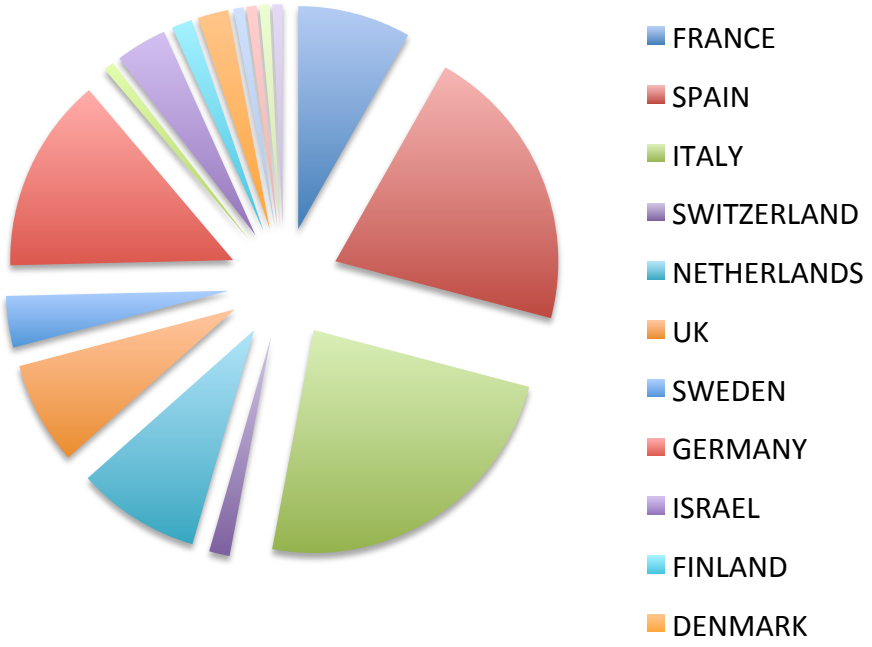
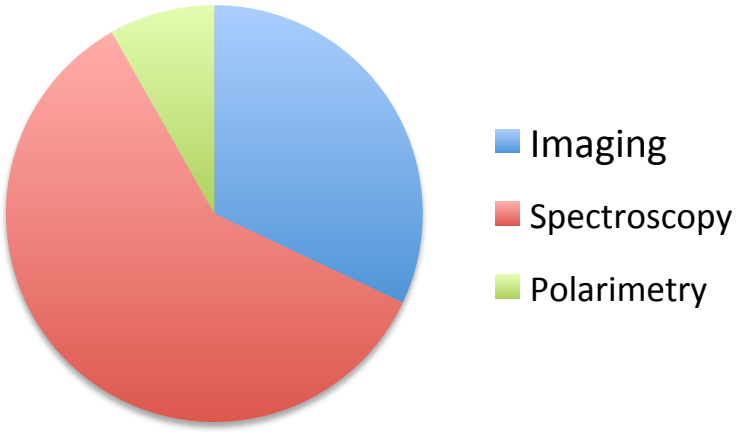
THE **N**ETWORK FOR **U**LTRA**V**IOLET **A**STRONOMY
AN **EU BASED COMMUNITY** (WWW.NUVA.EU)

## COUNTRIES

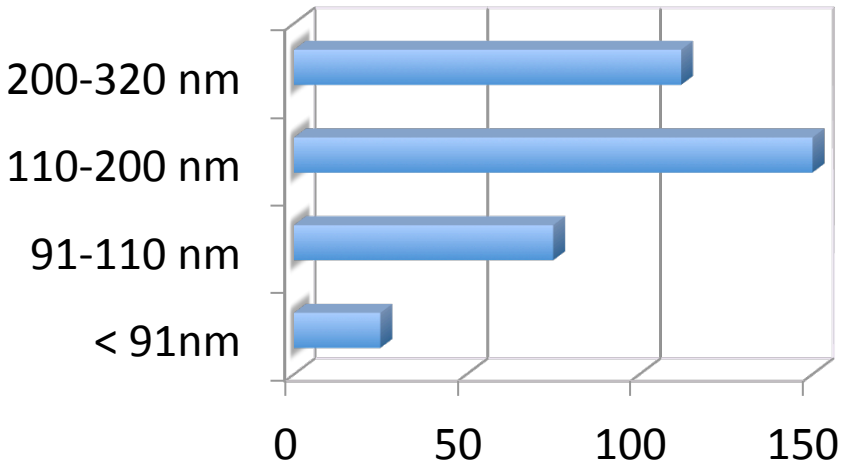



## CHARACTERISTICS OF **PREFERRED INSTRUMENTATION**

### OBSERVING MODES




### WAVELENGTH RANGE




FoV : 5-60 arcmin
Time resolution : 1-300 s
Spectral dispersion : 1,000-3,000/10,000/50,000
Telescope size : 2m (79) / 6m (75) / >20m (only 13!!!)

**SOME DEMANDS**

- High dynamic range
- No bright objects limit
- High orbits/monitorings

## NUVA FINAL RECOMMENDATIONS (27-II-2009)

SCIENCE TOPICS:
- COSMIC WEB AND STAR FORMATION HISTORY
- FORMATION AND EVOLUTION OF SOLAR-LIKE PLANETARY SYSTEMS
- PROPERTIES OF ATMOSPHERES OF EXOPLANETS

MISSIONS ROAD MAP:

| | |
|---|---|
| - HUBBLE | … 2020 (?) |
| - WSO-UV | 2020-2030 |
| - LARGE (6-10 M) MISSION | 2030…… (INTERNATIONAL COL.) |

TECHNOLOGIES:
- EFFICIENT/ROBUST COATINGS
- EFFICIENT OPTICAL ELEMENTS FOR WAVELENGTH SELECTION
- DETECTORS
- CLEVER DESIGNS

**CONCERNS:**
- AGING COMMUNITY/**LOSS OF TECHNICAL KNOWLEDGE**
- SOME **IMPORTANT SCIENCE WITH** ACTIVE/ON-GOING/PROGRAMMED LARGE FACILITIES (**VLT, ELT, ALMA, JWST,…**) IS **AT RISK IF ACCESS TO THE UV (WITH COMPARABLE SENSITIVITY) IS BLOCKED FOR 10-20 YEARS**

## STATE OF ART OF SOME EU BASED NEW CONCEPTS (NON-EXHAUSTIVE)

### HIGH RESOLUTION IMAGING: FRESNEL INTERFEROMETRY

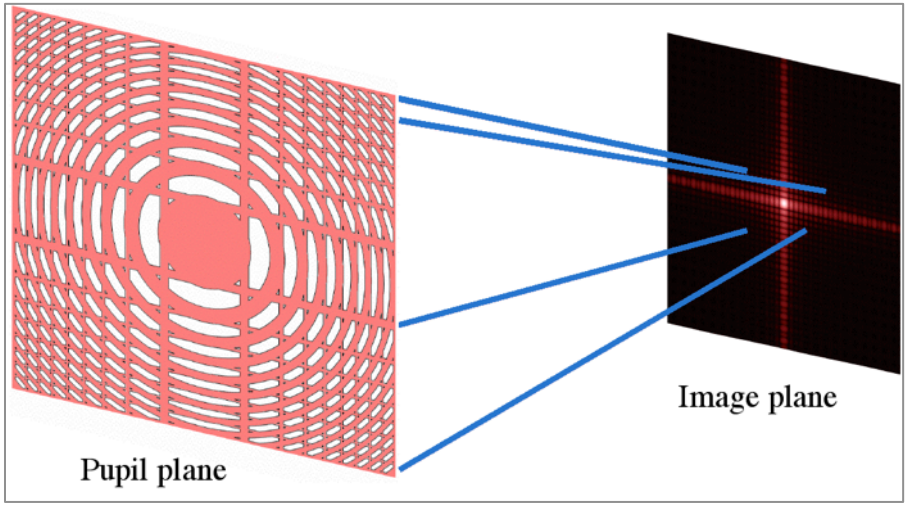



Image of a point source (Point Spread Function) given by a Fresnel Array. The four spikes around the bright central lobe have a low relative luminosity ($10^{-3}$), they are amplified, to be visible in this display. The four quadrants delimited by the spikes have a very low residual background level ($10^{-6}$ to $10^{-8}$).

**WHO:** Laurent Koechlin
**WHERE:** OMP/IRAP, U. TOULOUSE (FRANCE)

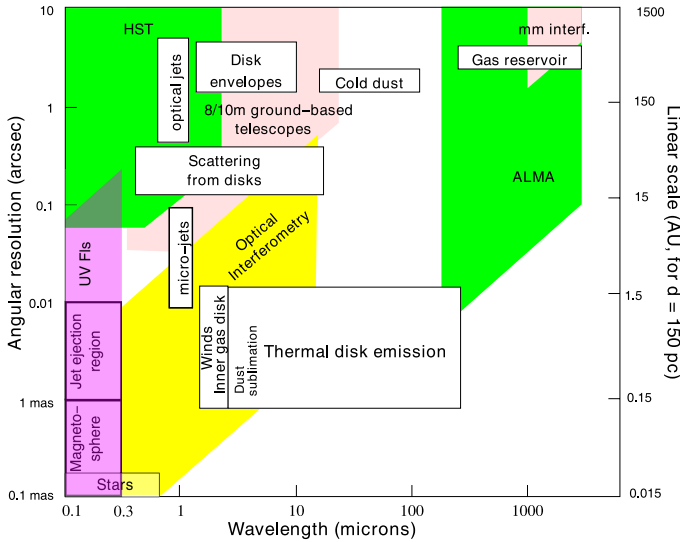
**CONSORTIUM:**
**FRANCE** (CNES, CNRES,U.TOULOUSE, OBSERVATOIRE COTE D'AZUR)
**SPAIN** (U. COMPLUTENSE MADRID)
**SWIZERLAND** (OBS. DE GENEVE)

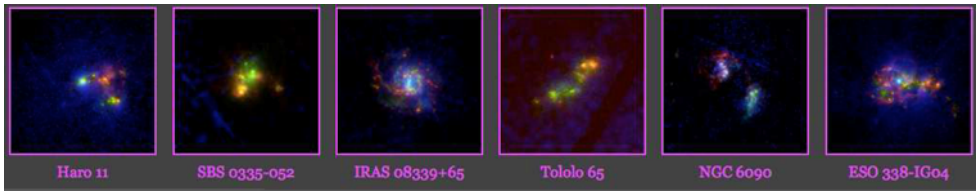
**RUSSIAN FED.** (INASAN, RUSSIAN ACADEMY OF SCIENCES)

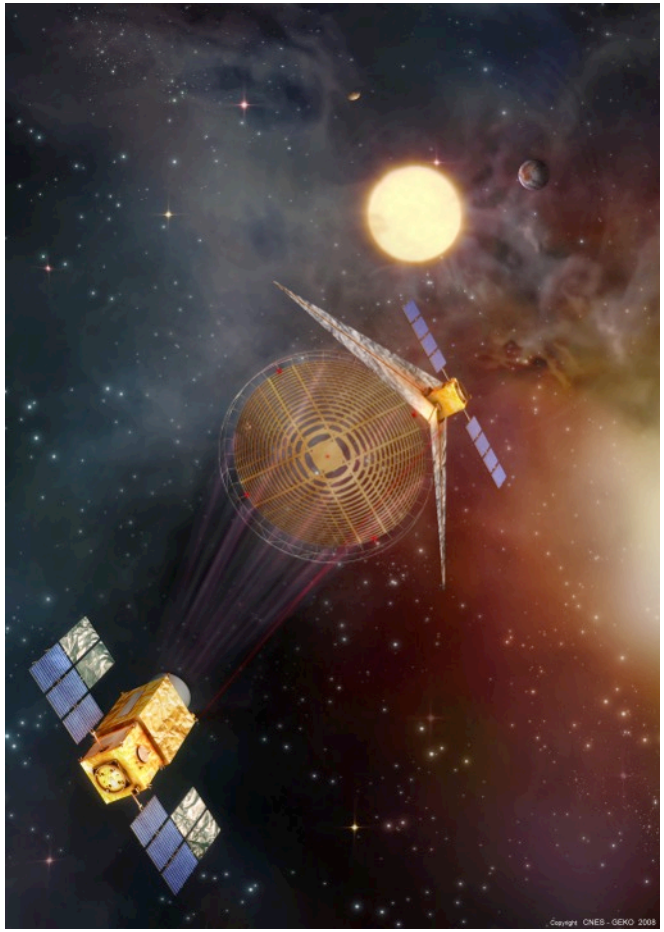
**US CONNECTION:**
**CfA** – MARGARITA KAROVSKA
**SOUTH WEST RESEARCH INST** – WILLIAM J. MERLINE

# HIGH RESOLUTION IMAGING: FRESNEL INTERFEROMETRY

## DISCOVERY SPACE



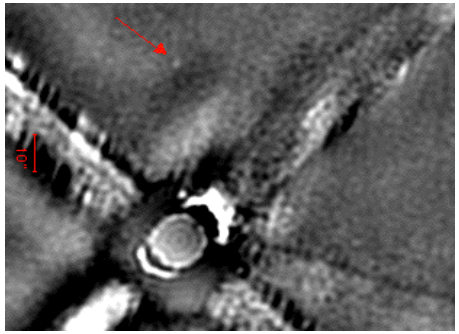
FI (4 M PRIMARY + 68 CM FIELD OPTICS)
GIVES **7MAS** RESOLUTION **@ Lyα**

# HIGH RESOLUTION IMAGING: FRESNEL INTERFEROMETRY

## MAIN FEATURES

1. Angular resolution (λ/D)
2. Image quality determined by accuracy in apertures carving
3. Non-circular PSF
4. Efficiency/transmittance 12%
5. Bandwidth limited to $\Delta\lambda/\lambda \approx 0.2$
6. Long focal length requires formation flying (18 km, λ≈150nm, Primary: 4M)
7. Same primary can be used for optics over a broad range (from 90nm-10μm)

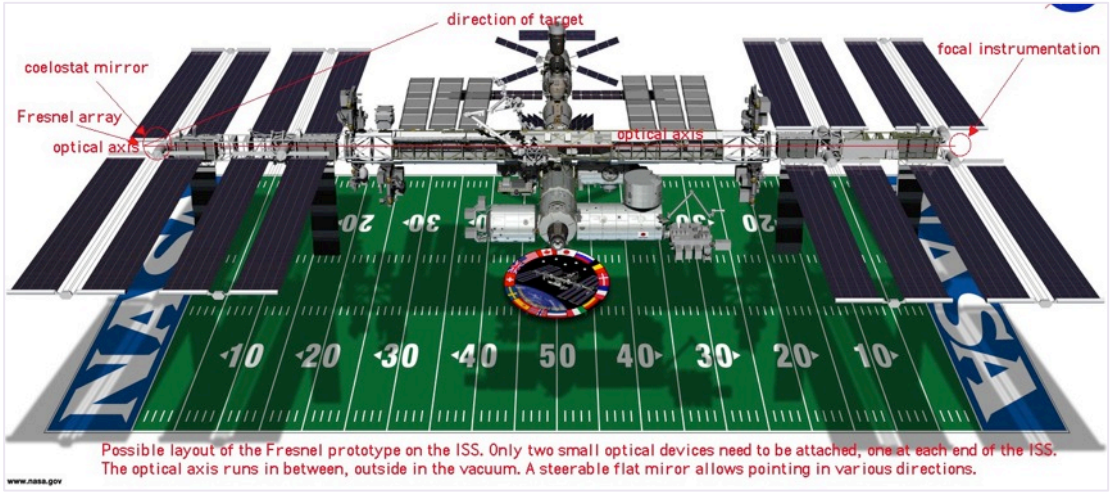
**1** **TEST IN OPTICAL RANGE** ✓



**2** **TEST IN AIR UV** ✓

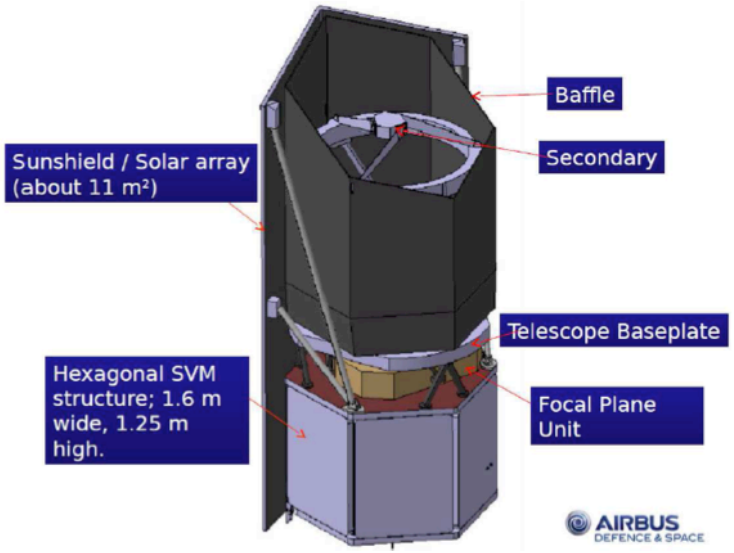
**3** **TEST IN SPACE UV**

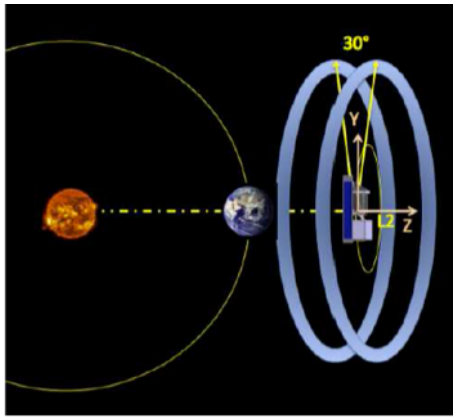
**TBD**




Possible layout of the Fresnel prototype on the ISS. Only two small optical devices need to be attached, one at each end of the ISS. The optical axis runs in between, outside in the vacuum. A steerable flat miror allows pointing in various directions.

# SPECTROPOLARIMETRY: 110-800NM, R= 55,000 **ARAGO**




**WHO:** Coralie Neiner
**WHERE:** LESIA, Paris-Meudon Obs. (FRANCE)

**CONSORTIUM:**
**261 scientists and engineers from 106 institutes in 21 countries: Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Czech Republic, Finland, France, Germany, Italy, Ireland, Netherlands, Poland, Serbia, Spain, Switzerland, Sweden, UK, and USA.**

**LEAD INSTITUTES participating in the PAYLOAD are:**
**LESIA (France), IRAP (France), CEA (France), MPS (Germany), CSL (Belgium), KU Leuven (Belgium), University of Leicester (UK), University Complutense Madrid (Spain), University of Geneva (Switzerland), University of Uppsala (Sweden), University of Vienna (Austria), Masaryk University (Czech Republic), University of Colorado (USA), and STScI (USA)**

**US CONNECTION:**
**University of Colorado** – KEVIN FRANCE
**University of New Mexico** – TONY HULL
**STScI**– WILLIAM SPARKS

# SPECTROPOLARIMETRY: 110-888NM, R= 25,000 - 34,000 **ARAGO**

## DATA ANALYSIS PRINCIPLE

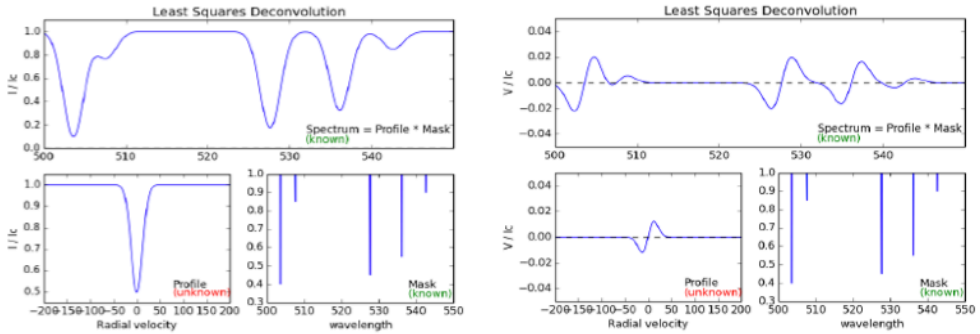
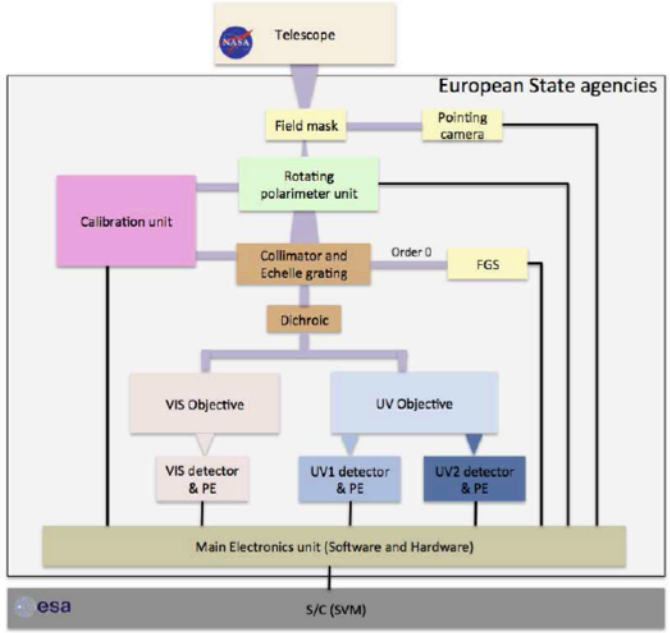



*Figure 11: From the observations of the Stokes spectra (e.g. Stokes I in the top left panel or Stokes V in the top right panel), knowing the list and properties (wavelength, depth, Landé factor) of spectral lines (mask), the LSD technique produces the averaged Stokes profiles.*

## BLOCK DIAGRAM




INSTRUMENT SCIENTIST: MARTIN BARSTOW

## TARGETS

| Type of stars | Stars with V=3-10 | Magnetic rate | Magnetic stars with V=3-10 |
|---|---|---|---|
| O | 558 | 7% | 39 |
| B | 19940 | 7% | 1396 |
| A | 53143 | 10% | 5314 |
| F | 61867 | 25% | 15467 |
| G | 55780 | 40% | 22312 |
| K | 88358 | 50% | 44179 |
| M | 10276 | 60% | 6166 |
| Classical Be | 1225 | 1% | 12 |
| Herbig Ae/Be | 44 | 10% | 4 |
| T Tauri stars | 58 | 100% | 58 |
| M dwarfs | 99 | 60% | 59 |
| White dwarfs | 9 | 10% | 1 |

*Table 1: Number of total or magnetic possible targets to chose from in the magnitude range V=3 to 10. The magnetic rate is the statistical number of magnetic stars among a class of stars (e.g., Petit et al. 2014, Wade et al. 2014).*

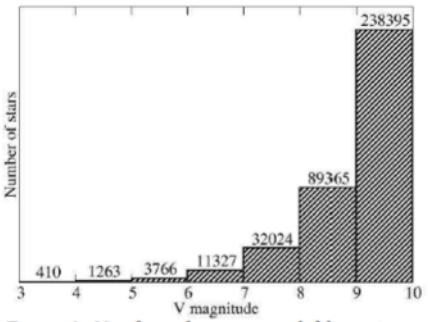



*Figure 9: Number of targets available to Arago in the magnitude range V=3-10.*

NON APPROVED FOR **M4**
BEING UPGRADED FOR SUBMISSION TO **M5**

# WORLD SPACE OBSERVATORY – ULTRAVIOLET **WSO-UV**

LAST OF THE SPEKTR MISSIONS FOR ASTROPHYSICS
IN THE **ROSCOSMOS** SPACE PROGRAM (TBCOMPLETED 2020)

**SPECTRUM-R**: SPACE-GROUND **RADIO** INTERFEROMETRY (LAUNCHED 2011)
**SPECTRUM-X**: **X-RAY** SURVEY (RUSSIA-GERMANY) TBLAUNCHED 2017
**SPECTRUM-UV**: **ULTRAVIOLET** OBSERVATORY (RUSSIA-SPAIN-MEXICO) TBLAUNCHED 2020

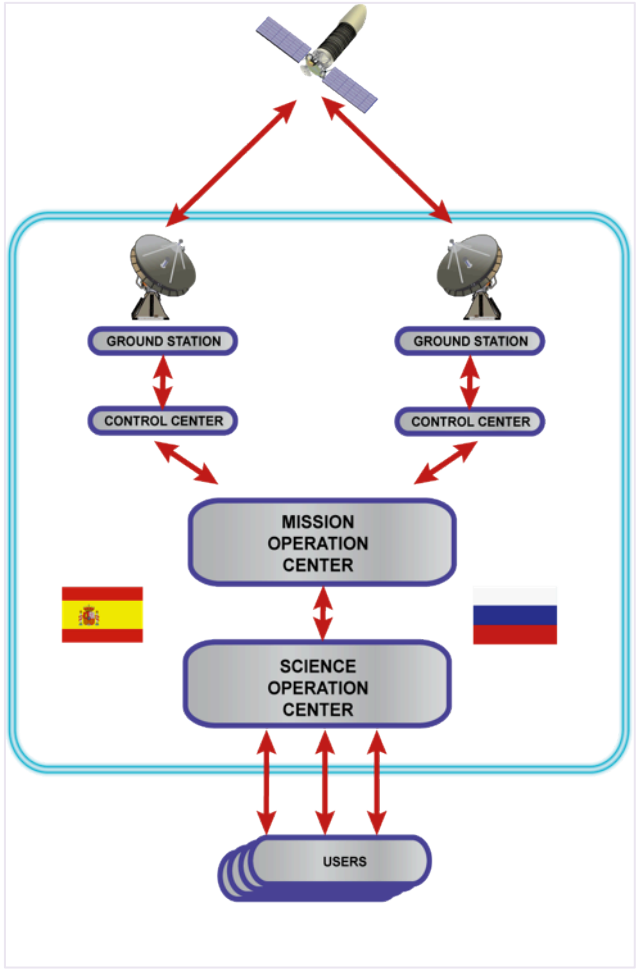
**CHARACTERISTICS:**

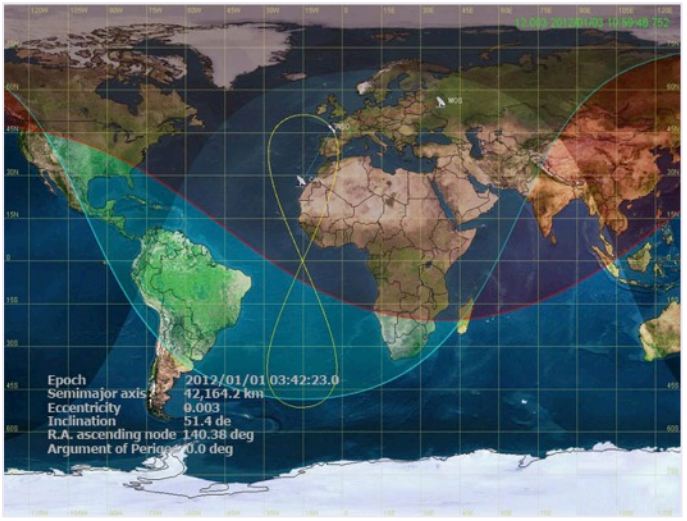
PRIMARY: 170CM
INSTRUMENTATION:
**WUVS:**
VACCUM UV ECHELLE SPECTROGRAPHS (VUVS) – 115-176 NM – **R**= 50,000
UV ECHELLE SPECTROGRAPH (UVS) – 176-310 NM – **R**= 50,000
LONG SLIT SPECTROGRAPH (LSS) – 115-310 NM – **R**= 1,000 – **θ** = 0.5 ARCSEC
**ISSIS/FCU:**
TWO CHANNELS FOR IMAGING AND SLITLESS SPECTROSCOPY – **R**= 500 - **θ**< 0.1 ARCSEC
FUV CHANNEL (FUV) – 185-320 NM
NUV CHANNEL (NUV) – 115 -175 NM

WSO-UV STRUCTURAL MODEL
LAVOCHKIN LABORATORIES

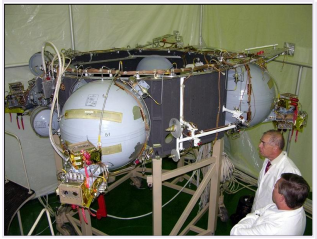
**STATUS: PHASE B-C**

## SHARED OPERATIONS BETWEEN SPAIN AND RUSSIA





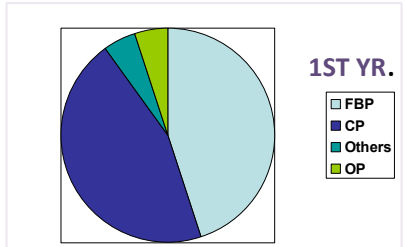


## WSO-UV SCIENTIFIC MANAGEMENT

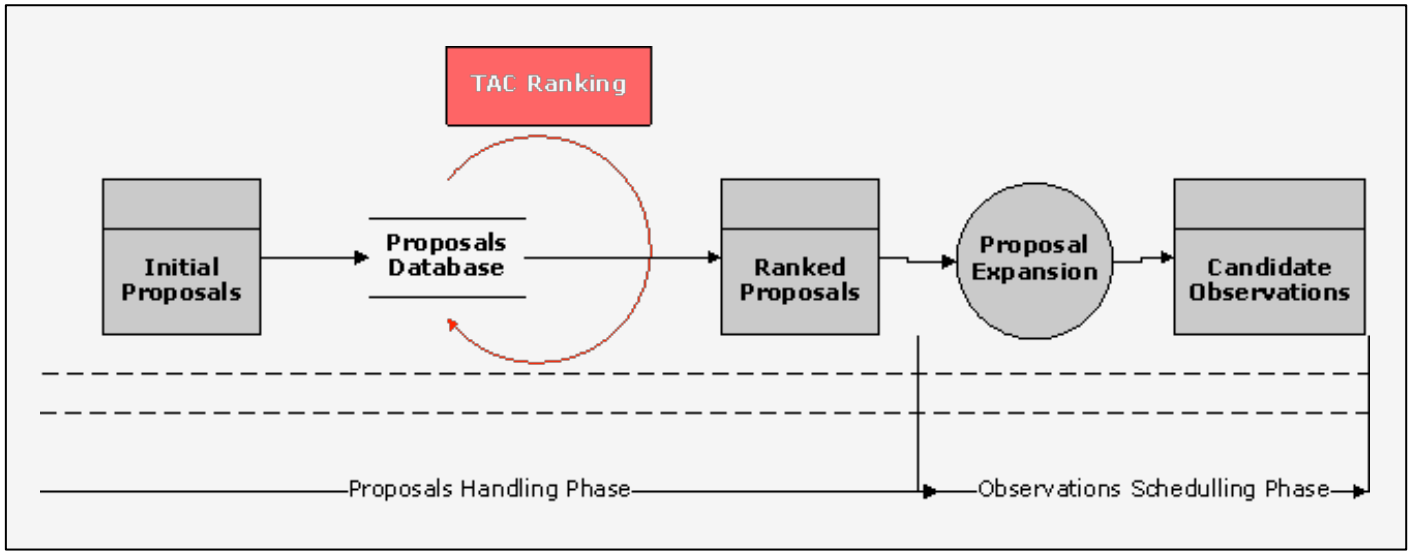
**CORE PROGRAM (CP)**: WSO-UV KEY PROGRAMS

**FUNDING BODIES PROGRAM (FBP)**: GUARANTEED TIME TO FUNDING AGENCIES

**OPEN PROGRAM (OP)**: INTERNATIONAL OBSERVING TIME (5% TO JOINT PROJECTS BETWEEN DEVELOPED AND DEVELOPING COUNTRIES)




## SCIENTIFIC PROPOSALS HANDLING



THE **N**ETWORK FOR **U**LTRA**V**IOLET **A**STRONOMY AN **EU BASED COMMUNITY** (WWW.NUVA.EU)

**INTERNATIONA**L **ROAD MAP** FROM THE INTERNATIONAL **A**STRONOMICAL **U**NION

*The main rationale behind the difficulties to fund UV missions is the cost of ultraviolet technologies that requires sharing costs among many actors and hence, a strong international coordination. The International Astronomical Union is the main coordination body for astronomy in the world, independently of whether facilities are space based or ground based. IAU is built for scientific interests and it is able to promote coordination at all levels among countries.*