VORTEX

Hitting the diffraction limit: first results of the AGPM-VORTEX project

Olivier Absil
FNRS Research Associate
Université de Liège

fnrs LA LIBERTÉ DE CHERCHER

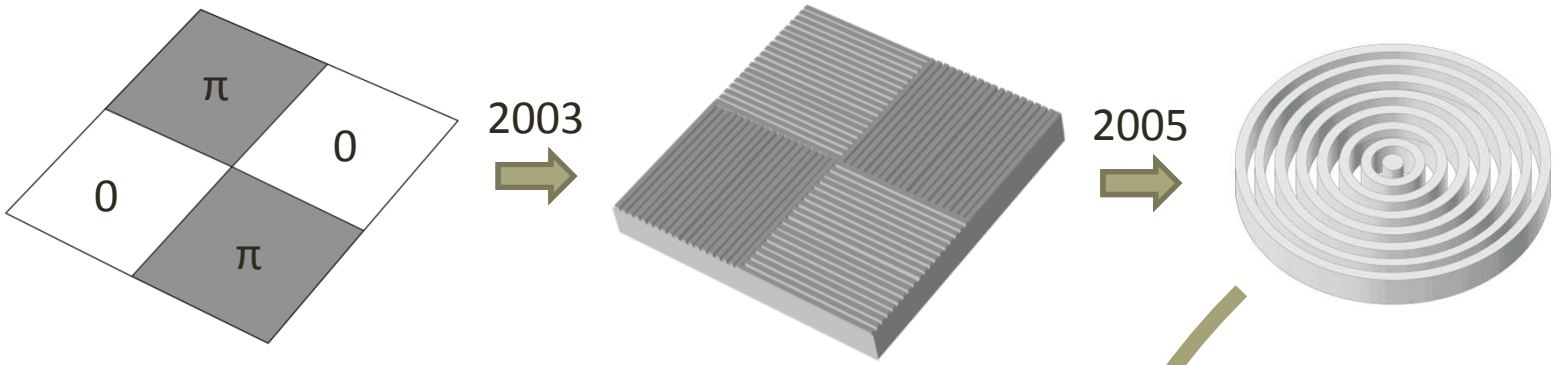
ulg

erc

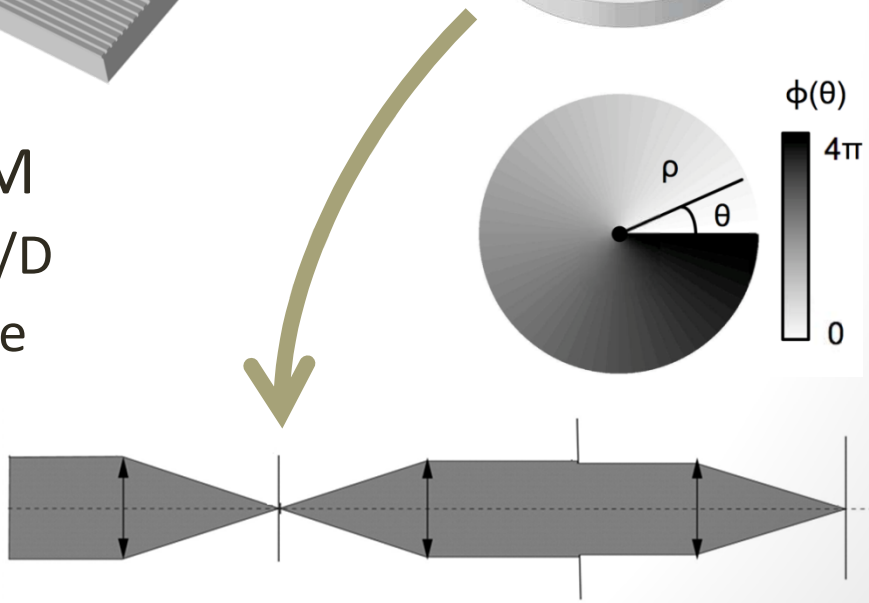
VORTEX

The birth of a concept

- FQPM → sub-wavelength gratings → Annular Groove PM

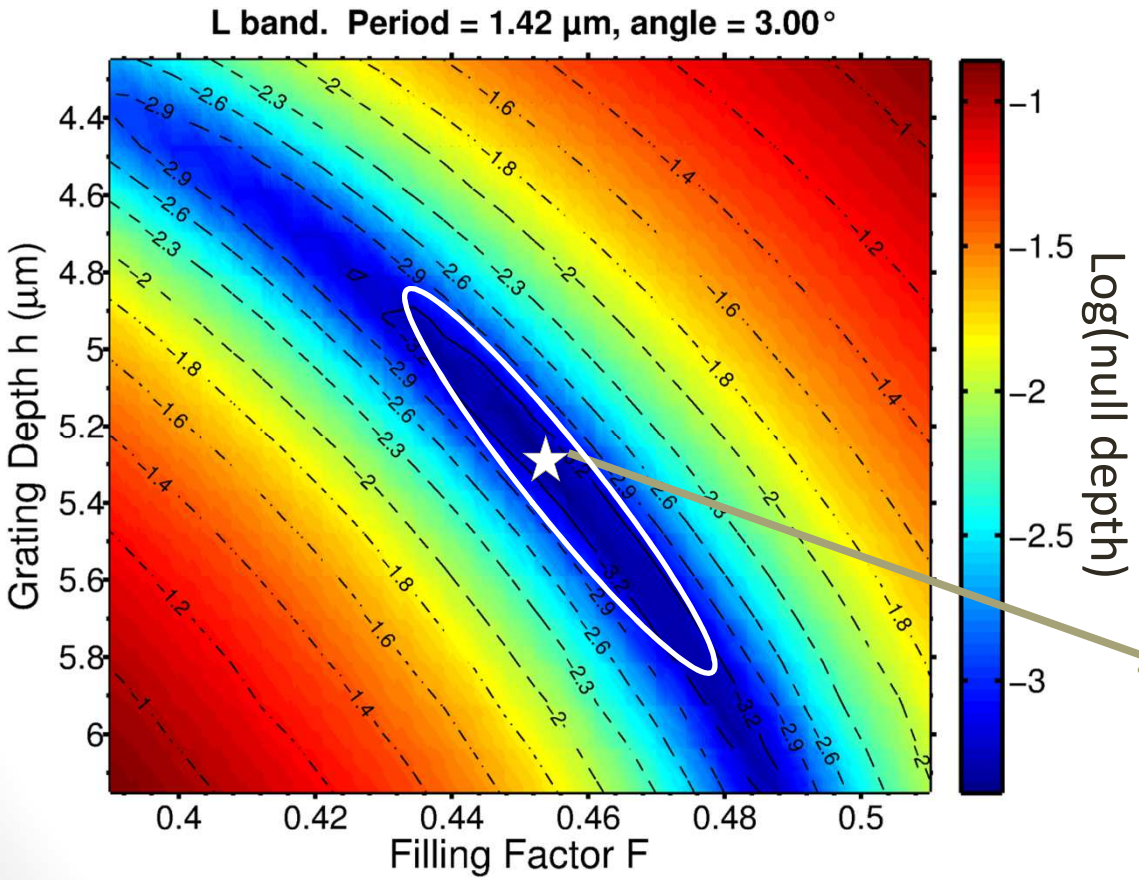


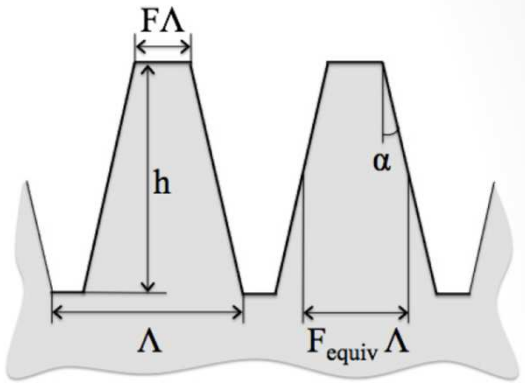
- Advantages of the AGPM
  - Inner working angle ≈ 1 λ/D
  - Clear 360° discovery space
  - Achromatic (SG design)
  - Easy to implement

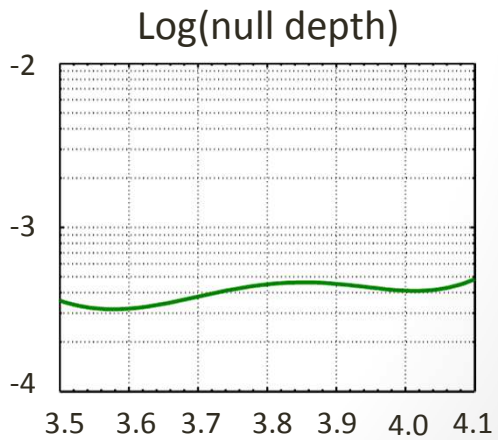


VORTEX

Grating design/optimization







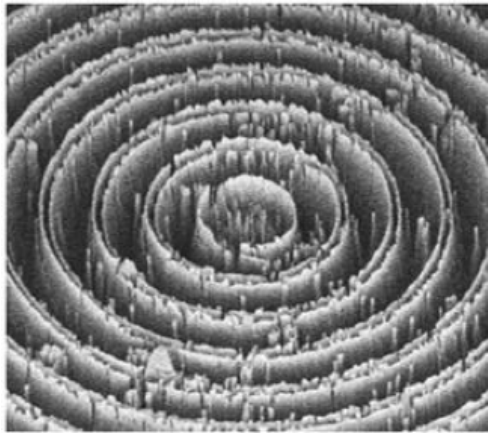
Delacroix et al. 2013

VORTEX

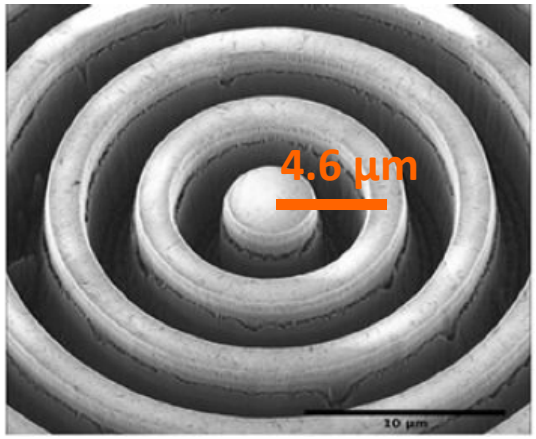
Etching on CVD diamond

- Nanoimprint lithography + dry plasma etching
  - N band (grating period = 4.6 µm)
  - L band (grating period = 1.4 µm)

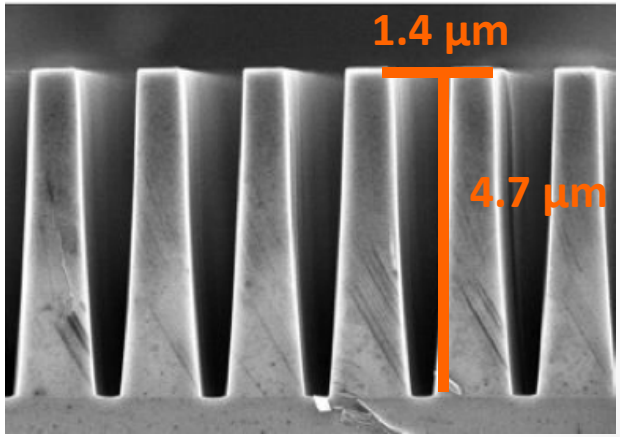
N band (Nov 2009)



N band (Feb 2012)



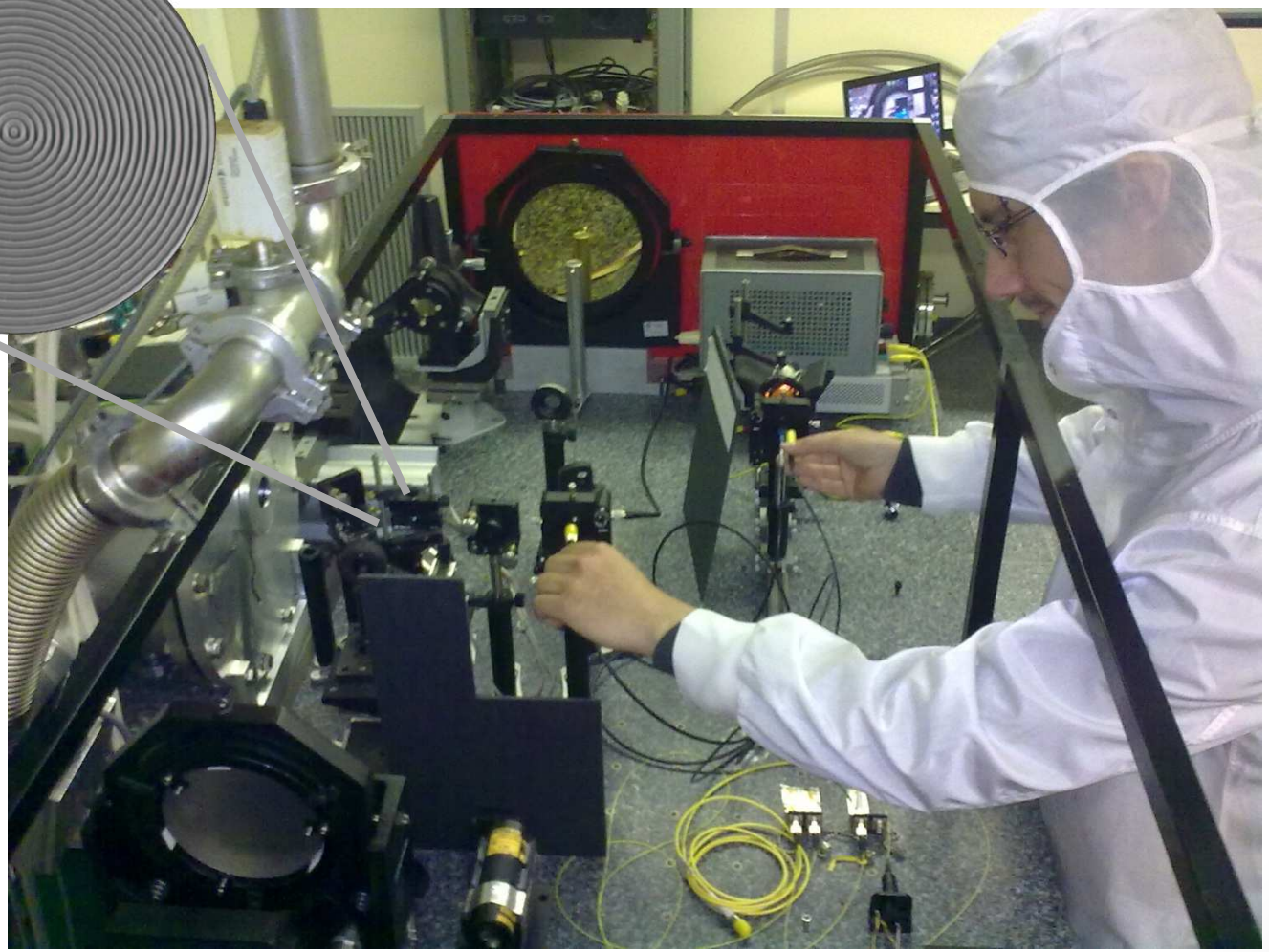
L band (Sep 2012)



- Parameters close to optimal … need to test!

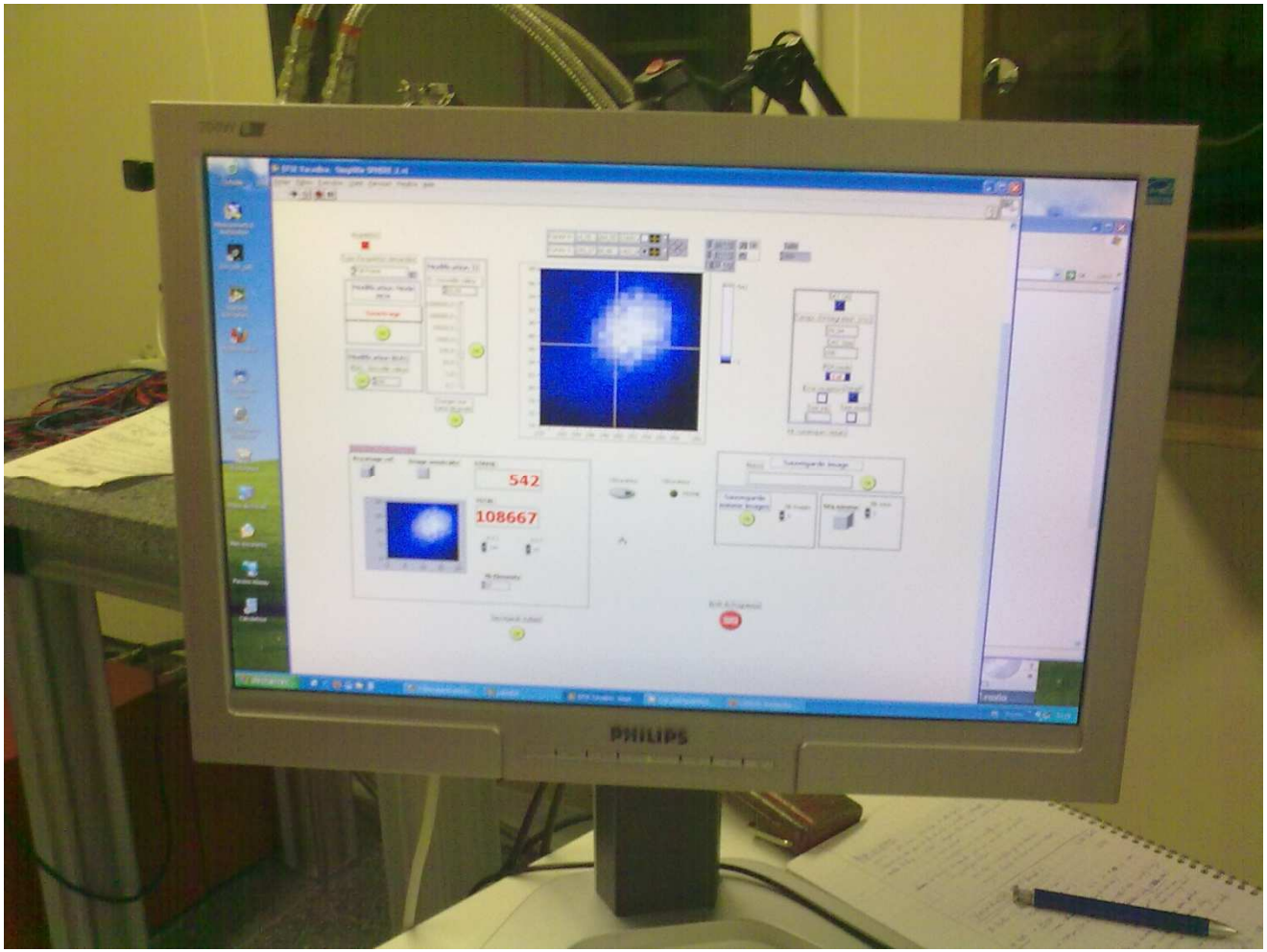
Setting up the bench

"Yacadire" @ Paris-Meudon



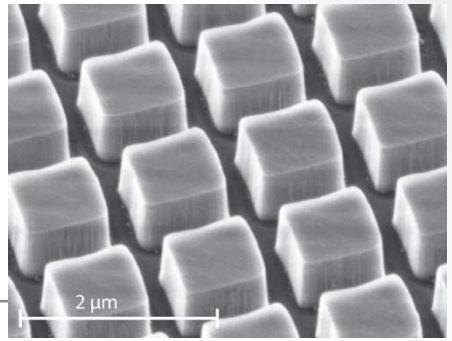
VORTEX

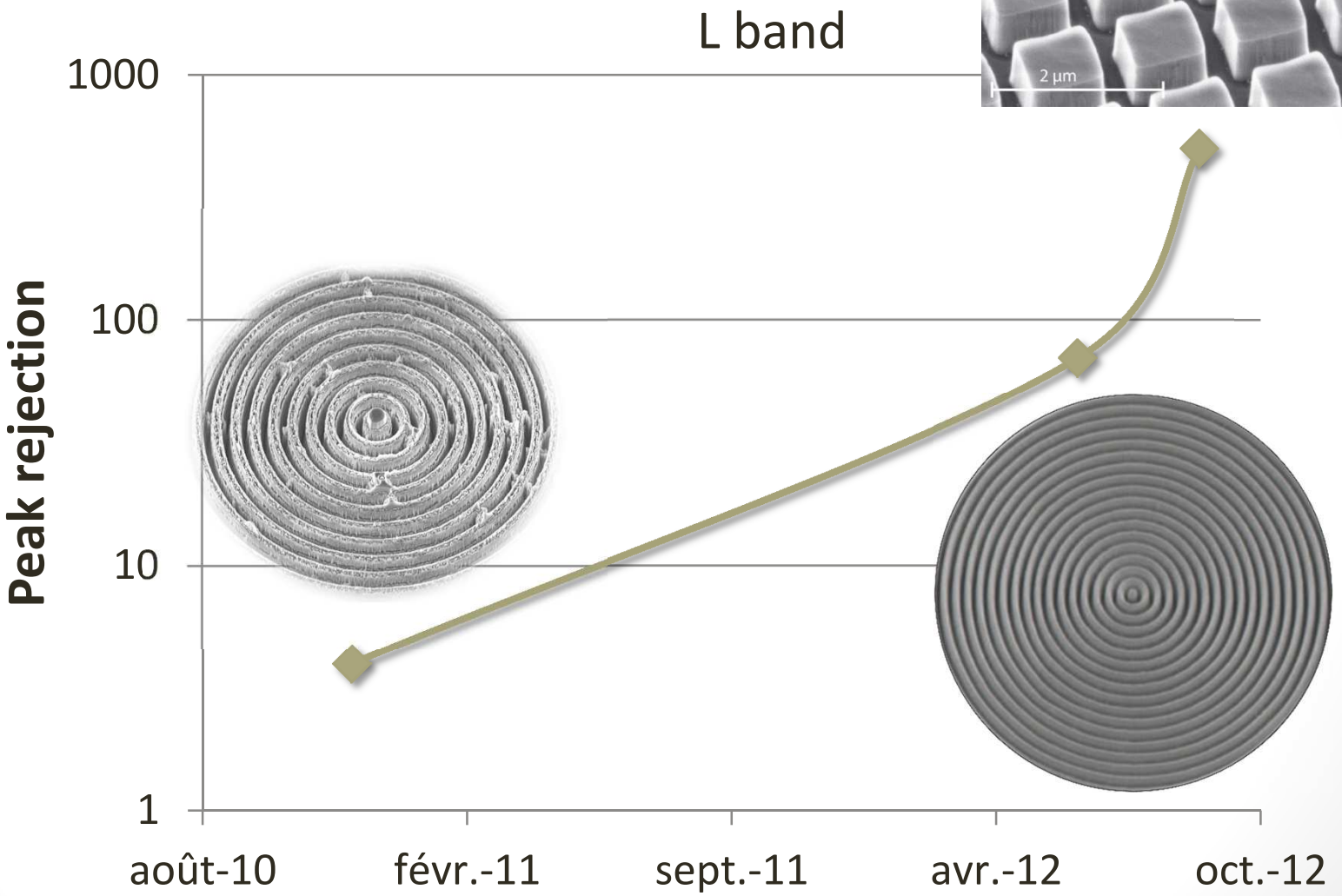
Anguish…



VORTEX

High performance

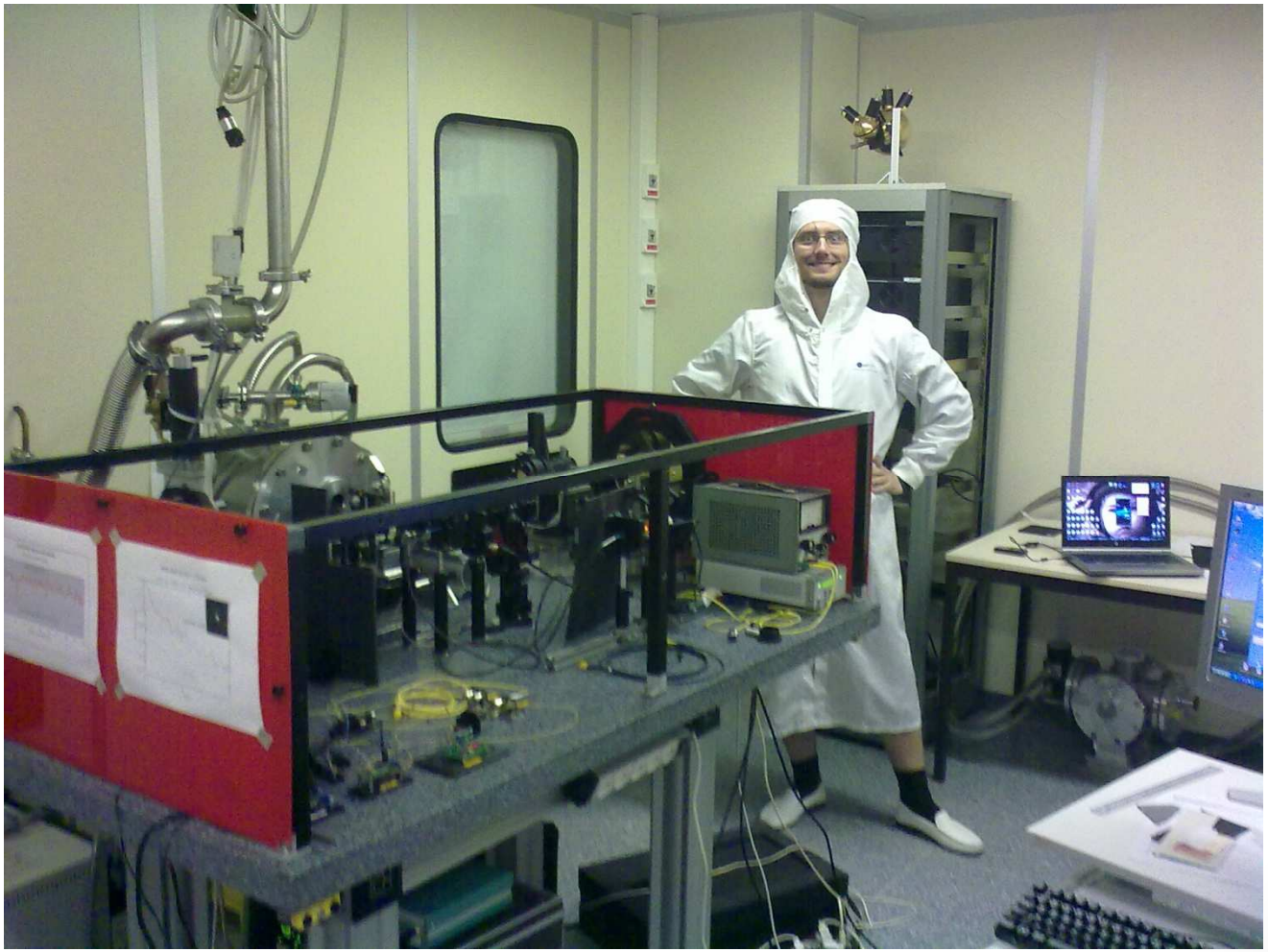




Delacroix et al. 2013

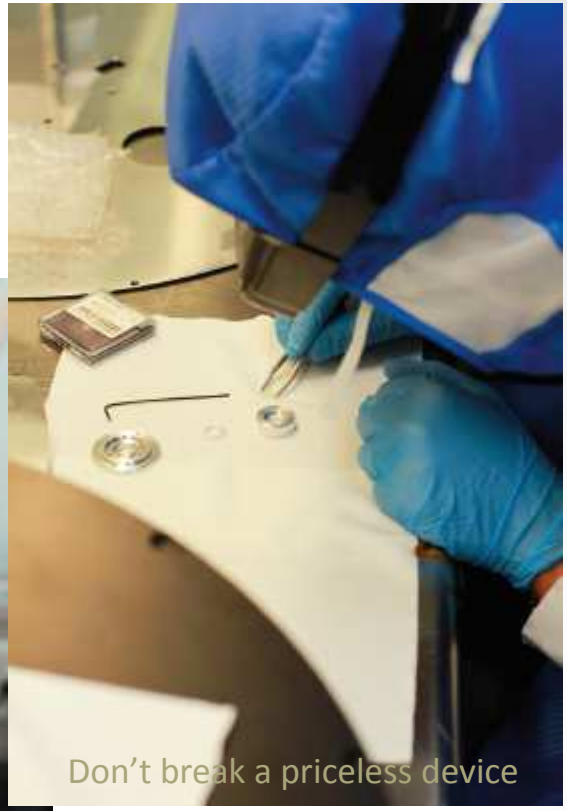
VORTEX

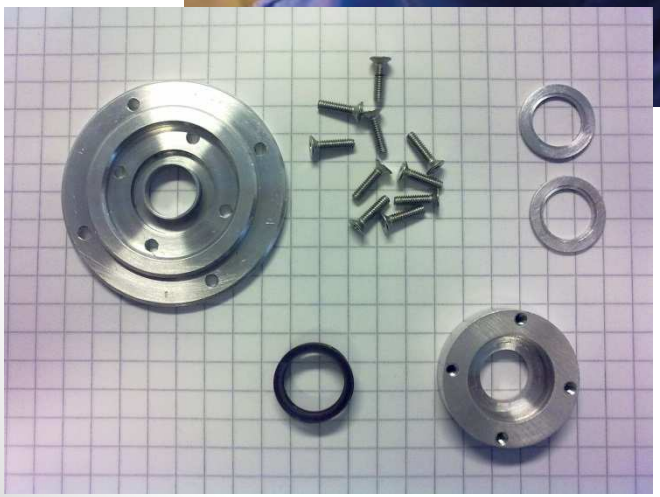
Bliss!

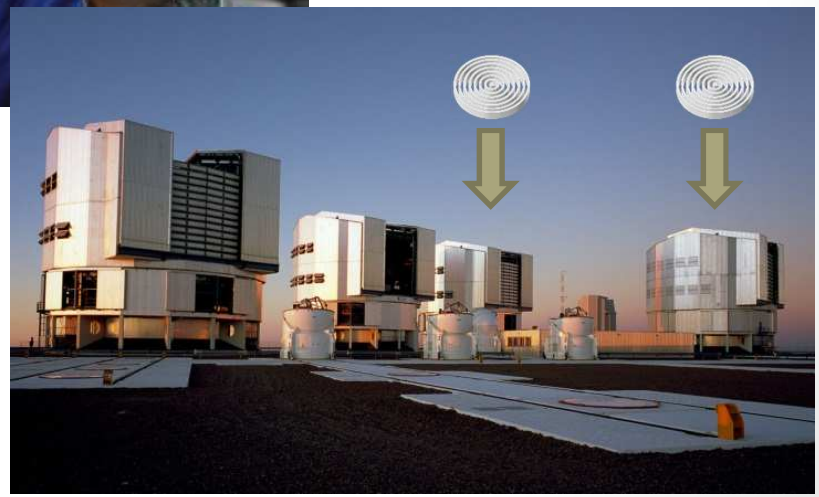


VORTEX

Installation at VLT



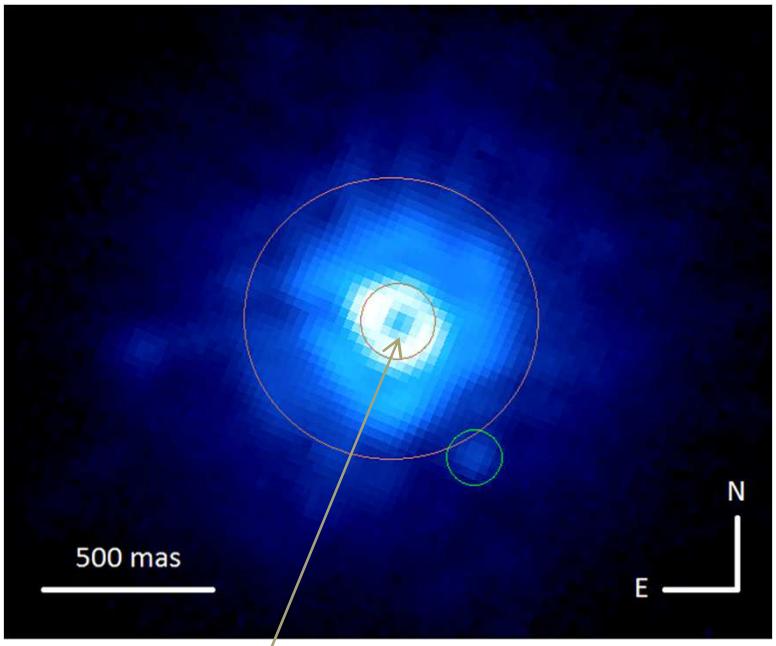




VORTEX

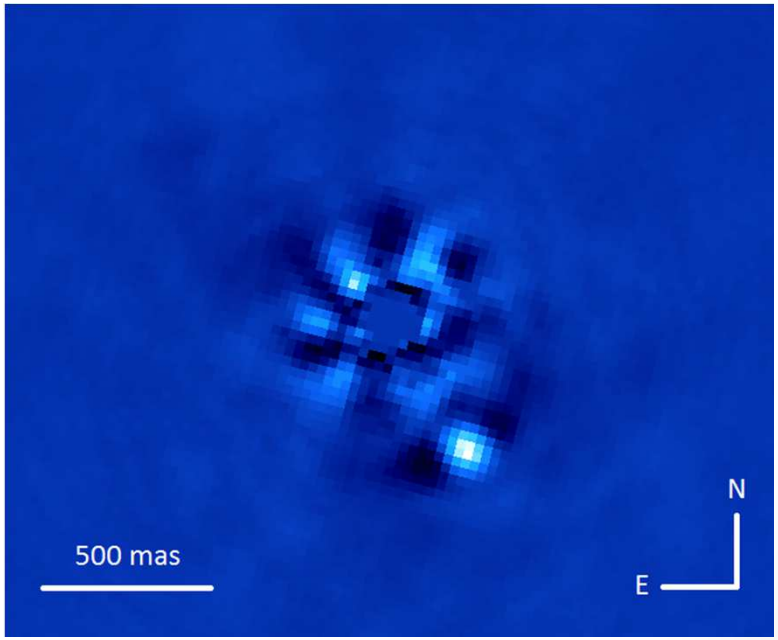
NACO: science demonstration

Raw image of β Pic



Peak rejection ~ 50:1

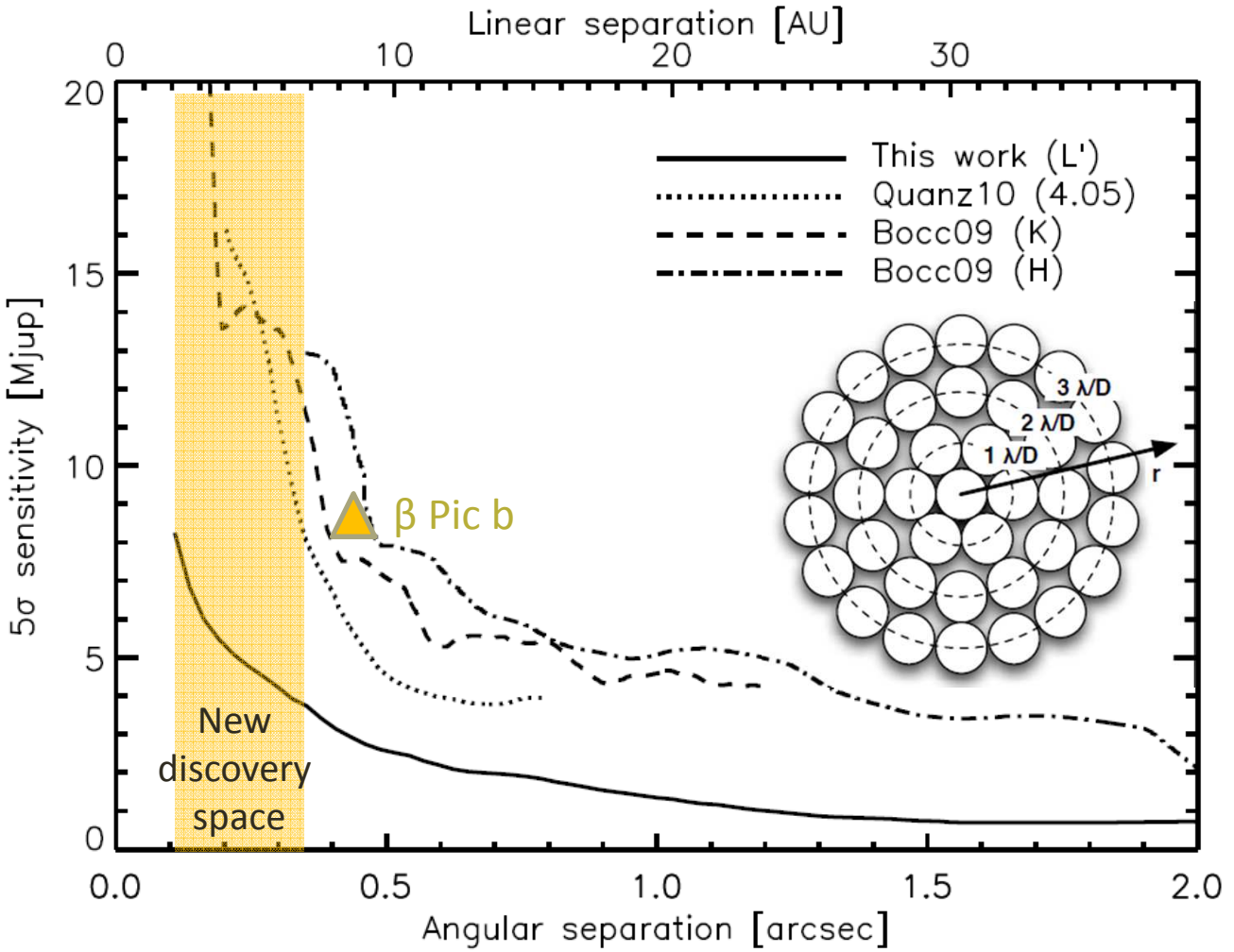
Post-processed image



Absil et al. 2013

VORTEX

Sensitivity to inner planets

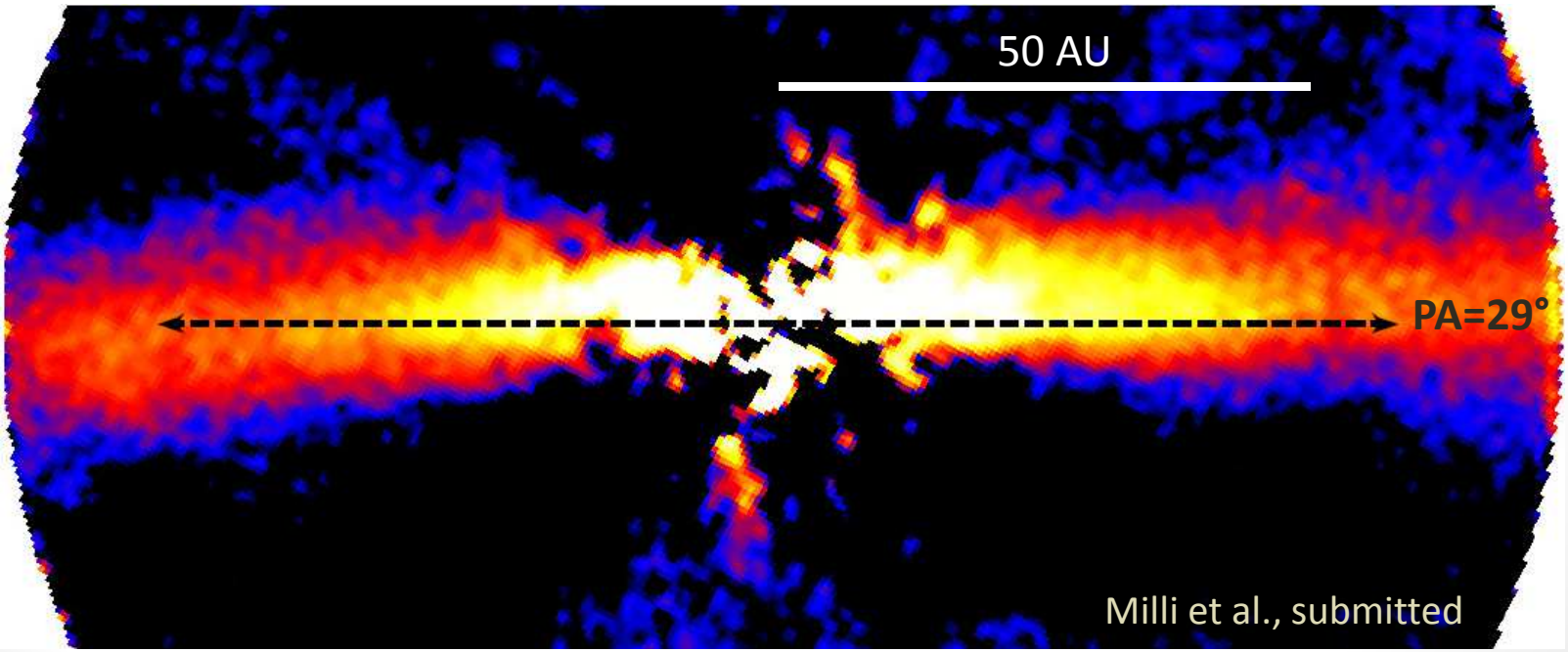


Absil et al. 2013

VORTEX

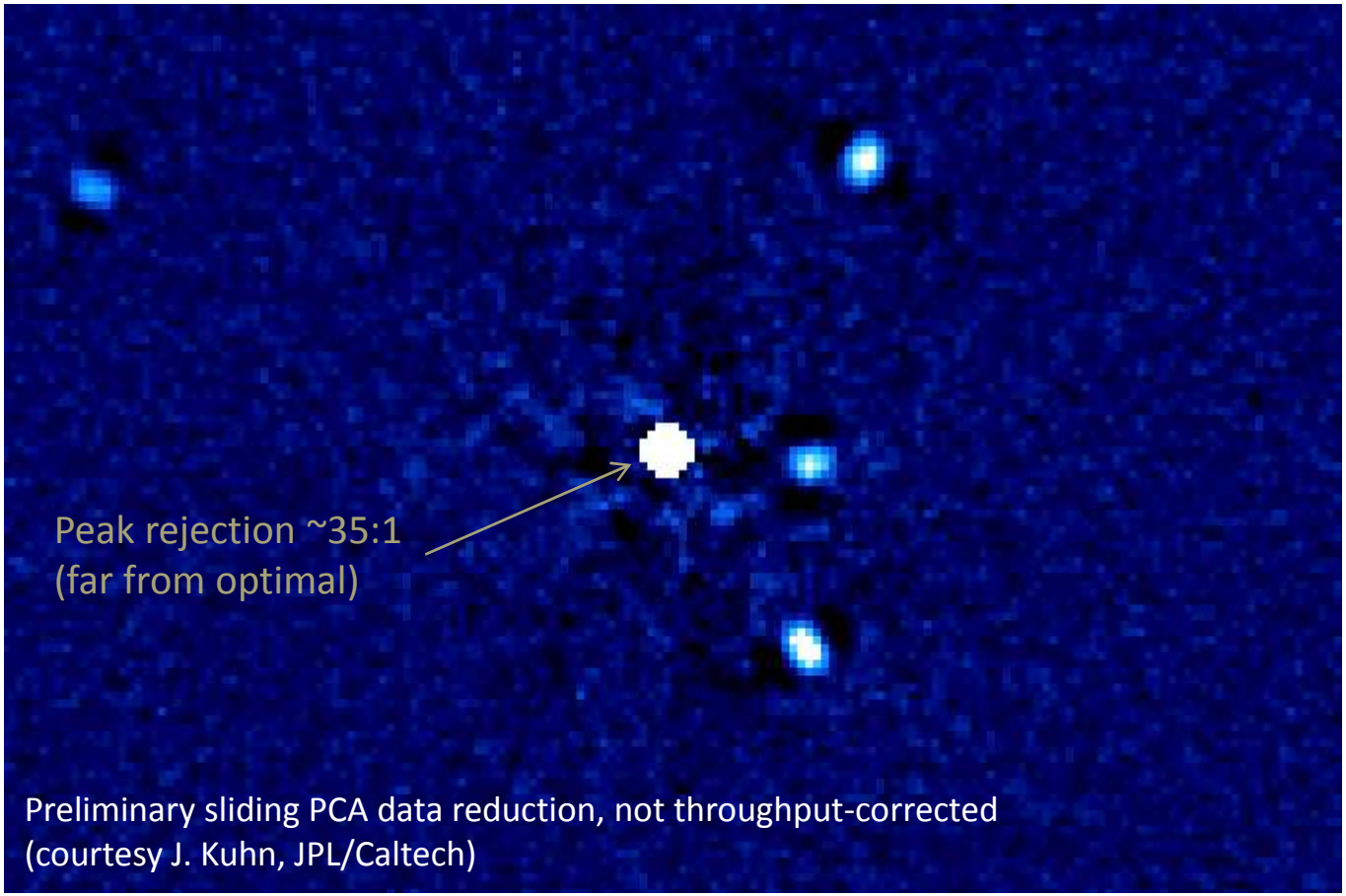
The β Pic disk at L band

- Warped, inner component
  - Disk detected down to 10 AU (0.4”)
- Spine offset and bowed (anisotropic scattering)



VORTEX

First light with LBT/LMIRCam



VORTEX

The VORTEX project

- **WP1: Exploitation of 1st generation AGPMs**
  - Install, test and optimize AGPMs on 10m-class telescopes
  - Perform the observations / analyze the data
- **WP2: Development of 2nd generation AGPMs**
  - Better L, M, N band AGPMs
  - Shorter wavelengths (K, H, … where's the limit?)
  - Beyond topological charge = 2
- **WP3: Test and validation of new ideas**
  - Exploitation of photon orbital angular momentum (OAM)
  - Post-vortex speckle cancellation techniques
  - Optimal apodization

VORTEX

A vortex in your instrument?

- We’re currently baking more L-band AGPMs

VORTEX