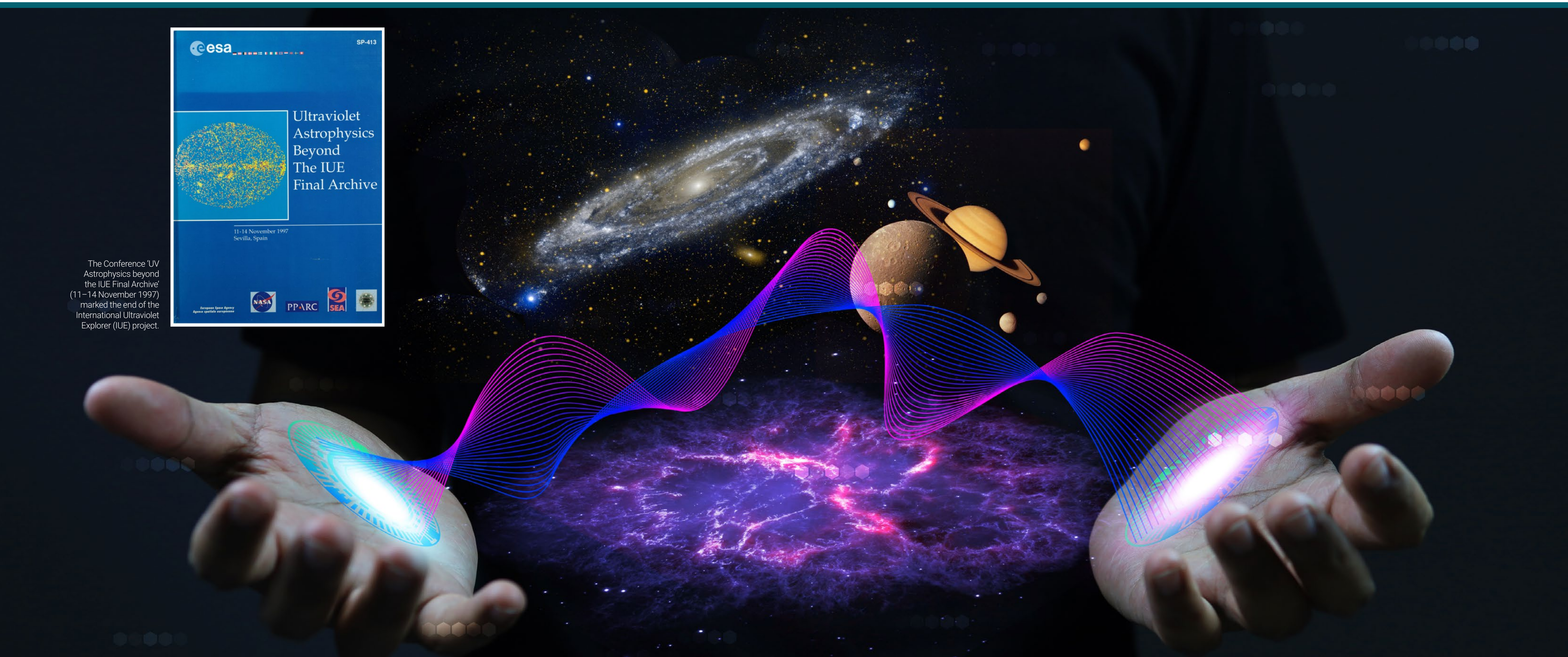


The Conference 'UV Astrophysics beyond the IUE Final Archive' (11–14 November 1997) marked the end of the International Ultraviolet Explorer (IUE) project.

Spektr-UF

Unlocking the secrets of UV

- Most of the Universe's secrets are buried within the furthest reaches of light's spectrum.
- Spektr-UF, also known as the World Space Observatory–Ultraviolet (WSO-UV), is a space-based telescope.
- It is the outcome of international cooperation.
- On board will be a formidable array of space instrument engineering.
- It will scan the Universe's ultraviolet (UV) wavelength to discover what's hidden from view.

For most of us, what we know of the marvels of space lies in what we can see, with or without optical telescopes. However, the majority of the Universe's secrets are hidden from view, buried within the furthest reaches of light's spectrum and other electromagnetic radiation. For astronomers, using telescopes to observe such extreme forms of radiation allows them to get a far more detailed view of the Universe. In the near future, that view will come to life, courtesy of a complex array of instruments currently being built by Russia in collaboration with Spain, Germany, and Japan. Once completed, the Spektr-UF, also known as the World Space Observatory–Ultraviolet (WSO-UV), will scan the Universe's ultraviolet (UV) wavelength signals to see what it can find. Astronomers can hardly wait.

Spektr-UF is the third such telescope mission driven by the Russian Federal Space Agency, Roscosmos, and made possible through international cooperation. The first, Spektr-R, launched on 18th July 2011, was a collaboration with the Russian Academy of Sciences and various international partners, including NASA and several European organisations. Spektr-R carried a 10-metre diameter radio telescope antenna – the largest single-dish space-based radio telescope ever launched at the time. The mission's main objective was to conduct high-resolution imaging and radio interferometry observations in coordination with ground-based radio telescopes using a process known as Very Long Baseline Interferometry. Spektr-R made significant contributions to radio astronomy before it stopped communicating in 2019, resulting in the mission being terminated.

The second Spektr mission, Spektr-RG, is a collaboration between Roscosmos and the German Aerospace Centre (DLR) designed to study the Universe in X-ray wavelengths. Launched on 13th July 2019, its primary goal is to conduct a high-energy X-ray survey of the entire sky, mapping celestial objects such as active galactic nuclei (AGN) – supermassive black holes at the centres of galaxies – galaxy clusters, supernova remnants, and other high-energy phenomena. With its help, scientists hope to investigate the properties of dark matter and dark energy and get insights into the evolution and formation of galaxies and galaxy clusters.

In scanning the Universe's UV wavelength signals, Spektr-UF will add to what Spektr-RG is showing to help scientists see more of the hidden dots they can join to complete a picture. What makes Spektr-UF particularly exciting for scientists is that there is much to 'see' in UV.

The secrets of ultraviolet

One of the most infuriating things for astronomers is knowing something is out there but not being able to 'see' it.

Imagine trying to look out a window coated with grease. We know that being able to observe the Universe's UV light – that electromagnetic radiation within the spectrum between X-rays and visible light – would provide a clearer picture, but because the Earth's atmosphere absorbs UV light, ground-based telescopes are largely ineffective. Hence, astronomers use a space-based telescope for more effective ultraviolet astronomy. Once Spektr-UF starts scanning space, scientists can expect a treasure trove of data.

UV light is particularly useful for studying young and hot objects in the Universe, so it can help capture the early stages of stellar evolution, including the birth of stars, their formation in molecular clouds, and their subsequent development. UV light is also effective

It's one of astronomy's more captivating anomalies that such a narrow wavelength of light can unlock such vast insights.

for examining what lies between stars, known as the interstellar medium. This space-within-space is not empty; it's full of gas, dust, and other materials. Spektr-UF should therefore reveal hitherto hidden information about the interstellar medium's composition, temperature, and density and provide a clearer picture of how stars form and galaxies recycle matter.

Spektr-UF will also complement Spektr-RG in examining active galactic nuclei. AGN accrete, or accumulate, large amounts of matter and emit intense radiation across the electromagnetic spectrum. By scanning the UV light near black holes, Spektr-UF should unveil the high-energy processes within them, allowing scientists to study the accretion disks, jets, and other phenomena associated with AGN activity.

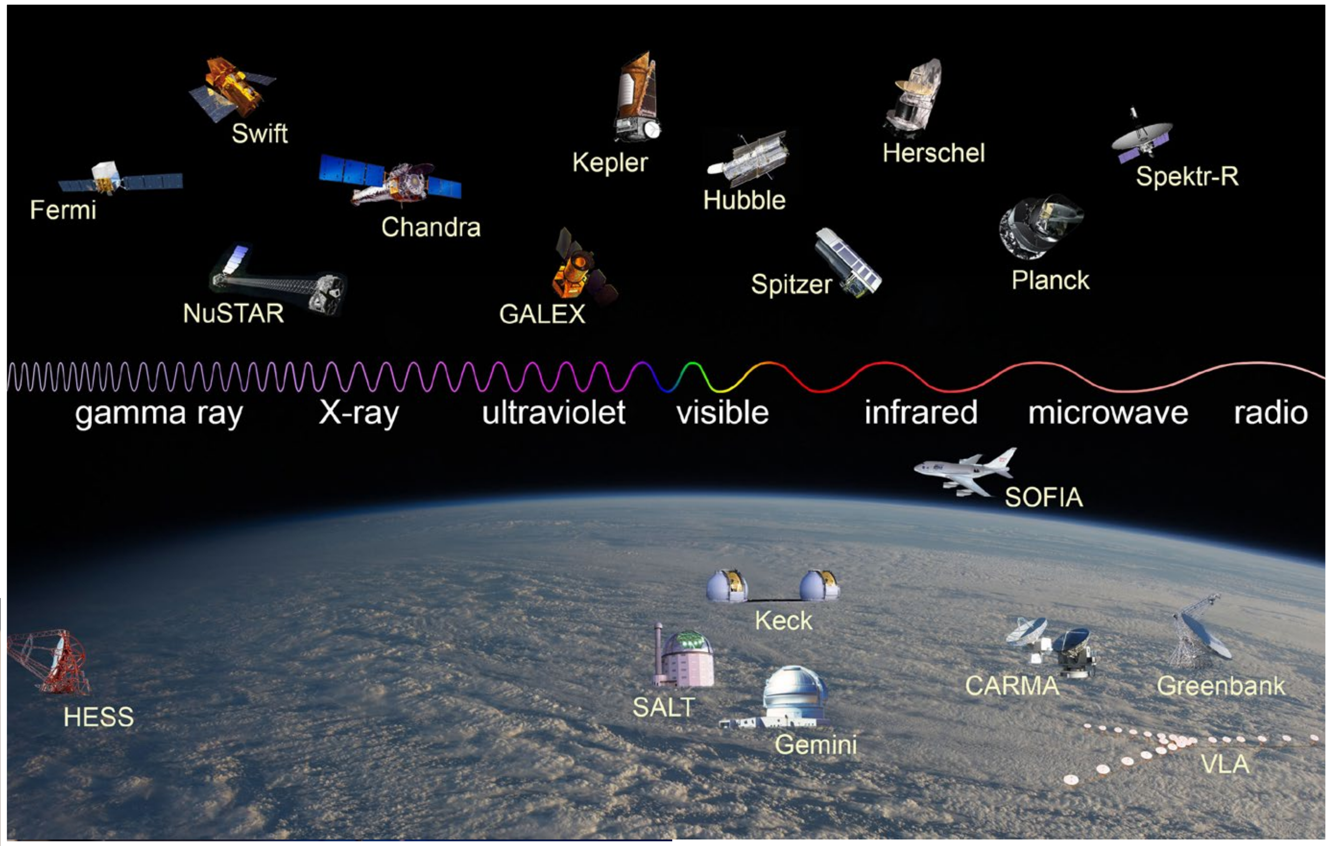
Of course, 'seeing' all this requires specialised equipment – far more than a 'standard' telescope. This is why Spektr-UF is more of an orbital observatory bristling with formidable space instrument engineering.

What's in the can

Once launched, Spektr-UF will take its place in geosynchronous orbit above the Earth's geocorona – the tenuous layer of hydrogen gas surrounding our planet's upper atmosphere. The main feature of the observatory is the T-170M Ritchey–Chrétien primary telescope with an aperture of 1.7 metres. Other instruments are grouped into a spectroscopy unit and a camera unit, the former to measure and analyse UV wavelengths and the latter for taking UV images.

Among the spectrographs is a significant and recent addition – a UVSPEX. In the latter part of 2020, the Japanese Aerospace Agency, JAXA, and Rikkyo University in Tokyo showed that its spectrograph could be a valuable part of the payload. The UVSPEX is designed to measure and analyse light in the UV wavelength region between 115 nanometers (nm) and 135 nm. This enables it to capture the presence of hydrogen, oxygen, and carbon. The main focus of UVSPEX is the myriad of Earth-sized exoplanets that we know lie beyond our Solar System. By examining the geocoronas of these planets, UVSPEX will give a clearer indication of whether they could harbour life.

The Spektr-UF will also carry a newer version of the Konus-UF onboard the Spektr-RG. Designed by the Russian Academy of Sciences, this instrument detects and analyses gamma-ray bursts – the most powerful form of electromagnetic radiation that can take anything between milliseconds to a few minutes, but release the equivalent of the total energy emitted by the Sun over its entire lifespan.



A selection of telescopes operating at wavelengths across the electromagnetic spectrum.

Model of WSO-UV telescope during 'Space Week' in Madrid, May 2011.

Andrzej Olchawa, CC BY-SA 2.0, via Wikimedia Commons

A window on the UV Universe

Spektra-UF will be the latest in a line of UV space telescopes dating back to the Ultraviolet Explorer (IUE), launched on April 26, 1978. A joint project between NASA, the European Space Agency, and the United Kingdom's Science and Engineering Research Council (SERC), IUE was the first space telescope specifically designed for ultraviolet observations. The telescope operated for over 18 years, far exceeding its planned mission duration of three years. IUE highlighted not only the benefits of space-based observations, inter-agency collaboration, and international cooperation, but also the importance of observations in the ultraviolet range.

It's one of astronomy's more captivating anomalies that such a narrow wavelength of light can unlock such vast insights. If the instrument array onboard Spektra-UF is impressive, the mission's scope is

Once Spektr-UF starts scanning space, scientists can expect a treasure trove of data.

expansive. It will open new opportunities in extragalactic astronomy – the Universe beyond our own galaxy, the Milky Way; stellar astrophysics – the study of individual stars, their properties, and their evolution; and cosmology – the study of the origin, structure, and evolution of the Universe as a whole. But it will also allow us to hone in on individual planets and wonder if we could ever go there.

Like any other highly technical international mission, Spektra-UF has had its fair share of challenges coming together. The launch was initially planned for 2007, and various setbacks have pushed the launch date. But with extra time comes added opportunities. Spectrograph technology keeps advancing, and the tweaks and additions the delay has allowed will make for a more powerful machine. Currently, Spektra-UF is due to leave the Earth in late 2028 atop an Angara A5M rocket from Vostochny Cosmodrome in the Amur Oblast region of Russia, about 5,500 km east of Moscow. It seems scientists with their eyes on the mission will have to wait a little longer.

The international team behind Spektr-UF refer to it as the 'window on the UV Universe', and it is an apt metaphor. Once it comes online, it will let in the light and the Universe will come alive.

Details

e: hans.haubold@gmail.com
t: +43 676 4252050
w: www.wso-uv.es/index.php?id=33
w: www.inasan.ru/en/sw/wso-uv

Bio

Hans J Haubold is a professor of theoretical astrophysics at the Office for Outer Space Affairs of the United Nations, New York and Vienna. His research focuses on the internal structure of the Sun, solar neutrinos, and special functions of mathematical physics. Additionally, he is interested in the history of astronomy, physics, and mathematics.

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- 193 Member States of the United Nations

Collaborators

- Willem Wamsteker (ESA)
- Boris Shustov (Russia)
- Ana Ines Gomez de Castro (Spain)

Further reading

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