

A SPECTROSCOPIC AND INTERFEROMETRIC STUDY OF W SERPENTIS STARS

KATHERINE SHEPARD

ADVISOR: DR. DOUGLAS GIES

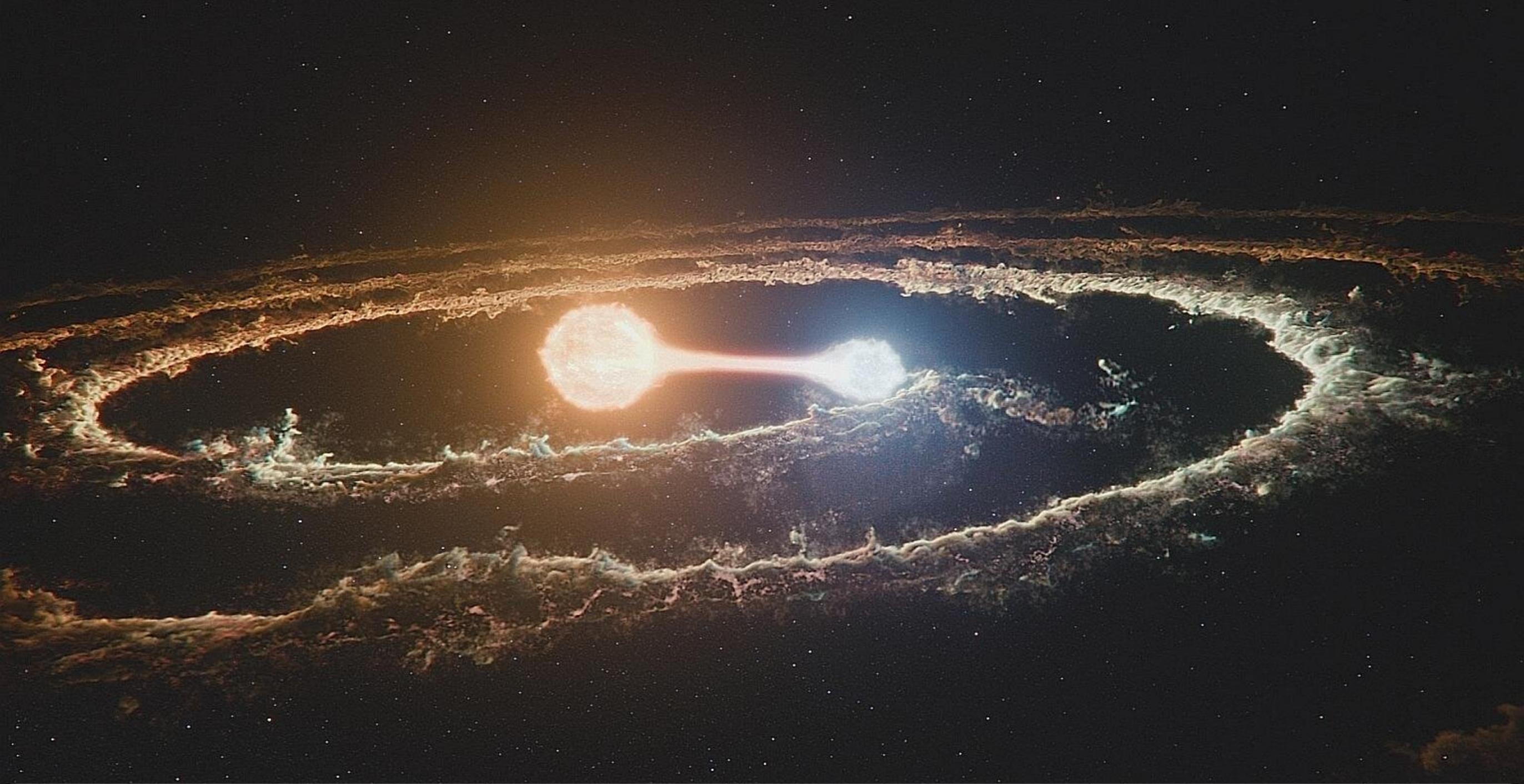
GEORGIA STATE UNIVERSITY



WHAT ARE W SERPENTIS STARS?

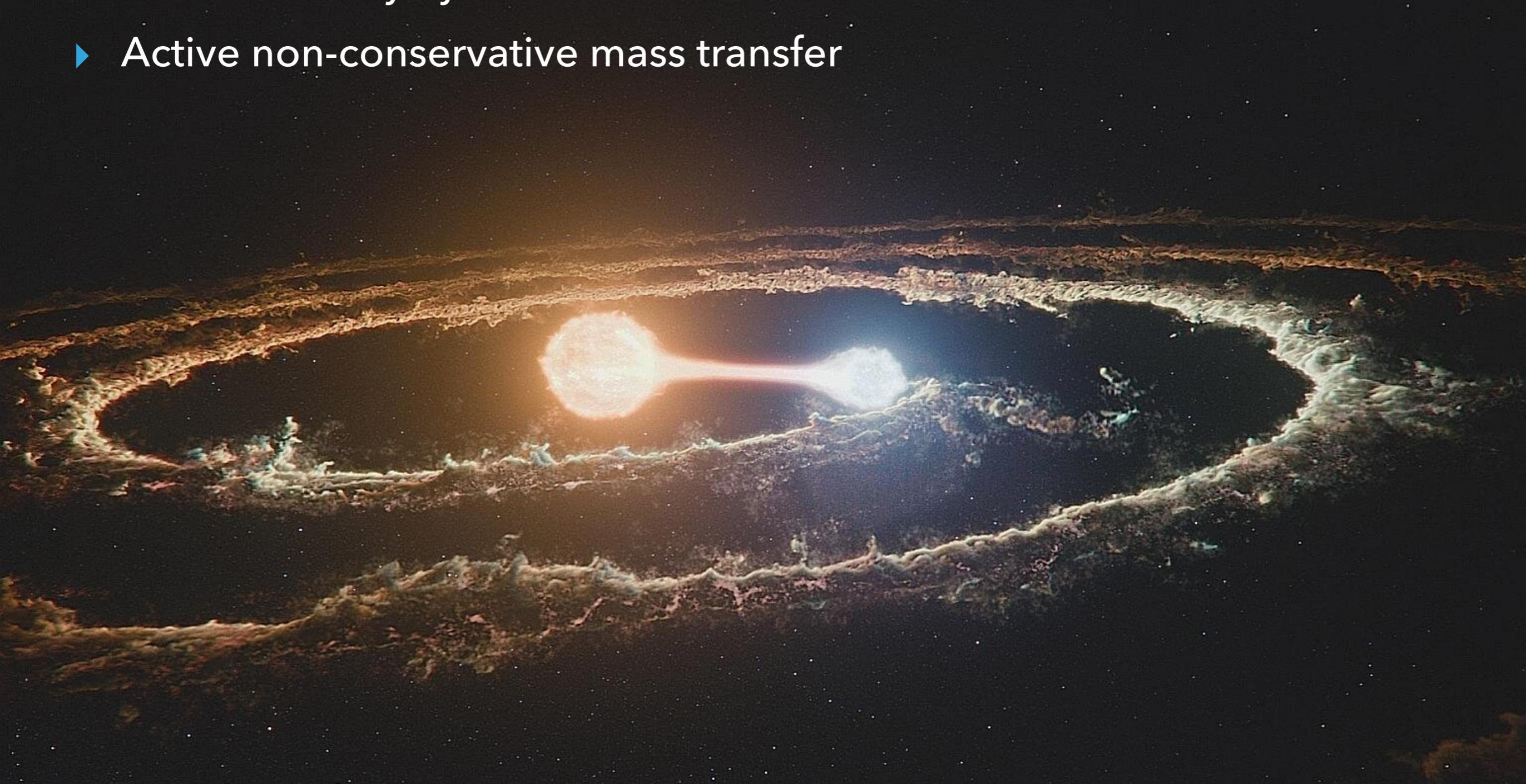


- ▶ Evolved Binary Systems



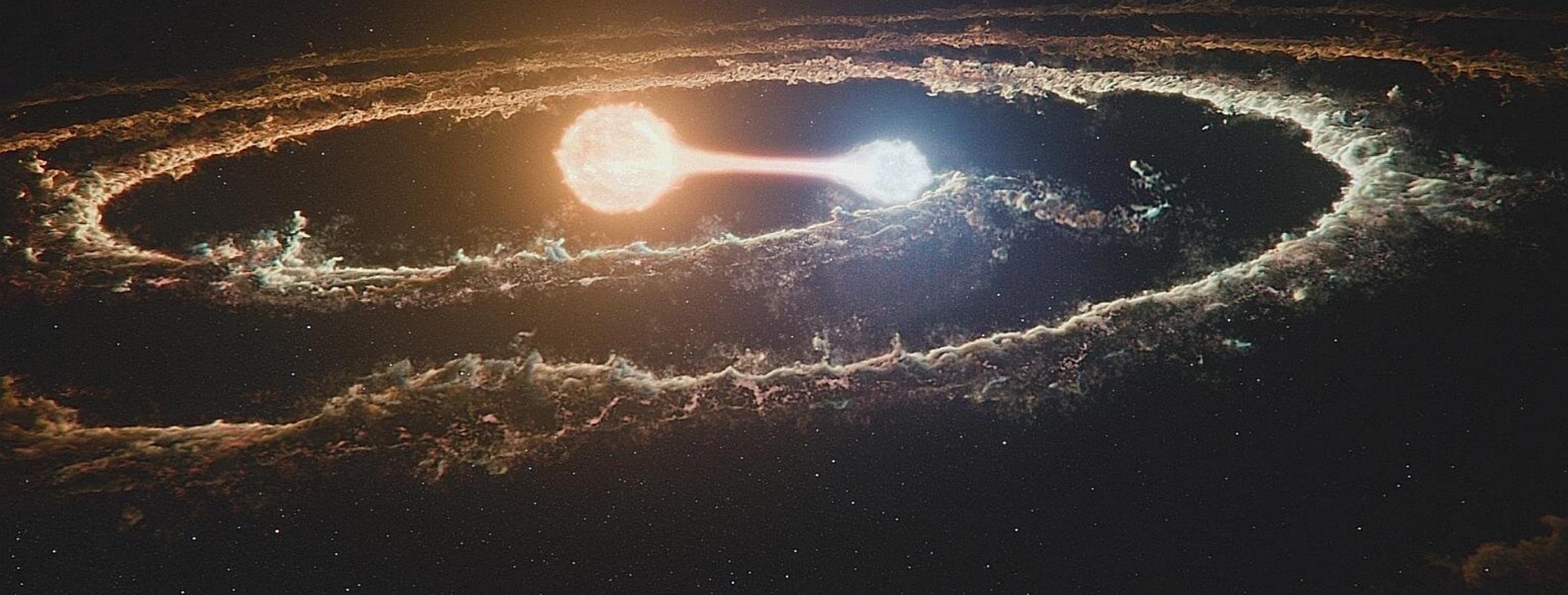
WHAT ARE W SERPENTIS STARS?

- ▶ Evolved Binary Systems
- ▶ Active non-conservative mass transfer



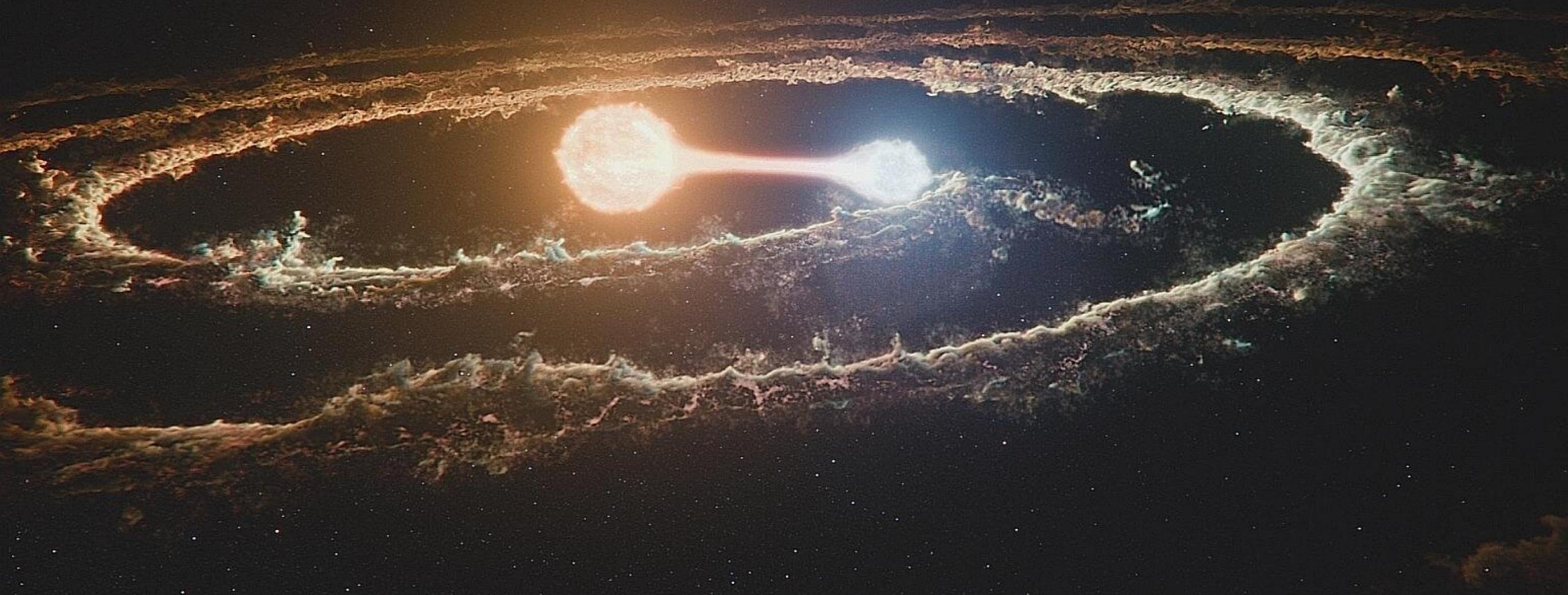
WHAT ARE W SERPENTIS STARS?

- ▶ Evolved Binary Systems
- ▶ Active non-conservative mass transfer
 - ▶ aka leaking material out of the system



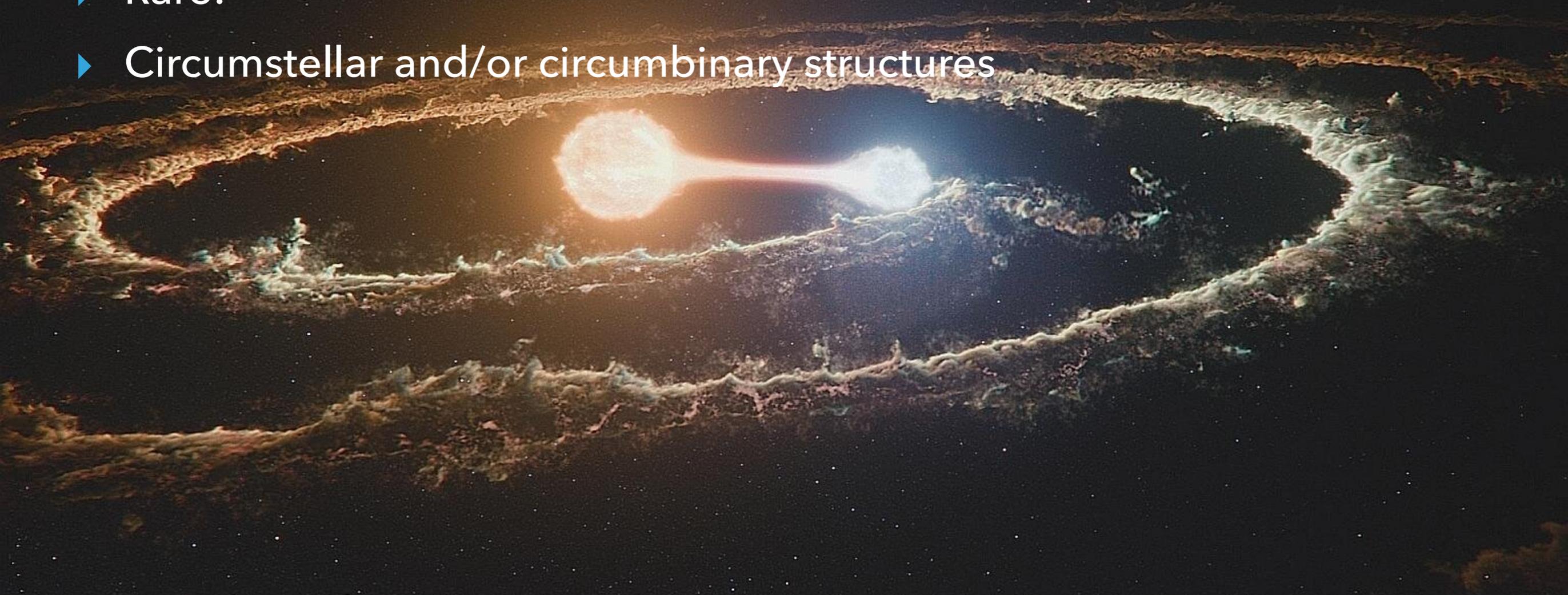
WHAT ARE W SERPENTIS STARS?

- ▶ Evolved Binary Systems
- ▶ Active non-conservative mass transfer
 - ▶ aka leaking material out of the system
- ▶ Rare!



WHAT ARE W SERPENTIS STARS?

- ▶ Evolved Binary Systems
- ▶ Active non-conservative mass transfer
 - ▶ aka leaking material out of the system
- ▶ Rare!
- ▶ Circumstellar and/or circumbinary structures



HOW DOES THIS HAPPEN?



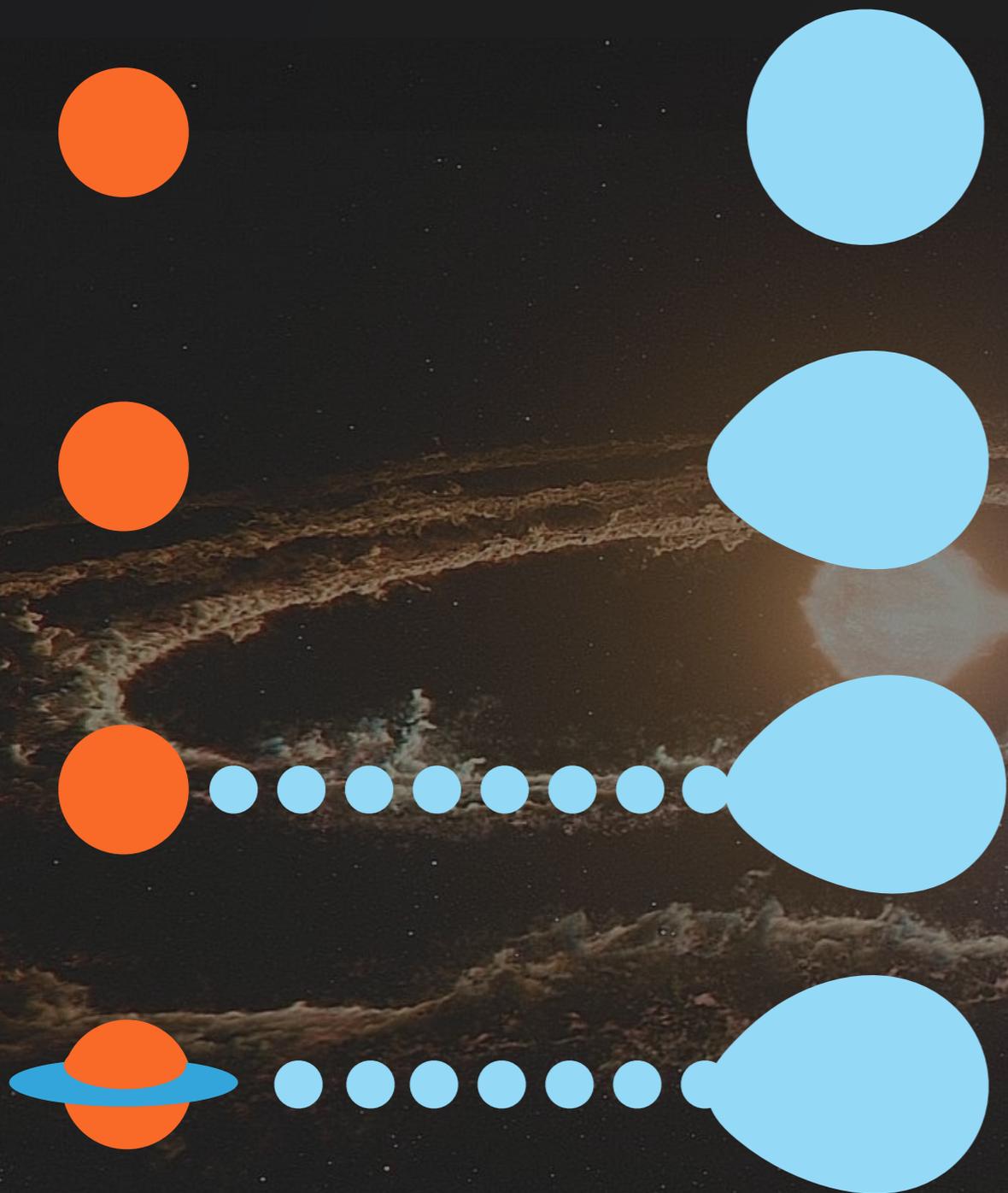
HOW DOES THIS HAPPEN?



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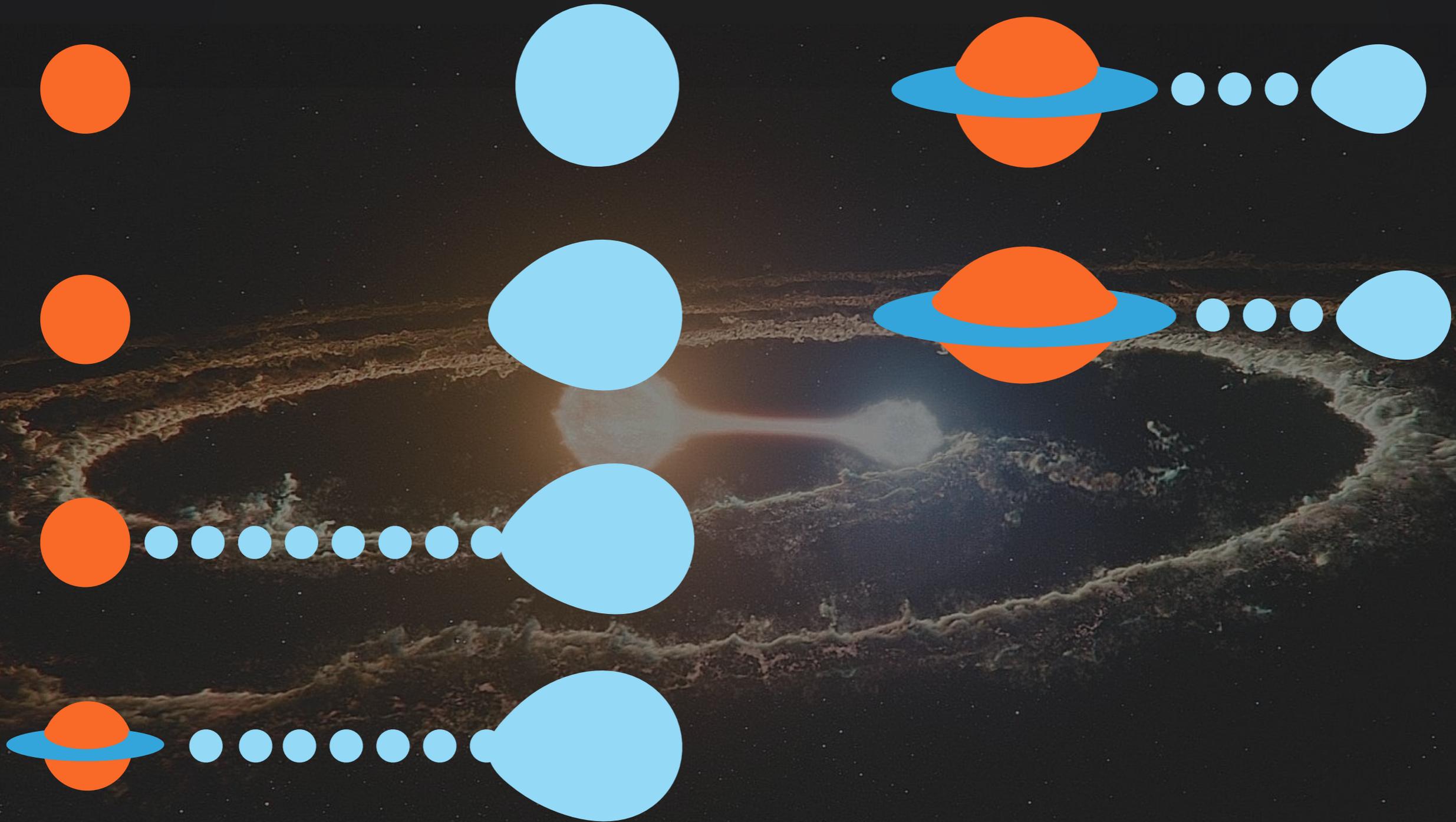
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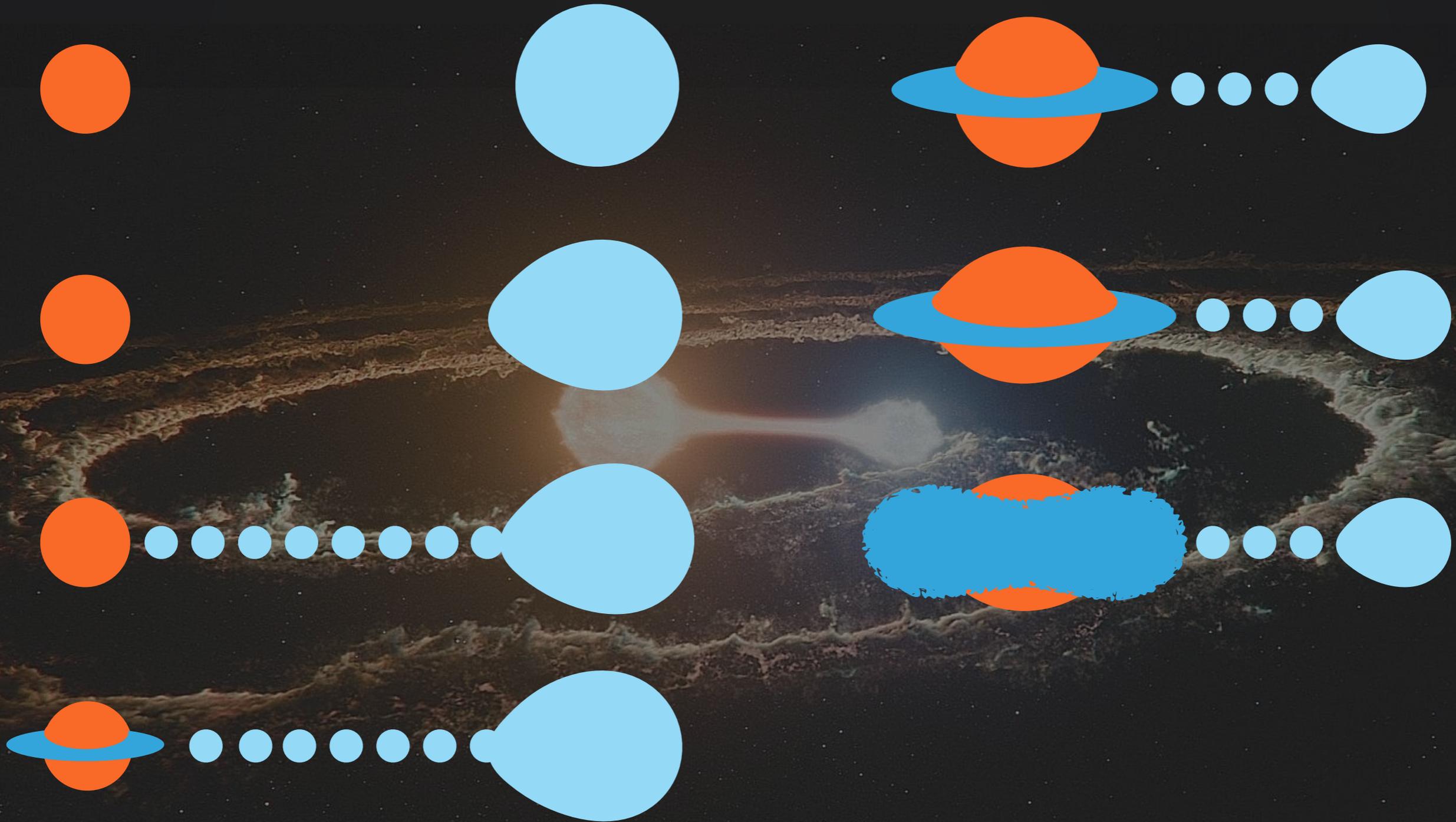
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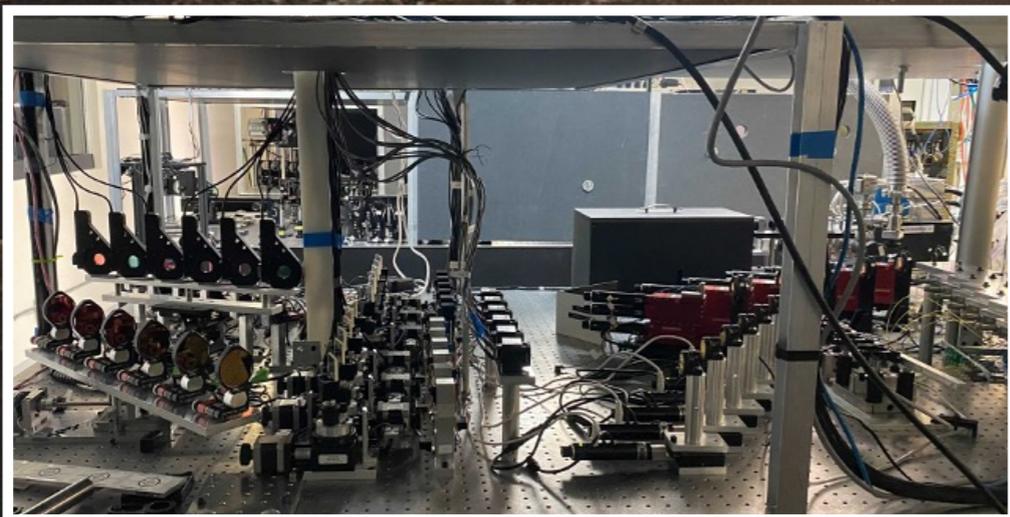
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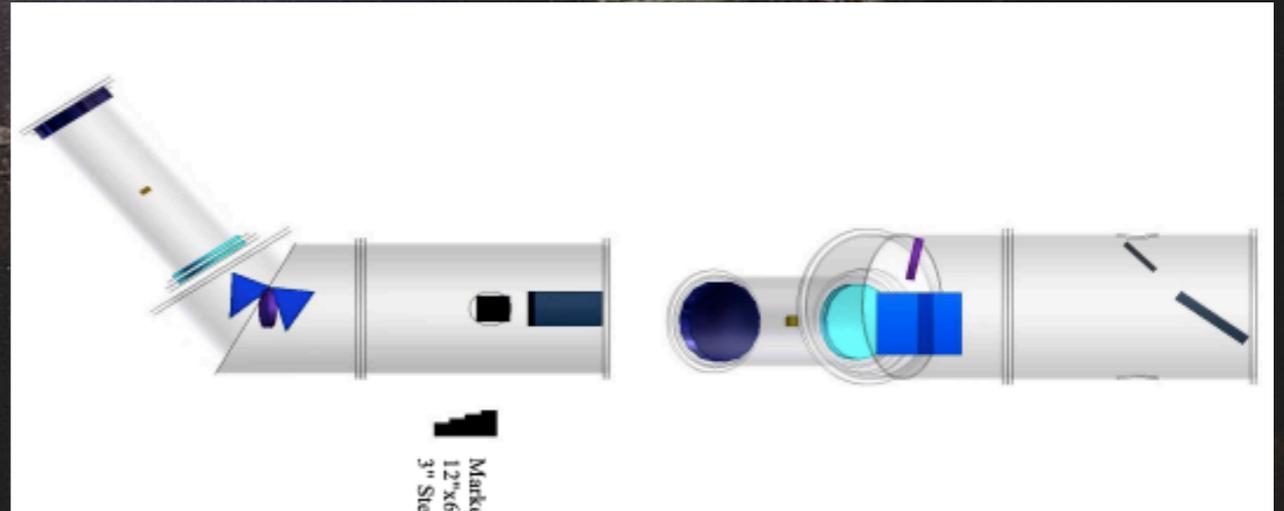
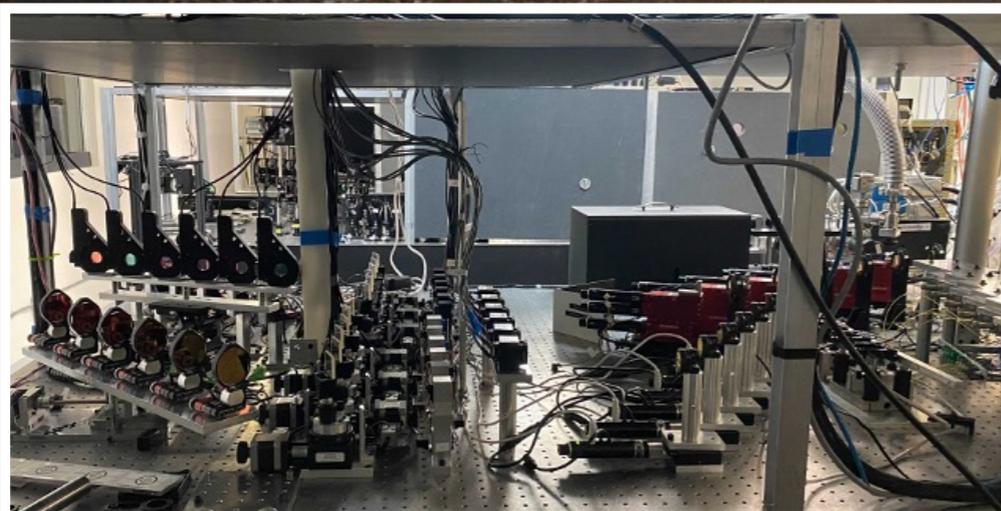
HOW DOES THIS HAPPEN?



HOW ARE WE STUDYING THIS?



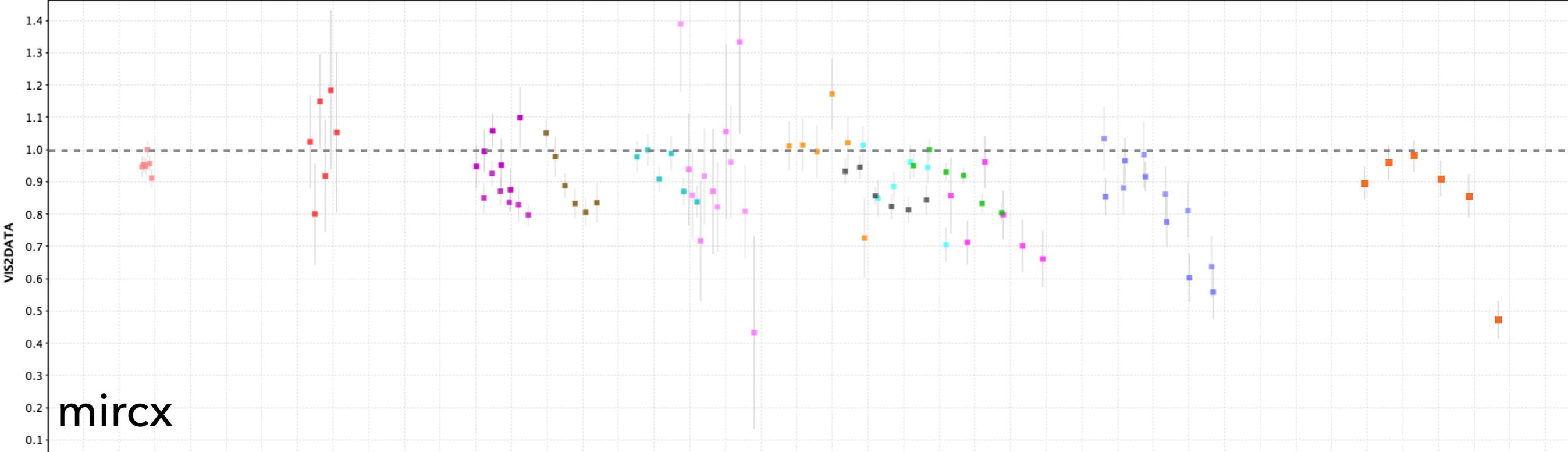
HOW ARE WE STUDYING THIS?



W SERPENTIS INTERFEROMETRY DATA 07/26/23

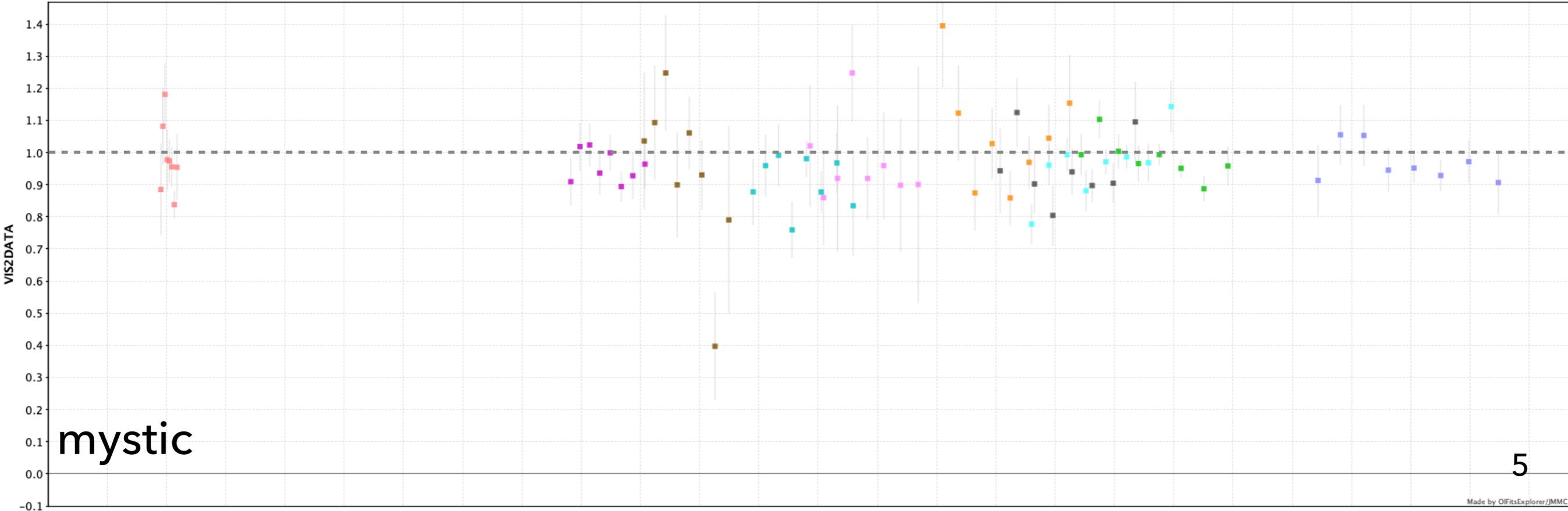


CHARA - MIRCX [1.515 μm - 1.7215 μm] - S1-S2-E1-E2-W1-W2
Day: 2023-07-26 - Source: HD_166126



mircx

CHARA - MIRCX [2.0064 μm - 2.375 μm] - S1-S2-E1-E2-W1-W2
Day: 2023-07-26 - Source: HD_166126

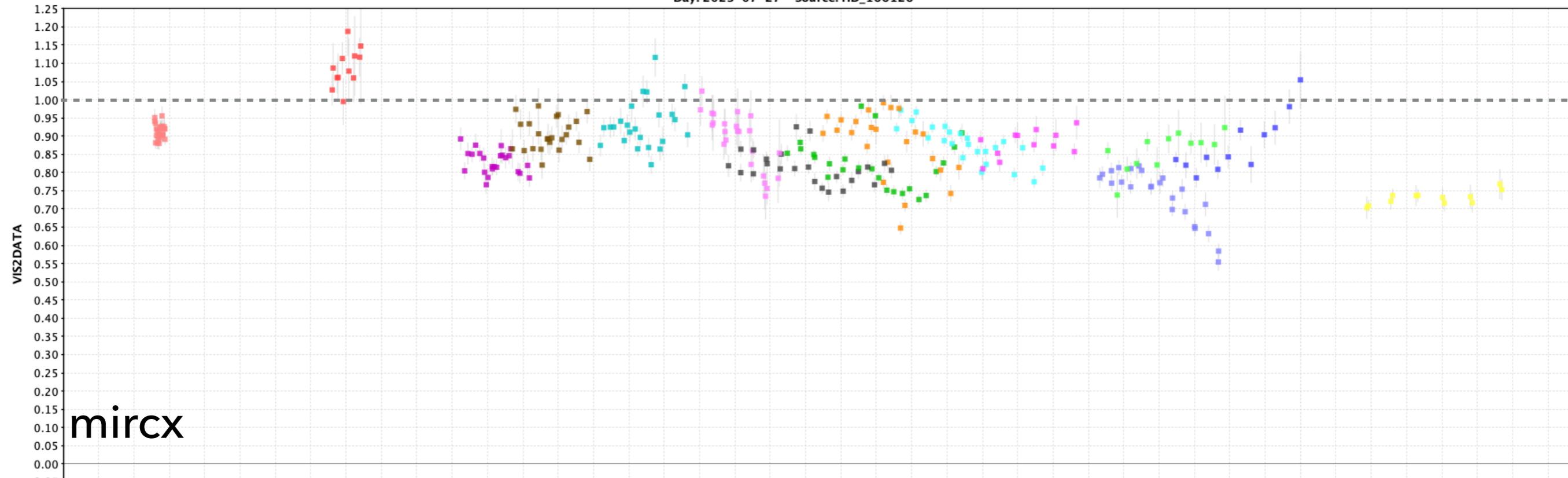


mystic

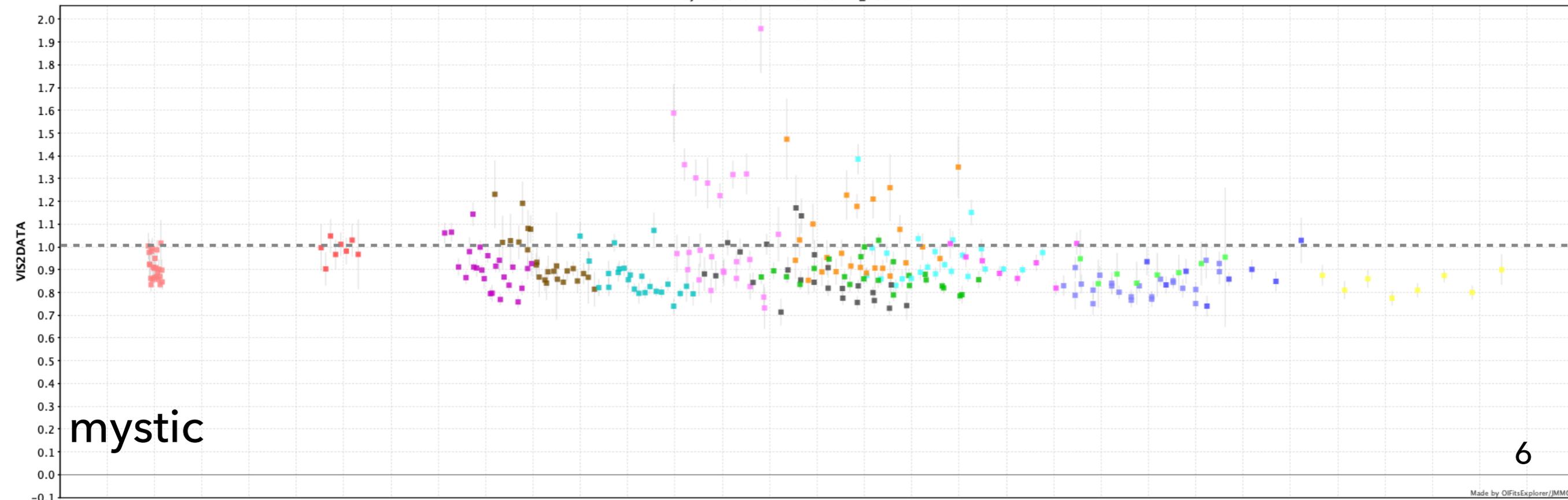
W SERPENTIS INTERFEROMETRY DATA 07/27/23



CHARA - MIRCX [1.5146 μm - 1.7215 μm] - S1-S2-E1-E2-W1-W2
Day: 2023-07-27 - Source: HD_166126



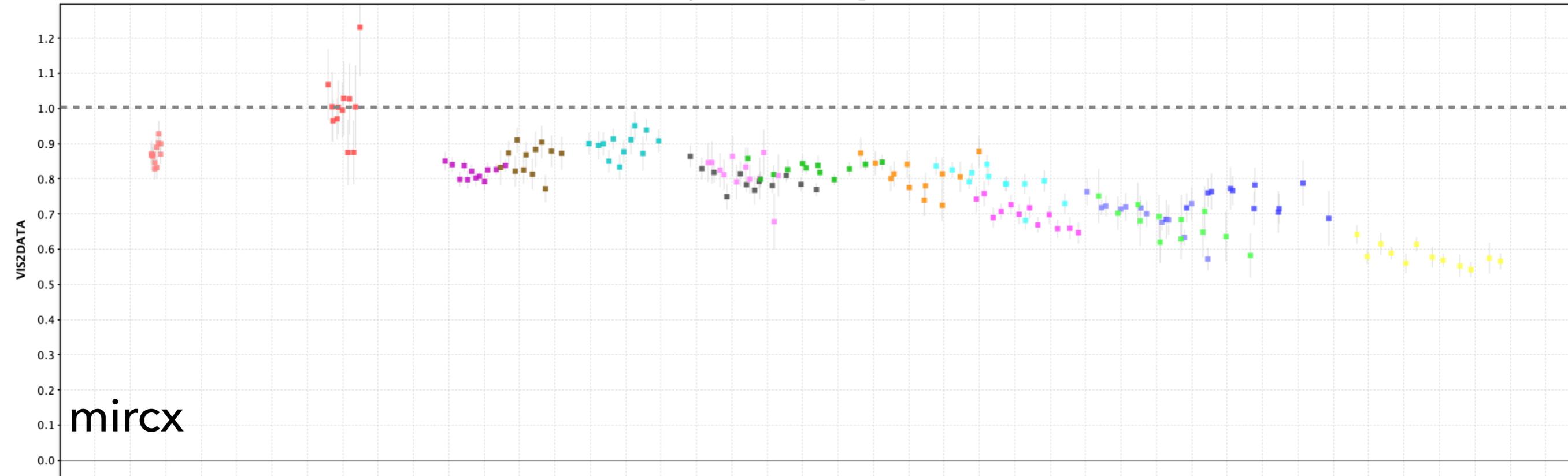
CHARA - MIRCX [2.005 μm - 2.3752 μm] - S1-S2-E1-E2-W1-W2
Day: 2023-07-27 - Source: HD_166126



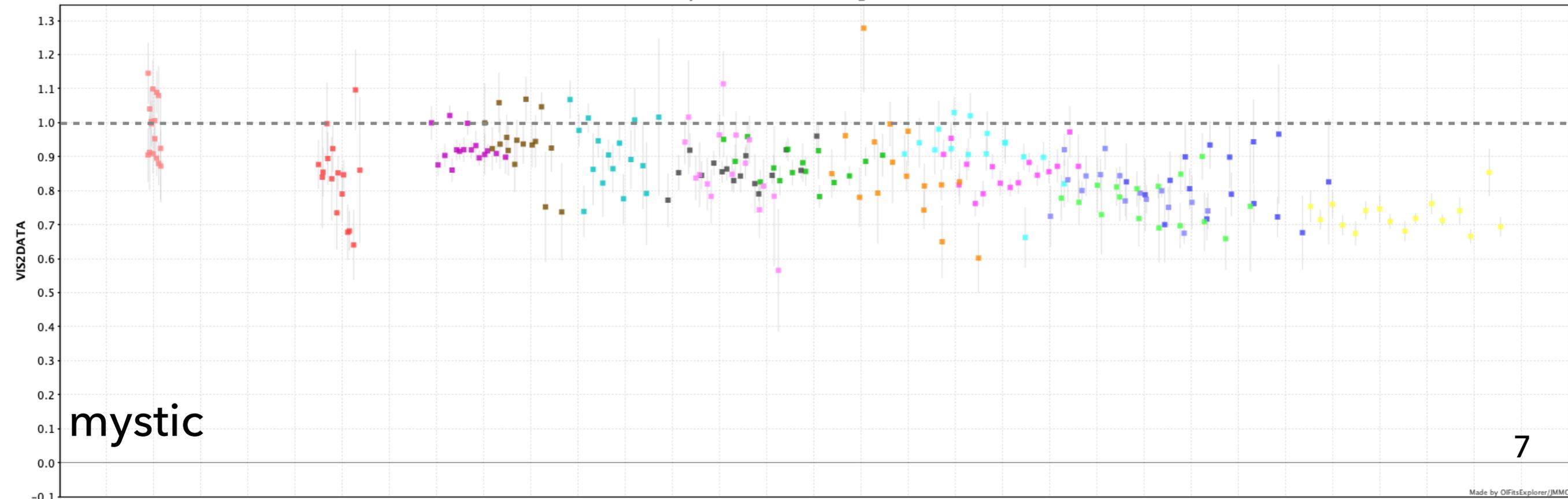
W SERPENTIS INTERFEROMETRY DATA 07/28/23



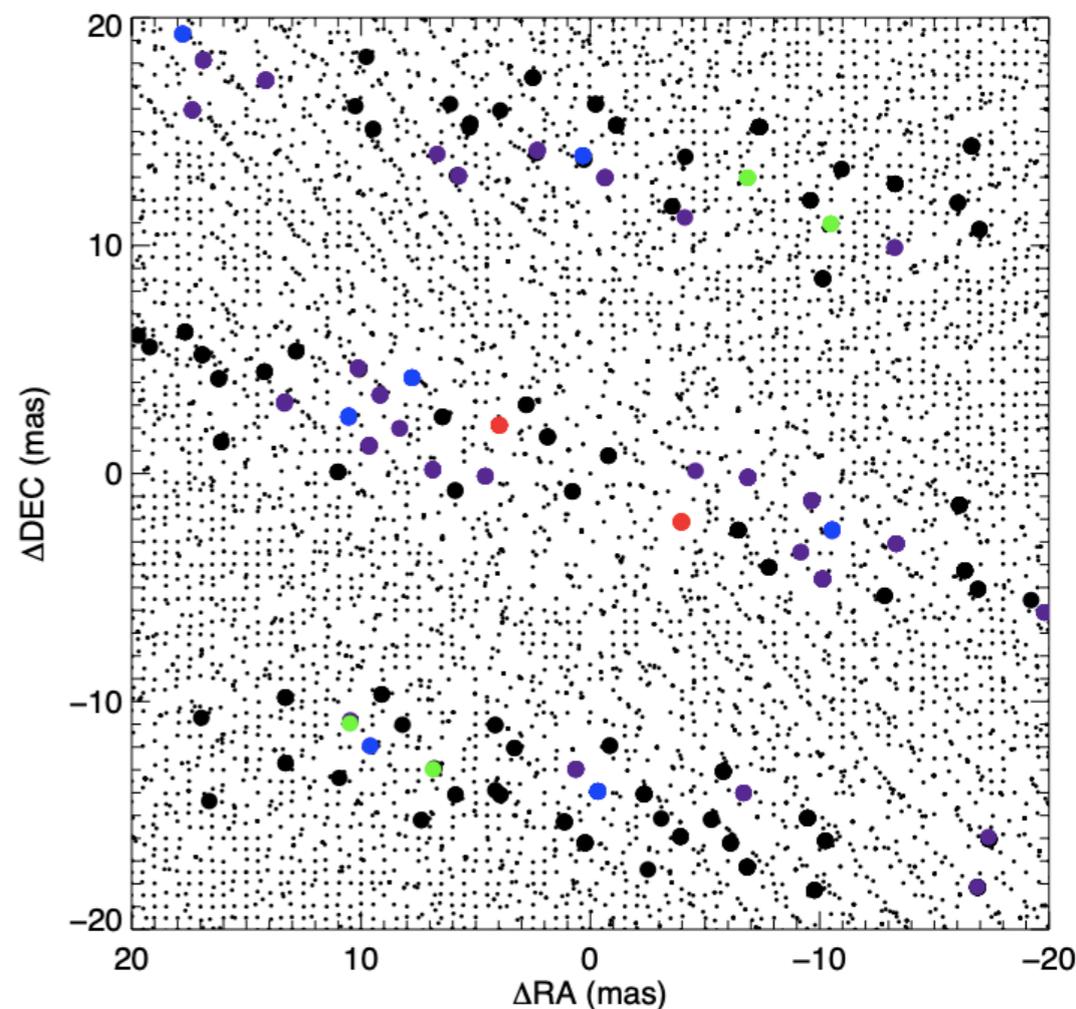
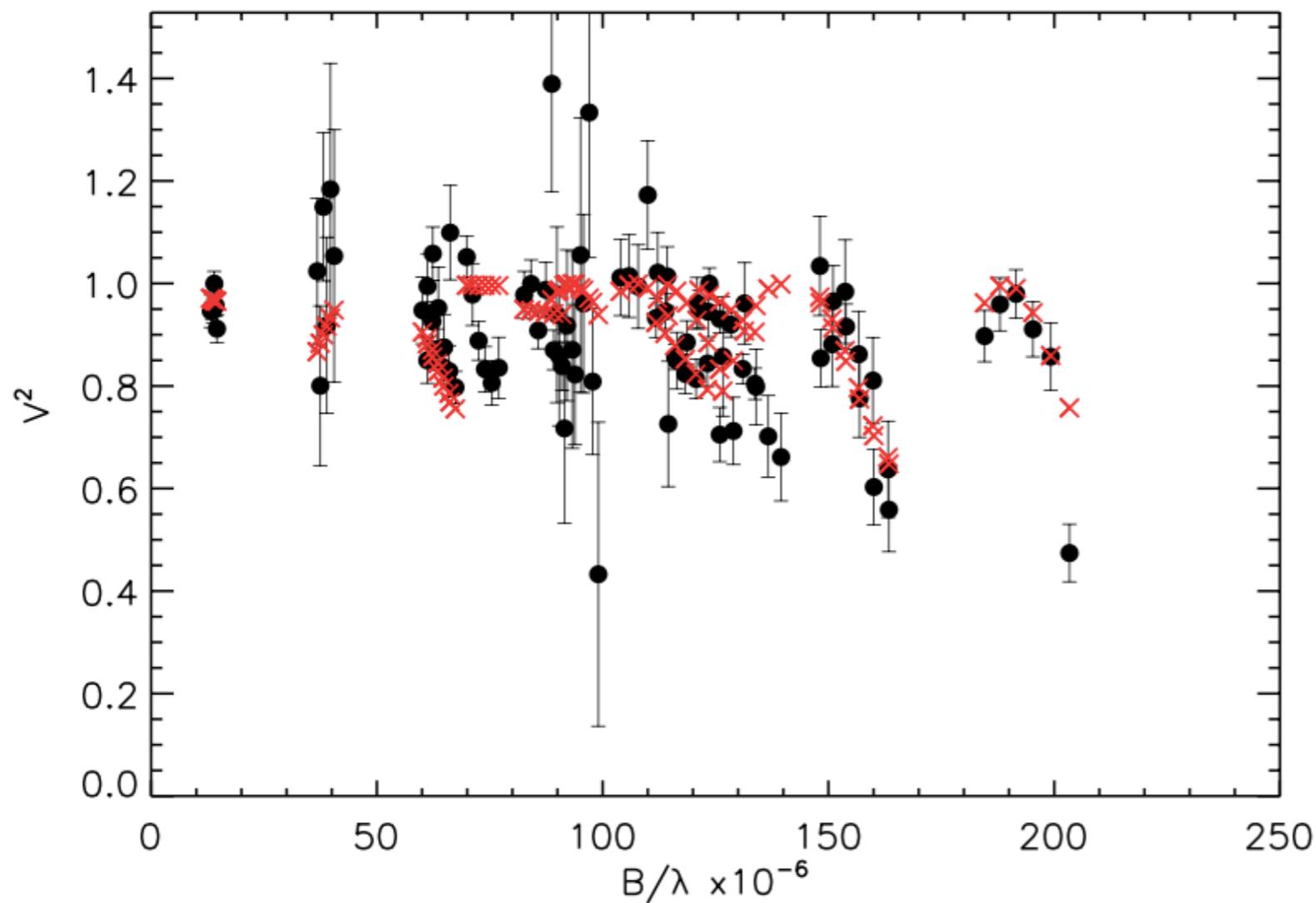
CHARA - MIRCX [1.5138 μm - 1.7214 μm] - S1-S2-E1-E2-W1-W2
Day: 2023-07-28 - Source: HD_166126



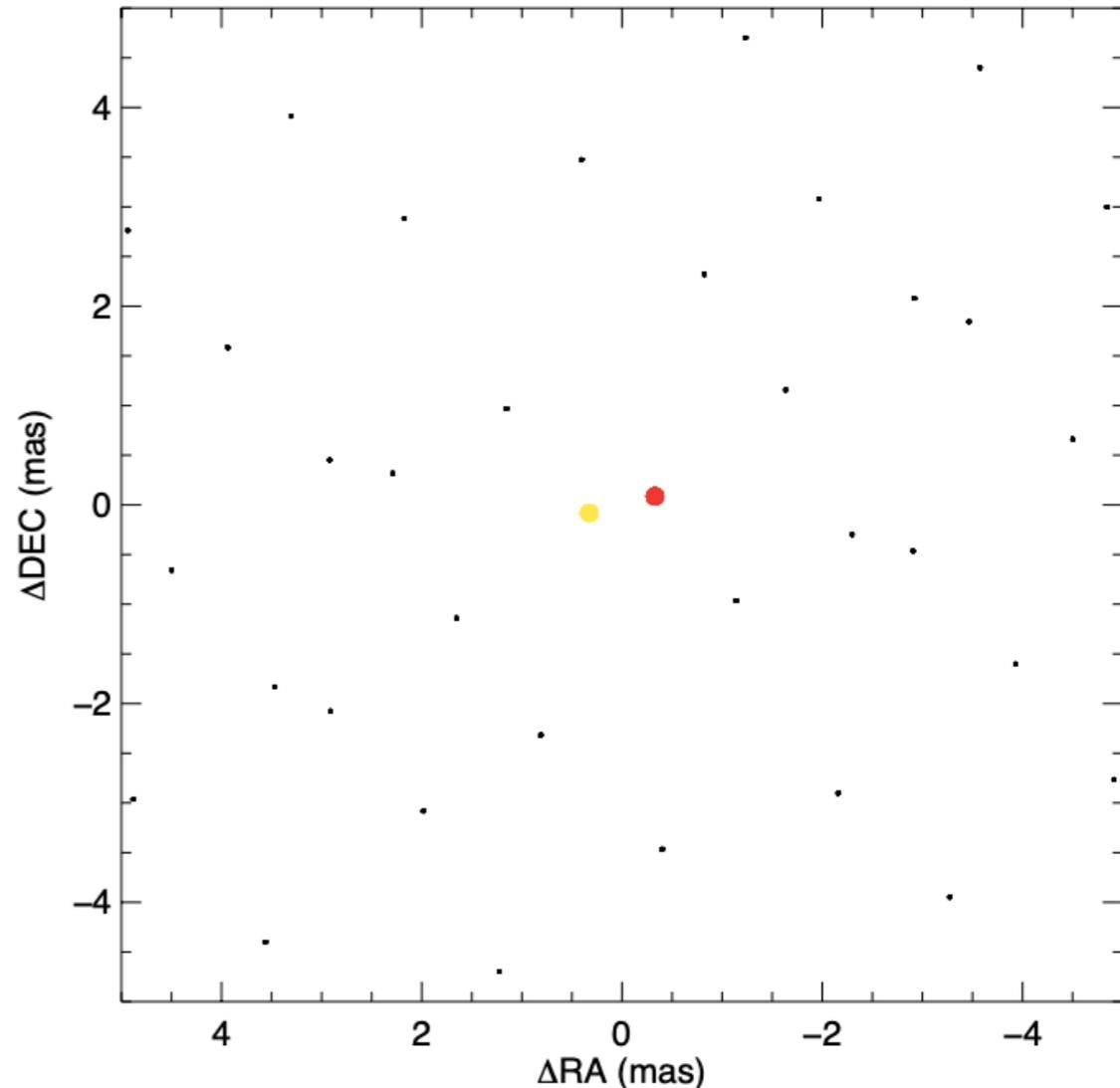
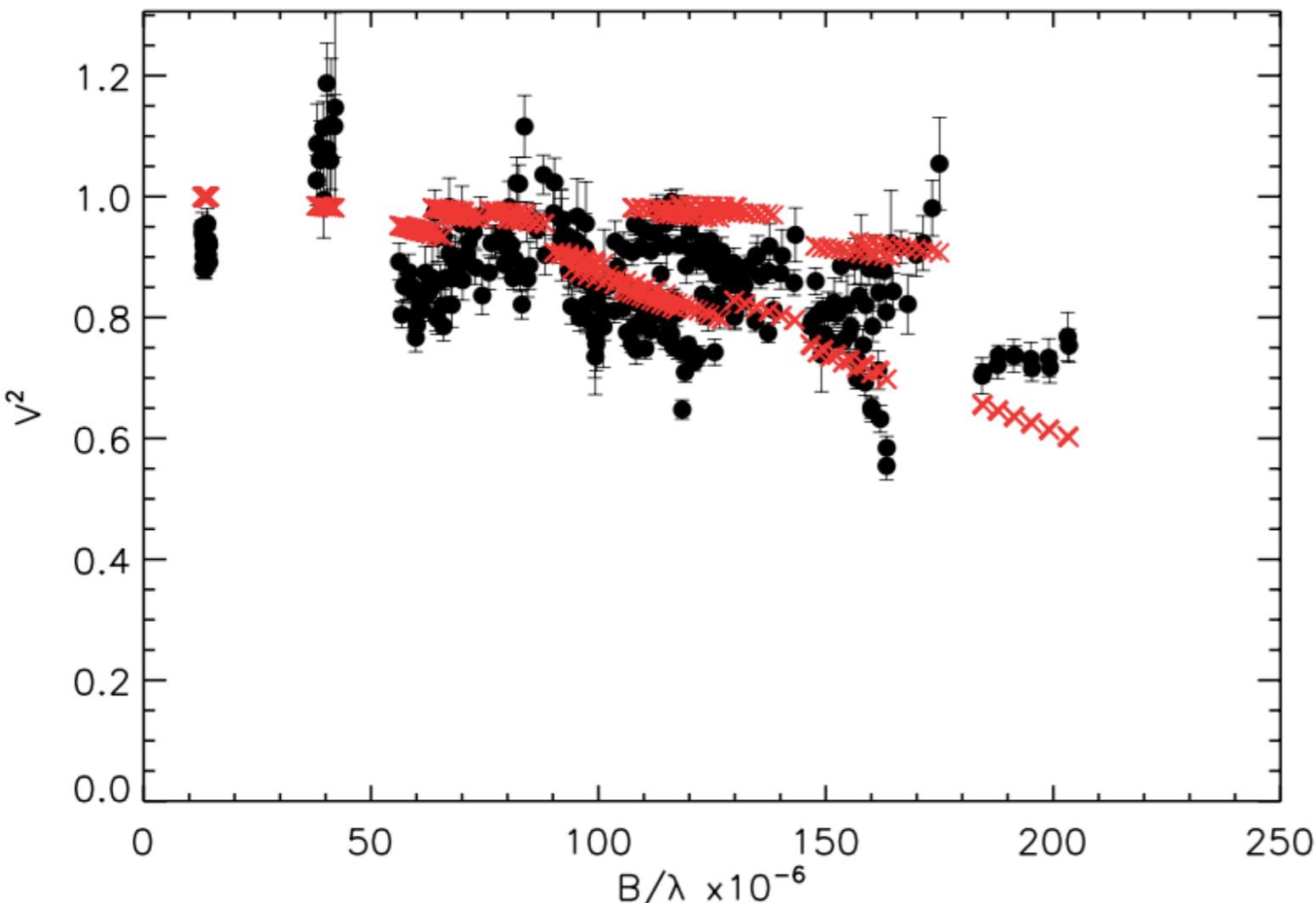
CHARA - MIRCX [2.0028 μm - 2.3752 μm] - S1-S2-E1-E2-W1-W2
Day: 2023-07-28 - Source: HD_166126



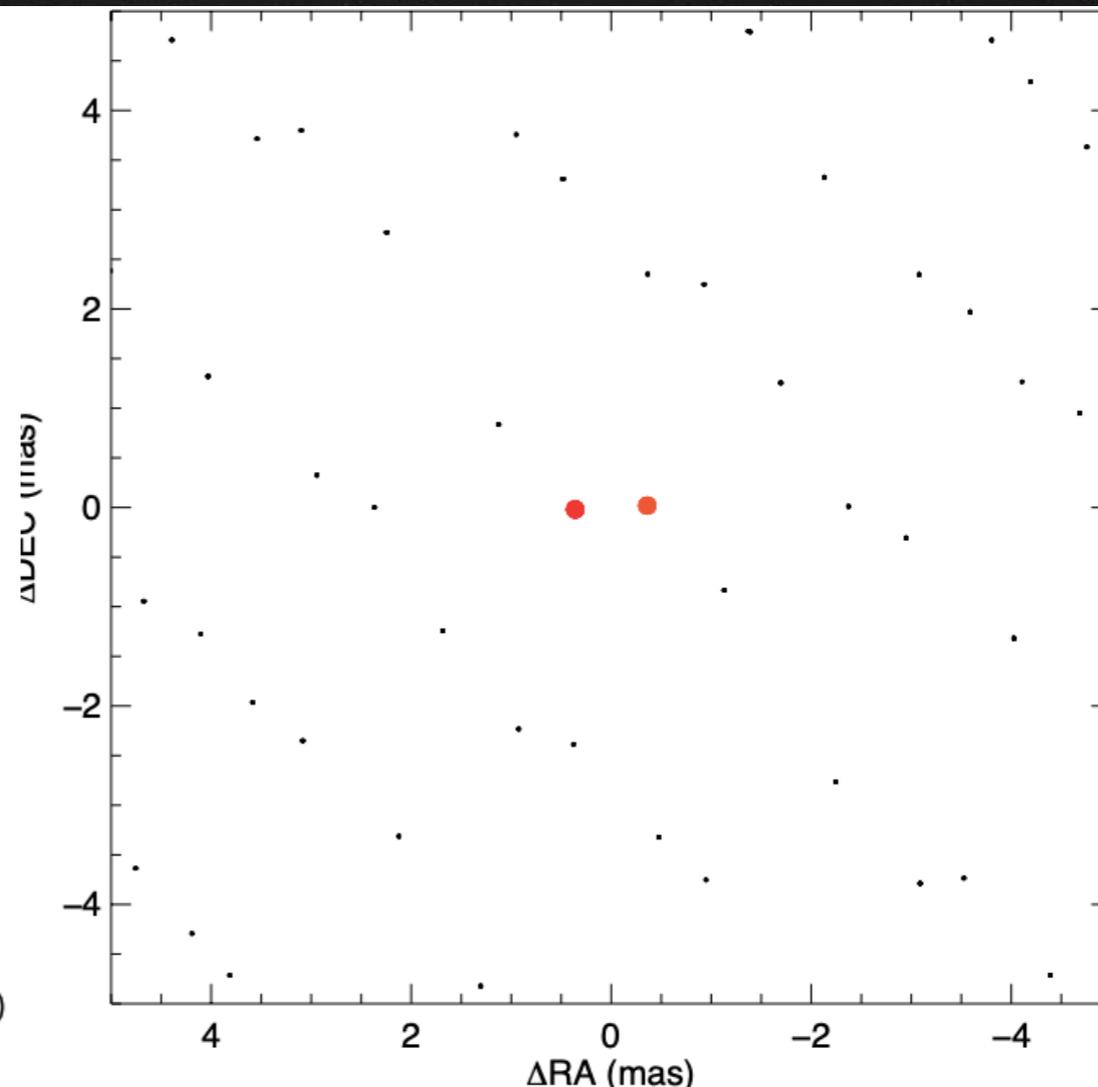
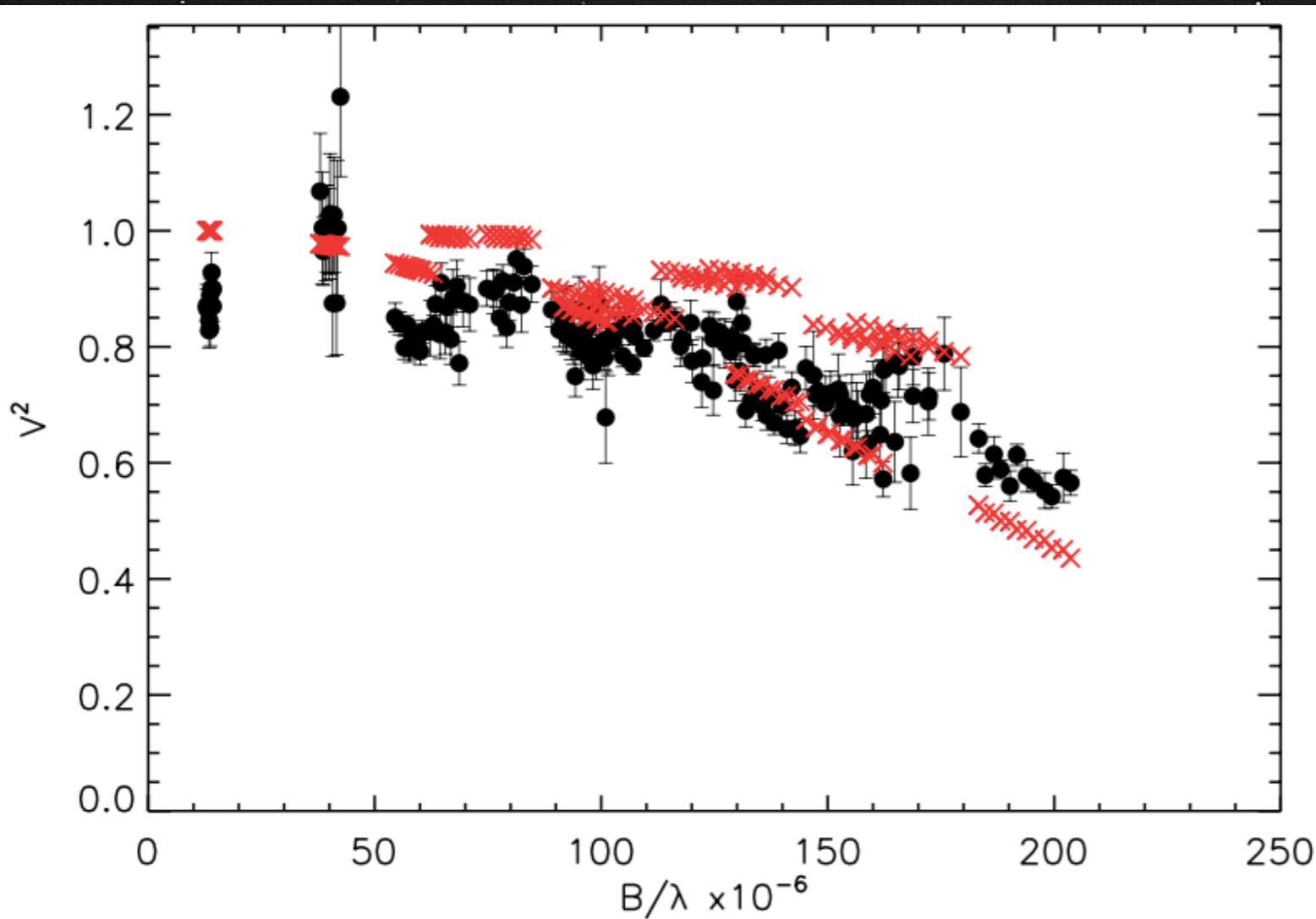
W SERPENTIS MODEL 07/26/23



W SERPENTIS MODEL 07/27/23



W SERPENTIS MODEL 07/28/23



W SERPENTIS MODELS + RADIAL VELOCITIES



▶ 07/26/23



W SERPENTIS MODELS + RADIAL VELOCITIES



▶ 07/26/23

▶ 07/27/23



W SERPENTIS MODELS + RADIAL VELOCITIES



▶ 07/26/23

▶ 07/27/23

▶ 07/28/23



LESIA



Observatoire de la CÔTE d'AZUR



THE UNIVERSITY OF SYDNEY



Australian National University



KYOTO SANGYO UNIVERSITY

UNIVERSITY OF EXETER

W SERPENTIS MODELS + RADIAL VELOCITIES



▶ 07/26/23

▶ 07/27/23

▶ 07/28/23



Never been done for W Ser before now!

Thank you CHARA!

WHAT DO I WANT TO DO WITH THE CHARA DATA?



- ▶ W Ser is 1 of 9 systems in our sample



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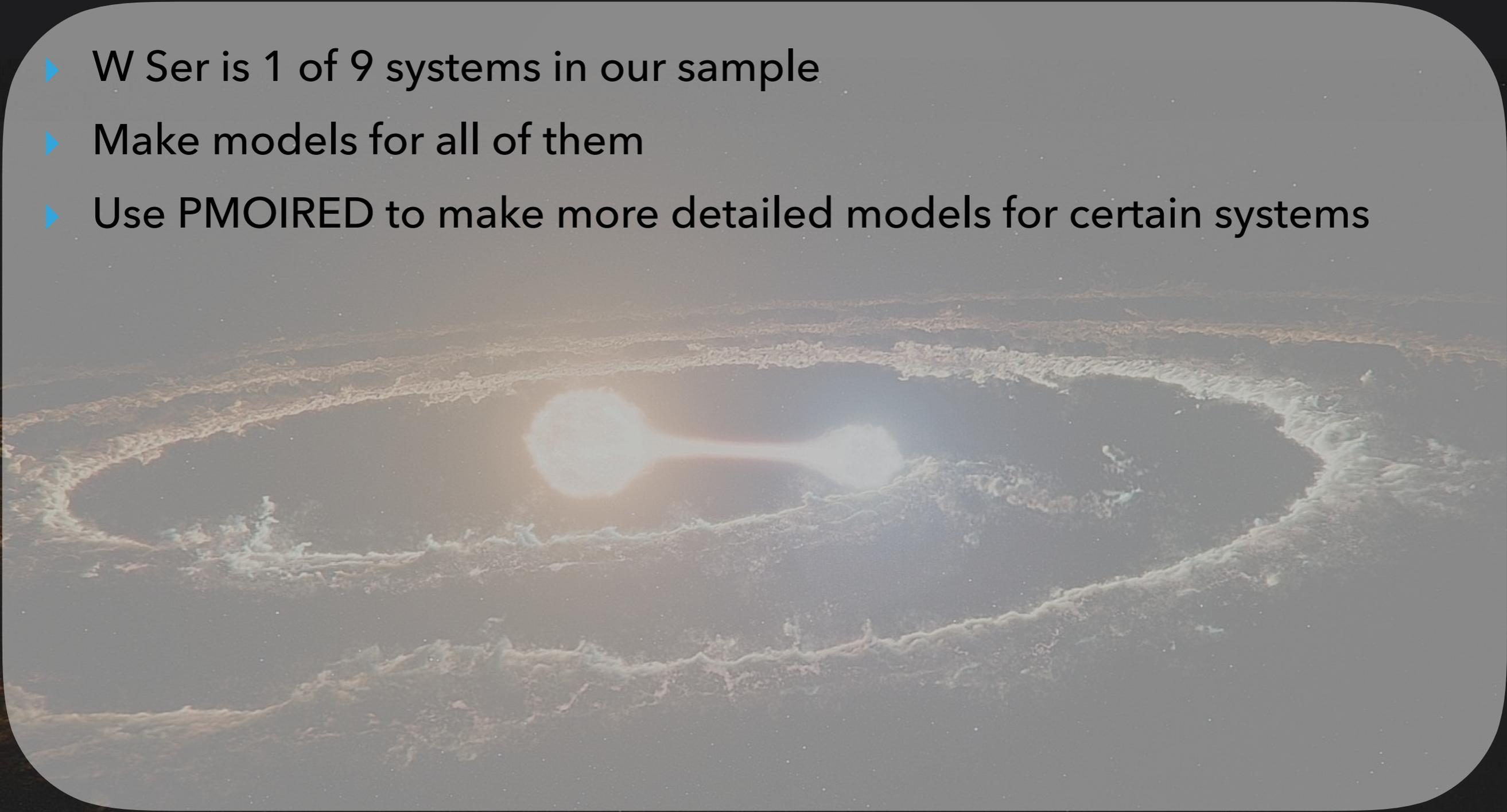
- ▶ W Ser is 1 of 9 systems in our sample
- ▶ Make models for all of them



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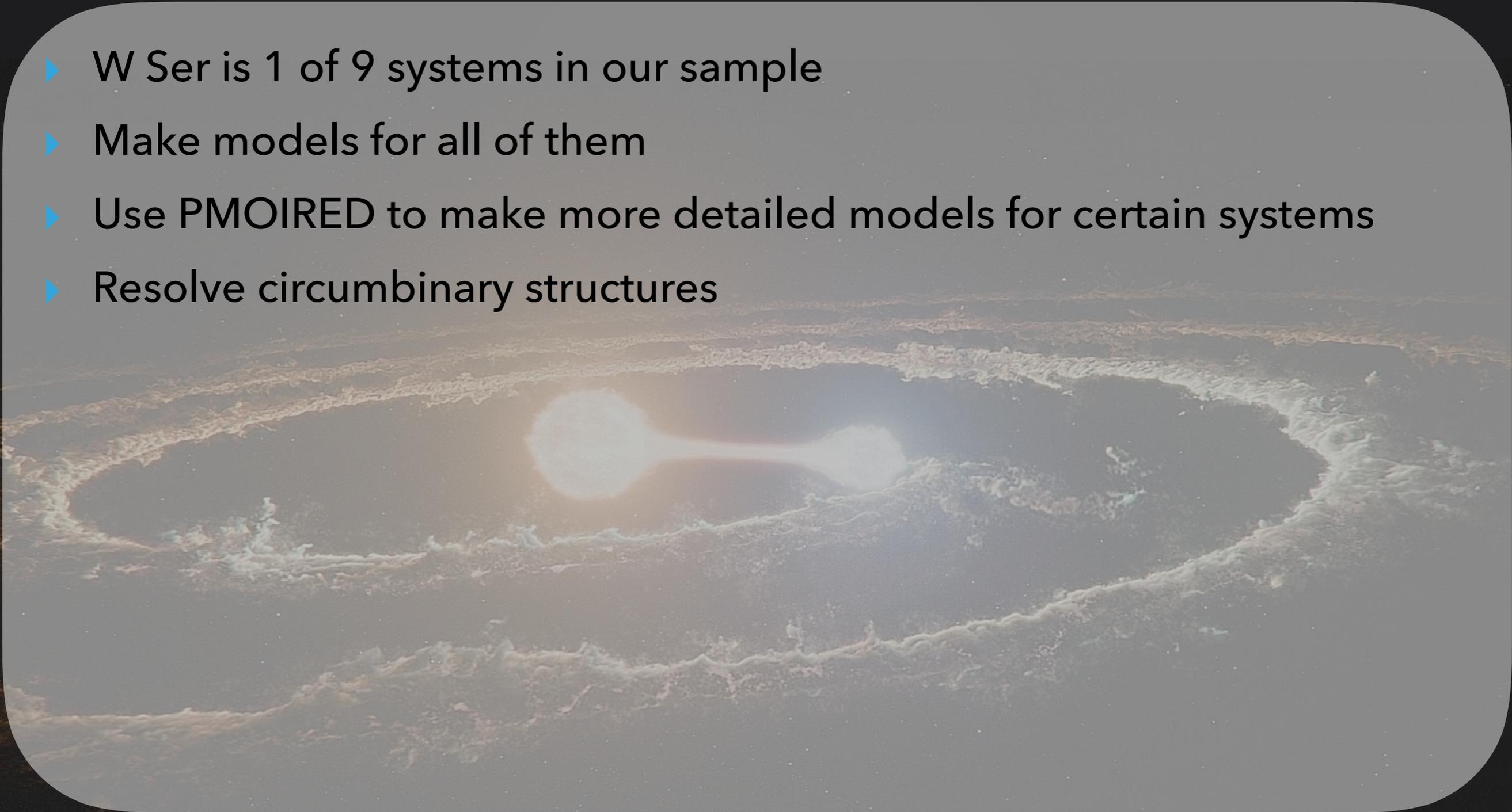
- ▶ W Ser is 1 of 9 systems in our sample
- ▶ Make models for all of them
- ▶ Use PMOIRE2 to make more detailed models for certain systems



WHAT DO I WANT TO DO WITH THE CHARA DATA?



- ▶ W Ser is 1 of 9 systems in our sample
- ▶ Make models for all of them
- ▶ Use PMOIRE to make more detailed models for certain systems
- ▶ Resolve circumbinary structures



WHAT DO I WANT TO DO WITH THE CHARA DATA?



- ▶ W Ser is 1 of 9 systems in our sample
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- ▶ Use PMOIRE to make more detailed models for certain systems
- ▶ Resolve circumbinary structures
 - ▶ Extent of structure

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- ▶ Use PMOIRE to make more detailed models for certain systems
- ▶ Resolve circumbinary structures
 - ▶ Extent of structure
 - ▶ Flux distribution

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 - ▶ Flux distribution
- ▶ Or the inner binary if possible

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- ▶ Or the inner binary if possible
 - ▶ From models get separation

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 - ▶ Determine flux ratio

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- ▶ Resolve circumbinary structures
 - ▶ Extent of structure
 - ▶ Flux distribution
- ▶ Or the inner binary if possible
 - ▶ From models get separation
 - ▶ Determine flux ratio
 - ▶ Get a mass estimate!

THANK YOU!



Space cat back alive

PARIS, Saturday. — France has successfully sent a cat into space on board a Yonique rocket and brought it back to earth alive.

An Armed Forces Ministry messenger said the flight was marked out from Strasbourg last in the future.

The cat was named Félicette. The cat was sent into space as part of France's program of space biology research in which there has been already been one cat.

Scientists said in the cat's last excited signs to be transmitted to the experimental base through out the flight, the cat was very calm.

The cat was found in a small container in the tail of the carrying rocket.

Tests

The cat was in good health when she was brought back to earth.

Two French cats plus six mice were on the flight to check the effects of altitude of gravity on an animal's nervous system and brain activity. These effects were found to be normal.

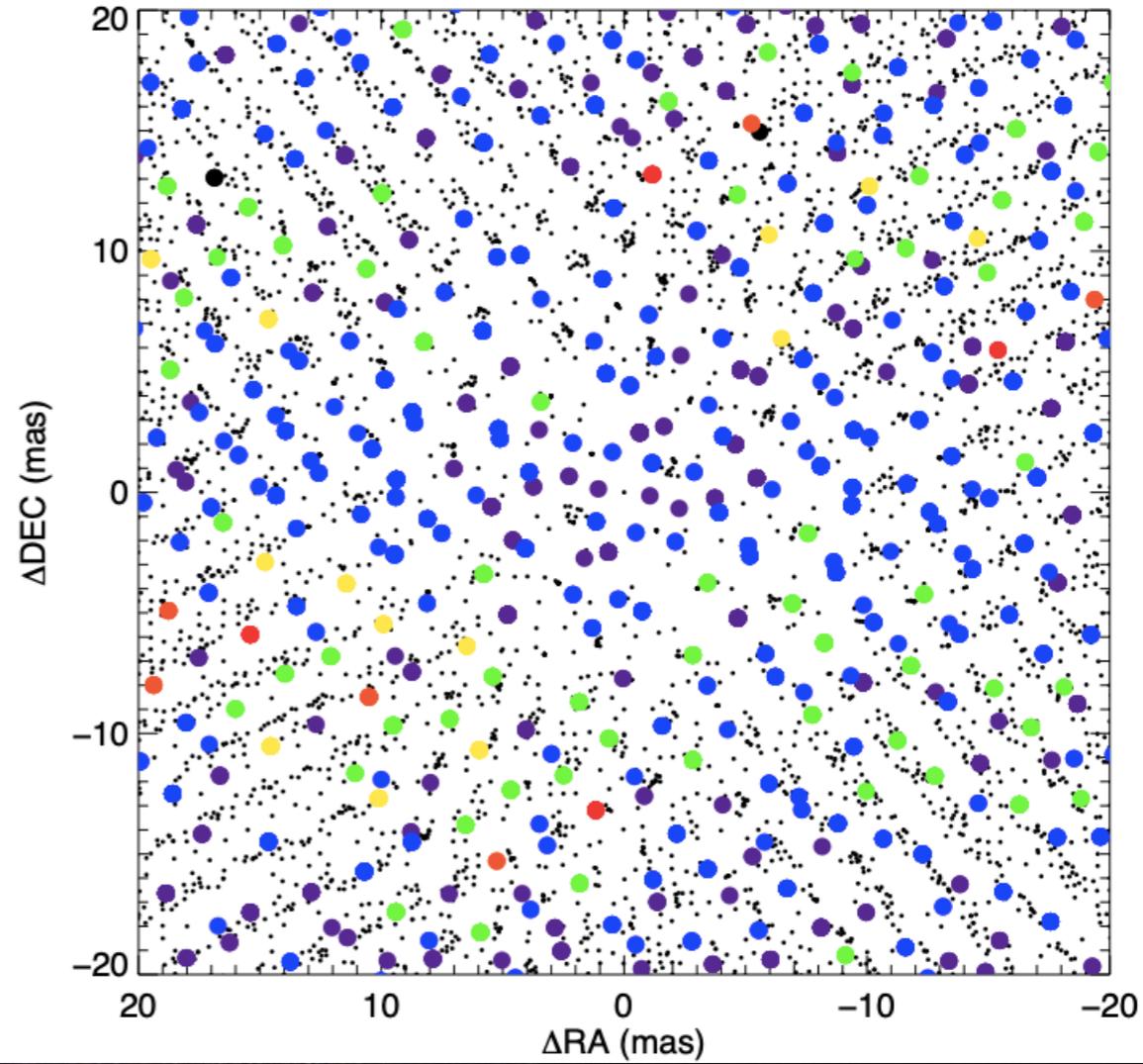
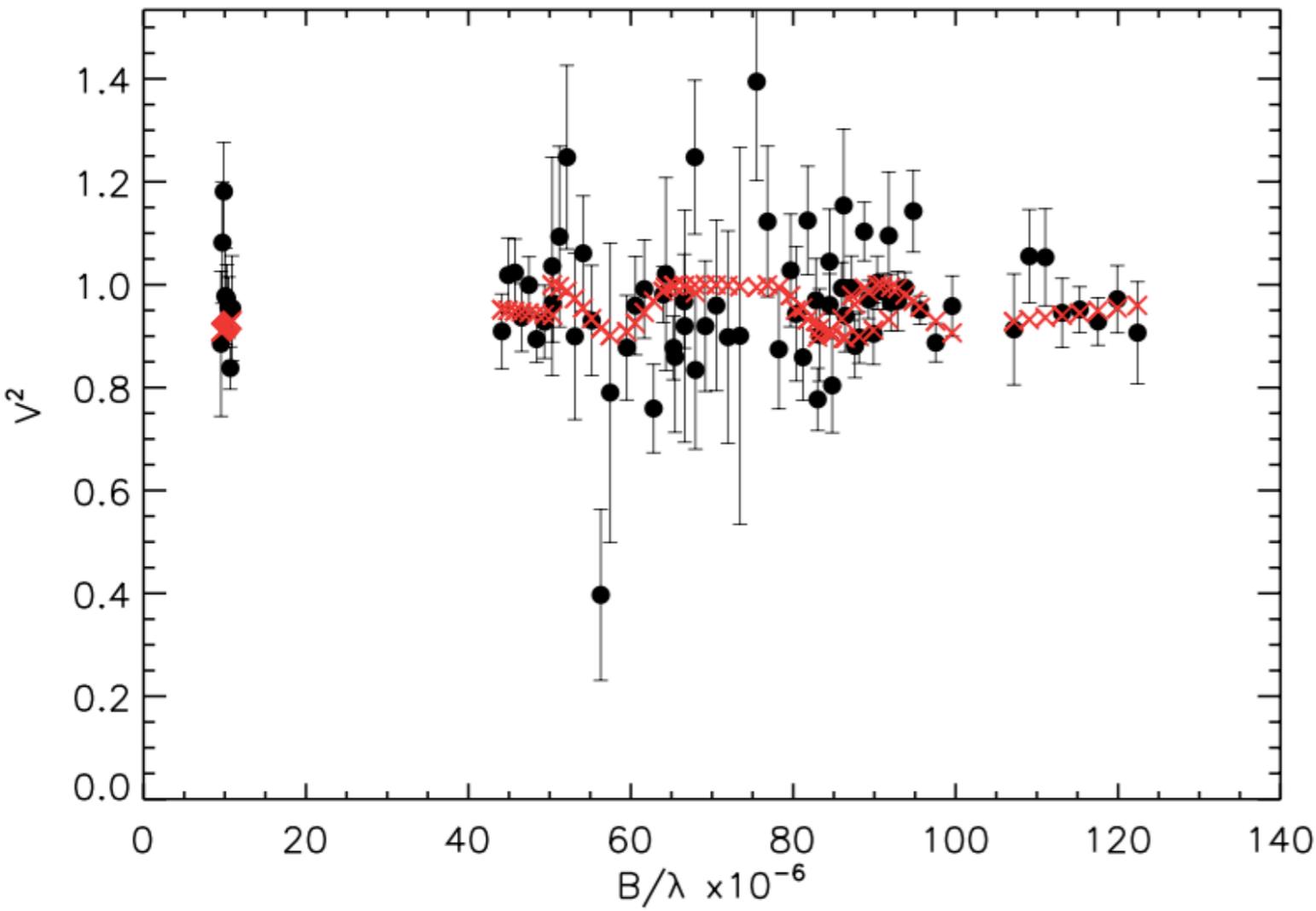
By using a cat, the scientists were able to analyze an animal's reactions more accurately and with a very delicate apparatus which is not allowed only in a laboratory.

A DOUBLE FRACTURE

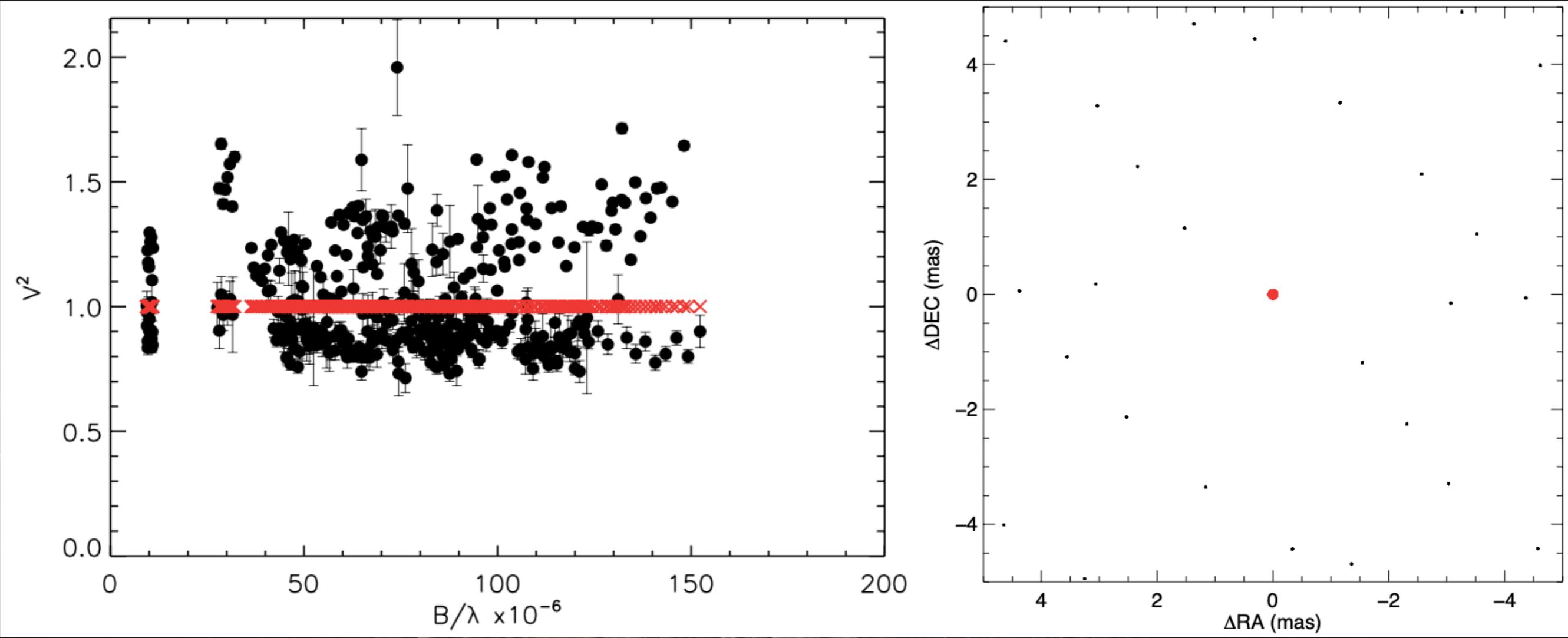
NEW YORK, Sunday (A.P.) — A boy, 14, of St. Petersburg, Florida, had a double fracture in a lower leg that he would give a doctor's office of \$100.

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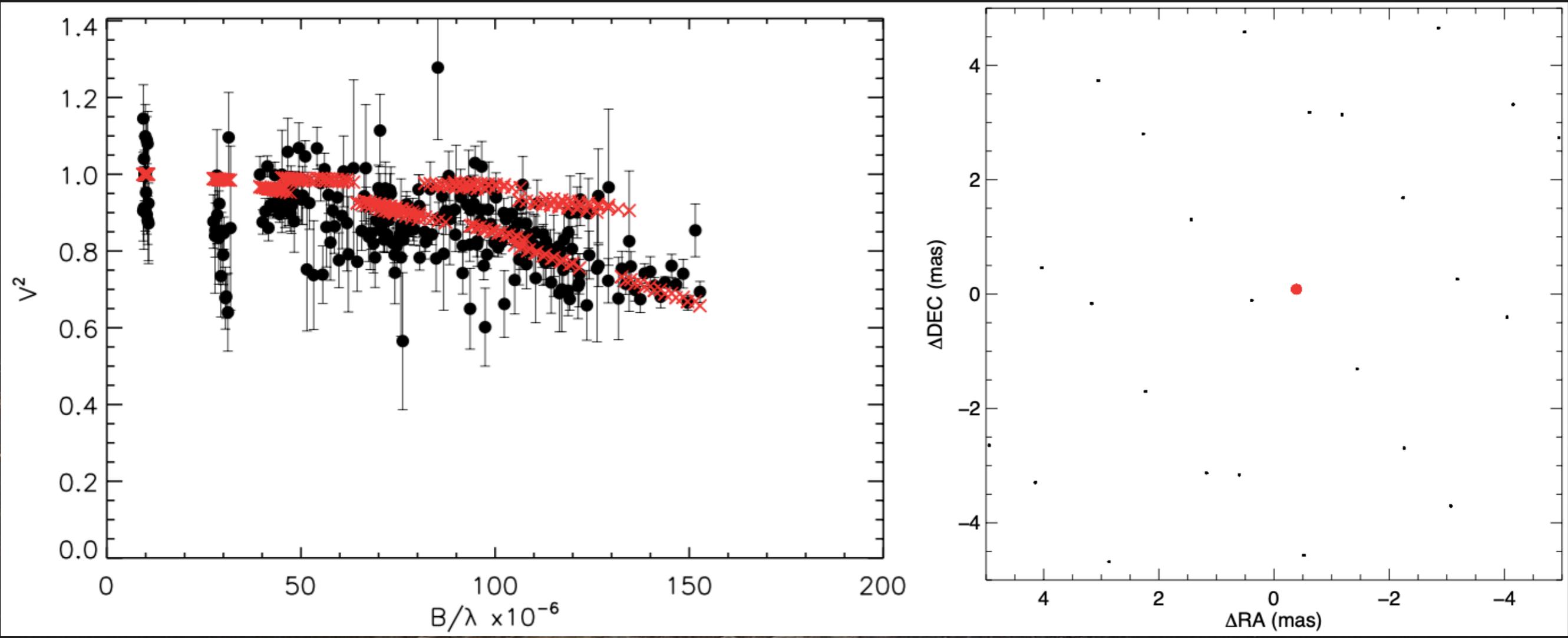
MYSTIC 7/26/23



MYSTIC 7/27/23



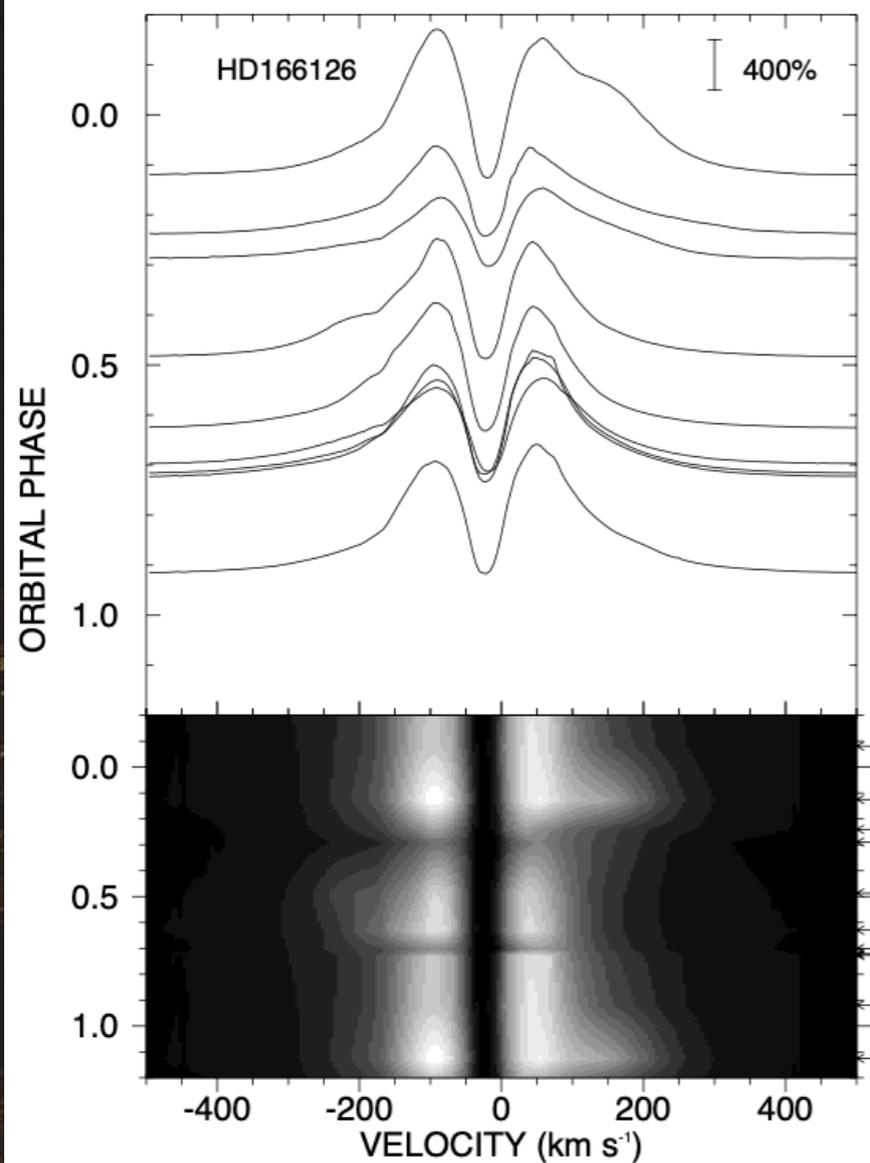
MYSTIC 7/28/23



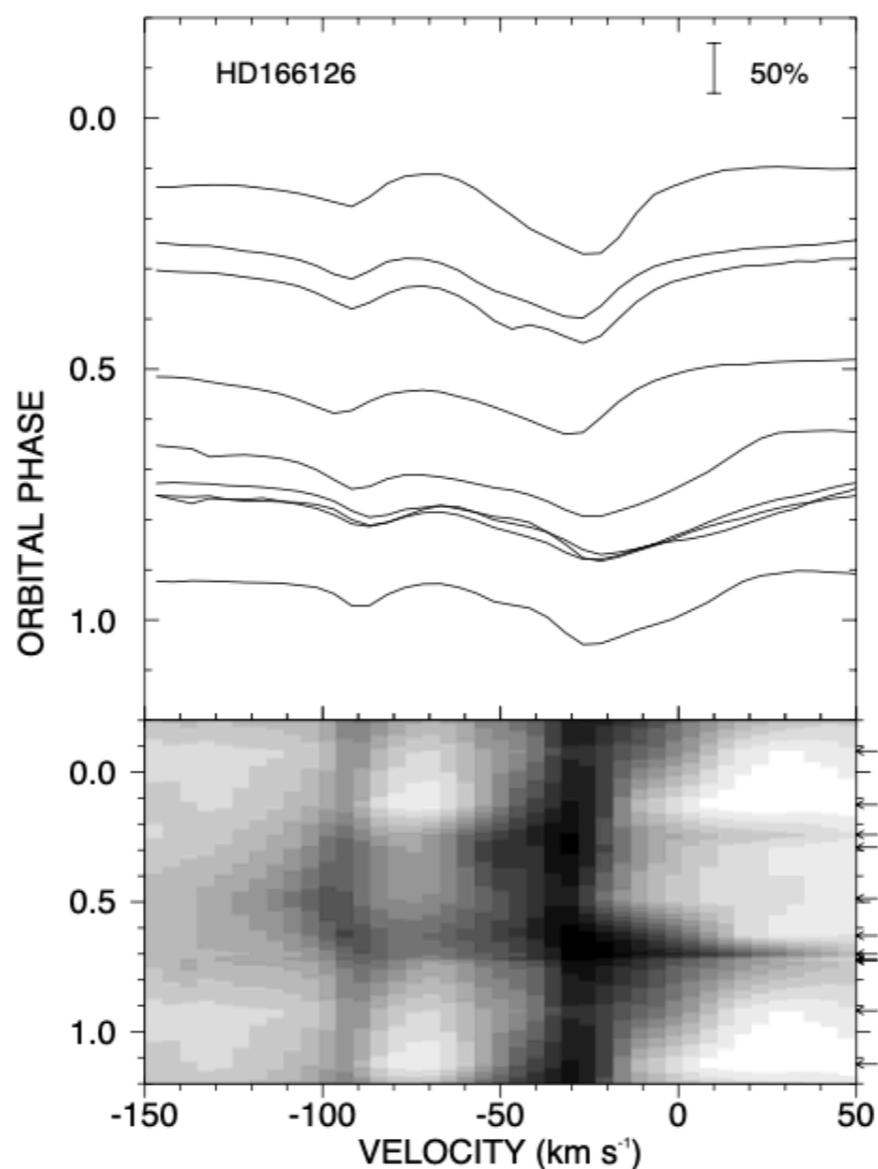
RADIAL VELOCITIES



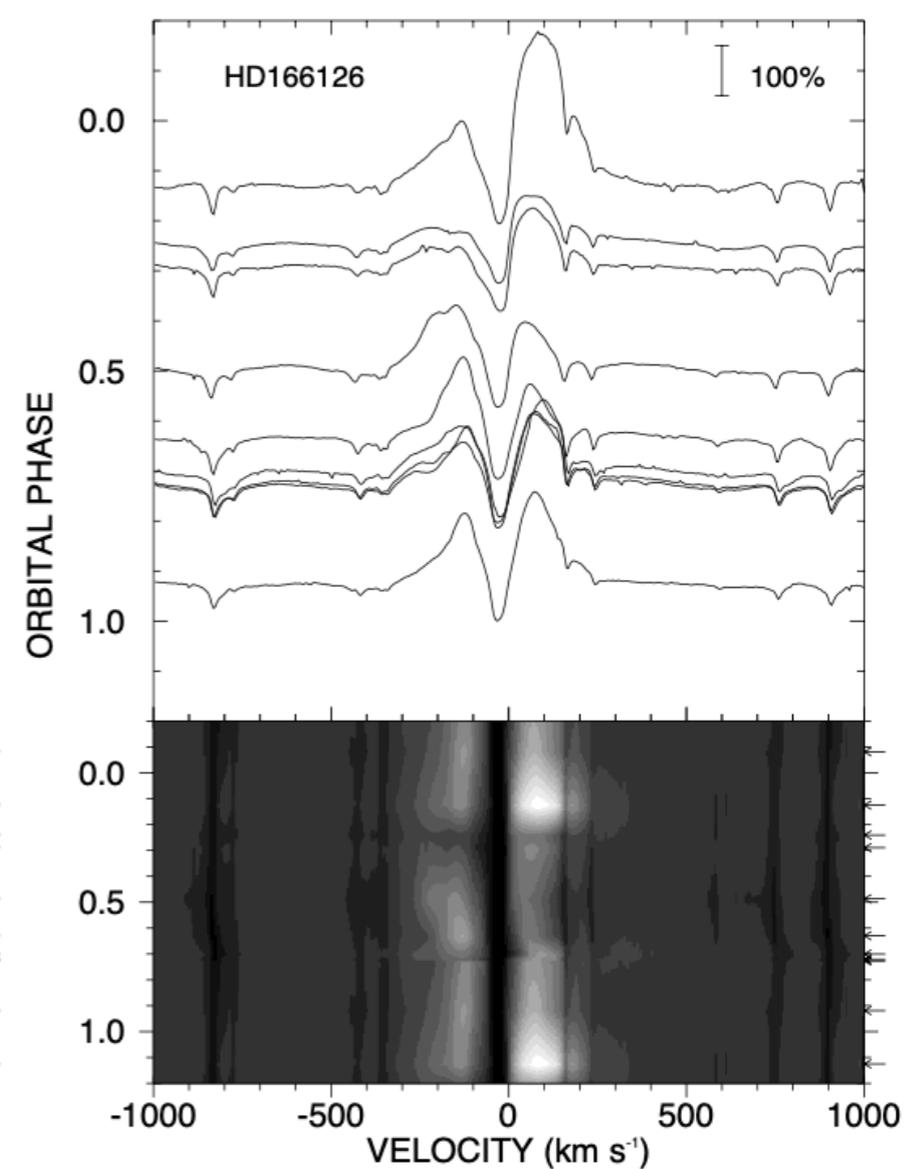
6563 H-Alpha



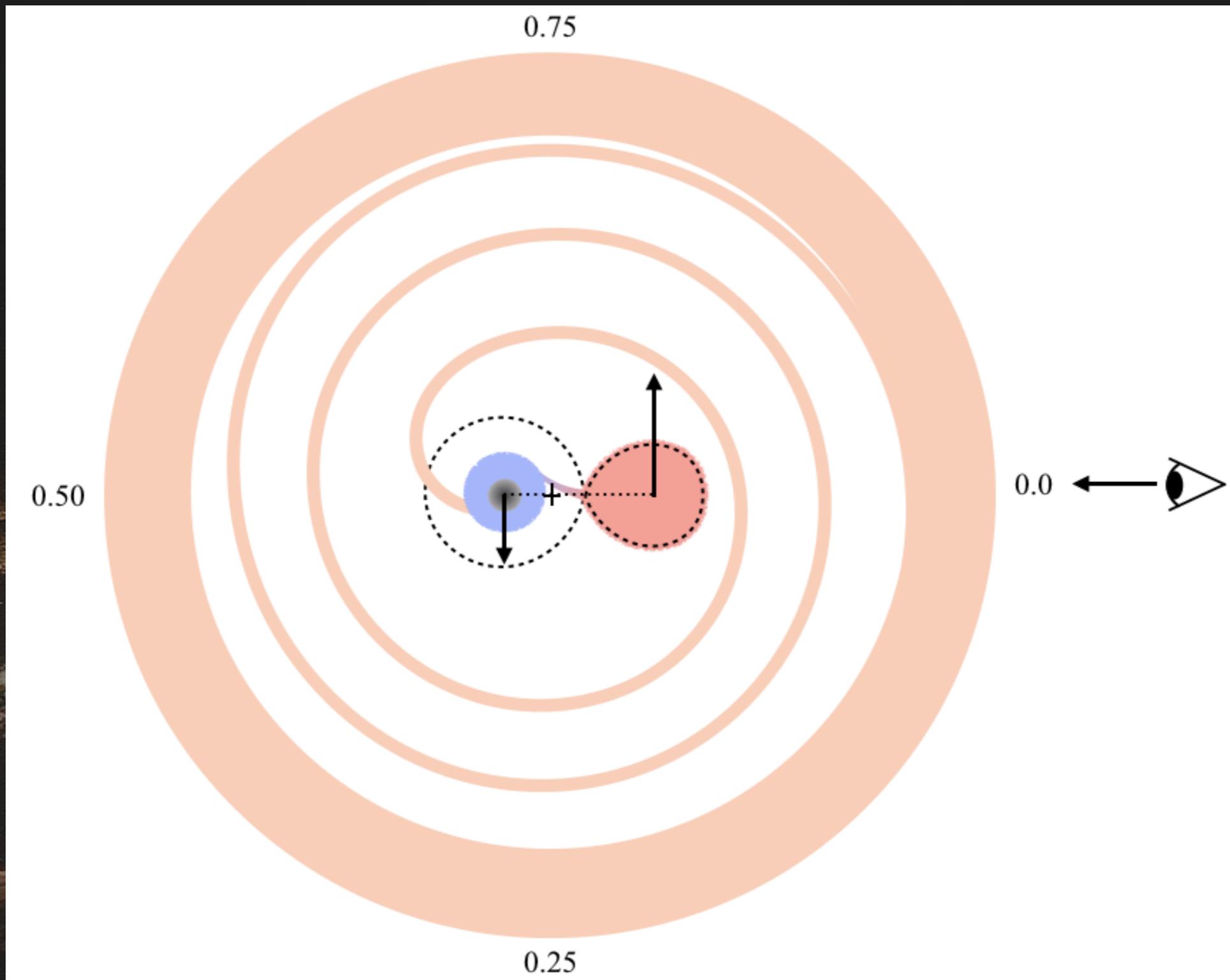
4583 Fe II



4861 H-Beta

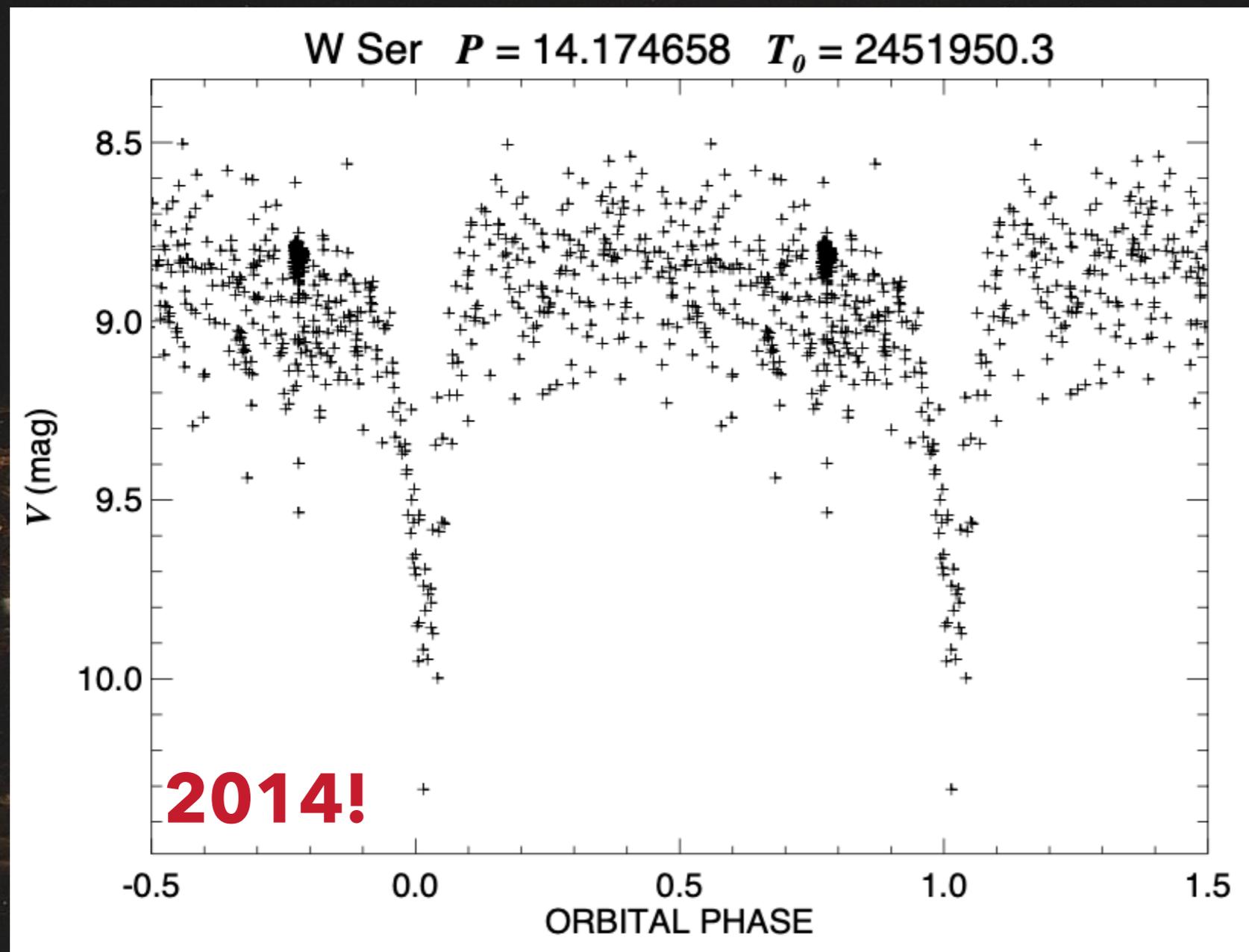


W SER MODEL



W SERPENTIS – PERIOD AND LIGHT CURVE

- ▶ Period is increasing by ~ 18.8 s/yr (Erdem & Öztürk 2014)
- ▶ P (2014) = 14.160 days (Erdem & Öztürk 2014)



- ▶ P (2024) = 14.171595 days
- ▶ Period is increasing = mass ratio reversal (mass gainer is larger than mass donor)
- ▶ No secondary eclipse visible