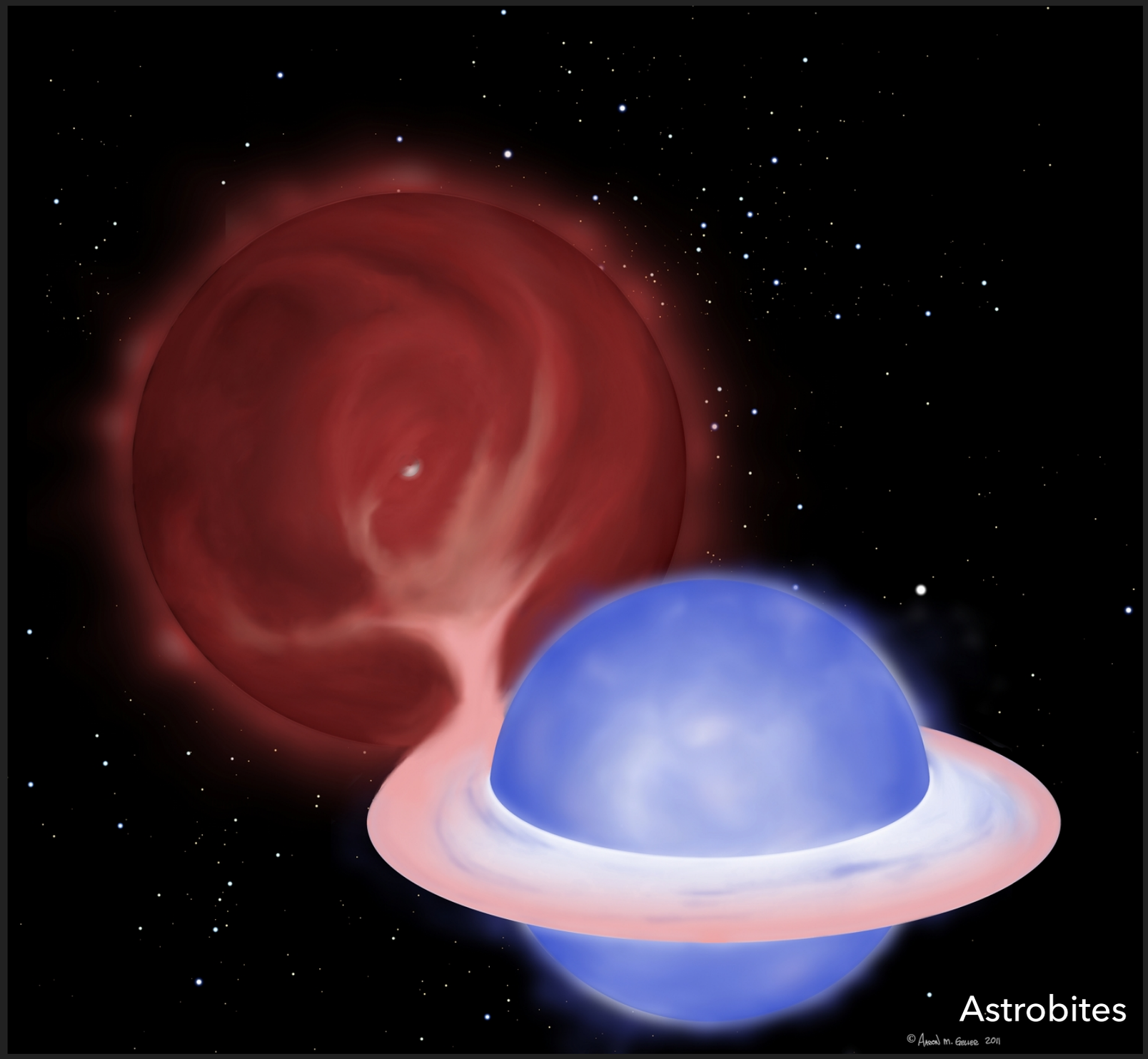
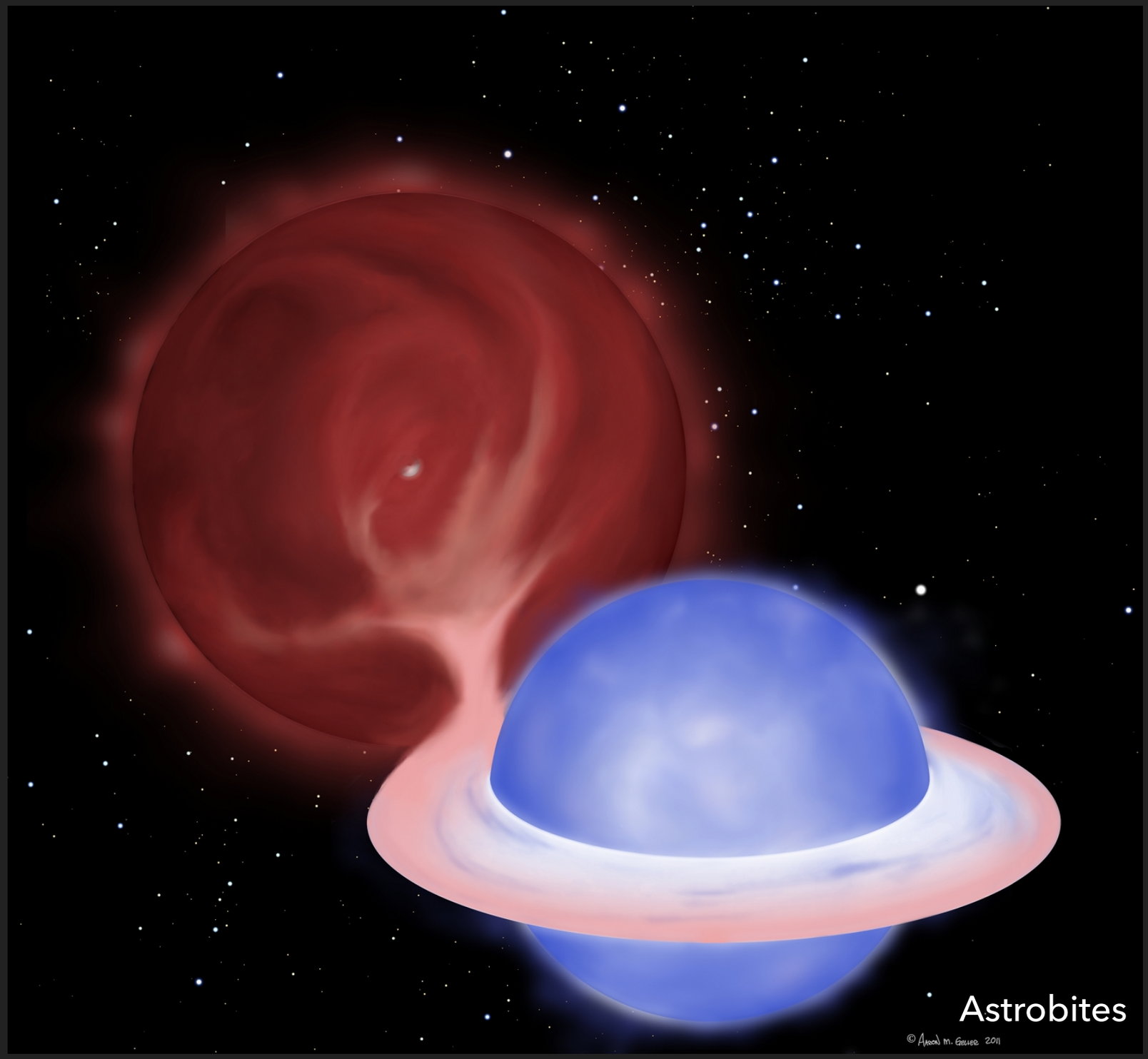


WHAT ARE THEY?

- Rare Binary Systems
- Massive Stars
- Nonconservative active mass transfer
- Circumbinary disks



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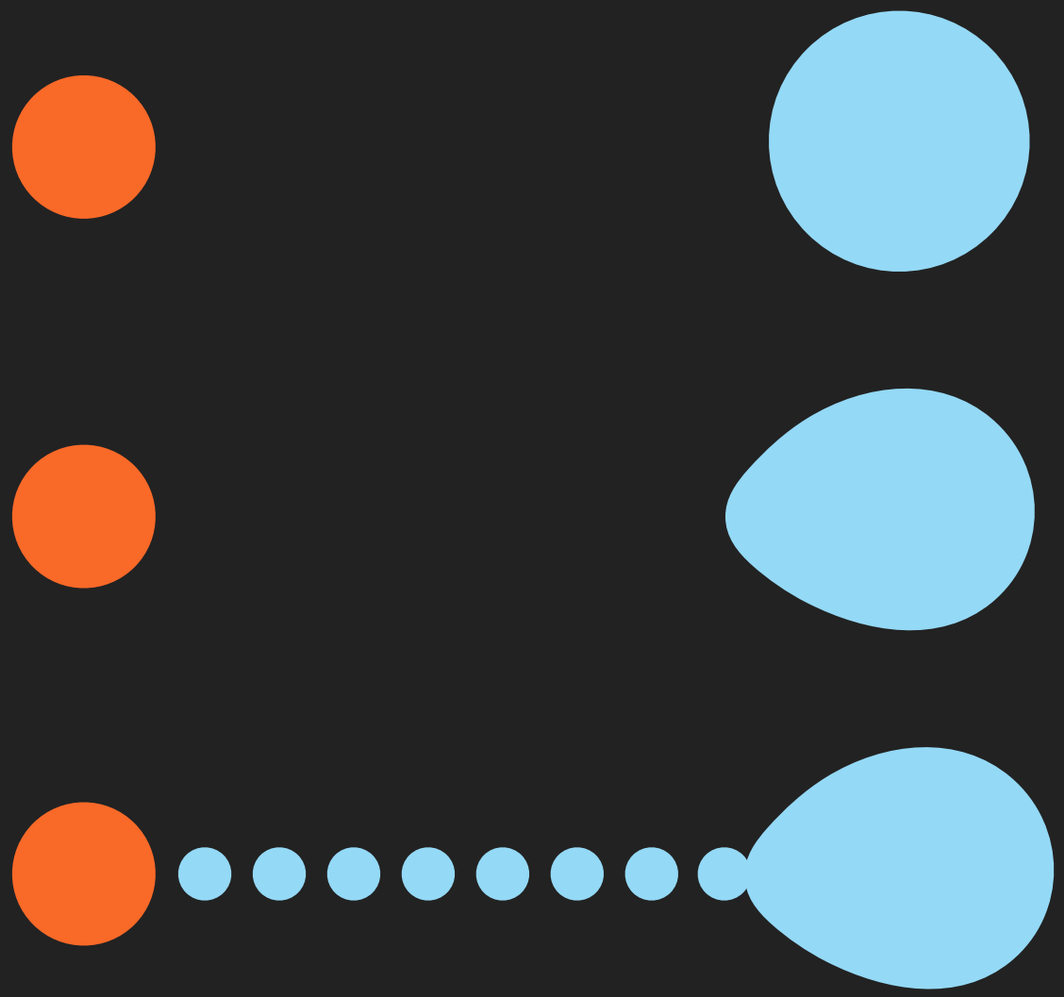

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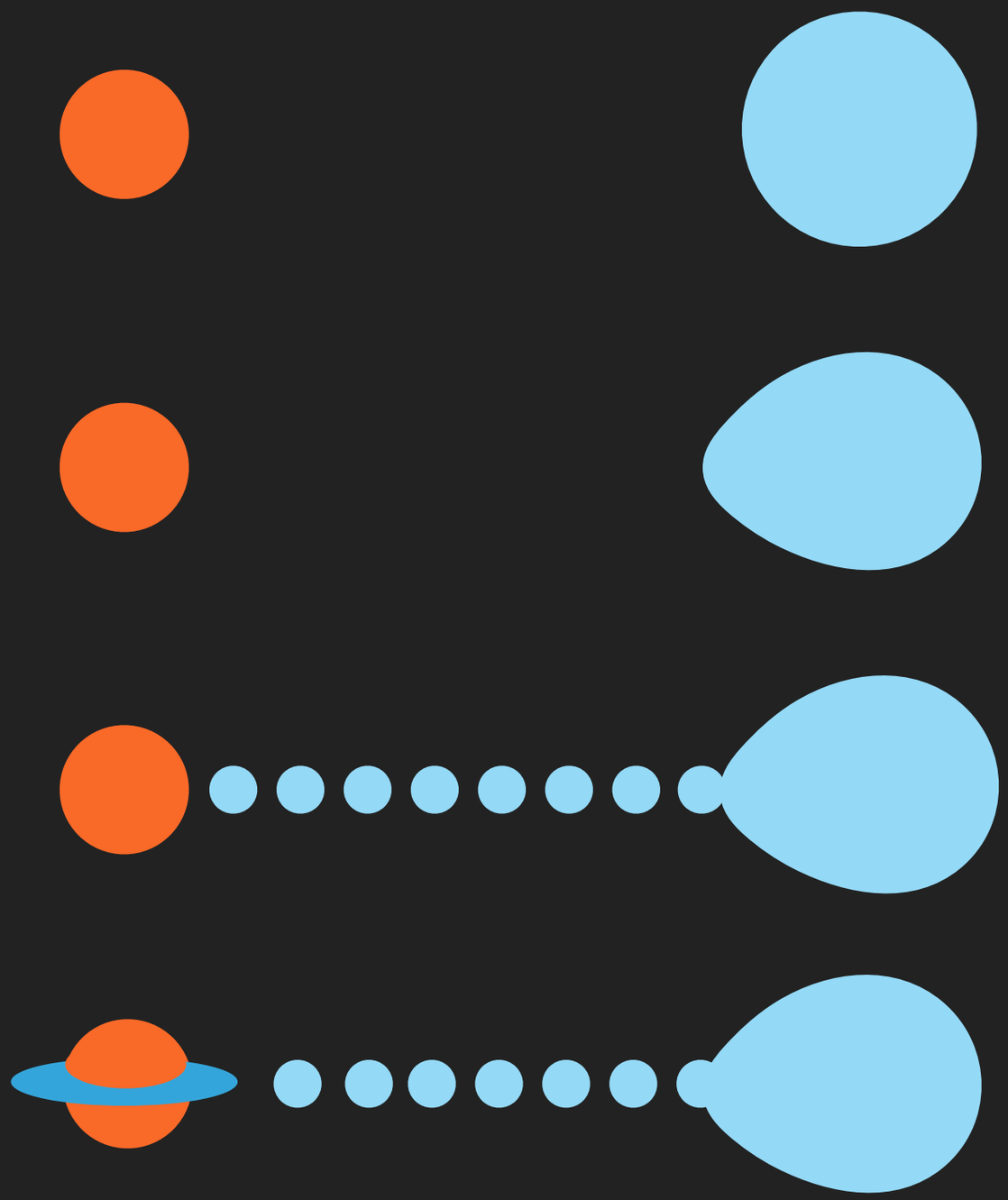

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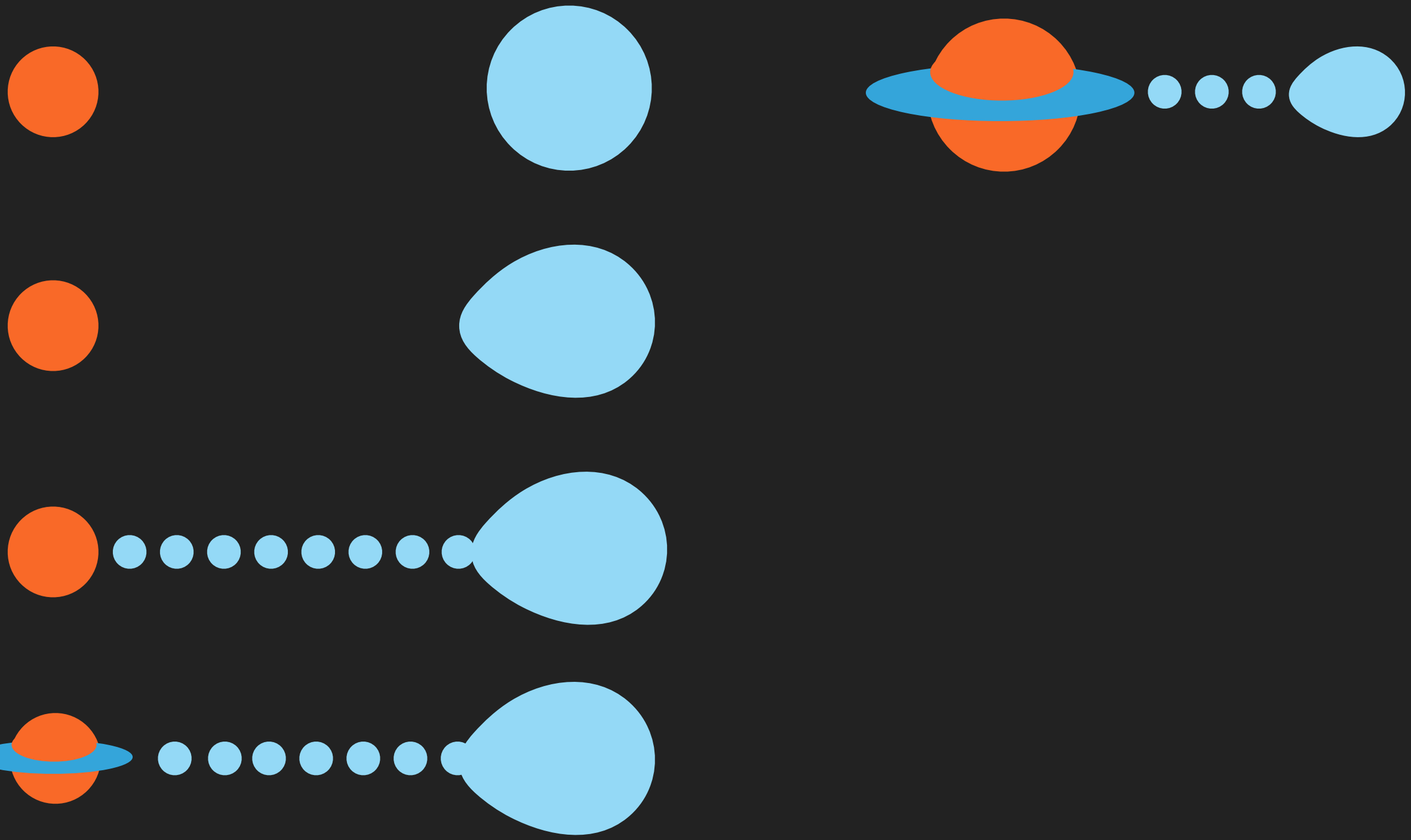

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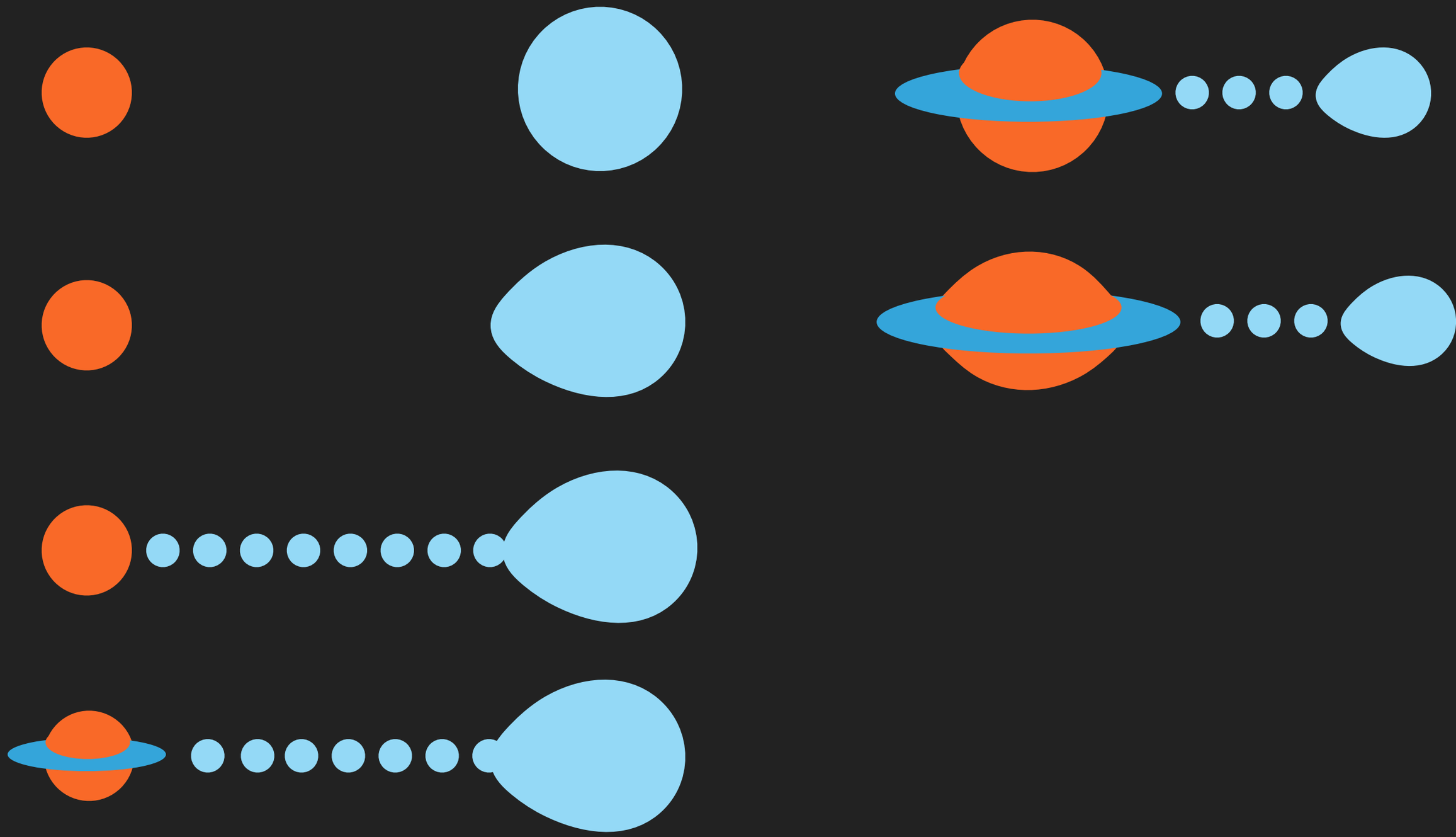

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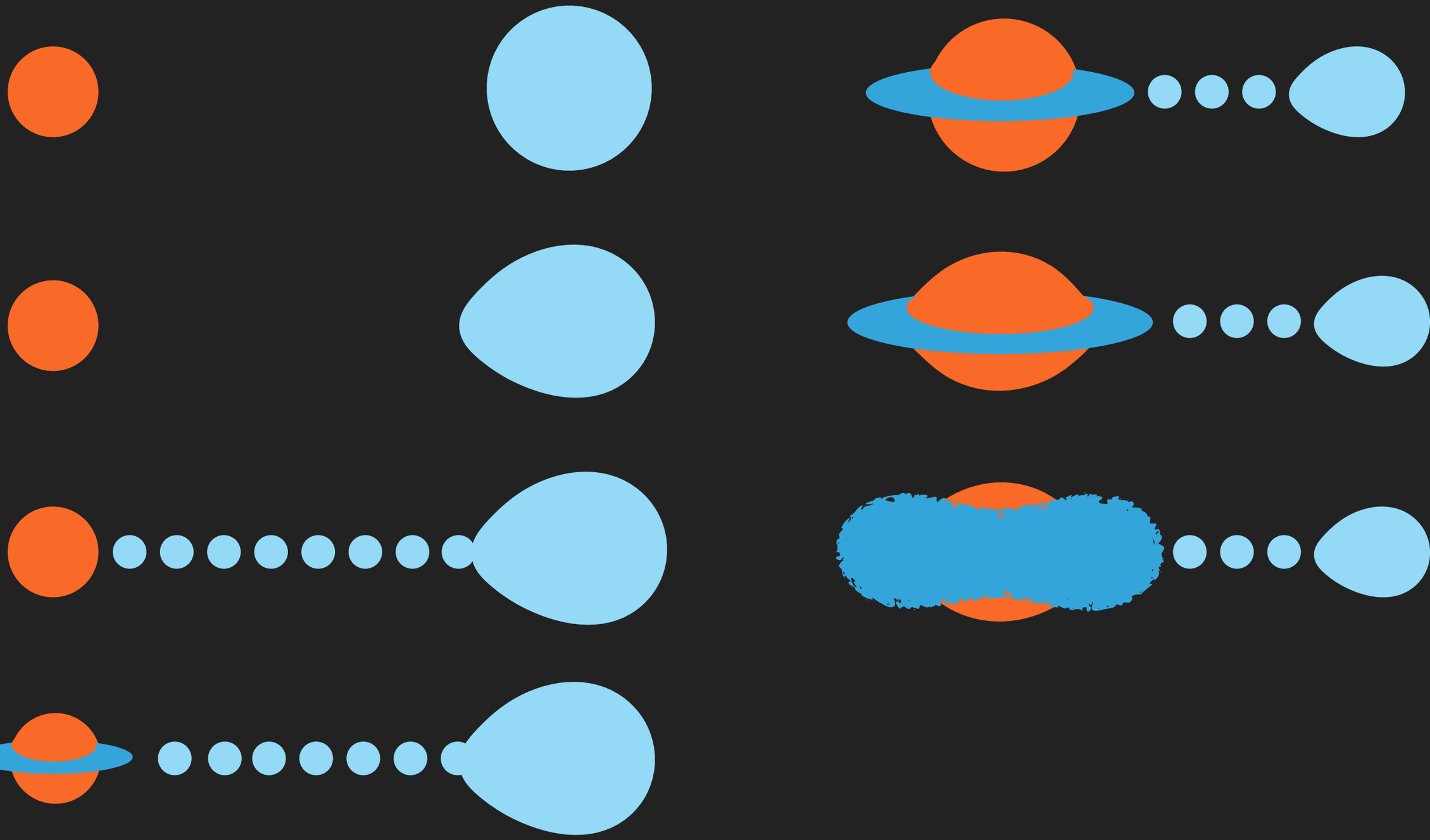

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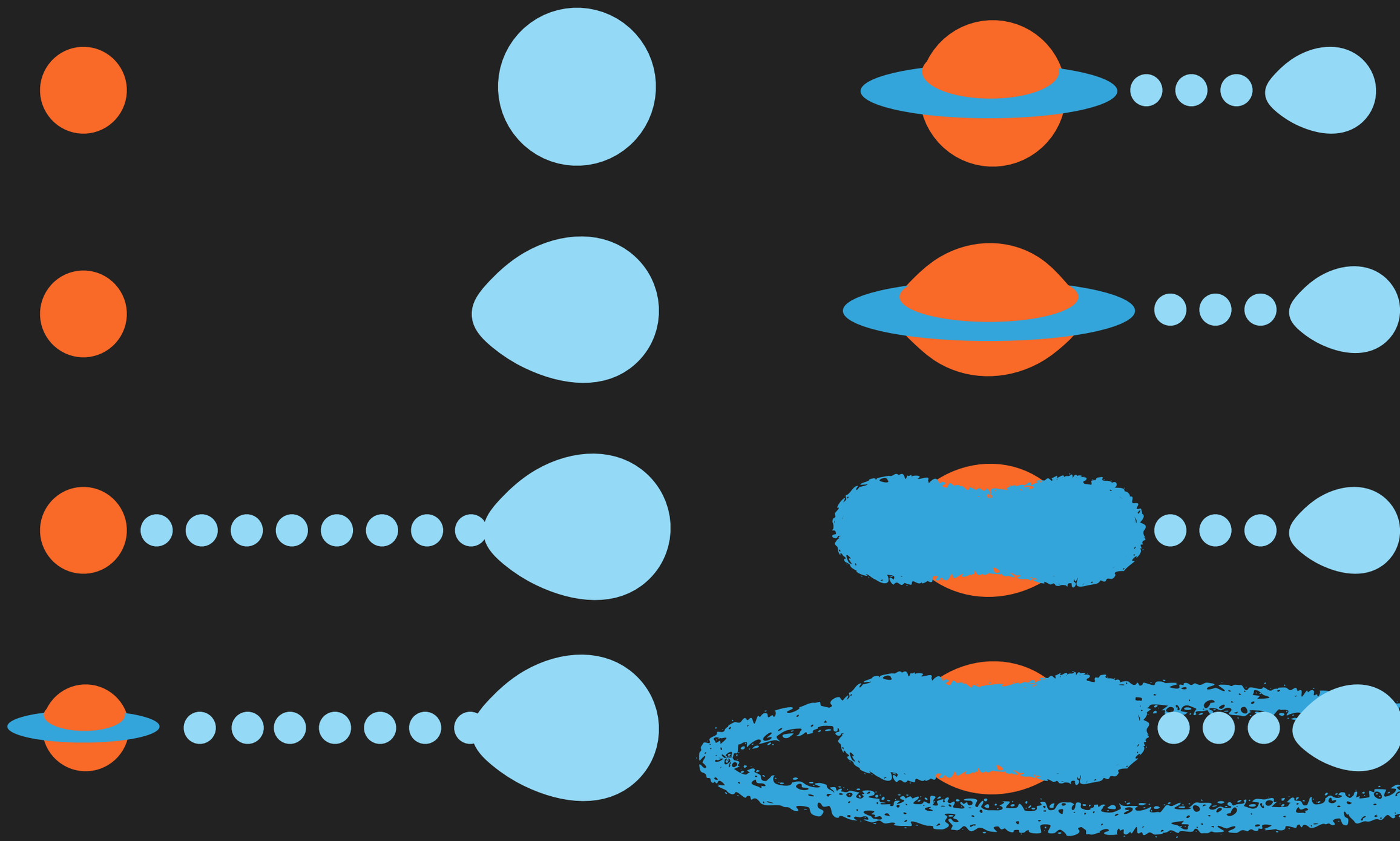
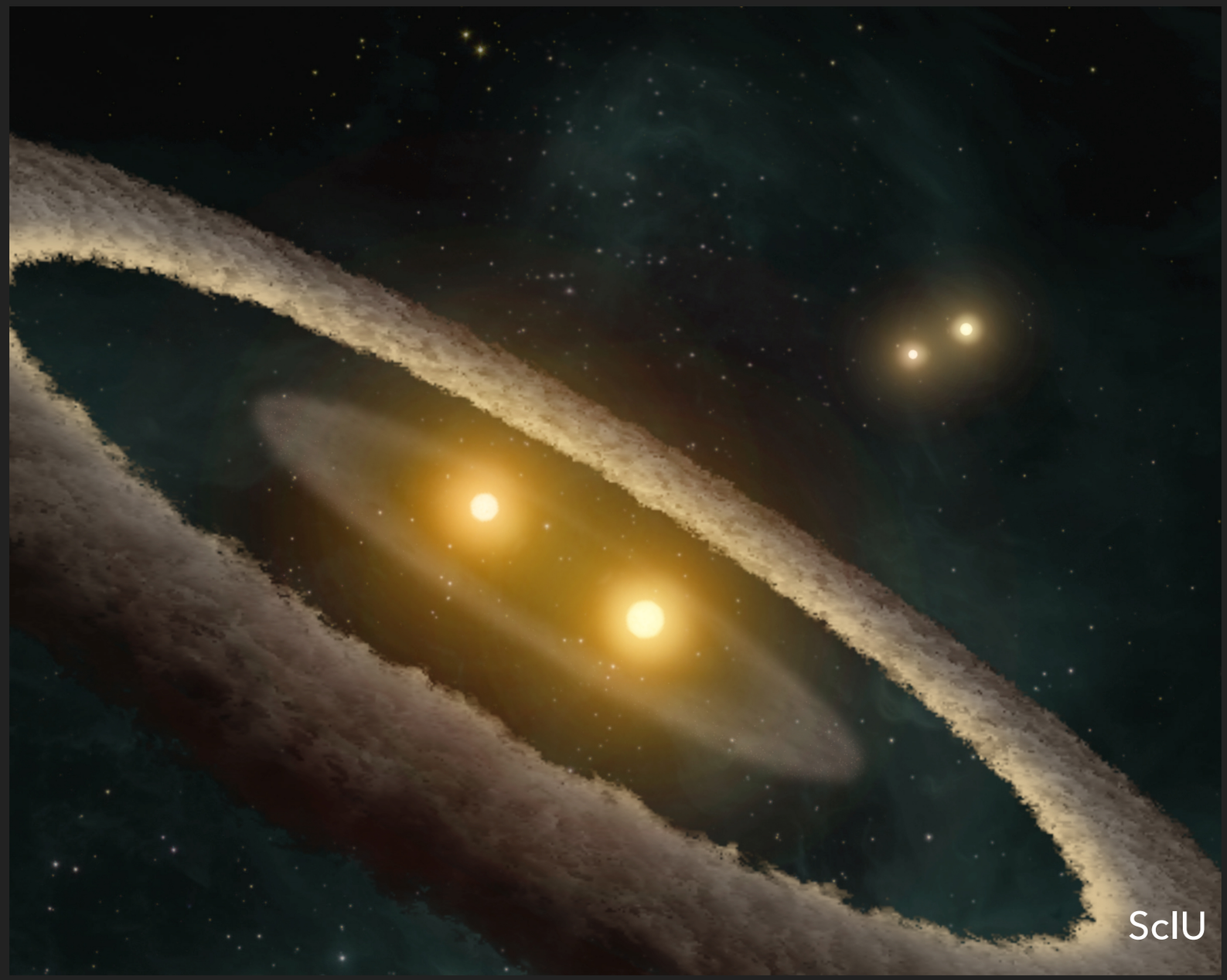


WHY AM I STUDYING THESE?

- What do these systems evolve into?



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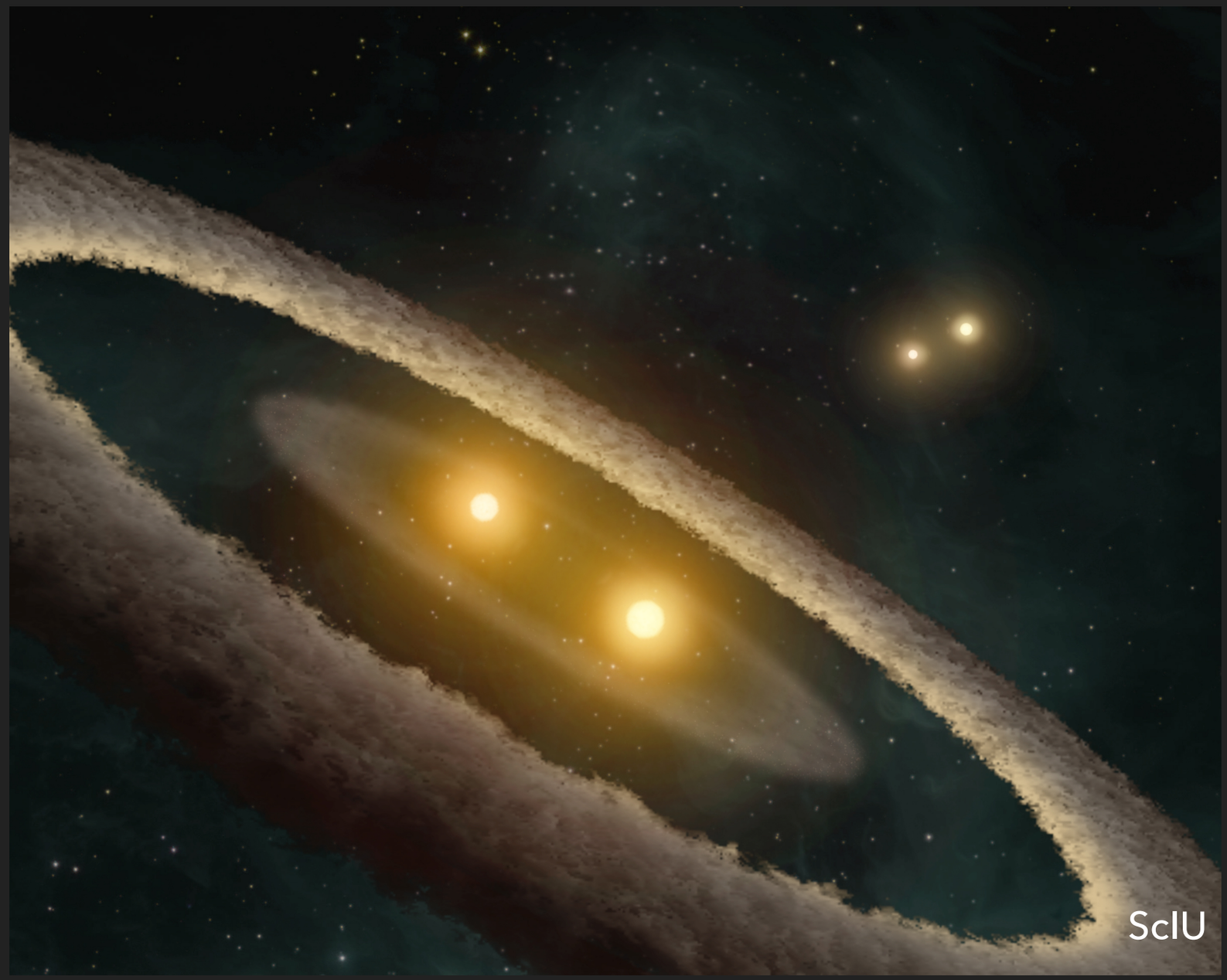
- What do these systems evolve into?
- What happens to the disk?



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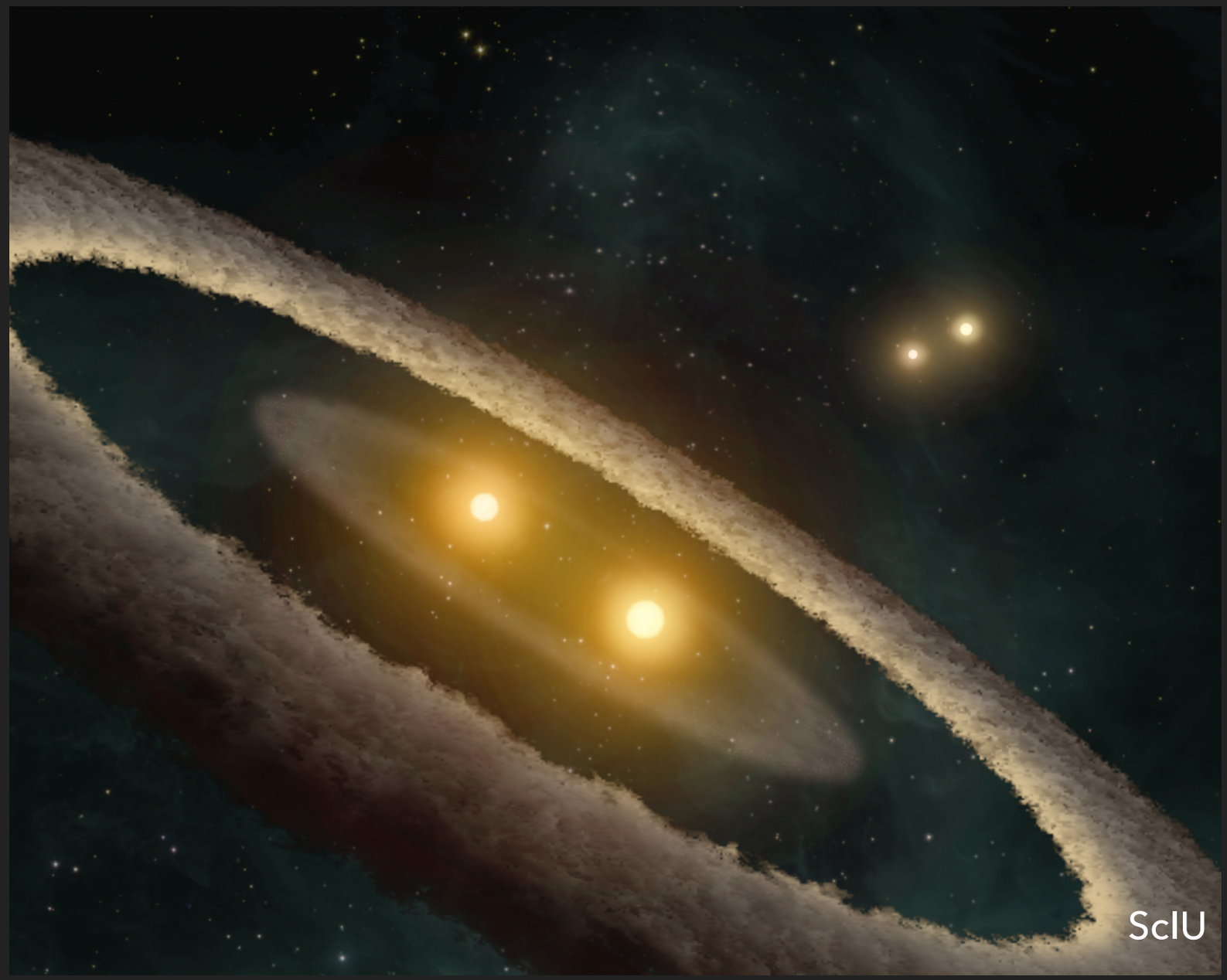

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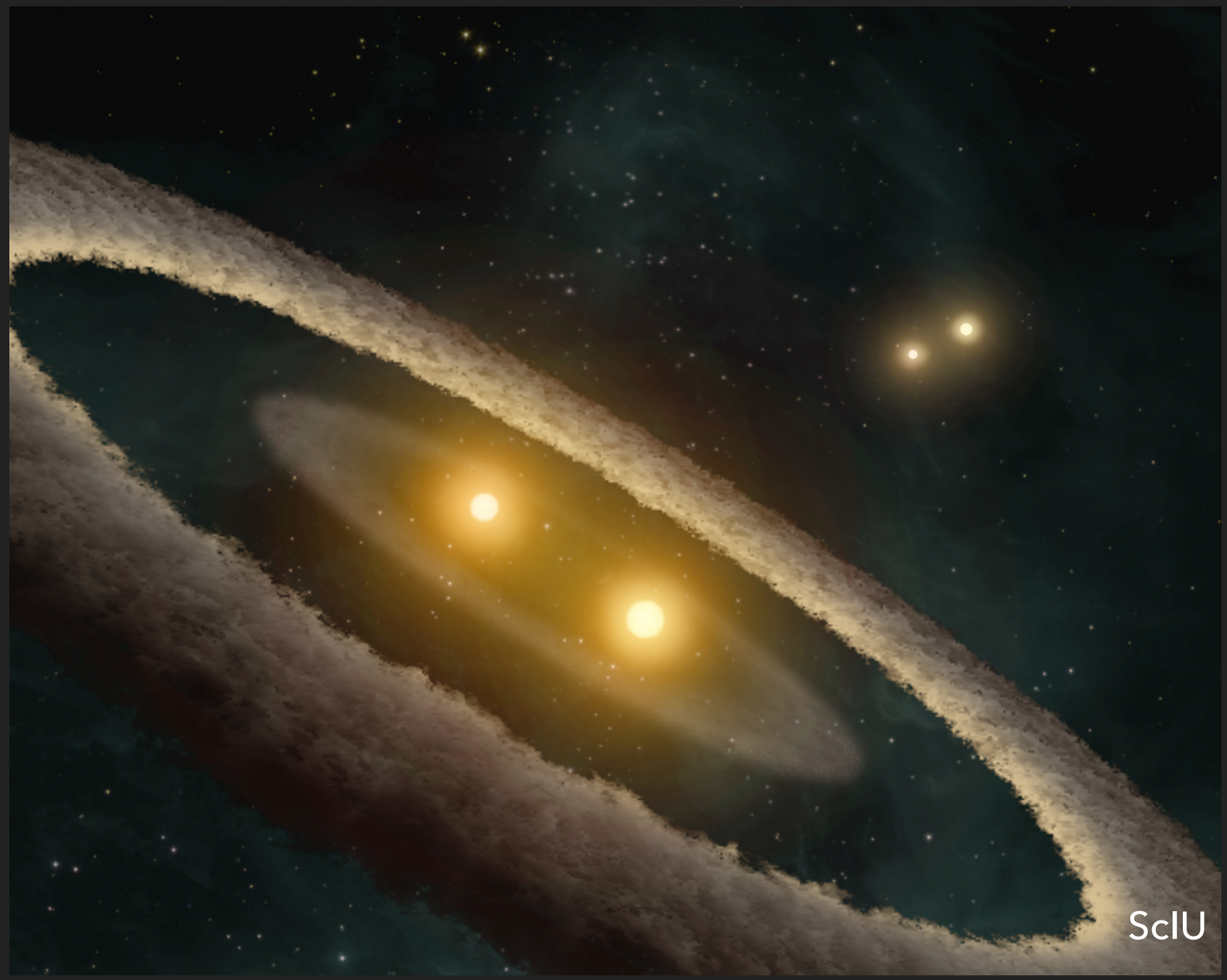

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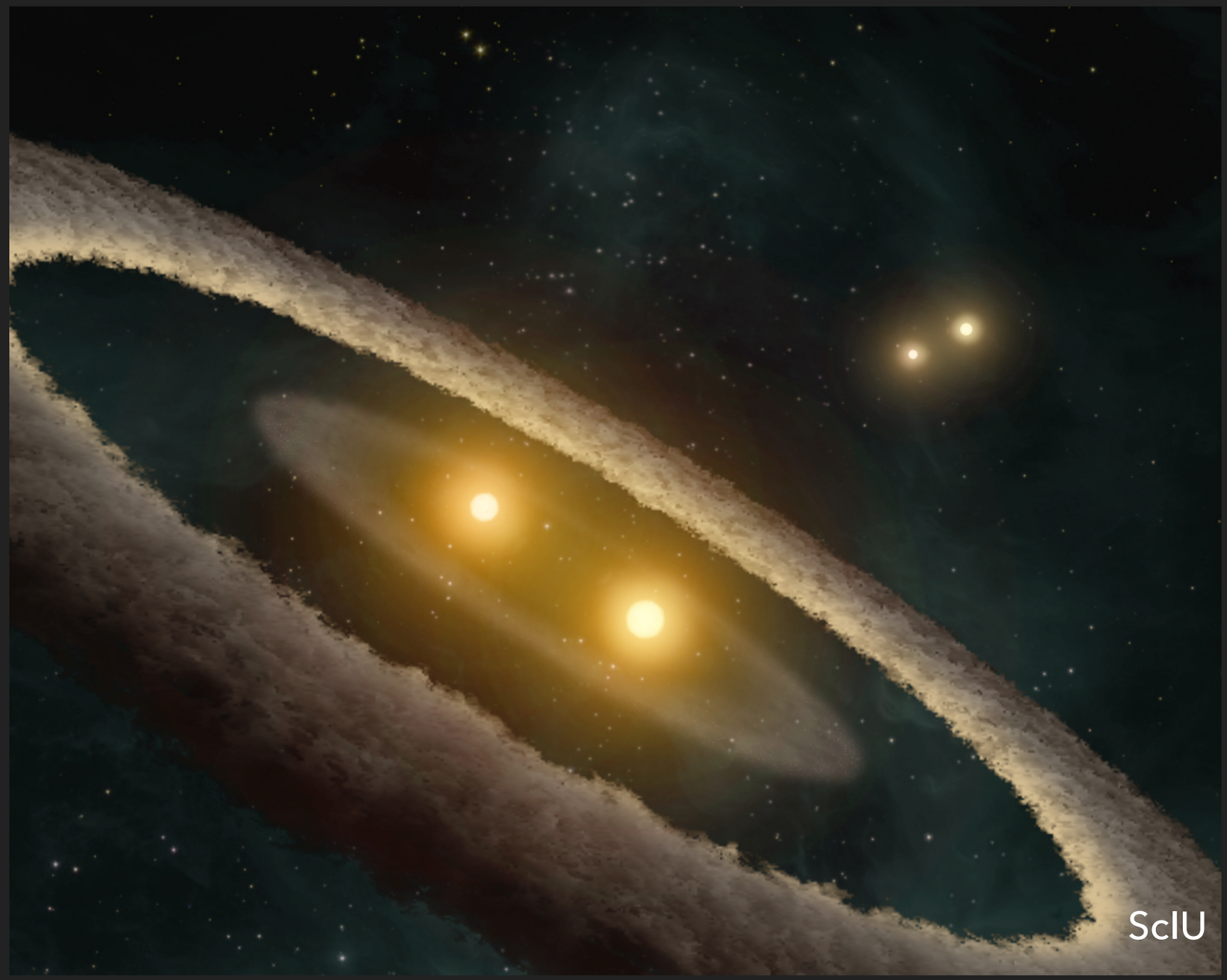
- What do these systems evolve into?
- What happens to the disk?
- How many of them exist?
- How do they influence their surroundings?
- Further develop understanding of dynamics of mass transfer between stars



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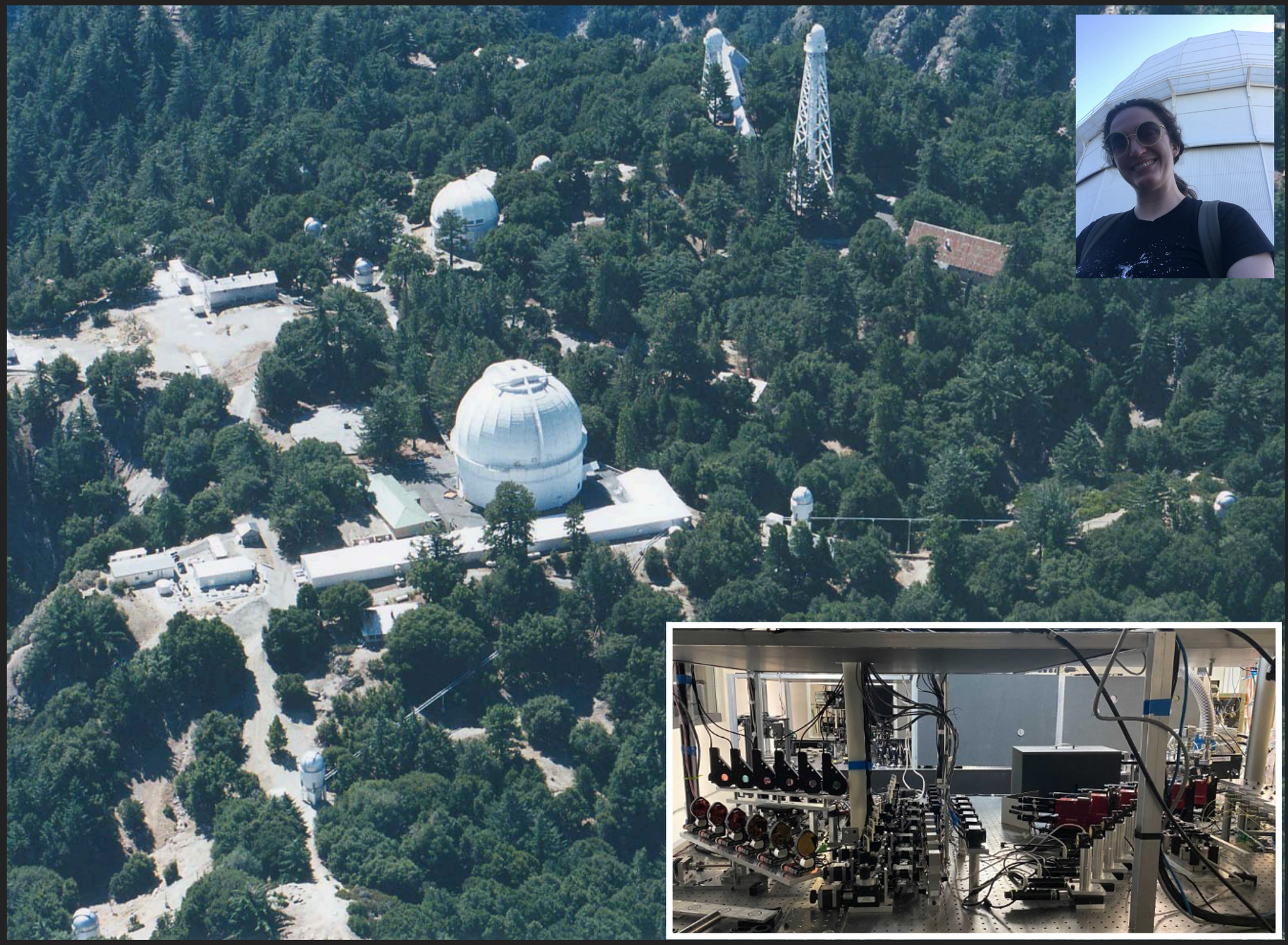

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Interferometry

- Look at system as a whole
- Mass distribution of circumbinary disk
- Size of disk
- Separation of inner binary
- Orientation of system
- Binary motion signatures

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Spectroscopy

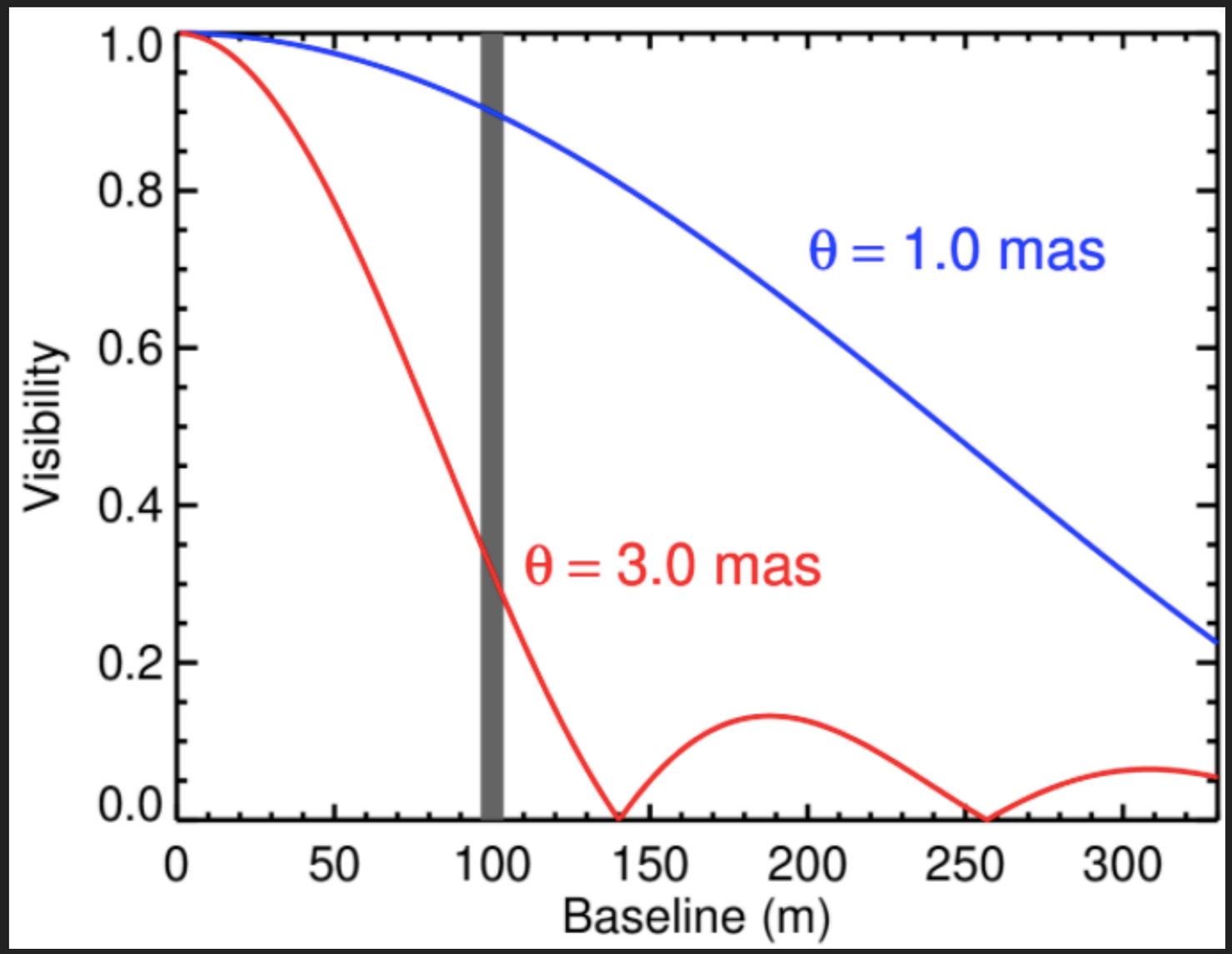
- Look at energy levels
- Confirm orbital periods
- Maybe map orbits
- How does orbital phase influence circumbinary disk

NUMBER OF OBSERVATIONS SO FAR

Star Name	Spectral Type	# of MIRCX		# of Mystic		# of APO
		5T	6T	5T	6T	
BD+14 3887	B3 Ibe	-	1	-	-	3
HD 181615	B2 Vp sh	-	1	-	-	9
V729 Cyg	O6.5 Iafe	-	4	-	2	3
HD 198288	A3 Ibep	1	3	1	1	12
HD 216200	B4+F9 III	-	4	1	2	20
HD 218393	B3 pe+ K1 III	2	3	2	-	21
HD 166126	F8/G2 Iaep	1	-	-	-	4
HD 166937	B8 Iab(e)	2	-	-	-	7
HD 169515	O9.7 Ibep	3	-	2	-	8
HD 45677	B2 IV/V[e]	-	-	-	-	4
HD 45910	B2 IIIe	-	-	-	-	8
HD 50138	A1 Ib/II	-	-	-	-	7
HD 51480	Be sh	-	-	-	-	6

REFRESHER ON VISIBILITIES

- Large objects produce smaller fringes (and vice versa)



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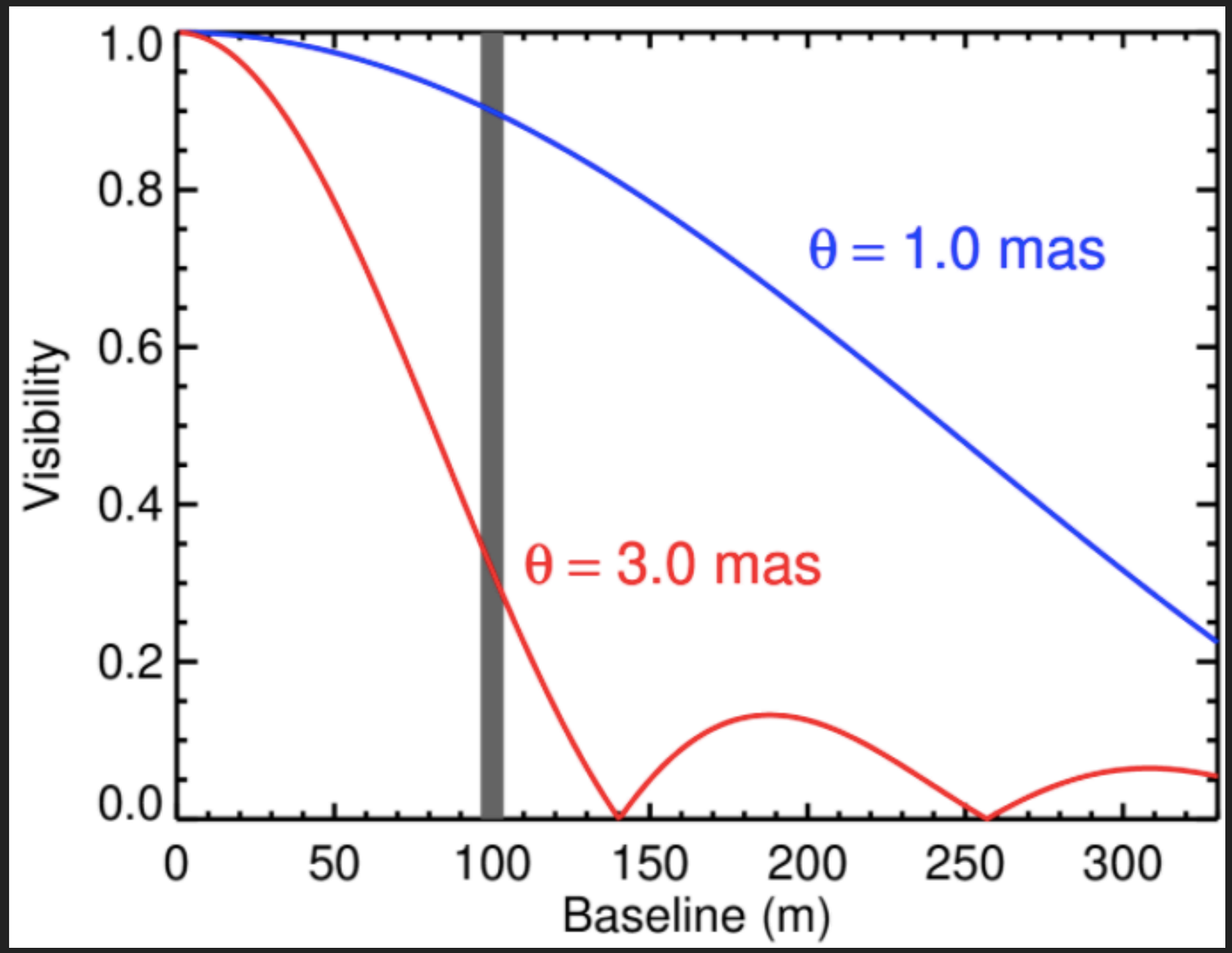
- Visibilities measure the difference of the maximum and minimum amplitude of the fringe

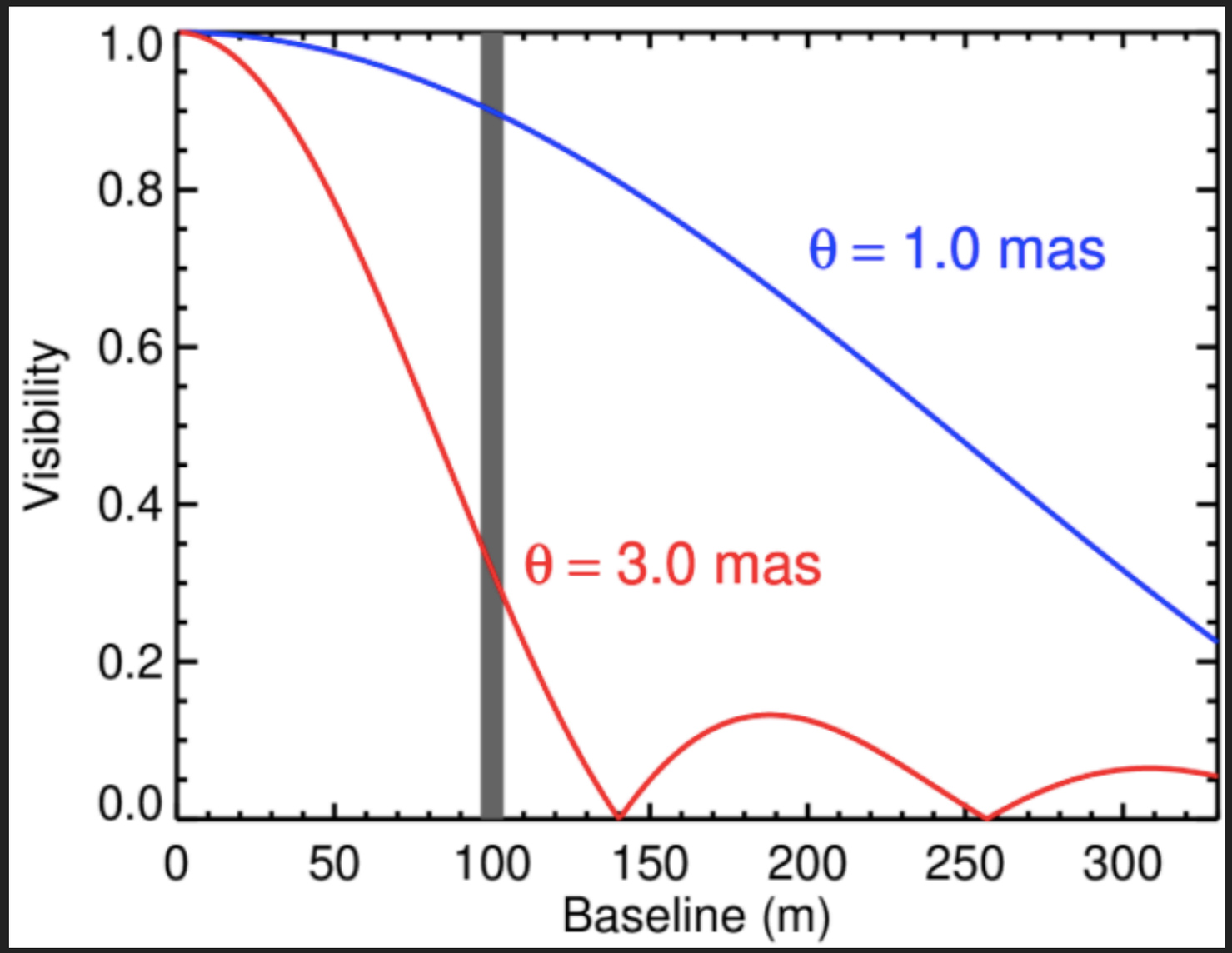


REFRESHER ON VISIBILITIES

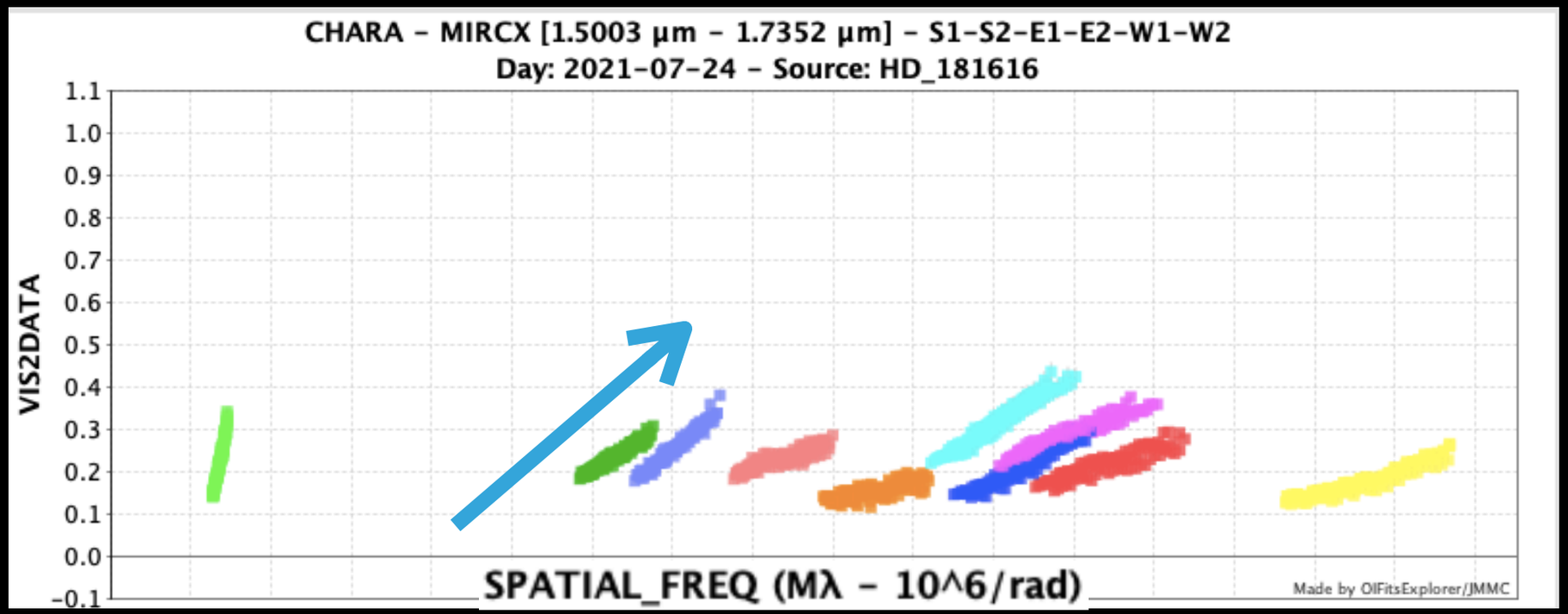
- Large objects produce smaller fringes (and vice versa)

- Visibilities measure the difference of the maximum and minimum amplitude of the fringe

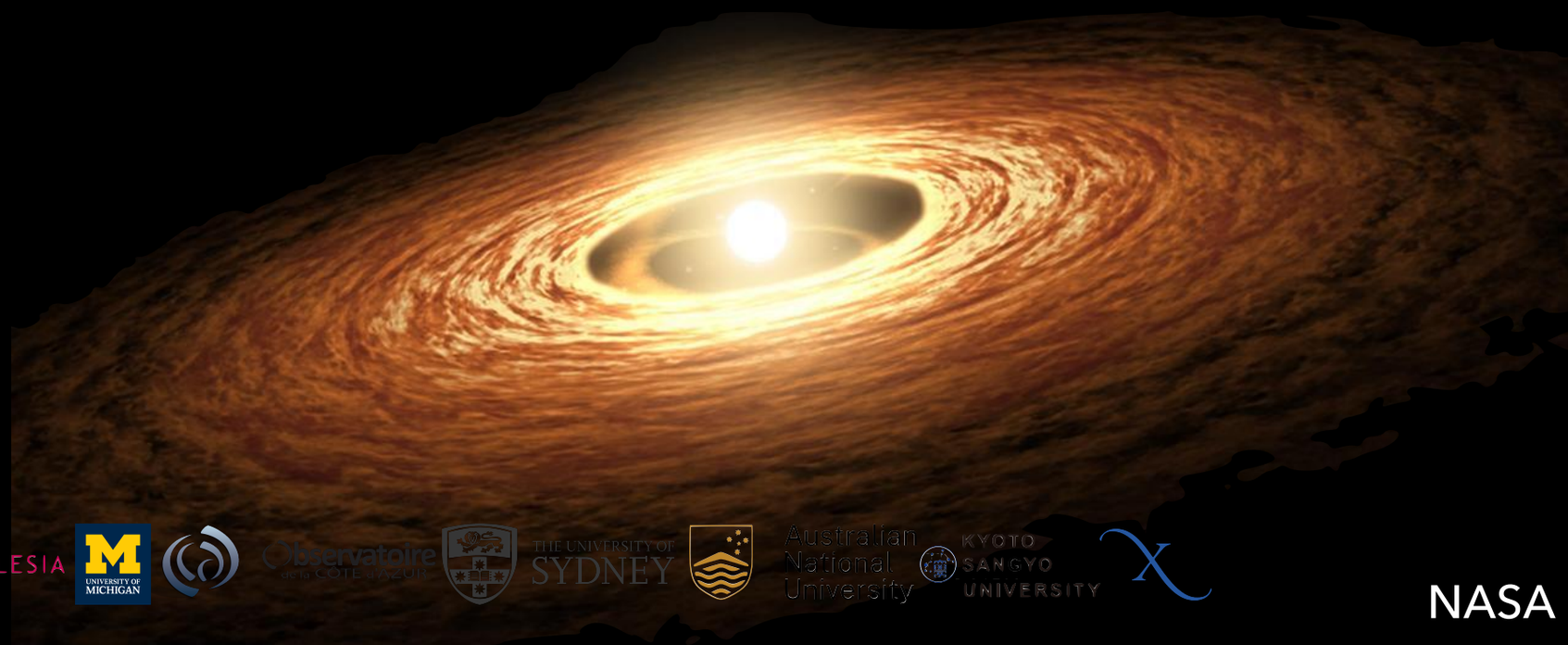
- A large object will produce smaller visibilities



INITIAL LOOK AT MIRCX DATA



- Frequency is inversely related to wavelength



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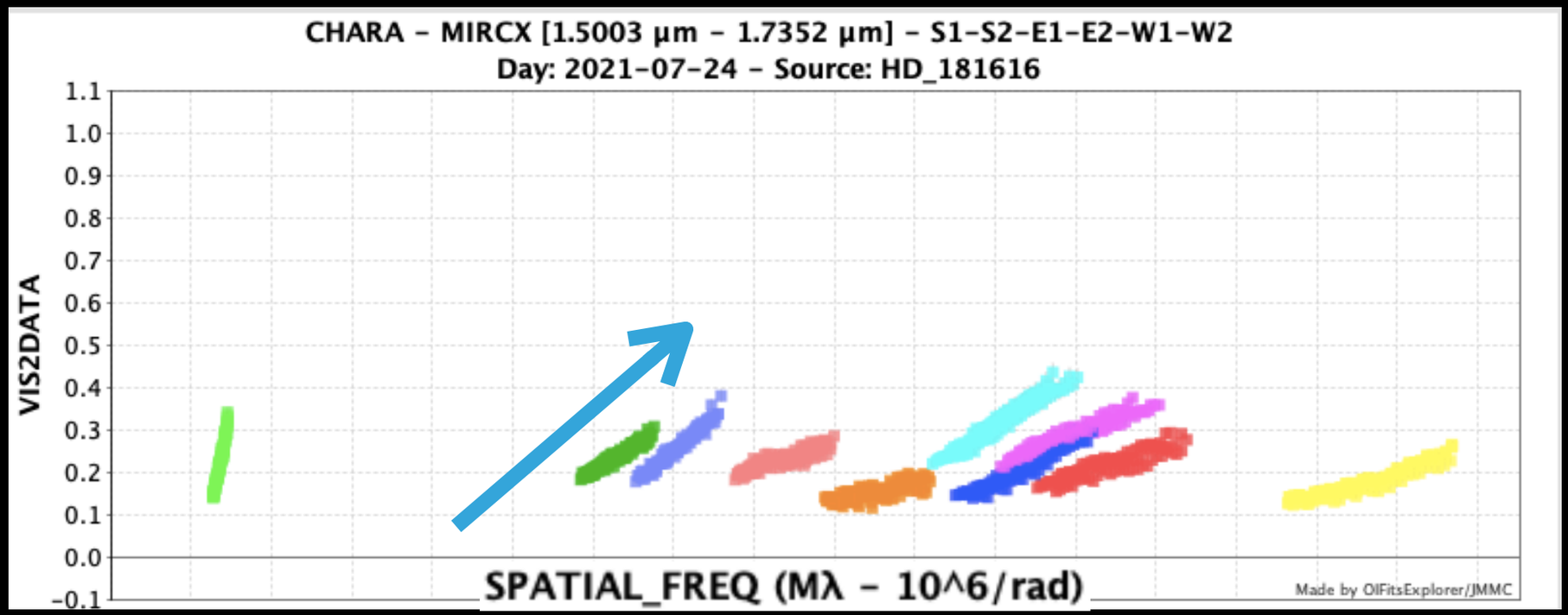

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- So smaller frequencies = longer wavelengths

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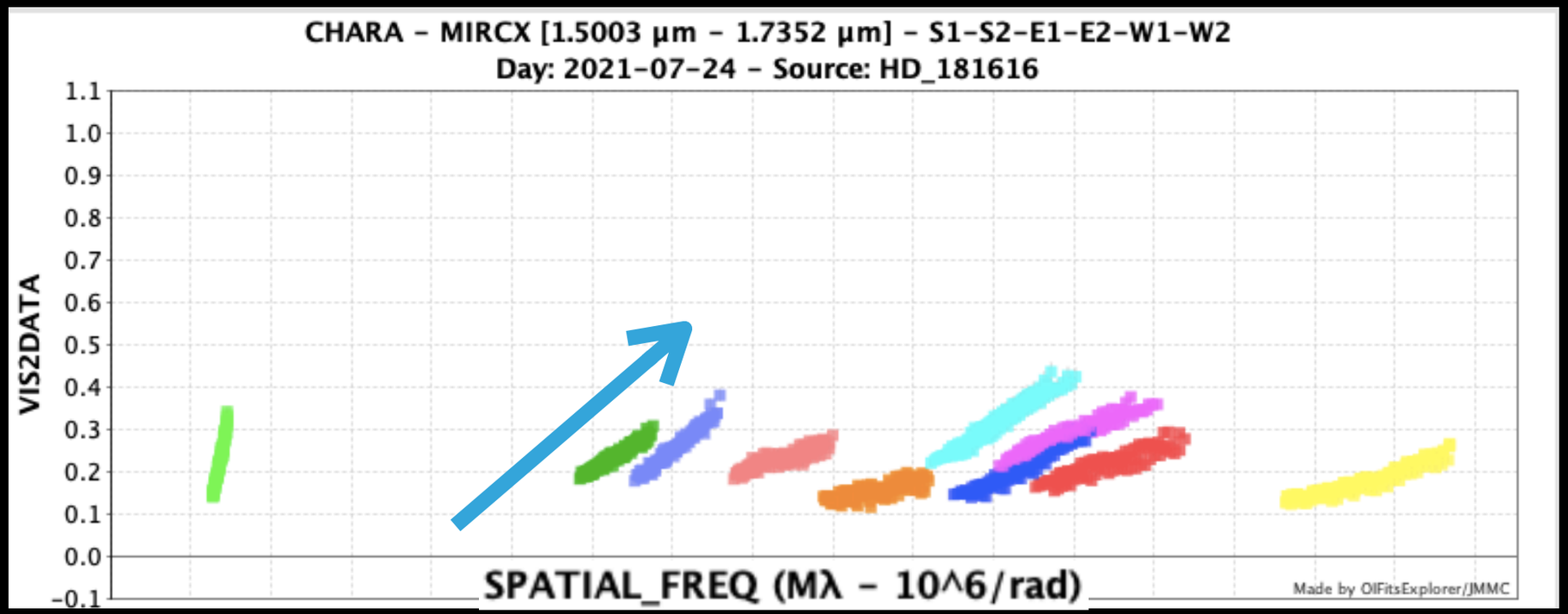

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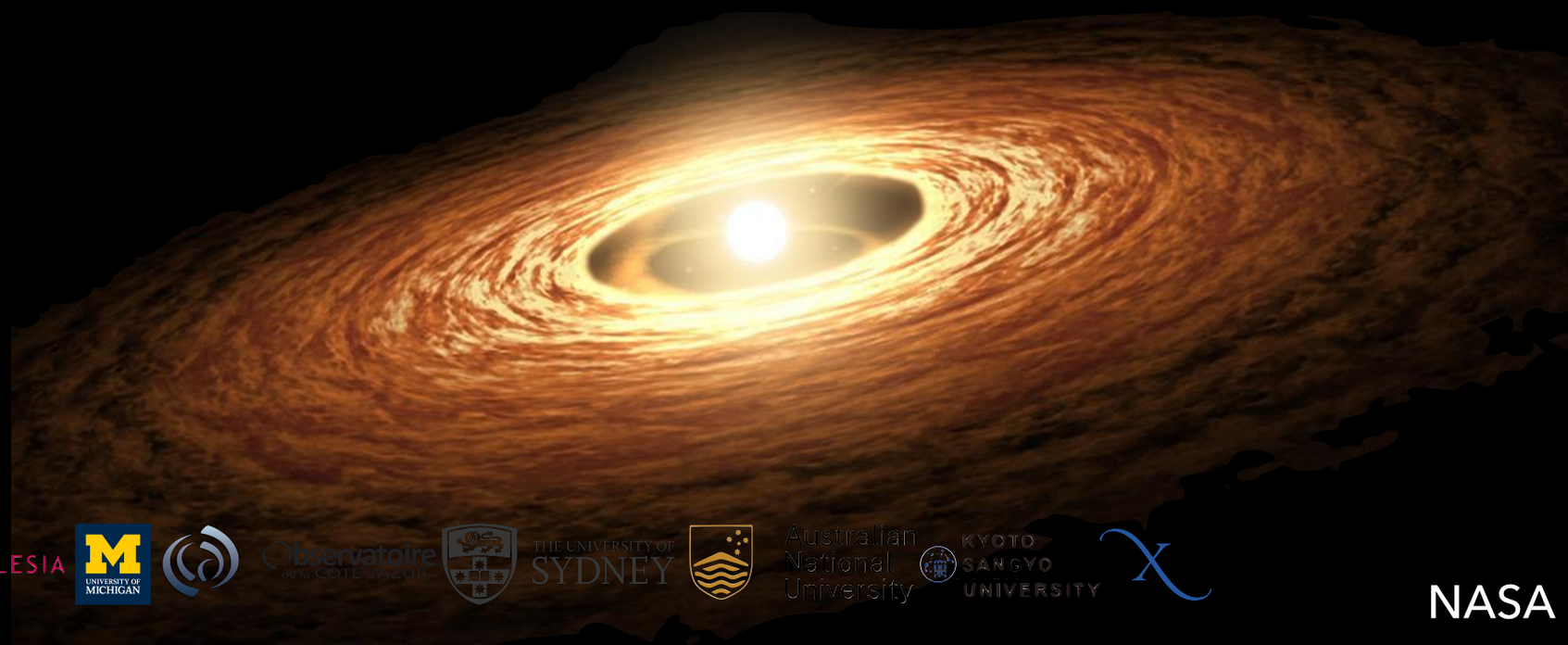
- Longer wavelengths correspond to cooler objects and vice versa



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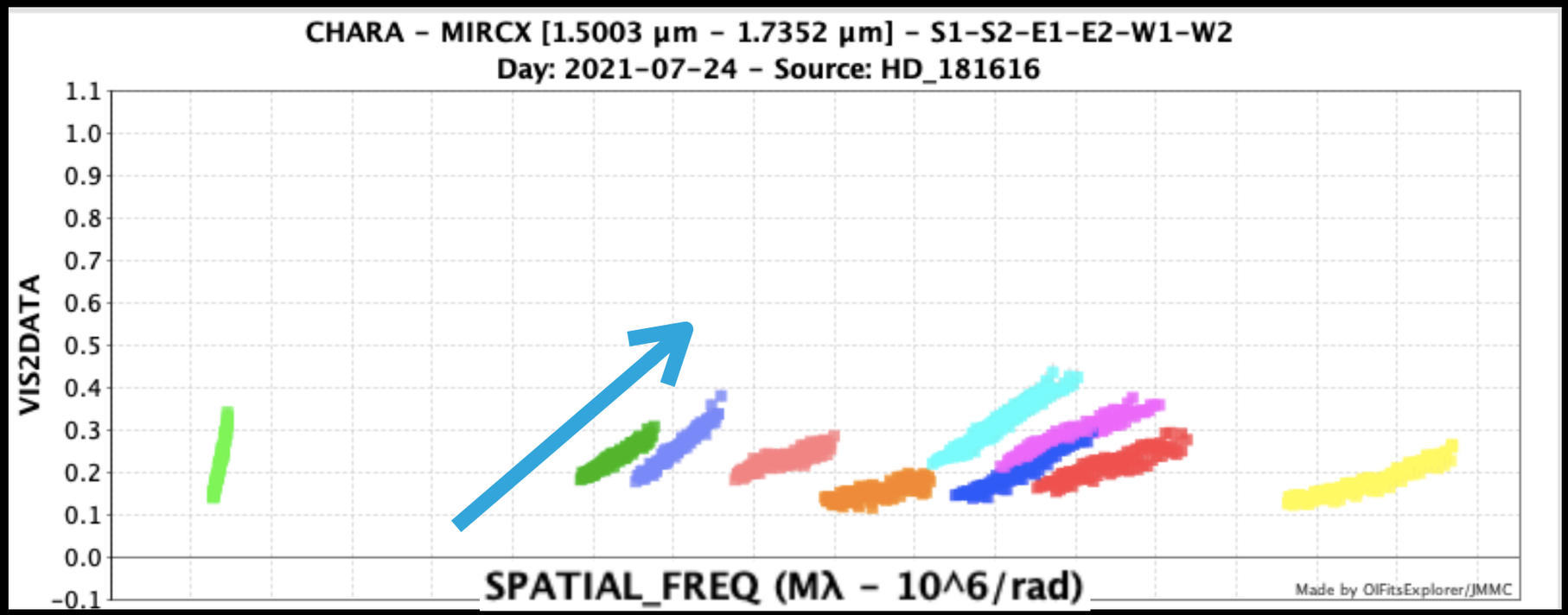

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- The bigger, cooler, outer disk produces a smaller visibility while the smaller, hotter, inner disk produces a larger visibility

NASA

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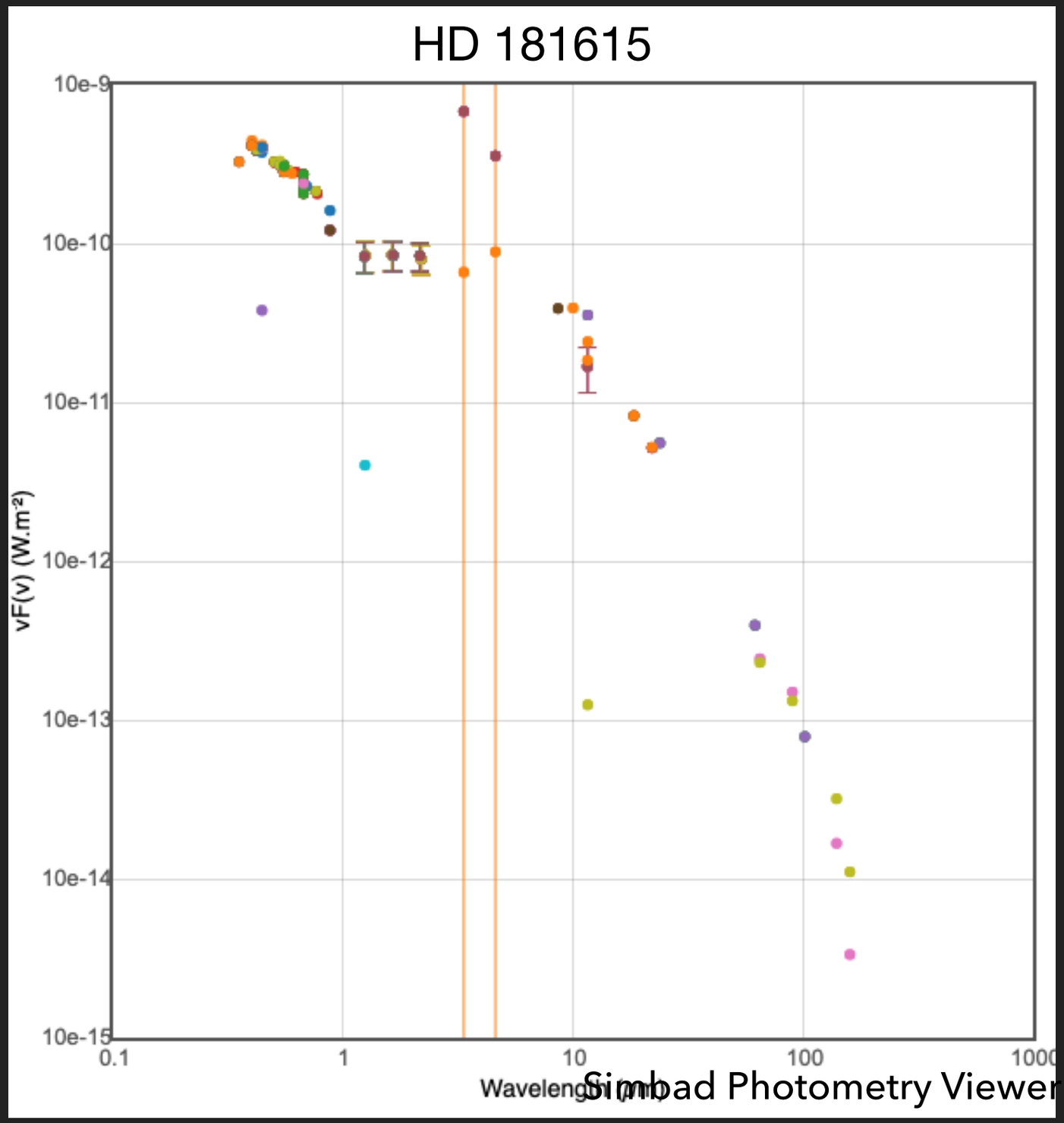

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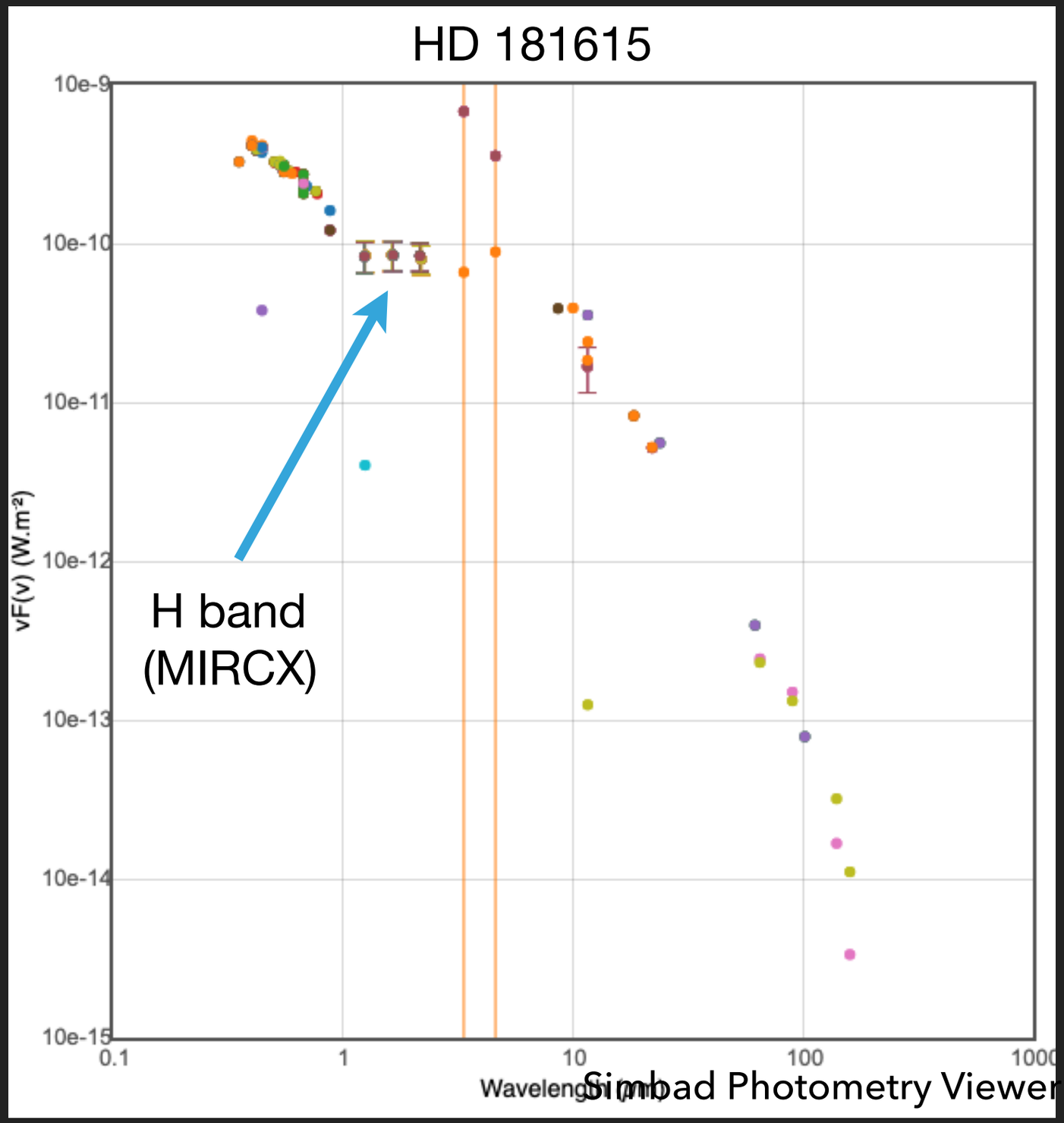

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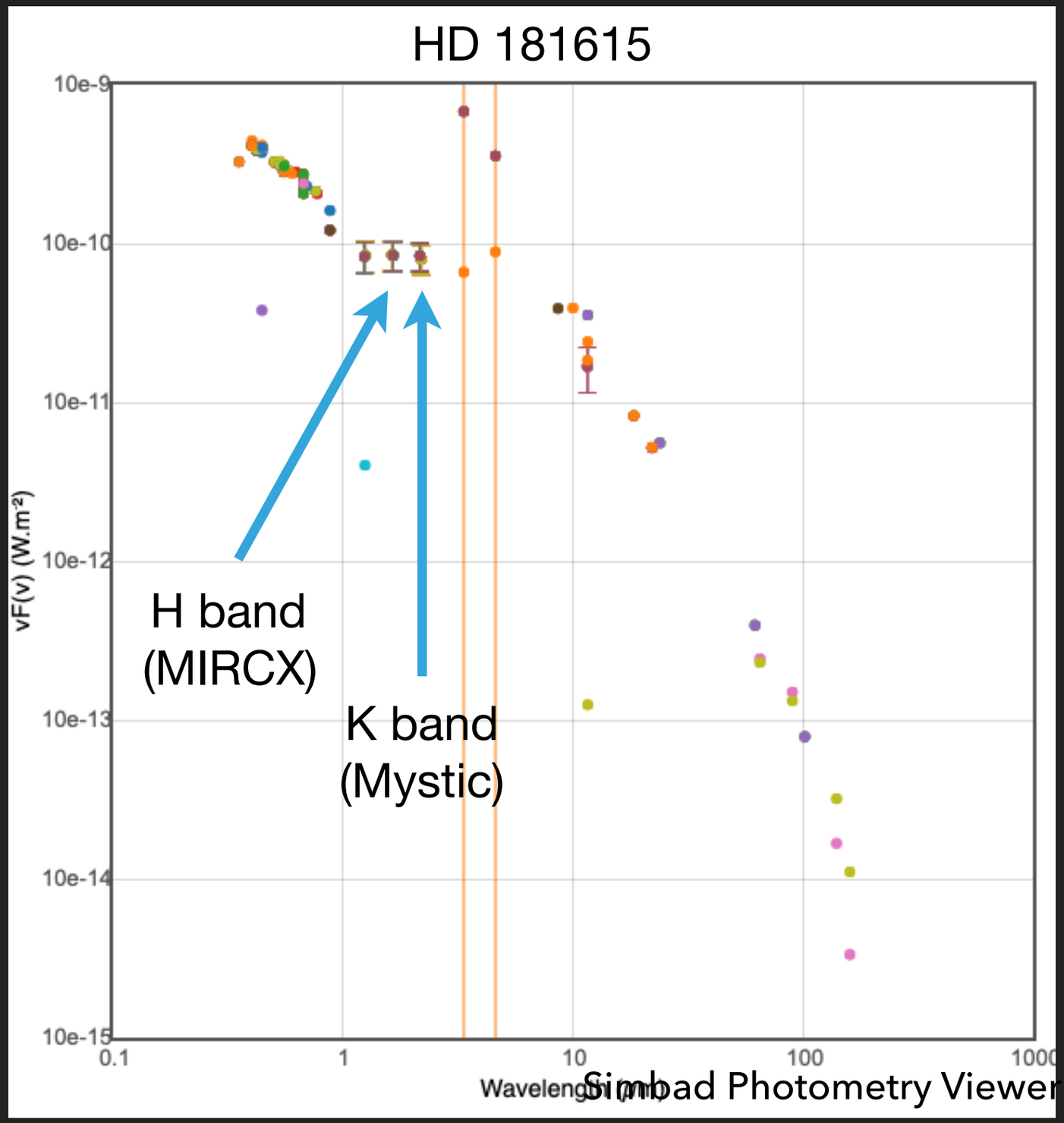

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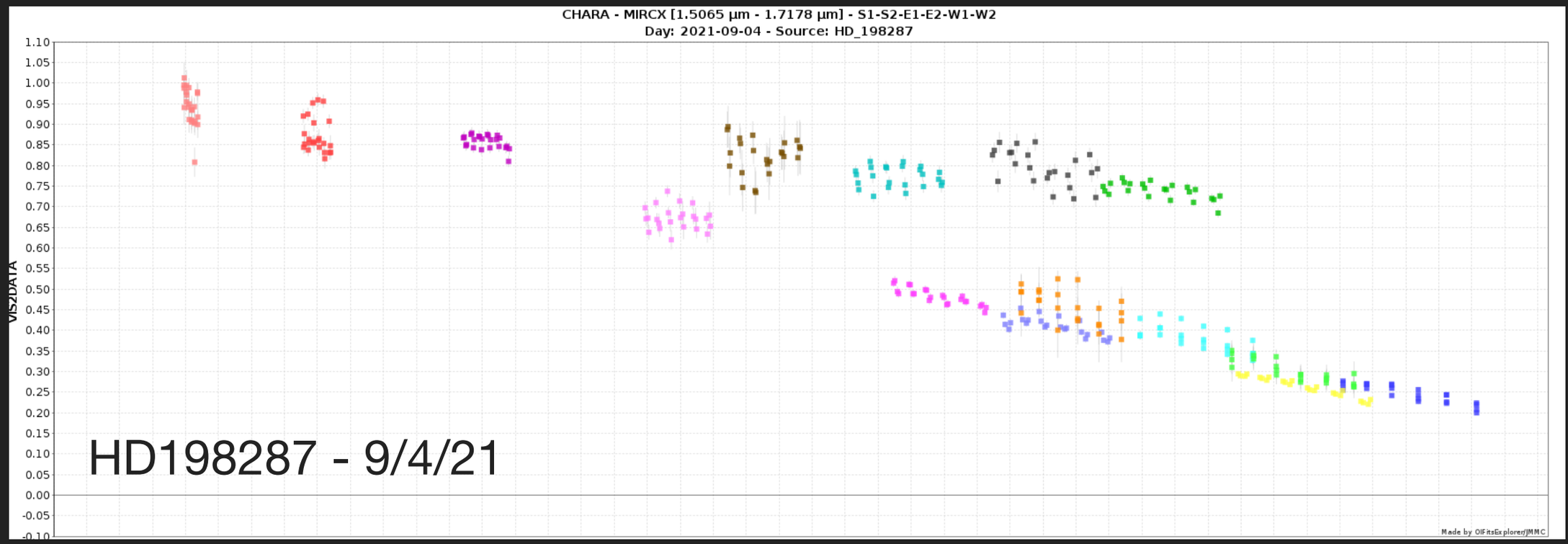

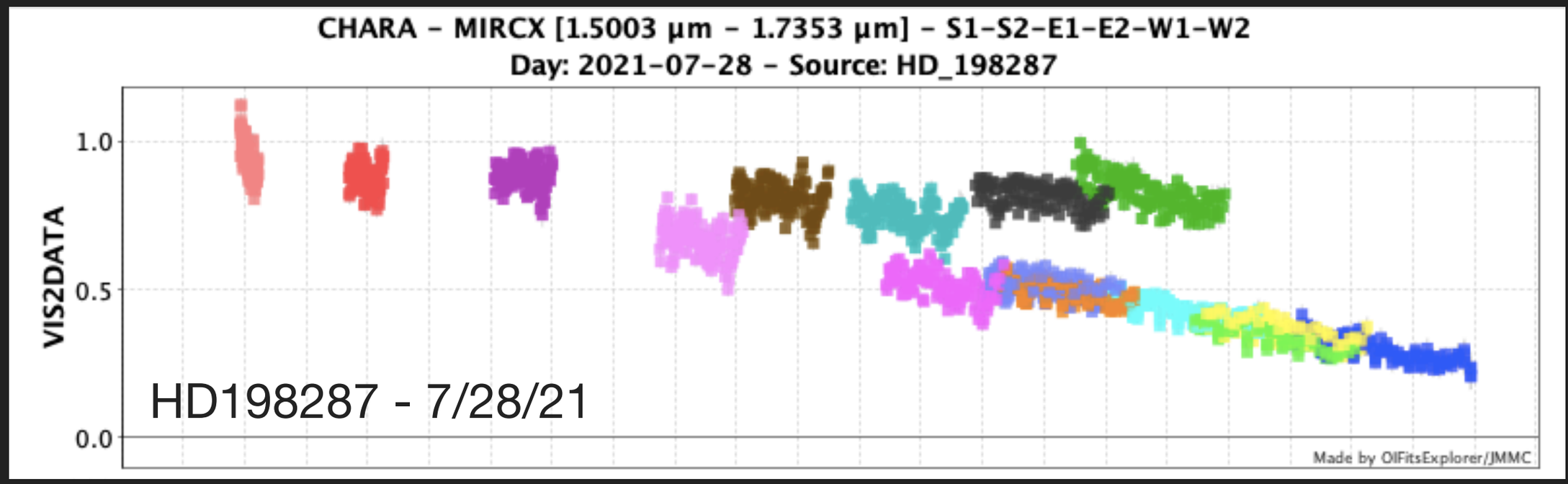

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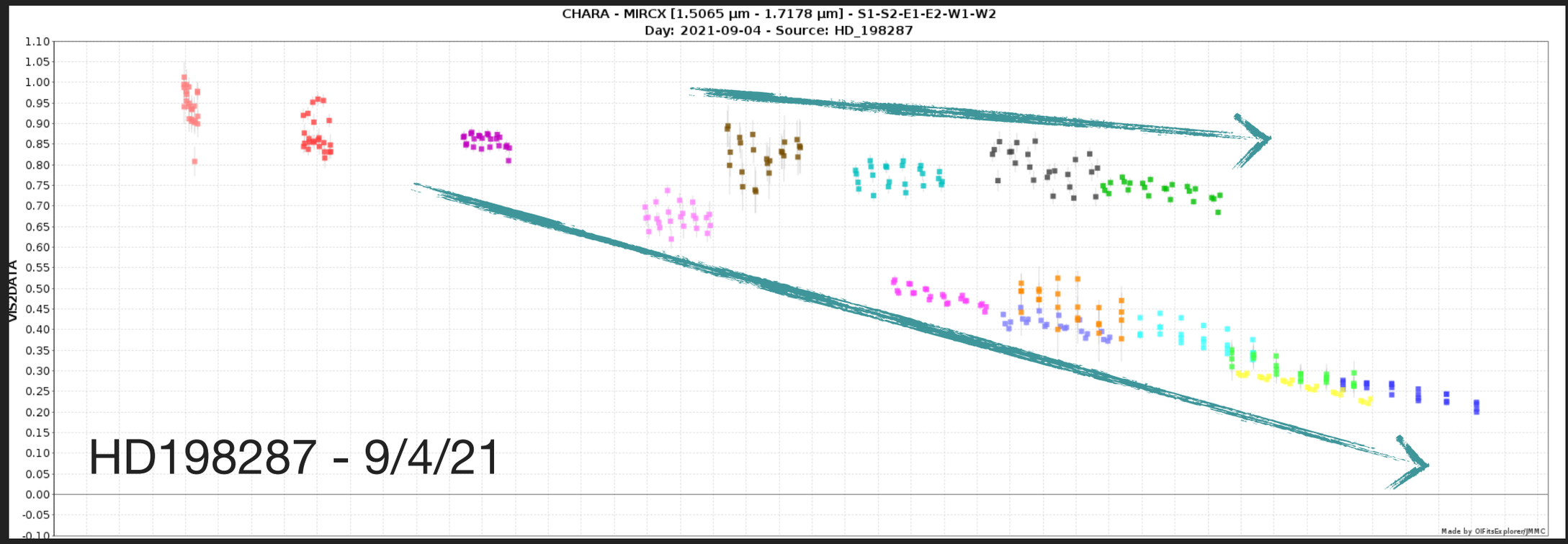

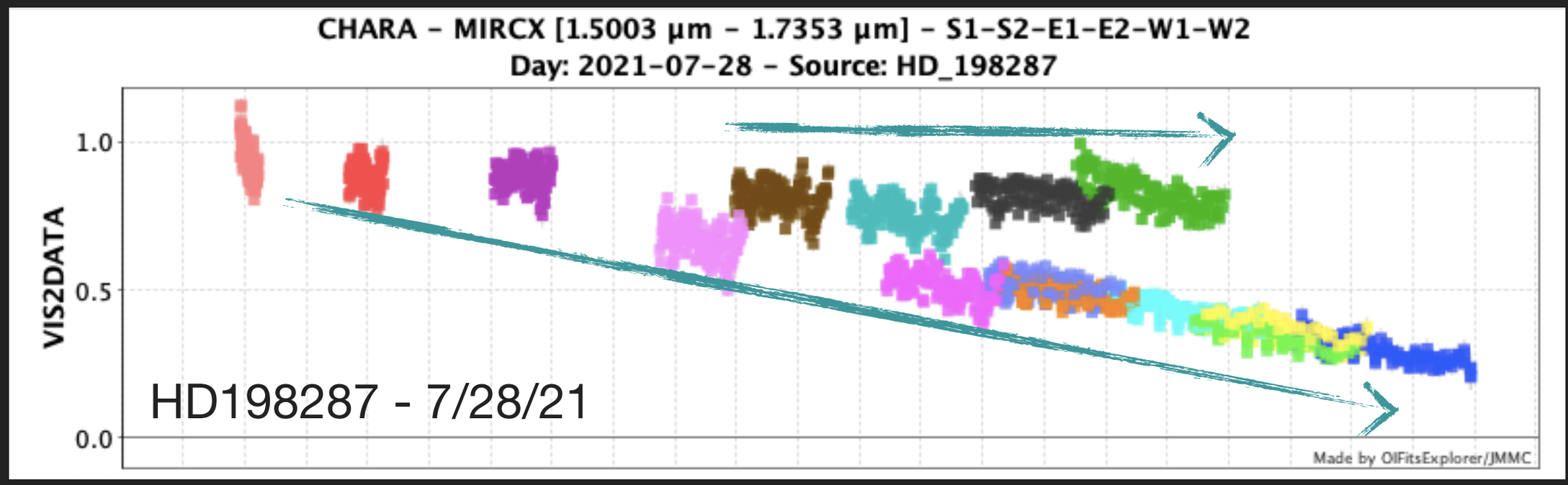

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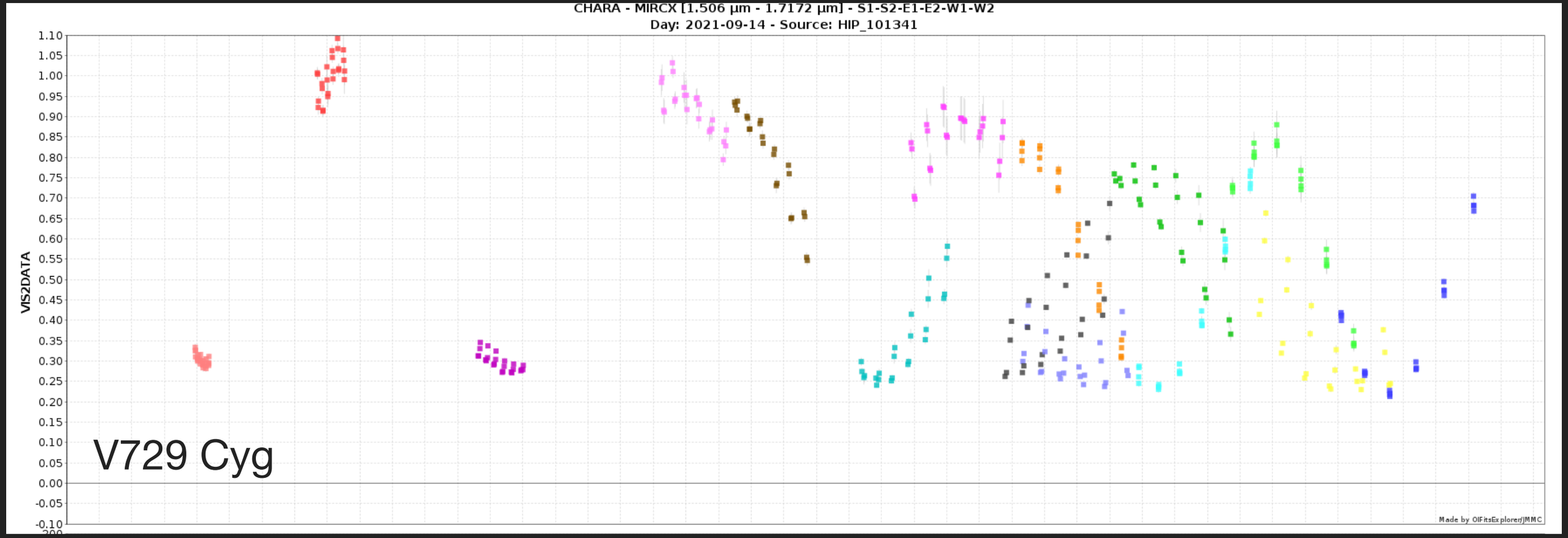

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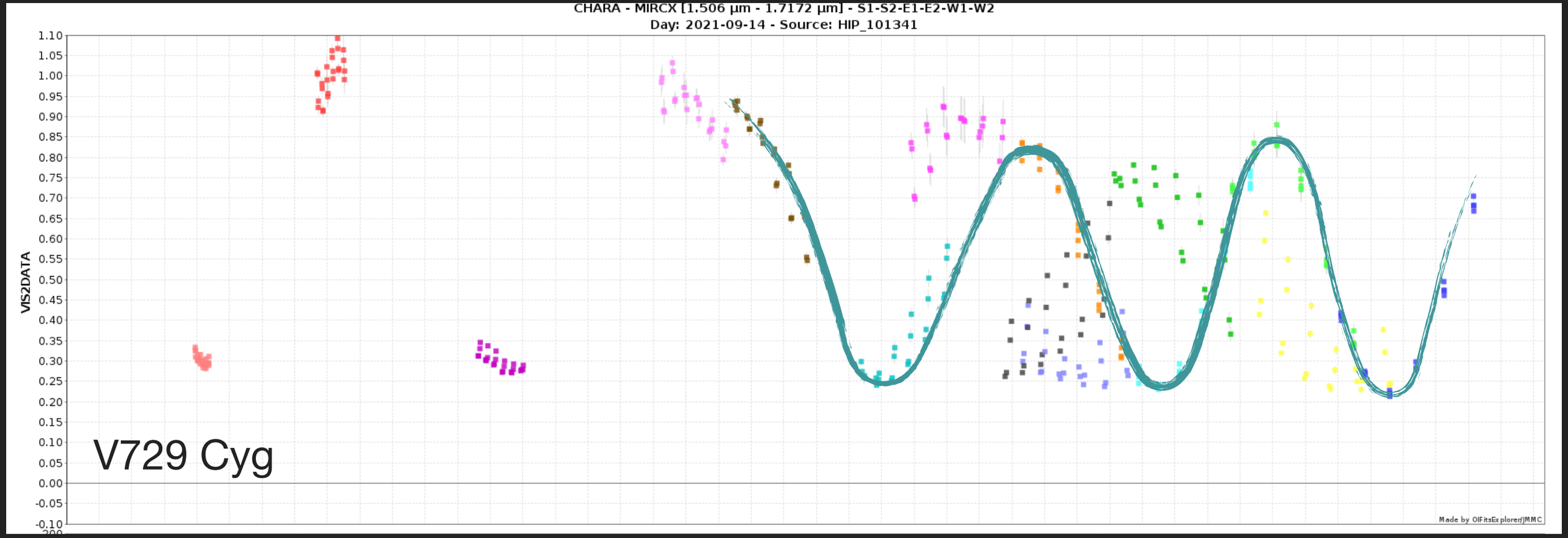
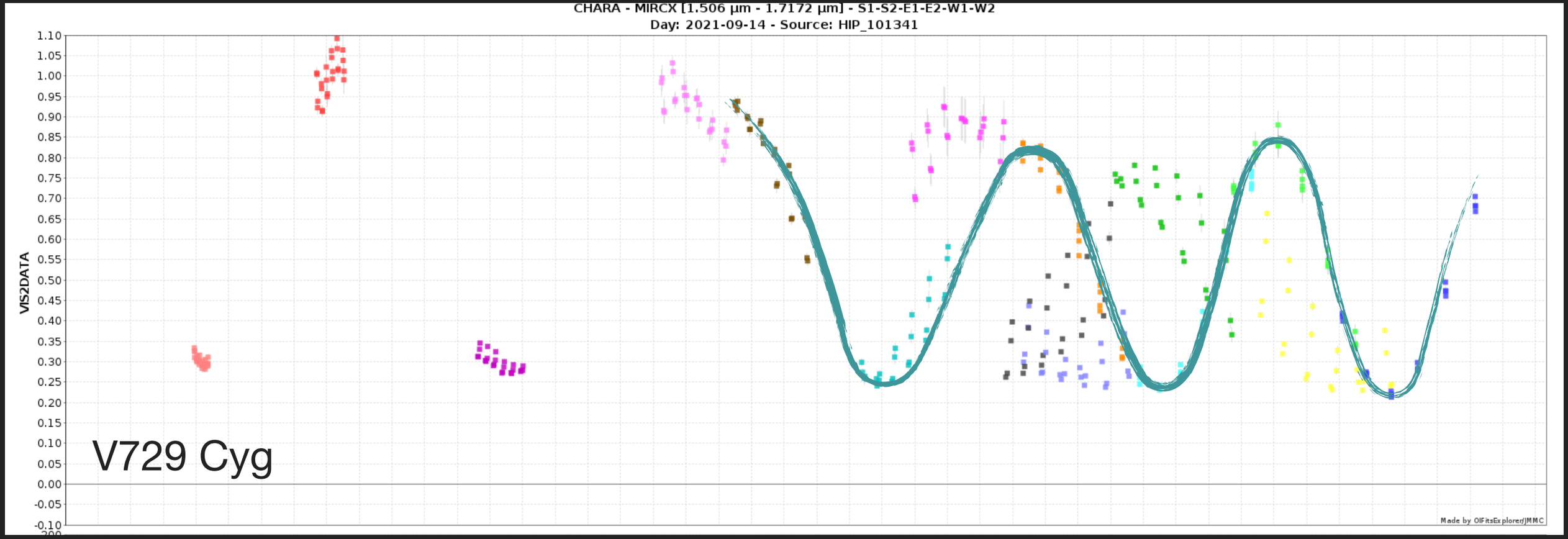


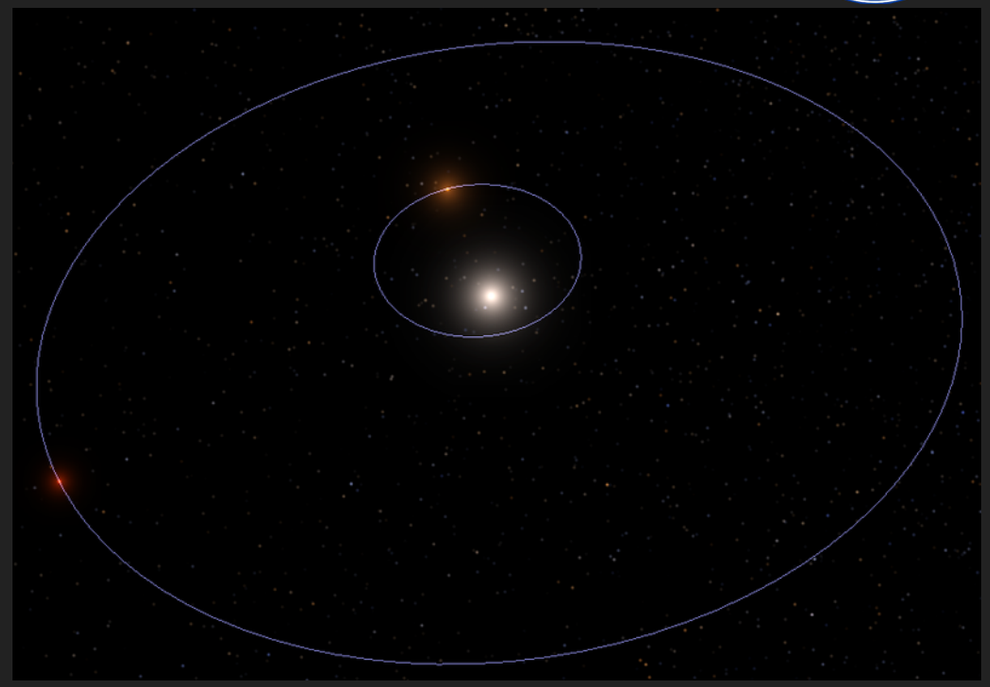
INITIAL LOOK AT MIRCX DATA

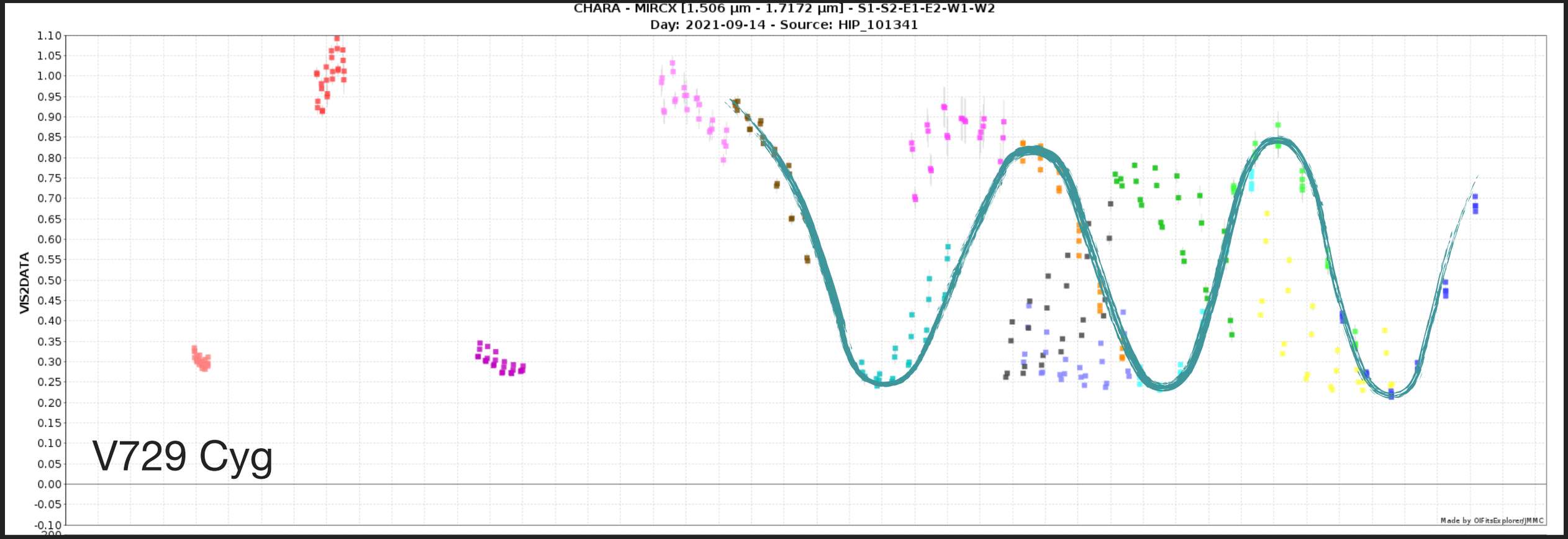
- Not binary motion



INITIAL LOOK AT MIRCX DATA

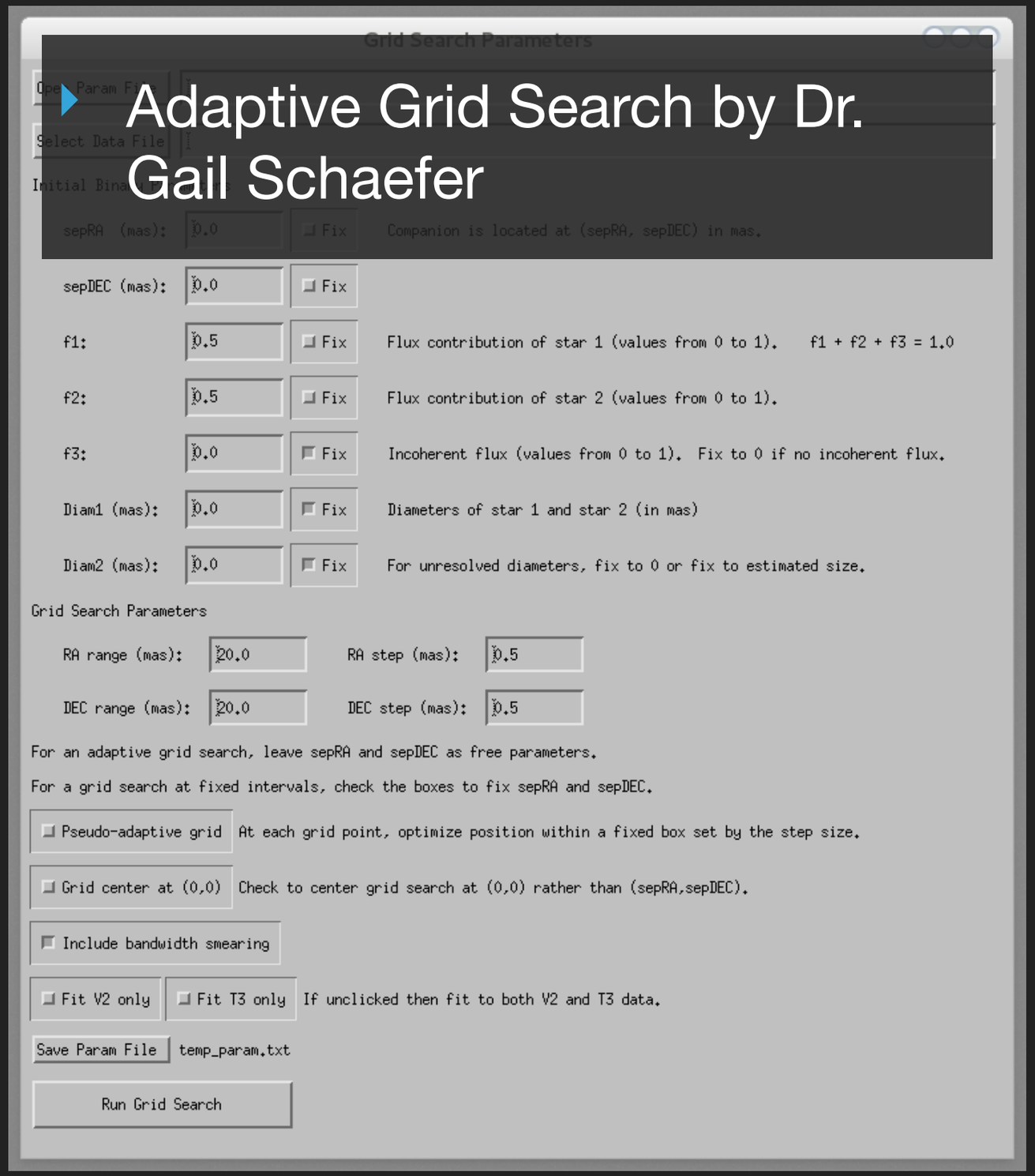
- Not binary motion
- Actually tertiary motion!

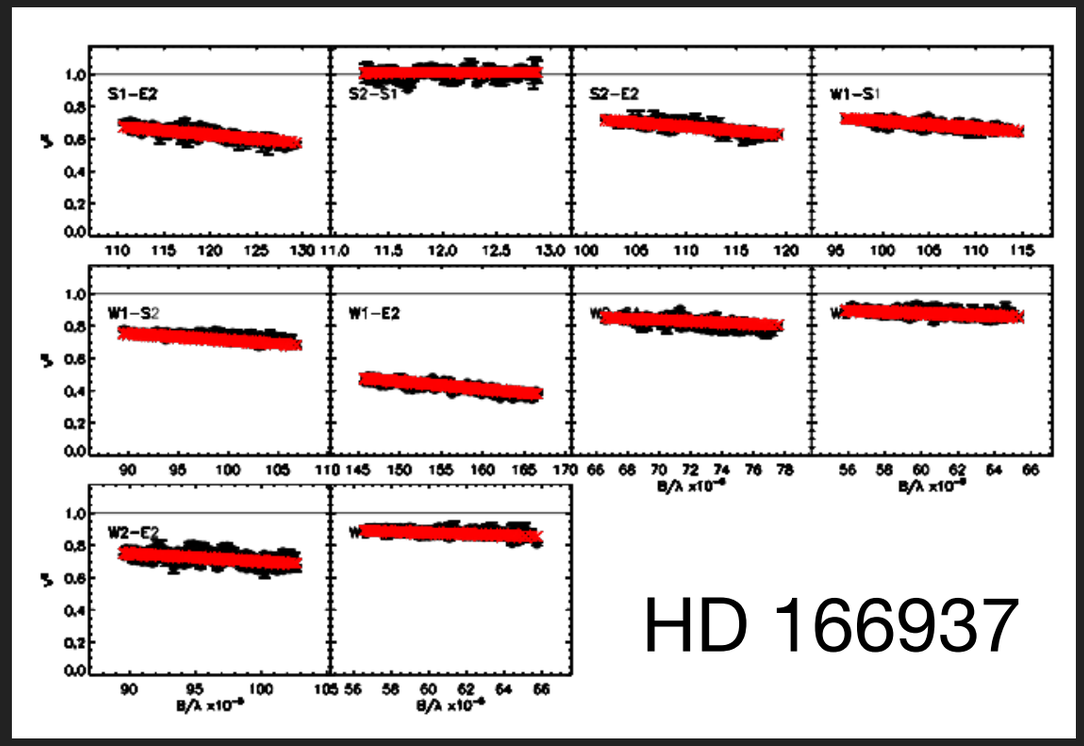




SIMPLE MODELS – 7/2421

- Adaptive Grid Search by Dr. Gail Schaefer





HD 166937

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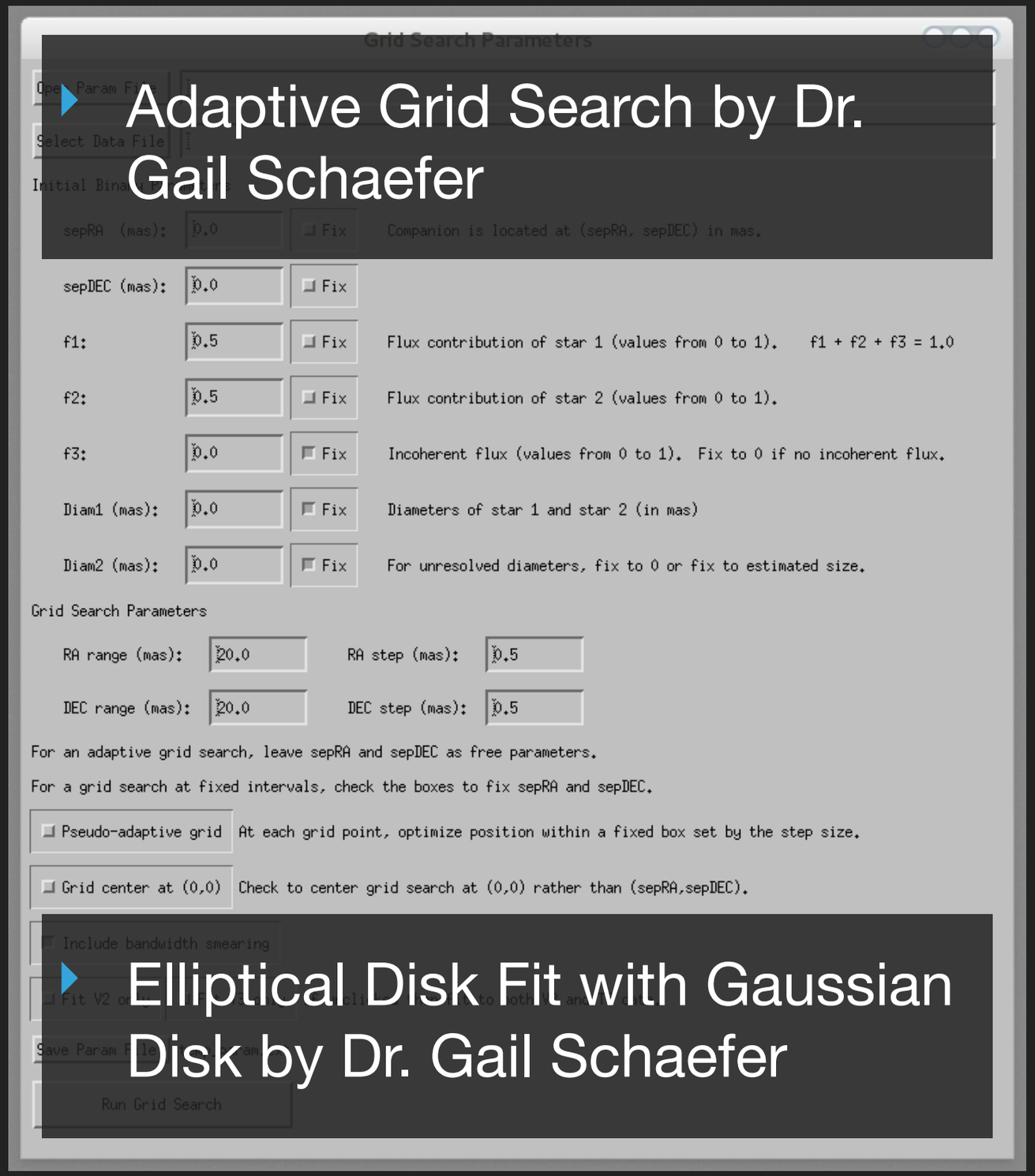
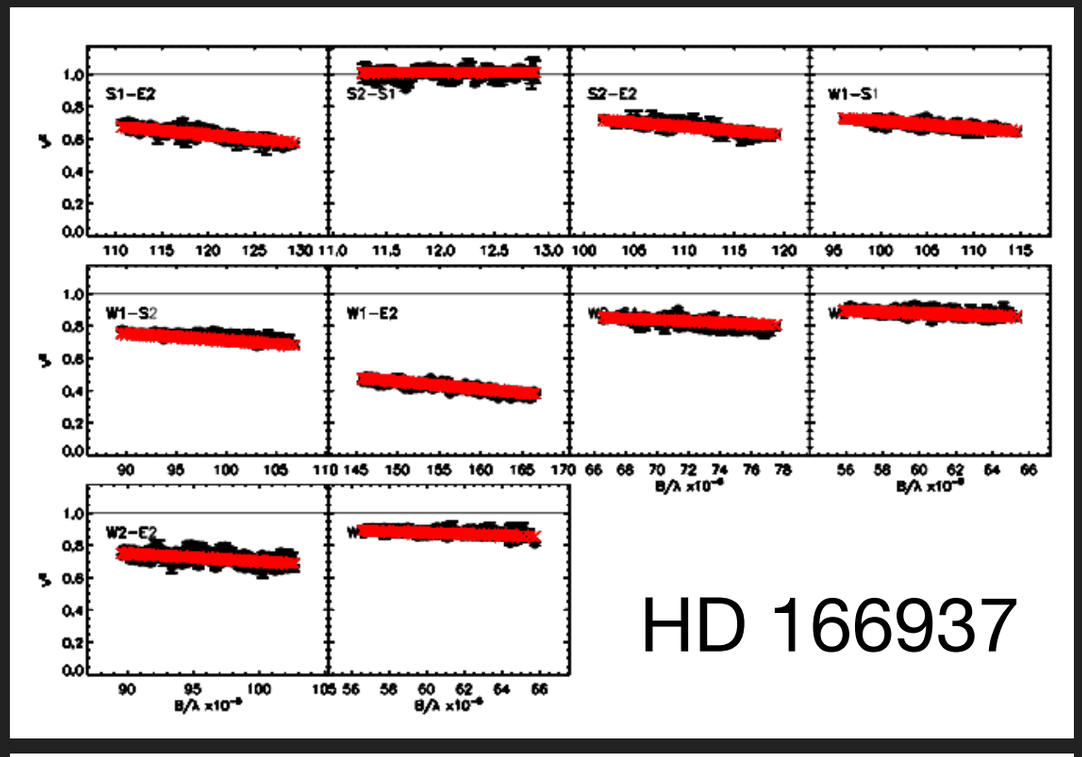


- Elliptical Disk Fit with Gaussian Disk by Dr. Gail Schaefer



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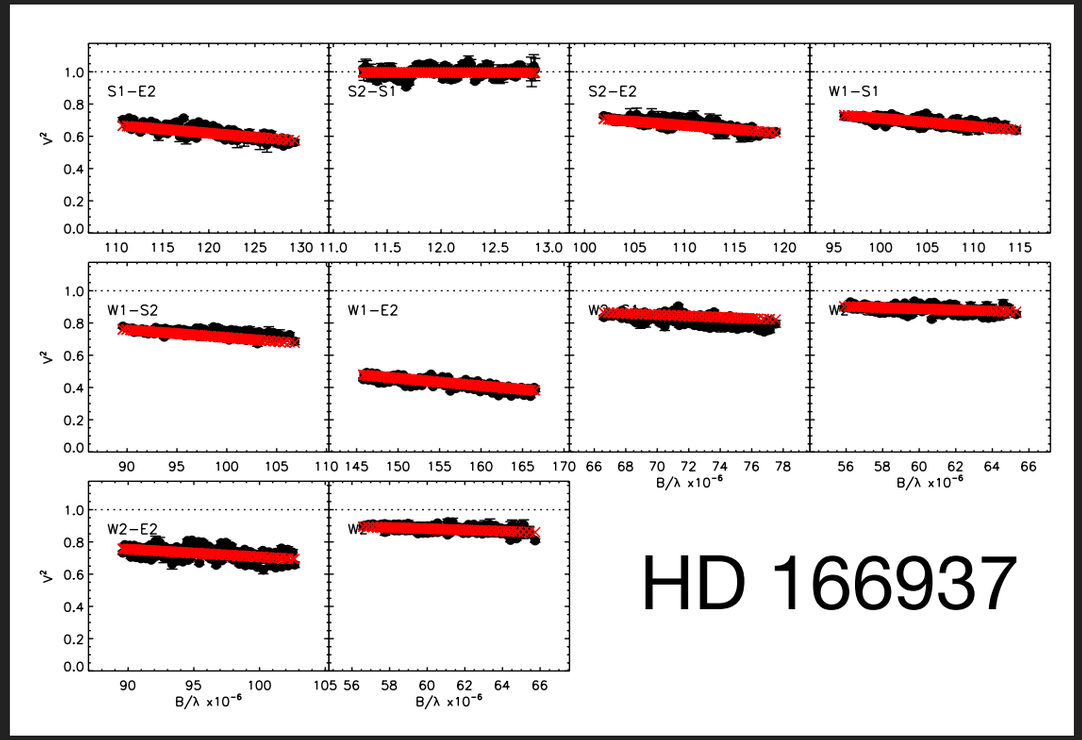

HD 166937

SIMPLE MODELS – 7/24/21

Star	Separation	Disk?	F1	F2	F3
HD 166937					
HD 198288					
HD 181615					
HD 216200					
HD 218393					

- Separation: Binary separation in mas
- Disk?: Are there indications of a disk in this system?
- F1: Flux of the primary component
- F2: Flux of the secondary component
- F3: Flux of any additional component (disk, tertiary companion, etc.)

SIMPLE MODELS – 7/24/21

Star	Separation	Disk?	F1	F2	F3
HD 166937	1.457	Y	0.999	0.008	**-0.008**
HD 198288	3.15	Y?	0.331	0.577	0.091
HD 181615	**1.2**	Y	**0.065**	**0.45**	**0.54**
HD 216200	1.248	Y	0.870	0.036	0.093
HD 218393	0.410	Y?	0.442	0.482	0.074

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QUESTIONS?

BONUS SLIDES

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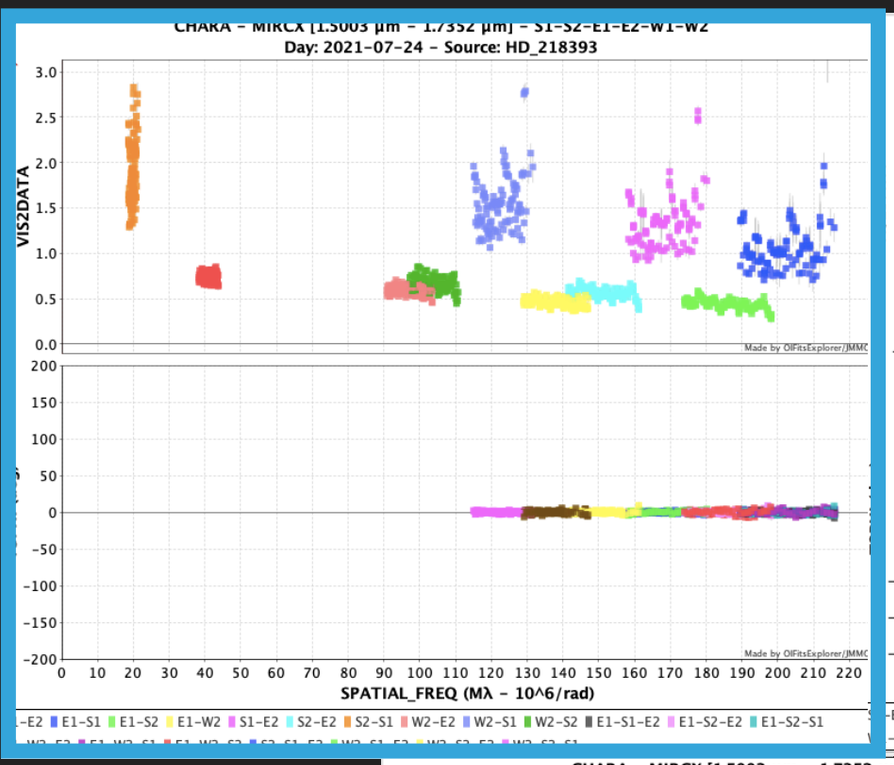
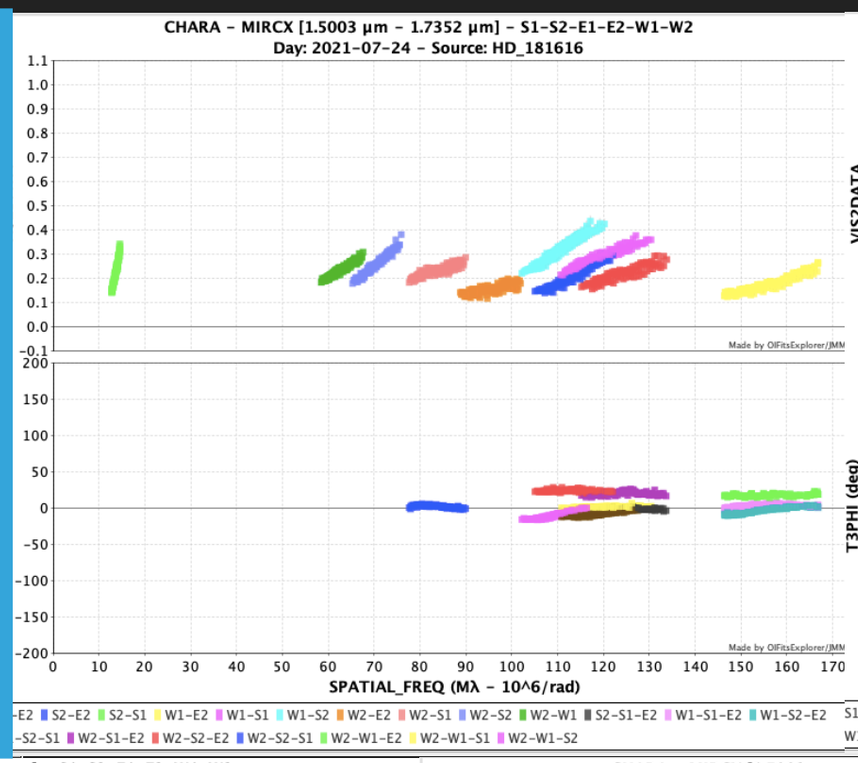
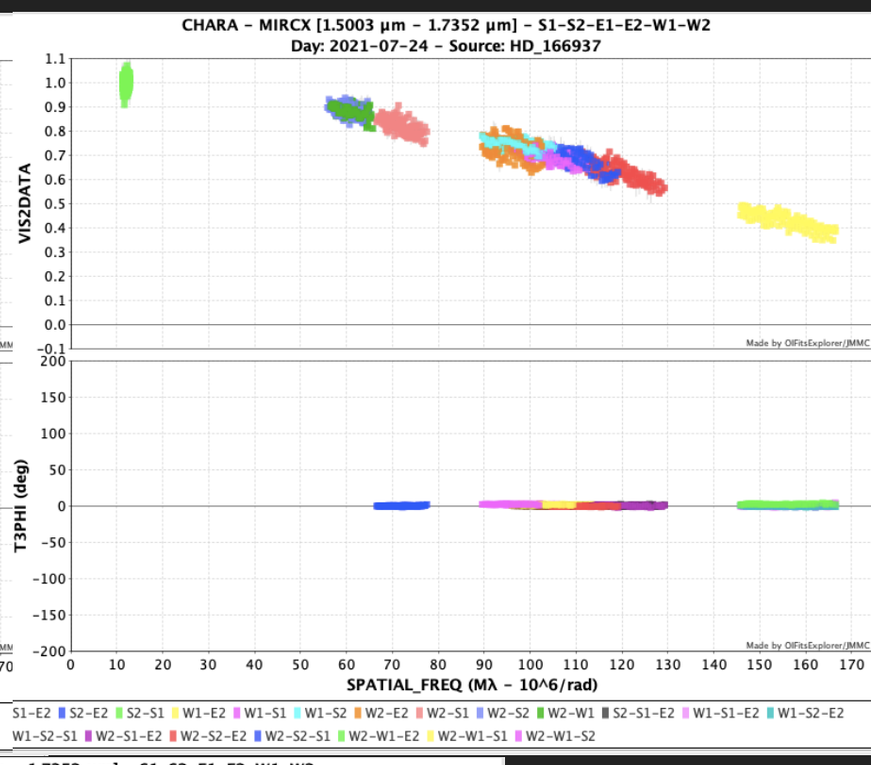
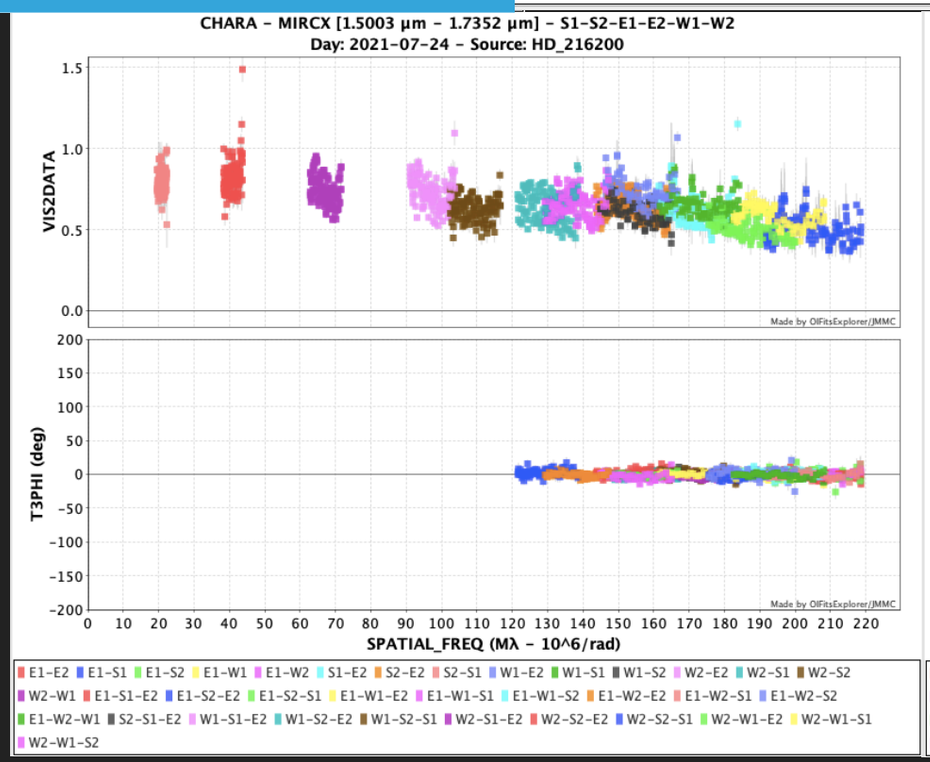
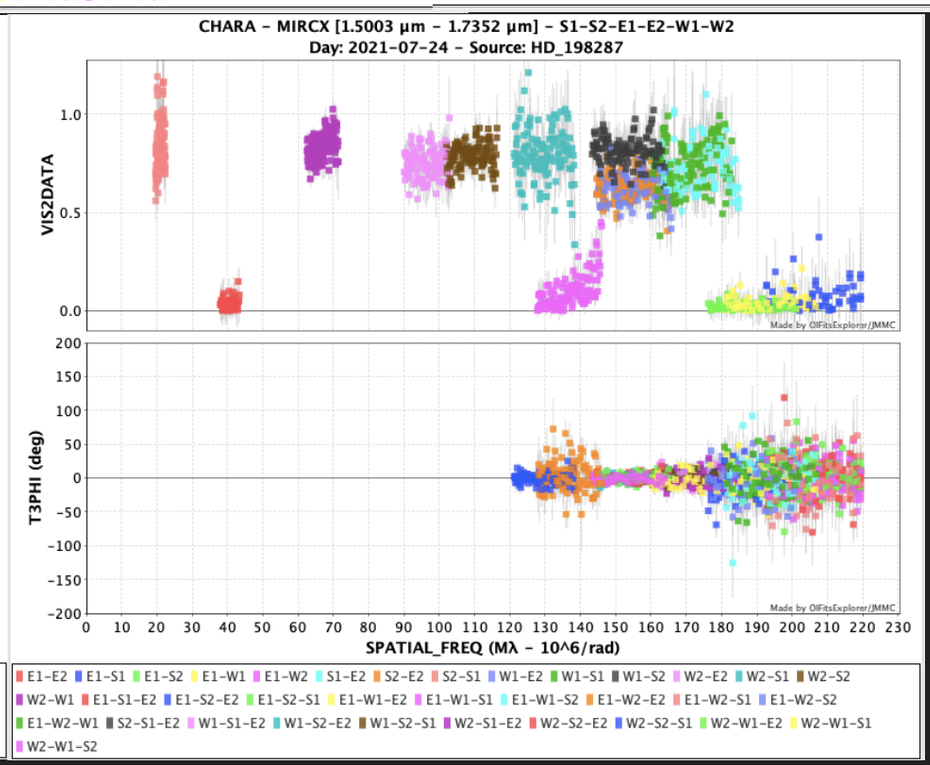








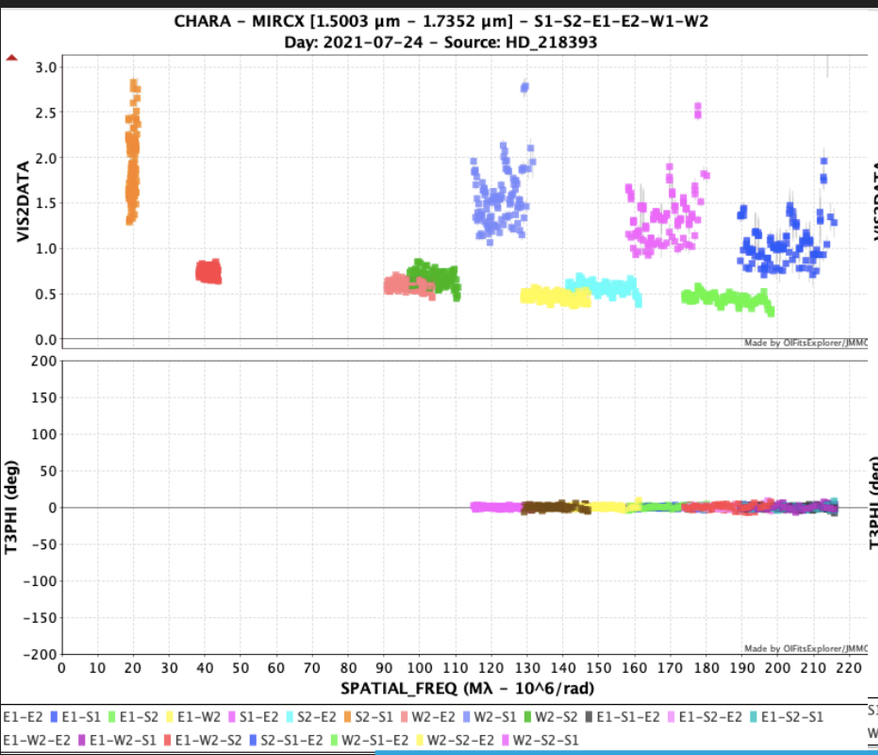


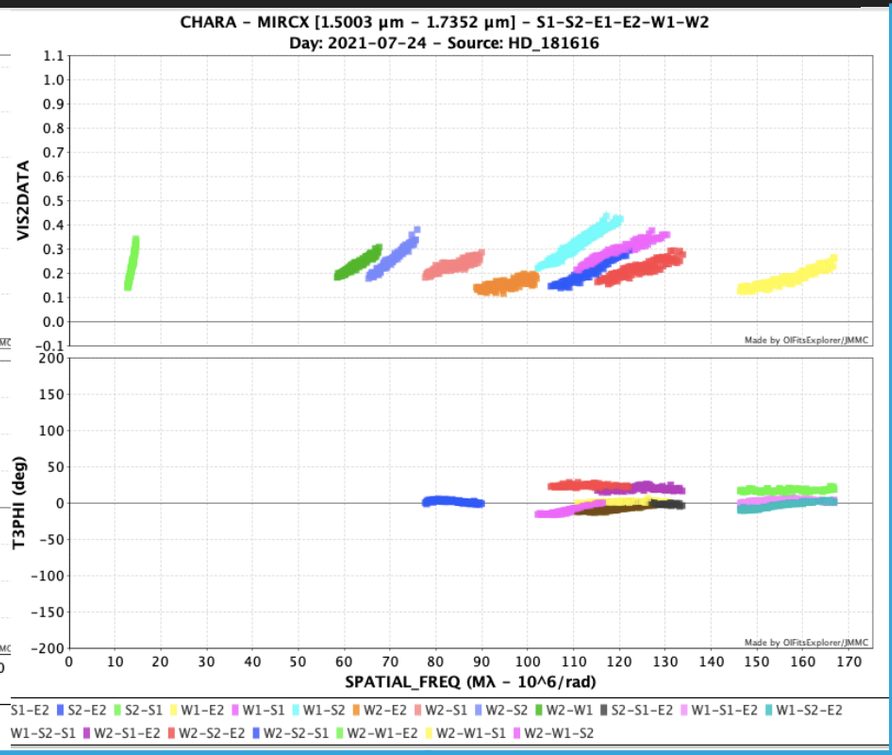
INITIAL LOOK AT MIRCX DATA – 7/24/21

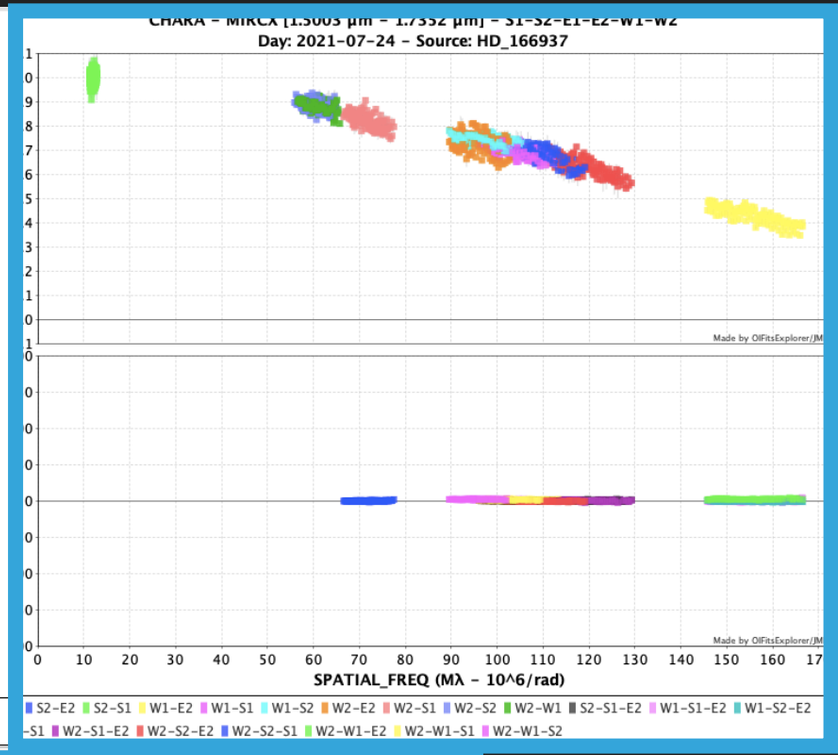
3.0

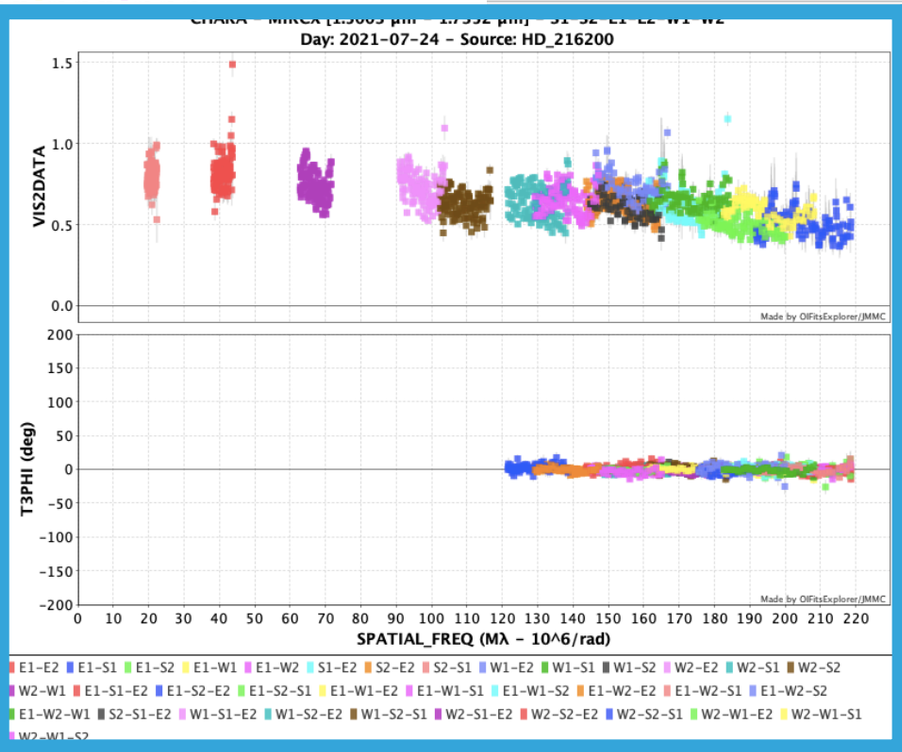
1.0

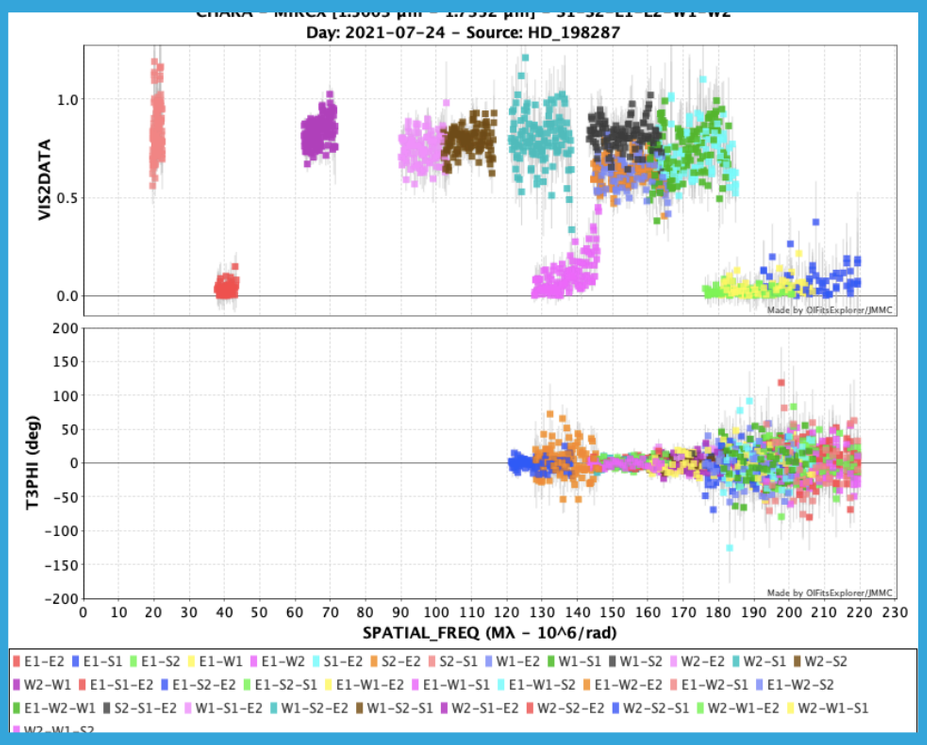
INITIAL LOOK AT MIRCX DATA – 7/24/21



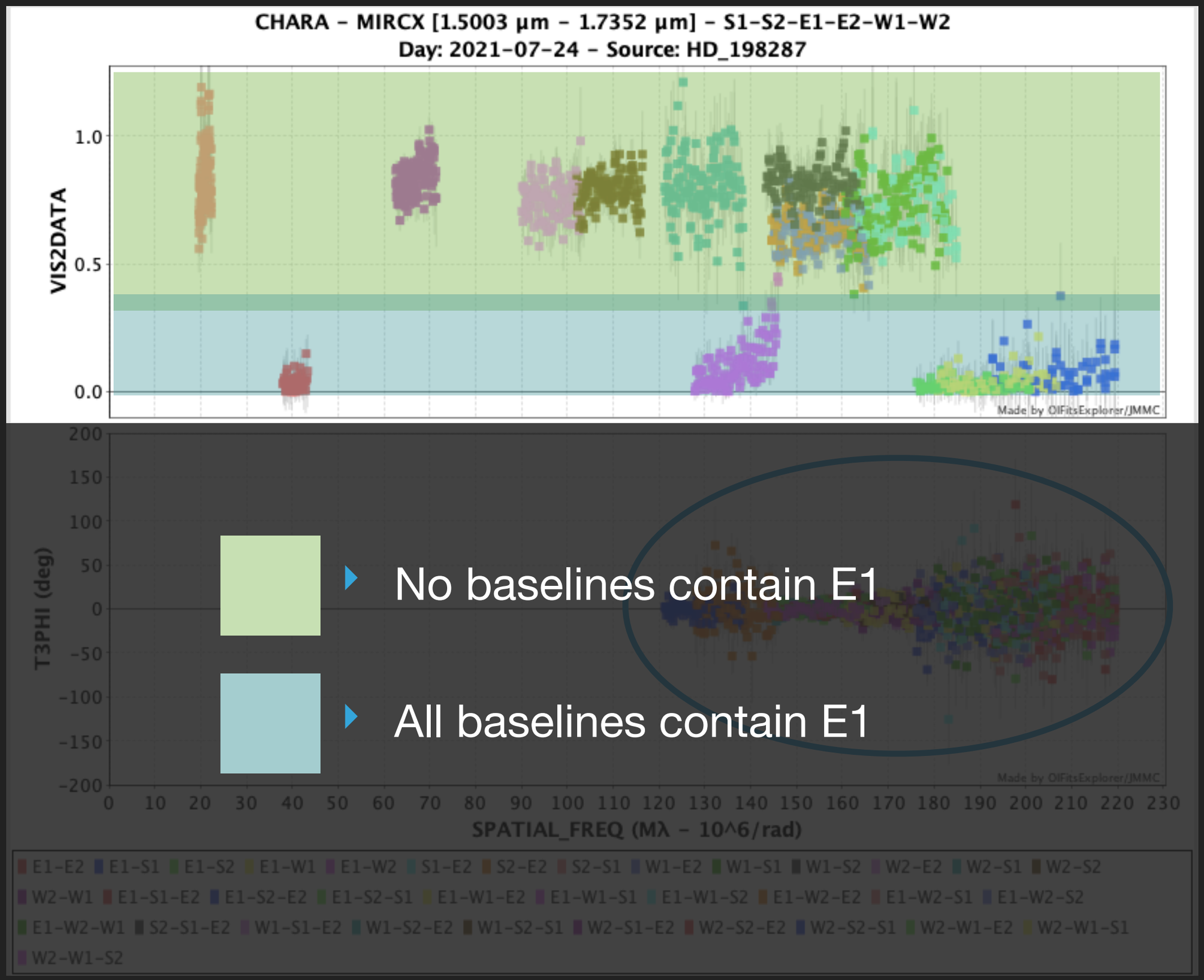






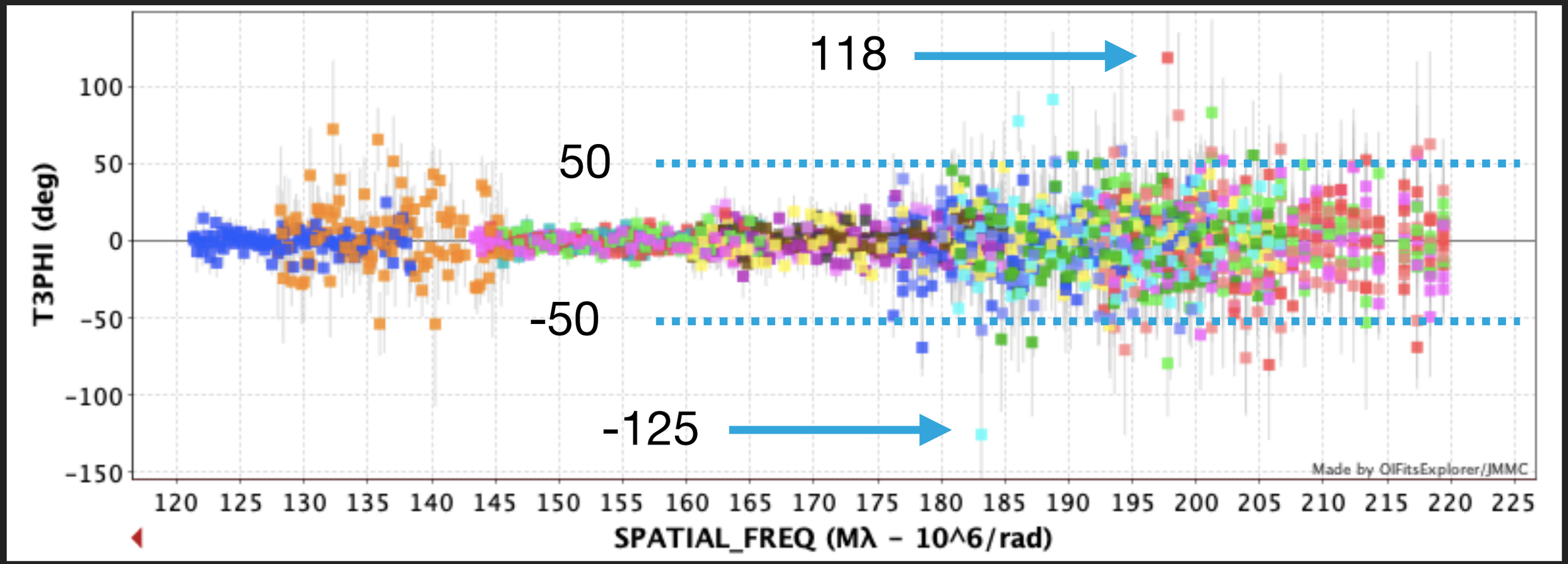


INITIAL LOOK AT MIRCX DATA – 7/24/21



- No baselines contain E1
- All baselines contain E1

INITIAL LOOK AT MIRCX DATA – 7/24/21

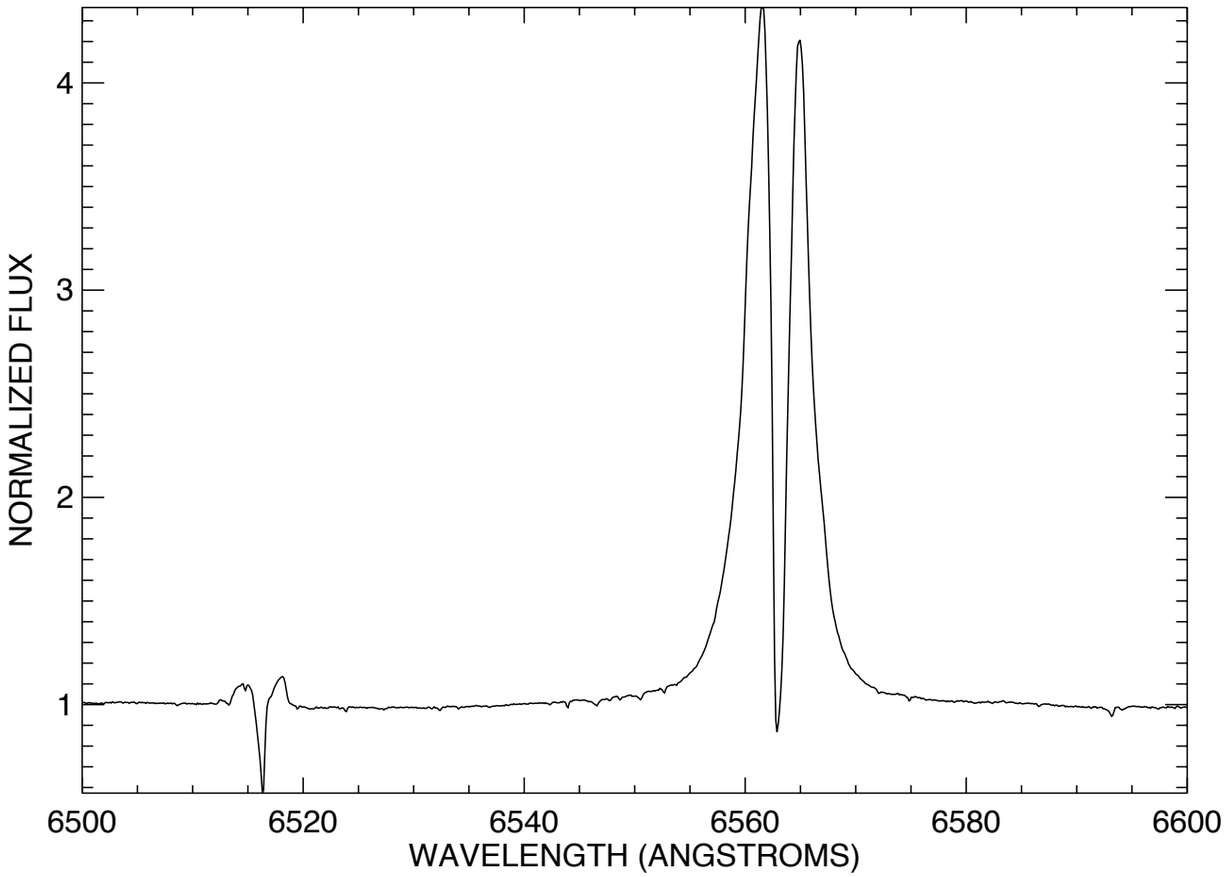


- Significant non-zero scatter in the closure phase
- There might be an asymmetry in the disk!

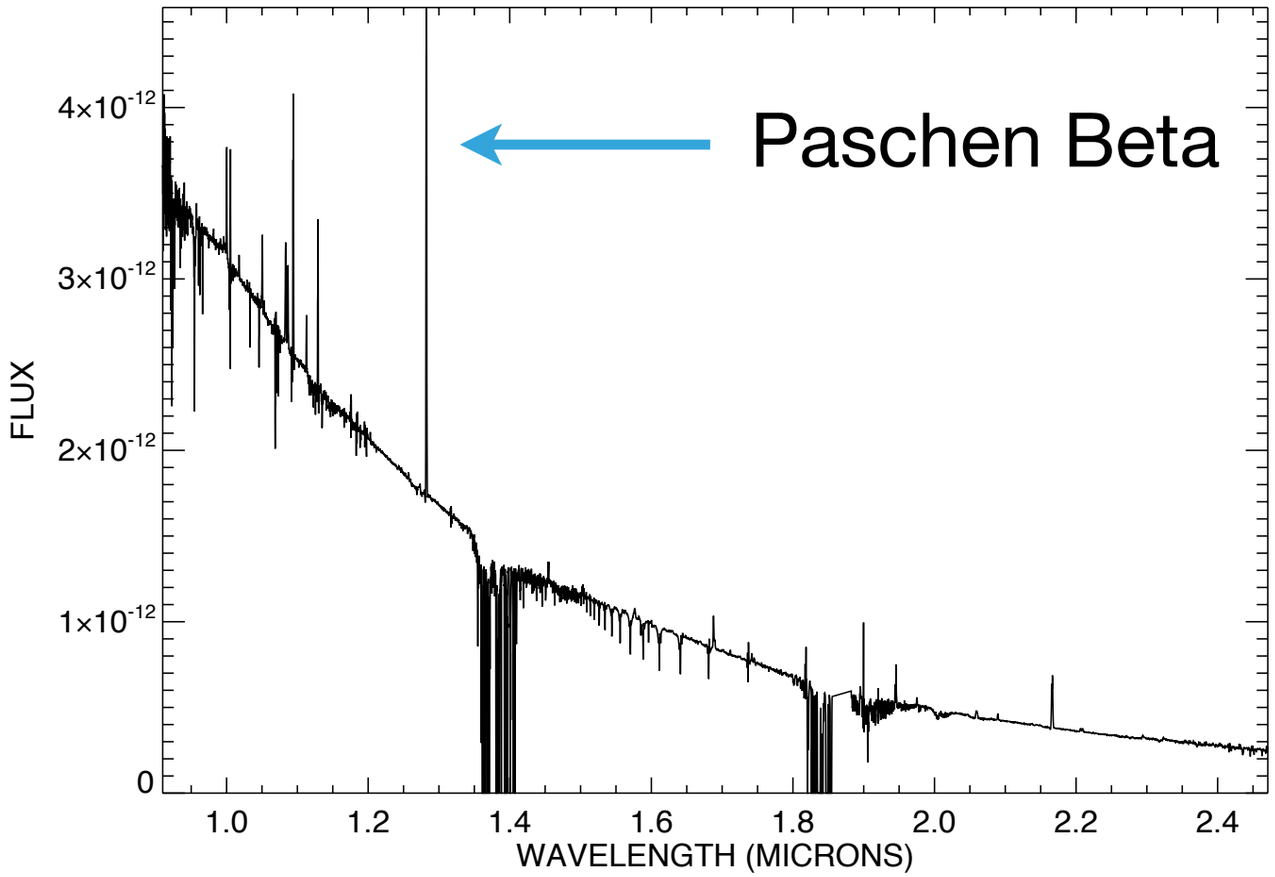
INITIAL LOOK AT APO DATA

HD 198288

Echelle Spectrum (VIS)



TripleSpec Spectrum (NIR)



SIMPLE MODELS – 7/24/21

Star	Separation	Disk?	F1	F2	F3
HD 166937	1.457 +/-0.018	Y	0.999 +/- 0.0006	0.008 +/- 0.0002	-0.008 +/- 0
HD 198288					
HD 181615					
HD 216200					
HD 218393					

- Separation: Binary separation in mas
- Disk?: Are there indications of a disk in this system?
- F1: Flux of the primary component
- F2: Flux of the secondary component
- F3: Flux of any additional component (disk, tertiary companion, etc.)