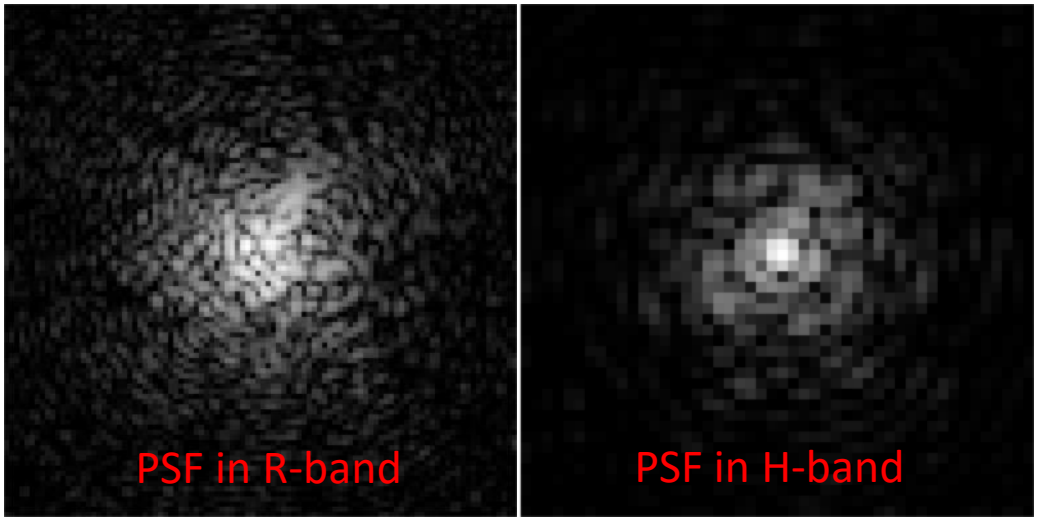

Differential spectral piston induced by a single-mode fiber

Injected piston in H band *w.r.t.* R band

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Injected piston in H *wrt* R band

- **The issue :**
  - Spectral decorrelation of the phase distribution.
  - The image quality is worst in R band than in H band: speckles appear !
  - The coupling with the fiber mode is affected.
  - **The *injected* piston is corrupted at lower wavelength and at lower r0.**

- **Objectives of the study :**
  - **Define the injected piston (???).**
  - Quantify this effect with **simulation** tools :
    - Code from Mike Ireland.
    - PAOLA from Laurent Jolissaint.
  - Include a **tip-tilt correction** and quantify its effect on the *injected* piston.
  - Validate it **on sky** in May 2020 at CHARA :
    - FRIEND in the visible (R band),
    - MIRCx or SPICA-FT in the infrared (H band).
  - Publish a **referee paper**.

Injected piston in H *wrt* R band

- **Definition of the *injected* piston (???) :**
  - **Piston across a pupil plane :**
    - **Piston_pup_t = average(atan[Pupil_t]) *$\lambda/2\pi$**
    - Pupil_t has to be unwrapped !
  - **Piston injected into a SM fiber** :
    - Analogy with the coupling efficiency ?
    - Coupling = abs($\int$ Pupil_t x Gaussian dxdy)/($\int$ Pupil_t dxdy $\int$ Gaussian dxdy)
    - Piston_t = atan ($\int$ Pupil_t ~~x Gaussian~~ dxdy) *$\lambda/2\pi$ => **WRONG !**
    - **Piston_t = avg (atan ($\int$ Pupil_t) x Gaussian/max(Gaussian) dxdy) *$\lambda/2\pi$**
  - Gaussian = **fundamental mode** of the SM fiber, transposed in the pupil plane.
  - Gaussian amplitude normalized to 1 at the center (**phase weighting function**).
  - Gaussian width in the pupil plane is the same whatever the wavelength.
  - Gaussian width in the image plane is smaller at lower wavelength so as to fit the diffraction-limited Airy disc.

Injected piston in H *wrt* R band

- Computation of the RMS of the differential *injected* piston (between H & R) :
  - Unwrap the temporal sequence of piston (2π phase jump may occur) :
    - pistonAOpup_t (H,R) = phunwrap(pistonAOpup_t (H,R))
    - pistonAO_t (H,R) = phunwrap(pistonAO_t (H,R))
  - Static piston correction (induced by the AO) :
    - pistonAOcorr_t (H,R) = pistonAO_t (H,R) - pistonAOpup_t (H,R)
  - Differential *injected* piston between two wavelengths :
    - Opd_t = pistonAOcorr_t (H) - pistonAOcorr_t (R)
  - RMS of the differential *injected* piston between two wavelengths :
    - Opd_Rms = stdev(Opd_t)

Injected piston in H *wrt* R band