

# European Interferometry Initiative

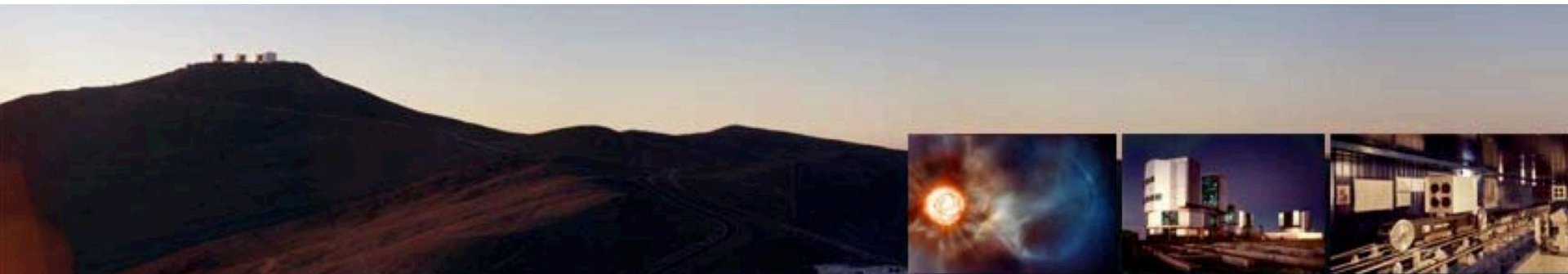
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Stefan Kraus  
University of Exeter  
President EII Science Council

EII Bureau: Paulo Garcia, Olivier Chesneau,  
Jean-Philippe Berger  
also thanks to: Guy Perrin, John Monnier



VLTI Community Days  
2014 January 16, Grenoble



# The European Interferometry Initiative

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Open association of institutes and laboratories willing to collaborate on the exploitation and development of long baseline interferometry in optical/infrared astronomy.

EII is the place where interferometry in Europe is discussed and organised on trans-national level

EII & ESO: EII should act aside ESO for scientific vision (trigger ESO's scientific thoughts, e.g. 2005 workshop on 2<sup>nd</sup>-gen. ) and act together with ESO to organize the community (VLTI Community Meetings, interact with the STC panel and with the VLTI Programme Scientist)

Lobbying with funding agencies and decision makers

A strong lobbying activity for interferometry in Europe is still necessary:

- We are in the E-ELT era
- ALMA is very strong and strongly supported
- Next big projects are the SKA, LSST ... no large optical interferometer!
- VLTI still needs strong support and strong vision (with a consistent plan-roadmap for the future)

# EII - Governing bodies

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## **Bureau:**

|                        |                      |
|------------------------|----------------------|
| President              | Stefan Kraus         |
| Vice-President         | Olivier Chesneau     |
| Secretary              | Paulo Garcia         |
| VLTI Project Scientist | Jean-Philippe Berger |

## **Science Council:**

|                |                      |
|----------------|----------------------|
| President      | Stefan Kraus         |
| Austria        | Josef Hron           |
| Belgium        | Jean Surdej          |
| Czech Republic | Pavel Koubsky        |
| ESA            | Malcolm Fridlund     |
| ESO            | Jean-Philippe Berger |
| France         | Alain Chelli         |
| Germany        | Thomas Henning       |
| Hungary        | Laszlo Mosoni        |
| Italy          | Sebastiano Ligori    |
| Israel         | Erez Ribak           |
| Netherlands    | Walter Jaffe         |
| Poland         | Andrzej Niedzielski  |
| Portugal       | Paulo Garcia         |
| Spain          | Carlos Eiroa         |
| Switzerland    | Didier Queloz        |
| United Kingdom | David Buscher        |

# OPTICON FP7 workpackages



The EII coordinates the activities of FP6 and FP7.

| Workpackage Number | Description  |
|--------------------|--|
| WP1                | Towards Adaptive Optics for the European Extremely Large Telescope |
| WP2                | Fast Detectors and Cameras   |
| WP3                | Astrophotonics   |
| WP4                | Image reconstruction in optical interferometry                     |
| WP5                | Development of Active Freeform Mirrors (AFMs)                      |
| WP6                | Novel Dispersive and Holographic Optical Elements for Astronomy    |
| WP7                | Transnational Access   |
| WP8                | Management   |
| WP9                | Innovation   |
| WP10               | European Extremely Large Telescope Science                         |
| WP11               | Time Domain Astronomy  |
| WP12               | Medium Sized Telescope Integration                                 |
| WP13               | Enhancing community skills - Integrating Communities               |
| WP14               | The European Interferometry Initiative                             |





# OPTICON FP7 workpackages

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Active working groups / Joint Research Activities:

- “Interferometric Image Reconstruction” JRA (2013-2016, chair: Eric Thiebaut)
- “Future of Interferometry in Europe” WG (2013-2016, chair: Jean Surdej)

Completed:

- “AGNs and the Galactic Center” (FP7-1, 2009-2012)
  - ➔ 2011 Lisbon workshop
- “Circumstellar disks and planets” (FP7-1, 2009-2012)
  - ➔ 2010 Kiel workshop & AARA article
- “Science cases for a 2<sup>nd</sup> generation facility” (FP7-1, 2009-2012)
  - ➔ 2010 JENAM session
- “Integrating interferometry into mainstream astronomy” JRA (FP6)
  - ➔ Feasibility studies for 2<sup>nd</sup> generation VLTI instruments
  - ➔ Offline data reduction: Model-fitting (LITpro) + image reconstruction
- Radiative transfer (FP6)
- Interferometry and astroseismology (FP6)

# Fizeau exchange grants

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## Goals:

- **Strengthen** nascent collaborations
- **Spread** interferometric knowledge across Europe
- **Enhance** the active participation of new countries in VLTI

## Methods:

- Fund short research/technical/training exchange visits (1 week – 1 month)
- Priority to young researchers and "knowledge poor" institutes
- Competitive calls twice a year (March and September)

Selection from an independent project office (chair: Josef Hron)

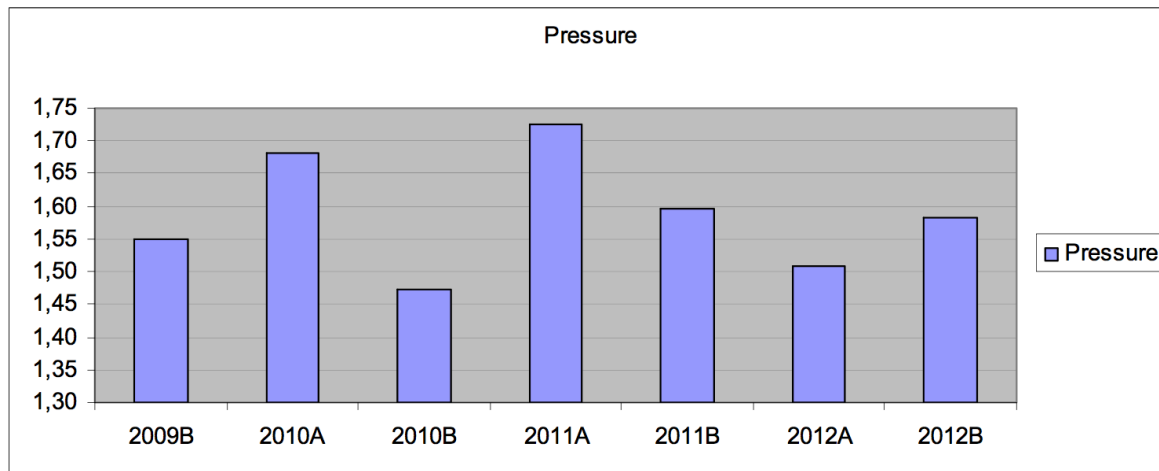
# Fizeau exchange grants

Publicity: Announced at OLBIN and through posters

Around 80 grants awarded between 2009-2012

Pressure stable around 1.6

Next call in March



# VLTI schools

- 2006 "Observation and Data Reduction with the VLTI", Goutelas
- 2007 "Circumstellar disks and planets at very high angular resolution", Porto
- 2007 "AGNs at the highest angular resolution", Torun
- 2008 "Astrometry and Imaging with the VLTI", Keszthely
- 2010 "High spatial resolution in astronomy", Porquerolles Island
- 2013 "High angular resolution for stellar astrophysics", Barcelonnette
- next: Cologne (likely 2015)



# Coordination

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GRAVITY and MATISSE are coming and require full attention in order to make them a success!

At the same time, start planning for the time after GRAVITY and MATISSE:

→ **Future VLT I instruments:**

Community feedback now could guide upcoming VLT I infrastructure decisions;  
Future VLT I instrument proposals will compete with UT instrument proposals

→ **Long-term scientific vision:**

helps to justify further technological developments in OIR interferometry.

# Future of Interferometry in Europe

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## EII working groups:

- Circumstellar disks and planets (2009-2012)
- AGNs and the Galactic Center (2009-2012)
- Science cases for a 2<sup>nd</sup> generation facility (2009-2012)
- Future of Interferometry in Europe (since 2013)

## Dedicated workshops on the Future of Interferometry:

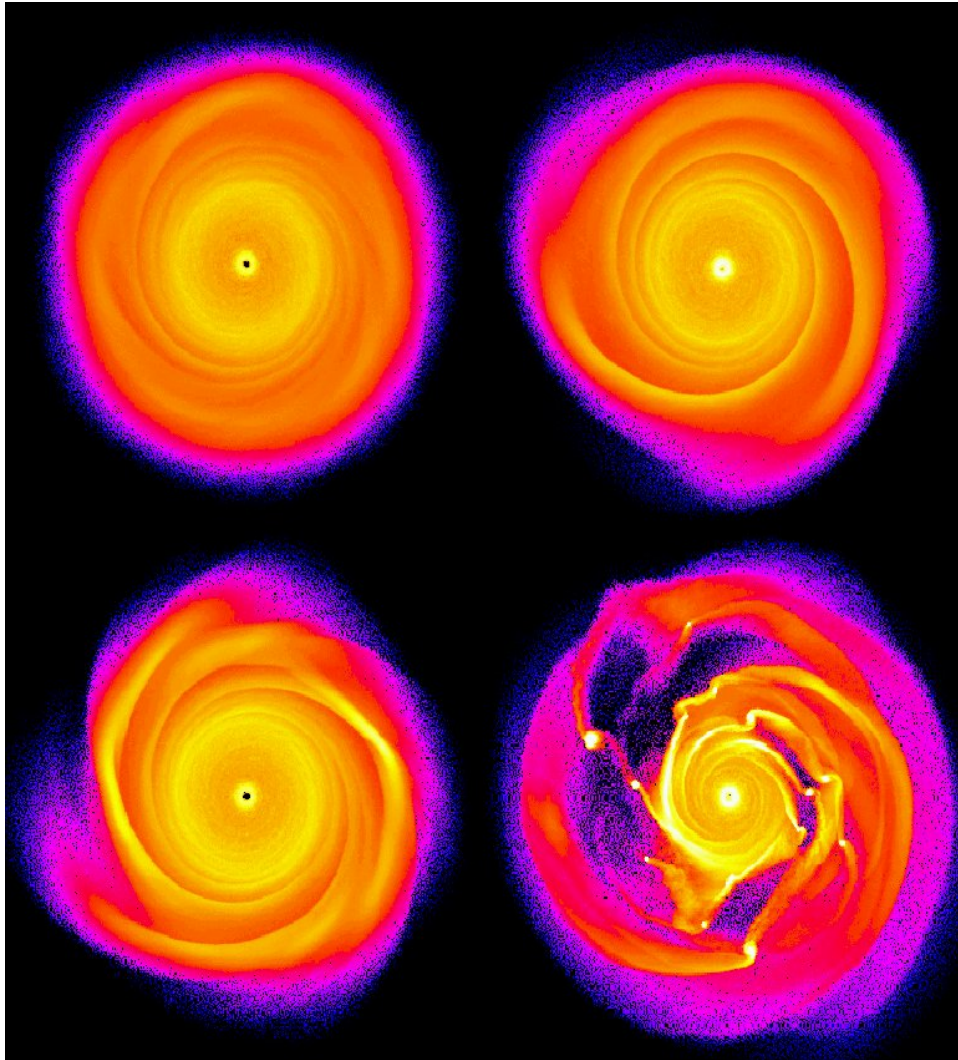
- 2004: Workshop "Science cases for next generation OIR interferometric facilities", Liege
- 2005: Workshop "Technology Roadmap for Future Interferometric Facilities", Liege
- 2010: JENAM session "Science Cases for OIR Interferometers – Present and Future", Lisbon
- 2013: EWASS session "Science with present & future interferometric instruments", Turku
- 2013: Workshop "Improving the performances of current optical interferometers & future designs", OHP

Similar efforts in the US (Interferometry Forum) and in national communities

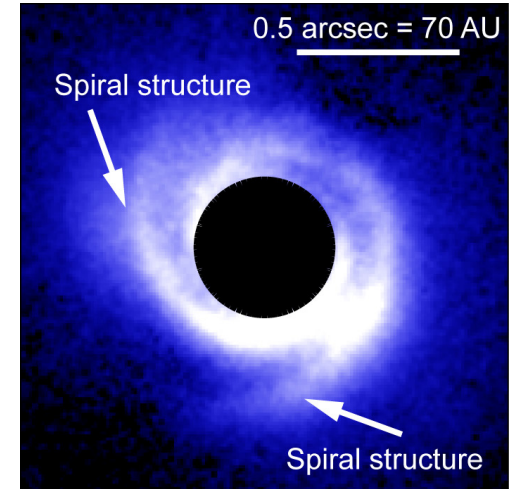


# Science Case: Planet Formation

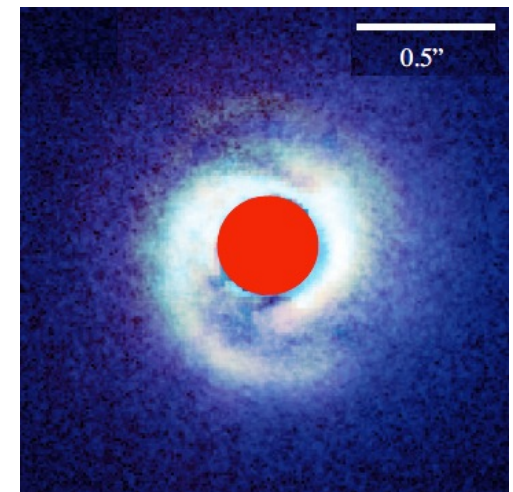
Planet formation is a highly complex & dynamical process



Quinn et al. 2002

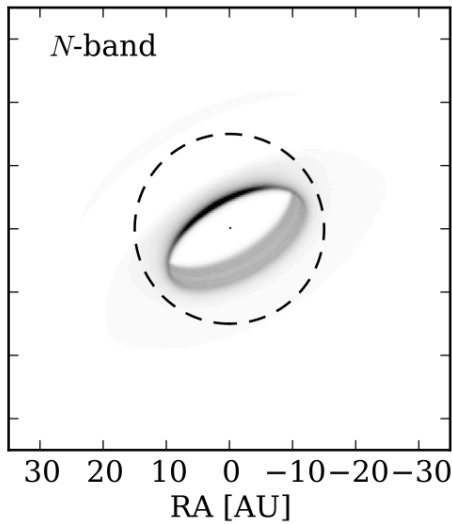


SAO206462, Dong et al. 2012

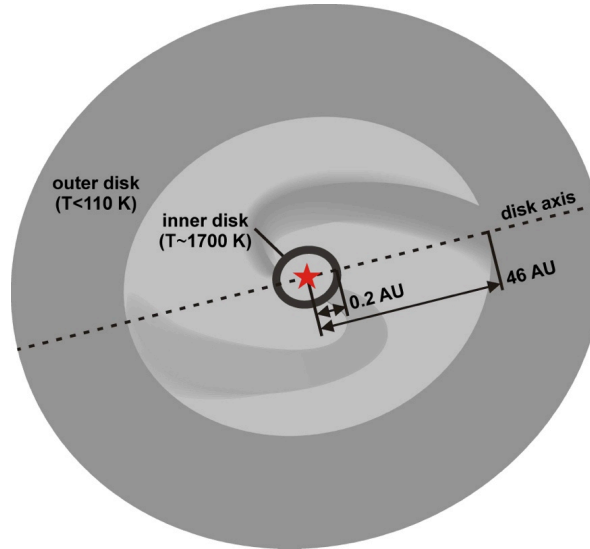


MWC758, Grady et al. 2013

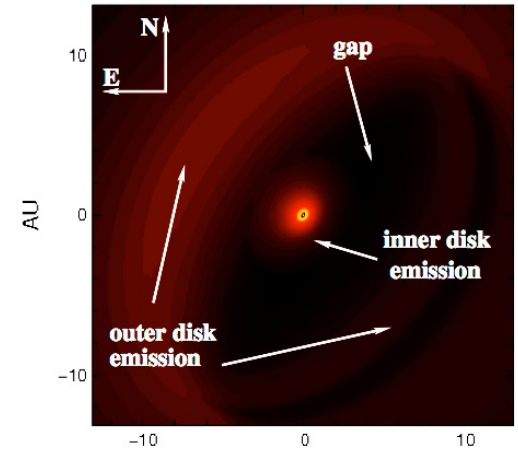
# Science Case: Planet Formation



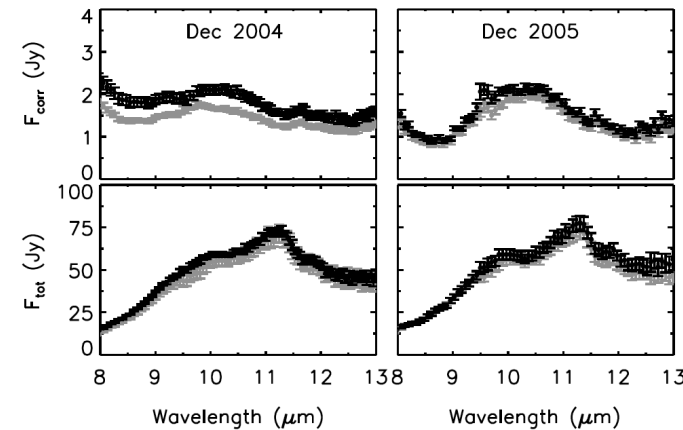
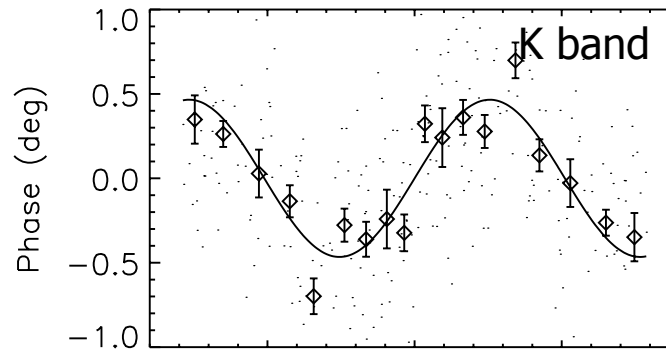
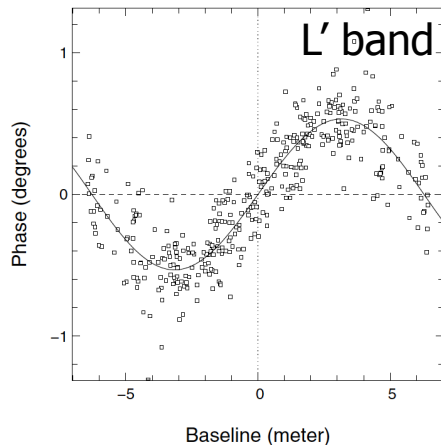
Huélamo et al. 2011  
Olofsson et al. 2011, 2013



Kraus et al. 2013



Benisty et al. 2010  
Tatulli et al. 2011  
Panic et al. 2012  
Mulders et al. 2013



→ Emission from outer disk?  
Companion signature?

→ Disk asymmetry

→ Temporal changes



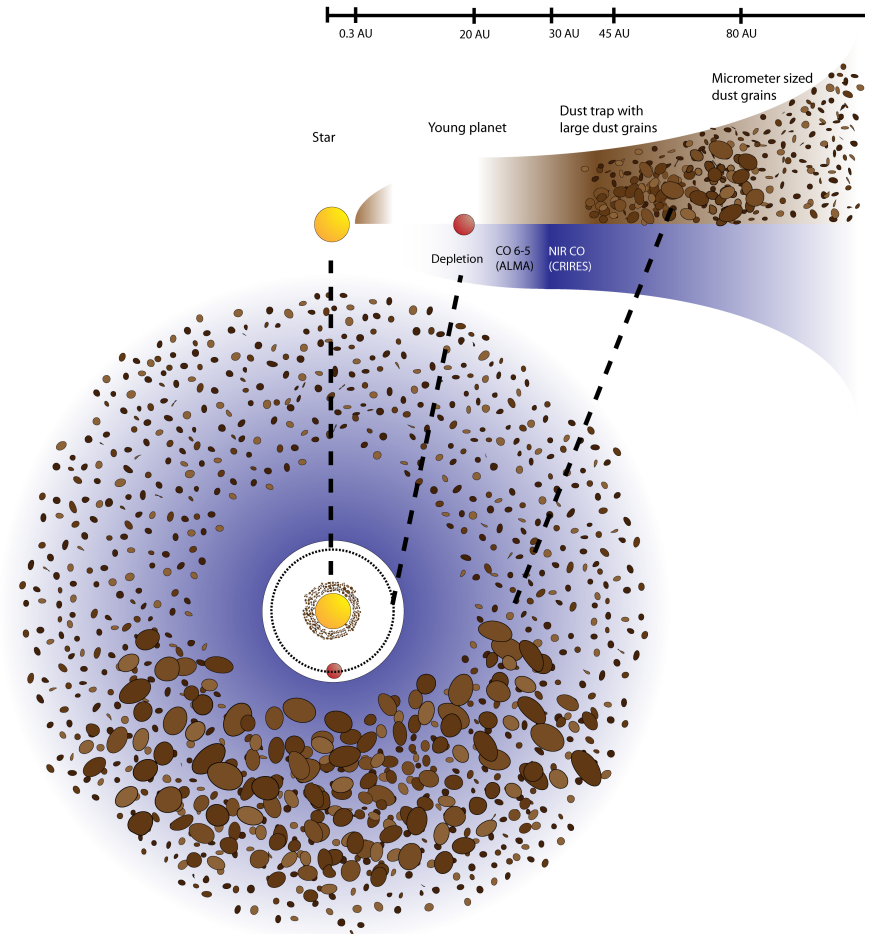
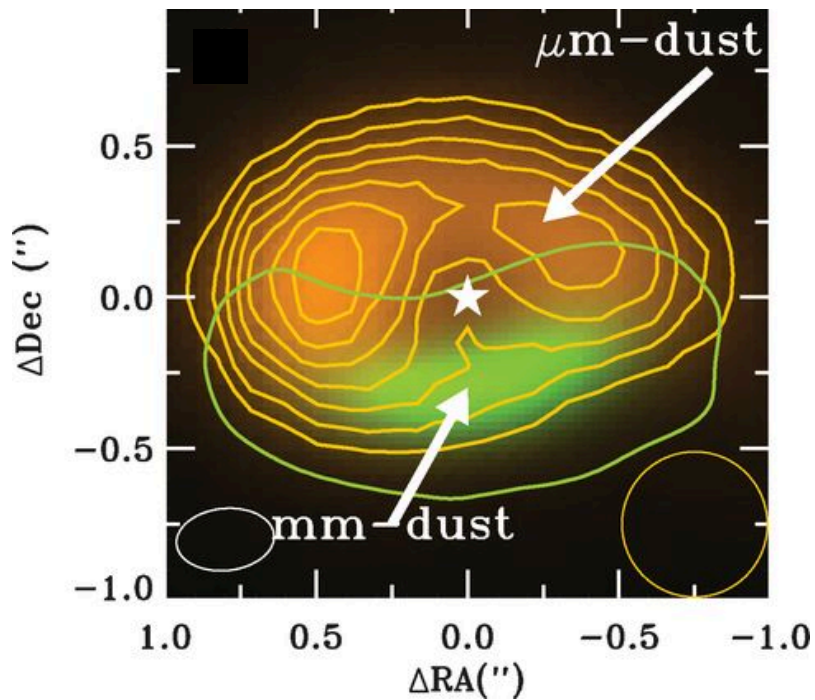
# Science Case: Planet Formation

Trace small dust grains & detect gradients in dust mineralogy

➔ early stages of grain growth and gap opening

Determine distribution of ices & water

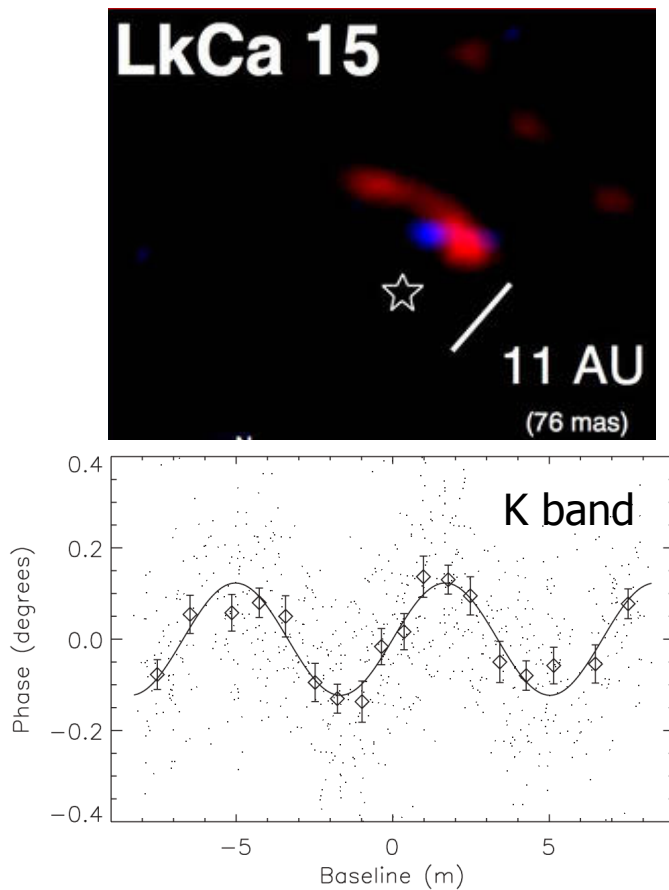
➔ link to habitability



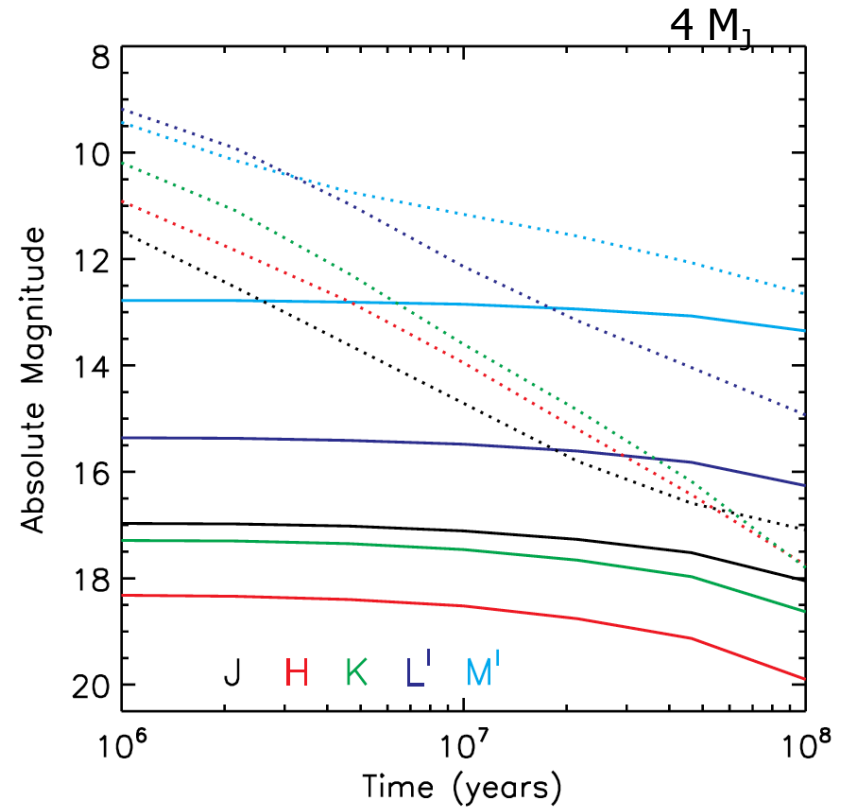
van der Marel et al. 2013

# Science Case: Planet Formation

Detect young, accreting protoplanets



Kraus & Ireland 2012



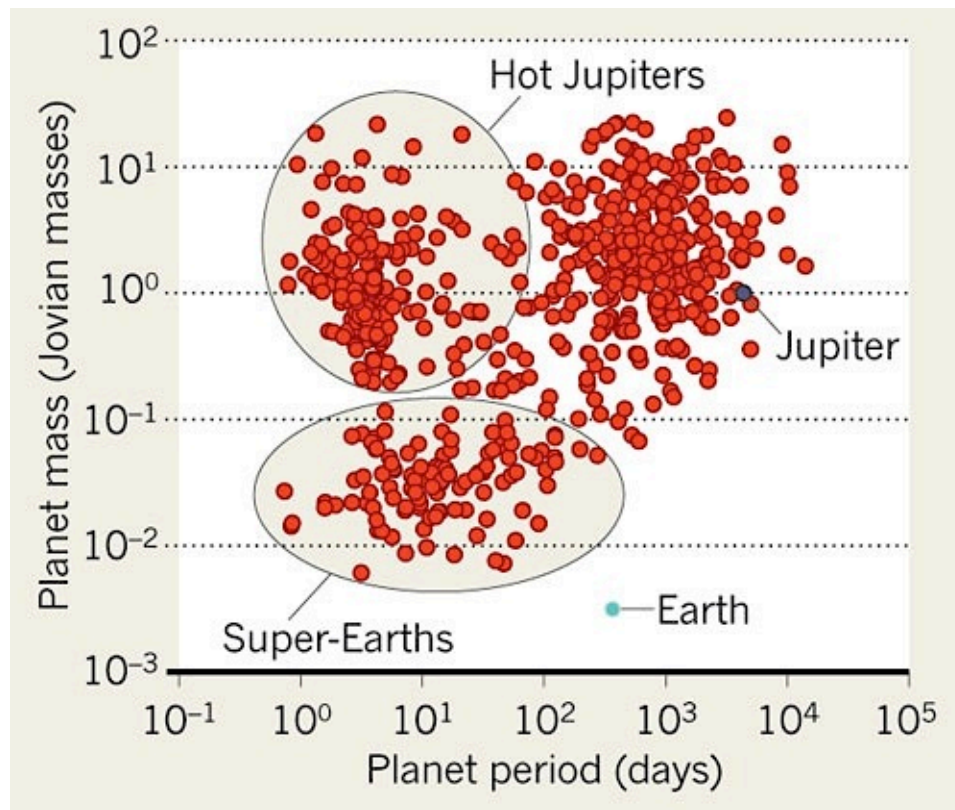
Forney et al. 2008

# Science Case: Planet Formation

Detect young, accreting protoplanets

→ constraints on **planetary migration**

→ link to **exoplanet statistics**

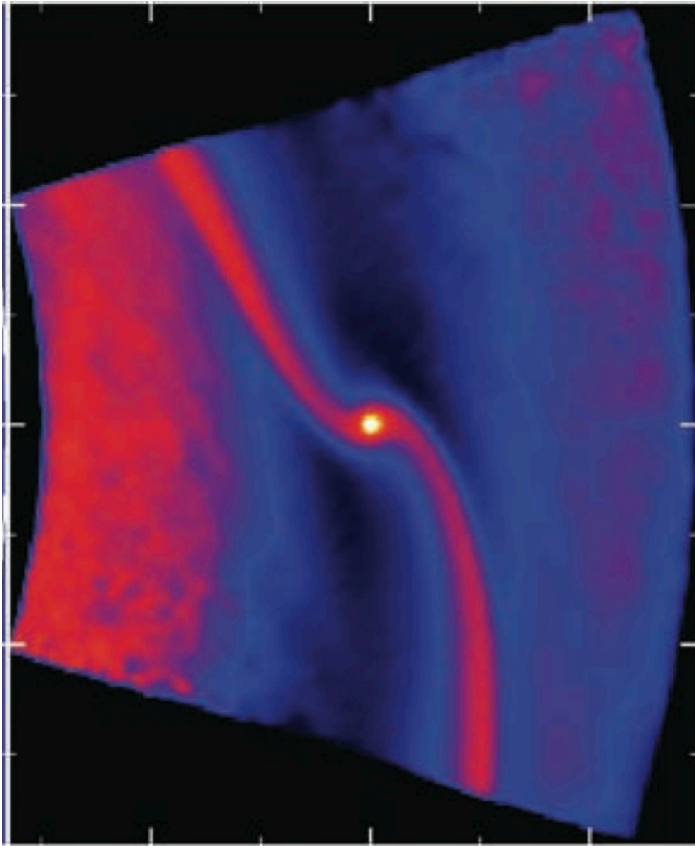


## Key questions:

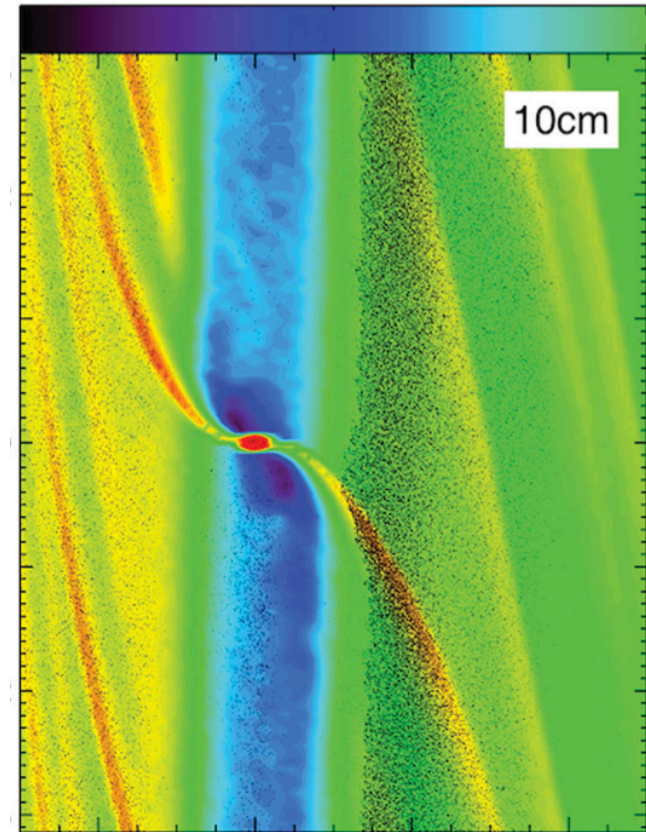
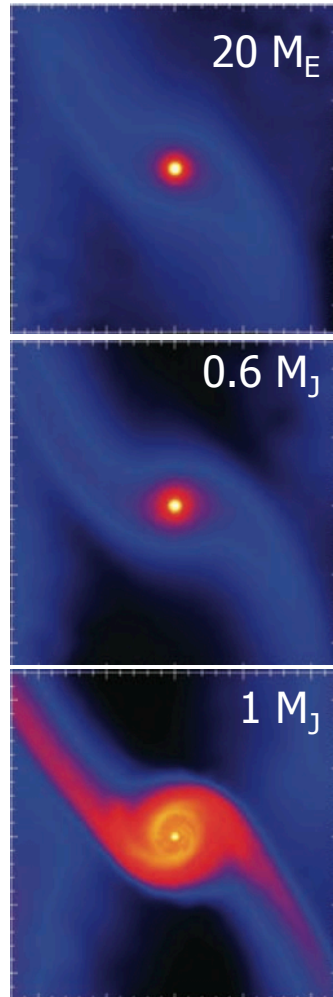
- (1) What determines the architecture of planetary systems?
- (2) Did the planets form where we observe them, or did they migrate due to planet-disk interaction?

# Science Case: Planet Formation

Study the protoplanetary accretion disk



Ayliffe & Bate 2009



Ayliffe et al. 2012

# Science Case: Planet Formation

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- Science case appears well suited to **gather support** from the wider astronomical community (see ASTRONET roadmap & US decadal review!)
- **Strong existing momentum** in the field (in particular due to ALMA)
- **Complementary aspects** to ALMA:
  - ➔ higher resolution allows probing terrestrial planet-forming zone, which is dominated by other mechanisms (dust sublimation, gas-disk truncation, magnetospheric accretion, ...)
  - ➔ NIR/MIR probes complementary opacity regimes, grain sizes, and line tracers
- The sensitivity requirements have already been demonstrated
- We benefit from exciting new technology developments on the horizon (MIR fibers, detectors, heterodyne beam combination with coherent laser combs, ...)



# Planet Formation Imager (PFI)

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## Strategy:

Build support in the science community & interferometry community, start lobbying with decision makers (e.g. ASTRONET, ESO) and prepare for upcoming funding opportunities (OPTICON, decadal review)

Tentative international “Kick-off committee” with balanced representation from EU, US, Australia, and IAU C54 has been formed

- Define **Scientific Advisory Committee** to develop and prioritize key achievable science cases
- Define **Technical Advisory Committee** to develop a technology roadmap, taking new technical developments into account
- Set up **Project Steering Committee**

A dedicated session at SPIE (Montreal, June 2014) has been proposed.

PFI will certainly also revolutionize other science areas

Sign up for PFI Mailing list and state your level of interest:  
[www.planetformationimager.org](http://www.planetformationimager.org)