UNIVERSITÉ DE GENÈVE

PRESS RELEASE

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Conclusive tests for the RISTRETTO exoplanet explorer

Key components of the new spectrograph designed at UNIGE have been successfully tested. They will enable analysis of light from the exoplanet Proxima b.

The RISTRETTO project, dedicated to observing Proxima b – the closest exoplanet to the Solar System — is reaching a new milestone: several key components of this high-precision spectrograph have been prototyped and successfully tested by the workshops of the Department of Astronomy at the University of Geneva (UNIGE). In addition, comprehensive simulations of the instrument indicate that RISTRETTO will be able to detect Proxima b, along with potential signs of oxygen or water in its atmosphere — a planet similar in size and temperature to Earth. These findings are detailed in two studies published in *Astronomy & Astrophysics*.

The stars that populate our galaxy are very far apart from each other. This poses a major problem for astronomers focused on detecting and studying exoplanets: it is extremely difficult to distinguish — or "resolve," in scientific terms — an exoplanet from its host star.

Only a few planetary systems can be resolved by the largest telescopes, such as the Very Large Telescope (VLT) at the European Southern Observatory (ESO). A second challenge makes the task even harder: a star like Proxima Centauri, the closest star to the Solar system, shines 10 million times brighter than a planet. Detecting the light from Proxima b with the VLT is like trying to spot the glow of a firefly orbiting a lighthouse in New York from the summit of the Matterhorn.

Scientists from the Department of Astronomy at UNIGE have decided to take on this challenge with the RISTRETTO high-precision spectrograph project. The instrument, which will be installed on the VLT, is based on new instrumental techniques.

Extreme tools

To mask the star's dazzling light, scientists have developed a new type of coronagraphic Integral Field Unit. This device uses an array of hexagonal lenses to cover the instrument's entrance aperture, while optical fibers channel the light to the spectrograph. By manipulating the properties of light, it is possible to partially "extinguish" the star in order to reveal the planet located nearby.

"We have developed a fully functional prototype that we have just tested at the Geneva Observatory," comments Nicolas Blind, research engineer in the Department of Astronomy at the UNIGE Faculty of Science and lead author of the paper on this cutting-edge instrumental development. "The performance meets our expectations and confirms our initial decision to develop this technology for RISTRETTO."

This artist's impression shows a view of the surface of the planet Proxima b orbiting the red dwarf star Proxima Centauri, the closest star to the Solar System.

High resolution pictures

This success comes on top of other recent achievements, particularly with regard to another key component of the instrument: its extreme adaptive optics (XAO). This system compensates for distortions caused by Earth's atmosphere that degrade astronomical observations. The team successfully validated several XAO components during trials at the Haute-Provence Observatory (OHP) in early October.

Detecting Proxima b

Using these initial technical results, scientists were able to model RISTRETTO on a computer to estimate its ability to detect the closest exoplanet to us, Proxima b, which is similar in size and temperature to Earth. "We incorporated synthetic observations of the star Proxima and its planet into our RISTRETTO simulation," says Maddalena Bugatti, a doctoral student in the Department of Astronomy at the UNIGE Faculty of Science and lead author of the research article on these simulations. "With only 55 hours of observations with the VLT, we can detect the planet, and in 85 hours we can tell if there is oxygen or water in the planet's atmosphere."

Supported by Swiss watchmaking

At the beginning of the year, RISTRETTO received financial support from Swiss watchmaker Swatch, which will enable the high-precision instrument to be completed before its installation on the VLT in 2030. The project is all the more important as it is set to pave the way for second-generation instruments on the Extremely Large Telescope (ELT), the 39-meter telescope currently under construction in Chile.

"These initial successes and results are very encouraging," says Christophe Lovis, associate professor in the Department of Astronomy at the UNIGE Faculty of Science, head of the RISTRETTO project and co-author of the various studies. "The next steps include testing the spectrograph in a clean room and then in real observation conditions with the 152 cm telescope at the Haute-Provence Observatory, as well as the complete design of the extreme adaptive optics."

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