1. Spectroscopic characterisation of young stars

Valentina D'Orazi, Silvano Desidera, Raffaele Gratton

Martina Baratella, Giovanni Carraro (UniPD)

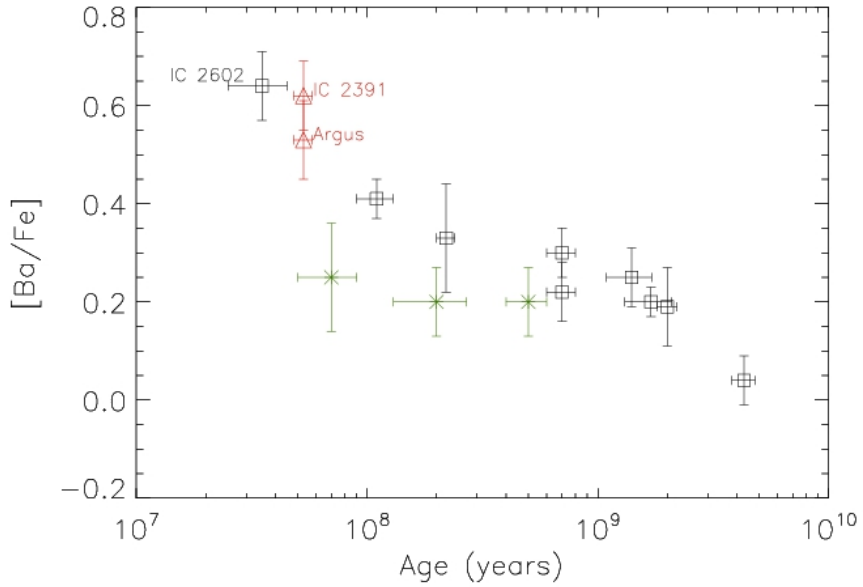
+

Many collaborators (L. Spina [Monash], S. Randich & L. Magrini [Arcetri], The Gaia-ESO consortium, J. Melendez [S. Paolo])

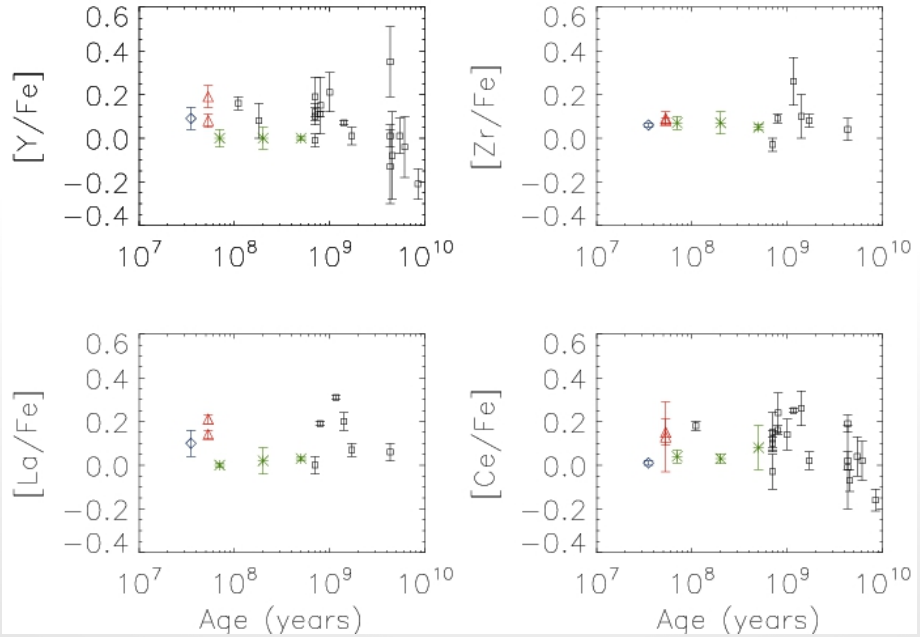
OAPD days, June 17 – 18 2019, Padova

The Barium issue

Open clusters with ages less than ~ 200 Myr display a very peculiar behaviour in terms of Ba content →
[Ba/Fe] up to 0.6 dex in PMS clusters : NO EXPLANATION !!!



The extremely high abundances for Ba (more than a factor of four the solar value) is NOT accompanied by similar enhancements in other s-process elements



D'Orazi, De Silva, Melo 2017

Whatever is the nature of this Ba enhancement, we can exploit it as an indication of youth and/or membership (Vigan+ 2016 for GJ758, D'Orazi+ 2017b for GJ504)

Age is extremely critical for planet-host stars

In particular for field stars present the common drawback of having significant uncertainties in their ages, which translates themselves into a corresponding uncertainty in planetary masses: this severely affects the calibration of the age-luminosity relationship for sub-stellar objects and is crucial to our understanding of how planets have formed.

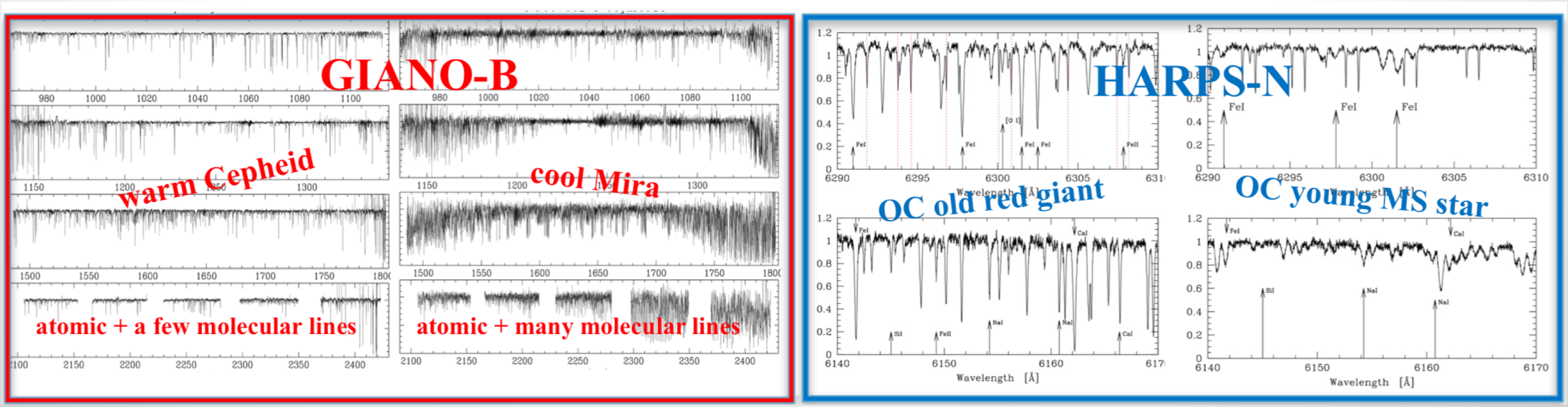
SPA – Stellar Population Astrophysics

PI L.Origlia, WP Resp. G.Bono[Miras/Cepheids], A.Bragaglia [OCs], E.Dalessandro [Massive Clusters]

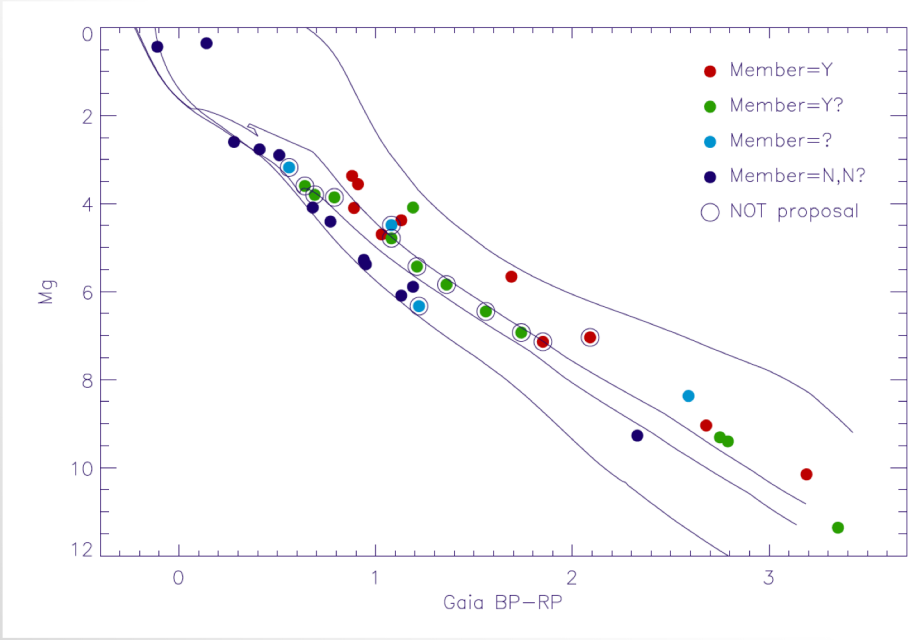
80 nights (26 already executed in AOT37,AOT38 + 13 in AOT39) / 3 yrs
GIARPS (GIANO-B+HARPS-N) spectra
500+ stars in the MW disk & clusters with different ages and RGC's

First high resolution, multi-element chemical maps of the Solar neighbourhood, Scutum-arm & Persei complexes and of the inner+outer disc

Aims: ** radial/azimuthal gradients, age-chemistry relations, cosmic scatter and other inhomogeneities*
** critical tests of stellar evolution & stellar physics*



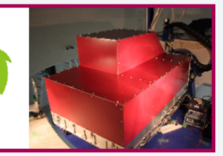
Determining the spectral properties of young, PMS stars in moving groups/young associations



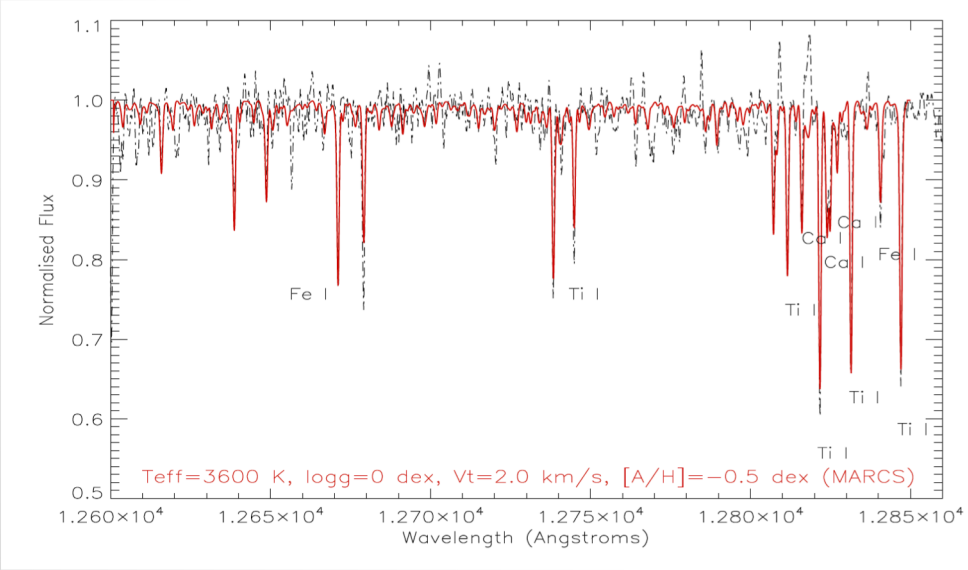
Identification of new members in the Cepheus Association [Desidera+, in prep.]

Deriving fundamental properties (Lithium, Rotation, Spectral type, kinematics) of possible members of the Cepheus association (also important in the SHARK-NIR context)

2. WINERED and the abundances of Miras



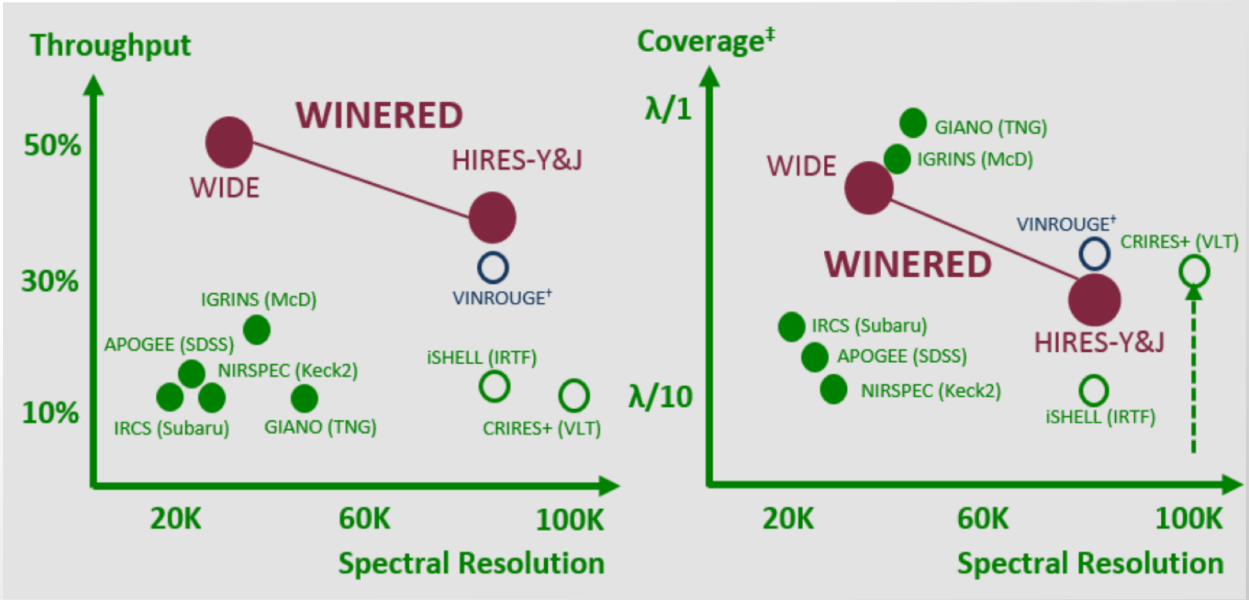
[V. D'Orazi, G. Bono, N. Matsunaga, Y. Wang et al]



WINERED (Warm INfrared Echelle spectrograph to Realize Extreme Dispersion and sensitivity) has three distinctive features: warm optics (no cold stop), wide spectral coverage (0.90–1.35 μm), and high sensitivity.

WINERED has two observing modes: "WIDE" (R=28,000) and "HIRES-Y&J" (R=68,000).

V1 in NGC 5927 (first high-resolution abundance study of a Mira, D'Orazi+ 2018). More to come on 47 Tuc and NGC 362 [Wang, D'Orazi+ 2019, in prep.]



3. Science cases for SHARK-NIR AT LBT

On behalf of the SHARK-NIR science team:

S.Antoniucci, F.Bacciotti, S.Benatti, M.Bonavita, A.Bongiorno, M. Bonnefoy, L. Borsato, W. Brandner, E. Brocato, F. Cantalloube, E. Cappellaro, G. Chauvin, R. Claudi, L. Close, I. Crossfield, P. Delorme,S. Desidera, F. Fiore, A. Fontana, E. Giallongo, T. Giannini, M. Gilke, V. Granata, R. Gratton, T. Henning, P. Hinz, M. Kasper, E. Lagadec, F. Launhardt, F. Leone, AL Maire, L. Malavolta, J. Males, F. Massi, D. Mesa, G. Micela, V. Nascimbeni, B. Nisini, I. Pagano, D. Perna, G. Piotto, L. Podio, M. Rieke, E. Sani, G. Scandariato, E. Sissa, A. Sozzetti, V. Testa, M. Turatto, S. Zibetti, A. Zurlo

Exoplanets: detection and characterisation

VD [INAF Padova] + Simone Antoniucci [INAF Roma]

Discs around young stars and their jets

Francesca Bacciotti [INAF Arcetri]

Extragalactic science:
AGN and QSO

Angela Bongiorno [INAF Roma]

Solar system
Main Belt & Trans-Neptunian objects

Davide Perna [INAF Roma]

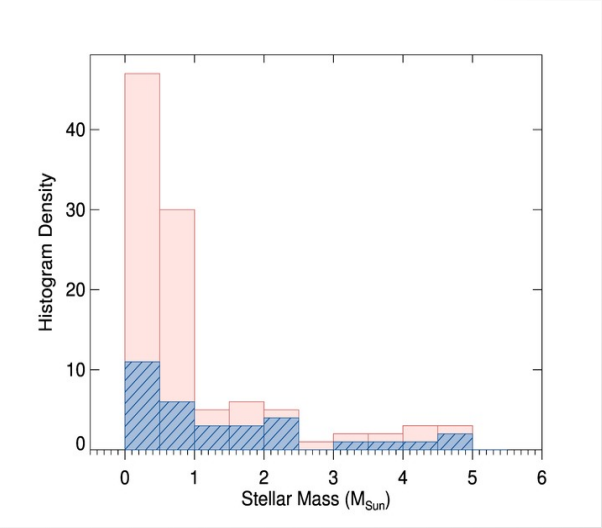
Giant Planets in wide orbits around low-mass stars

A special niche for SHARK is offered by the LBT AO at faint mag, especially with AO upgrade: wide planets orbiting low-mass stars (e.g., K/M dwarfs in young associations and SFRs like Taurus)

1. Giant planets in Star Forming Regions

Taurus-Auriga: ages of about 1-2 Myr, at a distance of about 140 pc. ***About 350 members were identified, 130 of which brighter than R=15.***

2. Giant planets around K/M type stars in young (loose) associations (age 10 – 100 Myr)



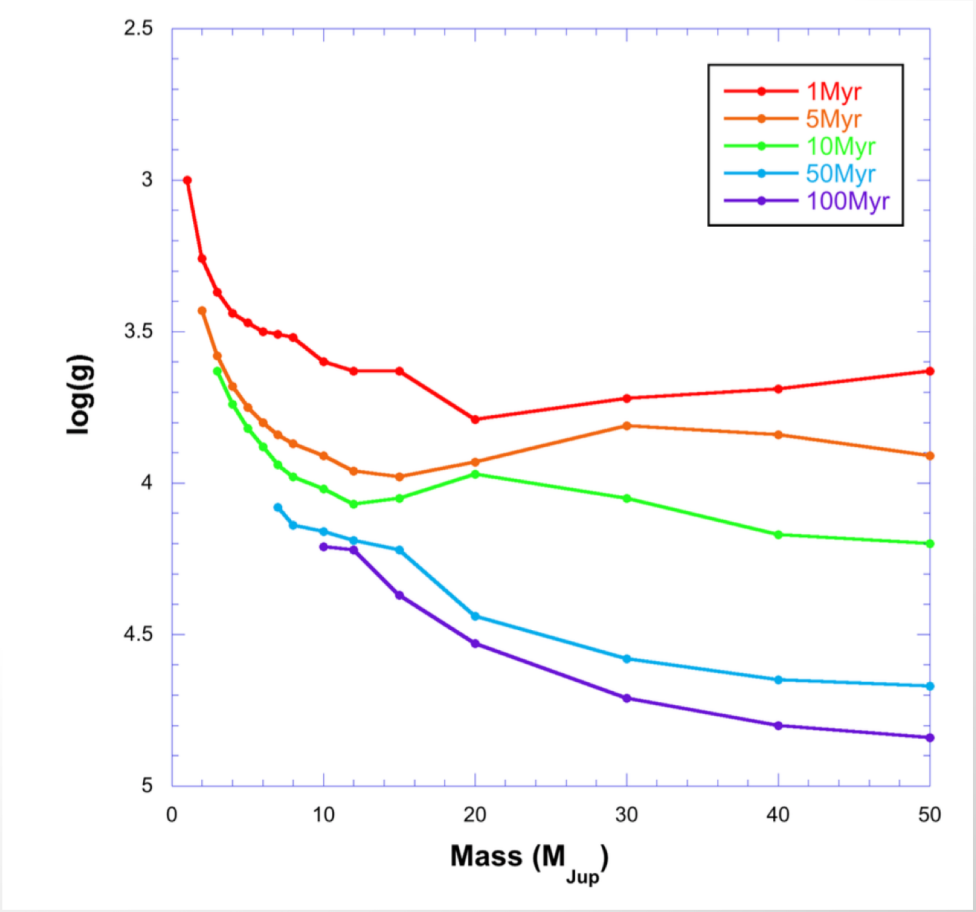
The identification and the physical properties of planets in their very early stages will allow to obtain crucial information on the formation mechanisms (core accretion, disc instability), together with the study of the planet-disc interactions

Key diagnostics for gravity estimates with coronagraphic long-slit spectroscopy

One way to distinguish between young and old brown dwarfs is to look for gravity-sensitive spectral features.

Young objects can exhibit significantly lower surface gravities (10–100 times) than the more massive, evolved dwarfs of the same spectral type.

Gorlova+(2003) showed that the neutral potassium (K I) lines in the J band are very sensitive to surface gravity.
Other sensitive lines are:
NaI at 1.14 um (Allers+2007) and FeH at 0.99 um (McGovern+ 2004)



See Bonavita, D'Orazi+ 2017 for HIP19176

Astrometry *[A. Sozzetti, OATo]*

Astrometric monitoring of short-period systems (typically < 10 au)
(total dynamical mass of the system and individual masses of the component if RV measurements available)

Two class of objects:

** Low-mass binaries (BD binaries, such as e.g., HD130948, Gl417)*
→ *evidence for luminosity problems for several systems, suggesting missing physical mechanisms in the atmospheric and evolutionary models of cloudy brown dwarfs with dust-rich atmospheres*

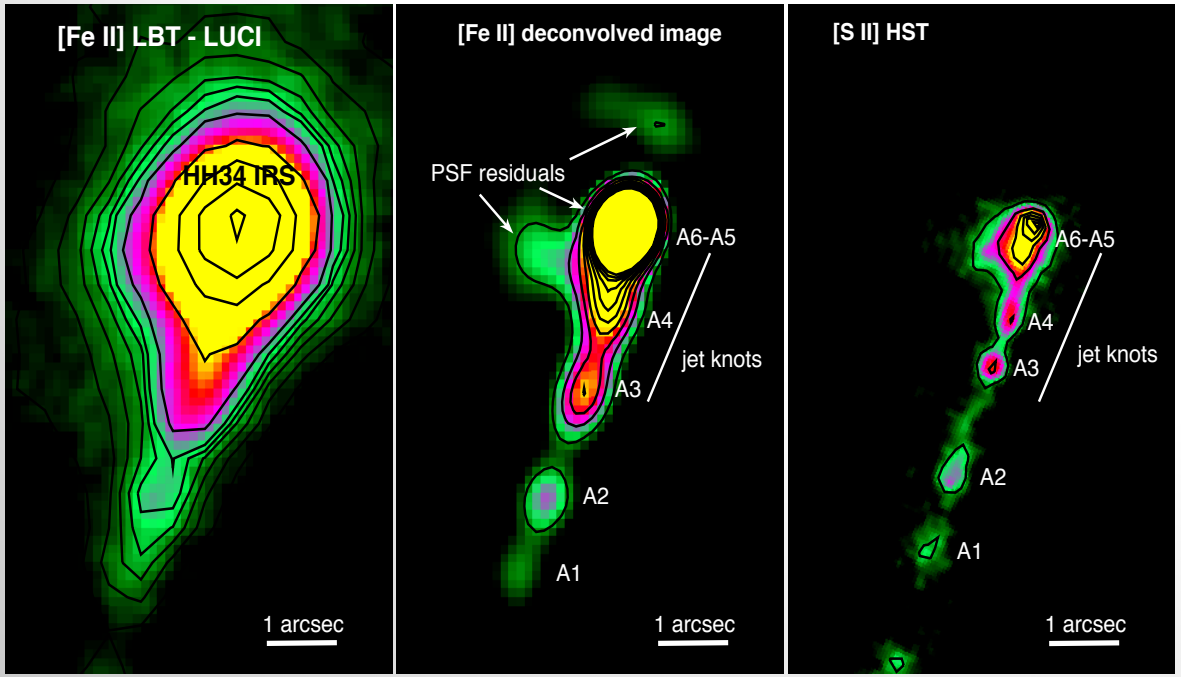
*** Young star primary and a brown-dwarf or giant planet companion*

SINERGY WITH GAIA

Discs around Young Stars and their Jets

- *High-contrast imaging of circumstellar discs with NIR coronagraphy.*
- *Coronagraphic or classical imaging of stellar jets*
- *2D kinematical maps of jets*

Narrow-band images of jets reveal the generation mechanism and its feedback on the star/disc



Antoniucci+ (2014)

Goals:

understand dynamic role of jets in shaping the disc structure

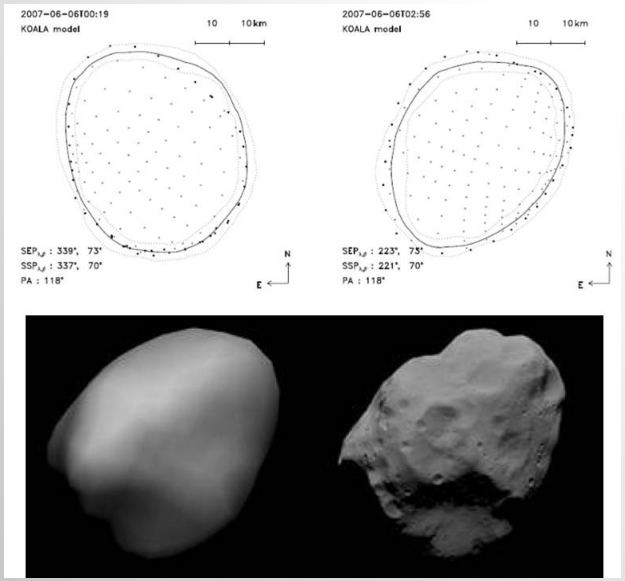
Probe the innermost regions of discs and jets in T Tauri stars (Binocular observations VIS+NIR)

H_2 as key tracer: SYNERGY with LMIRCAM

Near: Solar system
Far: AGNs/QSOs

1. NIR colours (Imaging) for Main Belt Asteroids [R=10-12, no need for AO guide star] to complement VIS colours.
About 100 of such large MBAs present an angular size larger than about 50 mas → 3D shape

2. Trans-neptunian objects (R=18-20, but slow-moving)



(1) Discover and fully characterise the AGN close pairs;
(2) Constrain the Black Hole feeding mechanism (e.g., SN driven winds vs gravitational asymmetries) in local Seyfert galaxies
(3) Trace, in bright quasars, molecular outflows powerful enough to clean the inner kpc and quench the star formation