

HWO Preparation Status & opportunities

M. Ferrari
on behalf of “Team France HWO”



HWO Preparation – Status et opportunities

Habitable World Observatory will be the next flagship mission of NASA in the 2040

Recommendation of the Astro 2020 Decadal

Science and Technologies studies started already (GOMAP HWO START/TAG)

Decision to be taken at the next Decadal Survey 2030

As a general astrophysics observatory (à la Hubble) it will concern all our community

Despite its name, it's not a mission dedicated to exoplanets

Exo-Earths characterization is only one of the science objectives

We need to mobilize the community and organize the French participation asap !

Remember that first discussions on JWST were initiated in ~1996-98 ...

Vision, Teamwork, Optimism & Patience: The Elements of Success

First science
conference

THE NEXT GENERATION SPACE TELESCOPE

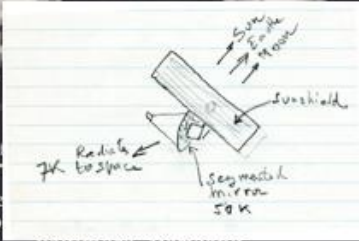
Decadal
Recommendation

1989

1997

2000

Preliminary
"Yardstick"
Designs



Baltimore, Maryland,
13-15 September 1989



NDE and
replan

2002

2011

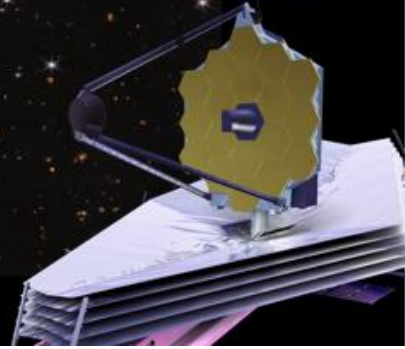
2012-2020

2021

Science
Working
Groups

lots of
hard work

some
delays



Meeting HWO « Team France » 30/31 January @ STScI



- Held in the framework of the TARPIN collaboration CNRS/STScI International Research Program
- Present to NASA the Team-France interests and expertise for HWO



Meeting HWO « Team France »

Large French representation



- Lionel SUCHET, Directeur général délégué
- Bernard LUCIANI, Directeur adjoint de l'Europe et de l'International
- Pascale DANTO, Chargée de Mission Nancy Grace Roman Space Telescope
- Nicolas MAUBERT, Représentant du CNES et Conseiller spatial à l'Ambassade de France aux Etats-Unis
- Thomas LESAGE et Chloé SAVINIEN, Chargés de mission au bureau du CNES à Washington D.C.



- Kumiko KOTERA (IAP), Iva LAGINJA (LESIA/CNES) and Marc FERRARI (INSU + IRP-TARPIN)
- Sylvette TOURMENTE, Directrice du Bureau du CNRS à Washington D.C.
- Erell GLOAGUEN, Chargée de mission au Bureau du CNRS à Washington D.C.



- Pierre-Olivier LAGAGE, Directeur du Département d'Astrophysique
- David ELBAZ, Directeur scientifique du département d'astrophysique
- Sunil FELIX, Conseiller nucléaire à l'Ambassade de France aux Etats-Unis



- Nicolas RIVIERE, directeur du programme des systèmes spatiaux et directeur de la recherche
- Antoine ROBLIN, directeur du département Optronique
- Thierry FUSCO, directeur adjoint scientifique du département Optronique



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- Thomas ...

Plus délégation de l'Ambassade de France à Washington



- Kumik - Laurent BILLI, Ambassadeur de France aux Etats-Unis
- Sylvette - Caroline MONVOISIN, Consule générale de France à Washington
- Erell G - Mireille GUYADER, Conseillère scientifique



- Pierre - Joaquim NASSAR, Attaché pour la science et la technologie
- David - Colonel David PAPPALARDO, Attaché de l'air et de l'espace
- Sunil FELIX, Conseiller nucléaire à l'Ambassade de France aux Etats-Unis



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Message from the CNES

Support to the French scientific community

- ❑ **Scientific themes around HWO are strategic for the French scientific community, and this was confirmed by the Scientific Prospective Seminar (both CNES and INSU)**

- ❑ **CNES was involved with the French laboratories in the Astro 2020 Decadal Survey :**
 - Participation of the French scientists in the NASA LUVUOIR and HABEX study teams
 - Missions' pre-studies (POLLUX, PEGASE)
 - R&D activities on-going : UV spectro-polarimetry, high-contrast imaging, ..

- ❑ **CNES is really eager to keep on the cooperation for HWO preparation**
 - Providing technical and funding support to the French labs on scientific and technologic activities with US partners
 - To be in a position to propose an adequate French contribution to the mission

Message from the CNES

Support to the French scientific community

- ❑ **Possible CNES involvement and support through**
 - Funding
 - Project/program management, system engineering, architecture, integration and tests
 - Expertise : Radiation, material, EEE, optical systems, detection...
 - Participation through ESA programs or within a consortium : “à la JWST”

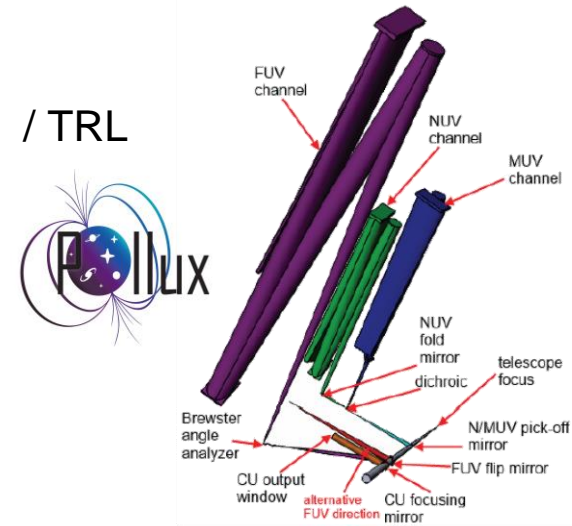
- ❑ **NASA-CNES discussions on HWO to be continue, on a regular basis**
 - CNES was no officially in the START/TAG foreign agencies observers (ESA, JAXA..)
 - Bilateral discussions exist in the framework of the Fr/US Space Comprehensive Dialog
 - Opportunities to include French scientist in the new Project Office to be discussed ...

Last meeting held at GSFC & NASA HQ 13 Nov. Strong CNES Interest reaffirmed

A long history of science collaboration in NASA flagships, from HST, JWST to RST

Decadal 2020 : Participation to LUVOIR and HabEx STDT (M. Ferrari / D. Mouillet)

- **Participation to STDT and Tech WG of both studies**
Science contributions
Identification of French possible contribution vs technologies gap / TRL
- **PI-ship (LESIA/LAM) of an European consortium**
Study of the POLLUX instrument with contribution of LESIA, LAM, IRAP, IAS and CEA,
Real expertise in Spectro-polarimetry (LESIA/ IRAP)
- **French expertise on High Contrast Imaging**
Contribution to JWST, Roman ST,
Several high-level test facilities in labs (LESIA, LAM, Lagrange, IPAG..)



A long history of science collaboration in NASA flagships, from HST, JWST to RST

CNRS International Research Project (IRP) : TARPIN (2023 – 2027)

Trans-Atlantic Research Program for Imaging New-worlds

Based on the long collaboration with STScI (>12 years) : *Co-PIs : M Ferrari / R. Soummer – STScI*

Dedicated to tech. preparation of future large missions for High Contrast Imaging

- LAM : Co-I Elodie Choquet
High quality Optics, Data processing algorithms, Science, bench
- LAGRANGE : Co-I Mamadou N'Diaye
Coronagraphy, Wave-Front Sensing, Science, bench
- ONERA : Co-I Jean-François Sauvage
WFS, OA control loop and algorithms, System, bench

Could be transform in an International Research Laboratory (ex UMI) in 2028

- Extend the collaboration to Astrophysics in preparation to HWO science programs (2030 Decadal)
- Idea submitted to INSU AA prospective → possibility to have CNRS researchers at STScI for HWO

- **AO in space developments**
(theory, simulation and in labs demonstration of key concepts)
 - System study for a multi-stage AO concept for HWO
 - Sub-nanometric – ultra stable WFS concept(s)
- **Dark-hole and post-processing of high contrast images**
 - Non-linear, AI-assisted, dark hole processes
 - Development of deconvolution-like approaches (based on ground-based how-know)
- **Based on French High Contrast expertise : From theory to lab validation**
 - Potential Lab validation in France and collaboration @STScI or JPL
 - Share of PhD students and post-docs

Strong interest of CEA teams (AIM - PO Lagage)

- JWST MIRI expertise well recognized
- Already part of the Pollux instrument in the LUVUOIR Decadal study
- Strong expertise for the study of a wide-field instrument with astrometric capabilities (HDI)

→ On-going instrument study :
Excellent interaction with HWO PO.



Integration of the Focal plan of the Euclid VIS instrument at CEA Paris-Saclay

Messages delivered to NASA by Team France

French research/space teams and agencies :

- Have a strong interest in participating in the HWO preparation, from now !
- Can contribute through ESA as partners of a consortium (JWST MIRI model)
- Can contribute in a bilateral CNES/NASA (Roman) or through direct labs collab.
- Could provide high-level expertise in several areas of science and technological development (high-contrast, wide-field, spectro-polarimetry, ...)
- Are ready to devote resources to contribute to science and TRL ramping.

French participation discussed with NASA

co-Chair positions for French scientists in the START WGs

- Pierre-Olivier Lagage : co-chair Science Data Simulation/Wide-Field sub-WG.
- Médéric Boquien : co-chair Science Case Simulation/Galaxy Evolution in the UV sub-WG.
- Céline Reylé : co-chair the Science Case Simulation/Astrometry sub-WG

Plus

- David Mouillet selected as one of the 3 ESA representatives
- And other scientists involved in various sub-WG

~100 French scientists registered in the WG/sub-WG mailing lists.

Organization HWO Team France

David is right : HWO is Short term !!! 2040 is tomorrow

Project office : Definition of the mission wrt the Decadal 2020 recommendation

- Phase A of instruments planned for 2028
- Start long lead item procurement as soon as 2027/28, just after RST launch...

Of course “**Precursor effort**” is needed

- Use existing/already planned missions (RST, ARIEL, PLATO, etc.), or instruments to prepare for HWO but do not think of another "preparation mission"...

Organization HWO Team France

HWO French steering committee being discussed with CNES & INSU

- Representatives of all agencies: CNES, CNRS, CEA, ONERA, etc..
- Participation of START Co-chairs, ESA representative (D. Mouillet)..
- Representatives of various initiatives ..

→ Organize the French participation in HWO

- Federate the various efforts existing in the community
- Be point of contact at national and international level
- Contact with HWO team at CNES/NASA level
- ...