


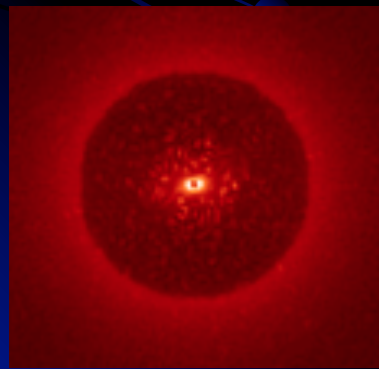
# Data reduction experience and tools, to get the best of exoplanet observations

David Mouillet, Markus Feldt,  
Jean-Luc Beuzit, Mickael Bonnefoy, Gael Chauvin,  
Nadège Meunier, Ole Moeller-Nilsson, Alexei Pavlov,  
Neil Zimmerman, et al

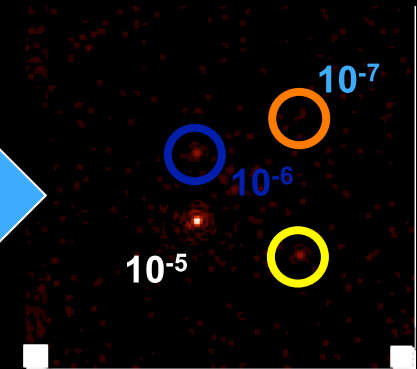
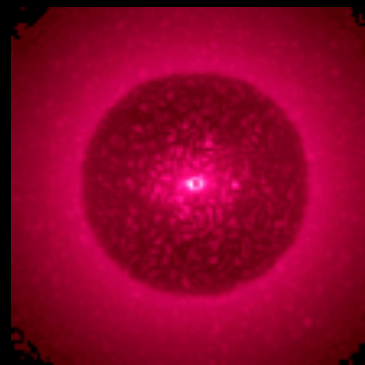


# Why caring about such boring matters as data reduction ?

- Not boring: field of research by itself
  - Signal processing = important and active field of research by itself ; a lot to exchange and gain with such specialists
  - Active field within astronomy:
    - Eg: in the last few months ! Soummer et al, Quanz et al, Milli et al, Ygouf et al, ...



Speckle field estimation

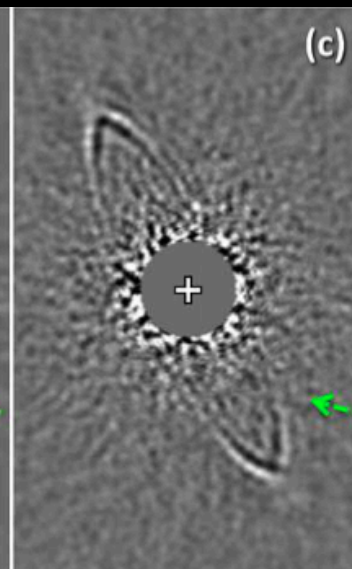
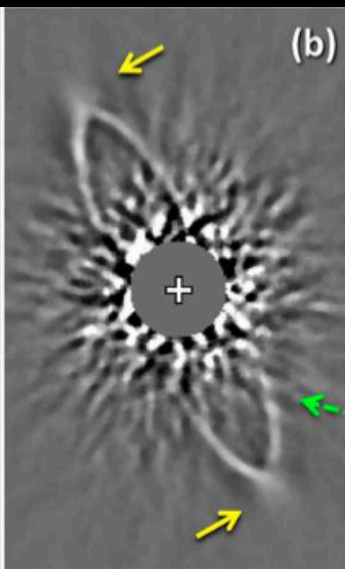
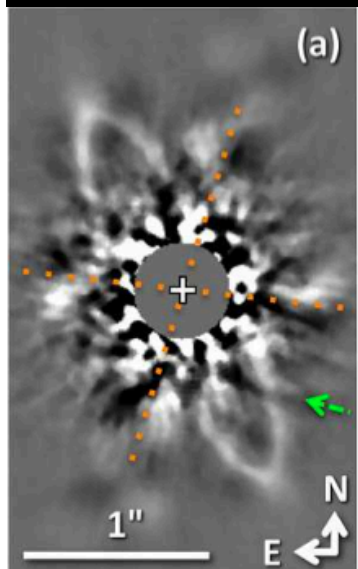
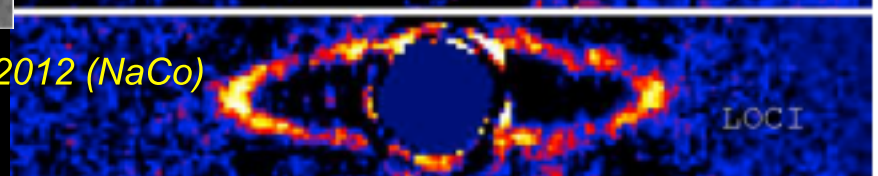
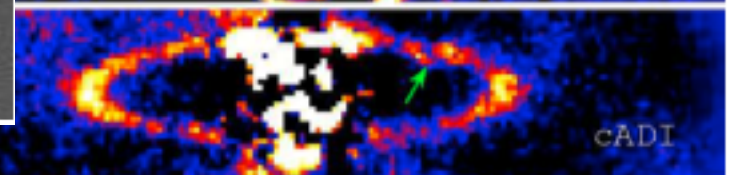
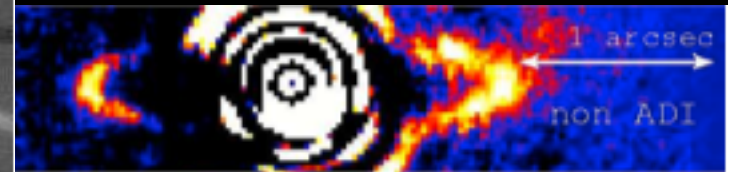
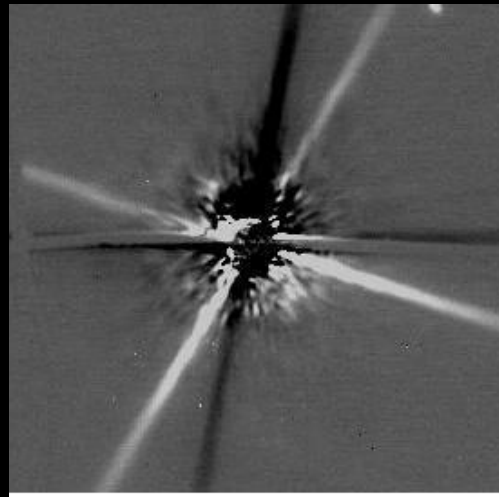
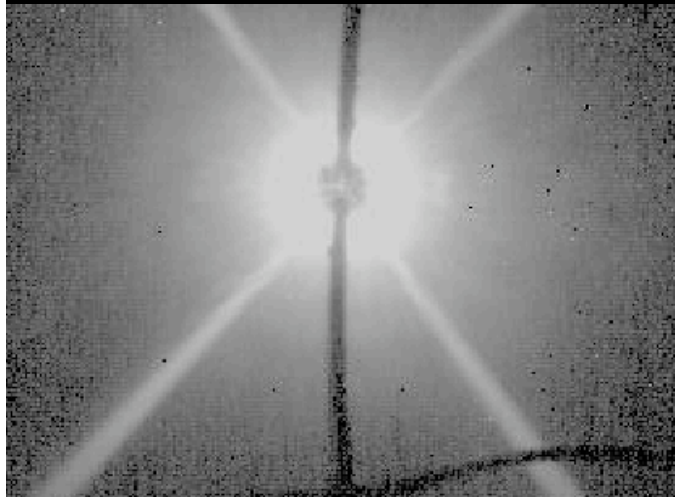


Object map estimations

# Why caring about such boring matters as data reduction ?

- Not boring: field of research by itself
- Motivation to produce and share efficient tools
- Mandatory anyhow for the most exciting astronomical results:
  - Detection of the faintest sources
  - Characterization capability at low SNR (ppm, photometry, spectroscopy,...)
  - False alarm issues, biases and artefacts ?

# Illustrative example: HR4796



Thalmann et al 2011 (HiCiao)

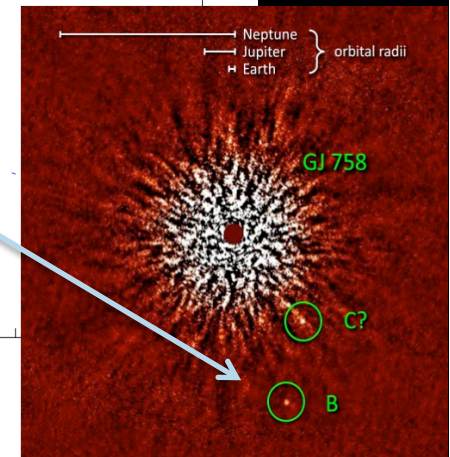
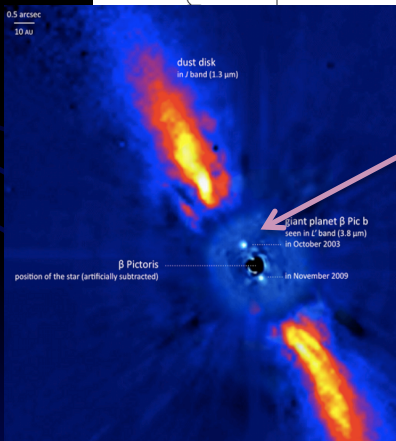
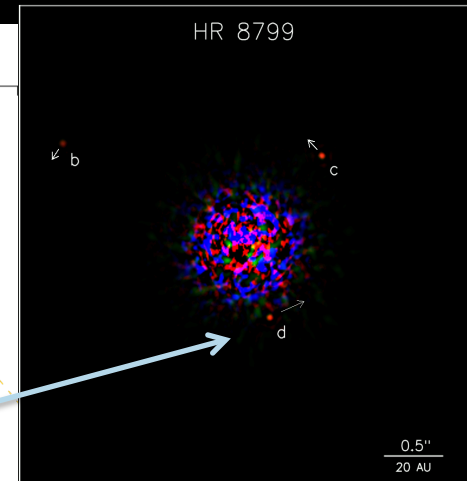
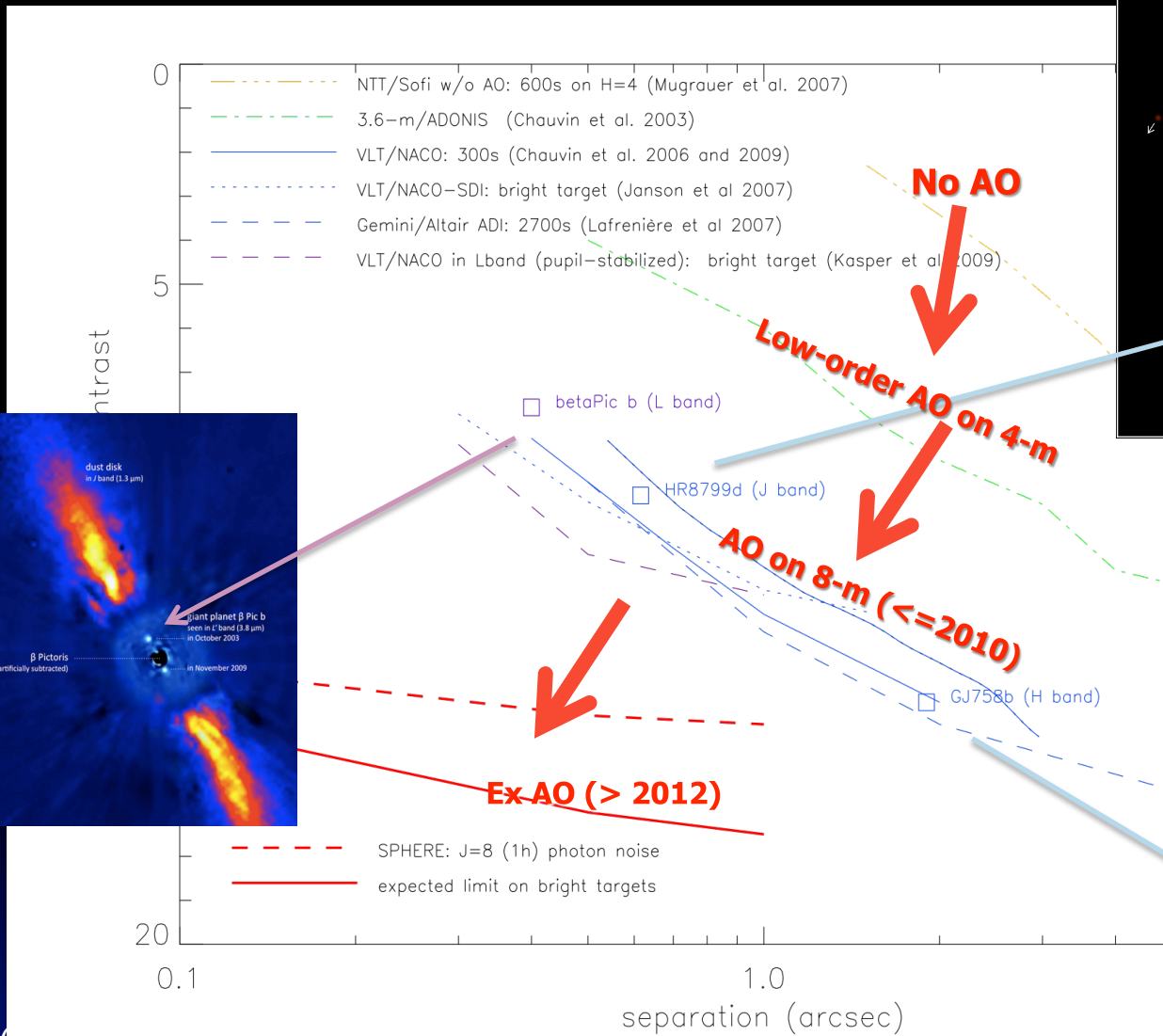
Lagrange et al 2012 (NaCo)

Milli et al 2012

David Mouillet: Data reduction and exoplanets.



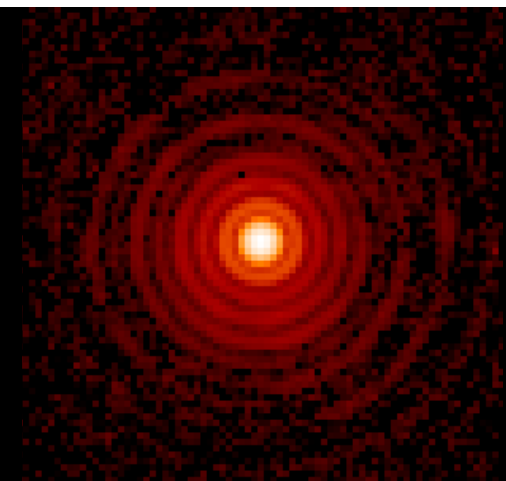
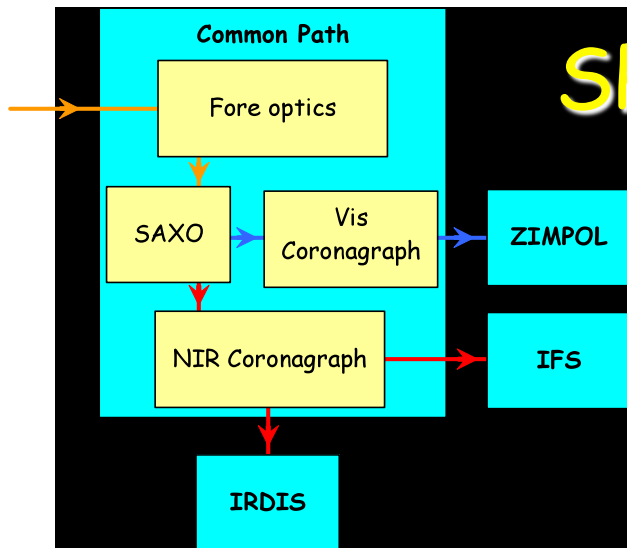
# Examples for point-like object observations



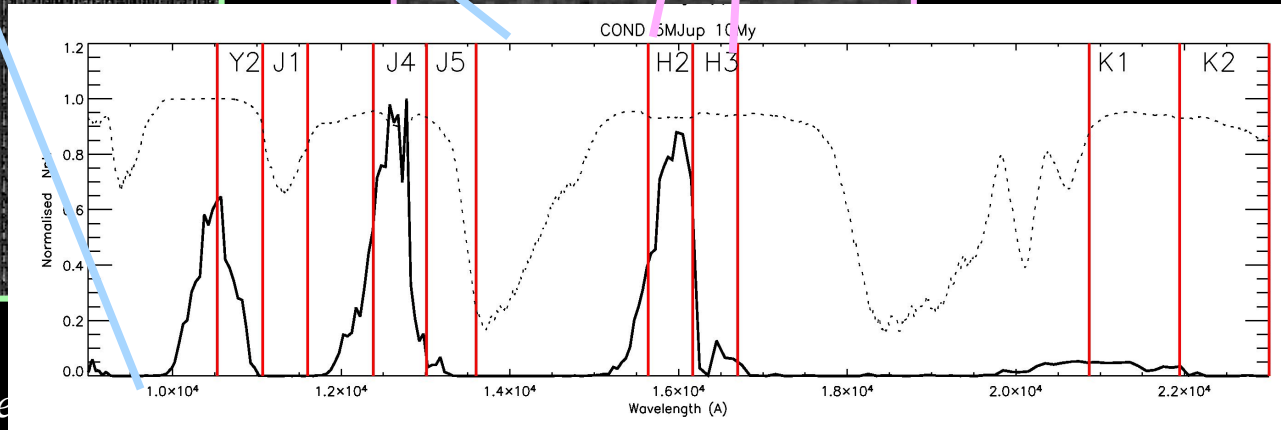
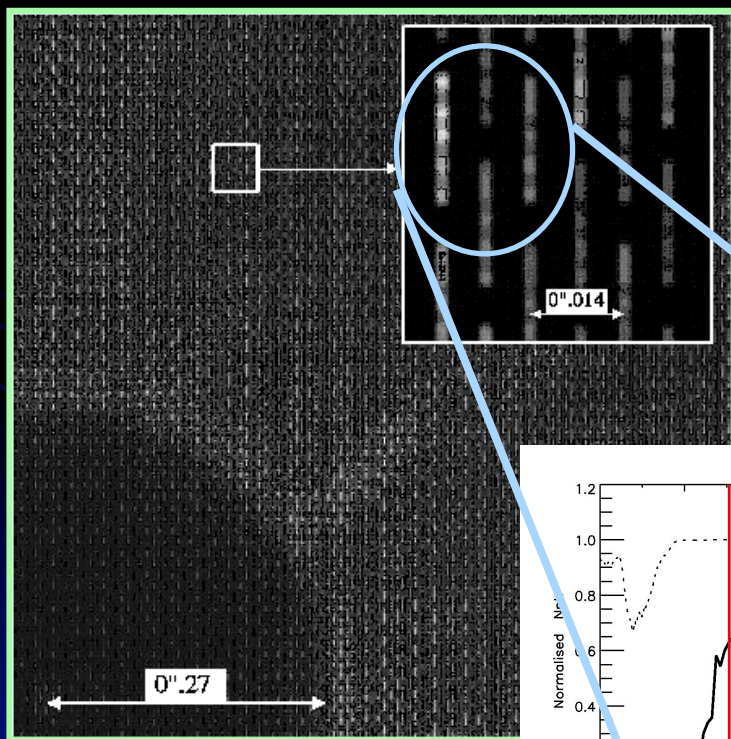
# A high potential field for Heidelberg - Grenoble collaborations

- Crucial step in between instrument development and observation exploitation
- Collaborations are already happening now
- Specific interest in the case of SPHERE

# SPHERE in NIR



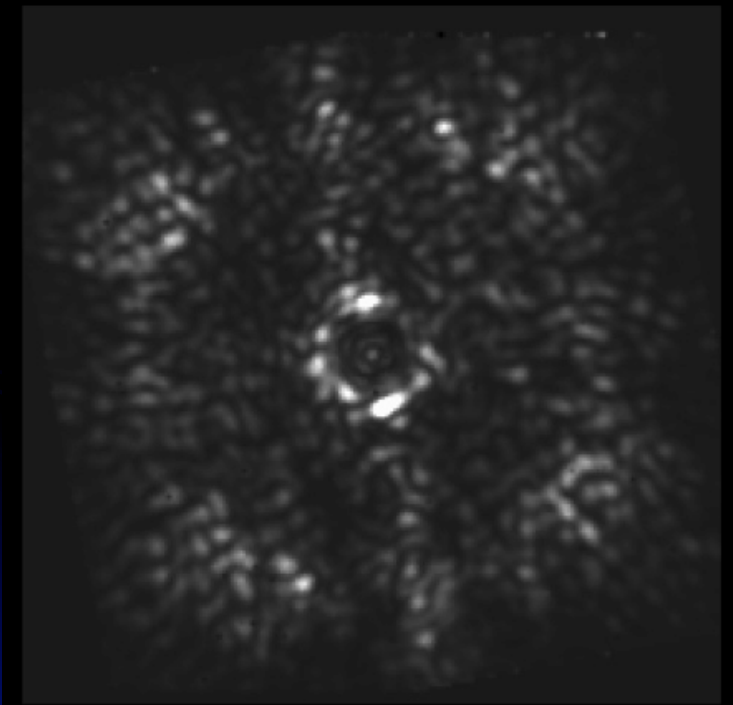
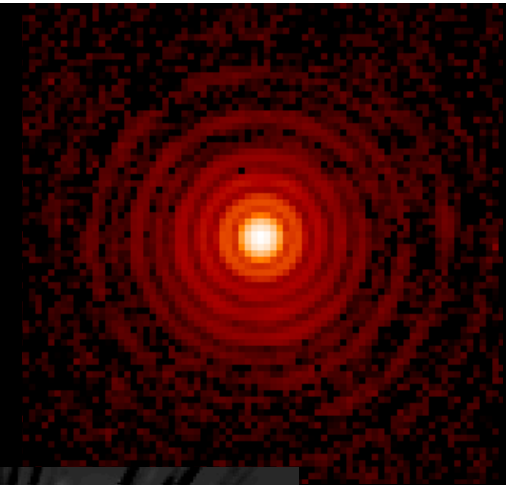
☀️ DBI in H + IFS in Y-J



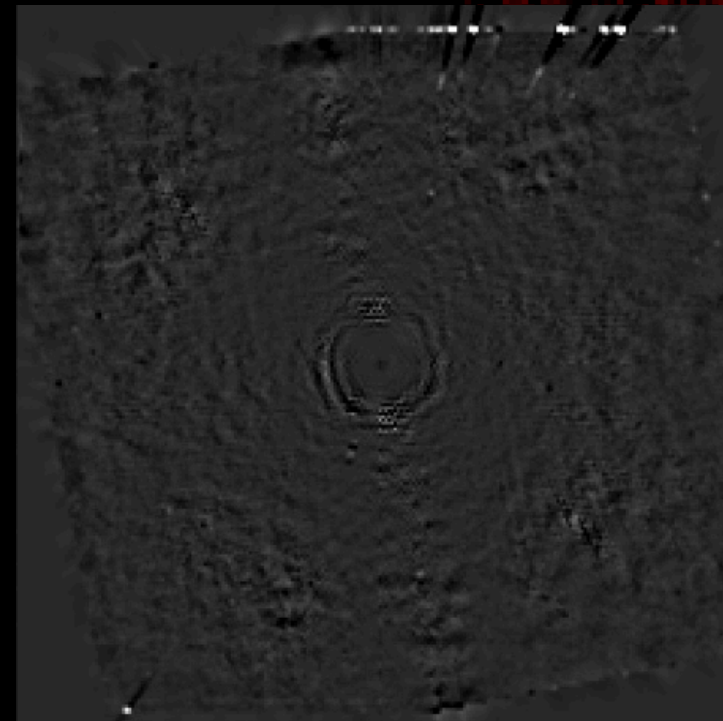
David Mouillet: Data re

# SPHERE in NIR

*Mesa , Gratton, (september 12)*



IFS extracted monochromatic image



Residuals after PSF subtraction  
At  $10^{-6.3}$   $5 \sigma$  level



# SPHERE data reduction pipeline

- A robust and consistent software product: high quality for ESO standards, version control, evolution potential, wide use in the community
- From raw data to reduced data for all obs modes
- + including some « data analysis »
- Developed in-time and along the instrument development
- « astronomer-friendly »: options, intermediate output products

# SPHERE (and others) data reduction

- = the best possible by now...
- .. But much more to come !!
  - To complete the current purposes according to actual data
  - To add new tools for better use of astronomical information : better efficiency and quality
    - Biases, false alarm, photometry, spectrum extraction, astrometry
  - To remain at the cutting-edge performance of signal extraction: observing learning curve, new algorithms
- Heidelberg - Grenoble as the ideal collaboration basis
  - Based on experience and building up on current investment
  - Combining expertise on instrument, pipeline and observations
  - With high ambition on breaking-through results
  - Involving astronomers, engineers and technical infrastructure