

WSO-UV field camera unit for comet and exoplanet observations

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Abstract. The World Space Observatory for Ultraviolet (WSO-UV) is a space observatory equipped with instrumentation for spectroscopy and for imaging in the UV spectral range. After the Hubble Space Telescope, WSO-UV will be the largest mirror telescope for UV astronomy. Thus, the WSO-UV space observatory will guarantee continuity of UV observation of comets and exoplanets.

Key words: space vehicles: instruments – ultraviolet: general – comets

1. Introduction

WSO-UV is a space observatory in geostationary orbit with an inclination of $\sim 40^\circ$. One has a 1.7-meter telescope capable of spectroscopy and direct imaging in the UV range of the spectrum (115 to 305 nm). The nominal lifetime is 5 years with an expected extension of up to 10 years.

The main scientific purpose of WSO-UV is the spectroscopic observation of faint UV sources and high resolution UV imaging (Fossati et al., 2014; Sachkov, 2016; Sachkov et al., 2018b). WSO-UV includes the T-170M telescope designed to fit requirements of high angular resolution and maximum effective area in the 115 nm–305 nm range. It provides the solar avoidance angle about 40° , that is important for observations of comets at low angular distance from the Sun.

An additional tool has recently been proposed for WSO-UV – UVSPEX, a UV spectrograph, is designed to measure atomic hydrogen and oxygen in the exospheres of terrestrial exoplanets (Tavrov et al., 2018). Examination of the transit photometric curves of the exosphere can help differentiate the different types of rocky planets.

2. Field Camera Unit

One of main instruments of WSO-UV is Field Camera Unit (FCU) which has two channels: NUV (near ultraviolet channel) and FUV (vacuum or far ultraviolet channel):

- FUV: the working wavelength range no narrower than from 115 to 176 nm;

Table 1. NUV channel filters to study Earth-like exoplanets.

Name	Type	Central wavelength, nm	FWHM, nm
F255W	Wide-band filter	255	50
F336W	Wide-band filter	336	50

- NUV: from 174 to 305 nm.

The FUV channel has an MCP detector, which is supplied under the international agreement between Russia and Spain. The main characteristics of the FUV channel are as follows:

- Diffraction-quality imaging.
- Highly sensitive photon-counting mode.
- High temporal resolution.

The NUV channel has a CCD detector sensitive from 174 to 305 nm (with a possible expansion to 1000 nm). The main characteristics of the NUV channel:

- Large field of view (FoV).
- Large dynamic range

Key scientific problems of FCU: study of planetary nebulae; UV behavior of a supernova; study of short-term (about 40 ms) variable sources; astroseismology; exoplanetary atmospheres; protostellar jets; Galactic globular clusters and variables. For more details on the scientific problems of the FCU, see Sachkov et al. (2018a)

The study of comets is one of the most promising areas of astronomy for the next decade. UV-spectroscopy of comets in the 115–300 nm wavelength range plays an important role, since this part of the spectrum contains most of the resonance lines of atoms of molecules and ions. The large FoV and high sensitivity of the NUV channel of FCU will make WSO-UV the most efficient observatory to track comet evolution.

To study Earth-like exoplanets by transits photometry method, two ozone absorption bands filters will be used: 230–280 nm (Hartley band, F255W) and 310–360 nm (Huggins band, F336W).

3. NUV channel: technical realisation of Hartley and Huggins bands

NUV channel is located in the center of telescope’s field of view. It provides high transmittance as it contains no additional optics except flat pick-off mirror. It

is equipped with 3 filter wheels with 5 filters and 1 open slot in each one, so up to 15 filters can be used with possibility of combination (see Fig.1).

Full-turn shutter contains 2 open slots for long exposures of faint objects and 2 slits with different width for bright targets and flat-field calibration (see Fig.2).

3.1. Conclusions

The large FoV and high sensitivity of the NUV channel of FCU will make WSO-UV the most efficient observatory to track comet evolution.

The WSO-UV space observatory, scheduled to launch in 2025, could become an important tool in cometary and exoplanetary UV research in the next decade.

Thus, The WSO-UV space observatory will guarantee continuity of UV observation of comets and exoplanets.

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