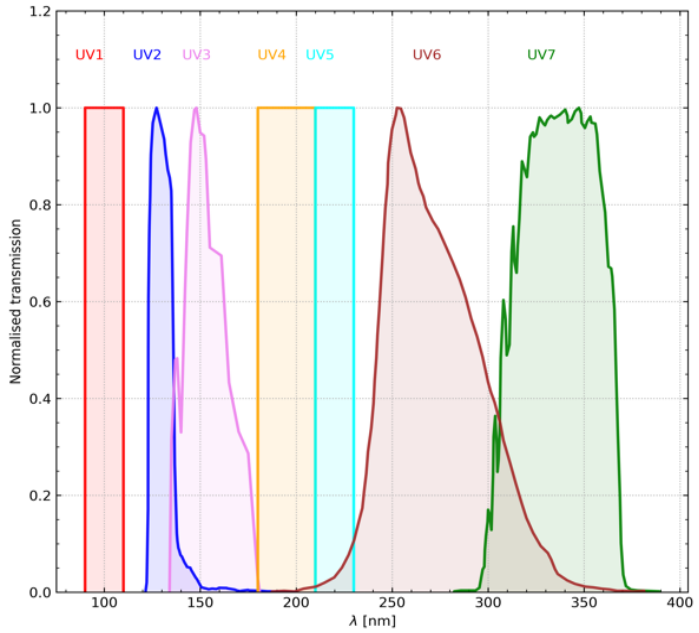
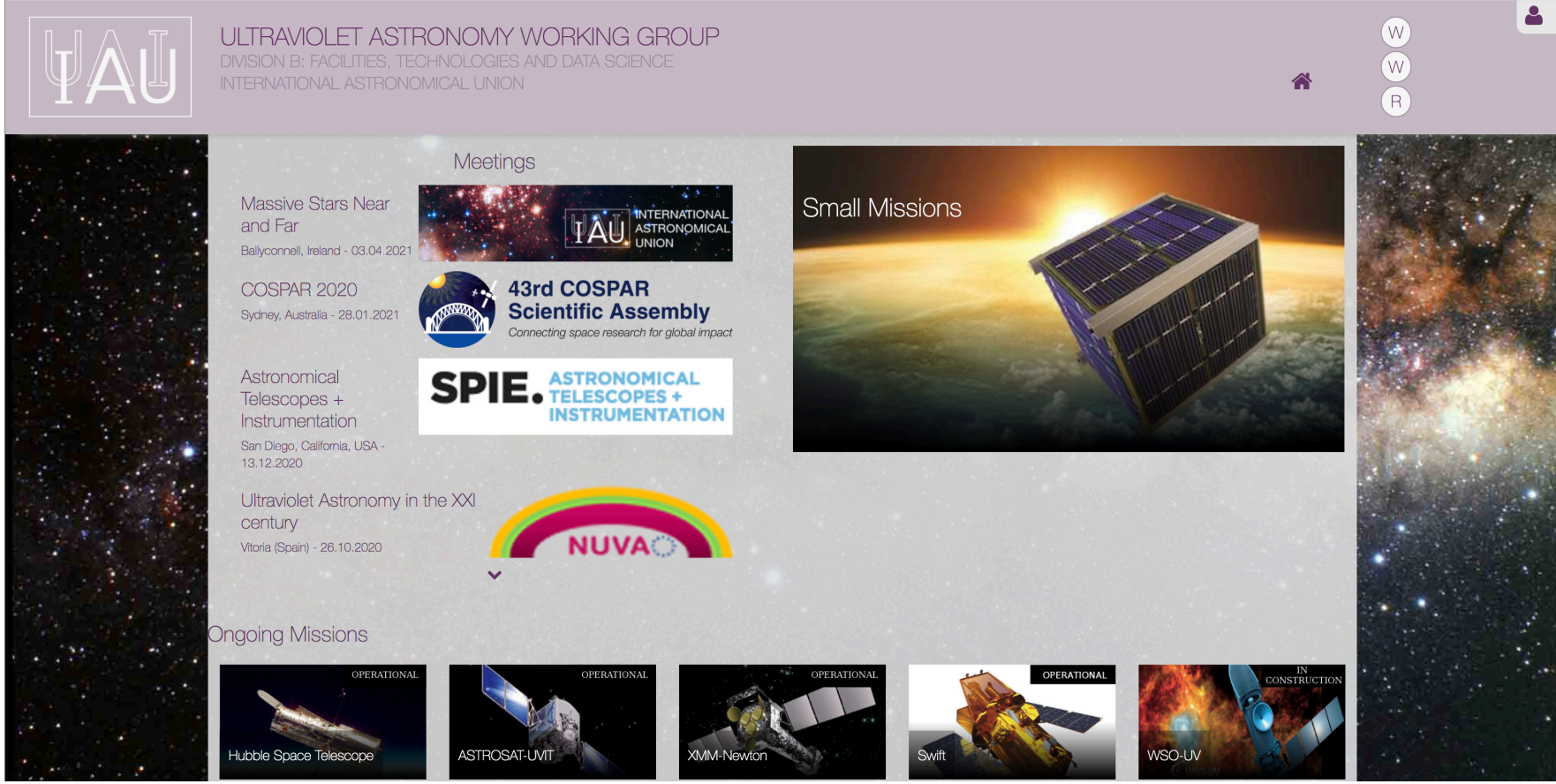
ULTRAVIOLET ASTRONOMY IN THE XXI CENTURY

e-Workshop 2020 – October 27-29

JcUVa



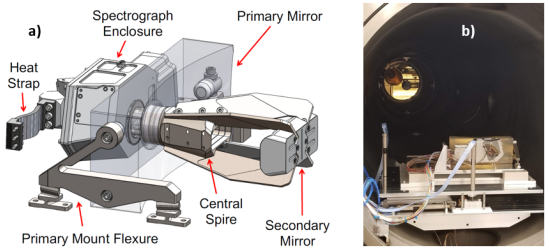


TOWARDS

- THE STANDARD PHOTOMETRIC SYSTEM FOR ULTRAVIOLET ASTRONOMY -

Ana I Gómez de Castro, Noah Brosch, Daniela Bettoni, Leire Beitia-Antero, Paul Scowen, David Valls-Gabaud, Mikhail Sachkov

WHY?

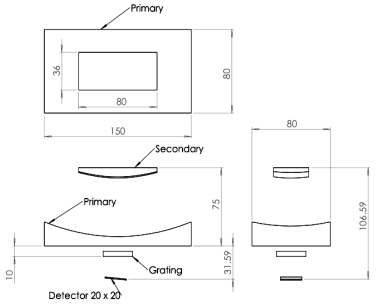


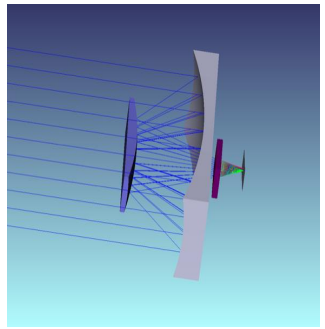
Ultraviolet (UV) astronomy was born in the late 60's with the advent of space astronomy. Though UV observatories have been scarce, photometric standards are well defined and carried over from mission to mission.

HOWEVER this scenario is going to change during the next decade because:

- Access to UV data is fundamental in many areas of astrophysical research.
- The planning of the main space agencies does not include any UV observatory (with the only exception of the Spectrum-UV (WSO-UV) observatory from the Russian space science program).
- The cubesat technology is cheap, accessible, fast and becoming widely spread.

As a result, it is expected that plenty of small or cubesat type missions will be flown to run well defined experiments, including survey type probes.





UV Telescopes in orbit or under construction

PROJECT	Operator	Main Characteristics	Status
HST	NASA & ESA	Observatory – type mission includes instrumentation for imaging and spectroscopy in the 100-320 nm range. Diameter of the primary: 240 cm Orbit: LEO	Flight
XMM-Newton/ OM	ESA	X-ray observatory includes an instrument, OM, with capabilities for UV imaging from 170-320 nm. **Diameter of the primary: 30 cm** Orbit: HEO	Flight
SWIFT/UVOT	NASA/PSU	γ-ray surveyor mission equipped with an instrument – UVOT- to detect the UV-optical afterglow 170-650 nm. **Diameter of the primary: 30 cm** Orbit: LEO	Flight
ASTROSAT-UVIT	ISRO	UV observatory operating in the 130-300 nm range with imaging and slitless spectroscopic capabilities. **Diameter of the primary: 37.5 cm** Orbit: LEO	Flight
Spektrum-UV/ WSO-UV	ROSCOSMOS	UV observatory operating in the 115-315 nm range with instrumentation for imaging and spectroscopy. Diameter of the primary: 170 cm Orbit: HEO	Launch scheduled 2025
China Space Station Telescope	CNSA	UV-optical surveyor with FoV=1.1x1.1deg^2 and Ang. Res.= 0.15". NUV filter covers the 255-320nm range. Diameter of the primary: 200 cm Orbit: LEO	Under Constr.
CUTE	NASA	Dedicated cubesat mission for exoplanetary research obtained spectra in the 255-330 nm range **Primary: 20cm x 8.5cm** Orbit: LEO/Sun synchronous	Launch scheduled 2021
SPARCS	NASA	Dedicated cubesat mission for exoplanetary research equipped with filters in the 115nm-320nm. **Diameter of the primary: 9 cm** Orbit: LEO/Sun synchronous	Under Constr. (Launch Fall 2021)

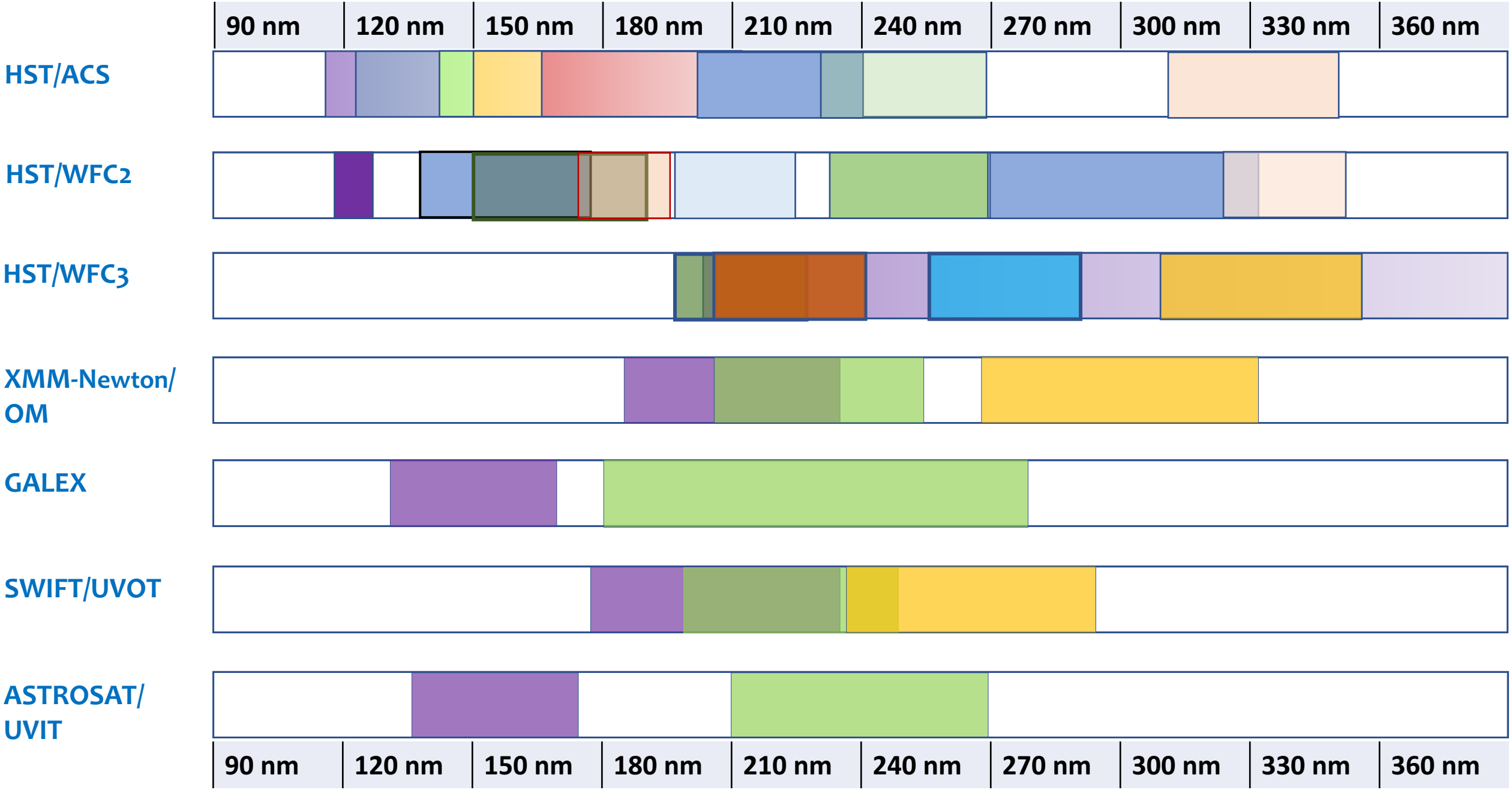
UV Telescopes under study

PROJECT	Teams	Main Characteristics
LUVOIR	NASA, EU, JAXA (& TBD)	UV-optical-infrared observatory type mission includes instrumentation for imaging, spectroscopy and spectropolarimetry in the UV range. Diameter of the primary: LUVOIR-A(15 m), B(10 m) Orbit: L2
CETUS	NASA	UV observatory type mission with instrumentation for imaging and spectroscopy in the 100-320 nm range. **Diameter of the primary: 150 cm** Orbit: L2
ESCAPE	NASA	Dedicated mission to EUV spectroscopy (7-165 nm) of nearby stars to measure the radiation driving at atmospheric escape. **Diameter of the primary: 46 cm** Orbit: LEO
EUVO	EU	UV observatory type mission with instrumentation for imaging and spectroscopy in the 100-320 nm range. Diameter of the primary: 5m to LUVOIR Orbit: L2
SIRIUS	UK, EU	EUV mission for spectroscopy in the 17-26 nm range with a predefined list of targets. Effective area: 10 cm^2 Orbit: L2
INSIST	Indian Institute of Astrophysics	UV observatory equipped for imaging and multi-object spectroscopy in the 150-550 nm range. **Diameter of the primary: 100 cm** Orbit: LEO
CASTOR	Nat. Research & Engineering Council of Canada	UV-optical surveyor. Simultaneous imaging coverage three passbands that span the 150-550 nm range. **Diameter of the primary: 100 cm** Orbit: LEO
ARAGO	Observatoire Paris-Meudom, EU	UV observatory equipped for high dispersion spectropolarimetry in the 119-320 nm range. **Diameter of the primary: 130cm** Orbit: L2
MESSIER	Observatoire de Paris, EU	Imaging surveyor operating simultaneously in 6 bands within the 200 to 1000 nm spectral range. **Diameter of the primary: 130cm** Orbit: L2
URIEL	Universidad Complutense de Madrid, EU	UV-optical observatory for spectropolarimetry in the 150-350 nm range **Diameter of the primary: 150cm** Orbit: L2
CAS	Tel-Aviv University, India, Spain	Dedicated cubesat mission for interstellar medium studies (UV bump). Surveyor, suitable for early alarms. **Primary: 15 cm x 8 cm** Orbit: LEO

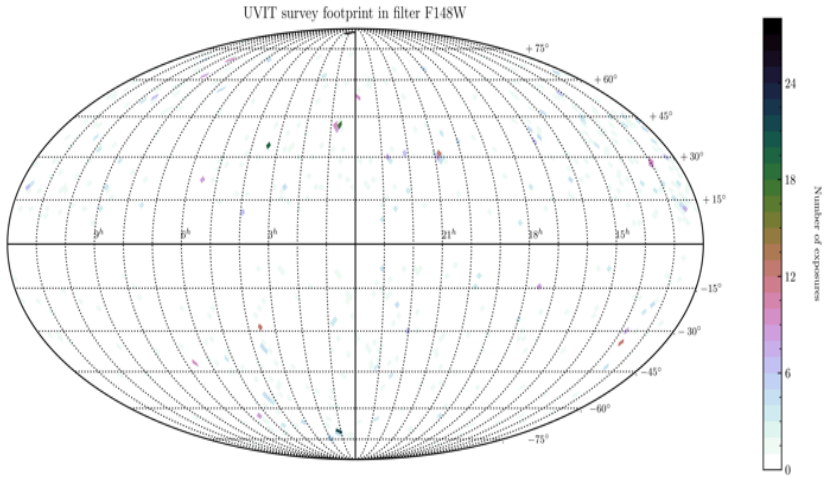
In this context, it is necessary to define some **common grounds to facilitate comparing and contrasting data from different UV missions.**

The **charter of the "UV astronomy working group"** (UVA WG) for the period 2018-2020 is **to set the grounds for the definition of a UV photometric system suitable to be implemented in small missions** and that grows on the scientific challenges addressed by using UV astronomical observations.

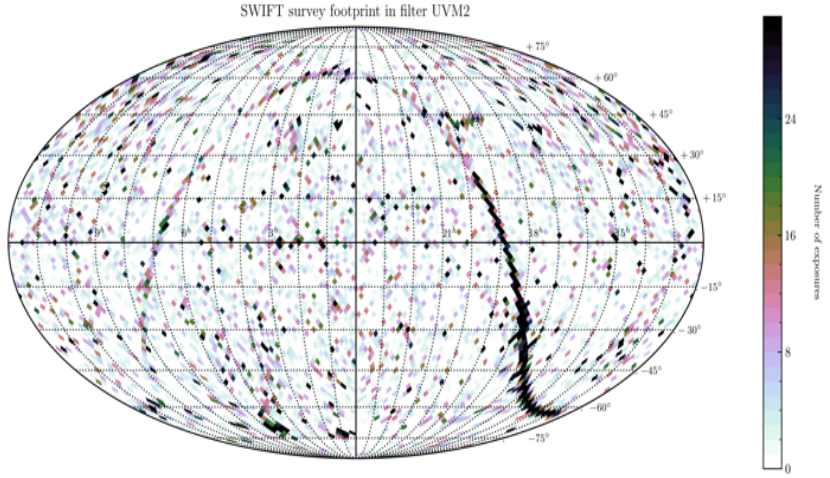
It is a community decision to adopt standards that will allow **easy data fusion from different missions.**

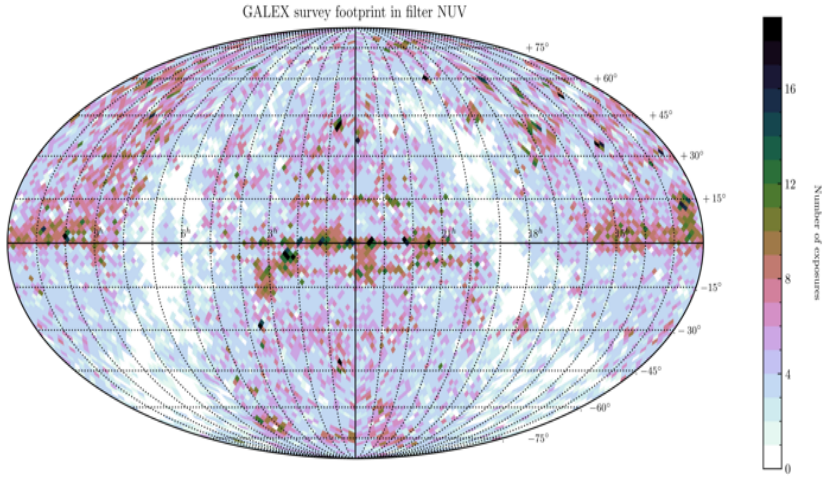

90 nm
120 nm
150 nm
180 nm
210 nm
240 nm
270 nm
300 nm
330 nm
360 nm
HST/ACS
HST/WFC2
HST/WFC3
XMM-Newton/
OM
GALEX
SWIFT/UVOT
ASTROSAT/
UVIT
90 nm
120 nm
150 nm
180 nm
210 nm
240 nm
270 nm
300 nm
330 nm
360 nm

UVIT Survey

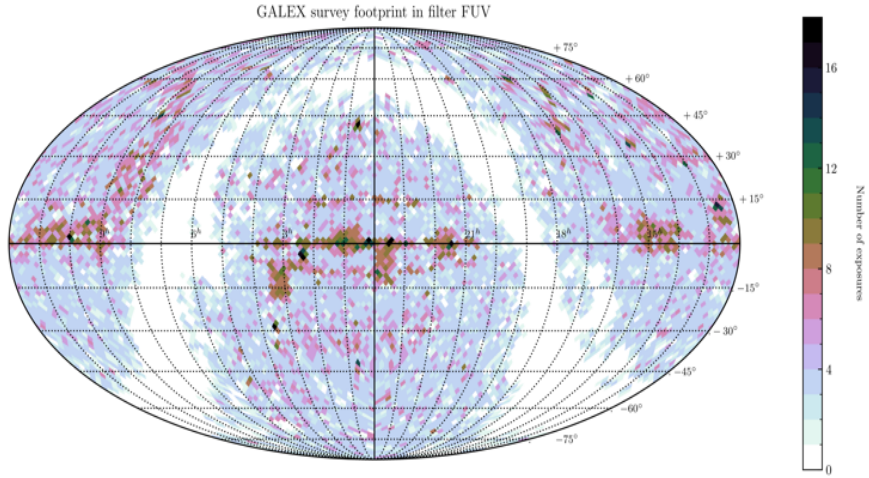


SWIFT Survey





GALEX AIS NUV



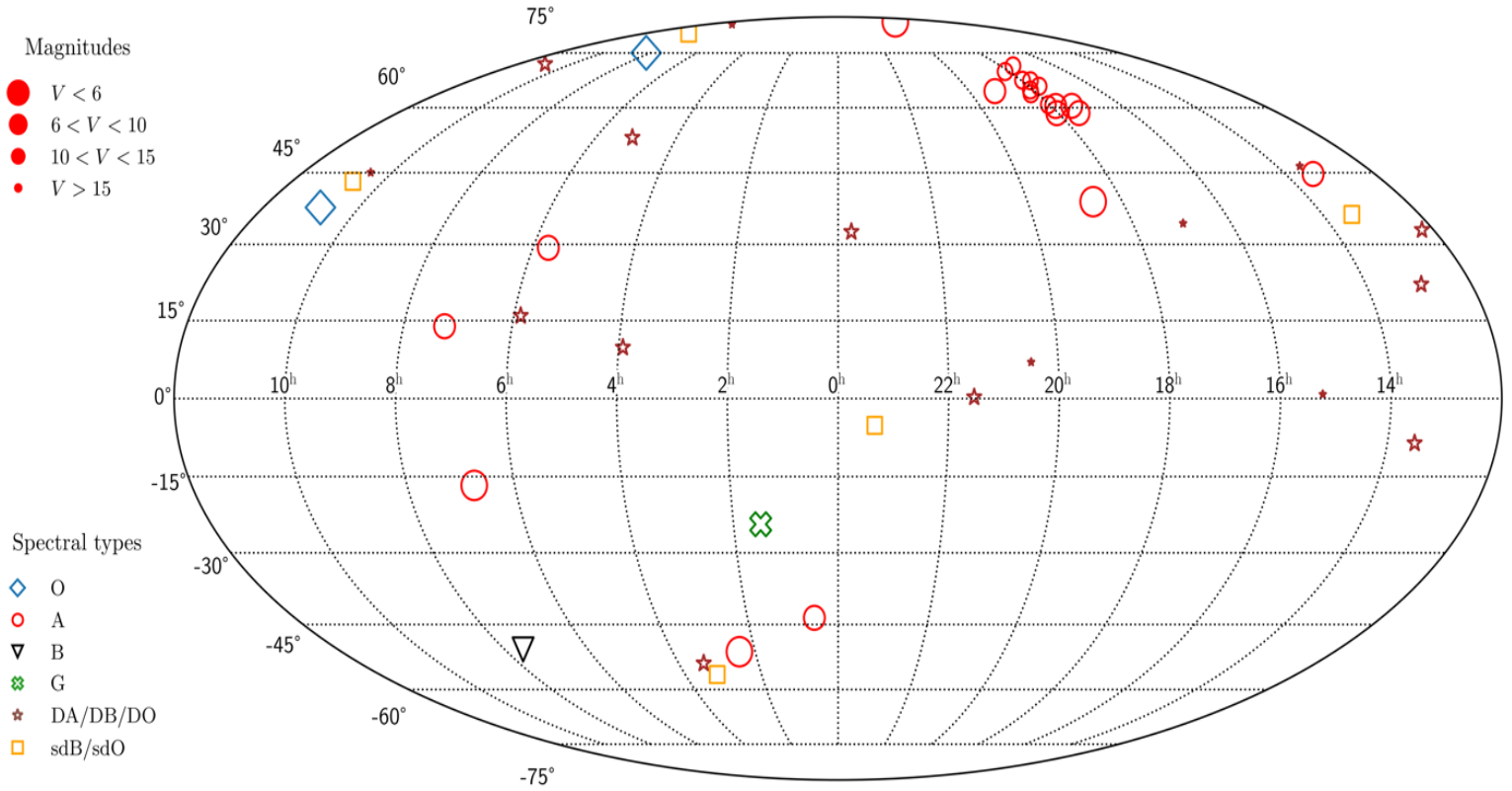
GALEX AIS FUV

COVERAGE OF THE MAJOR PHOTOMETRIC SURVEYS

✓ The HST system constitute the baseline for UV photometry and flux calibration.

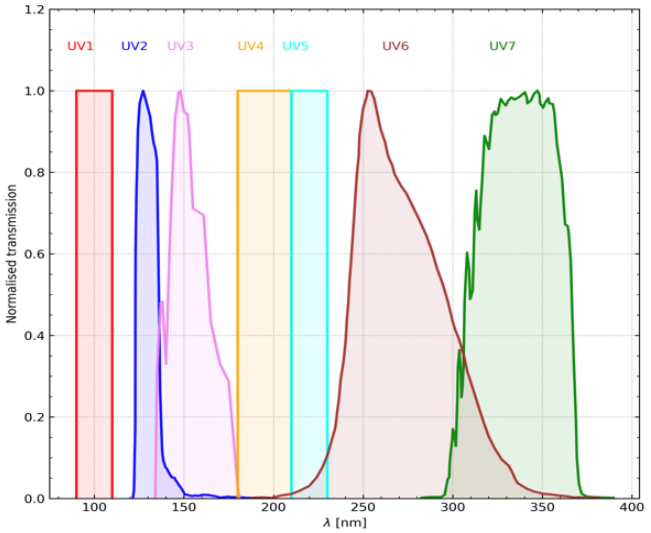
✓ The standards can be accessed through CALSPEC and their main characteristics are in Bohlin et al. 2014.

[The conversion of the IUE spectra on the white dwarf primary spectrophotometric scale (Bohlin et al. 1995) is described by Bohlin (1994, 1996)].

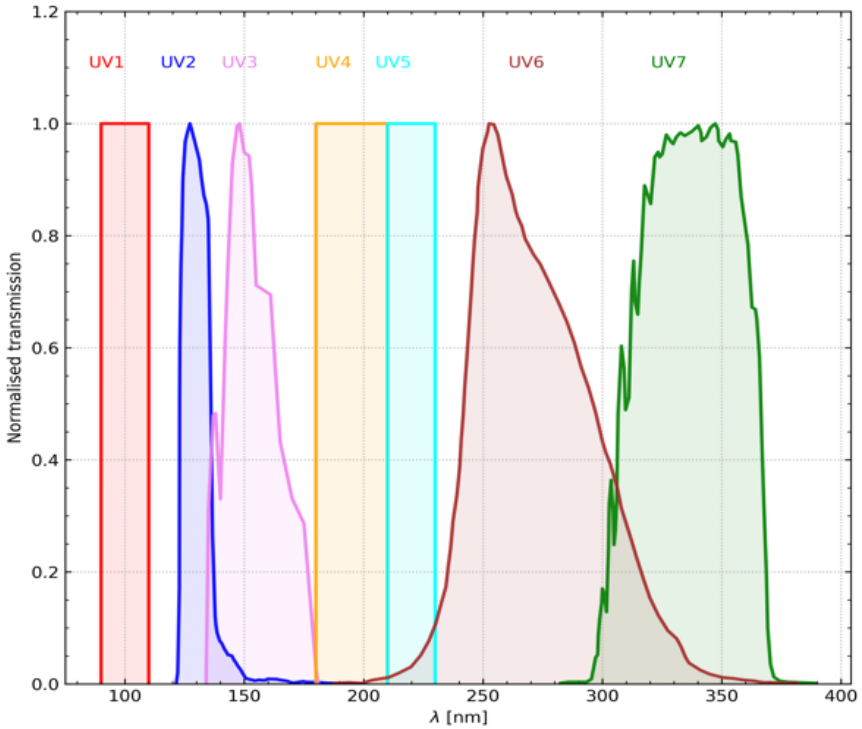


GENERIC CONSIDERATIONS FOR THE PHOTOMETRIC SYSTEM:

1. The **quantum efficiency of the photosensitive substrates used in the MCP detectors** is blind to longer wavelengths, which is a desired feature for many astrophysical applications. However, **not all detectors are solar blind**.
2. The **90-120 nm band requires a different observation/detection technology** hence, bands such as 110-140nm crossing the 115nm frontier are not easy to implement.
3. **Avoidance of the main geocoronal lines** since most missions will go to low Earth orbit.
4. The **UV bump must be taken into account** for ISM studies
5. The **GALEX FUV and NUV bands should be easily integrated** in the system
6. An **extension to the atmospheric cut-off reaching 350nm** is highly desirable.



UV PHOTOMETRIC SYSTEM



Band ID	Spectral Range	Objective	Comments on implementation
UV1	90-110 nm	FUSE window	
UV2	120-140 nm	Far UV avoiding geocoronal Ly-alpha	[CsI photocathode + F125LP (CaF2)] – [CsI photocathode +F140LP (BaF2)]
UV3	140-180 nm	GALEX FUV	As in GALEX
UV4	180-210 nm	Continuum shortward of the UV bump	
UV5	210-230 nm	UV bump	
UV6	230-280 nm	Near UV continuum, Fe bands	F250W (ACS/HRC)
UV7	280-350 nm	Ozone cut-off window	F330W(ACS/HRC)

PROCEDURE: EVERY MISSION TRANSFORMS ITS PHOTOMETRY INTO THESE BANDS

CYCLE FOR THE IAU RECOMMENDATION

In 2016 Division B creates
WG on UV Astronomy

At IAU GA 2018 – Vienna
a specialized group is created
to define the Photometric System

In March 2020 the group circulates to
the NUVA the draft proposal for evaluation

In May 2020, the revised draft is
approved by the UV Astronomy WG

In July 2020, the revised draft is approved
by Division B (*Facilities, Technologies & Data Science*)

In September 2020, Division B circulates
the draft to the IAU community at large

In October 2020, NUVA approves the
final document – **THIS MEETING**

Division B SC approves the final
Document and submits it to the IAU SC

At IAU GA 2021-Seul
The implementation of the UV
photometric system is recommended

NOW … FINAL DISCUSSION with THE UV COMMUNITY

- Questions and suggestions after this presentation till 18:00
- The document is hung on the Workshop Web Site (just below this presentation)
- During these days the writers of the document are open for comments, questions suggestions etc…
- After the meeting, the revised document will be submitted

THANKS !

News Space Agencies
Announcement of Opportunity (AO) soliciting proposals for Tenth AO cycle observations A10 opening : 8th June, 2020 Criteria for applying: ...

Hubble Space Telescope Cycle 28 Call for Proposals

We are pleased to announce the release of the Cycle 28 Call for Proposals for Hubble Space Telescope (HST) Observations and funding for Arch...

HST ULLYSES live

The STScI webpage for the UV Legacy Library of Young Stars as Essential Standards (ULLYSES) Director s Discretionary program is now live. In...

Fresnel Interferometer Array

This is a France led proposal to carry out high angular resolution, high dynamical range imaging suitable to image exoplanets and resolve st...

ULTRASAT

ULTRASAT is a mini satellite developed by the Israel Space Agency (ISA) and NASA. This project was proposed in 2010 by the Weizmann Institut...

LUVOIR

The Large UV/Optical/IR Surveyor (LUVOIR) is a concept for a highly capable, multi-wavelength observatory with ambitious science goals....

HabEx

The Habitable Exoplanet Imaging Mission (HabEx) is a concept for a mission to directly image planetary systems around Sun-like stars. HabEx ...

CETUS

CETUS is a probe-class mission concept proposed for study to NASA in November 2016. Its overarching objective is to provide access to the ul...

Bibliography
- Astronomy and Astrophysics
- Solar and Planetary Physics
- Instrumentation and Space Science
- NUVA Publications
- Past Conferences
- Archive of Science News

UV Groups & Centers

Job Offers

ULTRAVIOLET ASTRONOMY WORKING GROUP
DIVISION B: FACILITIES, TECHNOLOGIES AND DATA SCIENCE
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