



SEEDS



# Aperture Masking Interferometry for Subaru's Extreme AO

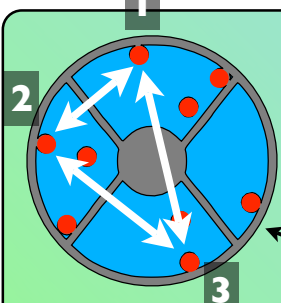
Frantz Martinache, Olivier Guyon & Vincent Garrel

## Abstract:

Aperture Masking **Interferometry** used in combination with **Adaptive Optics**, is a powerful technique that permits the detection of faint companions at **small angular separations**.

The **precision calibration** of the data achieved with this observing mode indeed leads to **reliable results up to and beyond the formal diffraction** limit, explaining why it has, in just a few years, been ported on most major telescopes.

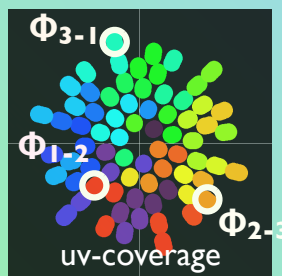
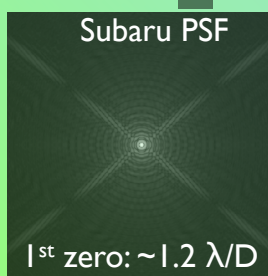
In this poster, we present its possible **implementation on Subaru**. We also discuss how the opportunity offered by the planned **Extreme-AO upgrade** to HiCIAO will push further the performance of this **already successful** technique, offering Subaru a unique access to a **very exciting region of the "contrast-ratio - angular separation" parameter space**.



### Mask up to 80 % of the mirror and ...

- Boost the resolution by a factor  $\sim 3$
- Benefit from the self calibration properties of closure phase
- Become insensitive to non-common path errors

Example of **non redundant** 9-hole mask optimized for **Subaru + IRCS' CH4s** filter



### Closure phase:

- Measure the degree of asymetry of a target
- Cancels AO residuals and non common path errors

### The trick:

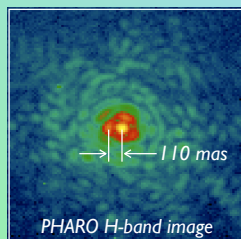
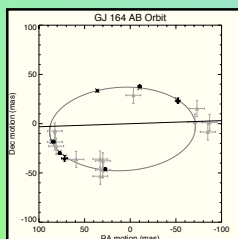
Gather phases by packets of three and add them up!

$$\begin{aligned} \Phi_{1-2} &= \Phi(1-2)_0 + (\Phi_1 - \Phi_2) \\ \Phi_{2-3} &= \Phi(2-3)_0 + (\Phi_2 - \Phi_3) \\ \Phi_{3-1} &= \Phi(3-1)_0 + (\Phi_3 - \Phi_1) \end{aligned}$$

Use them to reconstruct an image or fit a model

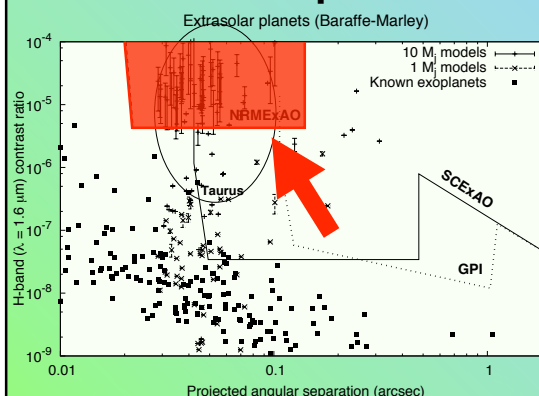
## An example of super-resolution:

50 mas orbit of GJ 164 AB resolved (in H and K) with the 5-m Hale Telescope



Martinache et al, 2009, ApJ, in press

## SCEXAO + mask performance:



## Conclusion:

Low cost, **minimal impact on hardware**, relaxed optical requirements yet **high scientific payoff** technique.

Calibration of the data currently seems limited by differential atmospheric refraction. We're **upgrading** our data reduction pipeline to account for this effect and **push toward higher contrasts**.

Martinache et al, 2009, in prep.