

## Final recommendations of the NUVA

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### 1. *On the science case:*

Three topics are clearly identified as requiring UV instrumentation to make significant advance in astrophysics: research on the cosmic web (both the diffuse component and the variation of the star formation rate with redshift), research on the formation and late evolution of Solar-like planetary systems and identification of the chemical composition and properties of the atmospheres of extrasolar planets. The science case is well developed in the NUVA books. There is however, an open issue that has not been yet developed: to which extent UV information is going to be required for the scientific interpretation of the results of the planned next large infrared and X-ray missions. In the same vein, it is not clear how the desired capabilities of future UV instruments would complement (or extend) those of the planned giant ground-based telescopes.

### 2. *The missions road map* is defined by the plans of the European Space Agency and the National Space Agencies in Europe:

- a. *Till 2013 HST with the new instrument COS* will provide unique opportunities to run high sensitivity pointed studies of the IGM and star formation at all scales. The sensitivity of this instrument for  $R \sim 10000$  and spectral range 102nm-170nm will not be matched till 2025-2030 when the next large UV missions are operated. In the mean time the American/French GALEX mission will provide, for the first time, a survey of the UV sky. The *NUVA recommendation* is to set-up an Intensive Training Network to form new specialists in UV data while exploiting rapidly the Archives to guarantee the maximum scientific return from the European participation in the HST/COS mission. The fact that E.S.A. has decided not to support the European Coordination Facility of the Space Telescope (ECF-ST) makes of the NUVA community the best suited to successfully carry out this challenging work.
- b. *From 2013 till 2023, the WSO-UV* will provide a 2m class facility for UV astronomy: imaging and spectroscopy. The imaging instrument is defined to extend the GALEX work in the study of individual objects and the spectroscopic instrumentation will nicely complement the HST capabilities providing unmatched sensitivity with spectral resolution  $R \sim 55,000$  and  $R \sim 2000$  in the entire 110-330 nm range. Two EU countries participate in the project: Spain and Germany. The NUVA is instrumental to harmonize the collaboration between the European members of the WSO-UV consortium and the rest.
- c. *In the long term, after 2025, a new large UV mission needs to be developed* likely in close collaboration with non-European Space Agencies. A cost-efficient structure for the management of such a large collaboration implies the implementation of trans-agency working groups that analyze the science case and identify the key technologies, at scales larger than the European Union since the very early stages.

The NUVA has run an analysis of the on-going European projects and the demands of the European astronomers (through the on-line NUVA

questionnaire). Most of the researchers are interested in the 110-320nm range to resolve and analyze AGNs, exoplanets, disks and starburst. The NUVA has agreed to run a detailed scientific analysis on the technological capabilities of Fresnel interferometer for this purpose.

3. ***On the technology:*** there are many technological issues to be addressed for the development of efficient UV instrumentation. To mention but a few characteristics to be improved: the inefficiency of the coatings, the difficulty to select the information in narrow spectral bands without heavy loss of flux, the detectors technology, the optical designs to minimize the number of reflections and select the spectral band in non-standard manners (like i.e. in Fresnel interferometry) or the search of materials with good optical performances in the 90nm-180nm spectral range. The NUVA integrates several instrument building teams that work in close collaboration with European companies however, there are not clear tools that allow to carry out research and innovation (R&I) joint projects for space investigation outside the framework of the European Space Agency (unfortunately, this kind of tools are only available for projects already approved by the Astronomy Working Group). As a result, national agencies are taking the responsibility of R&I for several areas of space research. An unpleasant consequence is that while the European Astronomers are able to work together as a single European entity, the industrial consortia are still driven by national interests. Finally, it is worth mentioning that the R&I plan for UV is rather close to the currently on-going plans for the optical range as described in the OPTICON package "Smart Instrumental Techniques".

Approved by the NUVA board