

How do new polarimetric observations challenge simulations?

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COSPAR 2024
45th Scientific Assembly
July 13-21, 2024 | Bexco, Busan, Korea

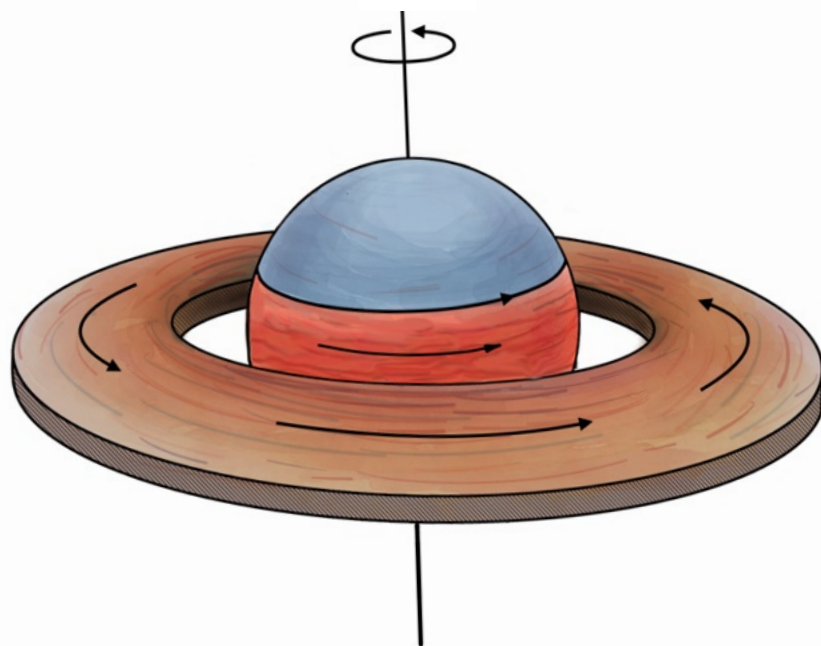


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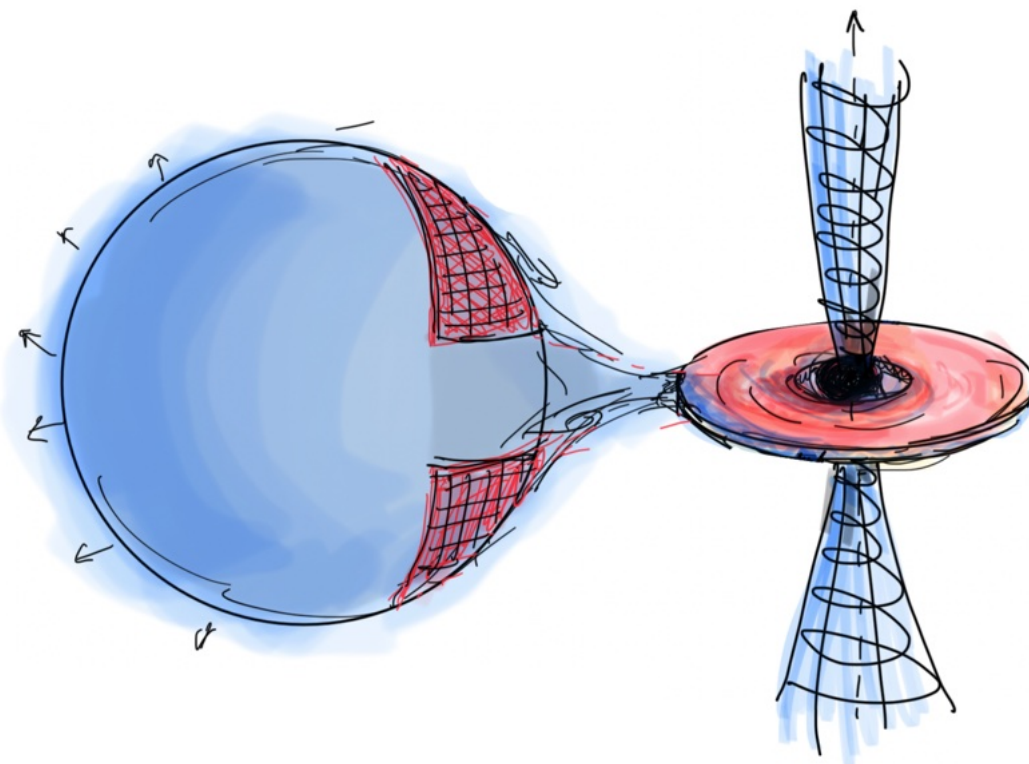
Motivation

How we often treat our sources:

neutron stars



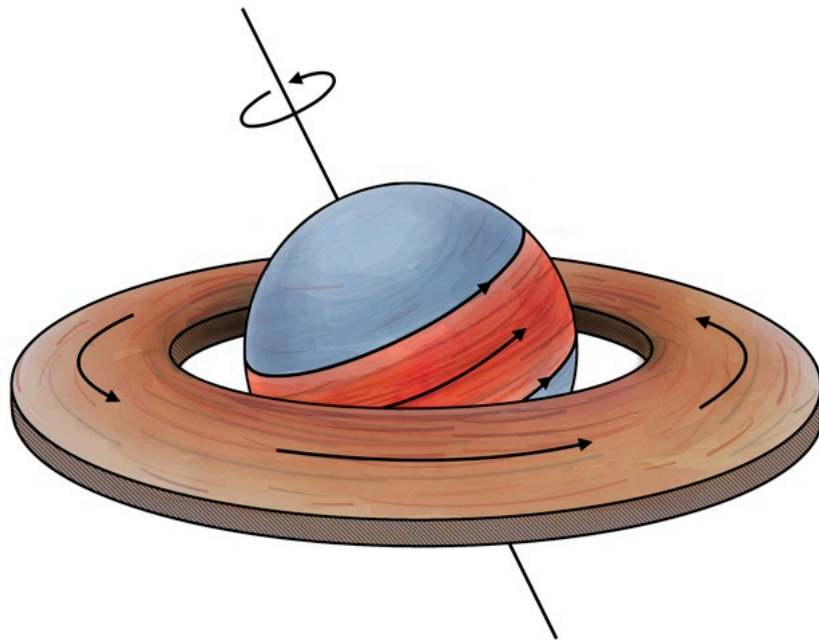
black holes



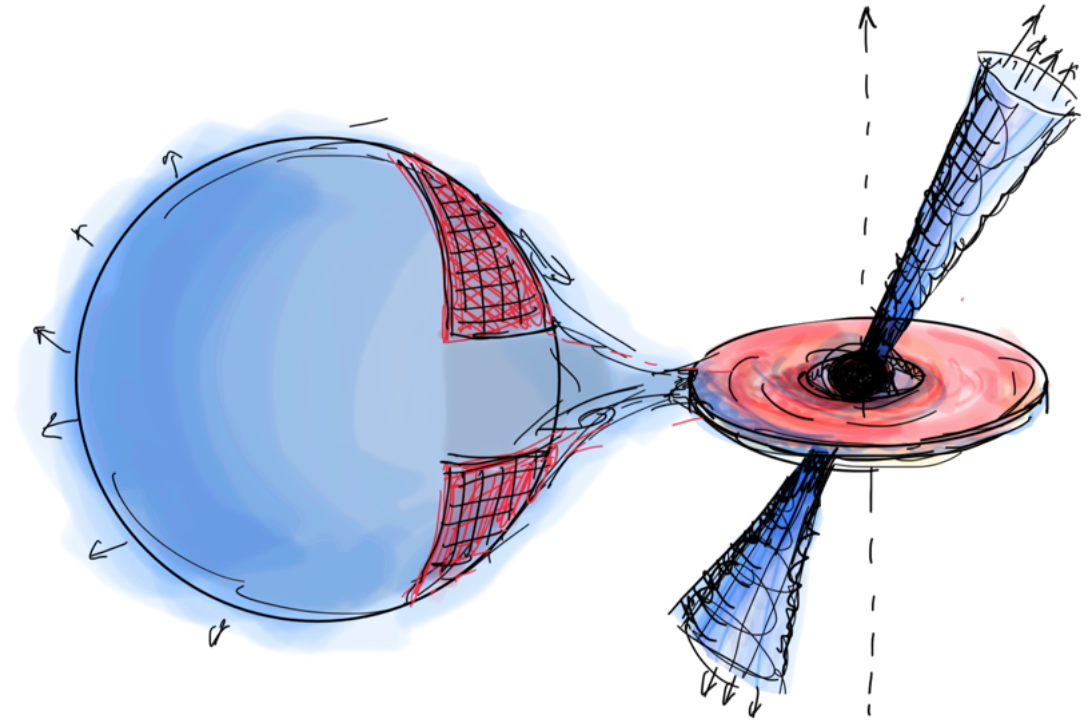
Motivation

How they may look in reality:

neutron stars



black holes



Motivation

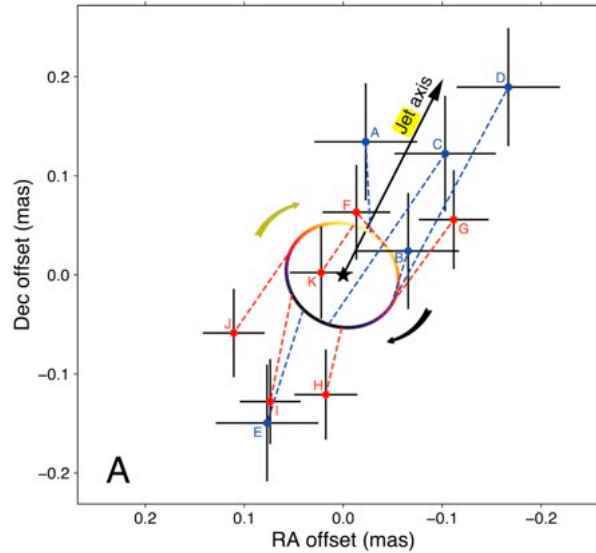
Pros and cons of symmetries

Pros:

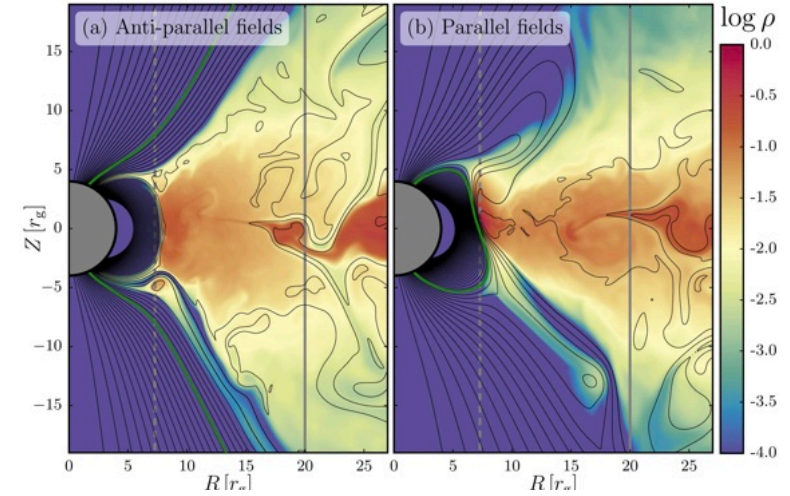
- Make physics easier
- Allow to go from 3D to 2D
- Make some processes stable

Cons:

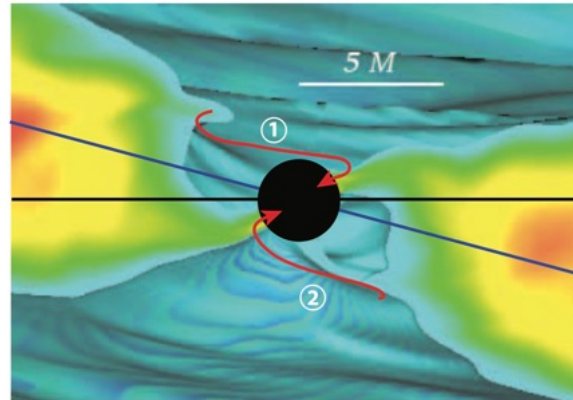
- Make some processes stable
- Prevent some processes to happen
- Cannot explain some observations
- Improper use leads to very wrong results



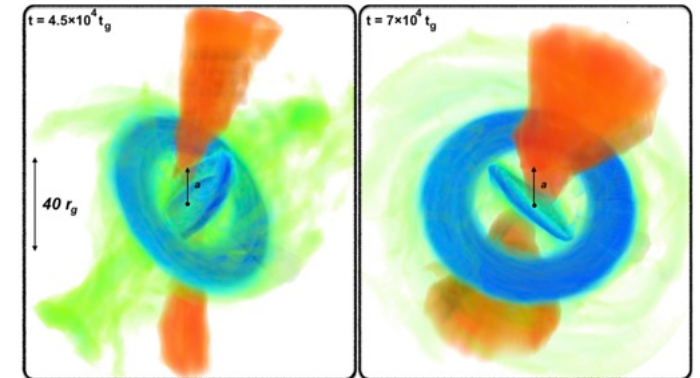
Miller-Jones et al., 2021



Parfrey et al., 2017



Fragile et al., 2007



Liska et al., 2021

New polarimetric observations

Tools which help to study the geometry of X-ray binaries

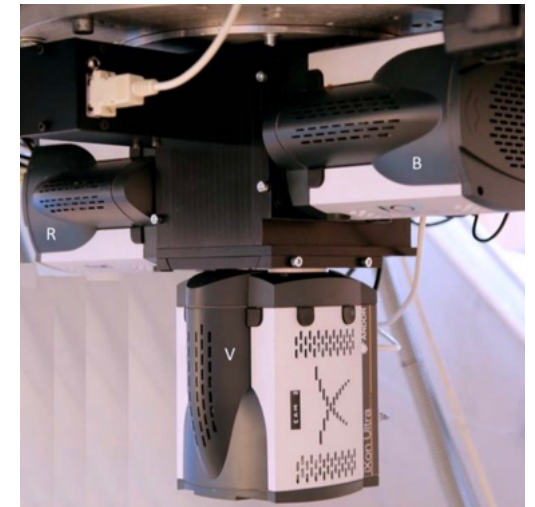


Nordic Optical Telescope (NOT)



La Palma, Canary Islands, Spain

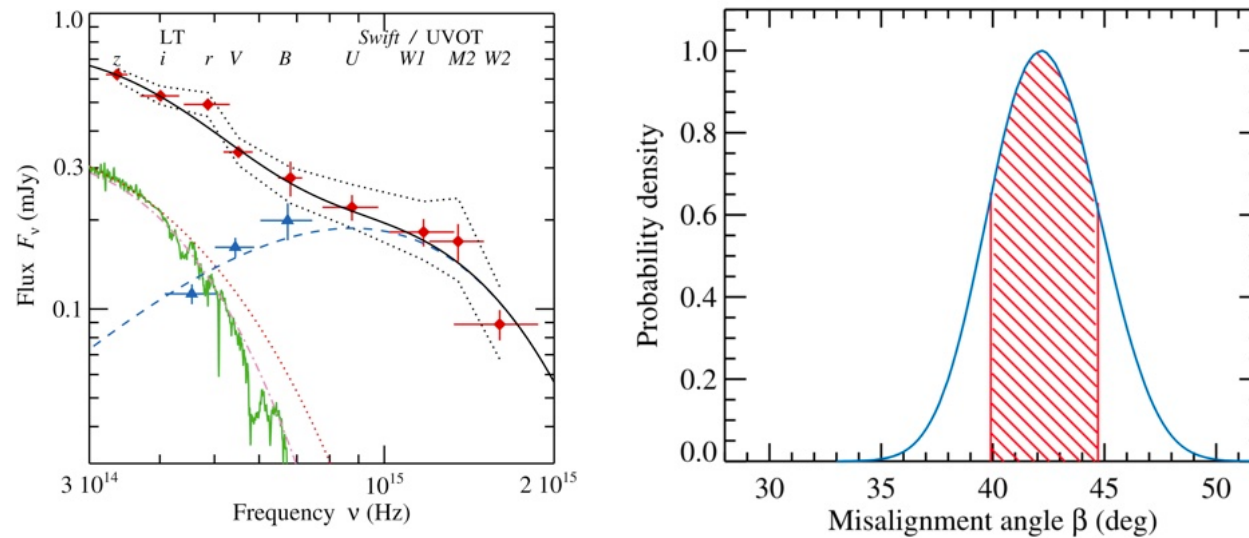
DIPol-UF polarimeter,
mounted on NOT



Simultaneous Three-color (*BVR*)
polarimeter

Evidences for misaligned geometries: MAXI J1820+070

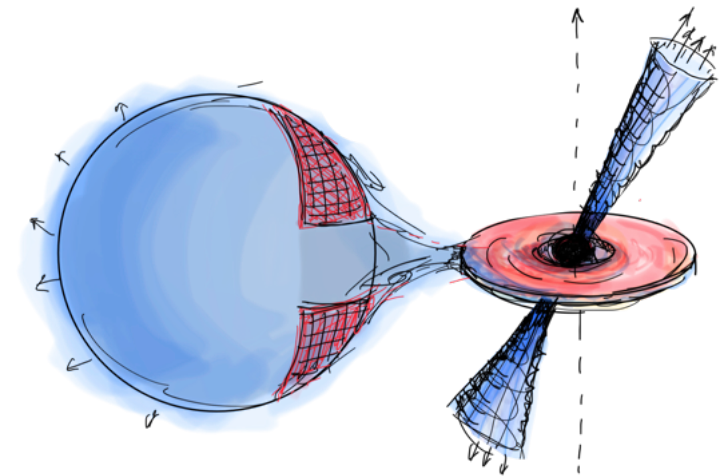
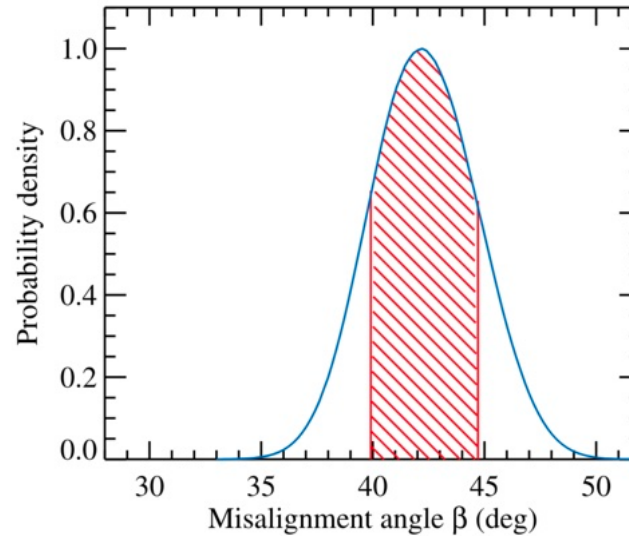
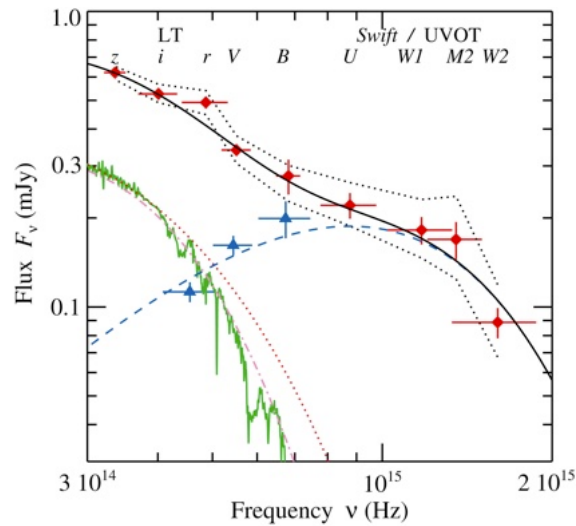
Additional polarized UV component implies jet-disk misalignment



Poutanen et al., 2022, Science

Evidences for misaligned geometries: MAXI J1820+070

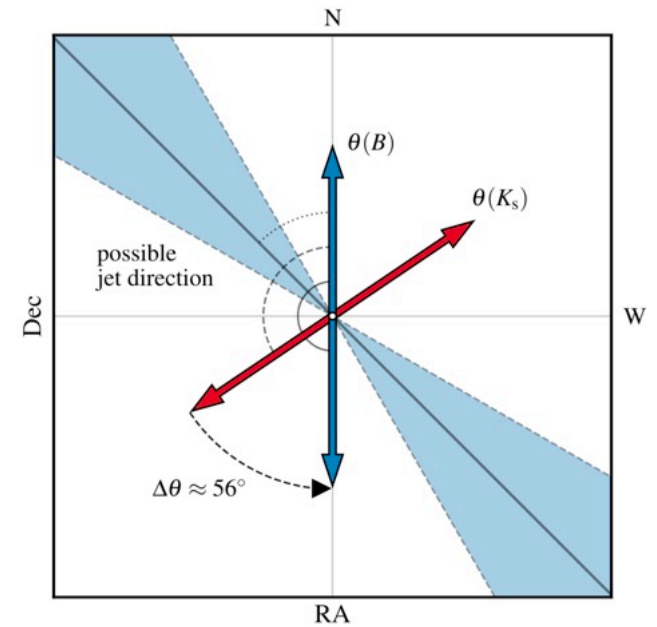
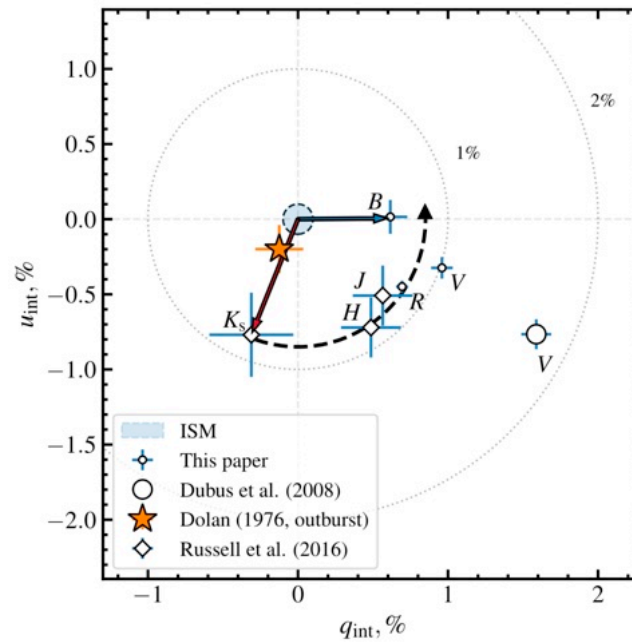
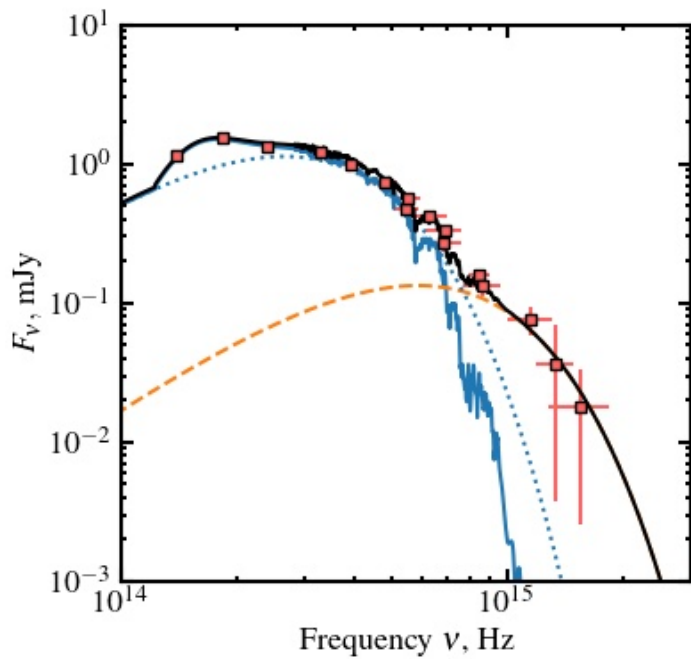
Additional polarized UV component implies jet-disk misalignment



Poutanen et al., 2022, Science

Evidences for misaligned geometries: A0620-00

Polarization angle rotation

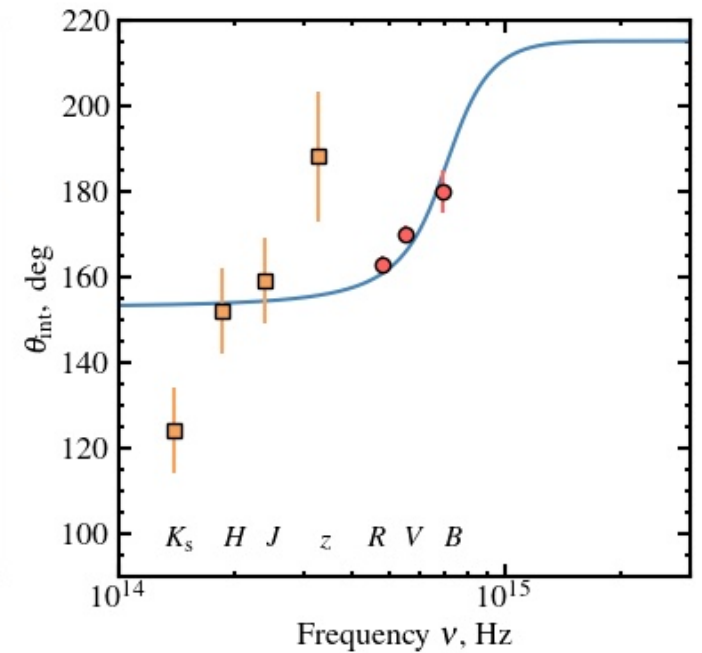
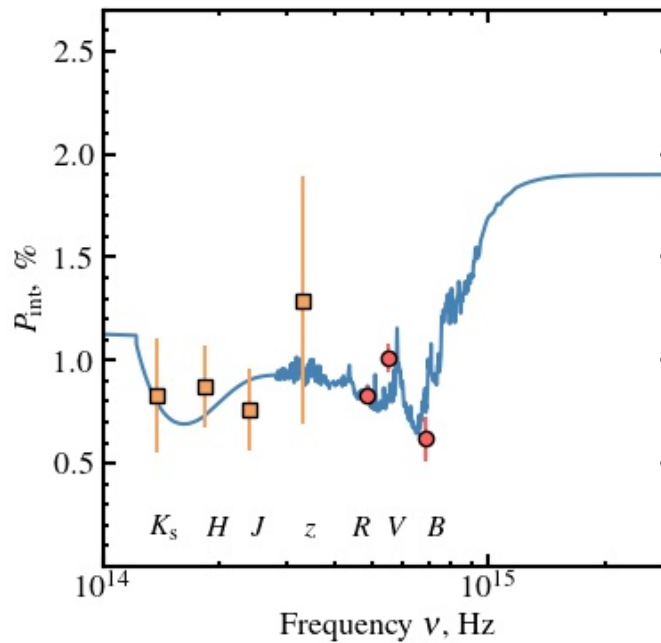
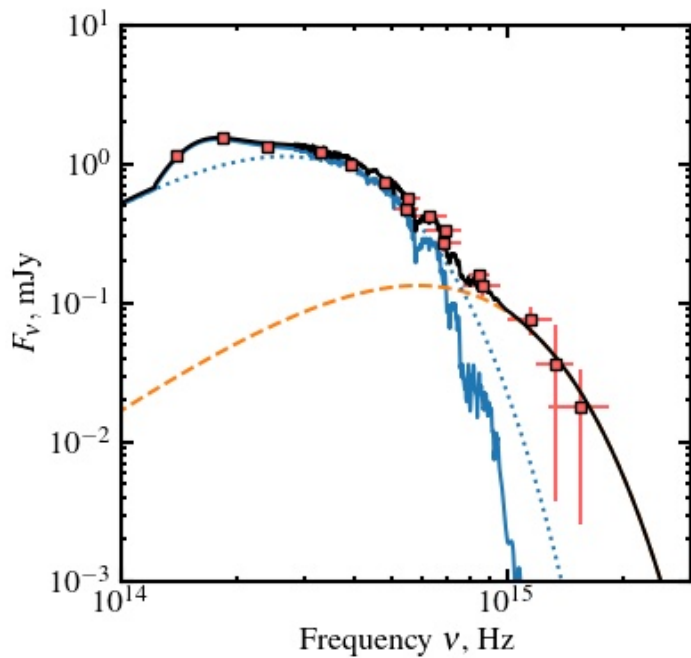


Kravtsov et al., 2024

E1.14, 14.07, 12:05

Evidences for misaligned geometries: A0620-00

Polarization angle rotation

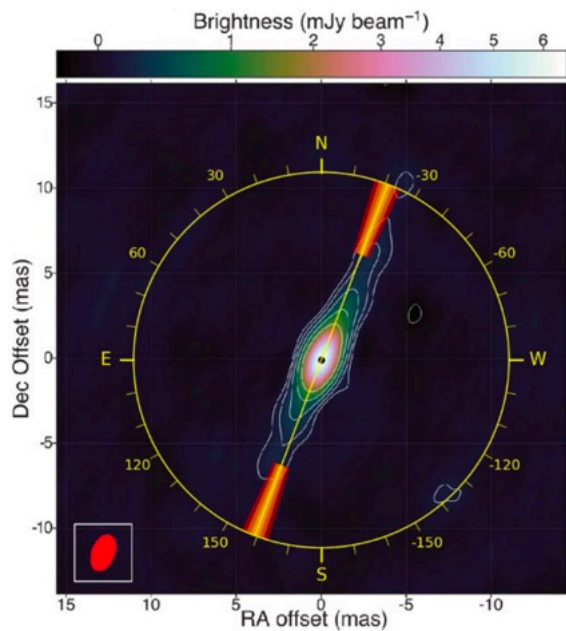


Kravtsov et al., 2024

E1.14, 14.07, 12:05

Evidences for misaligned geometries: Cyg X-1

X-ray polarization, superorbital variability, optical polarization profiles

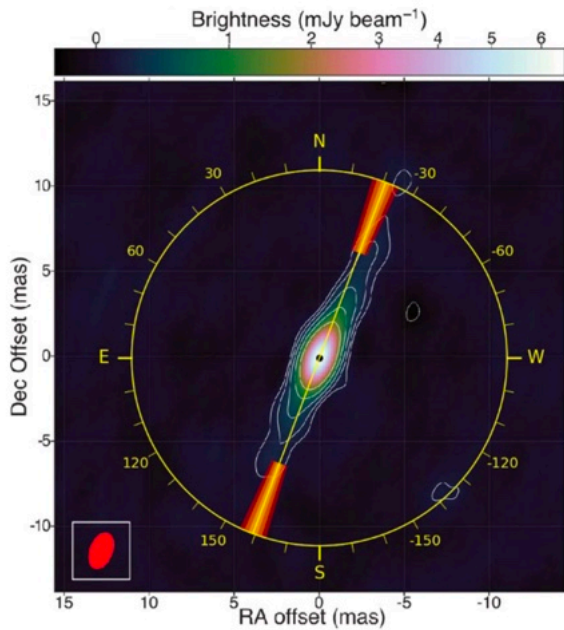


Krawczynski et al., 2024

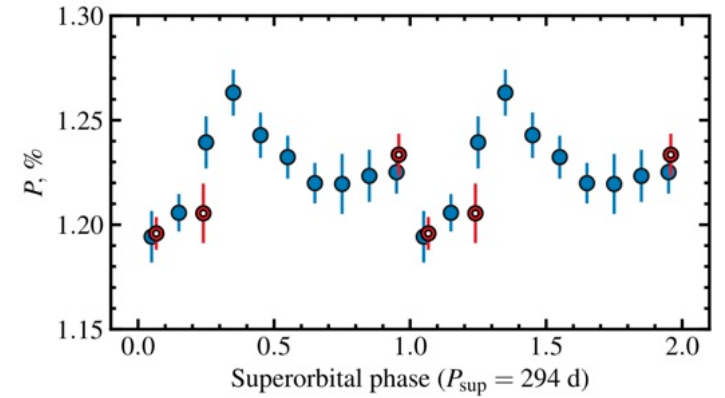
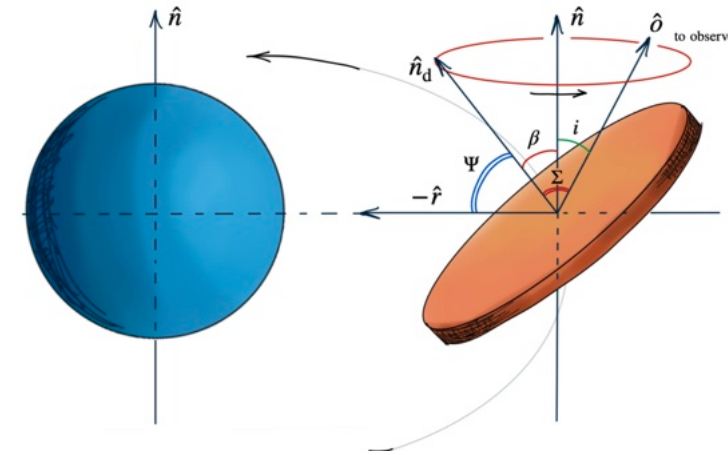
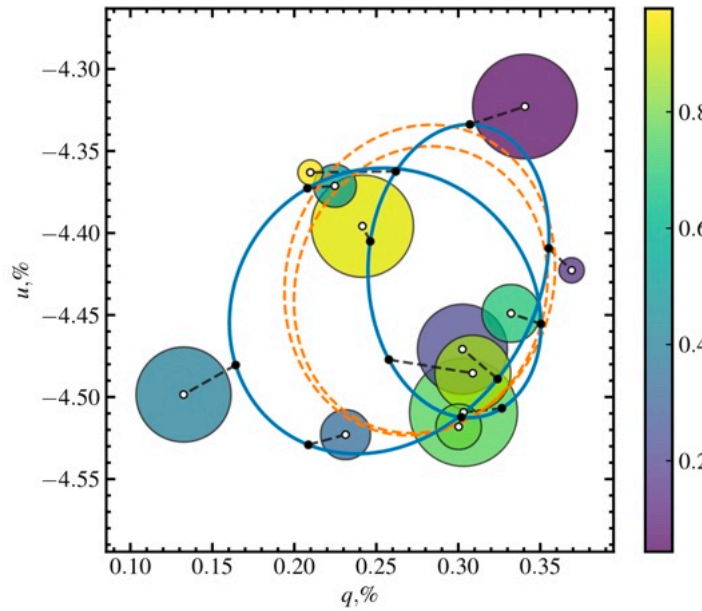
E1.13, 19.07, Ingram, Zhang

Evidences for misaligned geometries: Cyg X-1

X-ray polarization, superorbital variability, optical polarization profiles



Krawczynski et al., 2024

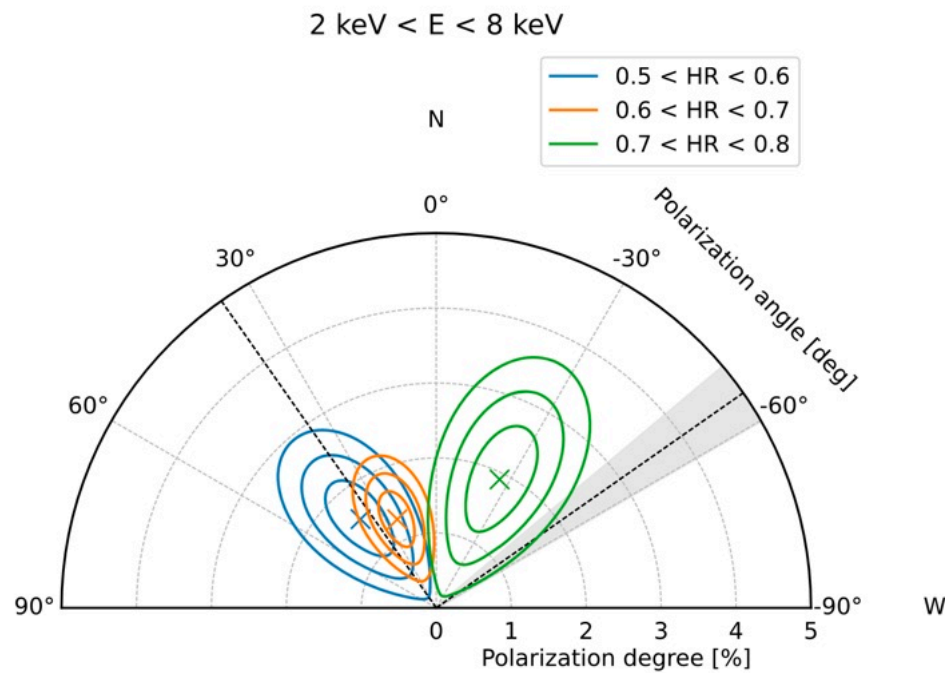


Kravtsov et al., 2023

E1.13, 19.07, Ingram, Zhang

Evidences for misaligned geometries: Cir X-1

X-ray polarization angle rotates between the states

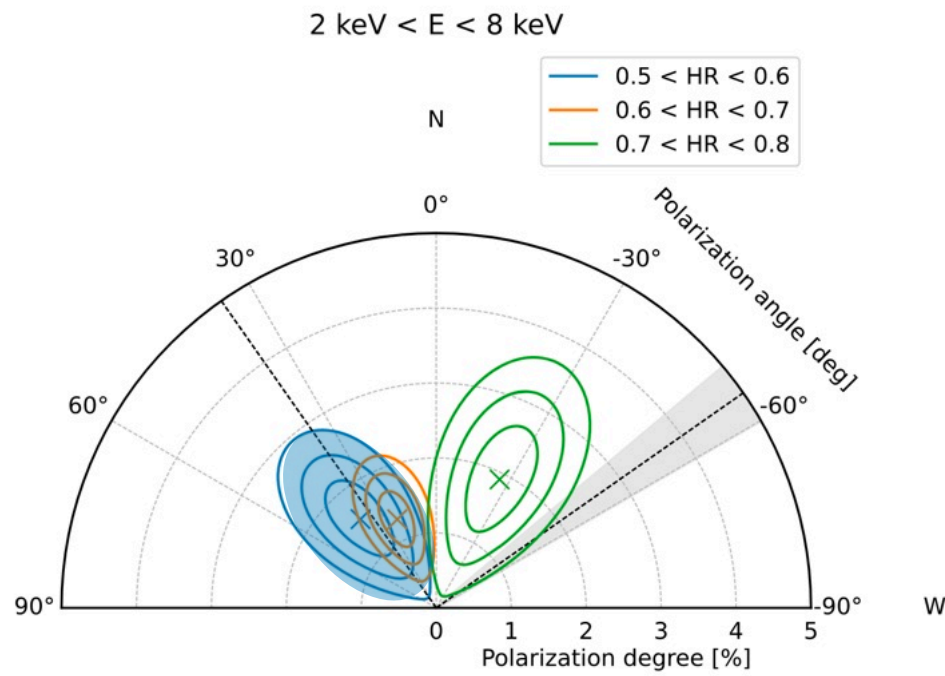


Rankin et al., 2024

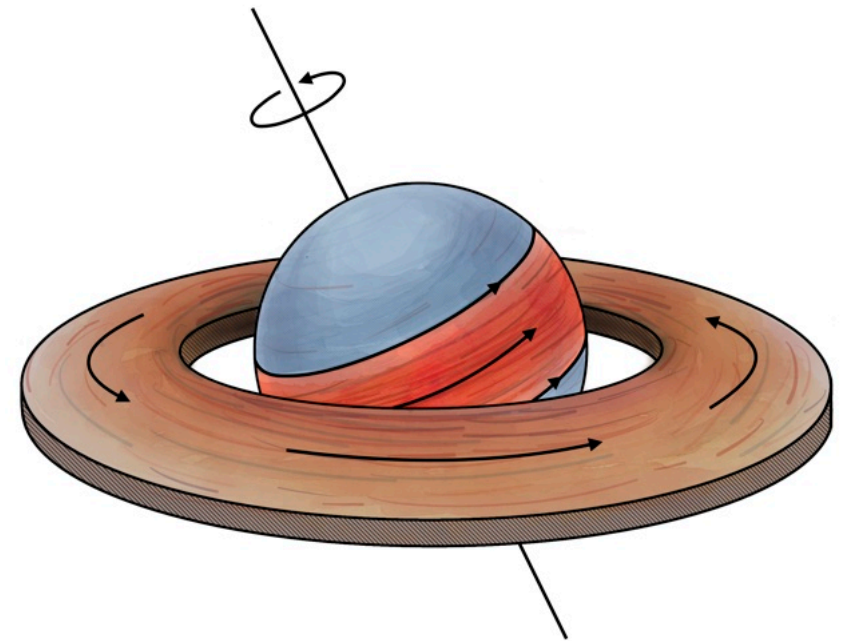
E1.13, 18.07, Di Marco

Evidences for misaligned geometries: Cir X-1

X-ray polarization angle rotates between the states



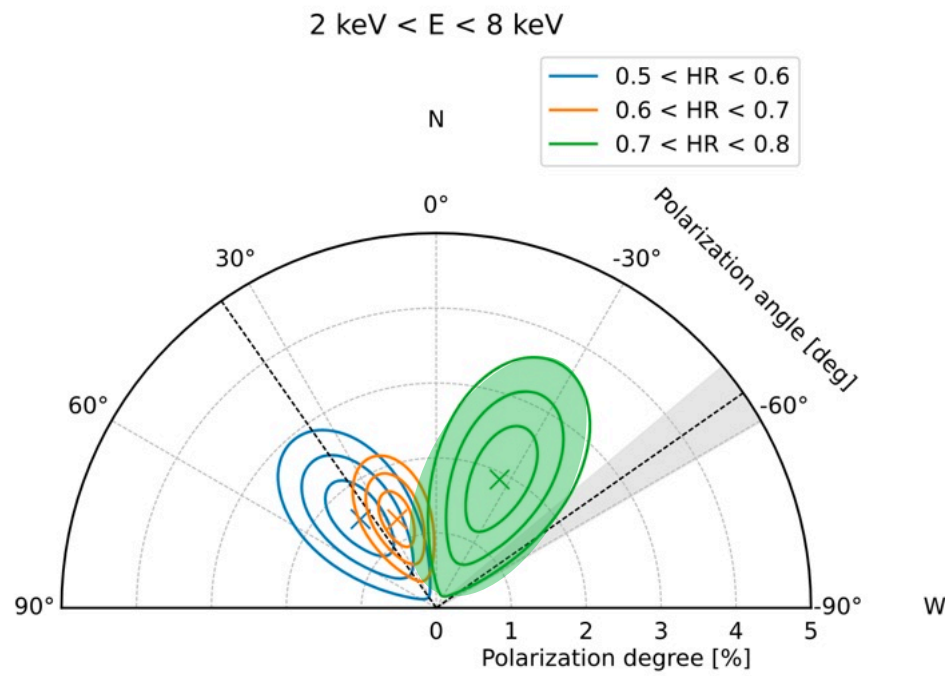
Rankin et al., 2024



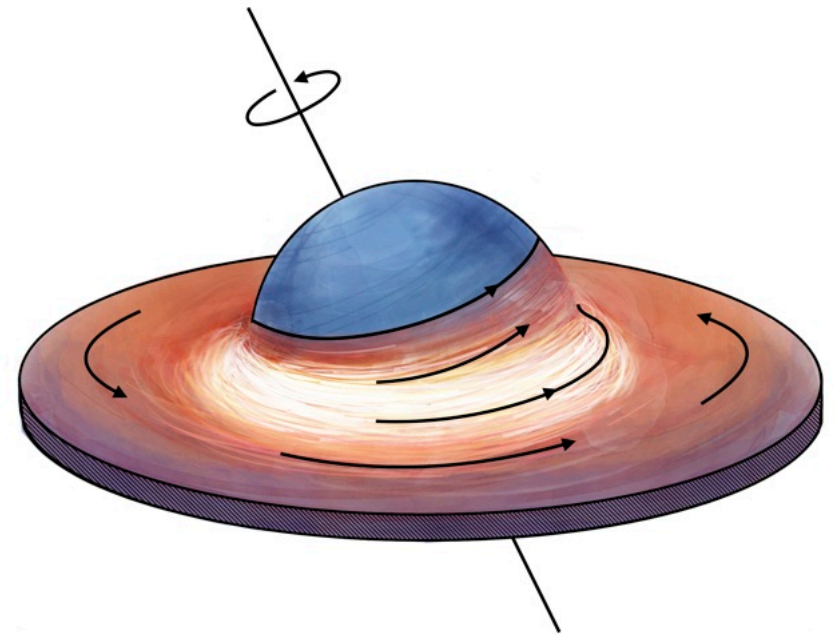
E1.13, 18.07, Di Marco

Evidences for misaligned geometries: Cir X-1

X-ray polarization angle rotates between the states



Rankin et al., 2024

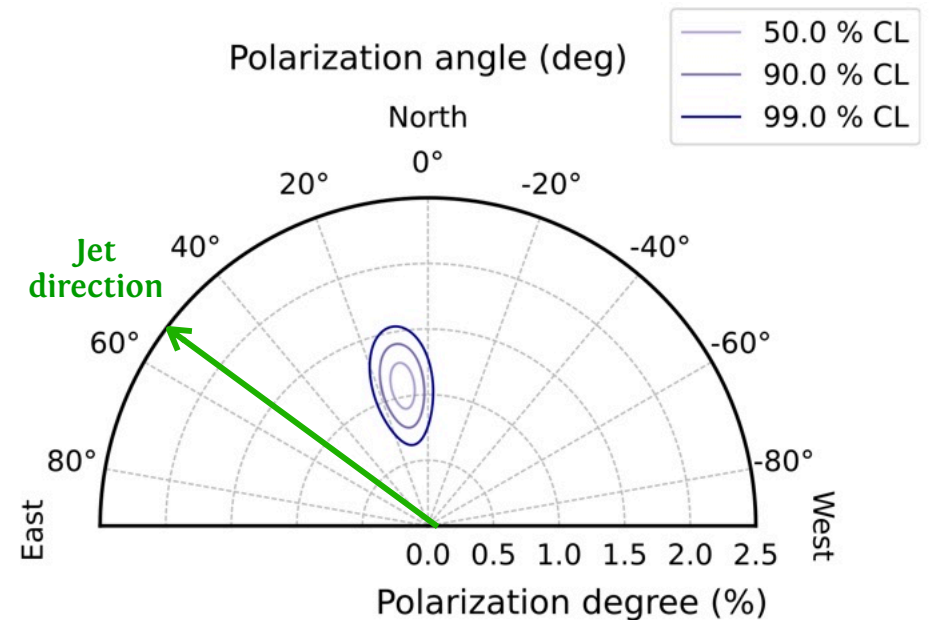


E1.13, 18.07, Di Marco

Evidences for misaligned geometries: Sco X-1

X-ray polarization angle differs from jet direction

"In the measurements reported here, both the model-independent and spectropolarimetric analyses show a PA at $8^\circ \pm 6^\circ$ **that is not aligned with the Sco X-1 radio jet**, which is at $54^\circ \pm 3^\circ$. The resulting rotation of the PA with respect to the radio-jet position angle is $46^\circ \pm 9^\circ$, different from the previous indication of alignment between the PA and radio jet." (c) La Monaca et al., 2024



La Monaca et al., 2024

E1.13, 18.07, La Monaca

Summary

- New polarimetric observations show indirect evidence of spin-orbit misalignment in BH and NS X-ray binaries
- It forces us to treat the spin as a free parameter in numerical, analytical, and statistical studies
- Shift from 2D to 3D and use of non-axisymmetric simulations is also appreciated



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