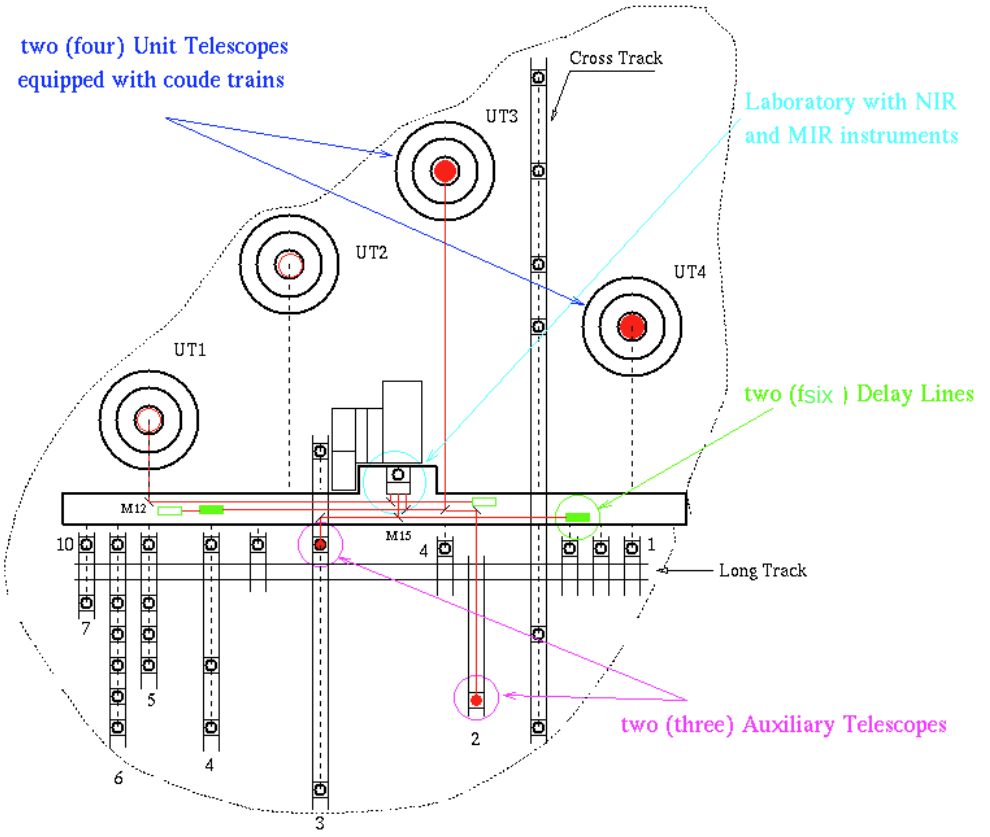
The VLT Interferometer and ESO Extrasolar Planet Search Projects

F. Delplancke, F. Paresce

The Very Large Telescope Interferometer



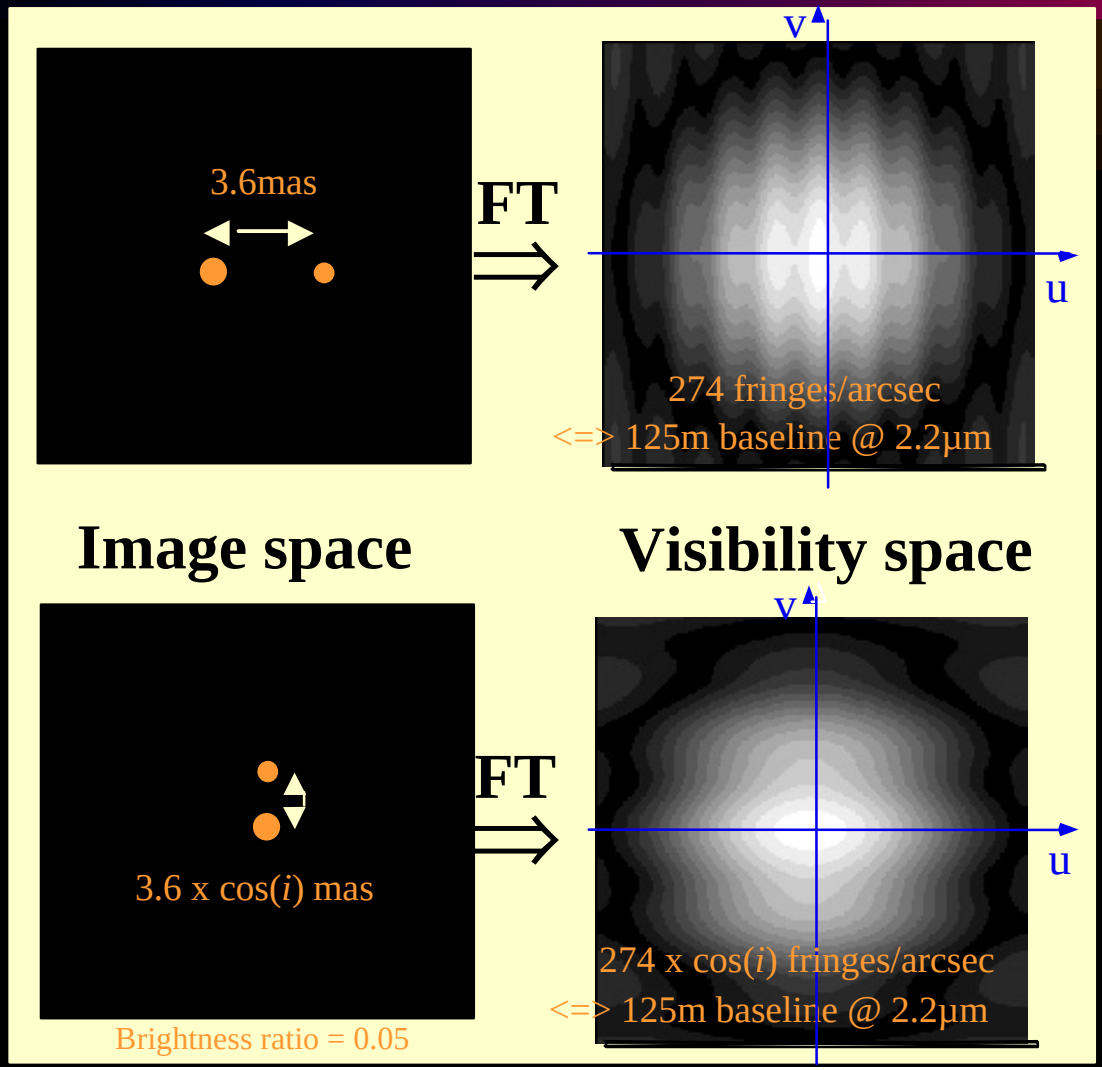
http://www.eso.org/projects/vlti

Planet detection methods at ESO

- Interferometry - VLTI:
  - modulus of the visibility
  - differential phase

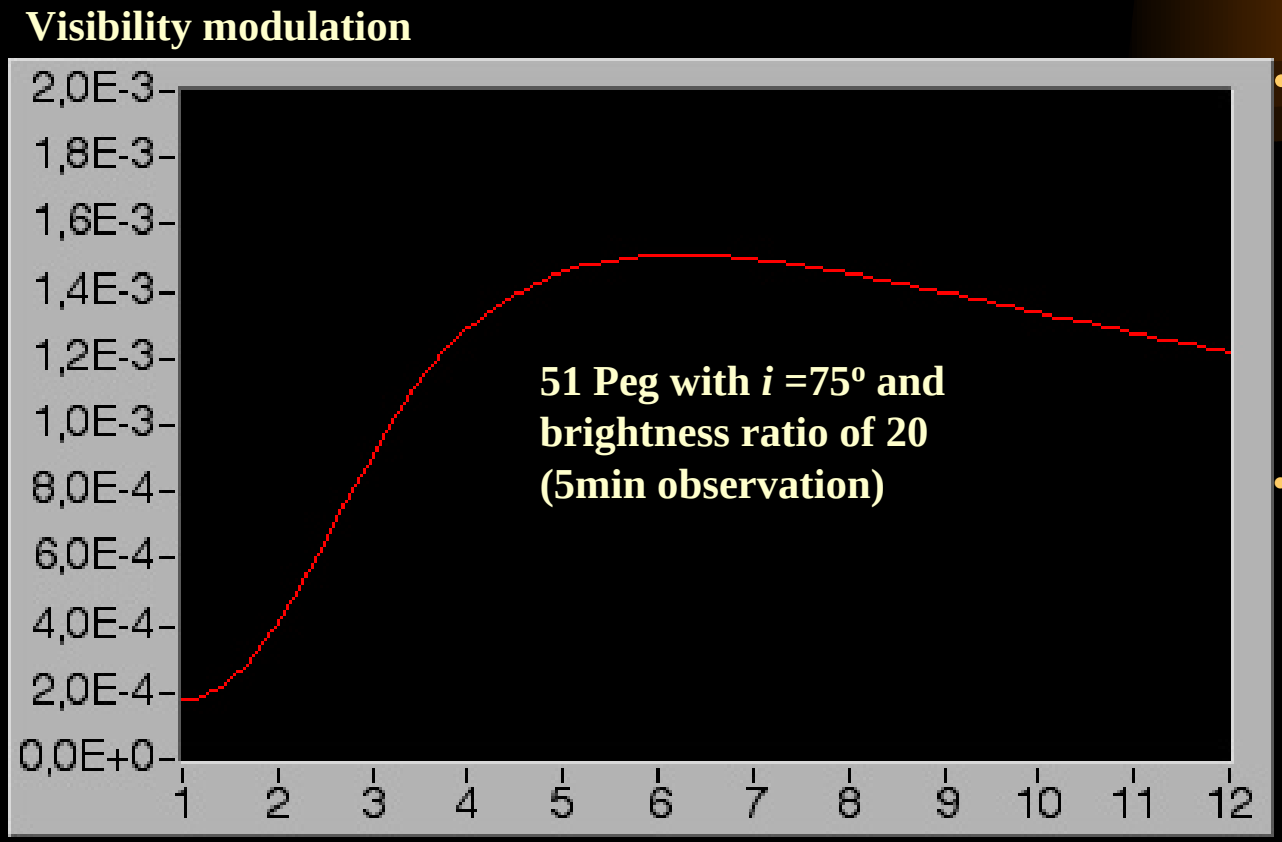
  } ⇨ Small planets, close to the star (~few mas)
  - astrometry ⇨ Large planets and separations
  - micro-lensing
  - nulling interferometry ⇨ Direct imaging
- VLT:
  - HARPS ⇨ radial velocities on 3.6m - 1m/s long term accuracy
  - Planet Finder ⇨ adaptive optics + direct imaging, coronography, polarimetry - larger separations

Modulus of the visibility - VINCI



- Variation of V^2 with time
- Variation amplitude depends on
  - brightness ratio
  - planet position

Modulus of the visibility - VINCI

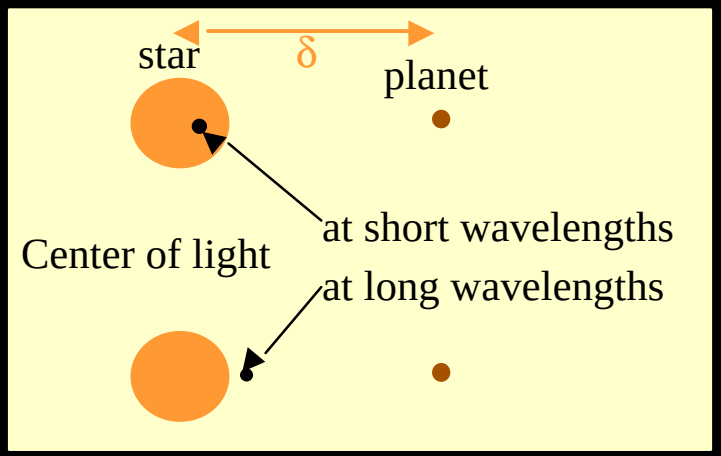


- Expected VINCI visibility accuracy:
  - 5% (seeing limited)
  - 0.3% (AO)
  - <0.1% (fringe track)
- SNR =10 possible for τ Boo in 30hrs (ATs) if synchronised with radial velocities

Figures and idea from V. Coudé du Foresto VLT Opening Symposium, March 1999, Ed. J. Bergeron

Poster 2K.3 "Hot jupiters with AMBER on the VLTI"
Thierry Forveille

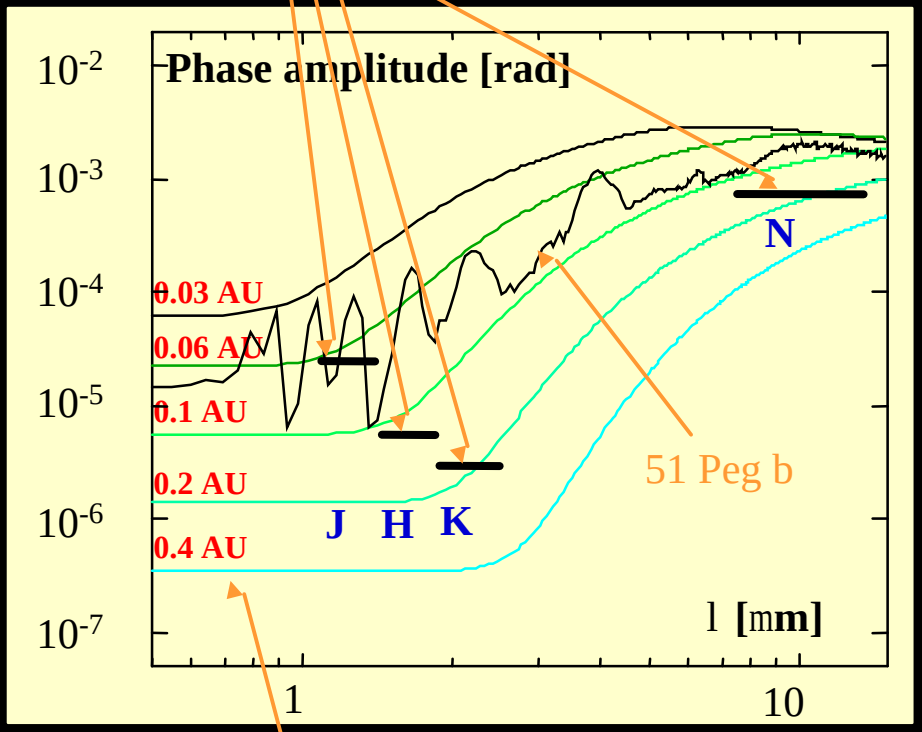
Differential phase - AMBER-MIDI



- Apparent star position = f(λ) as planet is brighter at longer λ
- Center of light moves closer to star if δ increases ⇨ sensitivity to small or large planets close to the star

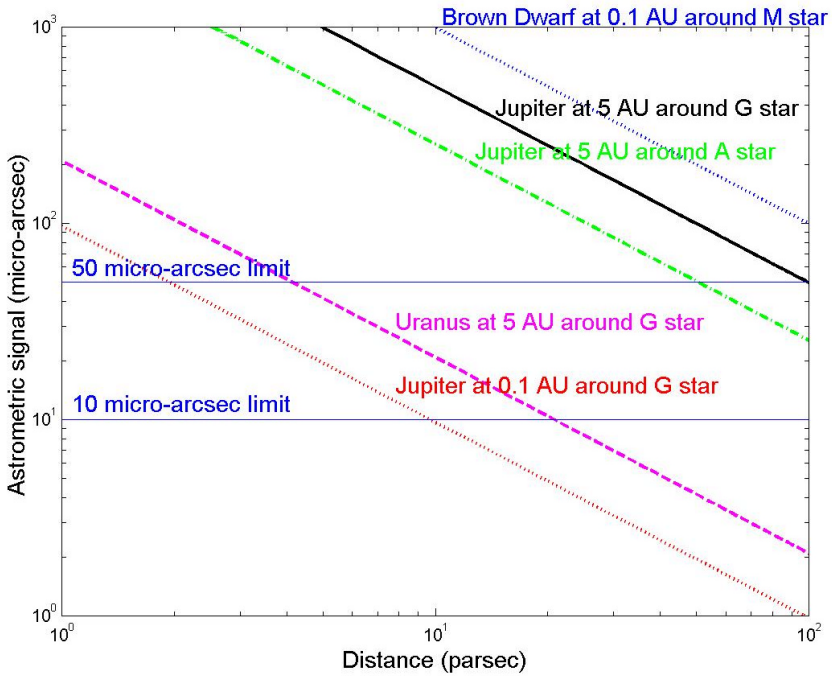
Figures and idea from B. Lopez and R. Petrov
Ref: VLT Opening Symposium, March 1999, Ed. J. Bergeron

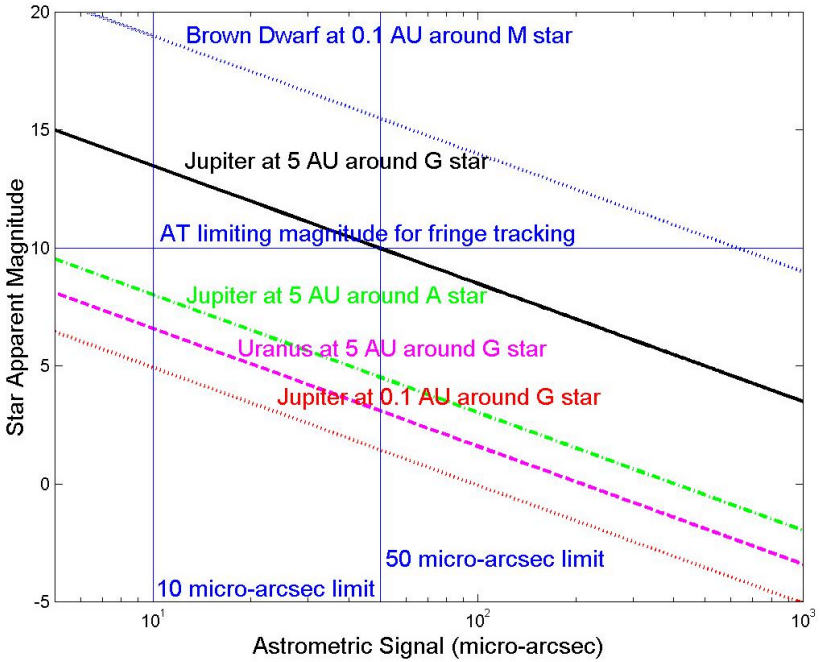
Performance of AMBER (J,H, K) and MIDI (N) for 5 hrs with UTs (baseline 80m) and spectral resolution of 25



1.4 blackbody Jupiters at 0.03- 0.4 AU + synthetic 51 Peg spectrum, sun like star at 10pc

Micro-arcsec astrometry - PRIMA



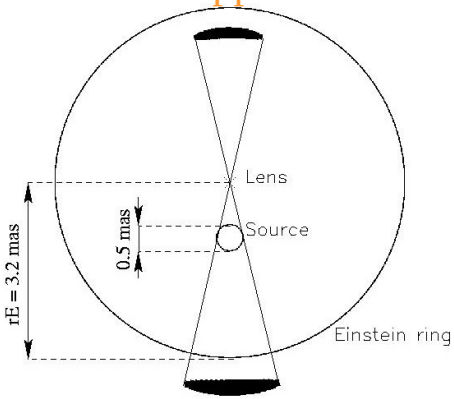


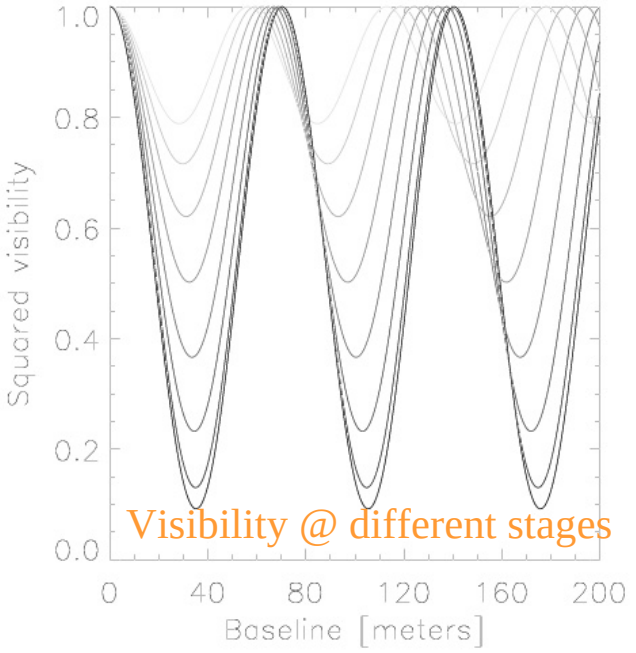
- If astrometric signal is large enough to be detected at 50 μas, the star (except brown dwarf) is always bright enough to be PRIMA guide star
- Need to find 2 (faint) phase-reference stars close by ⇨good sky coverage & non-resolved phase-reference star

Gravitational microlensing - PRIMA

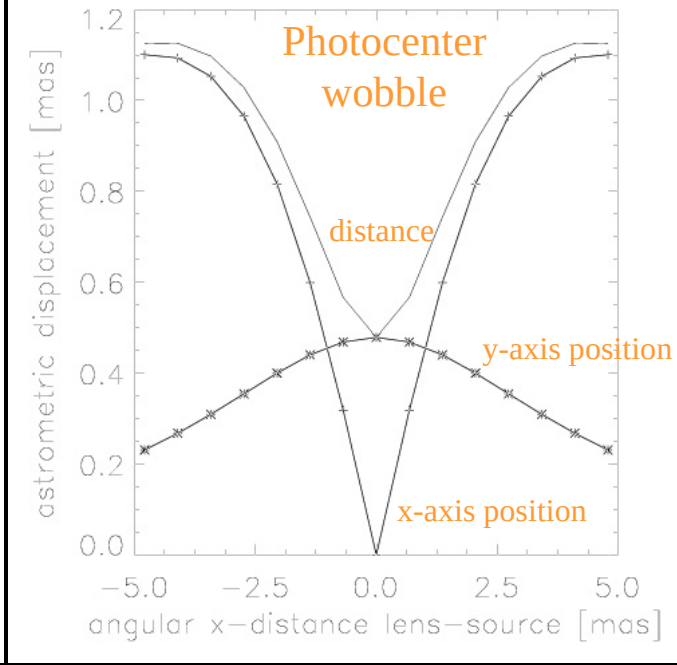
- Photometric alert
- Image resolved by VLTI
- Visibility & astrometric observations

Source image
at closest approach





Visibility @ different stages



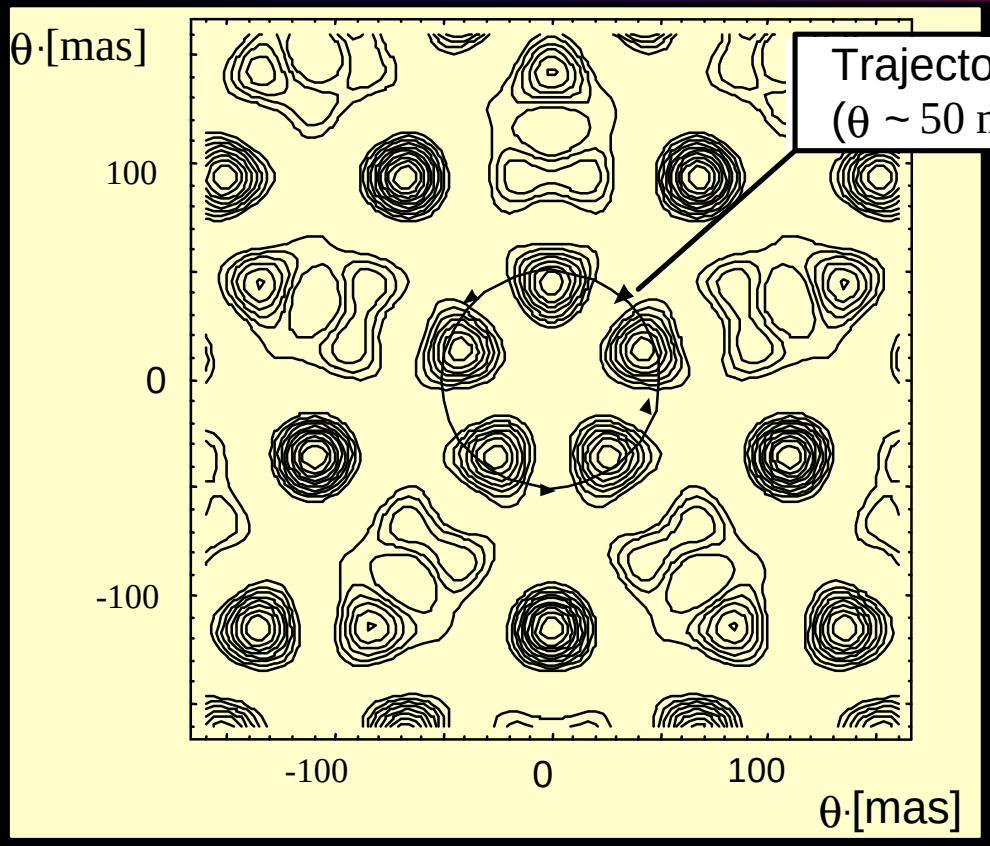
- If parallax is known
  ⇨ mass and distance to lens
- If planet ⇨ 3 images, resolved
  ⇨ planet mass

Galactic bulge source, 10 M_{sol} mass lens @ mid-distance, 0.5 mas ø, 1 mas impact parameter

Poster 2K.2 "Candidate VLTI Configurations for the GENIE Nulling Experiment"

O. Absil, P. Gondoin, C. Erd, M. Fridlund, R. den Hartog, L. Labadie, N. Rando, V. Coudé du Foresto

Nulling interferometry - GENIE



5 telescopes on a circle of 50m diameter at 10µm

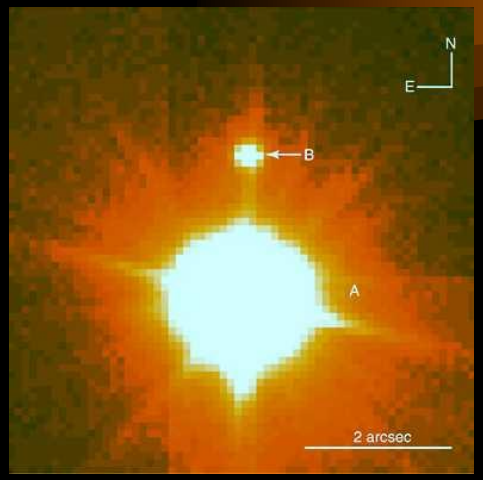
Courtesy Mennesson & Mariotti (1997)

- Achromatic dark fringe on star => deep null (10^{-4} in space)
- Interferometer tuned to planets at separation <=> first side lobe
- Direct imaging
- Wide wavelength band ⇨sensitivity
- GENIE = ground-based experiment for DARWIN
- Needs high order AO + very accurate fringe stabilizing (PRIMA++)

Poster 2I.8 "The Planet Finder Instrument: Proposal for a 2nd Generation Instrument for the VLT"
M. Feldt, S. Hippler, R. Gratton, Th. Henning, M. Turatto, R. Waters, A. Quirrenbach

Adaptive Optics - Planet Finder

- High contrast, adaptive optics assisted imager
- 2nd gereration instrument: Feasibility study to start soon
- 2 proposals: D/I/CH/NL/P or F/UK/CH/C



FORS2 I band
0.18” seeing

- Aim: gain 1 order of magnitude in detection of planets near bright stars ⇨ high Strehl (90% in K-H) for good contrast
- Coronography + multi-band imaging + polarimetry

Poster 1A.5 "From CORALIE to HARPS: Towards 1 m/s Precision"

F. Pepe, F. Bouchy, M. Mayor, and D. Queloz

Radial velocities - HARPS

- To be installed on ESO 3.6m telescope in la Silla
- Simultaneous Th-Ar reference cf. ELODIE & CORALIE
- spectral R = 90,000
- Vacuum spectrograph stabilized in temperature (0.1K)
- ⇨ 1 m/s long term stability