

Cassini/Huygens and Europe's next steps towards the outer planets ?

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Director of Science, ESA

Titan: from Discovery to Encounter
ESTEC, Noordwijk,
15th April 2004



This continues as ESA Space Science's Annus Mirabilis

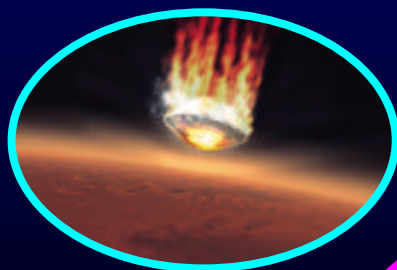
Integral – one year in orbit !



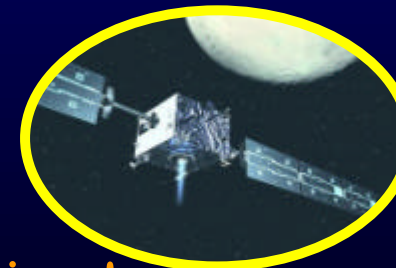
Mars Express arrives in Mars orbit !



Beagle2 captures public imagination !



Smart-1 on its way to the Moon !



Double Star 1 launched with China !



Rosetta launched to a comet!



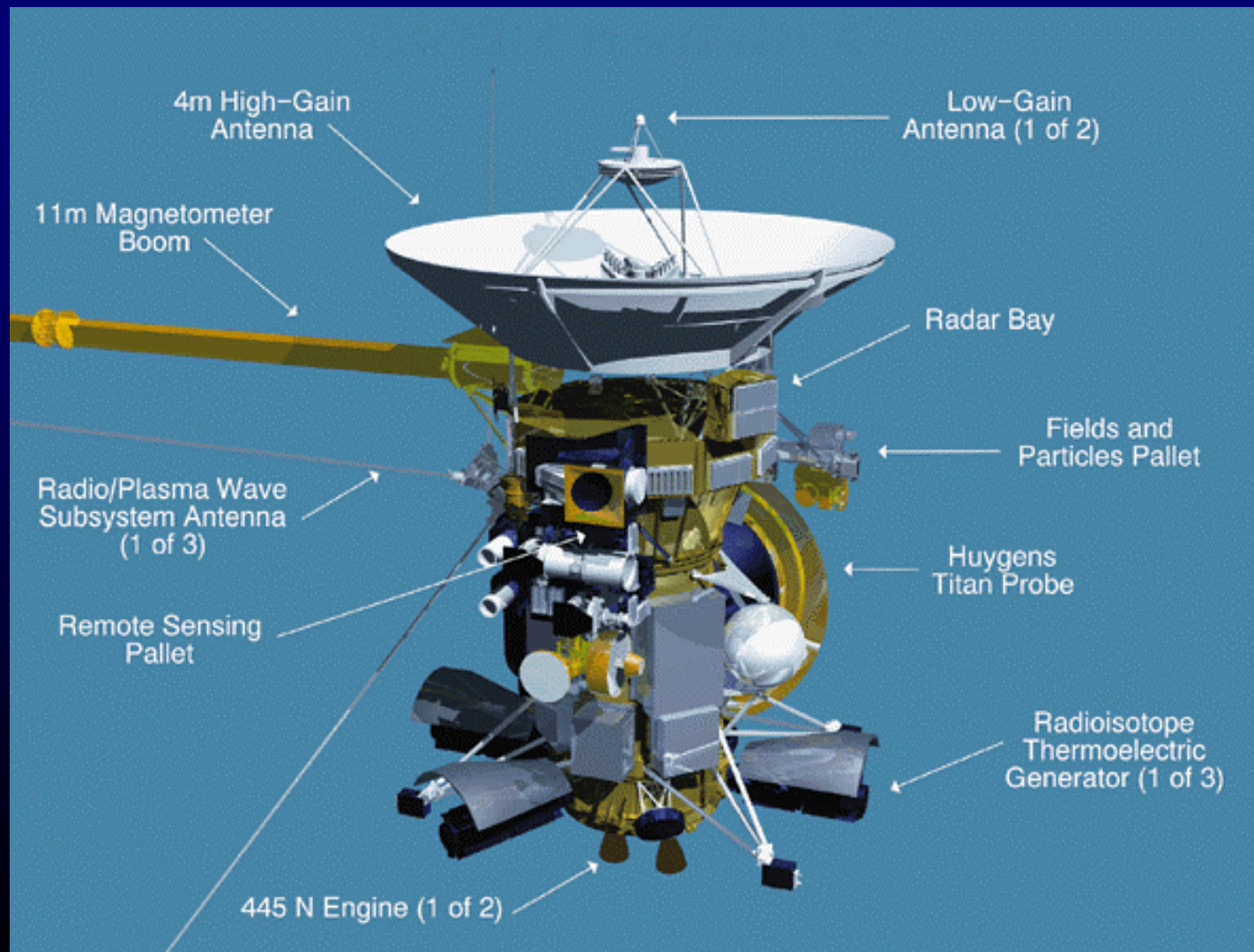
14 spacecraft in operations
Altogether
fall-time record!

Cassini-Huygens Saturn arrival June 30th 2004



January 15th 2005
Titan Arrival





Cassini Huygens - Timeline

~ 1980: Conception : First discussions (European/US scientists)

Early 80's : Studies :— first studies done by ESA/NASA

Late 80's : Proposed to ESA and NASA :

1989 : Firm commitment at ESA

1990 : Instrument team assembled + seeking national funding

1991-2: Design + Confirmation of payload

1992-1997 : Development + Integration and Testing

1997 : Launch

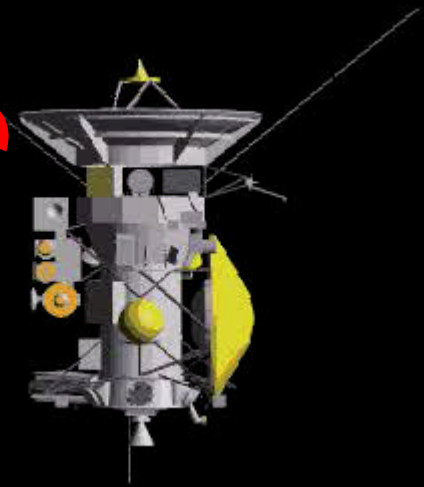
1998/9 : Flies by Venus and Earth

Late 2000-early 2001: Jupiter flyby

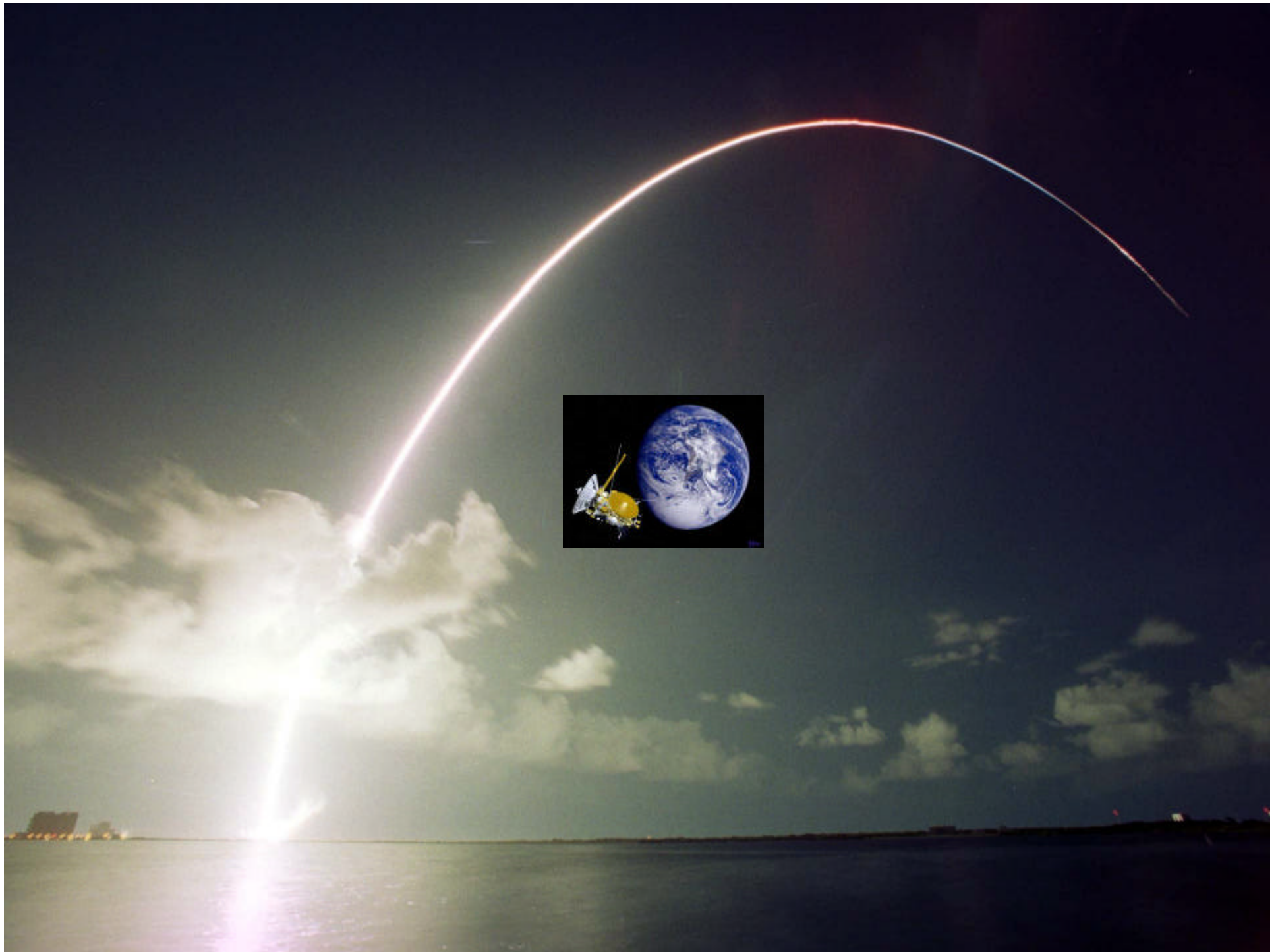
Mid 2004 : Saturn orbit insertion

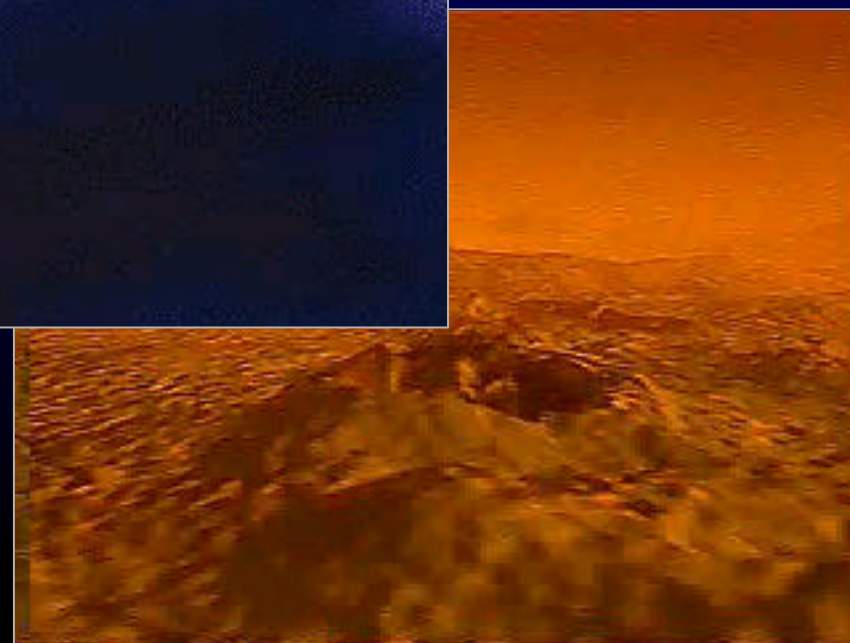
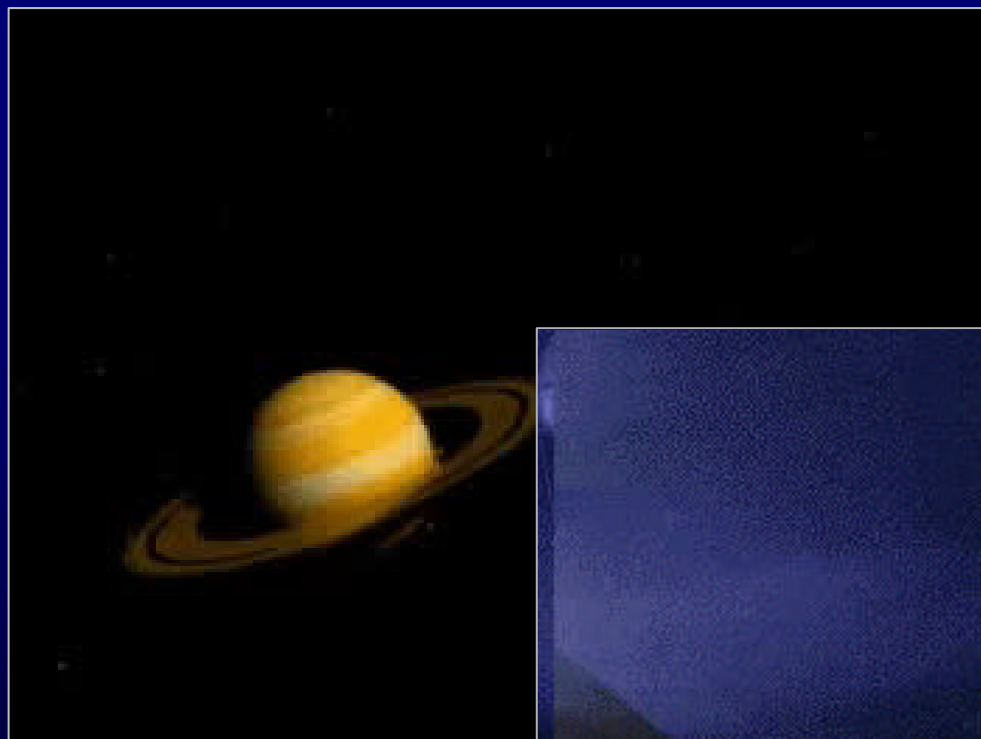
2005 : Huygens lands on Titan

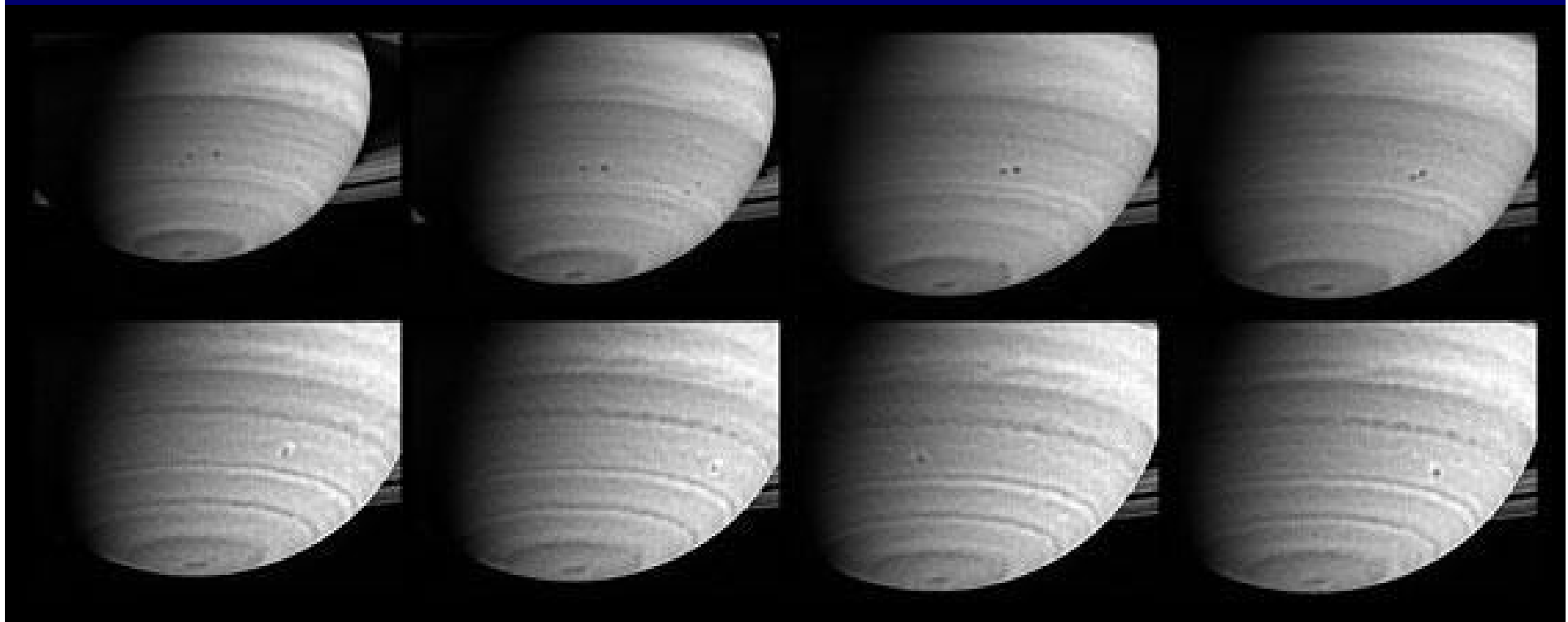
2009 : End of Prime Cassini Mission



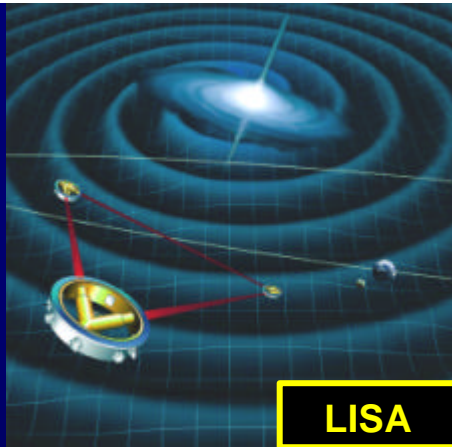








Still to come..... Astronomy/Fundamental Physics



LISA

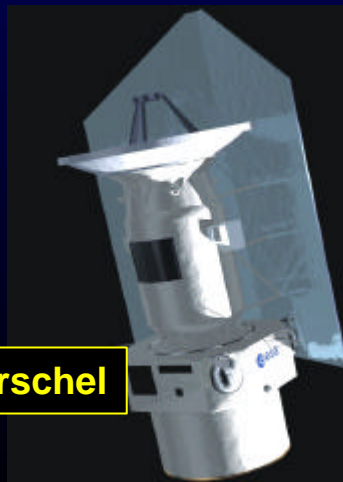


GAIA



Eddington

+ mscope



Herschel



Planck

+ Corot



+ Astro F



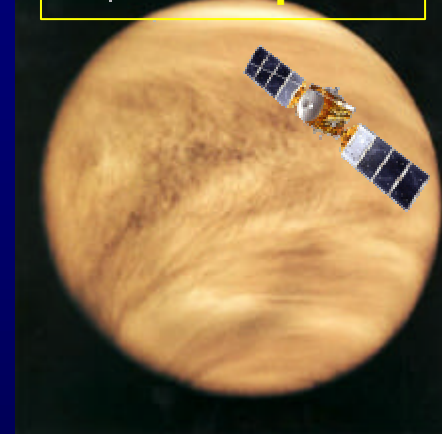
James Webb
Space Telescope

Still to come..... Solar System

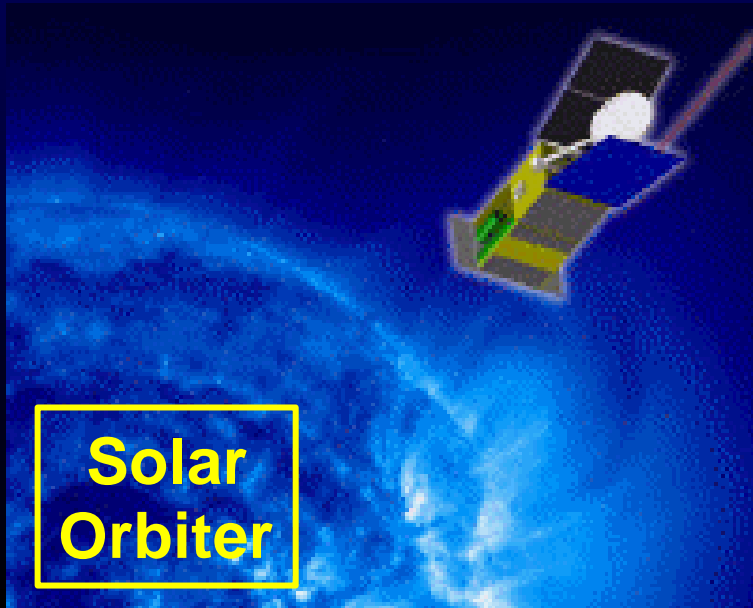
+ Solar B



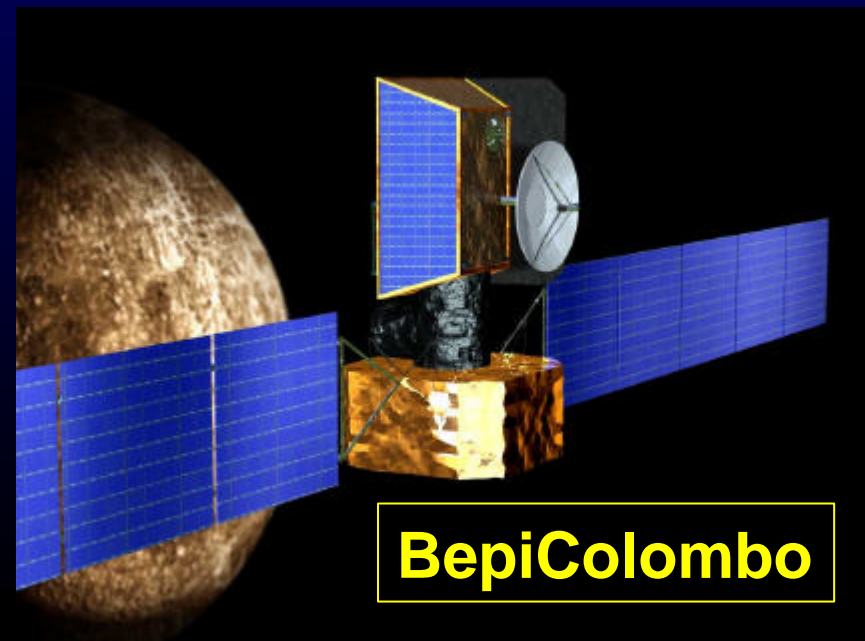
Venus Express

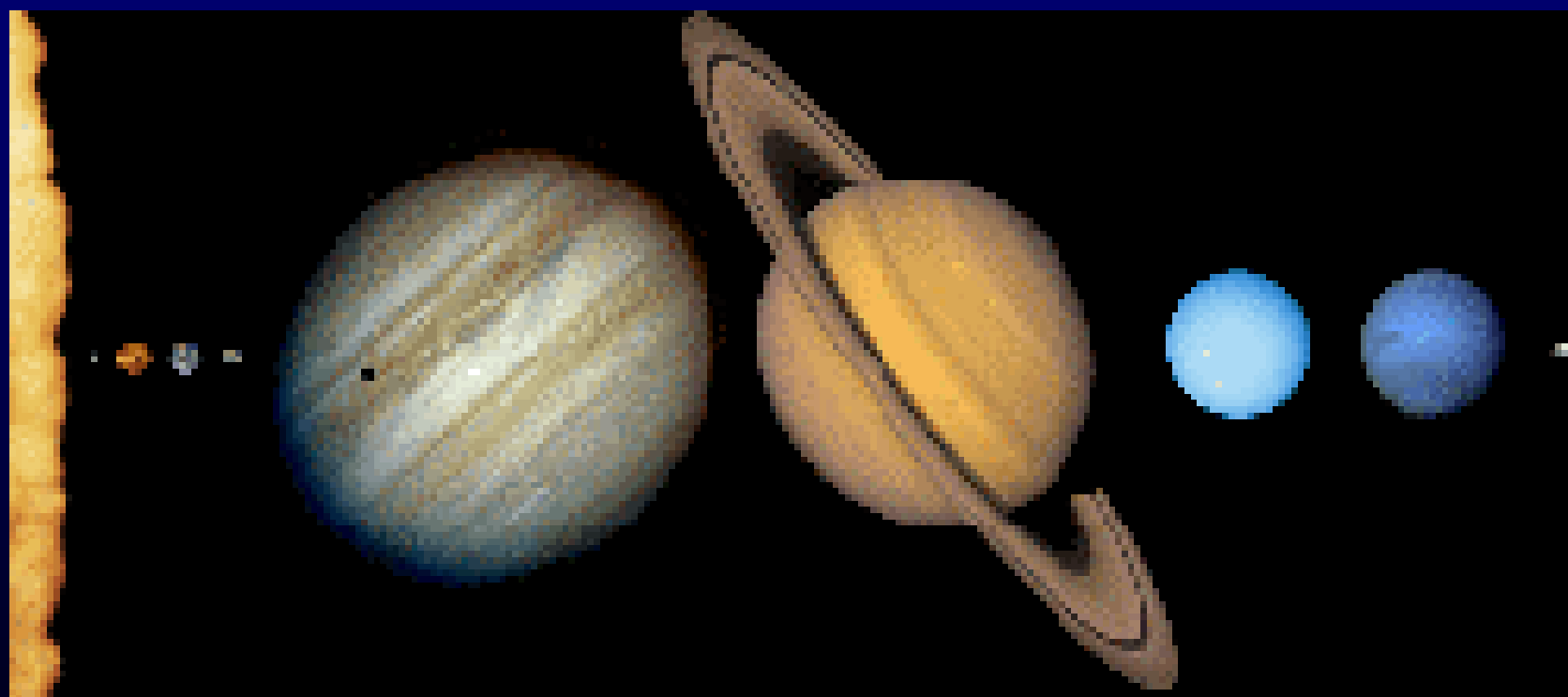


Solar
Orbiter



BepiColombo





Exploring the Outer Planets

USA + Germany → *Galileo*

USA + Europe + Italy → *Cassini/Huygens*



No independent European capability
due to cost & technology limits

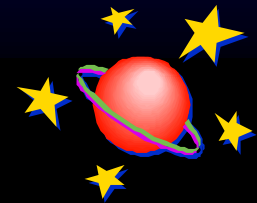
2002

Outer Solar System Exploration

Technology Reference missions allow a rapid analysis of future P/L & S/C needs

ST Technology Reference Mission : Jovian Satellite Explorer

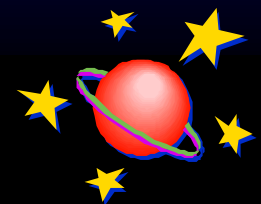
- Mission profile (How do we get there & in what form)
- Microsat buses (What is the capability—can we use them)
- Key payload elements (Resource focus)
- Technical problems (Simple solutions to killer problems)
- Timescales and financial envelope (150 M€ Launch 2008/9)
- Smart S/C investment strategy utilised in 2008/9 timeframe
- Implementation approach (How to organise further work)



2002 Technology Reference Mission : Europa Orbiter - Questions

- Can we send an orbiter to *Europa* at low cost (< 160 M€) ?
- Can we deliver a meaningful payload into Europa Orbit ?
- What are the technical problem areas & are there solutions ?
- What is the mission profile and is it realistic & feasible ?
- Could we get to *Europa* by 2011 ?

Europa could be replaced with other Jovian moons of interest (Io!) if we ensure solid technical solutions



Concept

Configuration

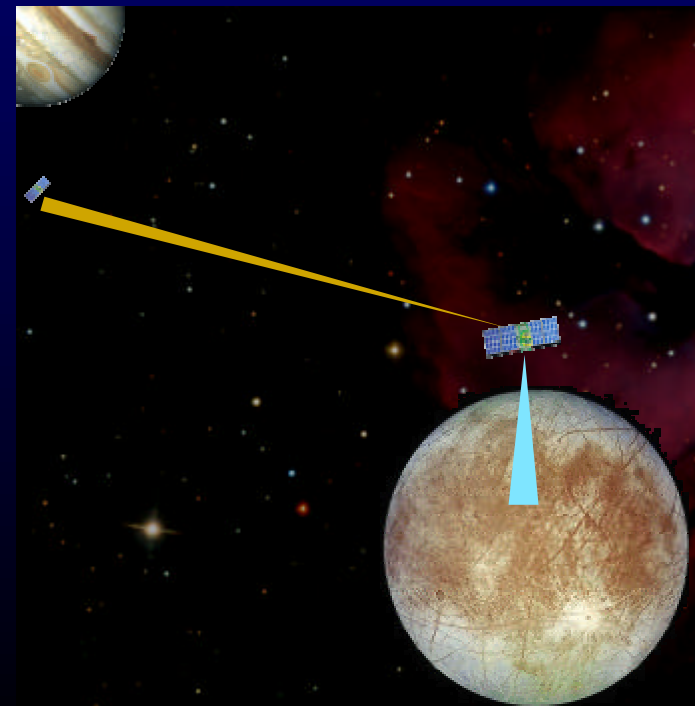
- 1 Orbiter at Jupiter in deep elliptical polar orbit
- Relay spacecraft in polar (200 km) orbit around Europa
- mass: ~350 kg each (before final optimization)

Phased approach?

Microsat Pair: Orbiter, Data Relay
Satellite and ice penetrator

Microsat Pair, lander + penetrator(s)

Microsat Pair + Deep subsurface
penetrator



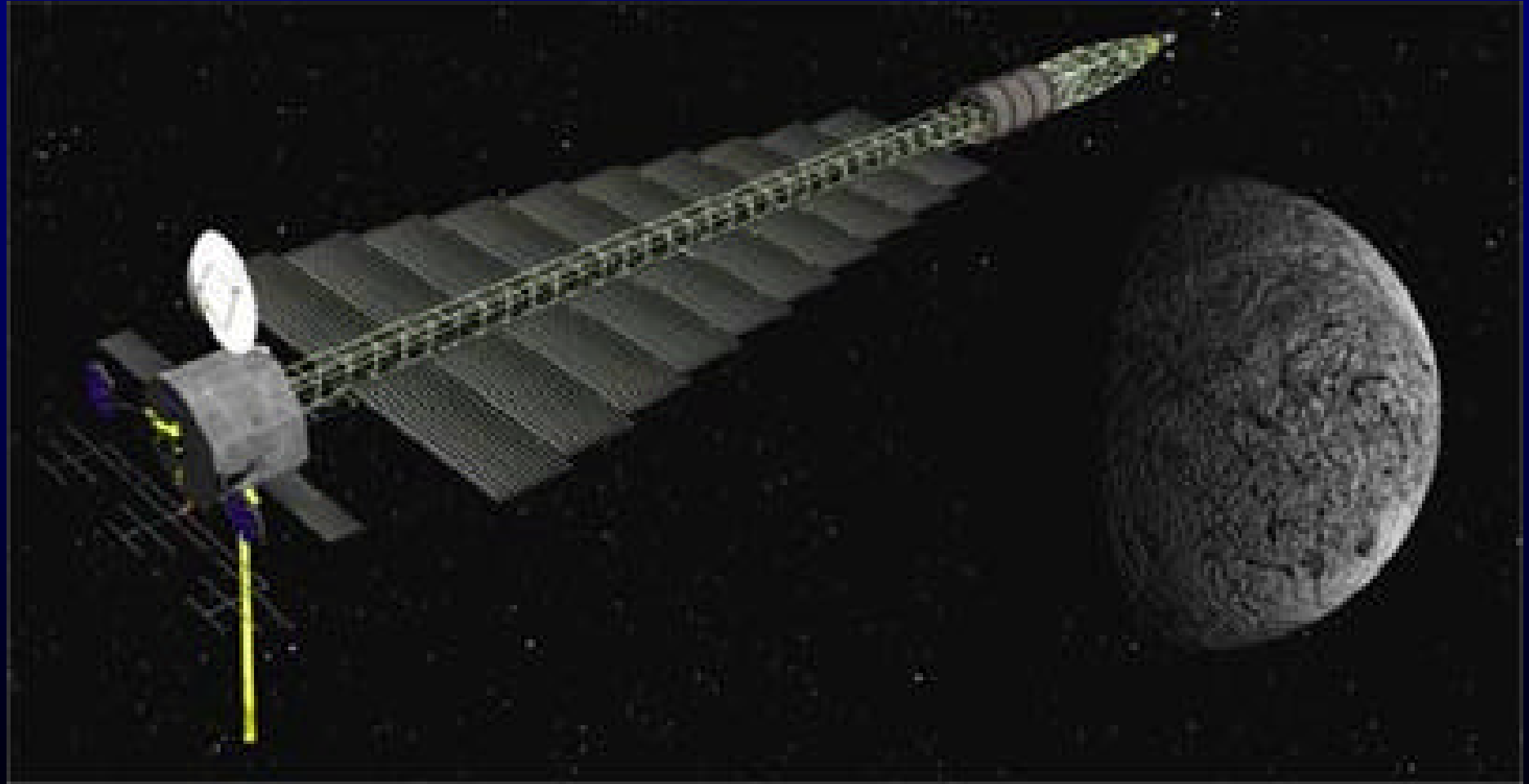
Outer Planets Exploration

• Jupiter Minisat Explorer

- Feasible to use Solar Electric Power (advanced cells & concentrators)
- Feasible scenario based on Soyuz Fregat Launcher (6 year transfer)
Total cost at ~ 400 M€
- Specific Technology needs due too severe radiation
(e.g. Europa ~ 2 Mrad for 60 day in orbit)
- Concept based on two spacecraft (Relay Sat + Europa Orbiter)

Interstellar Heliopause Probe

- Based on single Spacecraft
- Solar Sailing or Nuclear Electric Propulsion
- Severe lifetime issues
- Extreme delta-V requirement for 25 to 30 years transfer



The background of the slide is a photograph of a calm lake surrounded by a dense forest. Overlaid on the upper half of the image are numerous yellow stars of various sizes and shapes, some with long, thin trails, giving the impression of a starry night sky or distant galaxies. In the lower right foreground, a person wearing a red hat and a light-colored shirt is standing on a grassy bank, looking towards the water. A large, semi-transparent grey shape, resembling a stylized 'U' or a comet tail, is positioned behind the person.

What is beyond 2014?

The XPG activity: diverse group of people
Graduate student through to retired professor,
Philosopher through to particle physicist,
Geochemist through to ground-based astronomer,
Manned exploration enthusiast to cosmological theorist.



What are the themes for space science?
A call to the European Science Community

cosmic2015@esa.int



Deadline: June 1st 2004

Physical Scientific Questions

- Nature of physical laws.
- High energy physics beyond the accelerator.
- Quantum world, edges of space, CMB and black holes.
- Complex systems, turbulence.
- Universe: origin and evolution.
- Comparative planetology

Life in the Universe

What is life ??

continuous or not continuous transition from not living to living ?

if continuous: introduce a normative aspect

which criteria ?

a certain level of complexity

assembly of building blocks.

What are we looking for currently ?

very simple molecules.

how stable are they ?

What would we really like to look for ?

micro-organisms, biomarkers, prebiotic material, carbonaceous complex components

how do organic molecules evolve ?

some kind of organisation process in the interstellar clouds