Summary of the science discussions during the Special Session "Science with present and future interferometers" and "ASTRONET" session at EWASS 2013

Jean Surdej, Jörg-Uwe Pott, Olivier Chesneau

FIE « The future of optical interferometry in Europe» WG

Officially appointed members :
Olivier Chesneau, Lucas Labadie, Hervé Le Coroller, John Monnier, Jörg-Uwe Pott, Jean-Philippe Berger, Jean Surdej

3 telecons (no face-to-face meetings yet)

- ***Telecon 17_12_2012:***

- « Science with present and future interferometric instruments » (European Week of Astronomy and Space Sciences 2013 meeting, Turku, Finland, 10-11 July 2013) http://www.ss7.ulg.ac.be/programme.php

- « Improving the performances of current optical interferometers and future designs » (International Colloquium, Haute Provence Observatory, France, 23-27 September 2013)

- Working strategy of our WG to produce a white-like book on the future of interferometry in Europe : recruiting good science authors for the white paper

- ***Telecon 3_4_13 :***

- Future of interferometry within ESO, including PRIMA (action item for the next chair of Eii)

- There is a French prospective effort, ASHRA – meeting 4-8 june 13 ;

- US/European Interferometry Forum in Flagstaff, March 15, under the auspices of IAU-54 Commission

... (Excerpts of the response of Eii to S. Ridgway)

We confirm hereby that the Eii FIE (Future of Interferometry in Europe) Working Group (WG) to which we belong is definitely in favour of developing a good synergy with the Interferometry Forum that you chair.

We note that your forum is probably more concentrated with near-term practical issues but we also feel very much concerned by these, in addition to considering opportunities for the future.

We are very much aware that the success of future optical/IR interferometry will very much depend on our ability to gather a unique and strong community which will speak with only one voice.

We feel that in the future we should also coordinate the organization of conferences, meetings ... so that they are not so numerous and that more scientists will be able to attend.

...

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* ***Telecon 7_6_13 :***

- ESO white book : 5 member expert group will be selected and there is planning for a community workshop in 2014 on the future VLT/VLTI instrumentation program

- How to write the FIE white book?

Science with present and future interferometric instruments Special Session 7 at the European Week of Astronomy and Space Science — 10 and 11 July 2013, Turku, Finland

http://www.ss7.ulg.ac.be/programme.php
Username: ss7 Pwd: EWASS2013

5 invited talks: O. Chesneau, O. Pfuhl, S. Kraus, J.-P. Berger, D. Mourard (presented by J.Surdej)

6 contributed talks: P. Garcia, R. Oudmaijer, P. Kervella, J. Groh, S. Hönig, G. van Belle

5 posters: A. Bajkova, D. Buscher, D. Dravins, Y. A. Hafez, A. M. Jorgensen

Recommendations for ASTRONET (D. Mourard, presented by J. Surdej)

Tentative schedule for the roadmap:

- 2014: Gravity ➔ 2022
- 2016: MATISSE ➔ 2024
- 2016: AO on CHARA ➔ 2024
- 2016: NPOI+, MROI ➔2024

- 2020: 30-40m telescopes
- 2020 (?) : CTA
- 2025: SKA1

- 2015: ASTRONET review
  - >2015: sustainable activities for European coordination (TBD)
- 2020: US decadal survey

- 2014-2020: capitalize on science with currently existing facilities

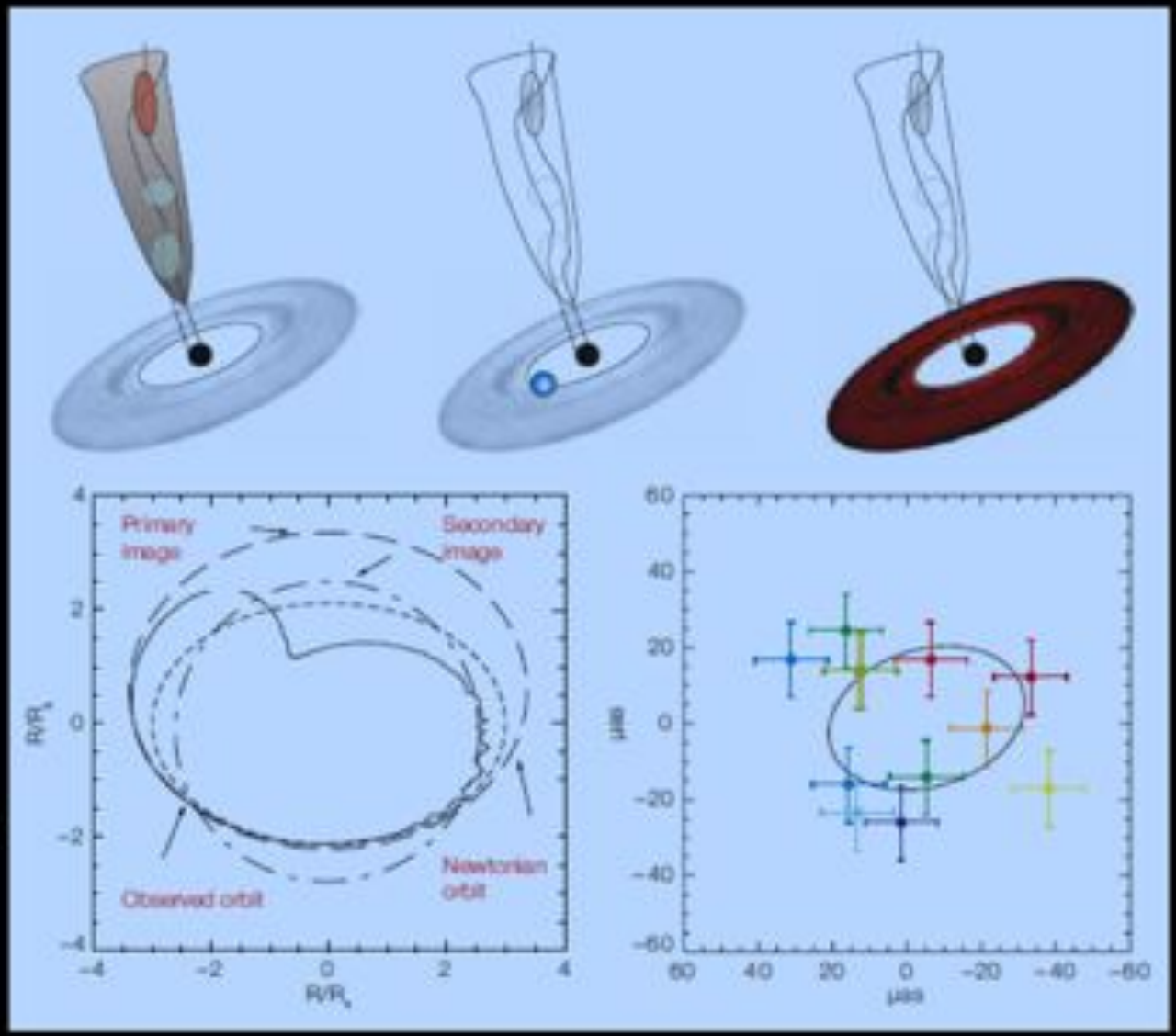
- 2014-2016: reinforce the global Astronomy science case for High Spatial Resolution
- 2016-2018: User requirements and main array's characteristics
- 2018-2020: Project definition
- 2020-2024: Project decision
- 2025-2030: Construction

Invited talk:

“Micro-arcsecond astrometry with GRAVITY” (O. Pfuhl)

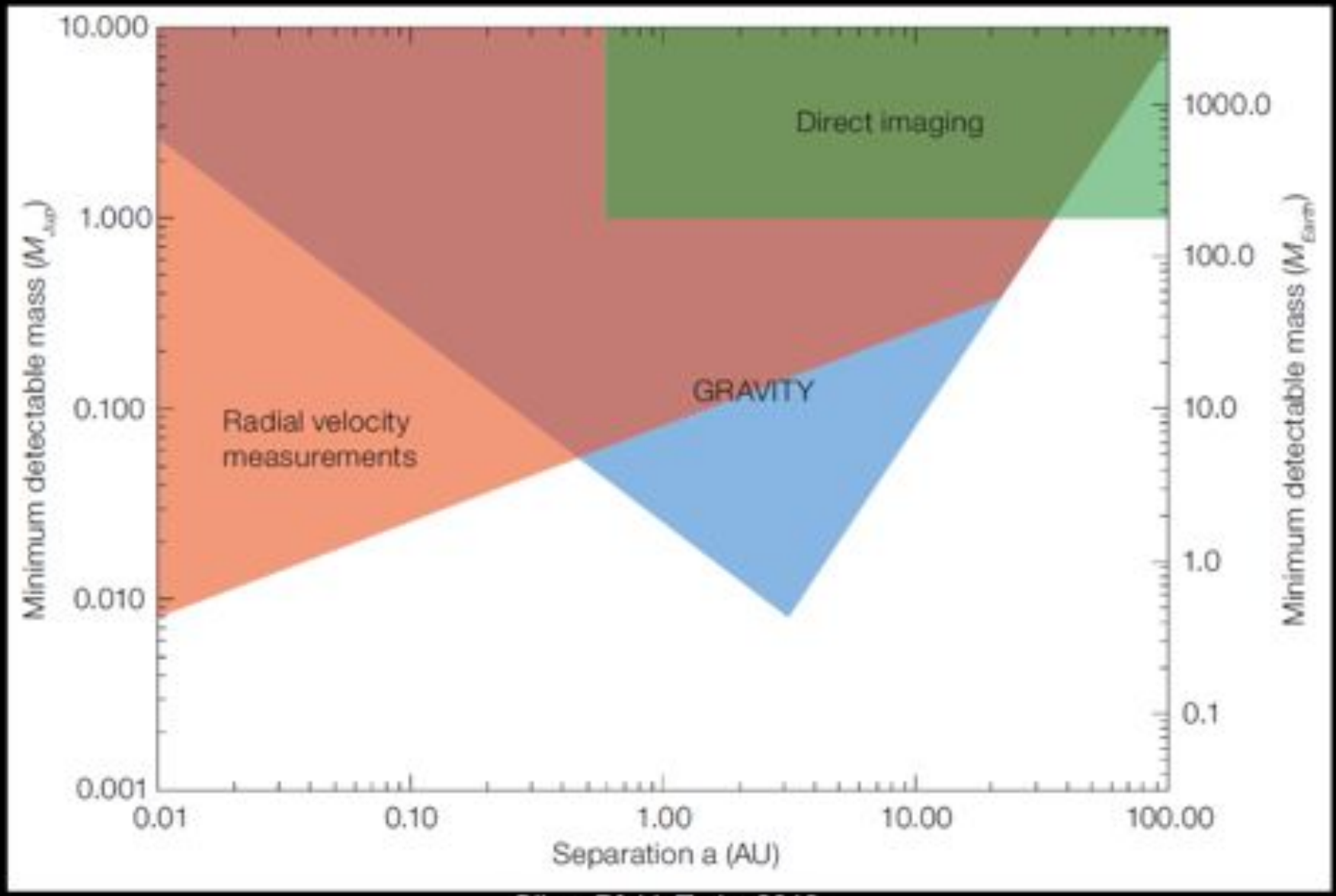
Probing the nature of flares with GRAVITY

How does it move?



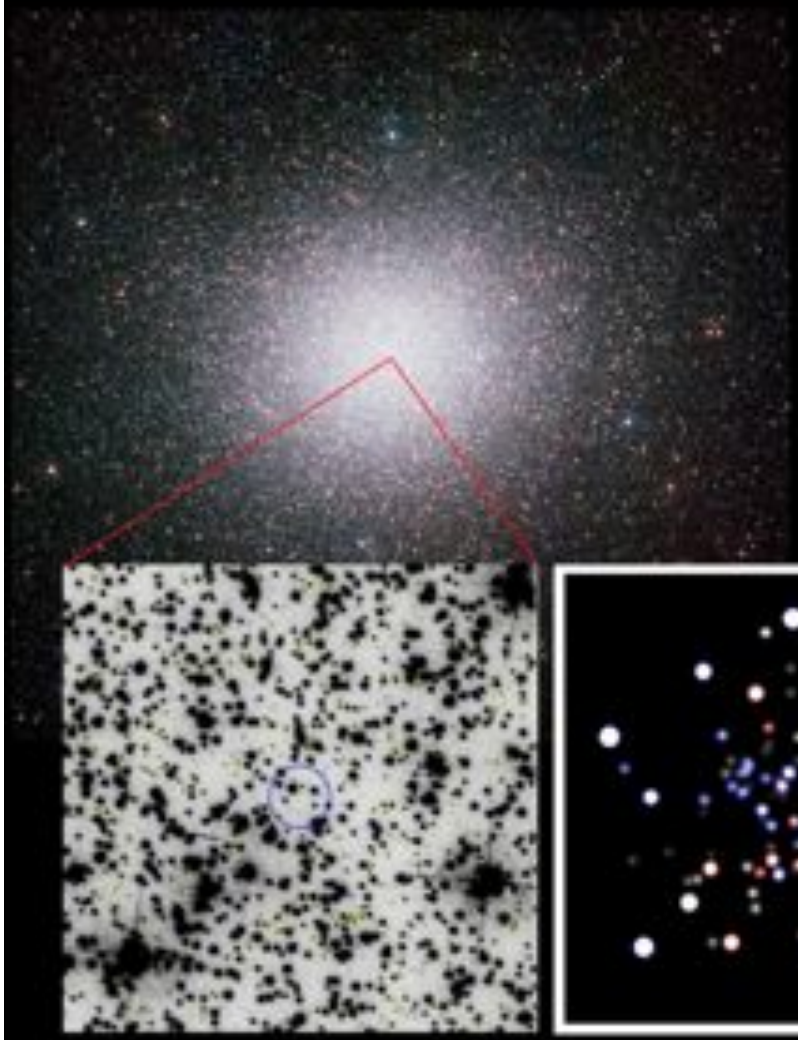
Paumard et al. 2005
Vincent et al. 2010

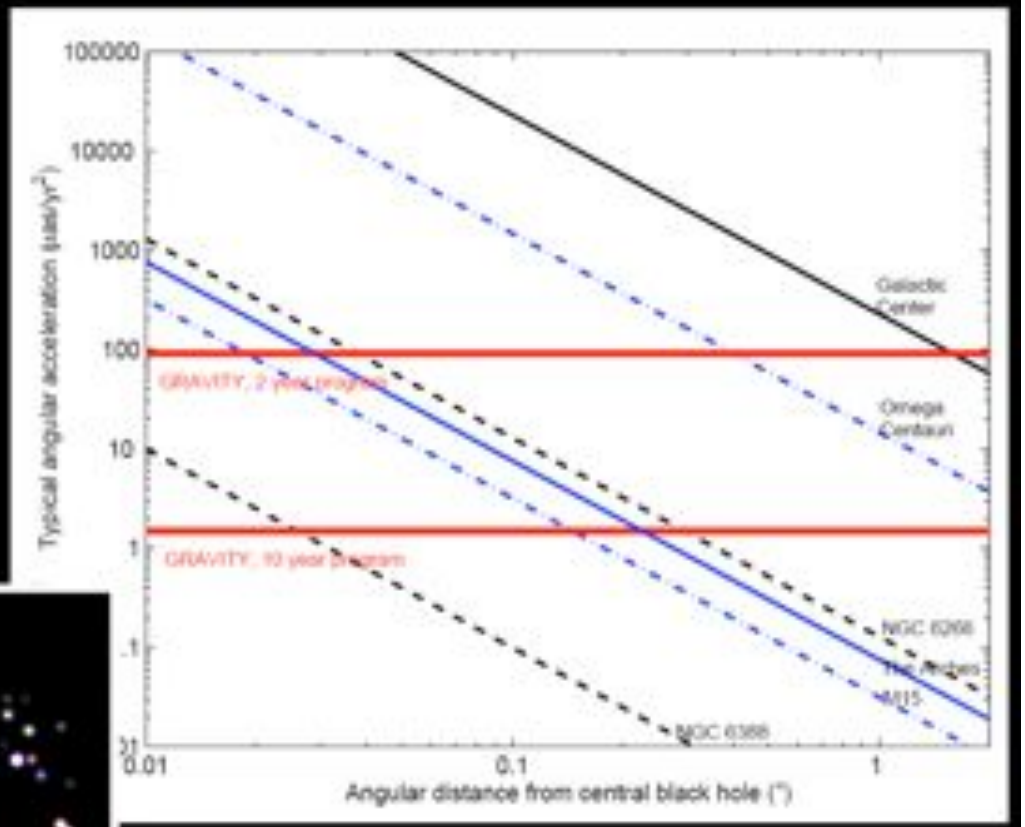
Planets around M-dwarfs



Oliver Pfuhl, Turku 2013

Intermediate Mass Black Holes





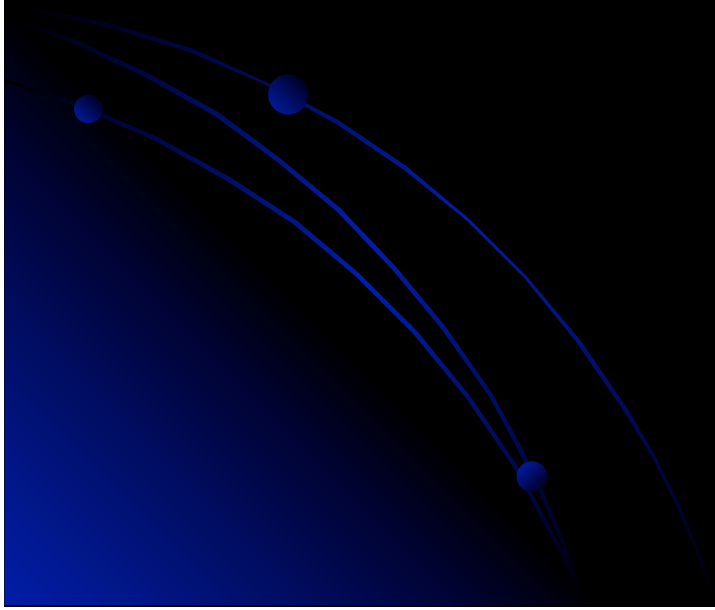
Courtesy of Gillessen et al.

Anderson et al. 2010

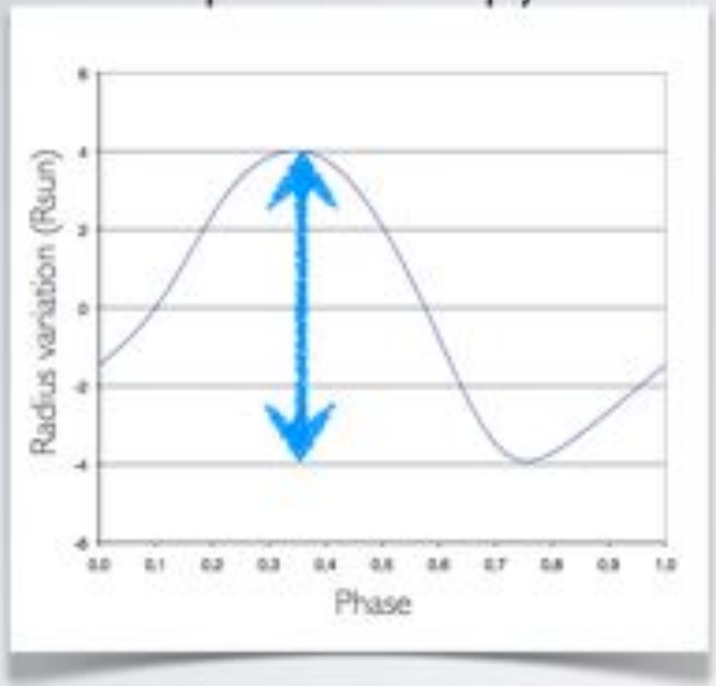
Oliver Pfuhl, Turku 2013

Contributed talk:

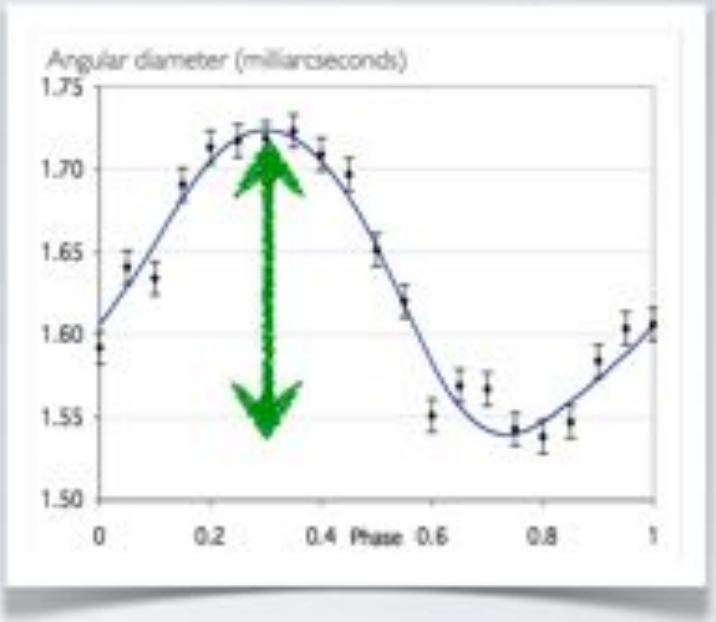
"Cepheid science with long-baseline interferometry: distances and stellar physics" (P. Kervella)



Spectroscopy



Interferometry

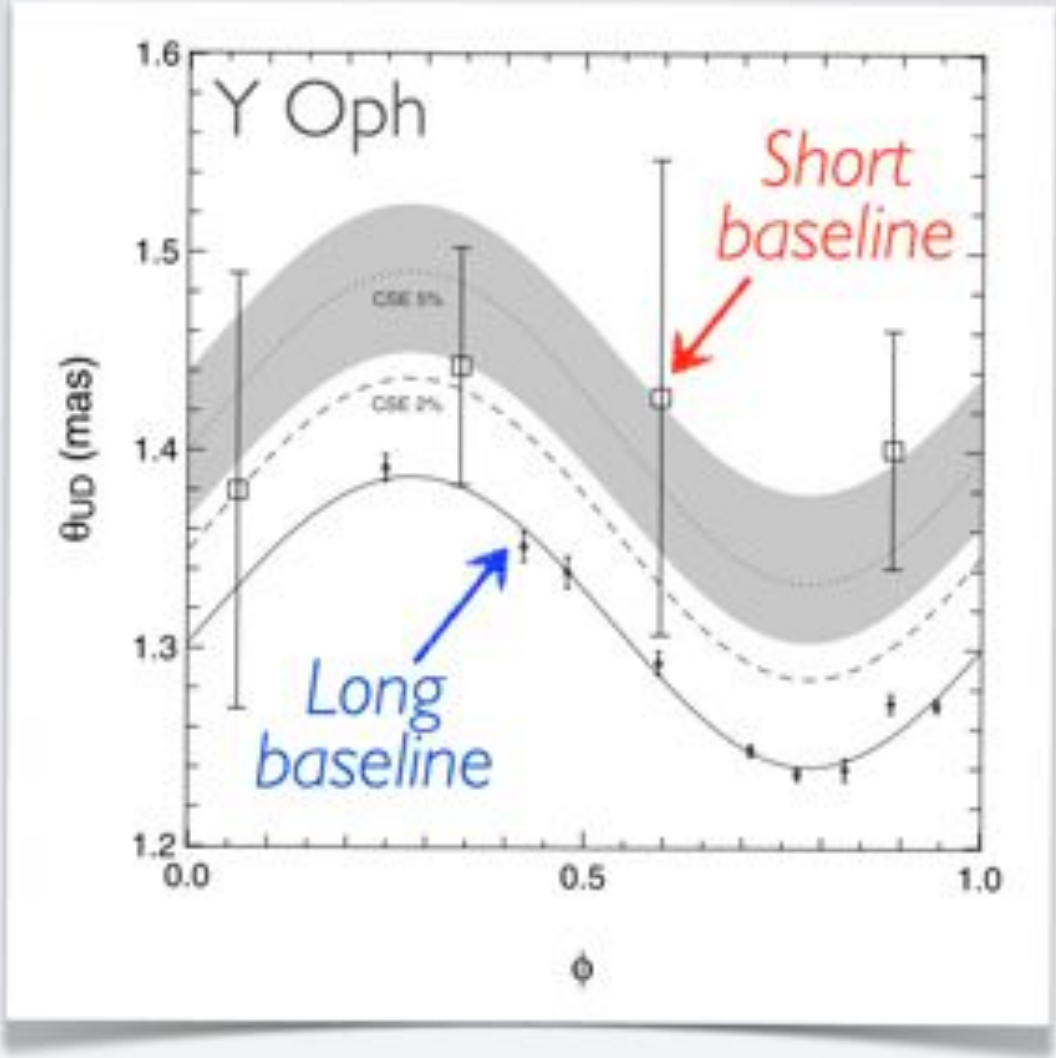


The distance d is given by the relation:

$$d = \frac{2\delta R(T)}{\delta\theta(T)} = \frac{-2\,k\,p\,\int_0^T v_{\mathrm{rad}}(t)\,dt}{\theta_{\mathrm{UD}}(T) - \theta_{\mathrm{UD}}(0)}$$

p = projection factor
$= V_{puls} / V_{rad} \sim 1.3$

k = limb darkening
$= \theta_{UD} / \theta_{LD}$
~ 0.94 in visible, 0.98 in IR

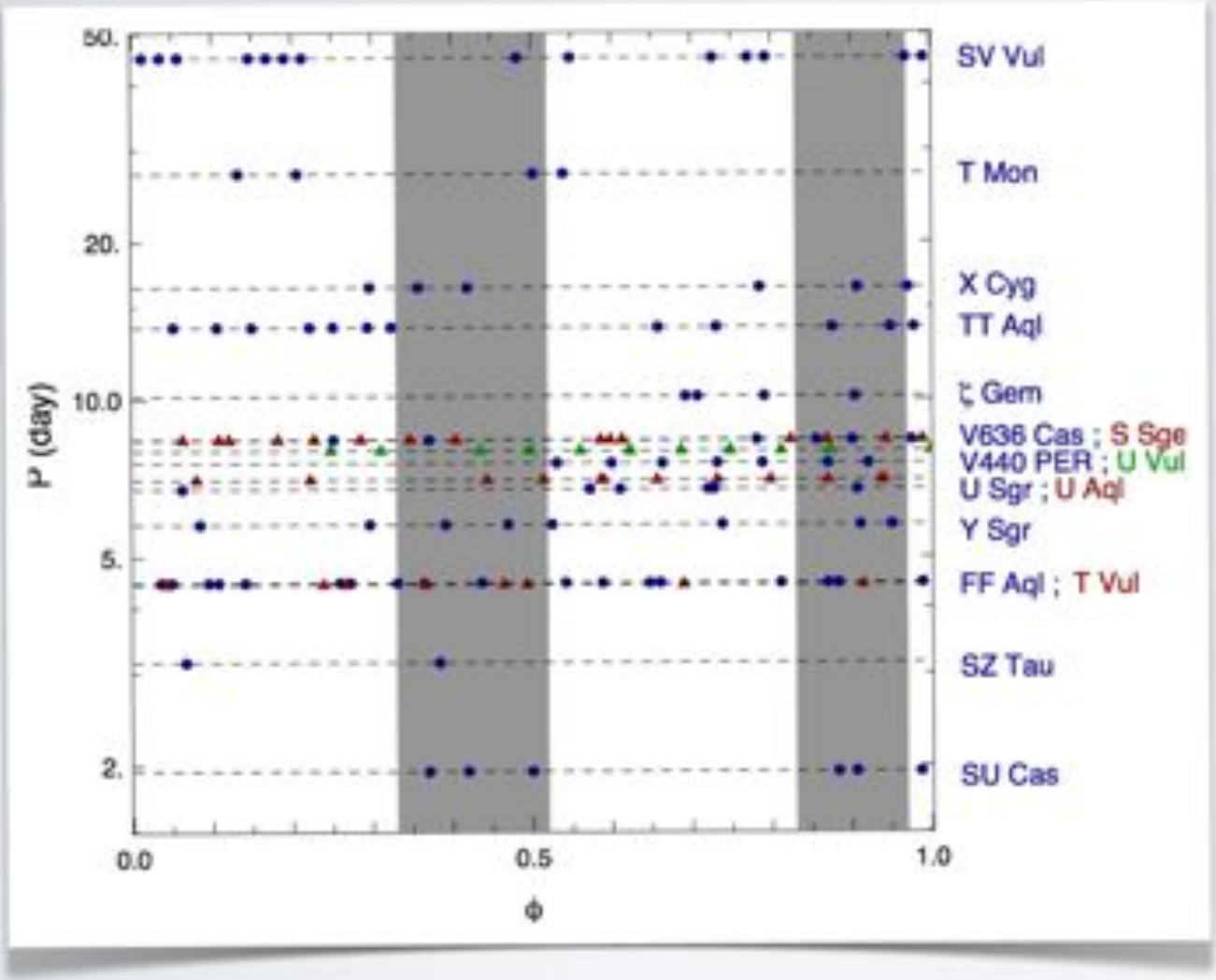


Extended circumstellar emission ~5% of the total flux in K

Unbiased distance: 491 ± 18 pc (4%) instead of 472 pc

Mérand et al. 2007, ApJ 664, 1087

CEPHEIDS OBSERVED BY INTERFEROMETRY

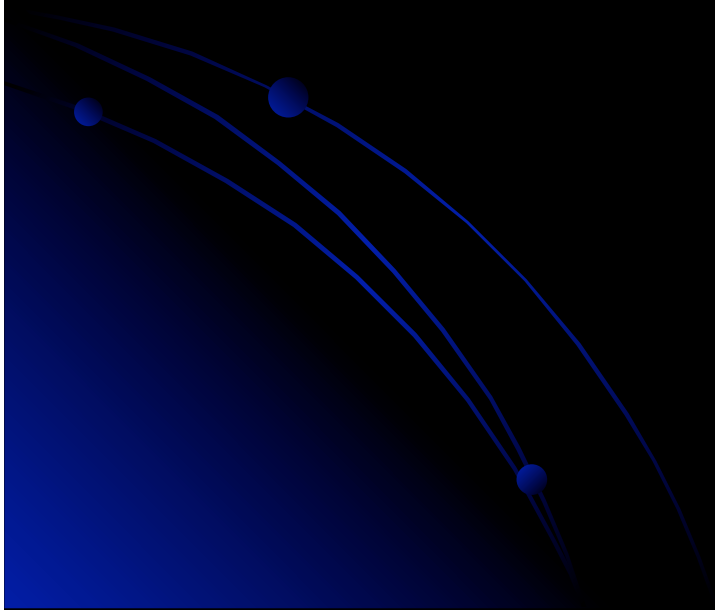


[Polaris] (3.97 d)
δ Cep (5.36 d)
X Sgr (7.01 d)
η Aql (7.17 d)
W Sgr (7.59 d)
β Dor (9.84 d)
L Car (35.6 d)
[RS Pup] (41.4 d)

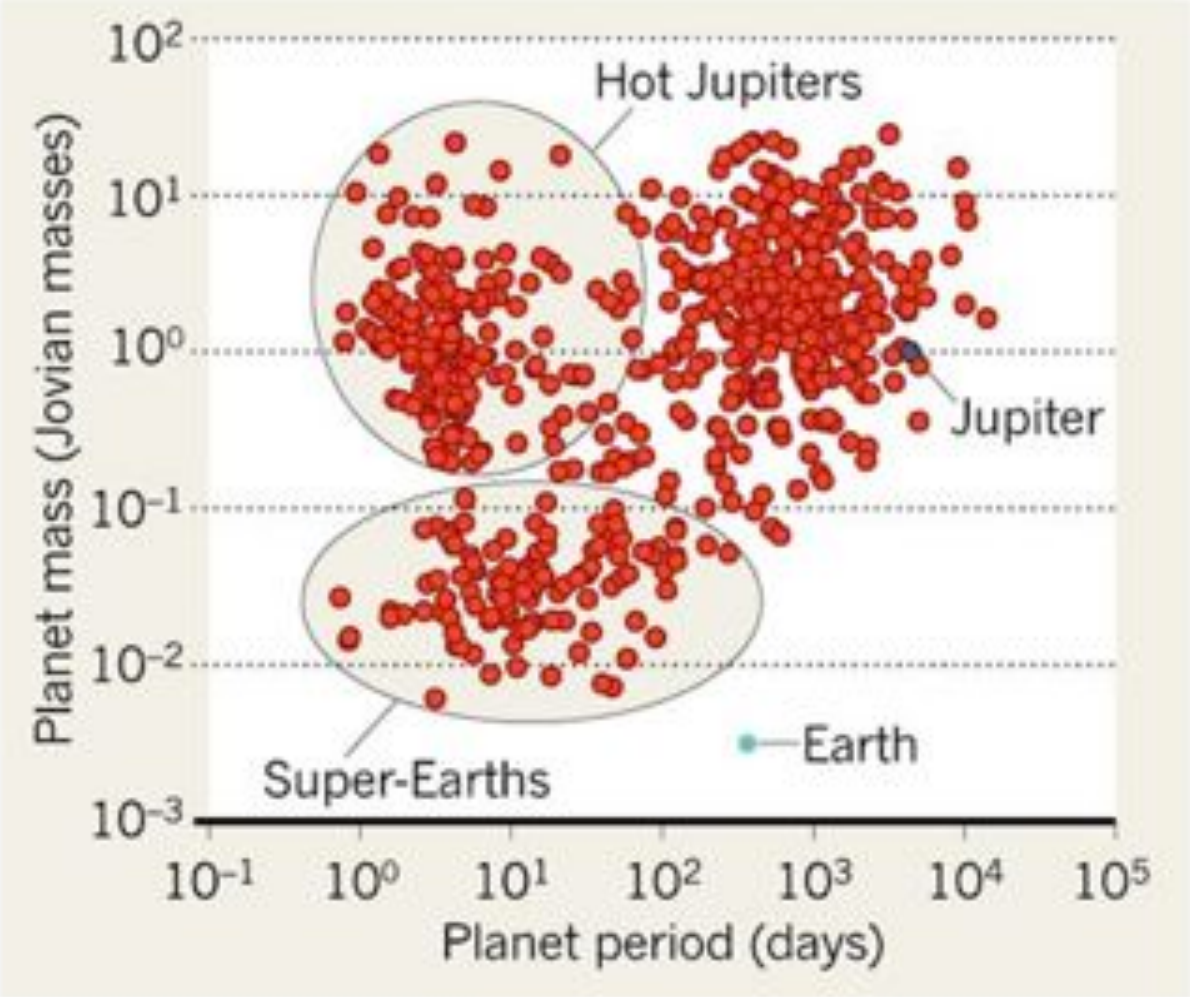
24 stars, with 22 stars suitable for IBW distance

Invited talk:

"Exploring the signatures of planet formation with multi-wavelength Interferometry" (S. Kraus)



Exoplanetary systems



Exoplanetary systems show surprising diversity

Key questions:

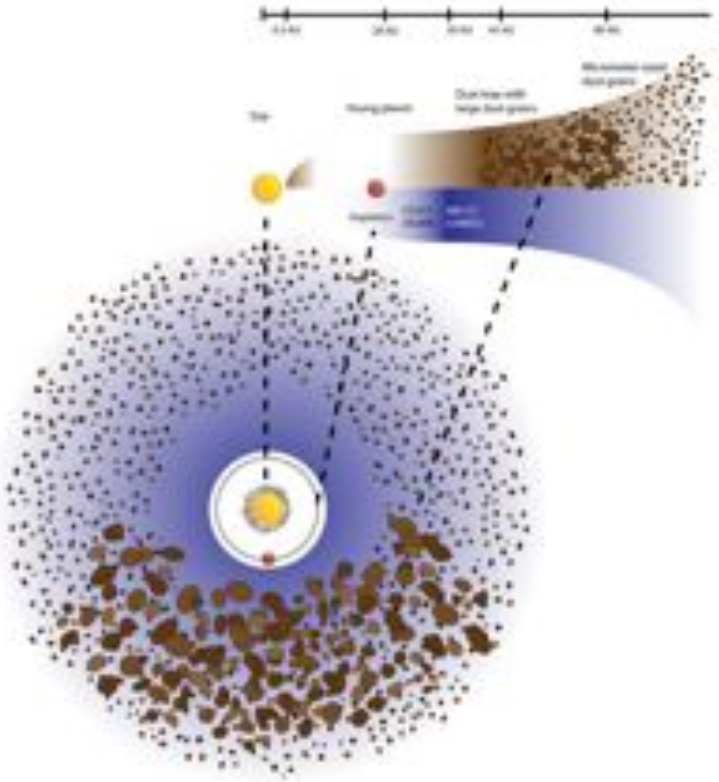
(1) What determines the architecture of planetary systems?

(2) Did the planets form where we observe them, or did they migrate due to planet-disk interaction?

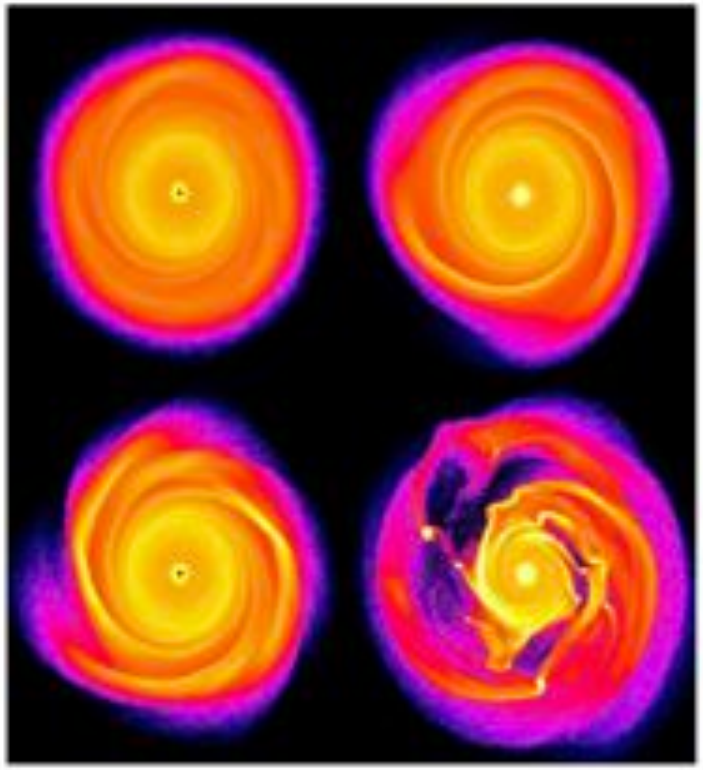
Hand 2011

Planet formation scenarios

Core accretion



Gravitational instabilities



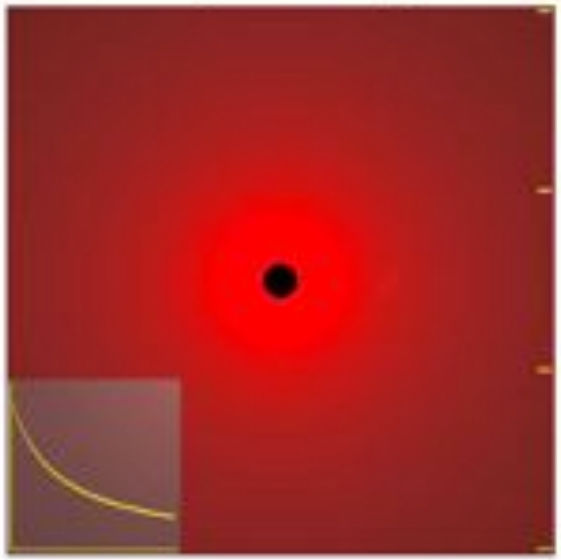
➜ Need to know **WHERE planets are forming** and **HOW they interact** with the disk material!

van der Marel 2013; Mayer et al. 2002

Signatures of planet formation

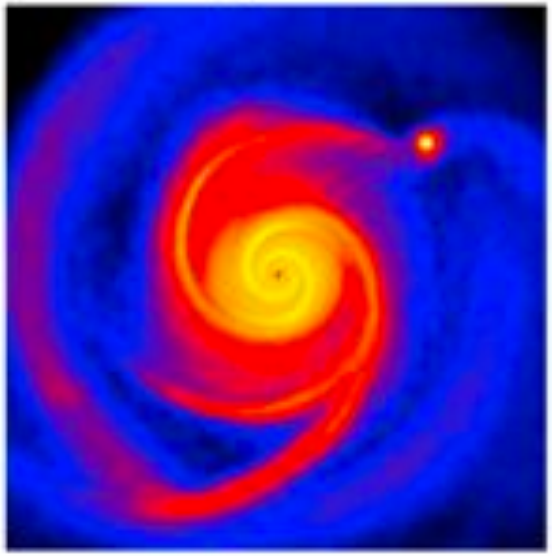
Planet formation alters the disk structure, causing
disk gaps, spiral arms, resonance effects, disk warping, ...

Gap clearing



Gaps leave signatures
in the SED
(e.g. Calvet et al. 2004)

Disk fragmentation



Disk warping

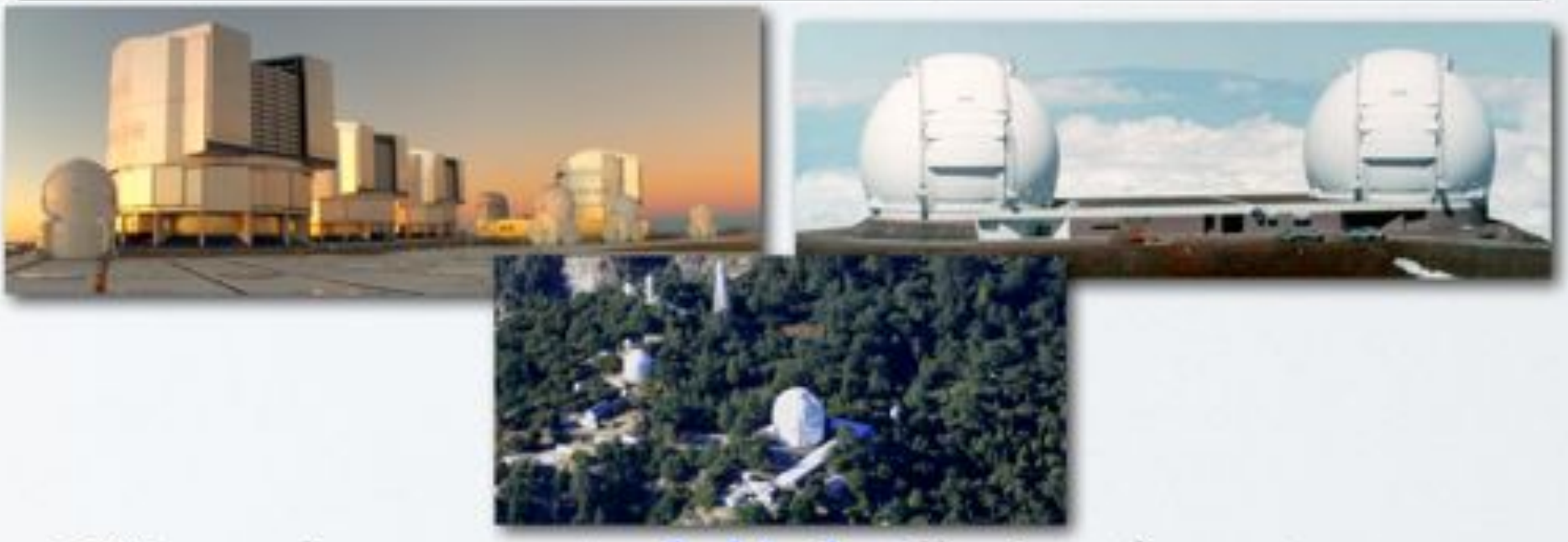
Asymmetric structures might cause
photometric/spectroscopic variability
(e.g. Muzerolle et al. 2009, Espaillat et al. 2011)

Armitage et al. 2005, Greaves et al. 2008

Contributed talk:

"The dusty heart of AGN revealed by IR interferometry" (S. Hönig)

IR interferometry of AGN

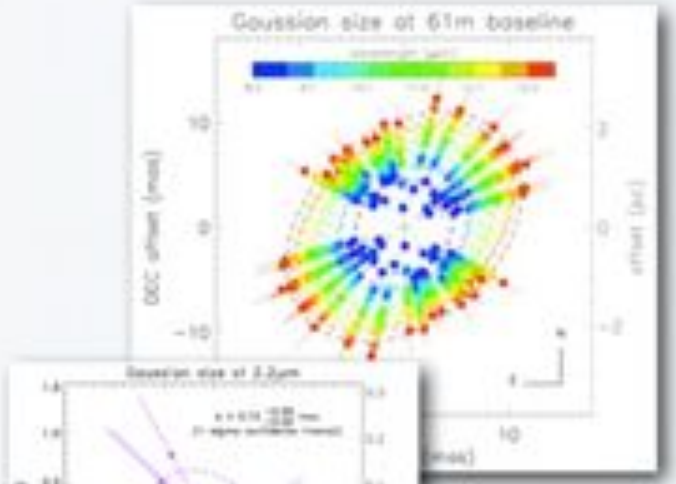


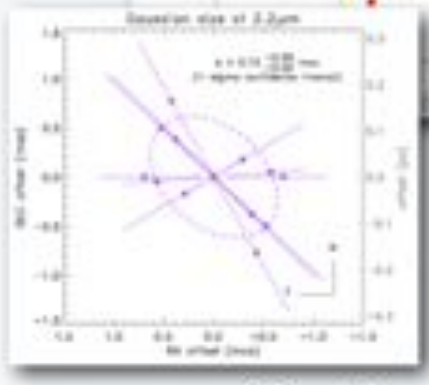
- We are always **one step behind** stellar interferometry...
  ... but we are **catching up**!
- **34 objects** successfully observed (plus 5+ with limits)
  → construction of useful samples; LP data just released[1]
- 9 objects with **closure phases**[2] in near-IR (→ images next)
- 3+ objects with additional **time-domain resolution**

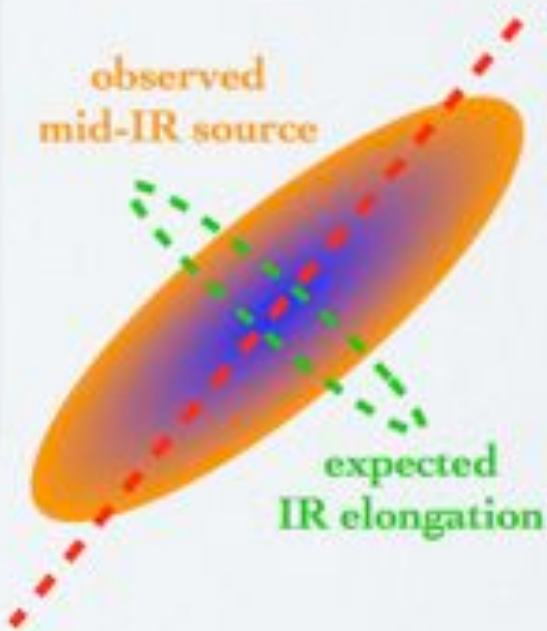
[1] Burtscher et al. 2013; [2] Weigelt et al. 2012, Kishimoto et al. 2013

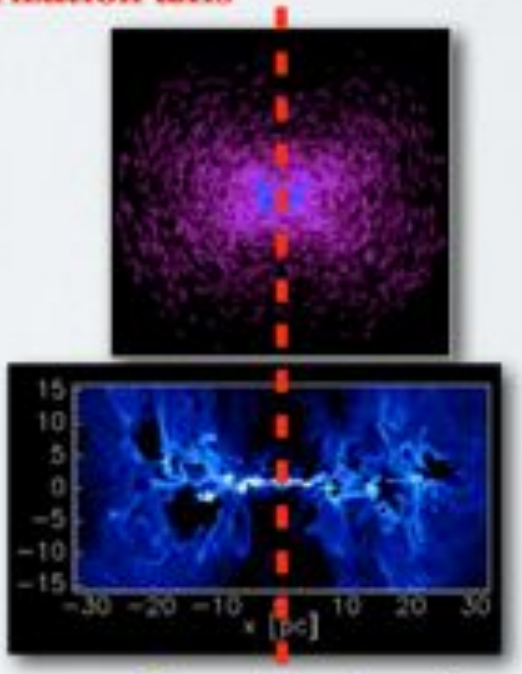
IR emission from the polar region

(publication + ESO press release on June 20)









- new finding: significant mid-IR emission from **polar region**[1] (→ **radiatively-driven dusty wind?** [2])
- tentative evidence of **dependence on accretion state** (L/L_{edd})
- will require reassessment of **models**, **interpretation**, ...

[1] Hoenig et al. 2012, Tristram et al. 2012, Hoenig et al. 2013; [2] Hoenig et al. 2012, Kishimoto et al. 2013b

The end of the road? NO!!!

- **Hurdles we are facing in AGN science now**
  - **sensitivity** limit: few AGN bright not observed by MIDI
  - **baseline** limitation: fainter objects are less resolved
- **Is there anything more to do?** **Heck yeah!**
  - recent discoveries show **requirement for good PA coverage**
  - **wavelength dependence** from hot to cool dust unexplored
  - **closure & differential phases**/images: Is the dust really **distributed symmetrically?** CP in **near-IR emission lines (BLR)**, ...
  - **time-domain regime**
  - cosmological applications, binary AGN, ...