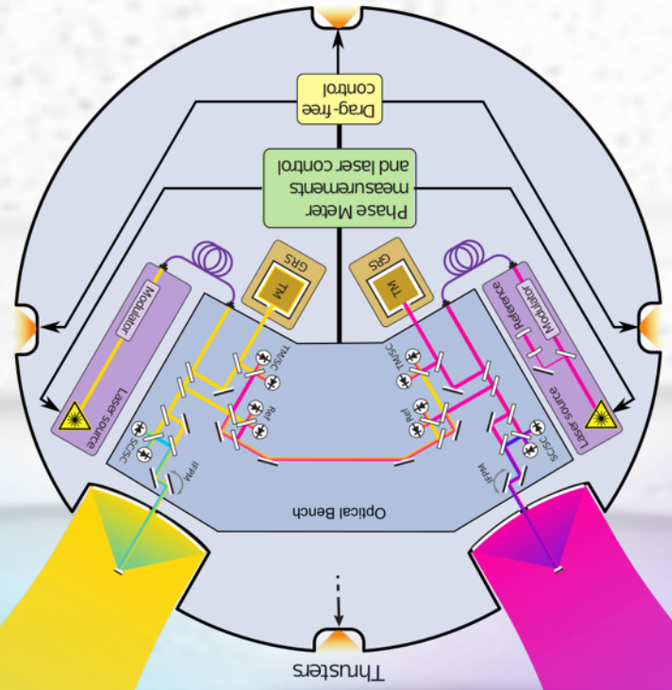
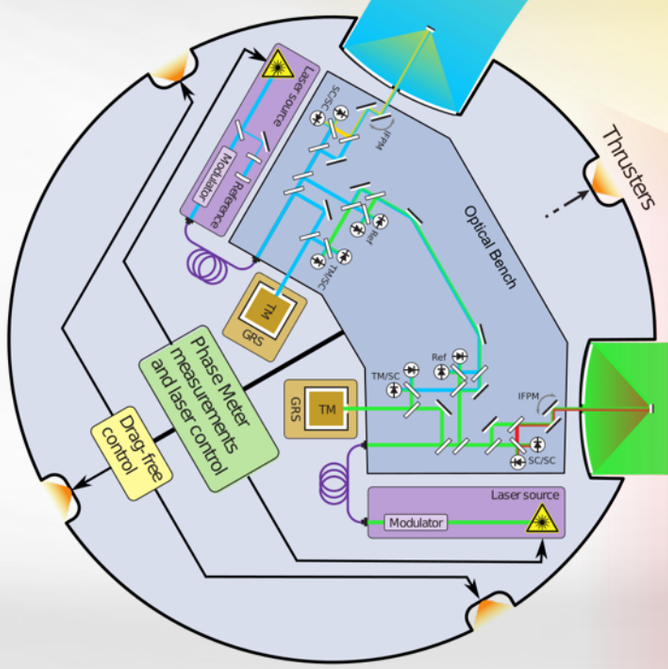
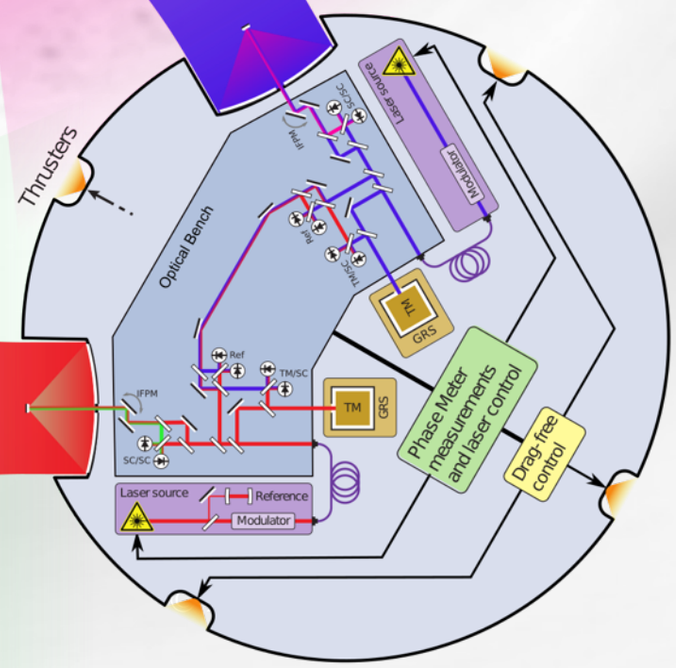
L'observatoire LISA

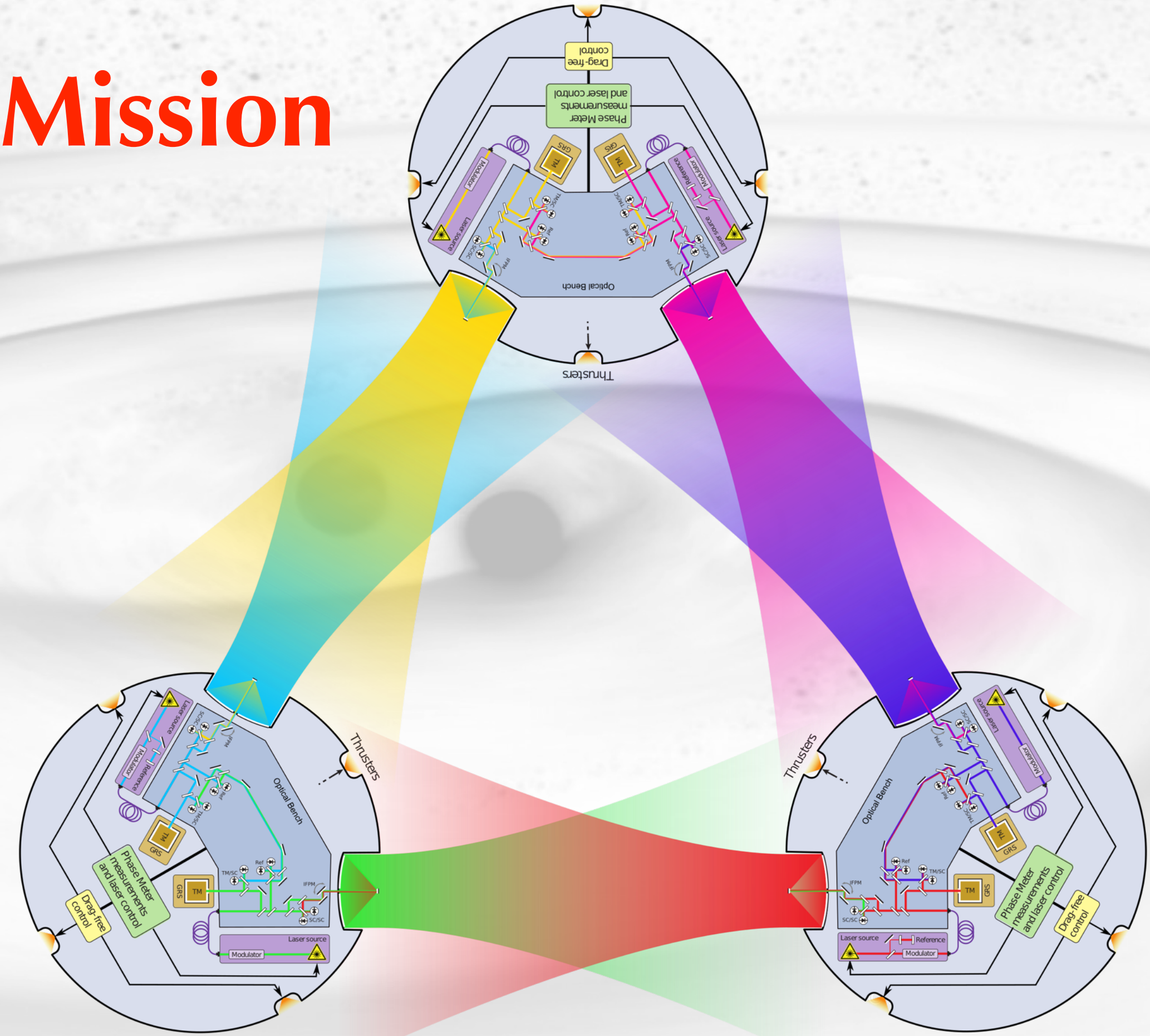
H. Halloin - APC





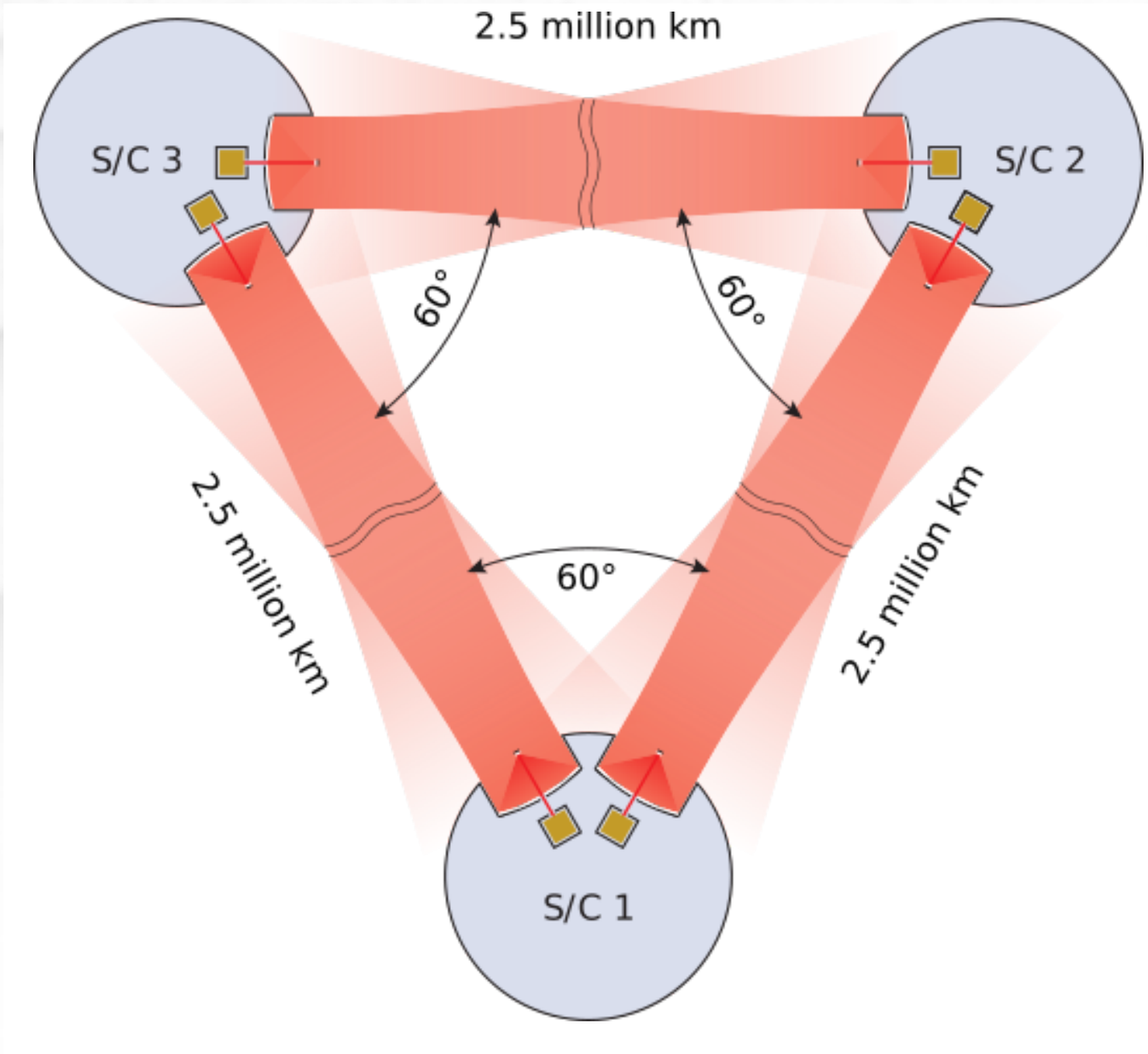


Profil Mission



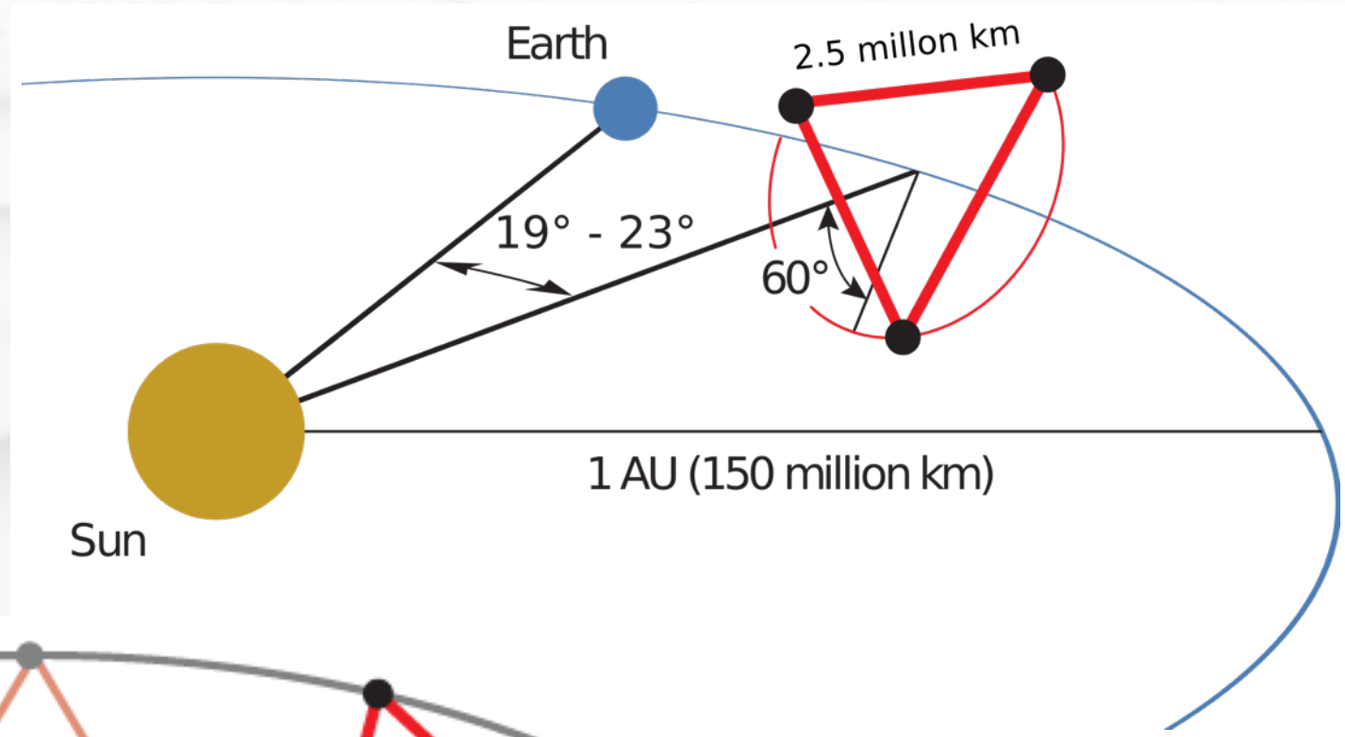
Paramètres clés

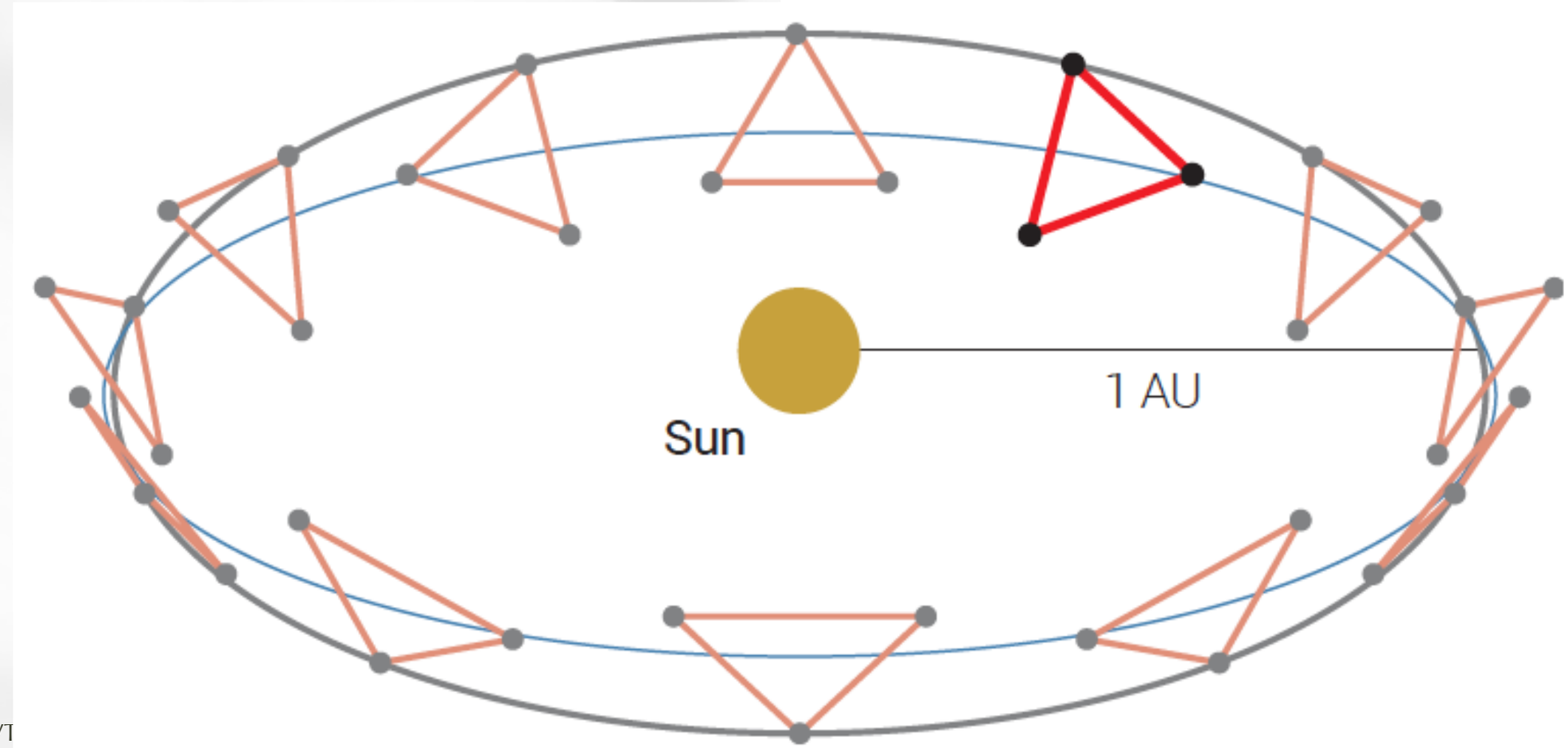
- 6 satellites en configuration équilatérale
- 3 bras / 6 liens ; 2,5 Mkm
- Télescopes : ∅ 30 cm
- Masses inertielles : copies de LPF
- 2 masses / satellites ; bancs optiques indépendants
- Lasers @1064 nm, 2W sortie de fibre
- Performance attendue : **~10 pm/√Hz @ 1 mHz**

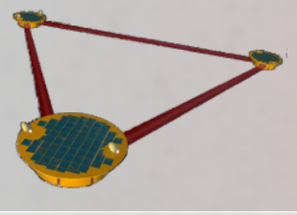


Configuration orbitale

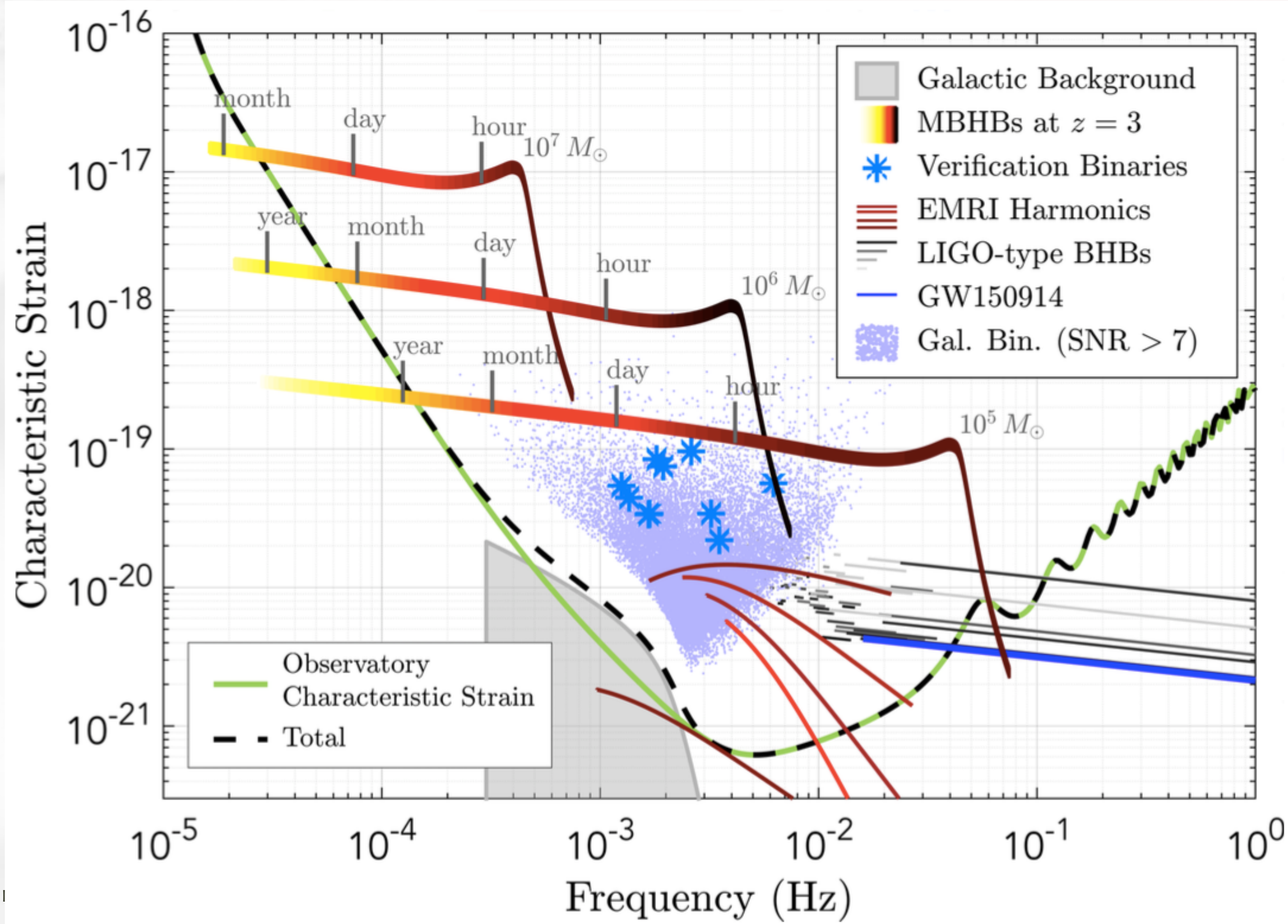
- Orbites terrestres
  - 19° à 23° derrière la Terre
  - Durée de mission :
    > 4 ans (consommables pour 10 ans)





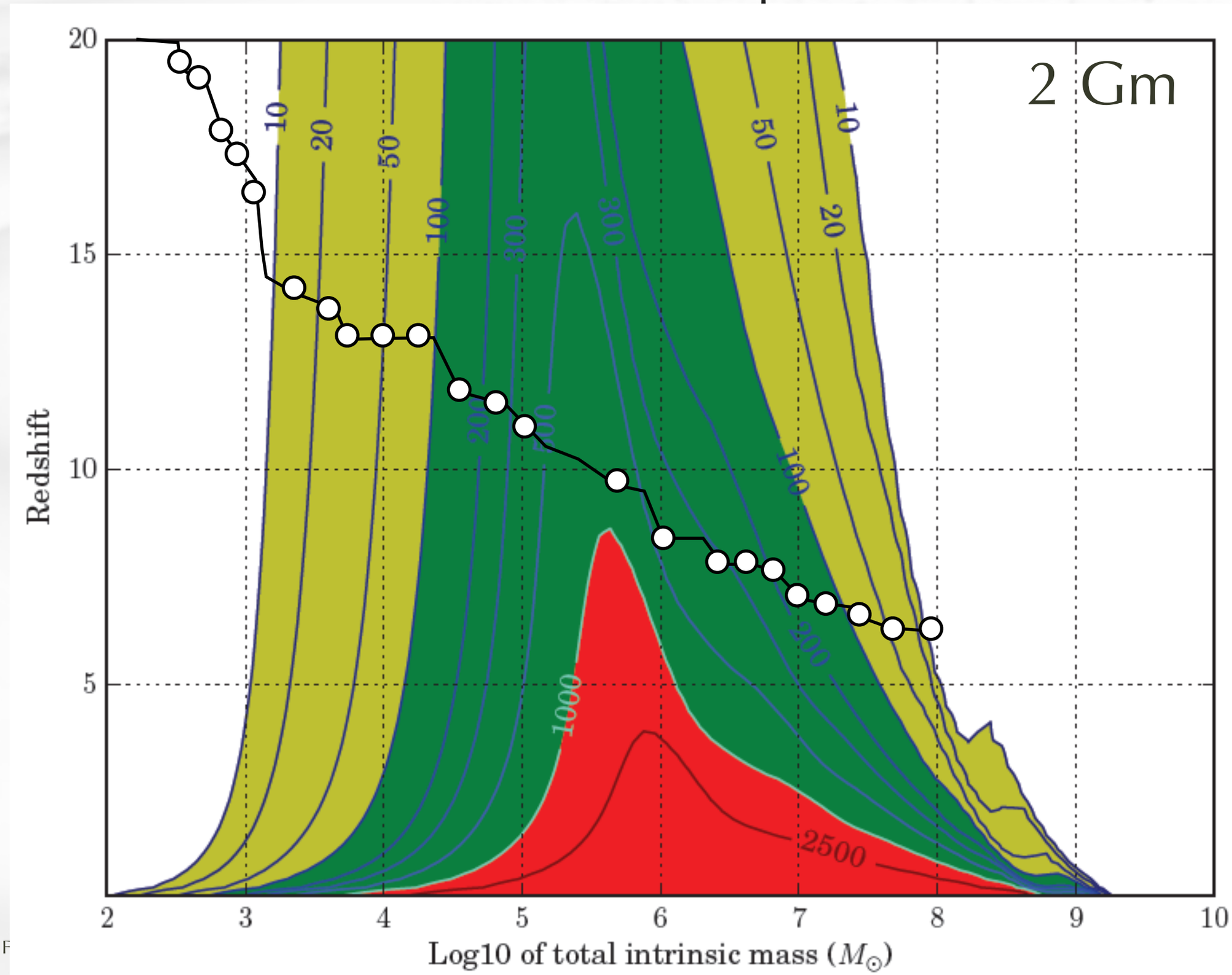


Bande passante de LISA

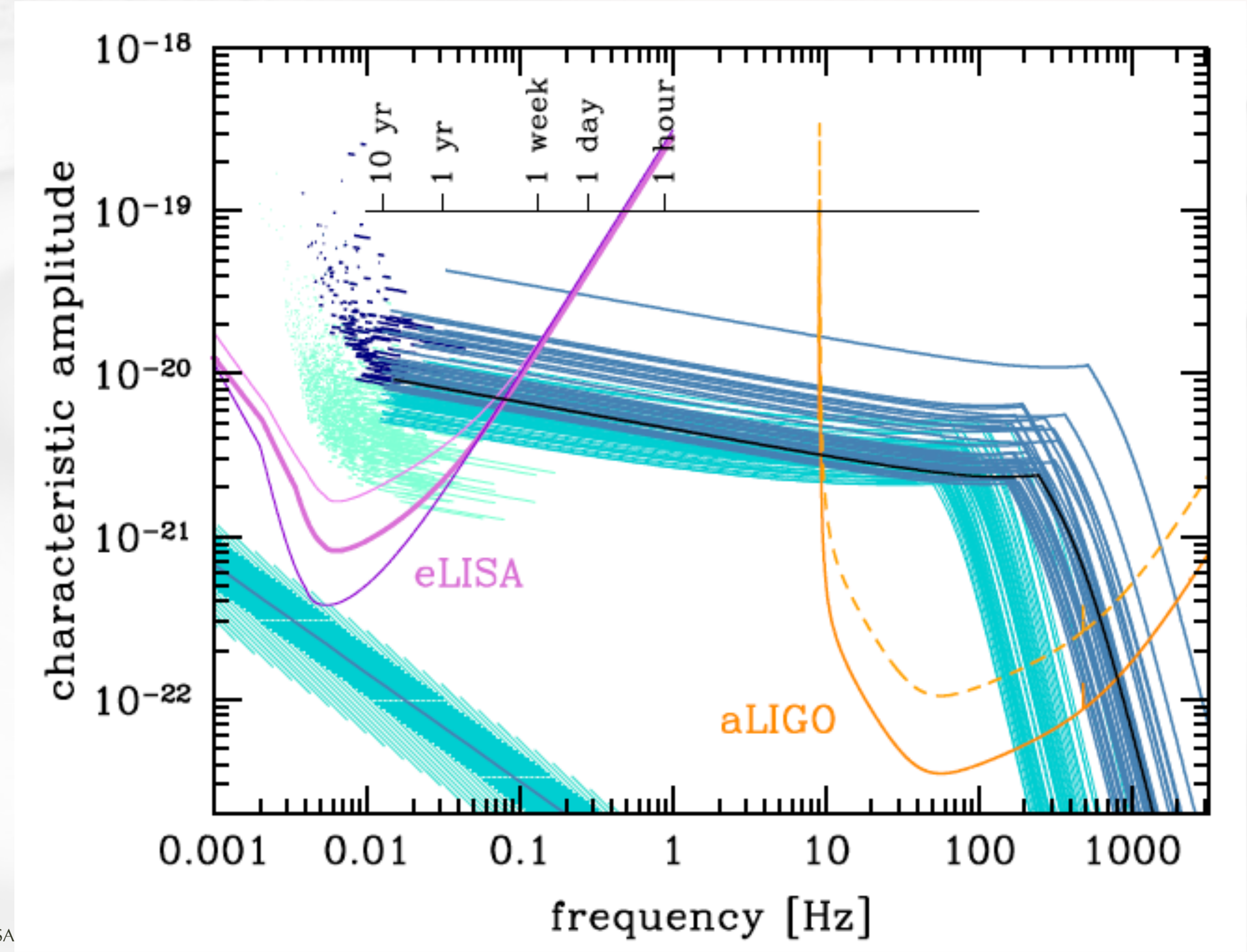


Détection des trous noirs supermassifs

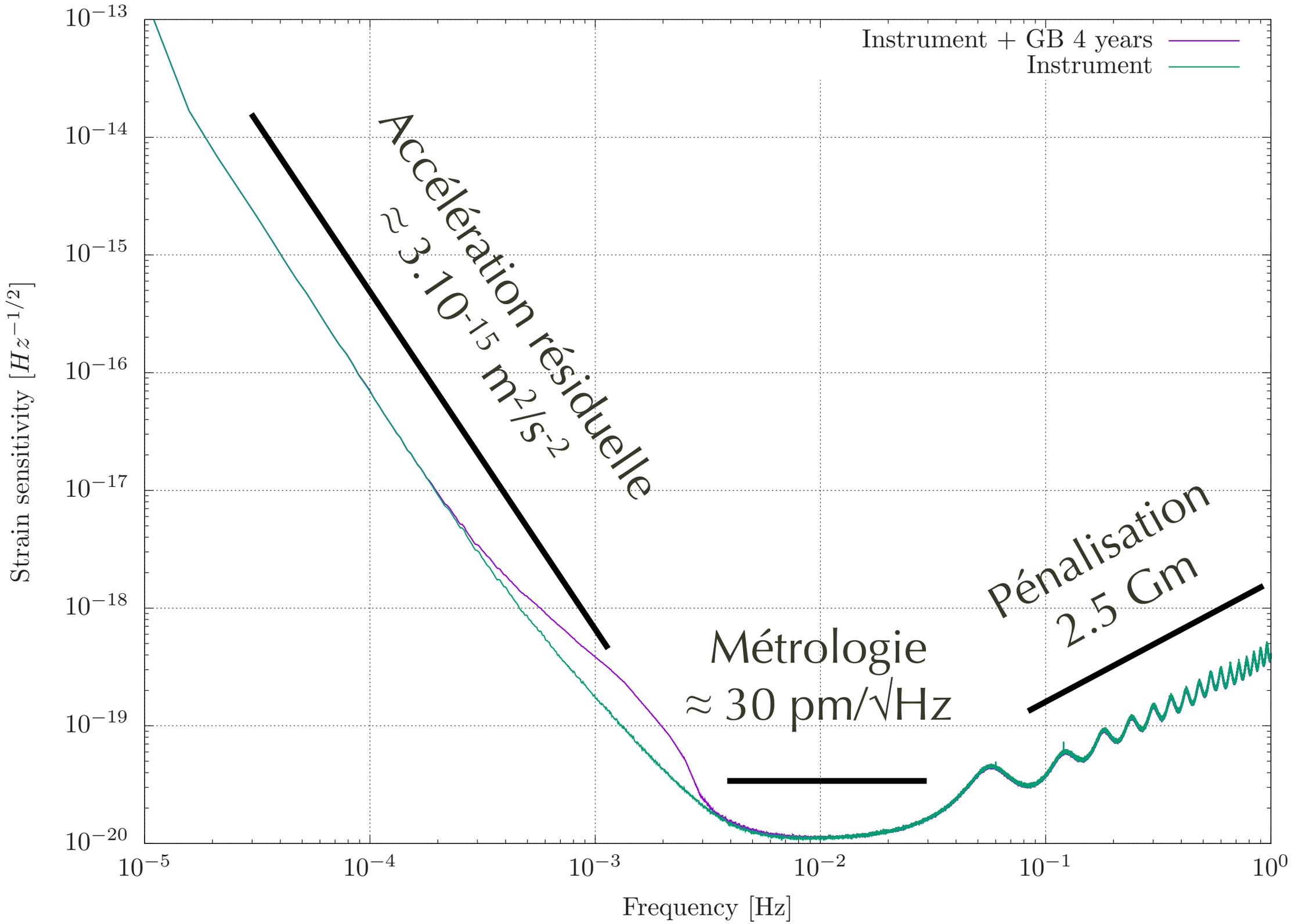
Evolution d'un SMBH et détection par LISA



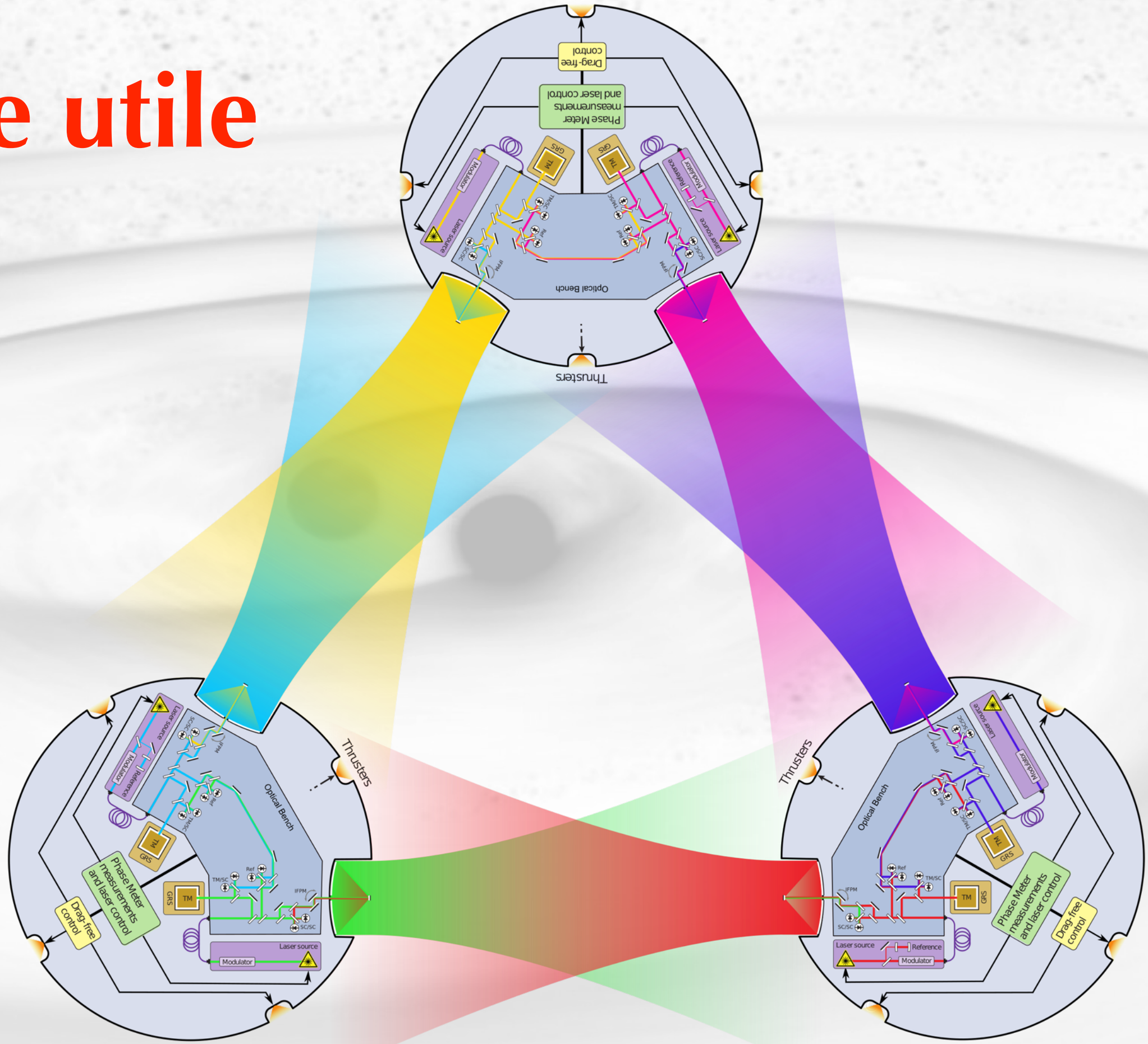
De LISA à LIGO/VIRGO



Performance globale

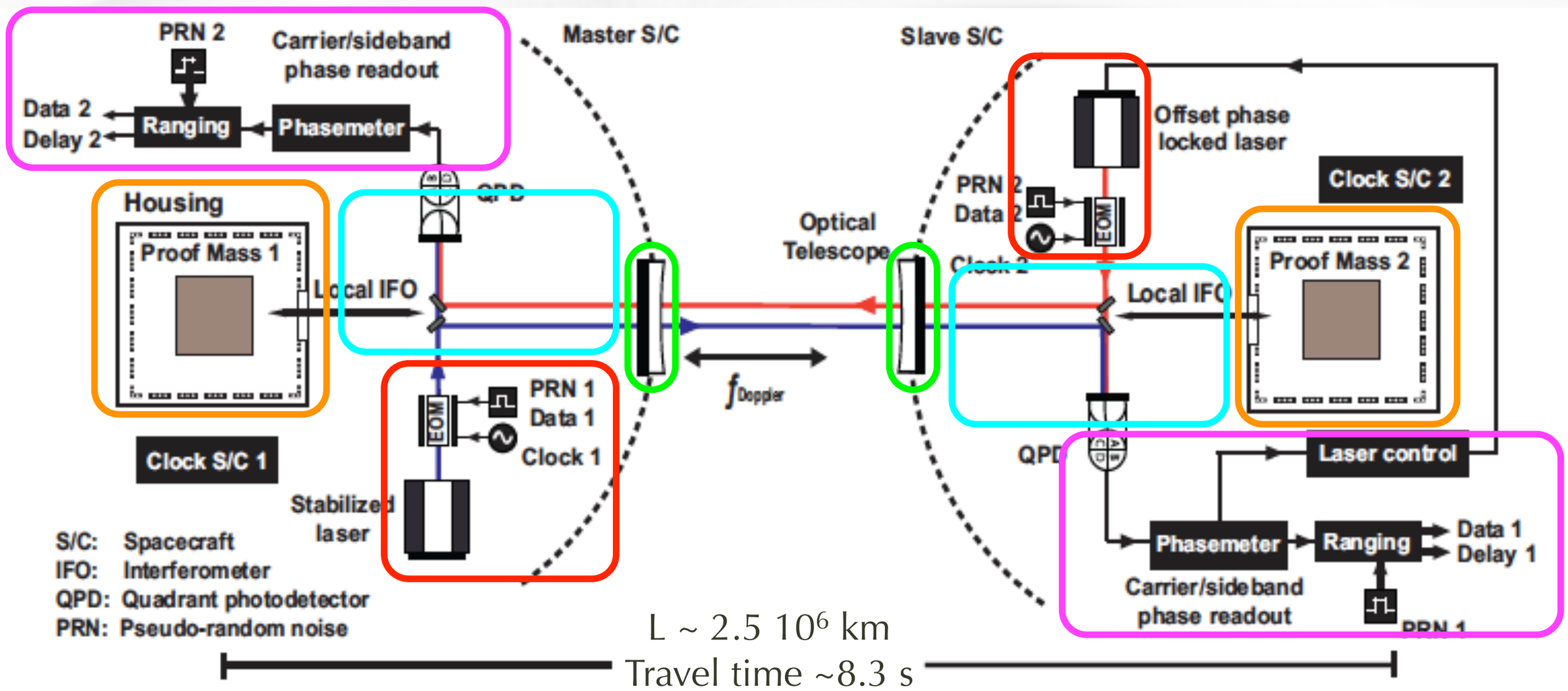


Charge utile



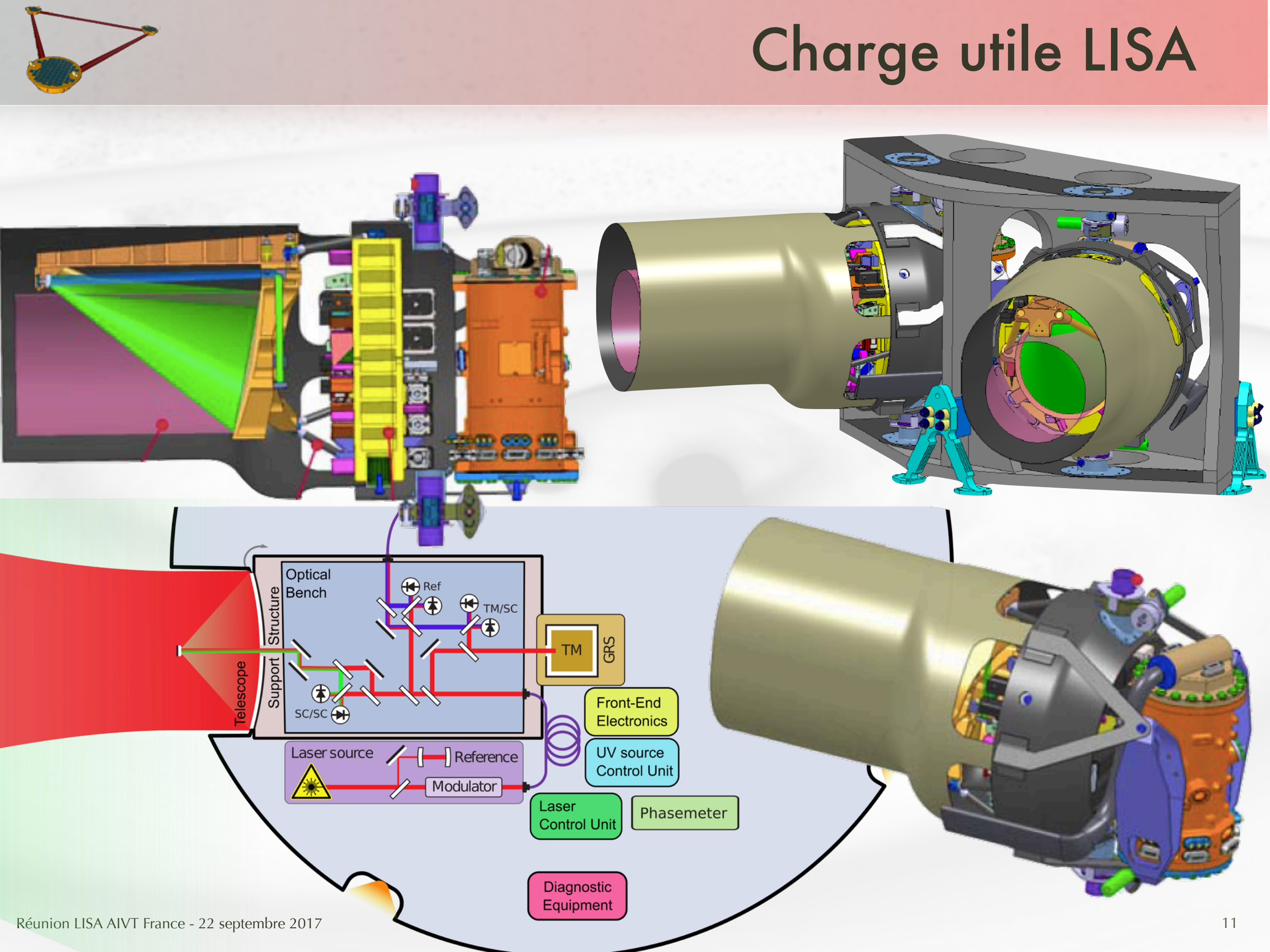
Elements de la charge utile

- Principaux éléments
  - Gravitational Reference System
  - Banc optique Zerodur
  - Phasemètre
- Telescope
- Laser source



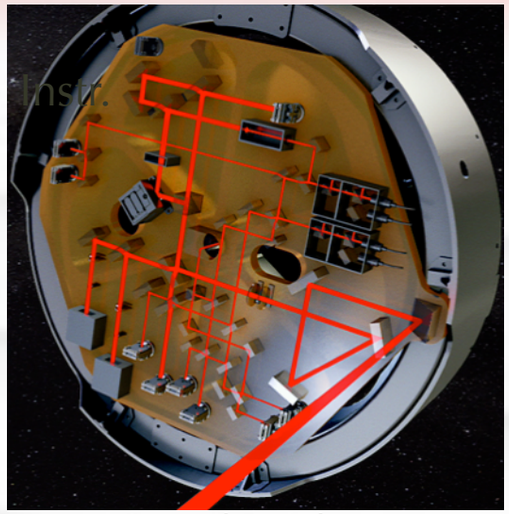
Esteban et al., «Experimental demonstration of weak-light laser ranging and data communication for LISA.», *Optics Express*, **2011**, vol. 19 p. 15937

Charge utile LISA

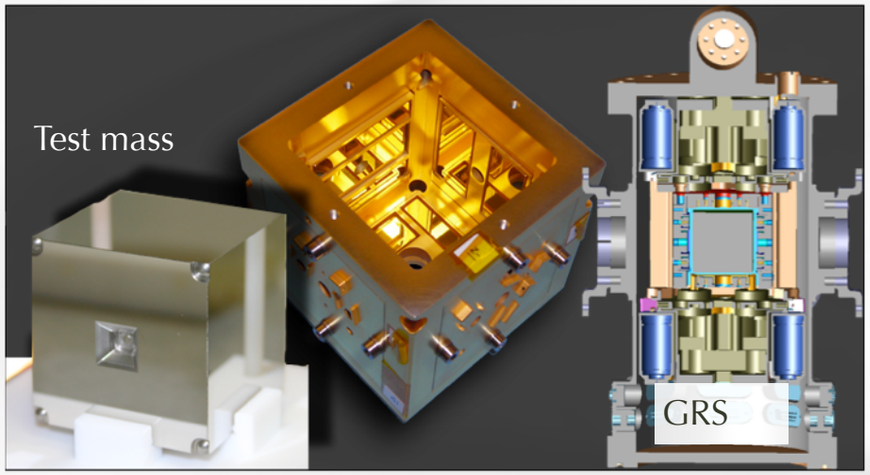


Charge utile

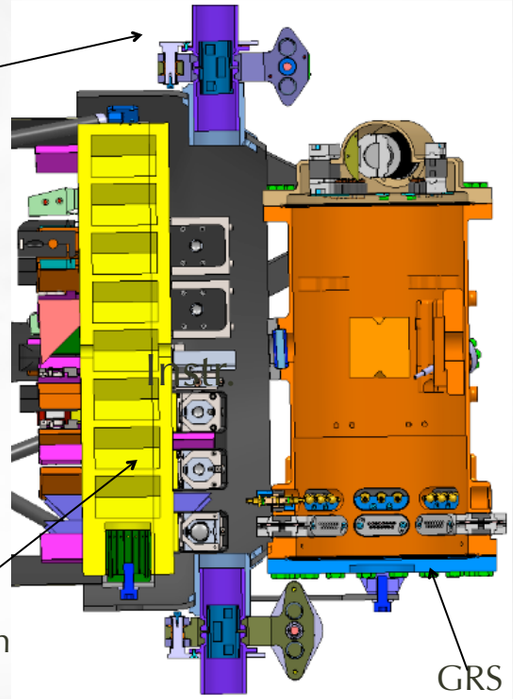
✓6x Bancs optiques avec photodiodes.
✓Photodiodes 4 cadrans : mesures des fluctuations de chemin optique + orientation
✓Acquisition de la constellation



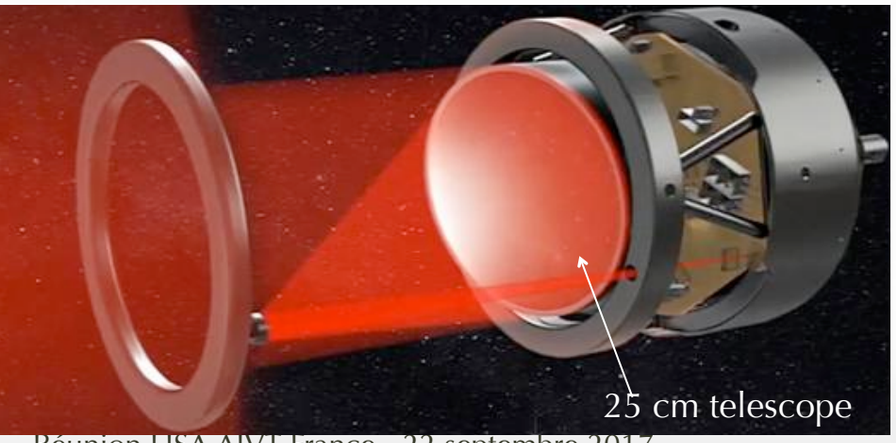
Optical Bench



✓6x GRS avec masses test, electrodes, cage, mechanisme de libération, contrôle de charge, électronique de proximité

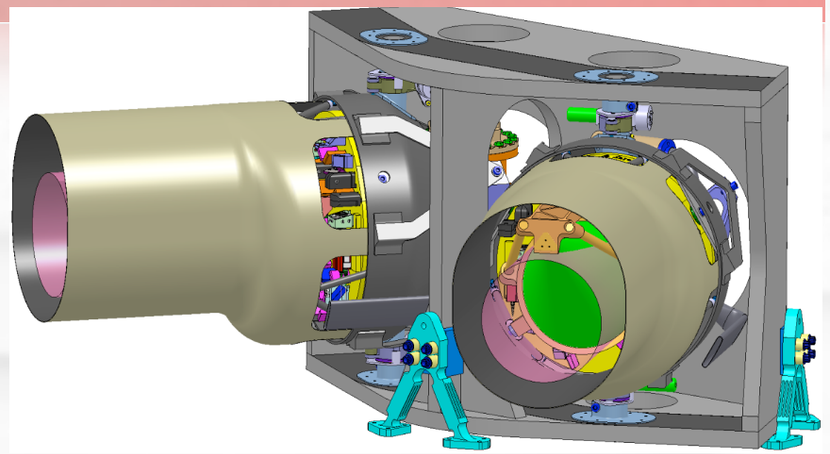


✓6x structures de maintien, liant sans contrainte télescope - banc - GRS.

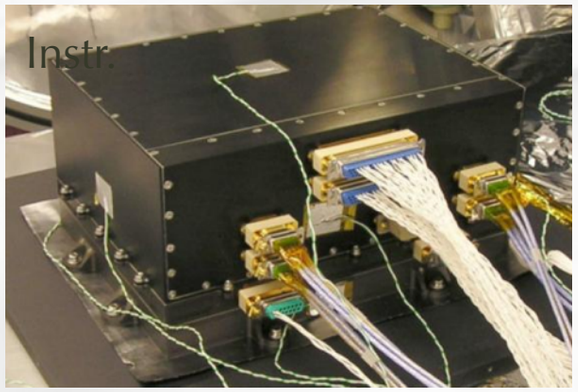


✓6x télescopes.

Charge utile



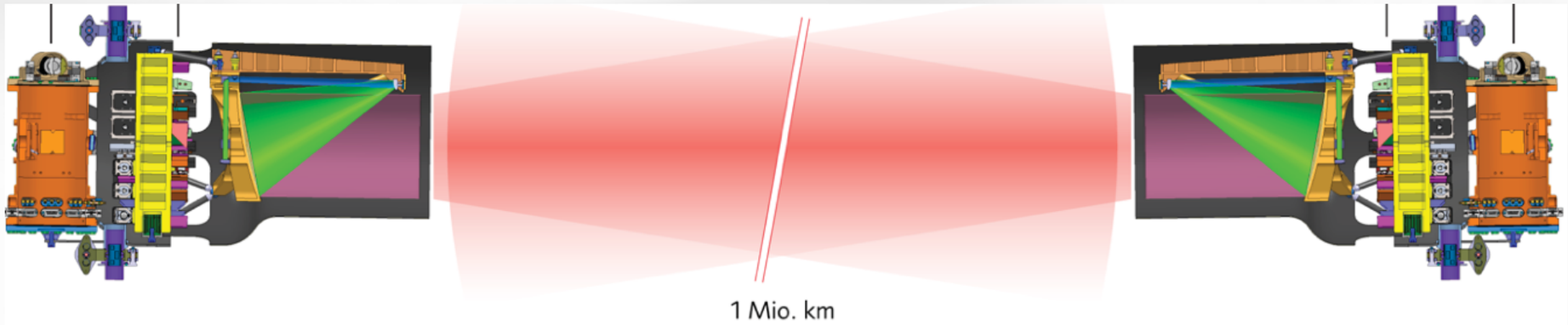
✓3x structures de liaison avec la plateforme



✓6x phasemètres traitant les signaux des photodiodes

- ✓ 2 porteuses / canal : 'science'+ synchronisation
- ✓ 4 canaux / photodiodes : centrage + tilt

✓6x lasers stabilisés @1064 nm, accordables, ~2W

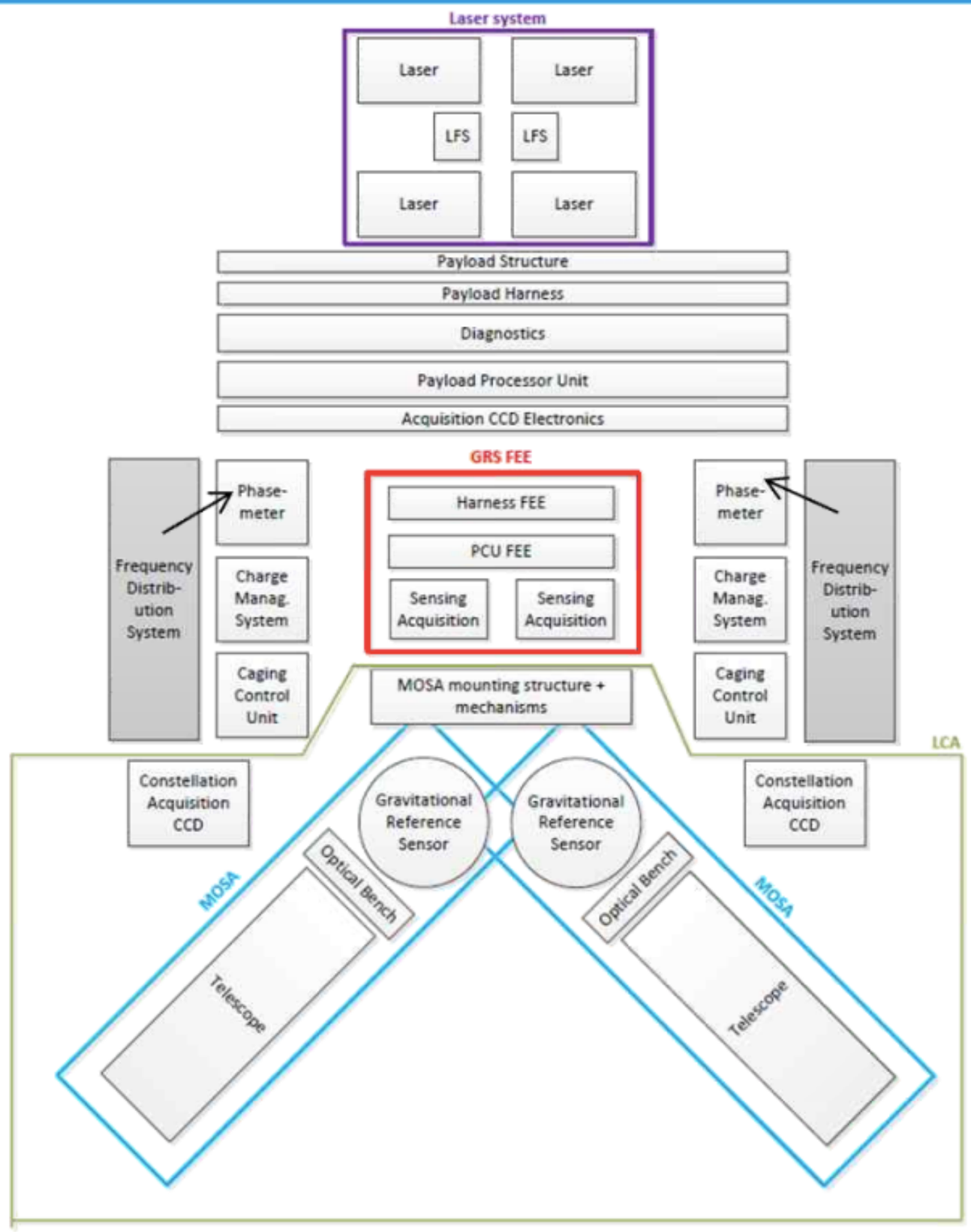


✓ 3x systèmes de diagnostiques (température, champ magnétique, radiations, …)

✓ + équipements d'integration et tests au sol (EGSE, MGSE, OGSE…)

Viewing CDF Presenter's screen

Payload: definition and breakdown



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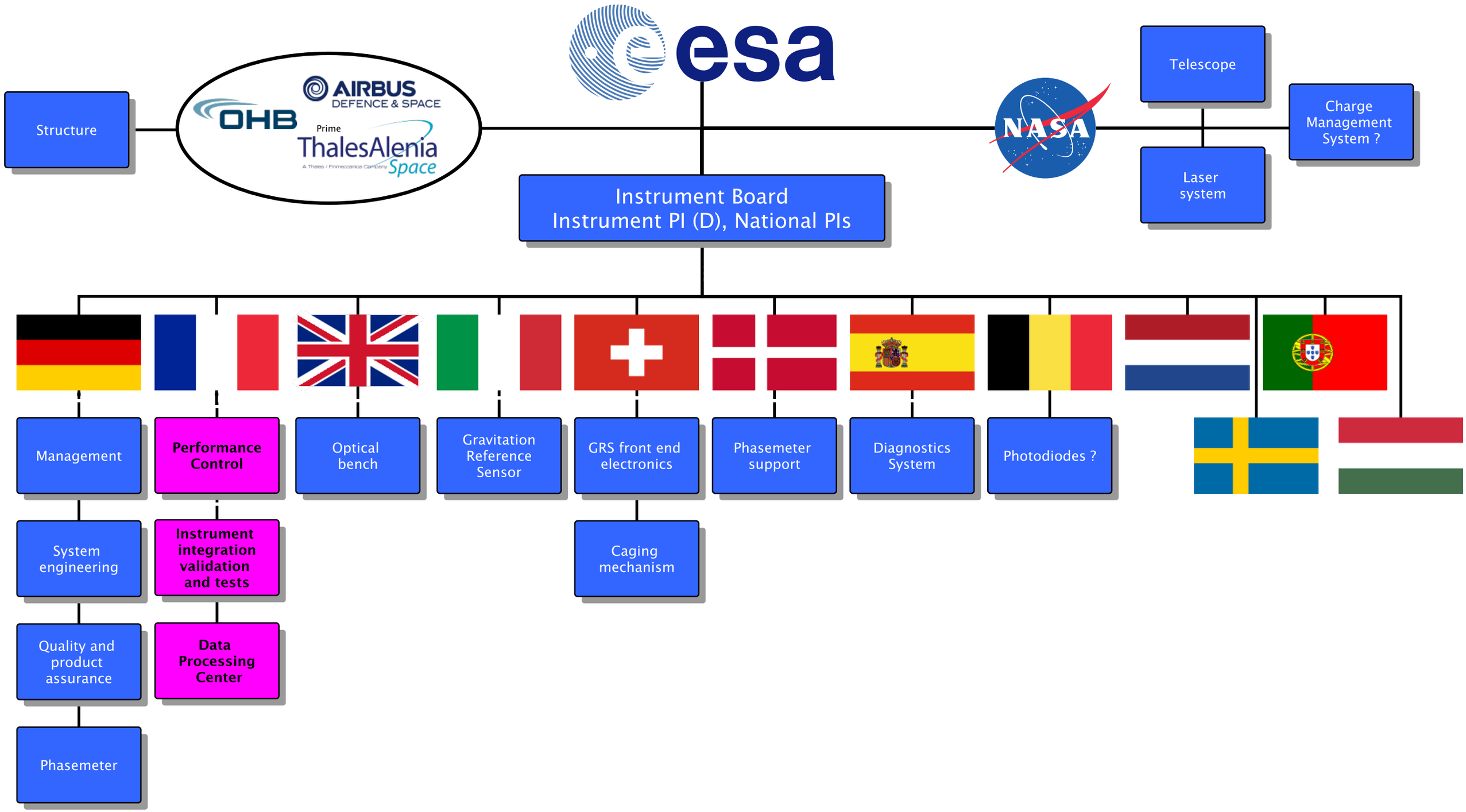
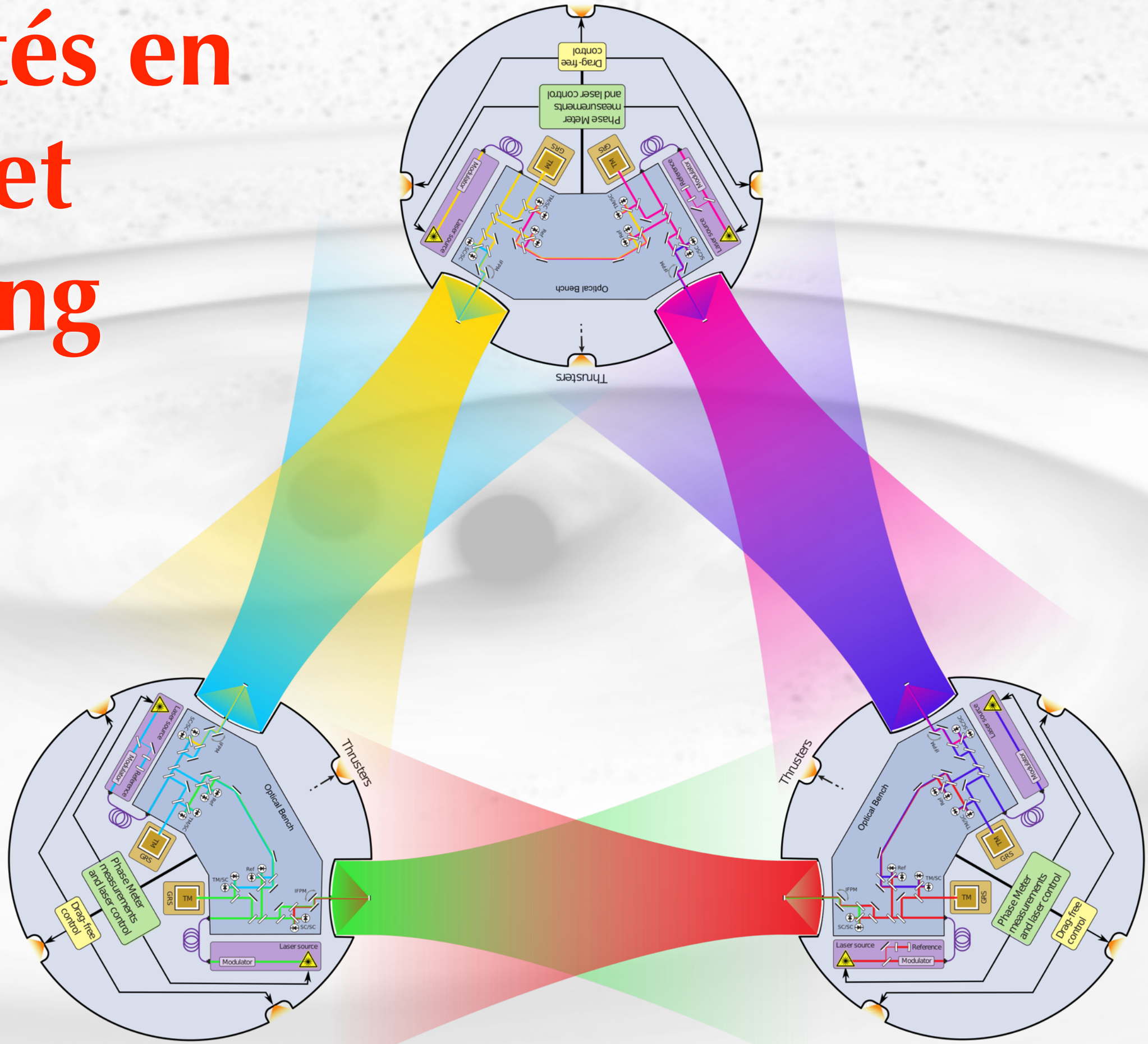
Contributions à la charge utile



Activités en cours et planning



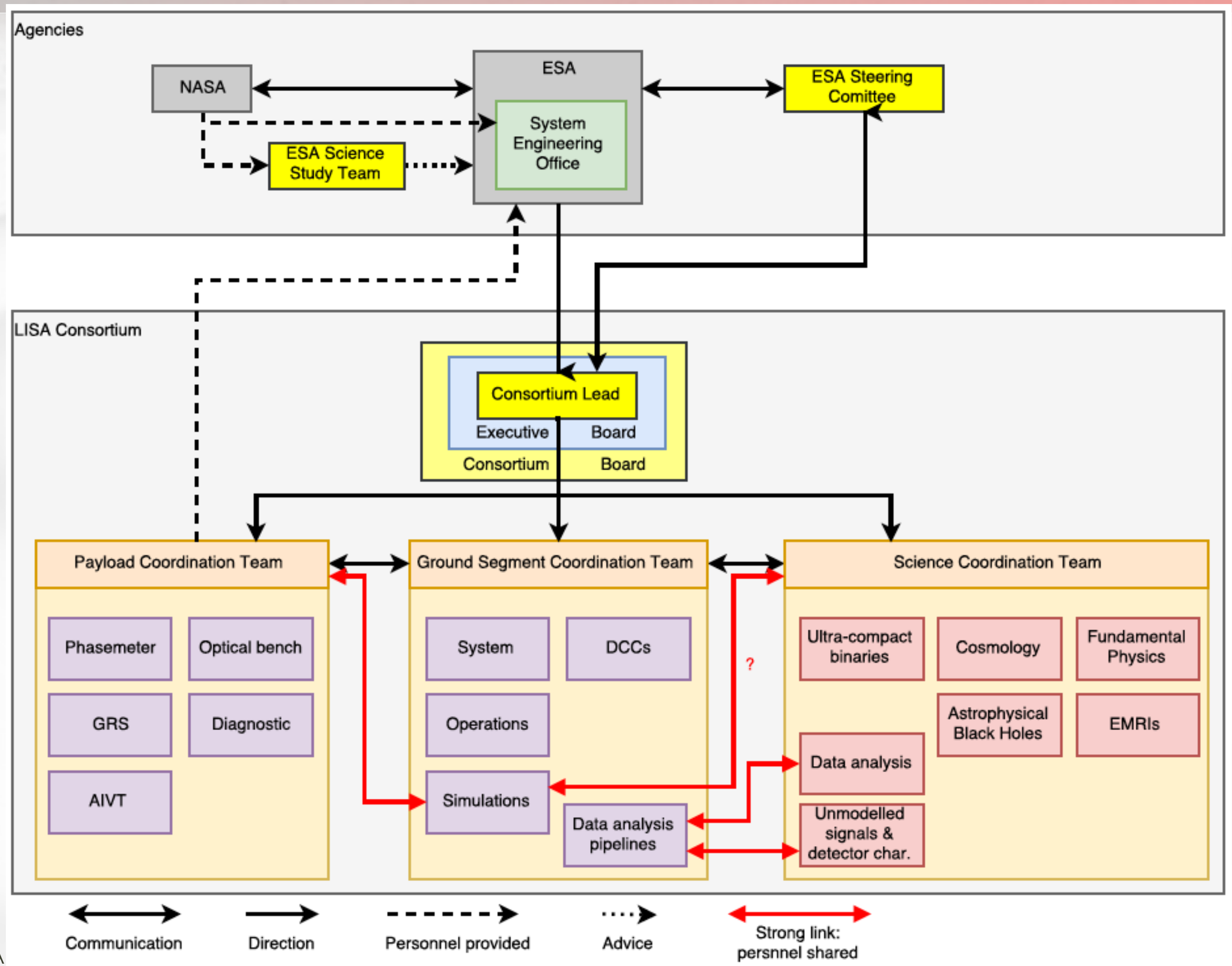
Phase 0 @ESA

- 1er semestre 2017
  - études missions (budgets systèmes, orbitographie, etc)
  - haut niveau, quelques études de charge utile (budgets)

- 2nd semestre 2017
  - Objectifs
    - Payload Defintion Document (fin Novembre)
    - Modeles de performances
    - Consortium management Plan
  - 8 sessions CDF dédiées

- Equipe ESA CDF : ~40 ingénieurs

Organisation du Consortium



Payload Coordination Team

- En charge de coordonner les activités associés aux livrables du Consortium

Coordination Team Lead (**Martin Hewitson**, Deputy: Bill Weber)
Metrology System (Gerhard Heinzel, Bill Weber, Ewan Fitzsimons, Guido Müller)
Instrument System Engineer (Hubert Halloin)

Phasemeter (**Gerhard Heinzel**, Bill Klipstein)
Optical bench (**Ewan Fitzsimons**, David Robertson)
GRS (**Bill Weber**, Rita Dolesi, Luigi Ferraioli, Peter Wass, John Conklin)
Diagnostics (possibly including 'payload' computer) (**Miquel Nofrarias**)
AIVT (**Hubert Halloin**, Nicoletta Dinu-Jaeger, Jeff Livas)

Agency Liaisons (Oliver Jennrich, Paul McNamara, Ira Thorpe)
Laser (Invited Experts: ESA Rep, Tony Yu)
Telescope (Invited Experts: ESA Rep, Jeff Livas)

Payload Coordination Team

- Principales missions du PCT en phase 0
  - Rédaction du PDD (Payload Definition Document)
  - Etablissement d'un modèle de performance
  - Etablissement de l'architecture fonctionnelle de la charge utile
  - **proposition d'un flot AIVT (Assemblage, Integration, Verification et Tests) des MOSAs**

- **==> Proposition d'un scénario et architecture mission en préparation de la phase A (2018)**

Réunions PCT et CDF

June 9th	Payload CDF Kickoff
June 15-16	Payload CDF Session #1
July 5th	Payload CDF Session #2
July 5th	PCT Kick-off telecon
July 6th	PCT Face-to-face #1
July 31st	PCT Telecon
Aug 22-24	LISA Architecture workshop
Aug 29th	PCT Telecon
Sept 7th	PCT Face-to-face #2
Sept 8th	Payload CDF Session #3
Sept 19th	Payload CDF Session #4
Sept 20th	PCT Face-to-face #3
Sept 27th	PCT Face-to-face #4
Sept 28th	Payload CDF PM#1
Oct 19th	Payload CDF Session #6
Oct 20th	PCT Face-to-face #5
Nov 1st	PCT Face-to-face #6
Nov 2nd	Payload CDF Session #7
Nov 20th	Payload CDF PM#2
Nov 23rd	PCT Face-to-face #7

Proposition de partage de responsabilités

Who's responsible for what? A working assumption…

- Consortium is responsible to deliver the 'LISA Instrument'
  - all sub-units (PM, OB, GRS, Diagnostics, etc)
- Telescope and MOSA structure comes from ESA
  - via NASA and Prime
- Consortium performs integration with Telescope and structure
  - France/CNES performing AIVT
  - with strong involvement of ESA, NASA and Prime

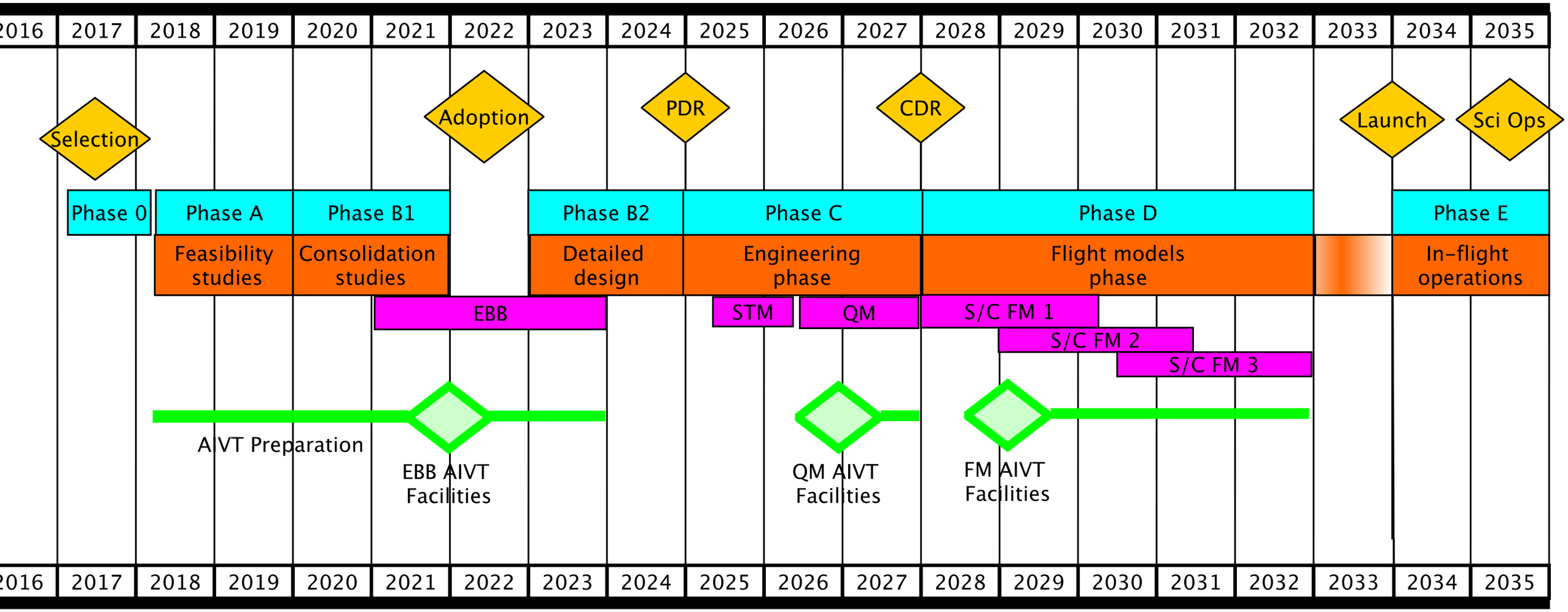
Phase A (2018 - 2020)

- Phase A industrielle
  - Deux études parallèles (concurrentes)
  - Mission entière, incluant une revue du design des charges utiles

- Phase A Consortium
  - Consolidation du design jusqu'à l'interface MOSA/LCA
  - Avec le soutien des agences nationales …

- Travaux Consortium/PCT en Phase A :
  - Definition de l'Elegant Breadboard (EBB)
    - Plan de développement
    - Design des unités
    - Plan AIVT
  - P/L AIVT Plan definition
  - Concepts de FDIR 'Science'
  - Science Exploitation Plan
  - Modèle de performance
  - Participation à l'ingénierie Système (I/F avec les industriels)
  - Plan de maturation technologique

Planning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2035
Selection
Adoption
PDR
CDR
Launch
Sci Ops
Phase 0
Phase A
Phase B1
Phase B2
Phase C
Phase D
Phase E
Feasibility studies
Consolidation studies
Detailed design
Engineering phase
Flight models phase
In-flight operations
EBB
STM
QM
S/C FM 1
S/C FM 2
S/C FM 3
AIVT Preparation
EBB AIVT Facilities
QM AIVT Facilities
FM AIVT Facilities