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Intensity Interferometry with Fresnel lens telescopes

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Future Prospects of Intensity Interferometry,
30 October 2024

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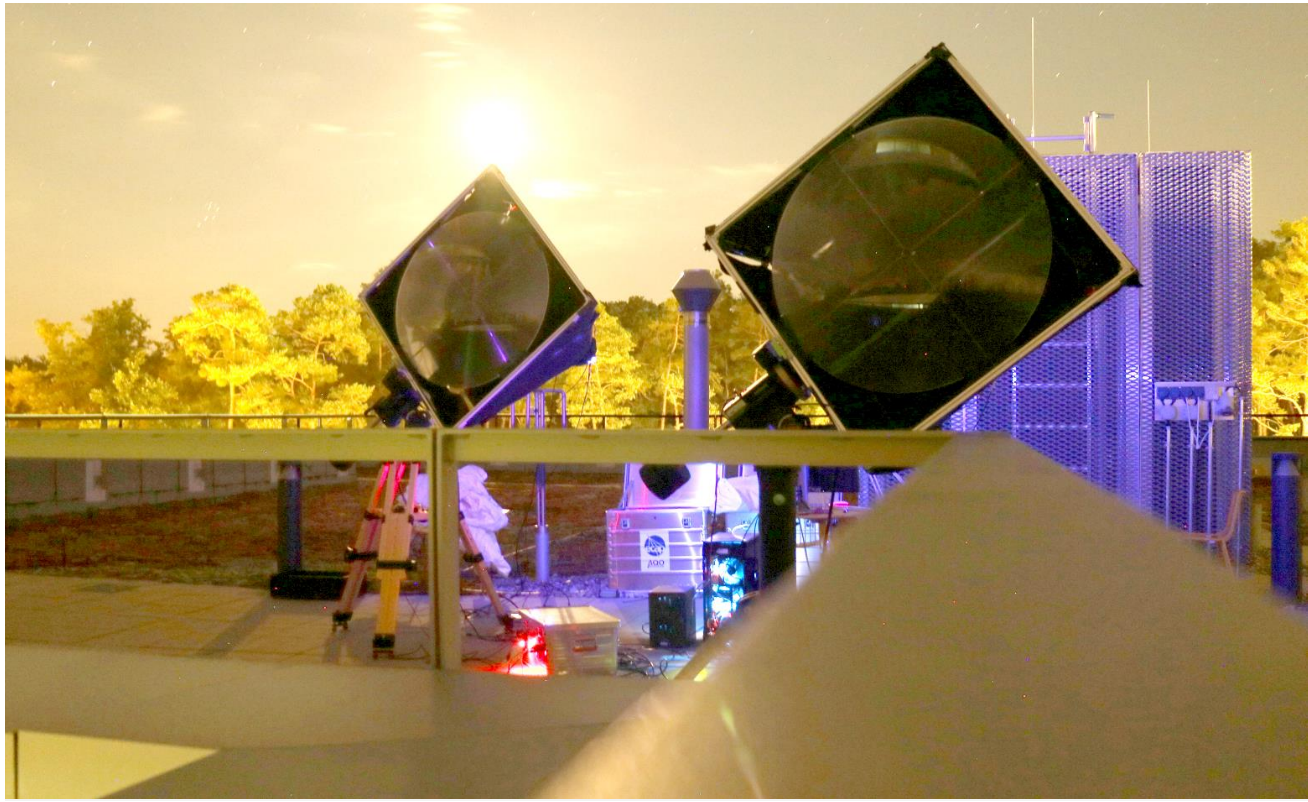
Design and construction of MI^2SO

Design and construction of MI²SO

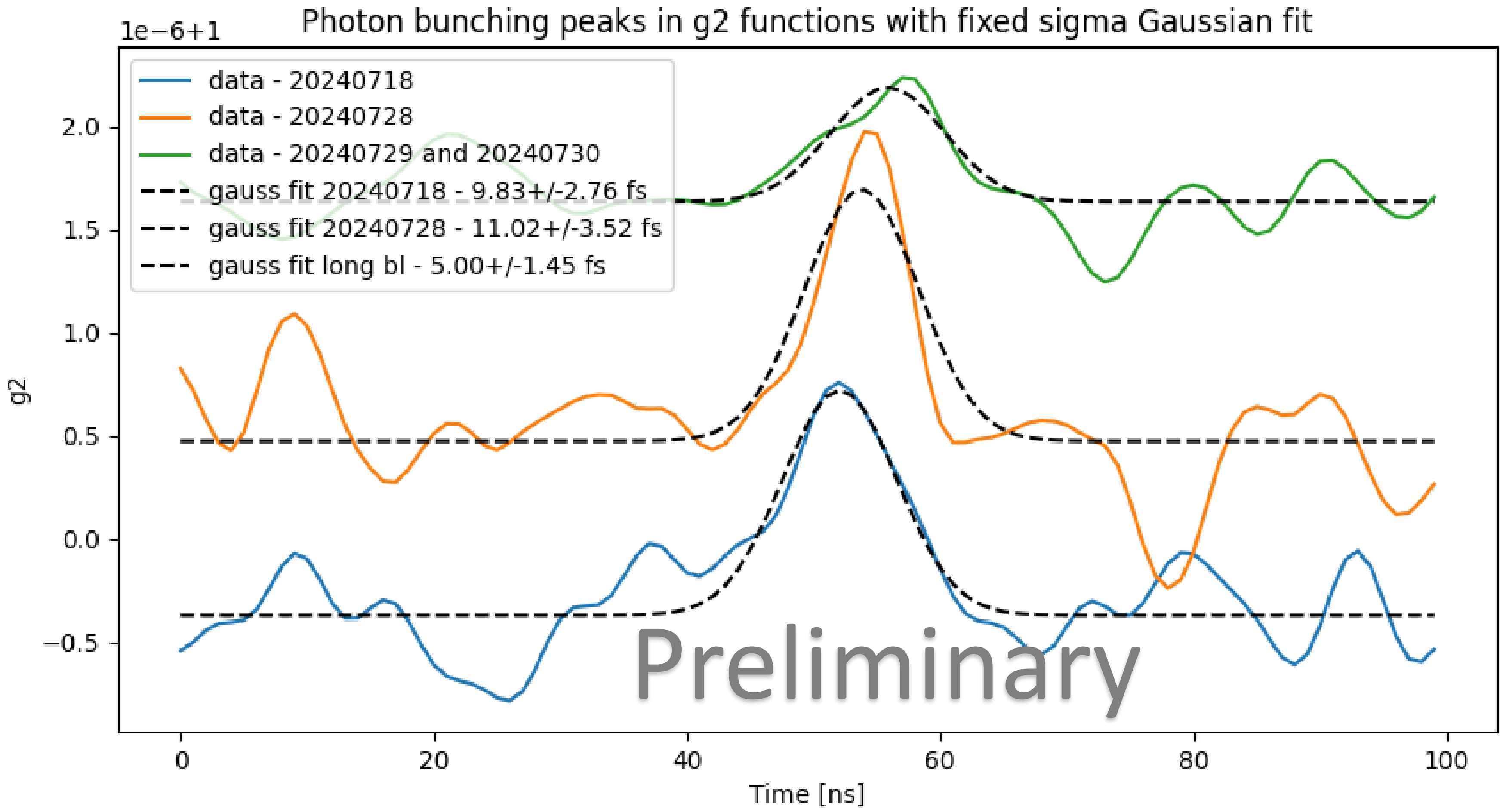
Mobile Intensity Interferometer for Stellar Observations

- 2x1m diameter Fresnel lenses
- Aluminium frame with 3D-printed lens holders
- Carbon fiber stabilizing frame
- 3D-printed PMT housing with adjustable focus position
- Darkroom cloth curtain "tube"
- Heating cables and air circulation fans



Intensity Interferometry with Fresnel lens telescopes

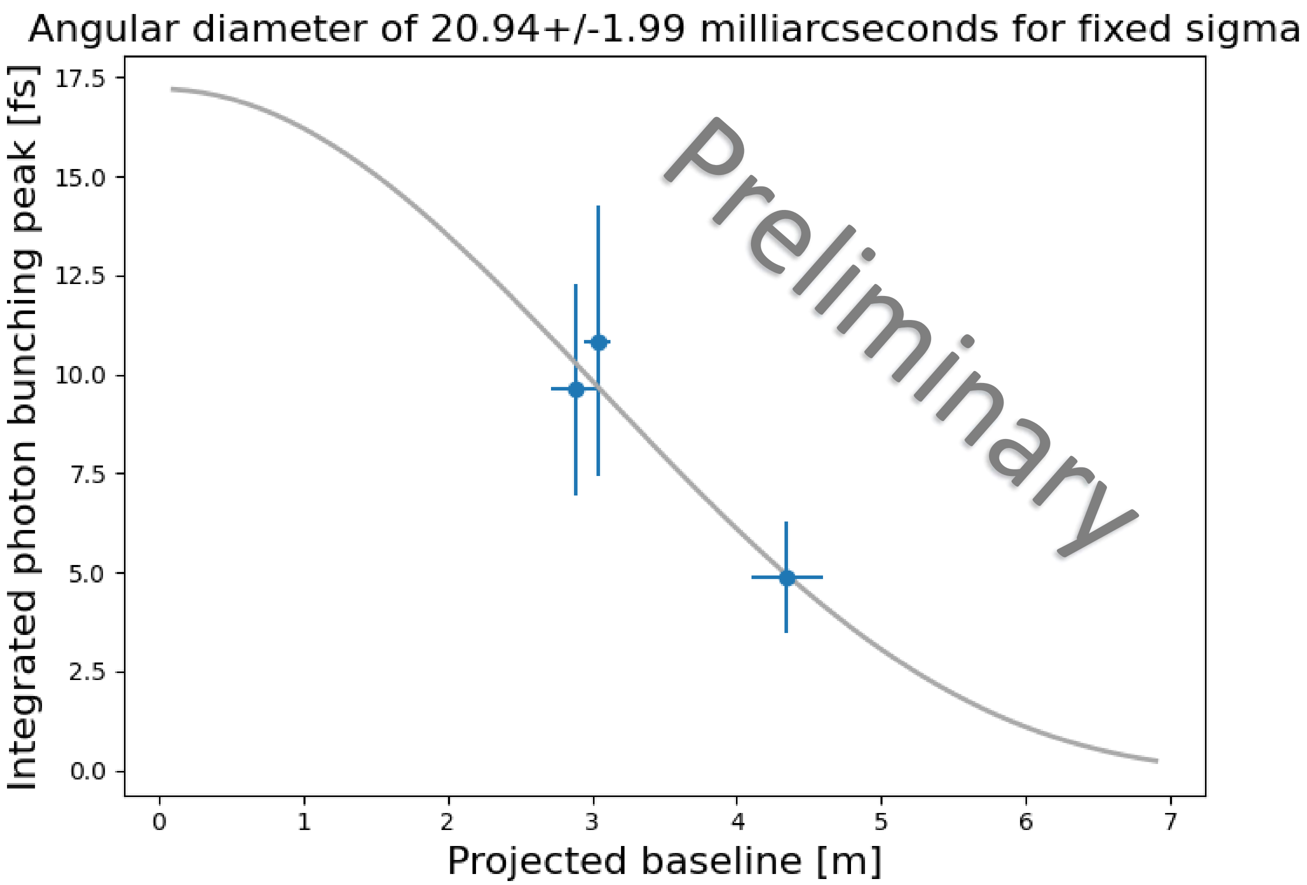
Arcturus measurements - Performance and complications



Intensity Interferometry with Fresnel lens telescopes

Arcturus measurements – Performance and complications

- 8h 40min of data (dutycycle and weather problems)
- 70-80% of predicted rate using datasheet transmission and detection efficiency
- Literature value 21.0 mas
- Magnitude 0 star
- Significant radio frequency noise (179 MHz and 181 MHz had to be filtered out, as well as 200 MHz lowpass)



Intensity Interferometry with Fresnel lens telescopes

Why Fresnel lens telescopes? Comparison with large mirror dish telescopes

Low cost → easy scaling in quantity - every extra telescope adds n-1 new telescope combinations

Low weight → mobility of telescopes, can adjust Fresnel lens telescope array on short timescales to allow new baselines and orientations

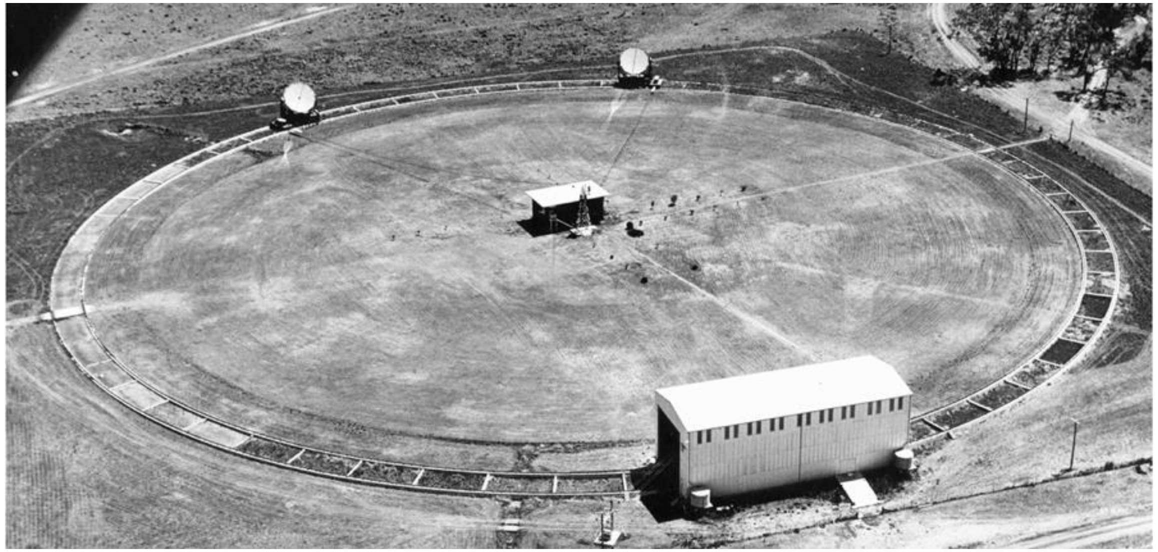


Image Credit: Barnaby Norris, University of Sidney

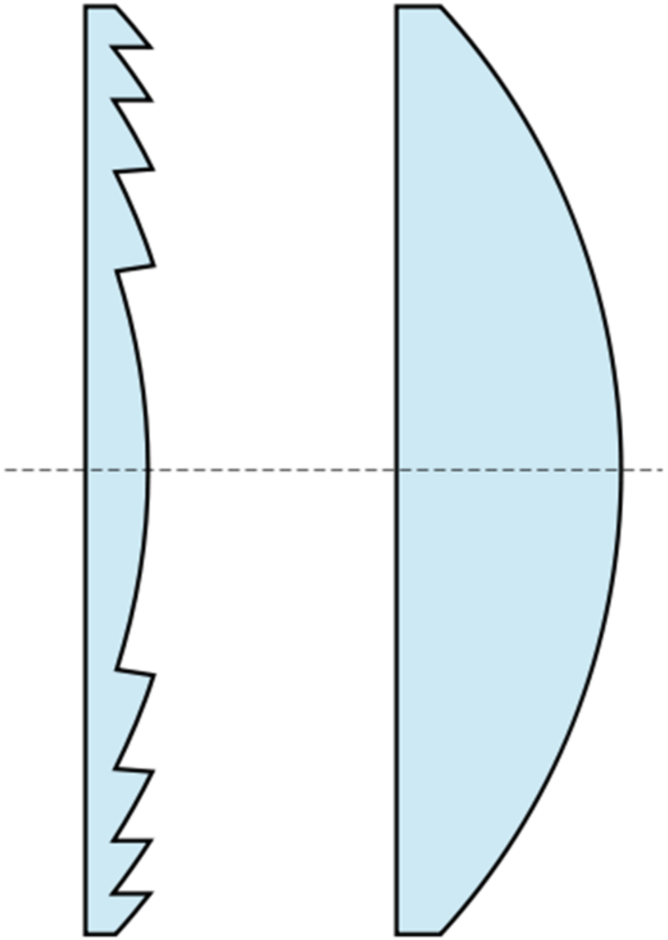
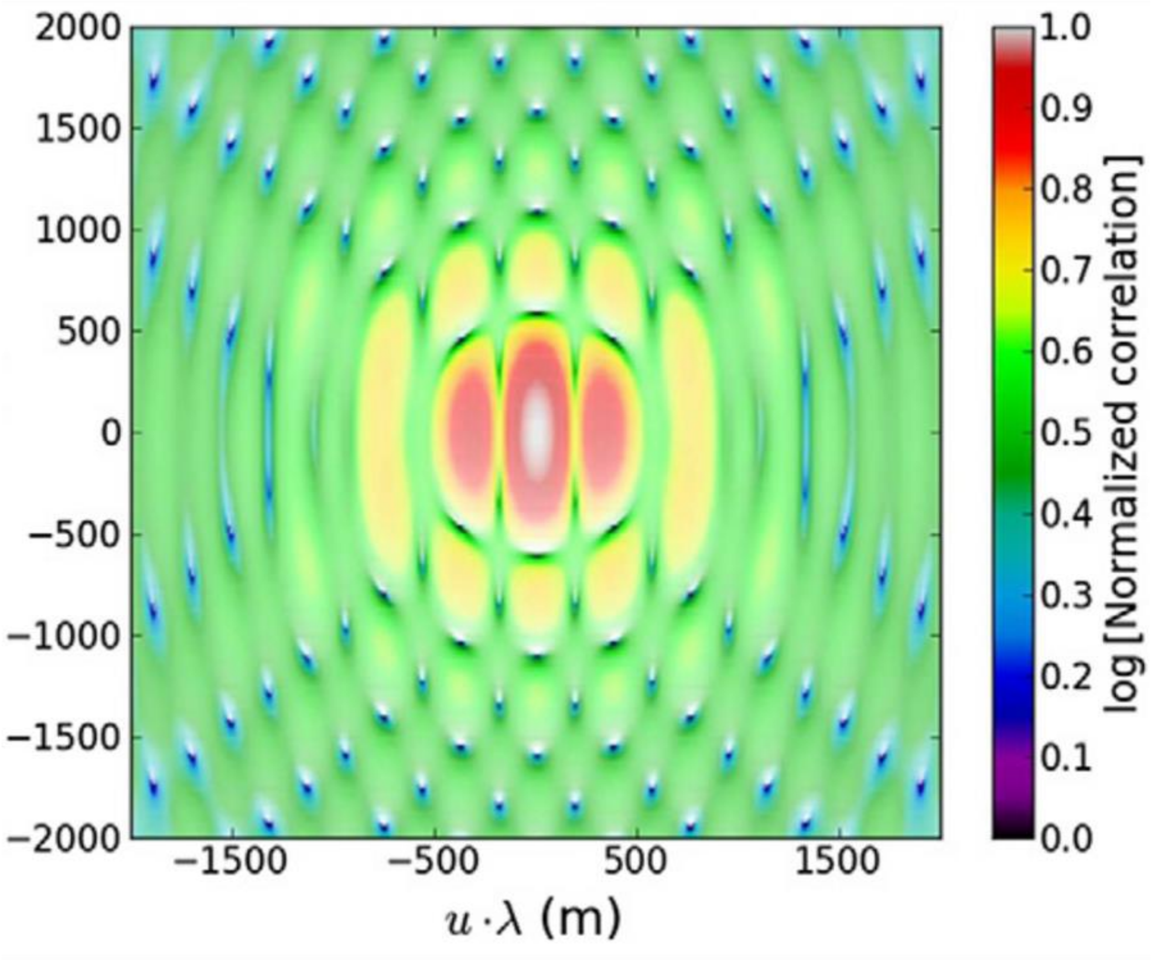


Image credit: Pko, Wikipedia

Intensity Interferometry with Fresnel lens telescopes

Why Fresnel lens telescopes? Comparison with large mirror dish telescopes

Binary system spatial coherence not a trivial Bessel function



Graph from: D.Dravins et al. Optical intensity interferometry with the Cherenkov Telescope Array. AP Phyics 43, 331-347 (2012). https://doi.org/10.1016/j.astropartphys.2012.04.017.

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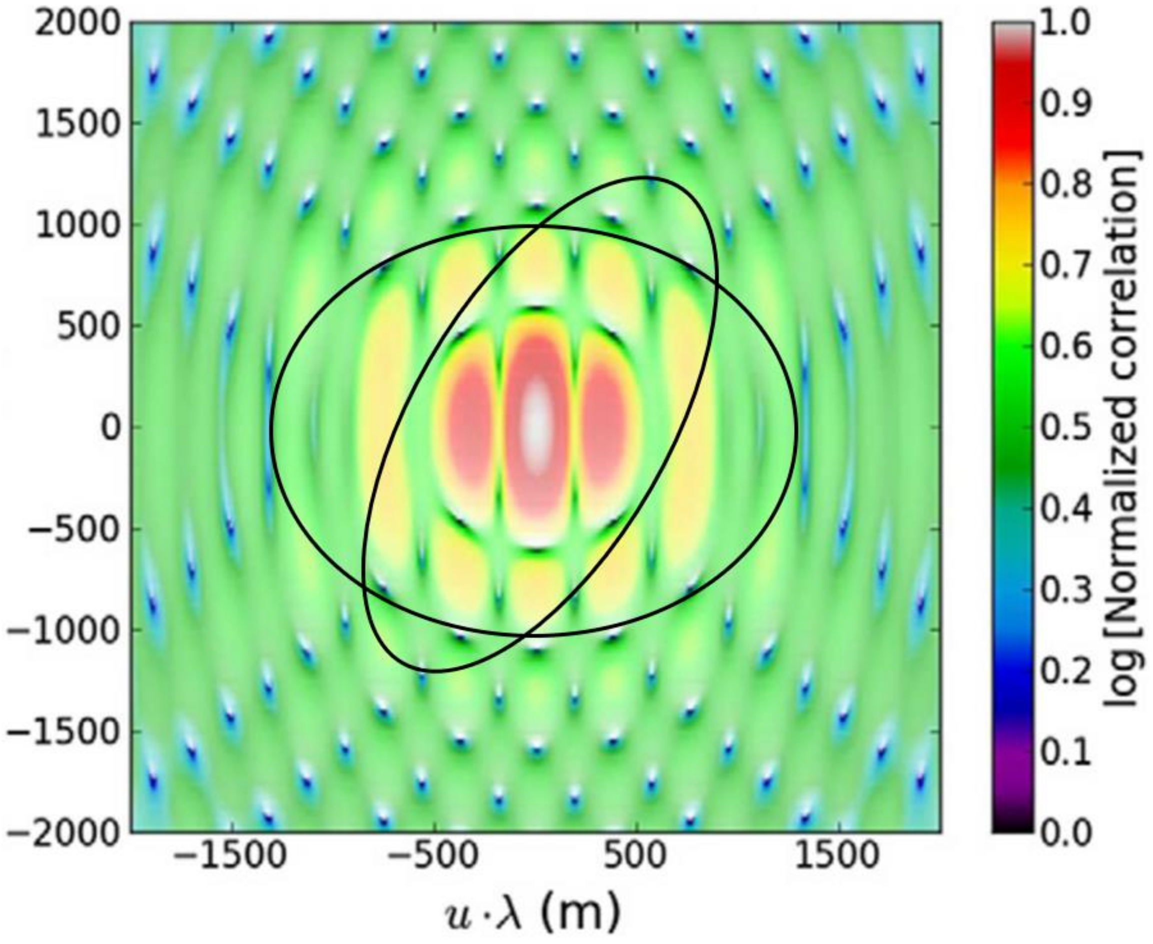
Combination of 2 telescopes produces elliptical path of datapoints in u-v plane



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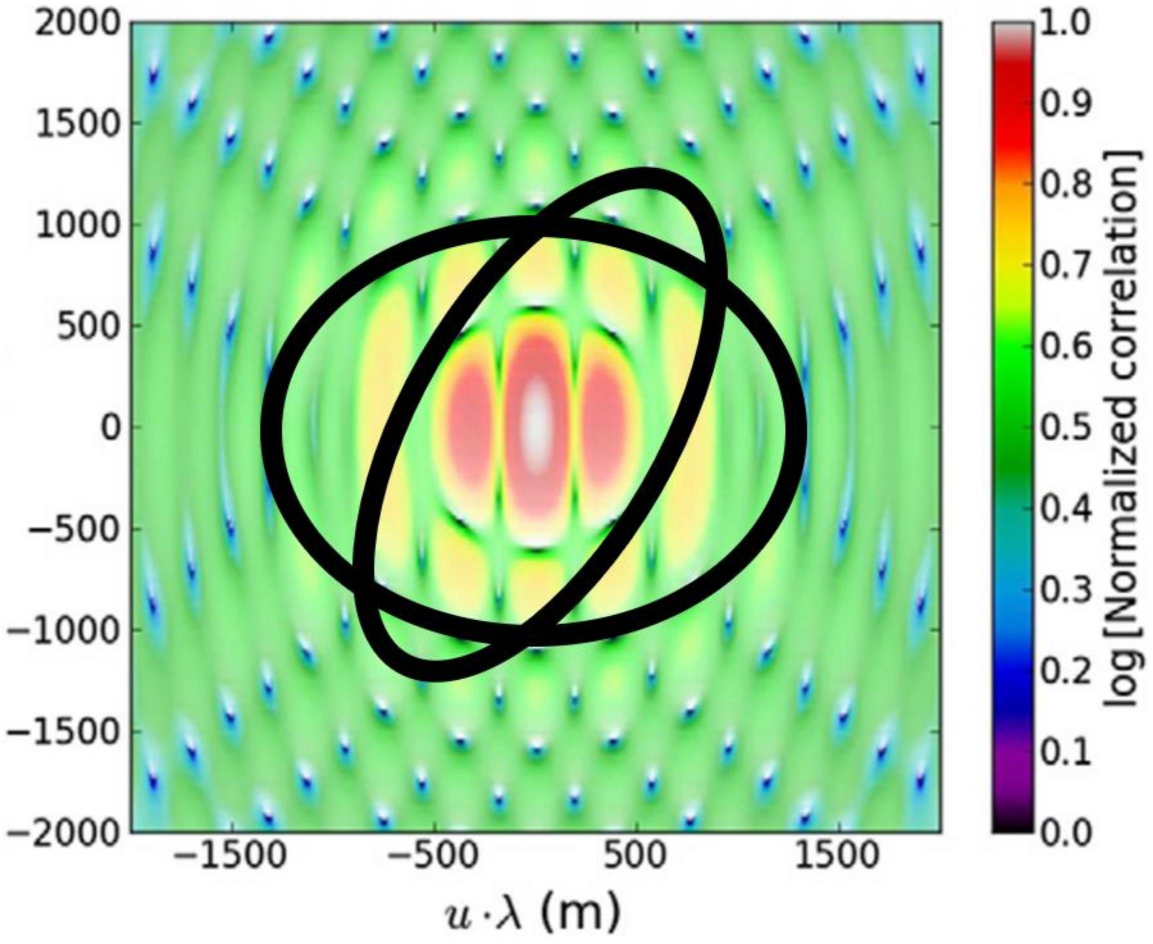
Binary system spatial coherence not a trivial Bessel function

Small baseline difference spatial coherence variations

Combination of 2 telescopes produces elliptical path of datapoints in u-v plane

Size of telescope "smears" datapoints



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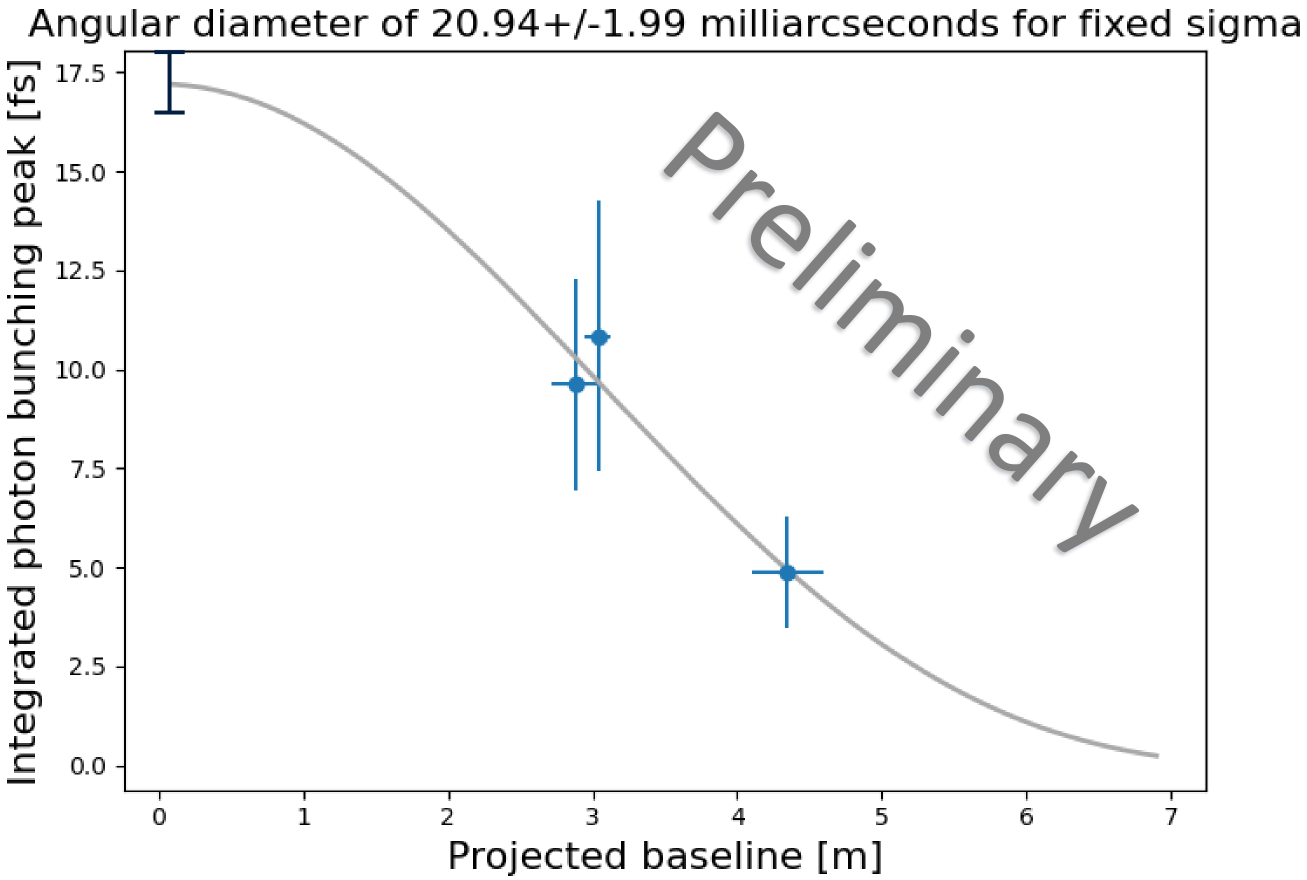
Combined Future

Zero baseline not star-specific

Use large collection area telescopes to determine zero baseline and/or “envelope” spatial coherence function of target system

Use small collection area telescopes (for example Fresnel lenses) to probe binary characteristics



Thank you for your attention!

Mock plot of 8m diameter telescope data for unknown singular/binary