MISSION OBJECTIVES

D Séguéla

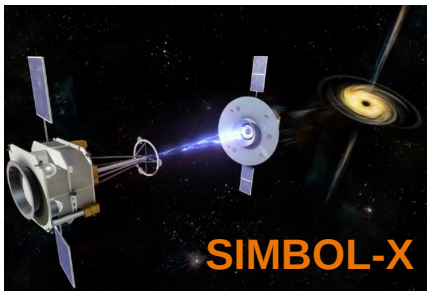
FFIORD Seminar – March 7th, 2012

SUMMARY

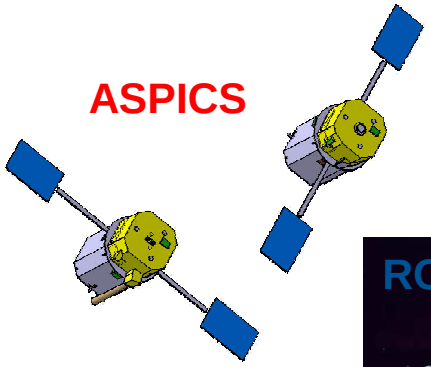
- Formation flying context in 2005
  - ✦Context for FFIORD decision
- FFIORD mission objectives
  - ✦Performance goals
  - ✦Limitations

FORMATION FLYING CONTEXT IN 2005

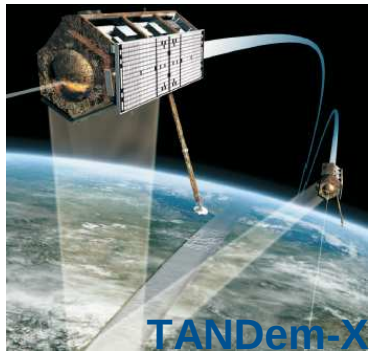
Several studies in Astrophysics, Solar Physics, Earth Observation

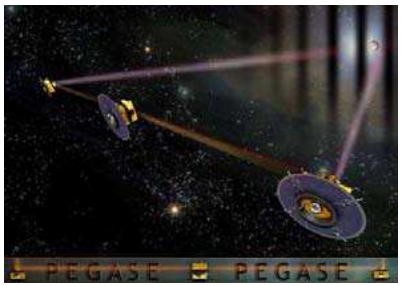


ASPICS



Interferometric cartwheel





to pave the way to DARWIN

FORMATION FLYING CONTEXT IN 2005

CNES is generally not in favour of purely technological missions

- a scientific payload is needed
  - to prove the interest of new technologies
  - to fulfill scientific objectives

The interest of early in-flight demo for critical technologies is questionnable

- but the RF metrology is needed whatever the FF mission except LEO
  - for first acquisition and re-acquisition of the formation
  - to ensure the safety of the formation (collision avoidance)

SNSB had decided a technological program for FF and RdV demonstration

- proposal for a cooperation with short term delay
  - PRISMA phase B started in 2005
  - launch goal date in 2008

At the same time, studies in ESA for PROBA3

- *far more ambitious than PRISMA*
- *discussions with CNES for a potential cooperation*

CONTEXT OF FFIORD DECISION

ESA TRP started in 2002
- RF metrology sensor based on GPS technology

SIMBOL-X preliminary study in 2002/2003

Scientific Prospective Seminar in July 2004
- selection of 4 missions
  ASPICS, MAX, PEGASE et SIMBOL-X
- preliminary studies in 2004-2005

CNES R&T started in 2004

PRISMA project
in-orbit validation of rendez-vous and formation flying technologies

SNSB proposal in April 2005 :
to fly a CNES FF experimentation

FFIORD decision in july 2005
- **RF sensor**
- **GNC algorithms**

Opportunity for low cost in-flight validation

MISSION OBJECTIVES

To validate in-orbit the correct functioning and to caracterize performances of RF metrology

- needed as 1st metrology level for all FF missions except those in visibility of GPS constellation
- depending on scientific needs, could be the only metrology level for relative distance

To measure performances thanks to an external mean : GPS

To develop and validate in-orbit algorithms for the relative positions control loop

To validate scenarii and strategies for future FF missions

- acquisition, keeping, collision avoidance
- in-orbit validation through an incremental process
- biases calibration

To test inter-satellite link using RF sensors

- FFRF ISL not used operationnally
  - ✦ PRISMA has its own RF inter-satellite link
- functional and performance tests

To transfer acquired knowledge to CNES partners

- today seminar

FFRF PERFORMANCE GOALS

Inter-satellite distance range

- from 30 km to 10 m

Distance and Line-Of Sight measurement accuracy

Accuracy (3σ)	90°> LOS > 45°	45°> LOS > 6°	6°> LOS
1 km < d	1m, 25°	1m, 3°	1m, 1°
10m < d < 1 km	1m, 25°	20cm, 3°	1cm, 1°

Inter-satellite link

- 4 kbps (TEB < 10-6) when d < 30 km
- 12 kbps (TEB < 10-7) when d < 500 m

LIMITATIONS

Technical

- LEO orbit→ poorly representative environment for future FF
- No micropropulsion → fine control performance cannot be demonstrated
- No choice for on-board configuration (antennae) but no problem with PRISMA configuration

Due to the experimental context

- Short duration experiment
  - drastic limitations on delta-V
  - no possibility to validate long term evolution
- FFIORD is a passenger
  - no redundancy
  - PRISMA FDIR always active
  - operations conducted by SSC

Linked to programmatic

- Huge constraints on planning and costs
  - some problems or limitations on sensors not solved (« use as is »)
  - limitations on on-ground RF sensor caracterization : RF, multi-paths
  - sensor development industrial organization