

# LUVOIR STDT Face 2 Face meeting #3

Proposition for a CNES contribution  
to LUVOIR instruments studies

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## Context

- ▶ CNES is willing to support the participation of French space laboratories to LUVOIR study, scientifically and technically,
- ▶ Taking in charge one the instruments conceptual studies is certainly the best way to be involved in the early phase,
- ▶ CNES, via PASO department, could support a “Phase 0” technical study, with a consortium of French and European laboratories.
- ▶ The UV instrument could be an opportunity for CNES to build on previous studies and to provide specific expertise (i.e. spectro-polarimetry)

## Context

- ▶ Continuation of CNES/NASA collaboration on UV missions or instruments (i.e. FUSE and GALEX)
- ▶ Existing Arago study for M5 ESA mission proposal, with potential contribution from US colleagues (Arago+)
- ▶ Proposition to ESA Call for New Science Ideas – 2016 [M. Barstow – Univ. Leicester]

### Cosmic Origins and the Search for Living Worlds

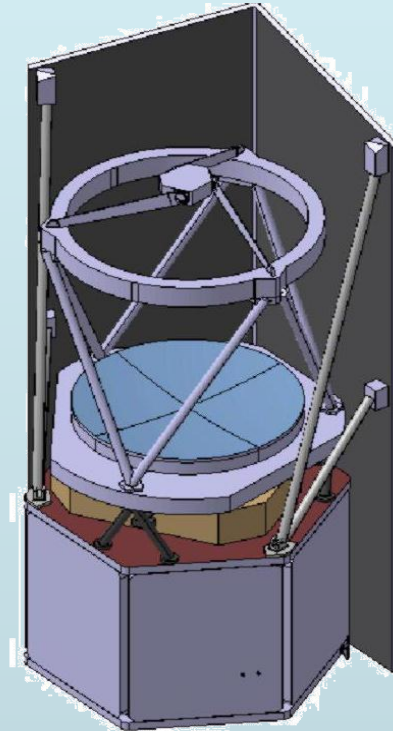
**Lead proposer:** Prof Martin Barstow – University of Leicester

**Core Team:** S. Aigrain, J. Barstow, M. Barthelemy, B. Biller, A. Bonanos, C. Bonoli, L. Buchhave, S. Casewell, C. Charbonnel, S. Charlot, R. Davies, N. Devaney, C. Evans, M. Ferrari, A. Ferguson, A. Fontana, L. Fossatti, B. Gänsicke, M. Garcia, A. Gomez de Castro, D. Gouliermis, T. Henning, L. Lamy, S. Larsen, C. Lintott, C. Knigge, C. Neiner, L. Rossi, S. Rugheimer, D. Sing, C. Snodgrass, D. Stam, E. Tolstoy, M. Tosi

- ▶ The conceptual study conducted by CNES could serve as a support for a future ESA contribution.

# ARAGO

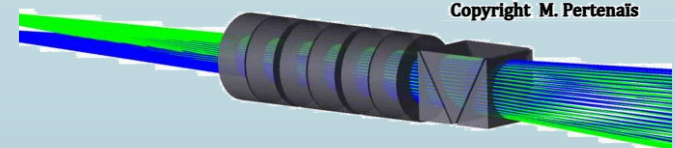
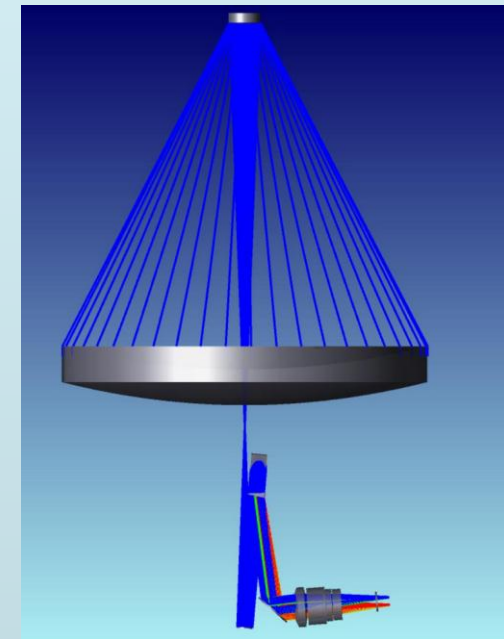
- ▶ Phase 0 study funded by CNES
- ▶ Submitted as ESA M5 proposal (P.I. C. Neiner – LESIA)
  - ▶ Pre-selec. 2017 – Selec. 2019 – Launch 2029
- ▶ UV and Vis high-resolution spectro-polarimeter
- ▶ Observations of all types of stars
- ▶ Four years mission with full-sky observation
- ▶ 270 scientists from 23 countries.  
12 European countries involved in the Payload Consortium.
- ▶ Scientific cases :
  - ▶ (1) What is the life cycle of matter in the Milky Way ?  
(stellar and planetary formation and evolution, ISM)
  - ▶ (2) How do stars affect their planets and the emergence of life ?  
(star-planet interactions, stellar wind and irradiation, conditions for life)



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# ARAGO

- ▶ 1.3-meter Cassegrain telescope
- ▶ A single UV - Vis polarimeter
- ▶ + Two classical high-resolution echelle spectrographs
  - ▶ UV [119-320] nm and visible [350-888] nm
  - ▶ MCP detectors for the UV / CDD for the Visible
- ▶ + Far-UV [90-125] high-resolution spectrograph Arago+ (potential NASA contribution)
- ▶ Polarimeter modulator :
  - Rotating stack of plates + beam-splitter
  - Observation process with 6 exposures @ 30°
  - allows to measure the full Stokes (IQUV) parameters
- ▶ Static polarimeter under development with CNES (low TRL)
  - ▶ Use of two birefringent wedges associated with a linear analyzer
  - ▶ No moving part and complete (IQUV) Stokes measurement with a single-shot exposure



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# UV Imager / Spectrograph - Scientific capabilities

- ▶ UV –Vis Wide-field imaging (typically 5x5 arcmin)
  - ▶ 5-10mas pixel  $\rightarrow$  60k x 60k !! ?
- ▶ Low to moderate resolution (100 - 5000) Multi-Objects Spectrograph
  - ▶  $\mu$ shutters (2nd generation NASA Nirspec type)
  - ▶ MOEMS programmable slits (CNES / ESA developments)
  - ▶ Possible combination with an IFU ?
- ▶ Single source High Resolution (100.000  $\rightarrow$  150.00 / 200.000 ?) UV spectrograph
  - ▶ HR UV and VIS spectro : 2 instruments or 2 chanel of a single one ? (I.e.ARAGO design)
- ▶ Far UV spectroscopy capabilities (down to 90nm ?)
  - ▶ Very low throughput in far UV (<110 nm) – Need coating development MgF<sub>1</sub> + protect layer ?
- ▶ UV polarization capability:
  - ▶ Existing solution for [120- 320]nm
  - ▶ Need again development for far UV spectropolarimeter [90 ? – 320] nm

# UV Imager / Spectrograph / Spectropolarimeter

## **CNES / Lab. interest**

## **First priorities**

From Scientific and technical levels:

- ▶ Single source High Resolution (up to 200.000) UV spectrograph
  - ▶ Possible extension to Vis as a 2<sup>nd</sup> channel of the same instrument ?
- ▶ UV spectropolarimeter capability: typically on [100 - 300]nm range
  - ▶ Existing strong expertise but need development to extend down to 90 nm

## **Other possible contribution / Technical expertise.**

- ▶ MOEMS based Multi-Objects Spectrograph
  - ▶ Programmable slits under CNES/ESA developments, with EU  $\mu$ electr. laboratories
  - ▶ Lab demonstrators + first light @ TNG Canarias in 2017

# Consortium and technical contributions

- ▶ **CNES** : Project management, Expertise support, Cost estimation, etc..
- ▶ **French space laboratories**
  - ▶ LAM : System eng. , overall optical design, performance estimation,
  - ▶ LESIA : [Spectro-polarimeter], Software,
  - ▶ IRAP : Spectro-polarimeter,
- ▶ **Main International Partners**
  - ▶ UK ATC : Opto-mechanics,
  - ▶ Univ. Leicester : Detection chain
  - ▶ Space Research Institute (Graz) : DPU
  - ▶ Other potential participations from :
    - Spain (Madrid / IAC), Nederland (Leiden/Amsterdam), etc..
- ▶ **All: LUVOIR Science cases for UV-Vis Imaging/spectro-polarimeter**



# UV Imager / Spectrograph / Spectropolarimeter

- ▶ **Possibly two UV (-Vis) separate instruments ?**
  - ▶ [1] Wide-field Imager / Multi Object Spectrograph with Low-Mid Resol.
  - ▶ [2] Single source High Resolution UV spectropolarimeter
  
- ▶ **Need to coordinate CNES study with the one led by Kevin**
  - Duplicate studies on some of the UV capabilities ?
  - Collaborative studies with cross-expertise ?
  
- ▶ **Interaction with / Integration in LUVOIR study**
  - Pass I/O parameters and data for interface with Telescope / Instruments
  - Shall CNES consortium participate in the “Design Lab.” sessions ? How ?
  - Not yet started officially → schedule slightly different

Many questions still to be discussed but we are really eager to participate and to bring our expertise. Everything is open.

## Upcoming actions

- ▶ Constitution of an Instrument Definition Group [on-going]
  - ▶ 1<sup>st</sup> meeting in December (TBC) → High level req., WBS, etc..
- ▶ Coordinate activities with STDT and GSFC teams on UV instruments scientific/technical capabilities [Urgently]
- ▶ Engage discussion with ESA considering Martin's answer to the ESA Call for New Science Ideas – 2016 [ASAP]
- ▶ French workshop on LUVOIR [January 2017]

