FFIORD,
Astronomy & Astrophysics

Olivier La Marle

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FFIORD

Prisma Satellites

SUMMARY

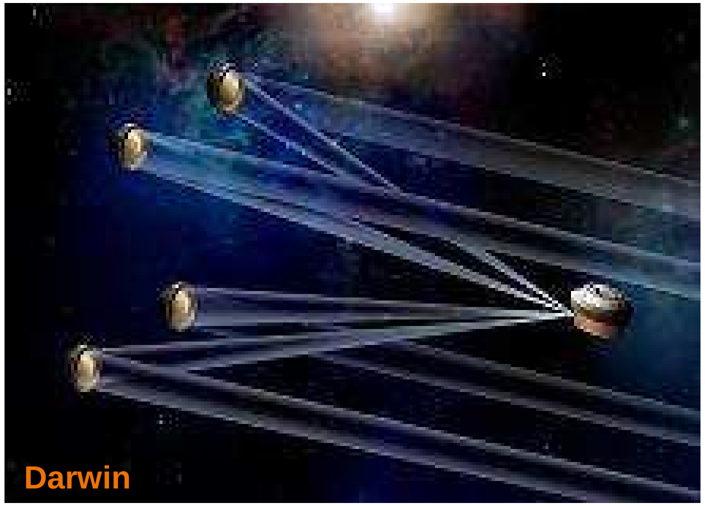
- Current monolithic space telescopes are reaching limits due to launchers fairing constraints:
  - ✦ UV ⇔ mm : mirror diameter ⇔ angular resolution

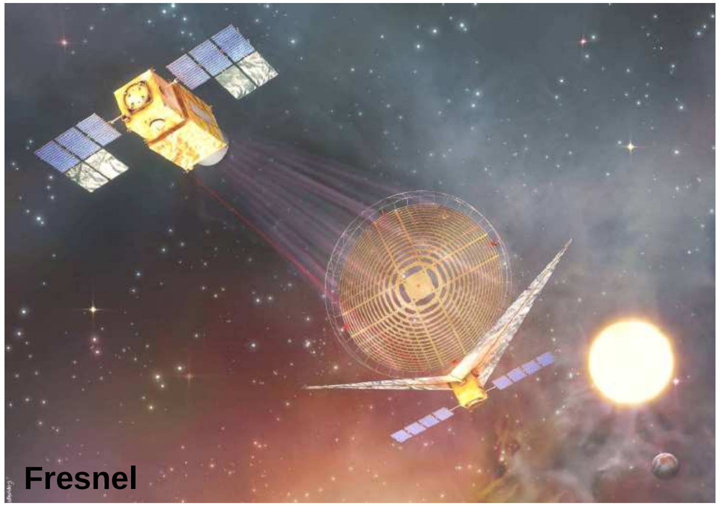
    Herschel Ø = 3.5m (largest telescope in space)
  - ✦ High energies : focal length ⇔ Focussing power Chandra FL ~ 10m; Athena~12m
- Future missions intend to overcome these limits with “distributed instruments”, using either steerable structures or formation flight
- PRISMA/FFIORD qualifies important aspects for future FF missions

Current requirements and concepts

High resolution imaging

- Objectives : exoplanets & circumstellar disks characterization, resolution of backgroung galaxies, stellar physics…
- Requirements : sub-milliarcsec resolution
- Requires to increase the primary mirror diameter or to keep several smaller telescopes in a very tight geometric configuration (interferometry, Fresnel lens imaging)
- Reached with a deployable mirror (JWST) or with several smaller telescopes in formation flight

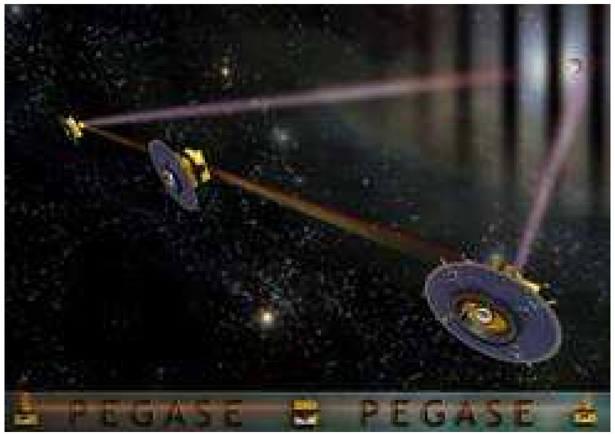


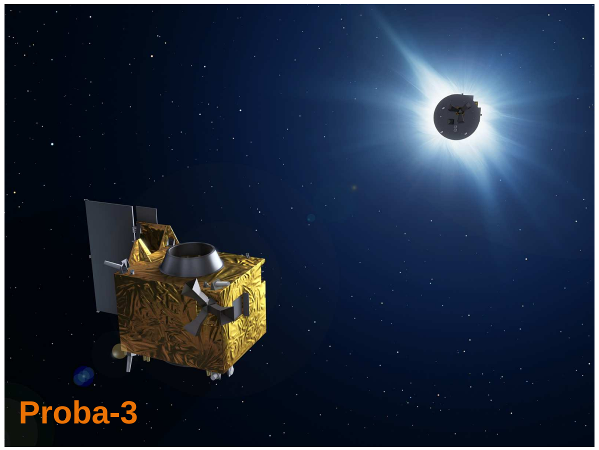


Current requirements and concepts

High contrast imaging

- Objectives : exoplanets & circumstellar disks characterization
- Requirements : 10^{-6} to 10^{-9} contrast between 2 nearby objects (planet/host star)
- High contrast imaging requires coronography or nulling interferometry technologies
- « Physical » coronographs must be far from the telescope ⇒ formation flight
- Nulling interferometry requires a large separation between telescopes formation flight or steerable structures

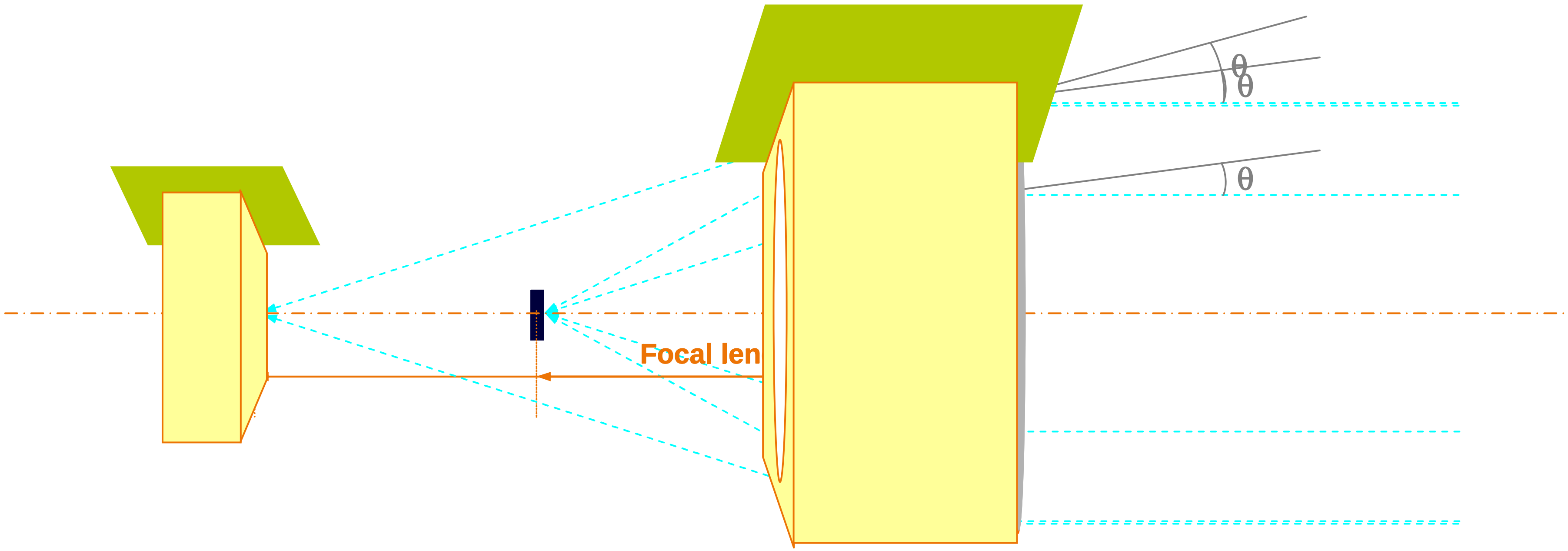




Current requirements and concepts

High energy focussing

- Objectives : study of the violent universe : accreting black holes and X-ray binaries, pulsars, quasars, Gamma-ray bursts afterglows, neutron stars, supernovae remnants, active galactic nuclei, etc.
- Deviating high-energy photons is a challenge as they penetrate matter
- Grazing mirrors are used



- Efficiency decreases when θ or E_{photon} increases => to increase either the efficiency or the upper energy cut-off threshold, one must increase the focal length

PRISMA/FFIORD and the future missions…

Numerous formation flying missions were proposed to agencies in the past years, most received a very good scientific evaluation, but were dropped because of risks (DARWIN-TPF-I, TPF-C, XEUS-IXO, COSPIX, GRI, NEAT….)

The FFIORD/PRISMA heritage

All these formation flight missions require :

- good to high accuracy relative metrologies and control (few mm to less than 1 mm) in a limited flight domain (less than 1°, few cm) for observing mode. This involves optical metrologies, micropropulsion, specific navigation&control S/W. TRL9 for ATV…
- Coarse to good accuracy relative metrology and control (~1m to few mm) in a very broad flight domain (ex 4 sr, 10m to 30 km) for « lost in space » formation (re)acquisition, anticollision handling, orbit correction manœuvres…
- Robust inter-satellite communication links

PRISMA/FFIORD (2 sat)

Main Formation Modes	Description
Science Formation Flying	FFRF & optical metrology Inter Satellite Link (ISL) Closed loop FF GNC with nominal performances Active FF FDIR Possible science data acquisition
Coarse Formation Flying	FFRF metrology Inter Satellite Link (ISL) Closed loop FF GNC with coarse performances Active FF FDIR No science data acquisition
Secured Free Flying	FFRF metrology Inter Satellite Link (ISL) No closed loop FF GNC Active FF FDIR No science data acquisition
Free Flying	2 satellites independent No active FFRF metrology No Inter Satellite Link (ISL) No science data acquisition Anti-collision managed by the Ground

Want to see more on deployable or active optics concepts?
Atelier « Telescopes spatiaux de nouvelle génération », CNES/ASHRA, IAS Toulouse, March 27-28
http://cct.cnes.fr/cctinfo/programme.htm