



The E-ELT Science Case

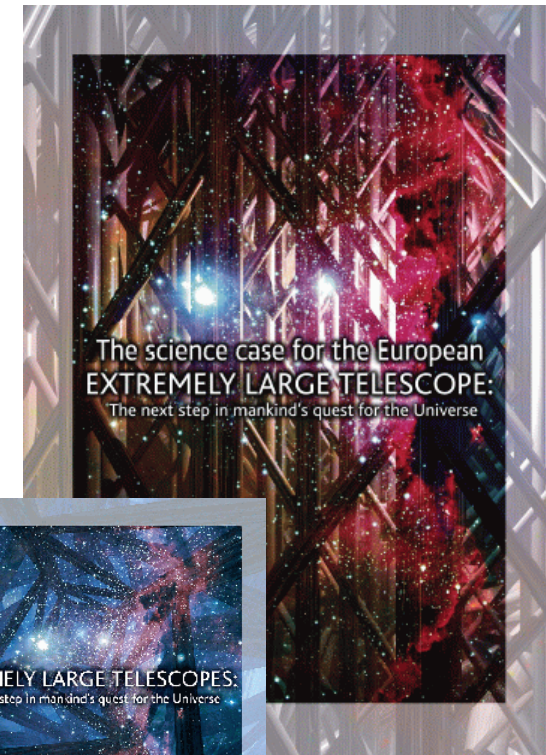
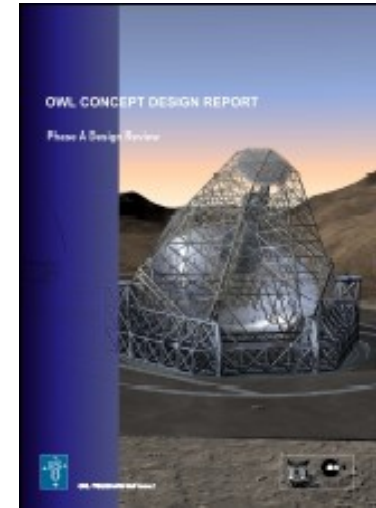
A Gazillion People



Overview

Some documents:

- OWL Blue Book
- Science case for the European Extremely Large Telescope
- Report of the ELT Science Working Group
- E-ELT project web pages
New Science pages in the making!
- OPTICON ELT web pages at <http://www-astro.physics.ox.ac.uk/~imh/ELT/>



Science Case Overview

- Planets and Stars
 - Solar system comets
 - Extra-solar system comets
 - **From giant to terrestrial exoplanets: detection, characterization and evolution**
 - Freely-floating planetary mass objects
 - **Young stellar clusters**
 - Origin of massive stars
 - LMC and SMC field star population
 - **Circumstellar disks**
 - Stellar remnants: black holes and neutron stars
 - Asteroseismology

Science Case Overview

- Stars and Galaxies
 - The intracluster stellar population
 - Planetary Nebulae as tracers of the element abundances in early type galaxies and diffuse light in clusters
 - Stellar clusters and the evolution of galaxies
 - **Imaging and spectroscopy of resolved stellar populations in galaxies**
 - Spectral observations of star clusters
 - Young massive star clusters
 - Measuring the stellar IMF in local group galaxies
 - Star formation history through supernovae
 - **Black holes and AGN demographics**

Science Case Overview

- Galaxies and Cosmology
 - Galaxy formation and evolution
 - **Physics of high redshift galaxies**
 - Deep galaxy studies at $z=2-5$
 - Galaxies and AGN at the end of reionization
 - **First light - The highest redshift galaxies ($z>10$)**
 - Topology of the IGM at $z = 2-3$
 - **Is the low-density IGM metal-enriched?**
 - Probing reionization with GRBs and QSOs
 - Gravitational lensing
 - Dark energy - Type Ia supernovae as distance indicators
 - **A dynamical measurement of the expansion history of the Universe**
 - Testing the variability of fundamental constants

9 Prominent Science Cases

“Prominent” science cases are considered to be among the most important scientifically and are useful for defining capabilities of the telescope.

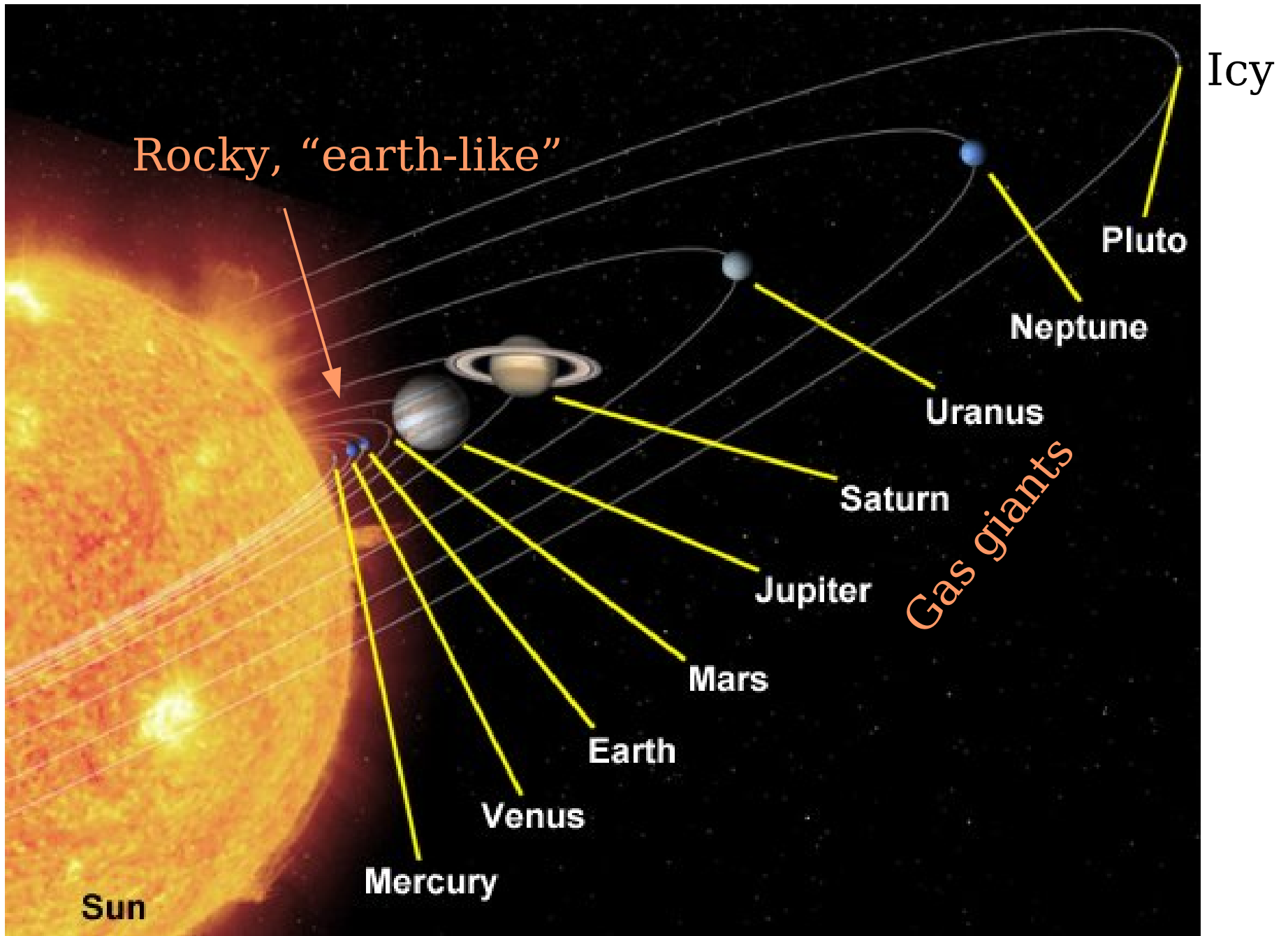
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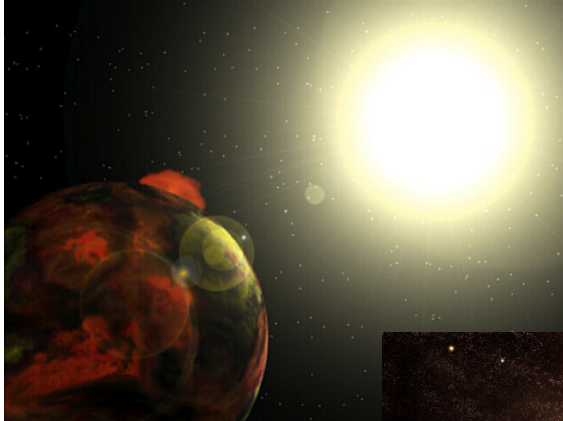
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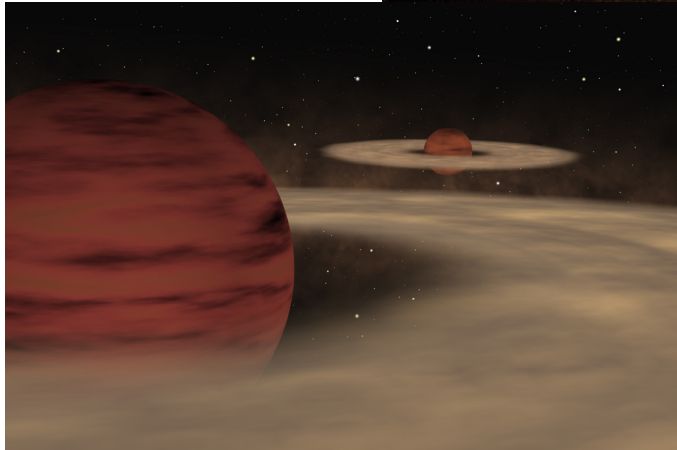
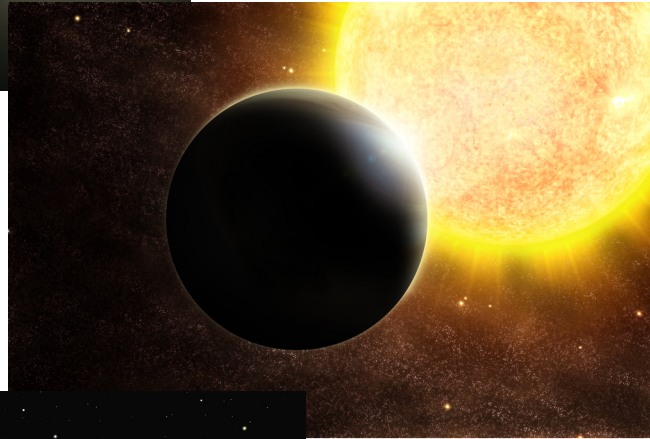
Planets - Solar System



Extrasolar Planets



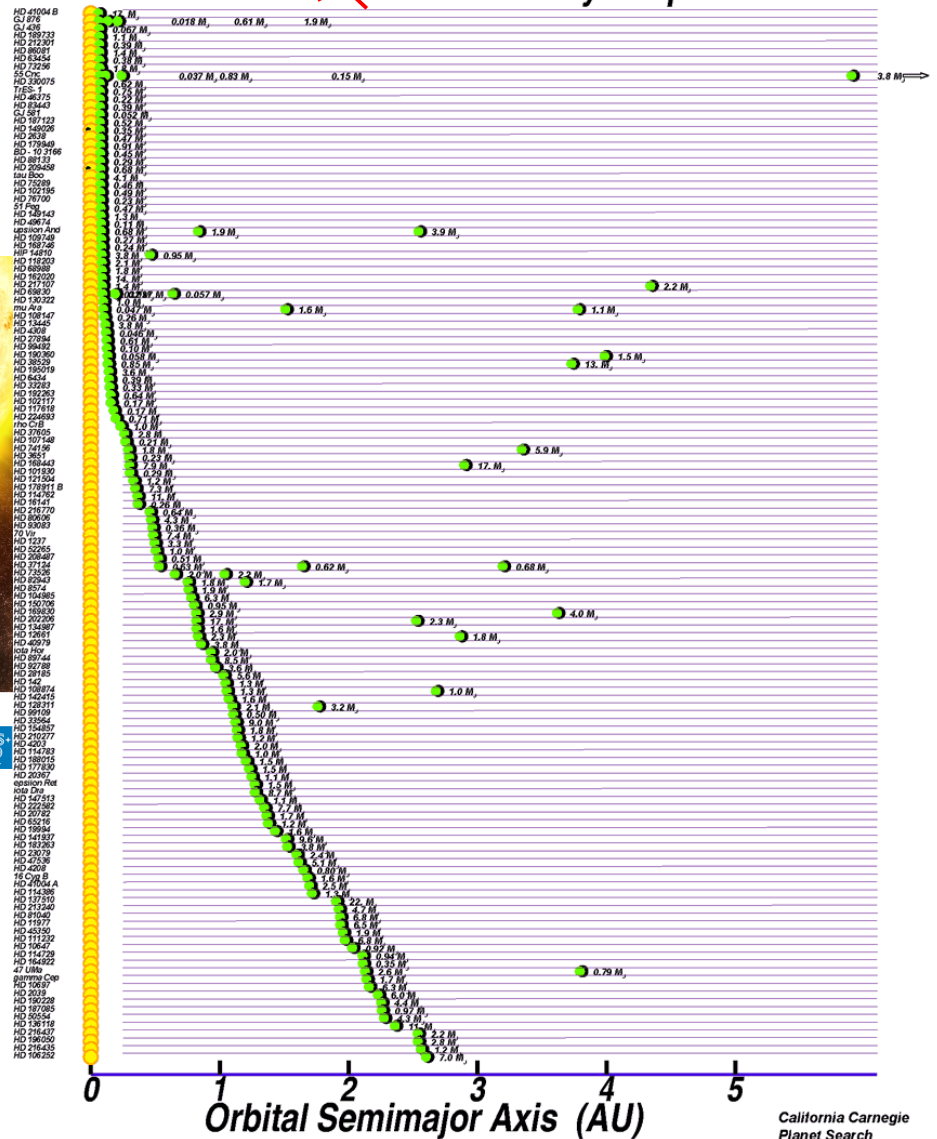
~7% of all stars have planets!



Double System of Planetary Mass Objects (Artist's View)

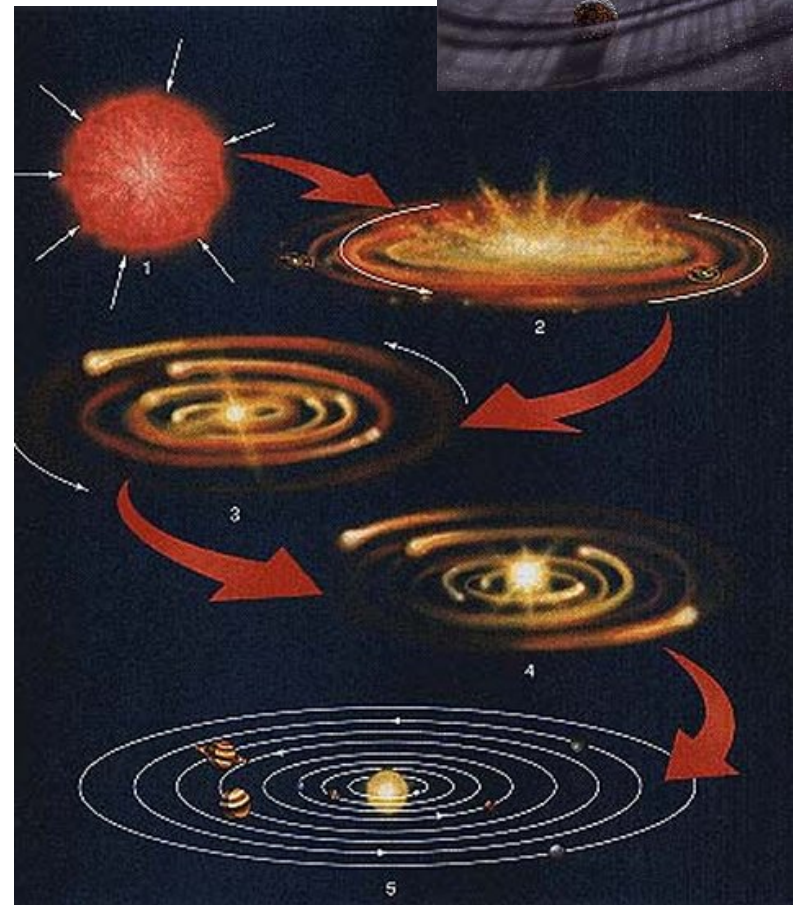


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The ~~176~~ Known Nearby Exoplanets

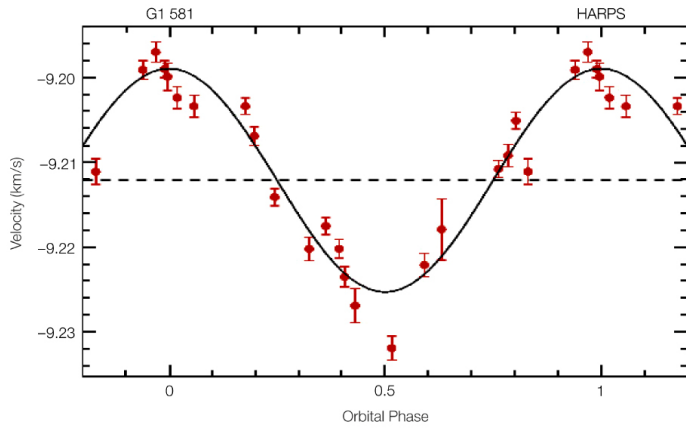
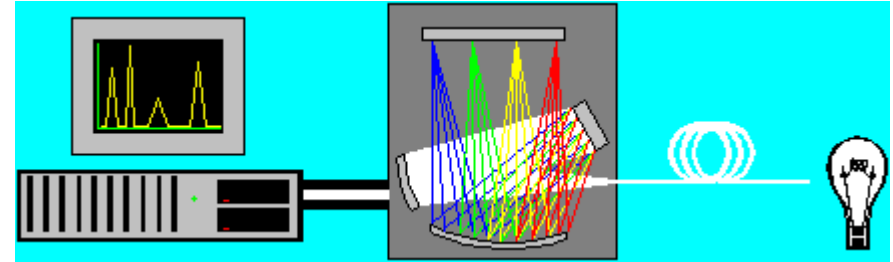
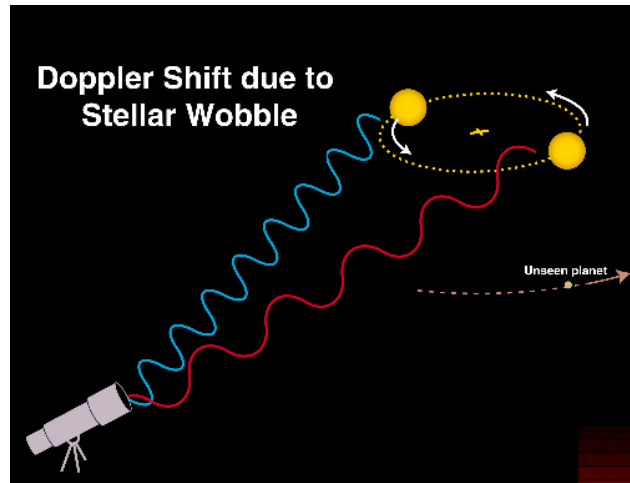
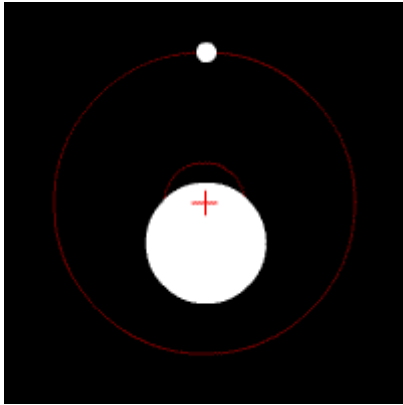


Questions

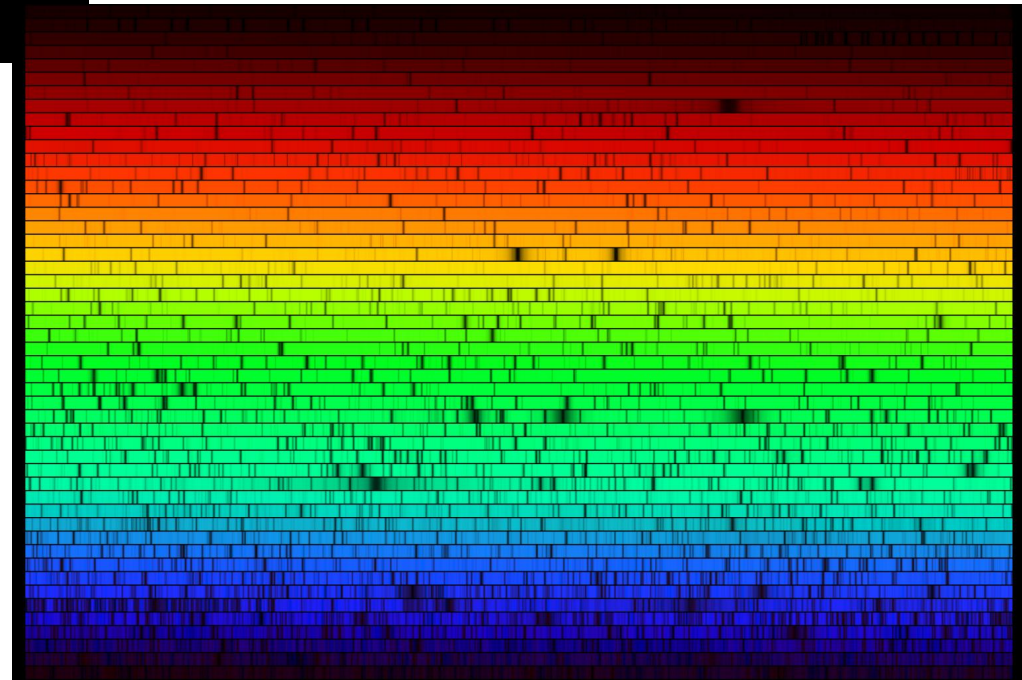
- How do planetary systems form?
- What are the planetary environments around other stars?
- How typical is our solar system?
- Are there other Earths?
- If so, is there life on them?
- How important is evolution for habitability?

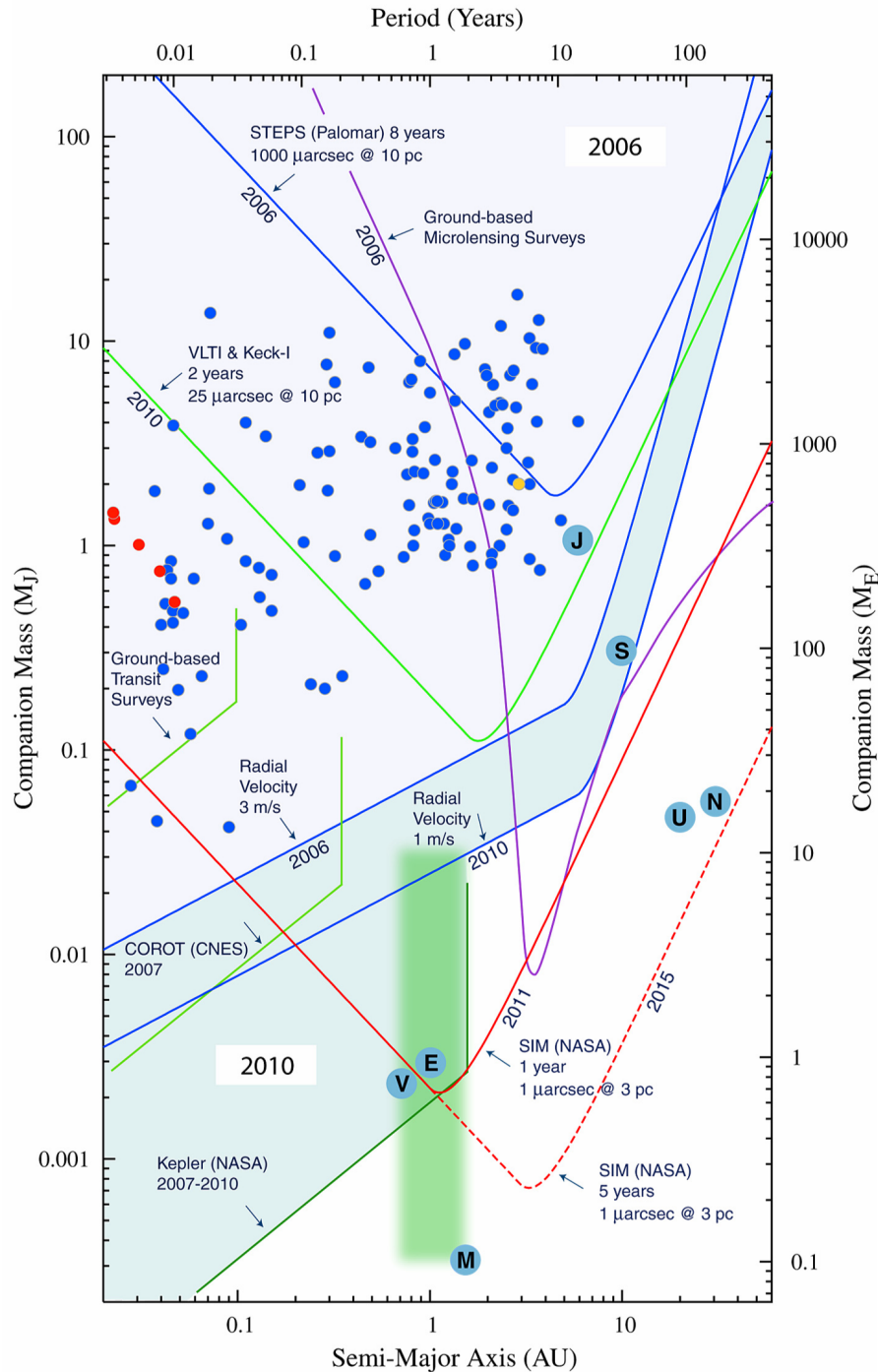


How to find exoplanets



Radial Velocity Curve of Gliese 581
(HARPS/3.6-m)



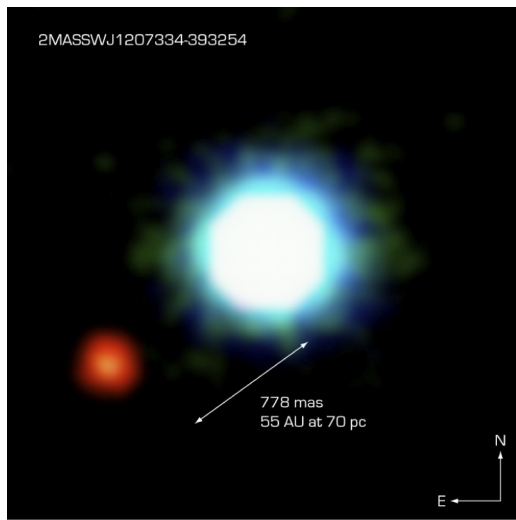
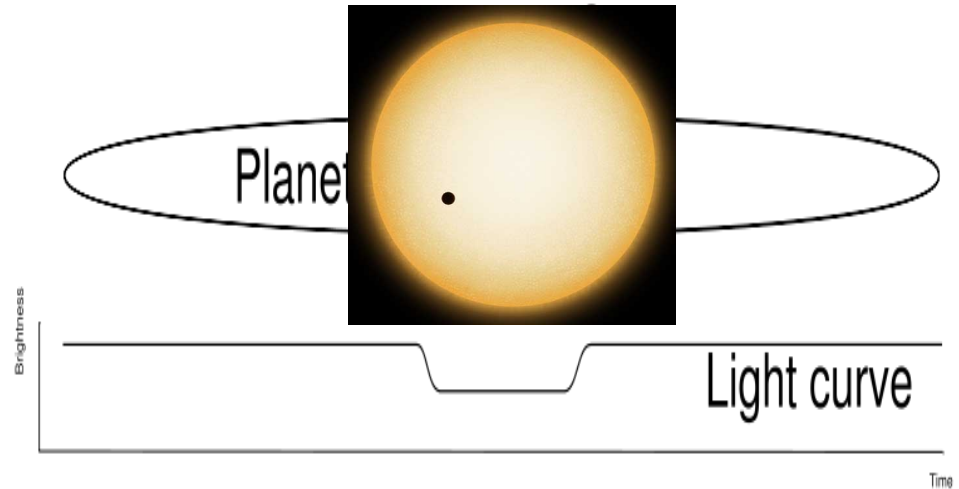


High-mass planets with short periods are easiest to find.

Finding Earths is very hard!

Other detection methods

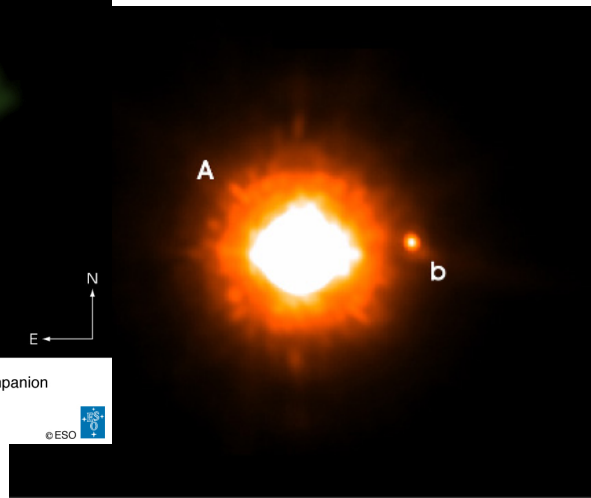
- Astrometry
- Transit
- Microlensing
- **Direct imaging**



The Brown Dwarf 2M1207 and its Planetary Companion (VLT/NACO)

ESO PR Photo 14a/05 (30 April 2005)

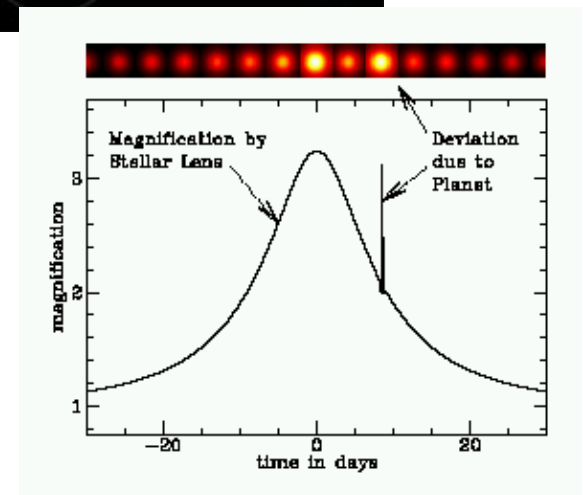
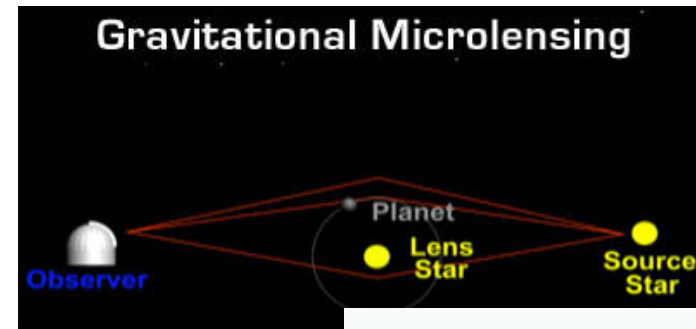
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The Sub-Stellar Companion to GQ Lupi (NACO/VLT)

ESO PR Photo 16a/05 (7 April 2005)

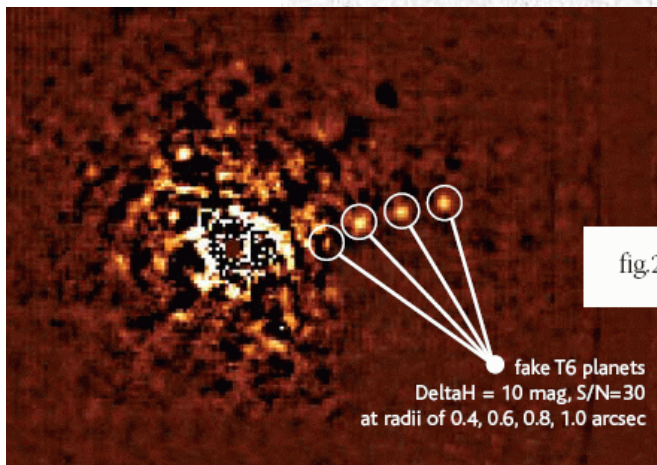
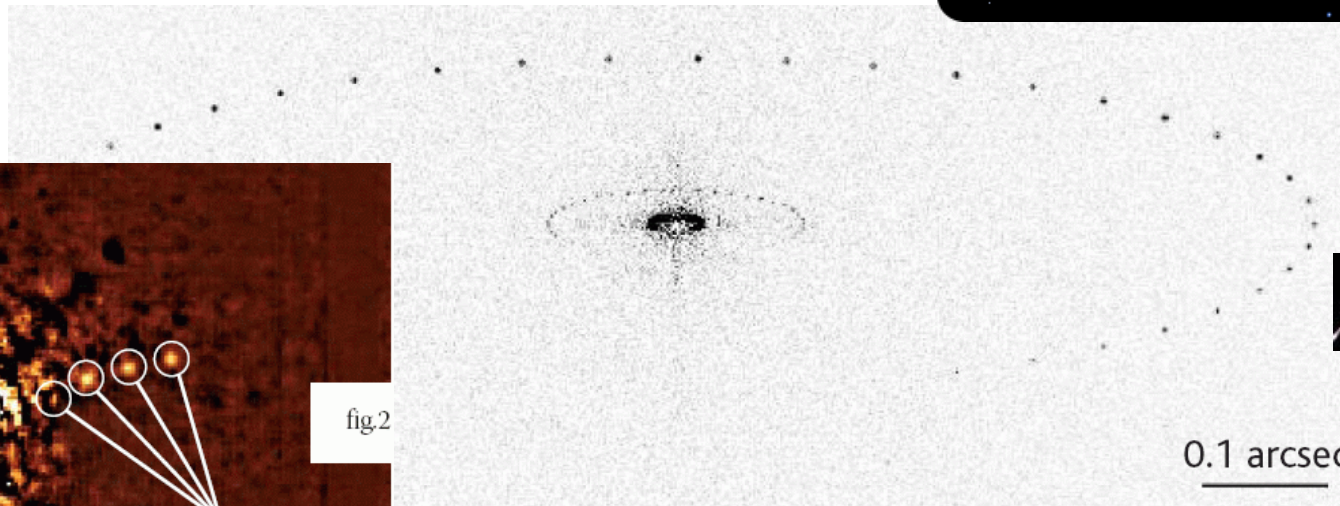
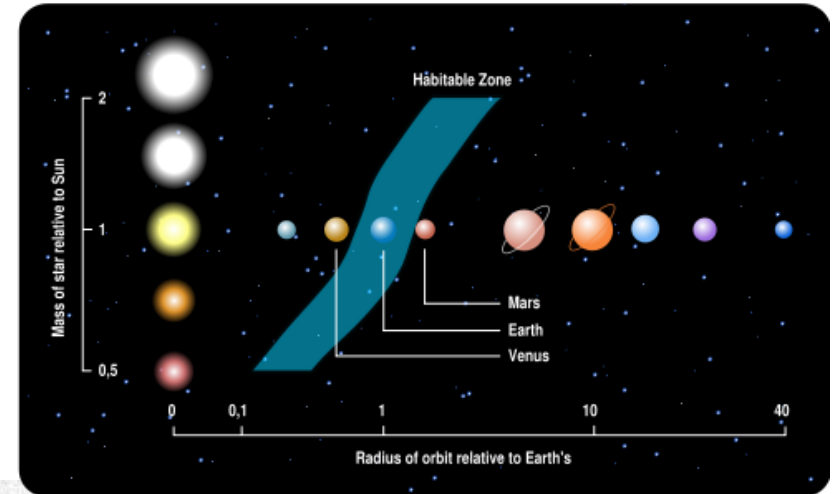
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What the E-ELT will be able to do

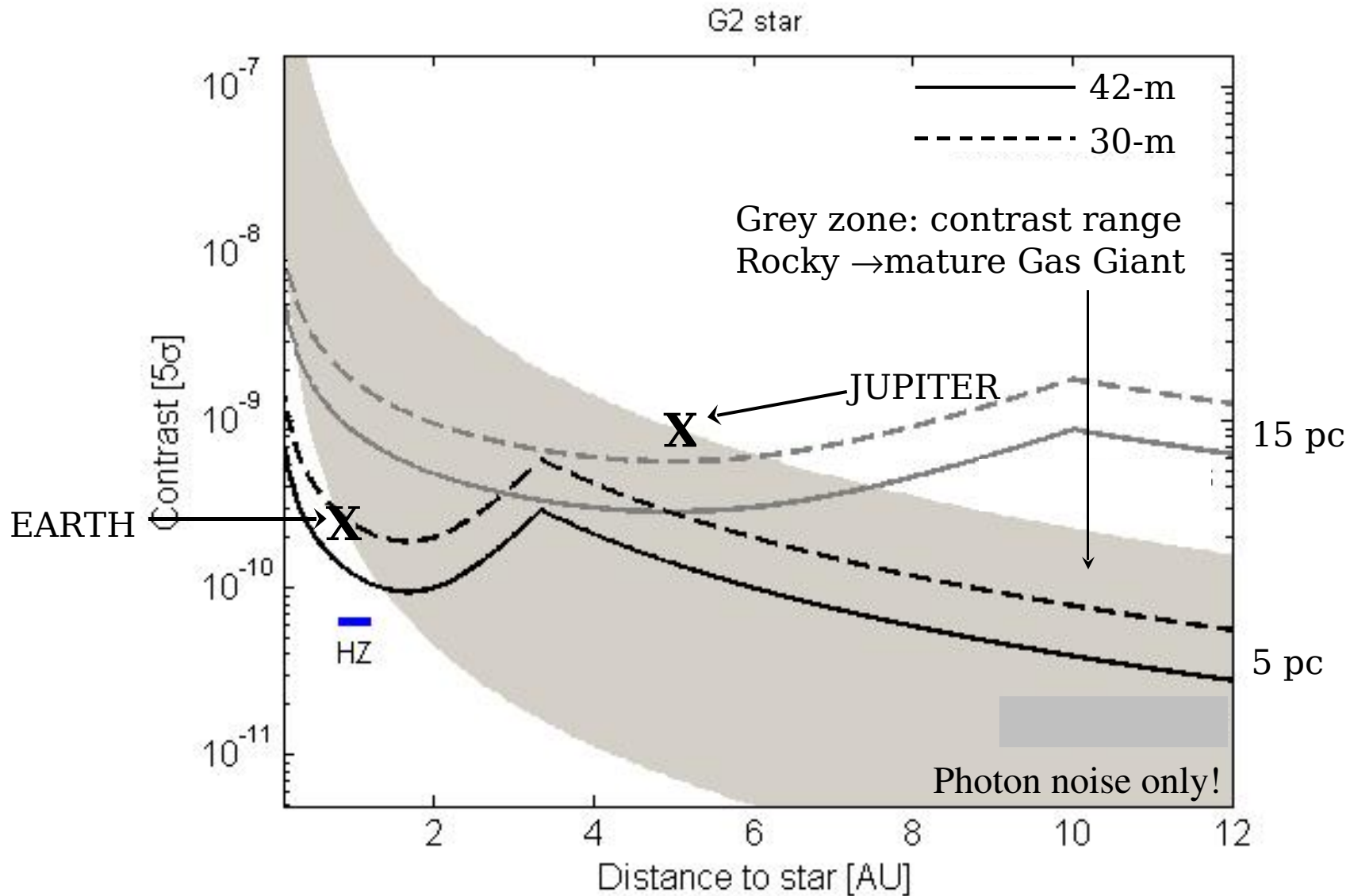
Discovery and characterization of exoplanets down to Earth-like masses in the habitable zone

- Direct imaging survey for planets around 150 stars within 20 kpc of the sun. Detecting Earths in the habitable zone requires a brightness contrast of 10^{-10} at 50 mas separation!



At ~400 km distance!

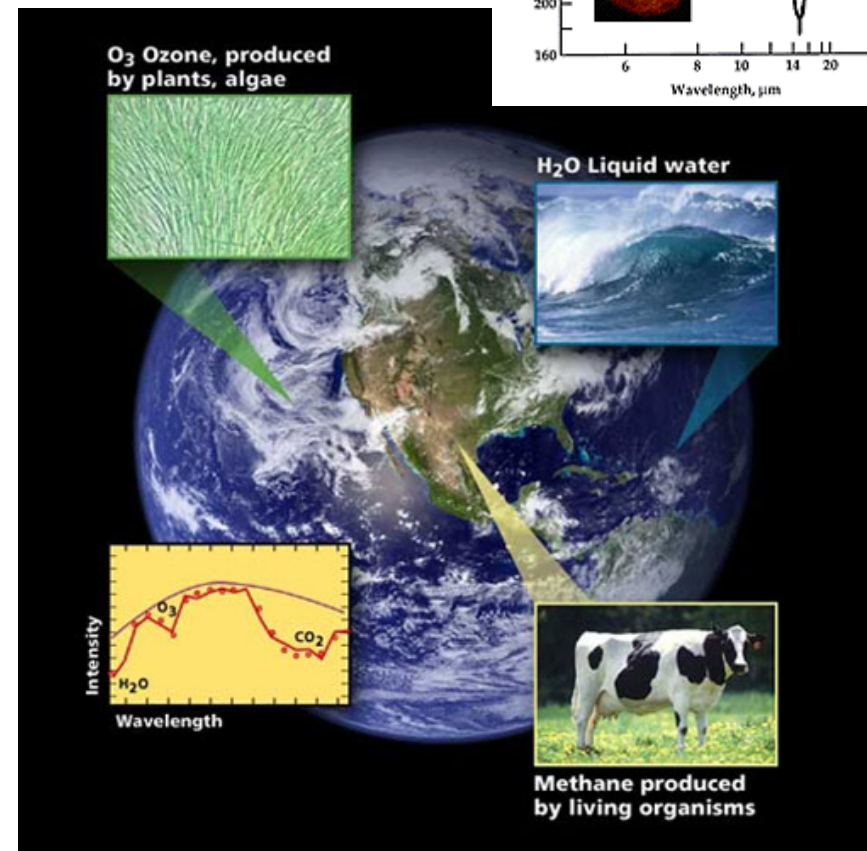
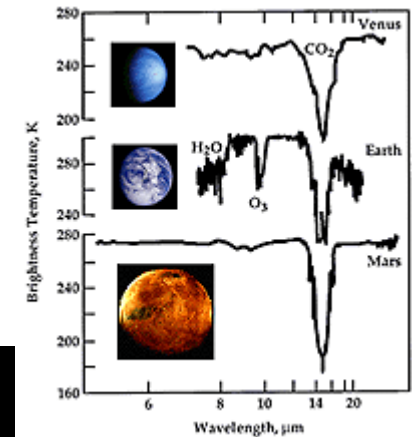
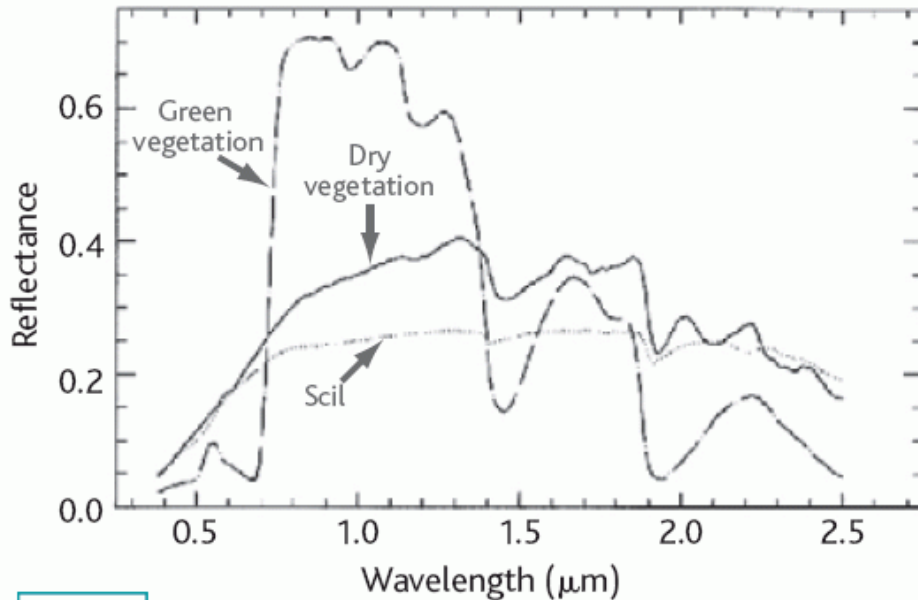
What the E-ELT will be able to do



What the E-ELT will be able to do

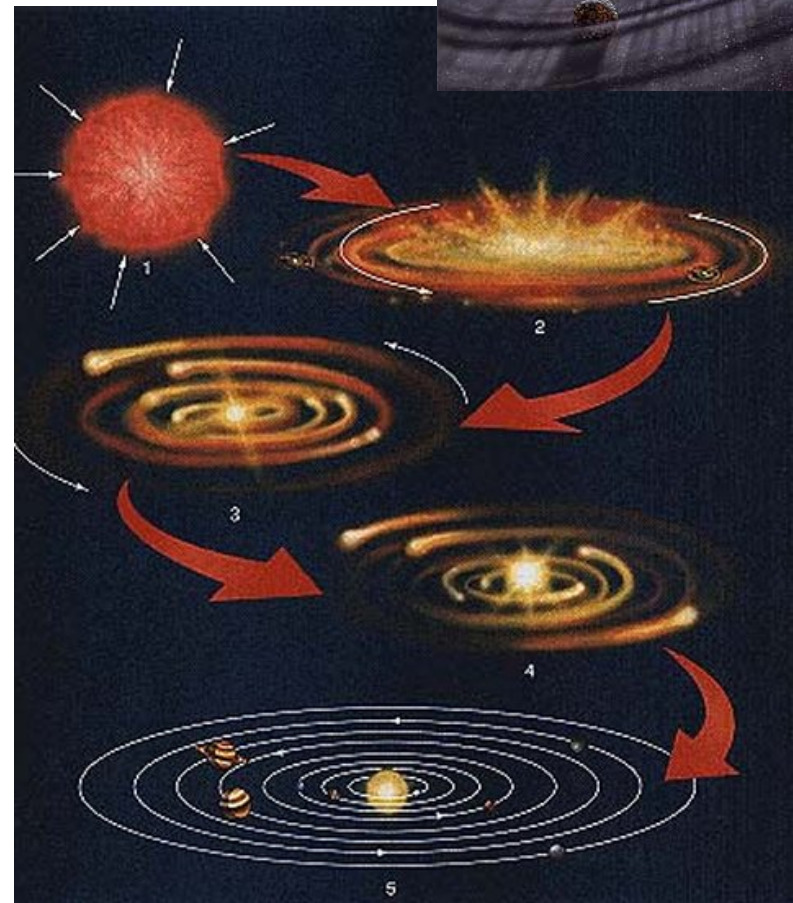
Discovery and characterization of exoplanets down to Earth-like masses in the habitable zone

- Follow-up low-resolution spectroscopy of discovered planets.
- ⇒ mass, radius, composition, atmosphere, temperature of planets. Detection of bio-markers?



Questions

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E-ELT will give answers to these

Questions

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