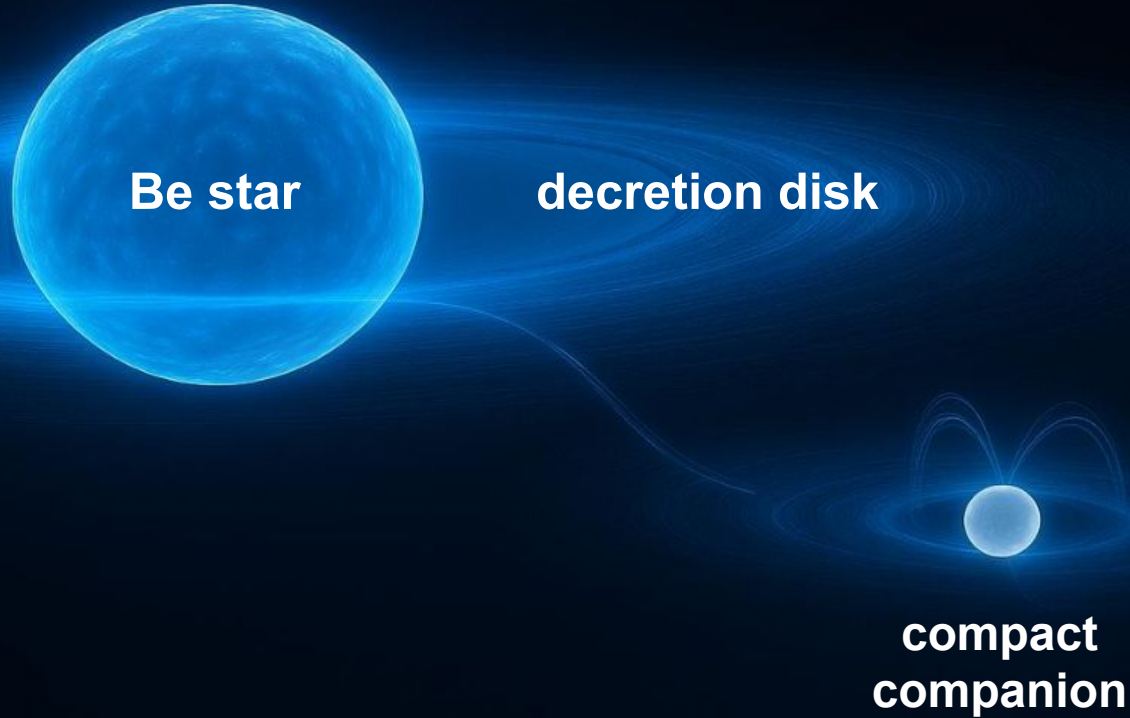


Resolving gamma Cassiopeiae with the MAGIC + CTAO LST-1 SII and high-resolution spectra

Irene Jiménez Martínez on behalf of Alejo Cifuentes Santos, Daniel Galán Diéguez,
and Michael Abdul-Masih, and on the MAGIC Collaboration and the CTAO-LST Project

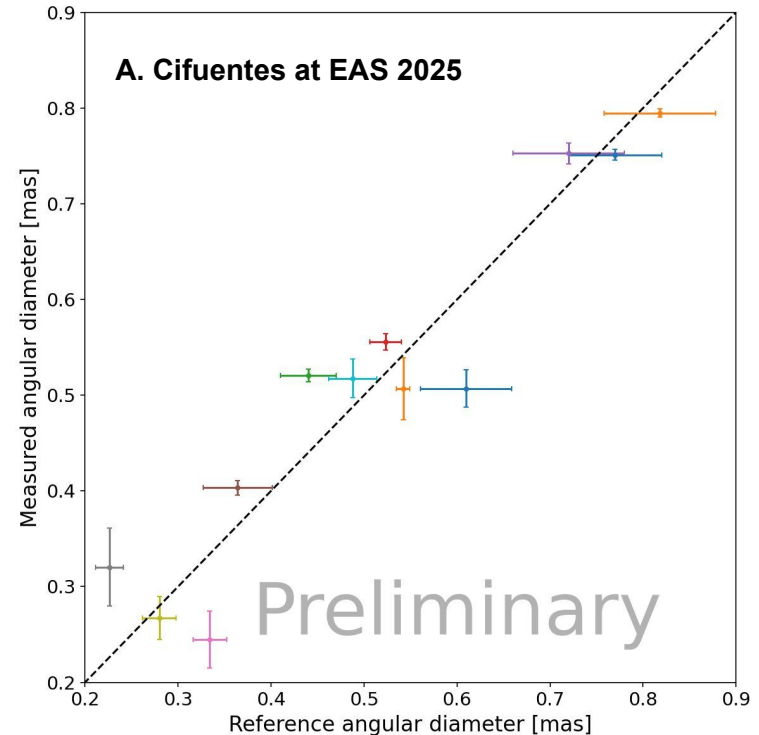
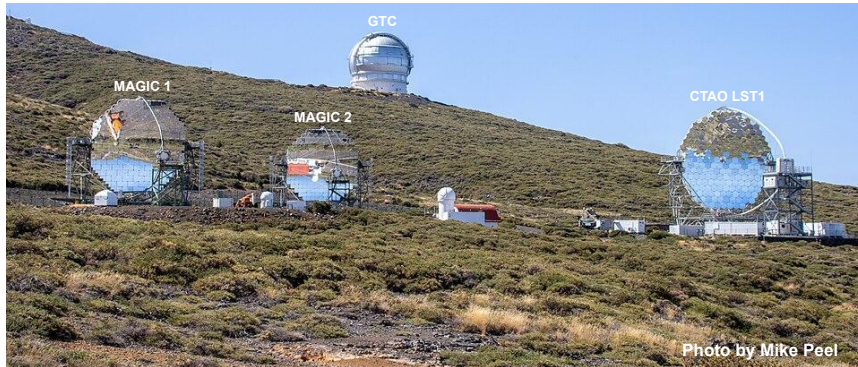
Stellar Intensity Interferometry Workshop 2026
5-9 October 2026
La Palma, Spain

gamma Cassiopeiae



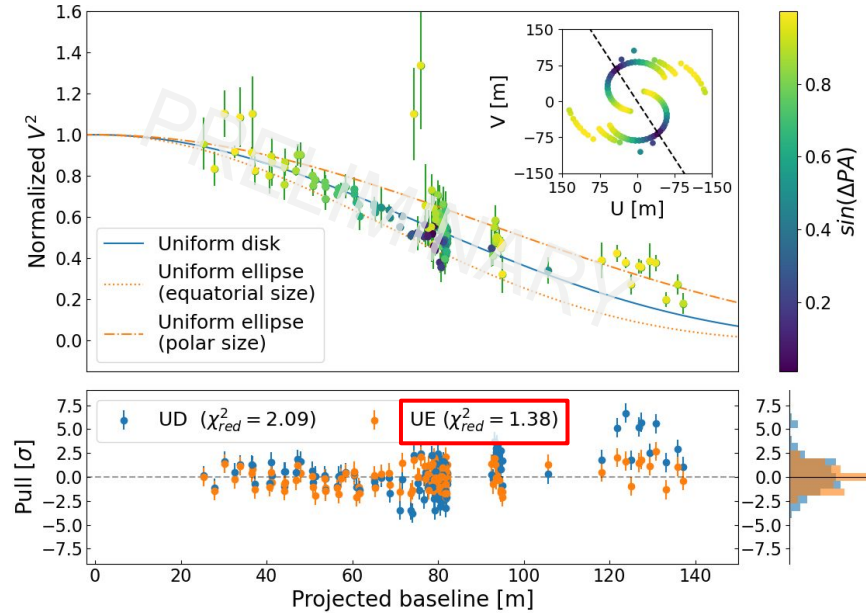
MAGIC+LST-1 Stellar Intensity Interferometer

- **MAGIC+LST-1 SII** system first light in **early 2024**
- Combined analysis of 12 non-oblate stars proved that **sensitivity matches expectations**
- We collected **108 hours of gam Cas** observations with **MAGIC SII** of which **3 hours were taken with MAGIC+LST-1 SII**

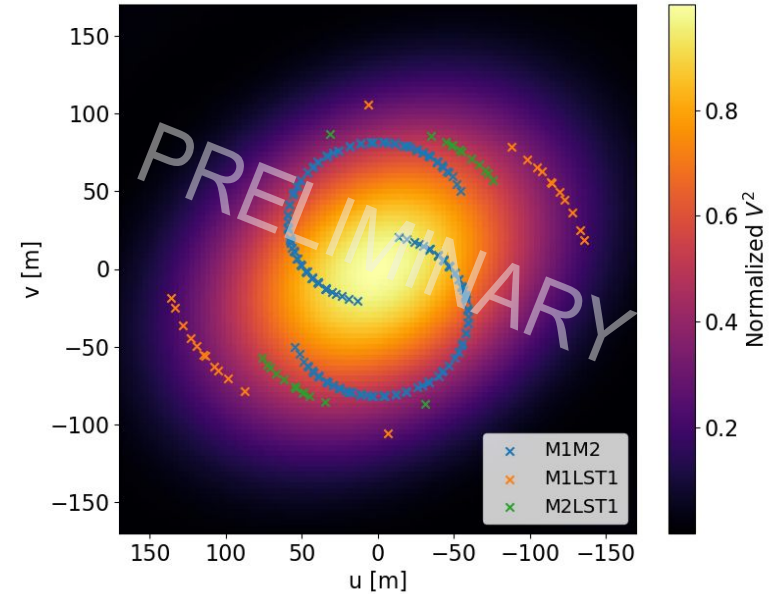


MAGIC+LST-1 SII measurements

1D: Visibility vs Baseline

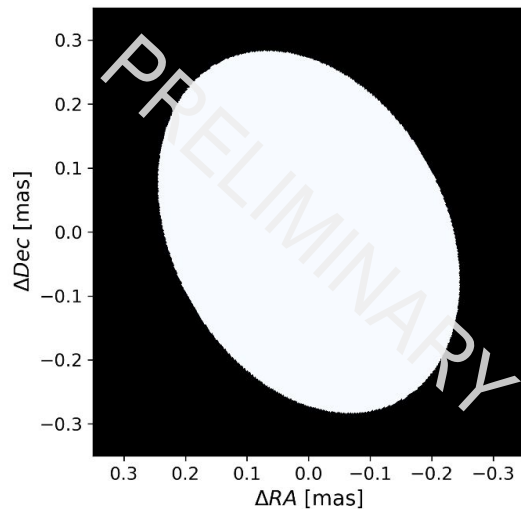


2D: UV plane

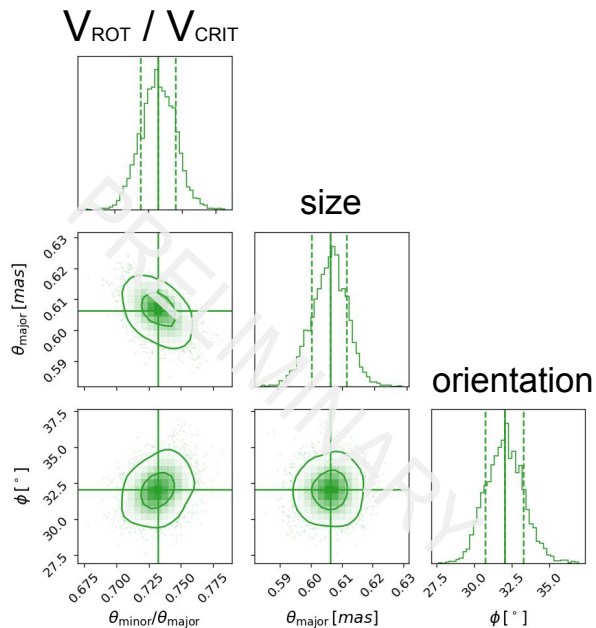


Simple model, only SII: uniform ellipse

On-sky model



Fit results:



Comparison with
VERITAS SII:

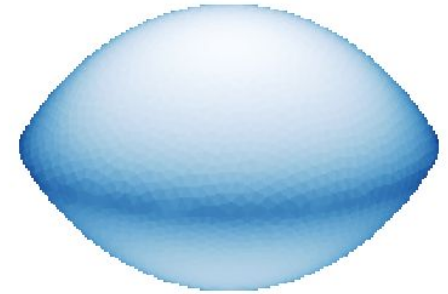
$\pm \text{stat} \pm \text{syst}$	$\Theta_{\text{major}} \text{ (mas)}$	$\Theta_{\text{major}} / \Theta_{\text{minor}}$	Equator PA (deg)
MAGIC + LST-1 SII (this work)	$0.606 \pm 0.006 \pm 0.009$	$0.73 \pm 0.01 \pm 0.02$	$32 \pm 1 \pm 1$
VERITAS SII*	$0.55 \pm 0.03 \pm 0.03$	$0.78 \pm 0.02 \pm 0.01$	$26 \pm 5 \pm 7$

*Archer et al. (2025), ApJ V995 id.191

Combining SII with spectroscopy

- Fast rotation produces **flattening of the photosphere**, and therefore gravity darkening due to temperature/gravity gradient
- Synthetic spectra are produced with **SPAMMS*** and **PHOEBE** models, for different inclinations and fractional velocities (oblateness)
- **Two scenarios were explored**: transparent and opaque decretion disk around the Be star
- The best fit is determined by both the synthetic spectrum that better matches the observed spectrum from HERMES and the geometric constraints from SII

*Abdul-Masih et al. 2020, A&A V636 A59



Transparent Disk

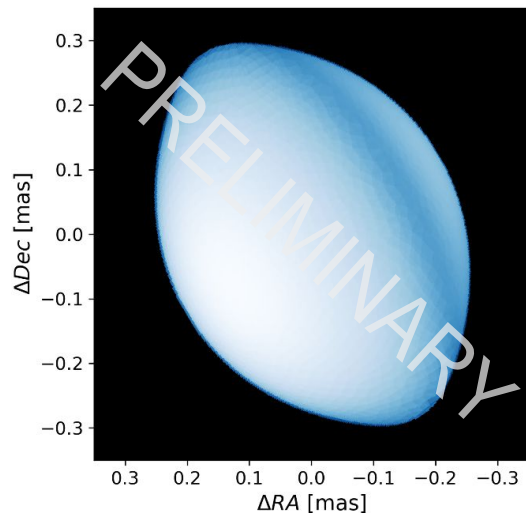


Opaque Disk

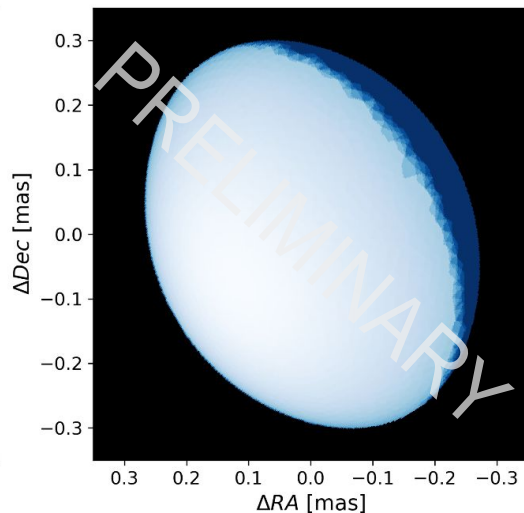
Opaque vs Transparent disk

PHOEBE models:

transparent

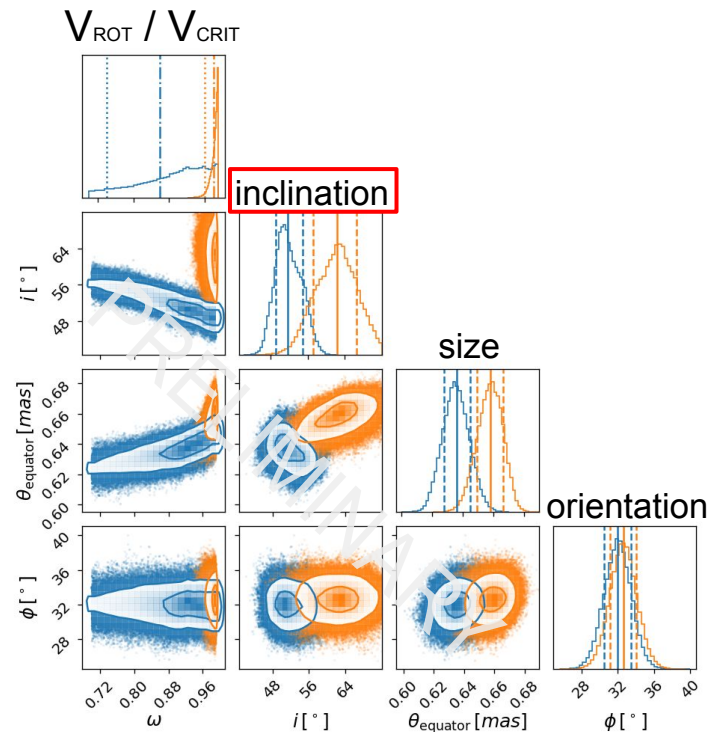


opaque



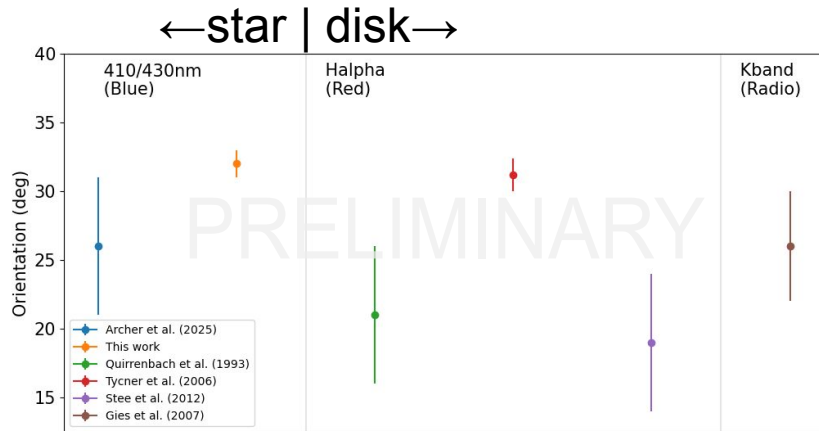
$\chi^2_{\text{red}} = 1.37$ for both

Fit results: spectroscopy + SII

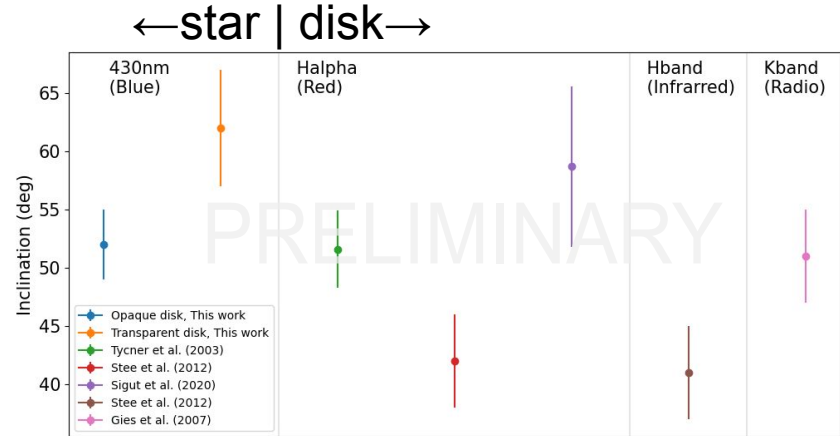


Comparison with other wavelengths: star vs disk

orientation

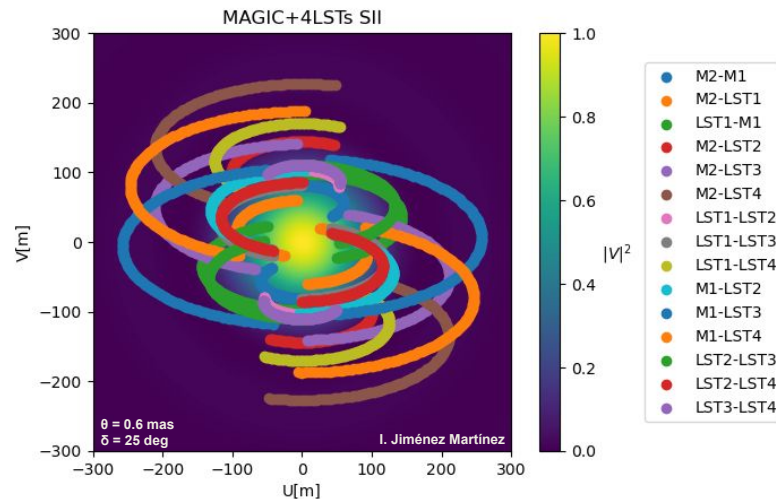
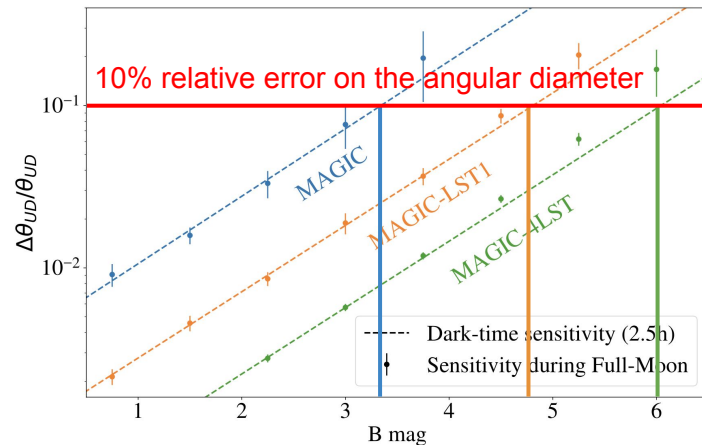


inclination



Future adding more CTAO-LSTs

- MAGIC+LST-1 and MAGIC+4-LSTs provide 3 and **15 baselines** and **orientations**, respectively
- Maximum baseline is **~250 m** instead of ~ 150 m
- Limiting brightness from ~4 mag to **6 mag**
- **Overall improvement from simulations on fast rotators:**
 - Error in mean diameter ~ 2%
 - Error in orientation ~ 5 deg
 - Error in oblateness ~ 5 %

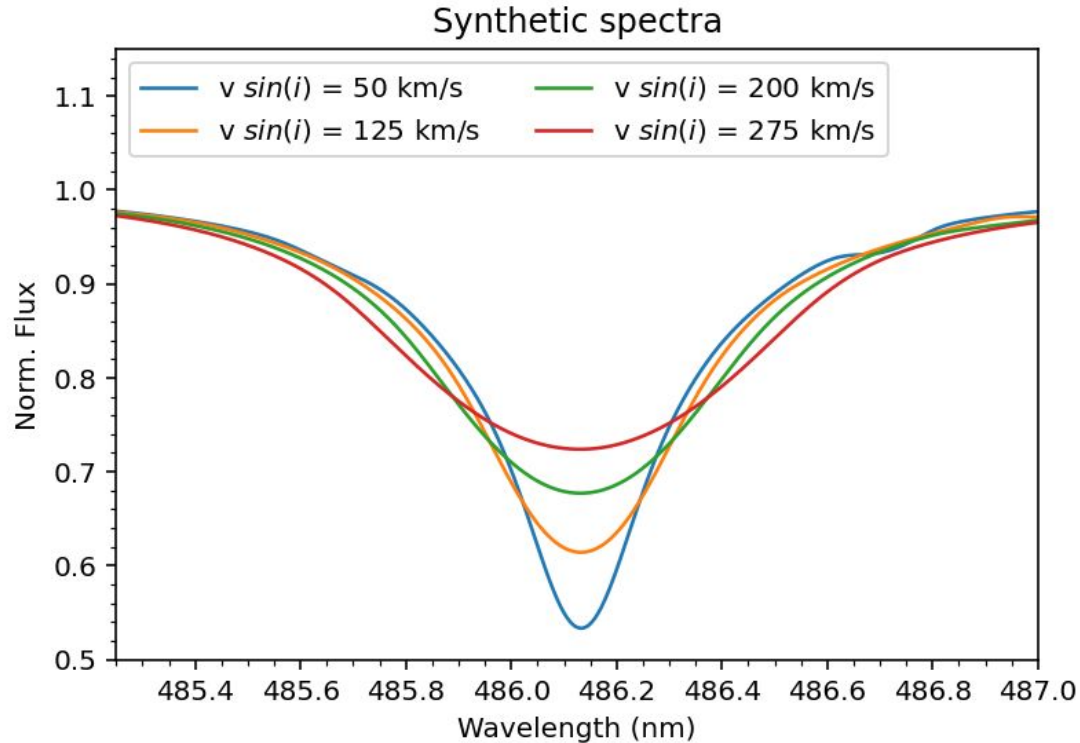


Conclusions

- Our SII observations of gam Cas in combination with high-resolution HERMES spectroscopy have allowed to put the **tightest constraints on the star's geometry and inclination**
- Results are in **agreement with VERITAS SII** results, proving SII is capable of exploiting this science case
- In **combination with the SPAMMS and PHOEBE codes** we explored two scenarios: opaque and transparentcretion disk
- This is the **first work that makes use of the MAGIC+LST-1 SII system**, it is currently under collaboration review in MAGIC, LST and CTAO
- A system of **MAGIC+4-LSTs SII** would allow to extend the target pool for tens of stars to hundreds of them, and with improved precision

Backup

Projected equatorial velocity



Precision comparison

- Example with fast rotator simulations with MAGIC+4LSTs:

- Error in mean diameter $\sim 2\%$
- Error in orientation $\sim 5^\circ$
- Error in oblateness $\sim 5\%$

