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Exploring the fastest timescales in Astronomy with OPTICAM

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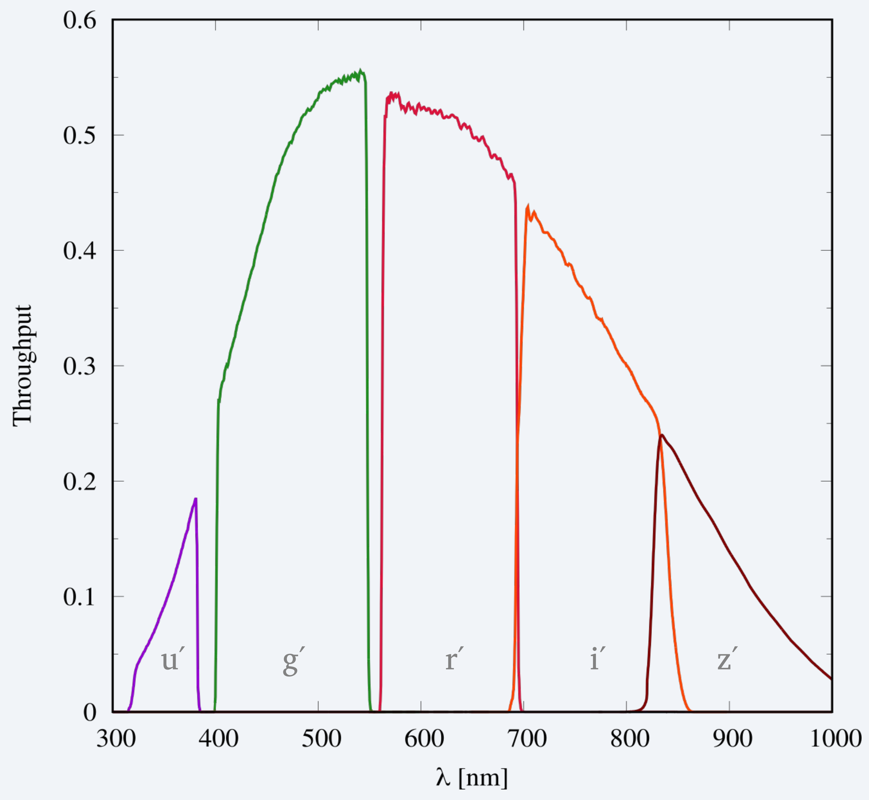
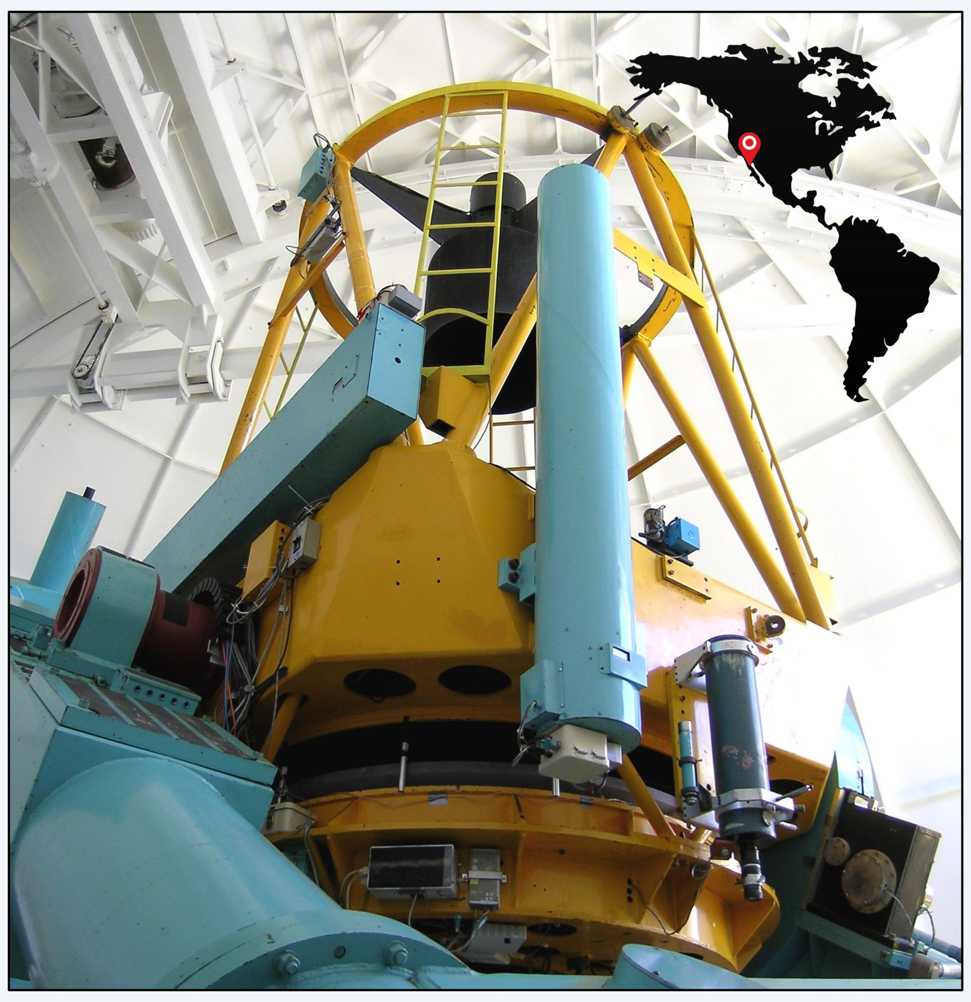


Throughput estimation of OPTICAM on the OAN-SPM 2.1-m telescope. OPTICAM will have a set of SDSS filters (u′g′r′i′z′), which is the most common filter set in modern Astronomy. This calculation considers the contribution of filters, dichroic beam splitters, camera lenses and the sCMOS detector

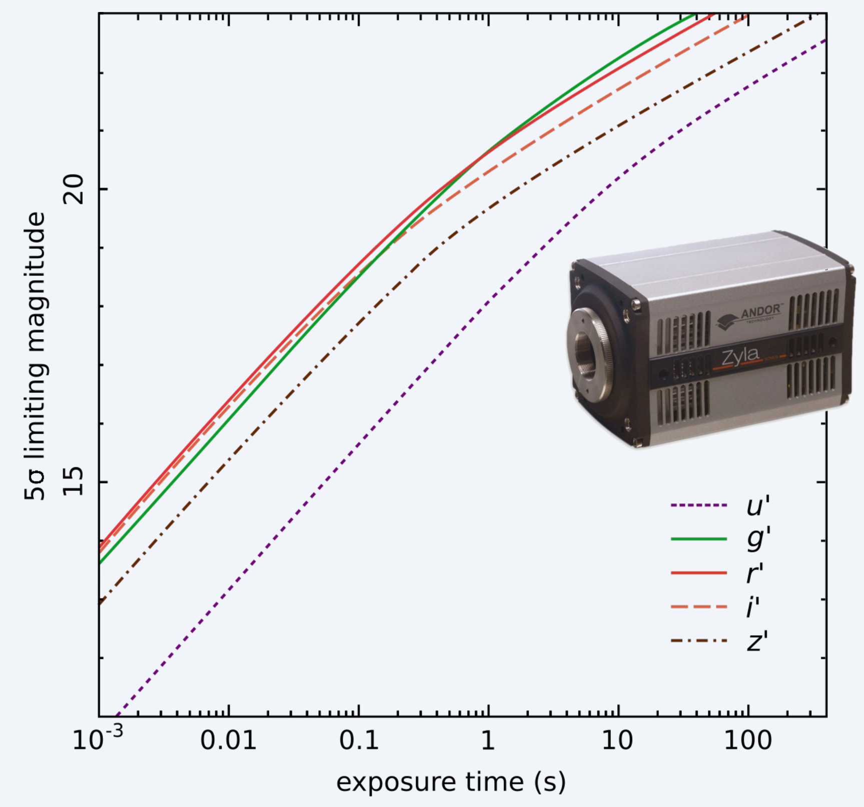
OPTICAM is a high-speed optical system designed to perform triple-channel fast-photometry. OPTICAM will have a set of u'g'r'i'z' SDSS filters which will allow coverage in the 320<λ[nm]<1,100 wavelength range. OPTICAM will be mounted in the Cassegrain focus of the OAN-SPM 2.1 m telescope, in Ensenada, Mexico. Incident light will be splitted into three different beams using a pair of dichroic beam splitters. One beam is dedicated to either the u′ or g′ filter, whereas the second beam will be dedicated to r' and the third beam to either the i' or the z' filter. These filter combinations will be selected through the use of a manual filter exchanger available on each arm of the optical system. The filters will be placed according to the astronomer science needs. The image acquisition will be done by means of three modern 2,048×2,048 Andor Zyla cameras observing the same patch of the sky of approximately 5×5 arcmin².}



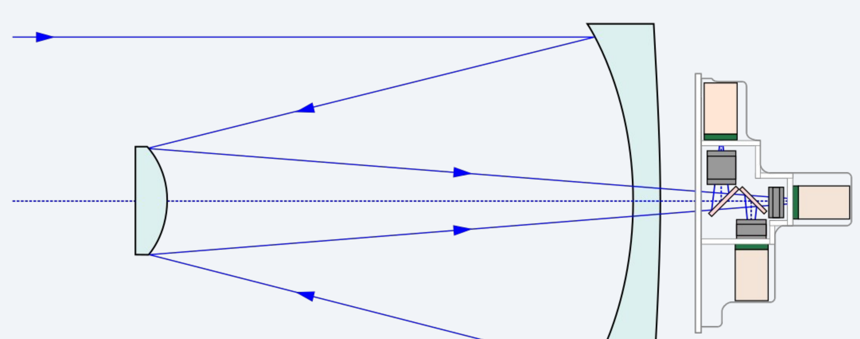
The OAN-SPM 2.1-m telescope. It is located at 115°27'49"W and 31°02'39" N with an altitude of 2,800 m.

OPTICAM is being built as a collaborative work between the Astronomy Goup of the University of Southampton (UoS) and the Institute of Astronomy of the Universidad Nacional Autónoma de México (IA-UNAM). OPTICAM will be capable of strictly simultaneous imaging, meaning that images will be acquired exactly at the same time through the use of a synchronisation card and dedicated object-oriented programming. OPTICAM will nominally allow sub-second imaging capabilities, nevertheless, higher readout speeds can be reached as function of the pixel array and binning configuration. The three cameras will be synchronised with the aid of a precise timing module. Each image header will be time stamped using this dedicated timing module equipped with a precise GPS system.

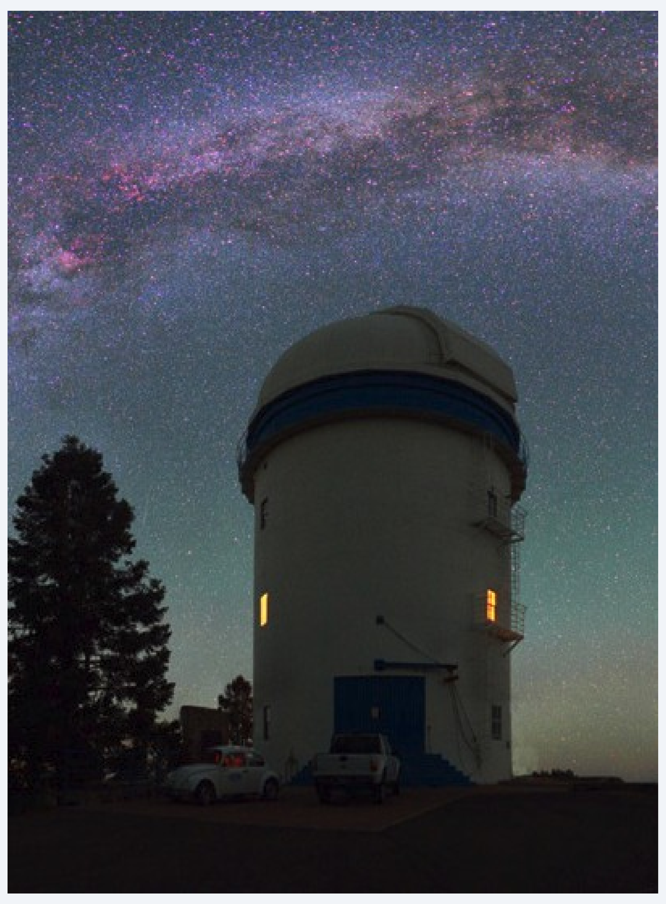
OPTICAM is a step forward towards a new generation of instruments with high temporal resolution, which will enable studies of very fast astrophysical phenomena occurring in the range of milliseconds and seconds, a range that previously could not be achieved by traditional CCD photometric techniques. Due to is fundamental design, OPTICAM can be used to observe a variety of astrophysical sources such as XRBs, pulsating WDs, accreting compact objects, eclipsing binaries and pulsars, stellar flaring events, exoplanets, stellar occultations among others. In addition, OPTICAM can serve as a complement to simultaneous multi-wavelength campaigns of fast variability phenomena, along with several high-energy space observatories. Observations taken with OPTICAM will remain proprietary for only six months and then will be made publicly available for the astronomical community.



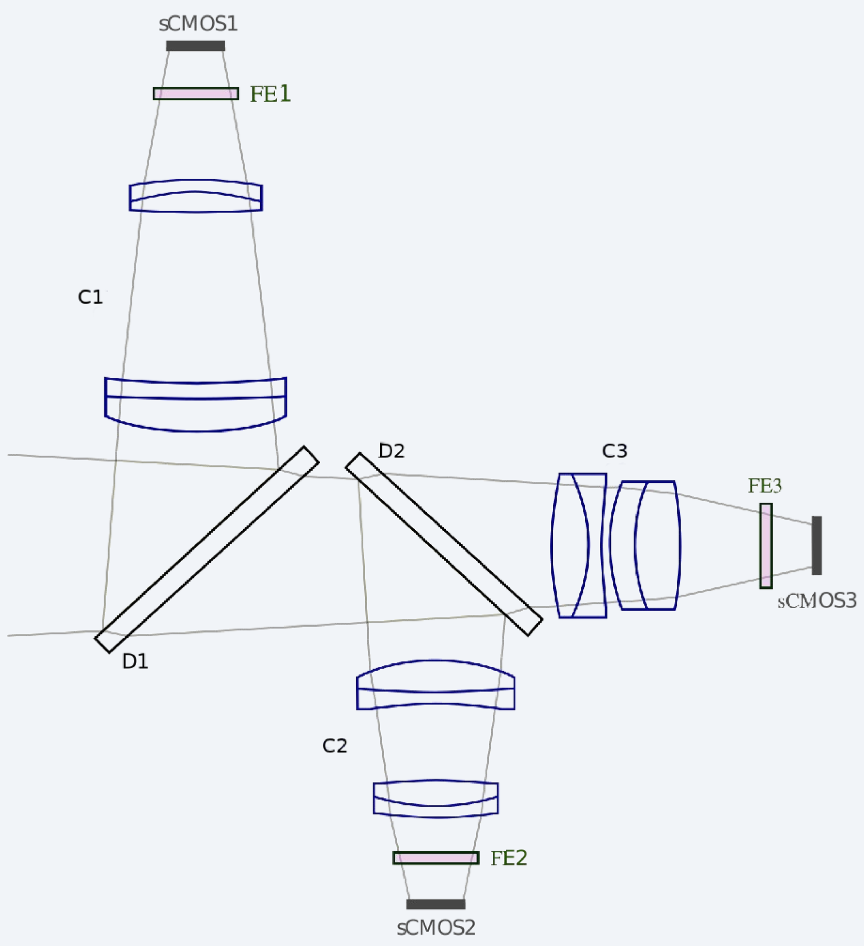
Preliminary limiting magnitude plot for a detection of OPTICAM (at a signal-to-noise of 5-σ) in the OAN-SPM 2.1 m telescope. OPTICAM uses 3 Andor Zyla 4.2-P sCMOS detectors, one for each arm of the system.



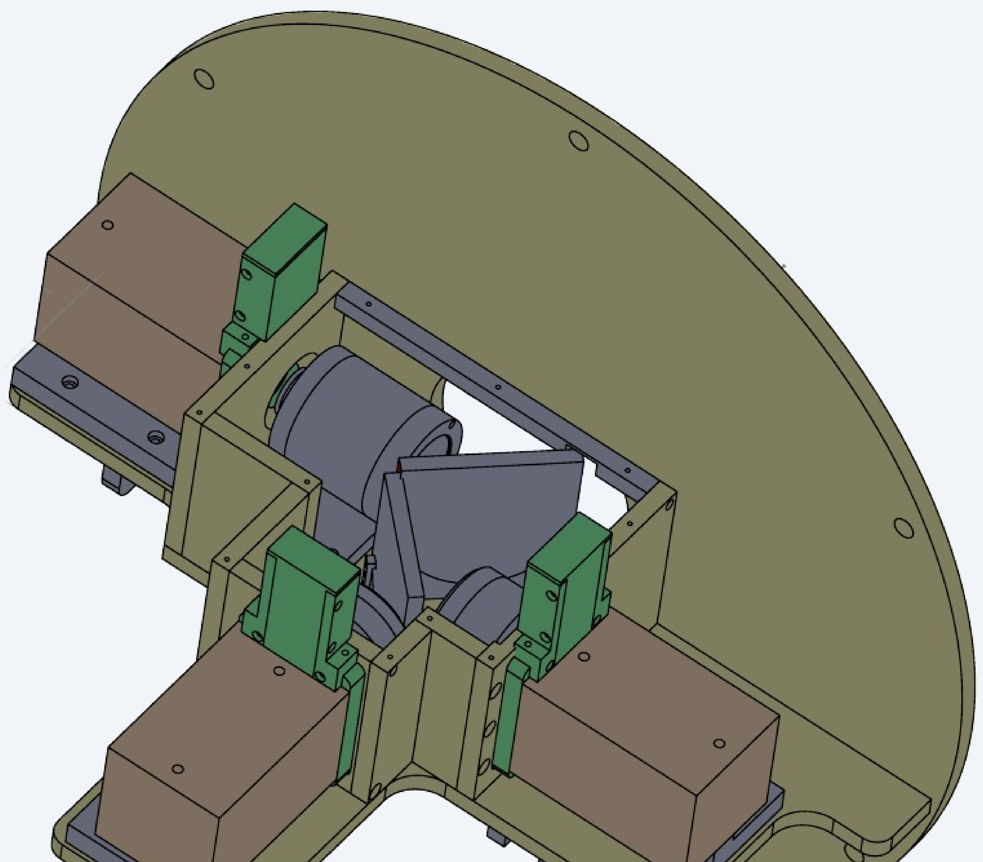
Layout of the optomechanical system of the OAN-SPM 2.1 m telescope and OPTICAM. Incident light is separated into three channels by two dichroics beam splitters. The diagram is not to scale but is for illustrative purposes



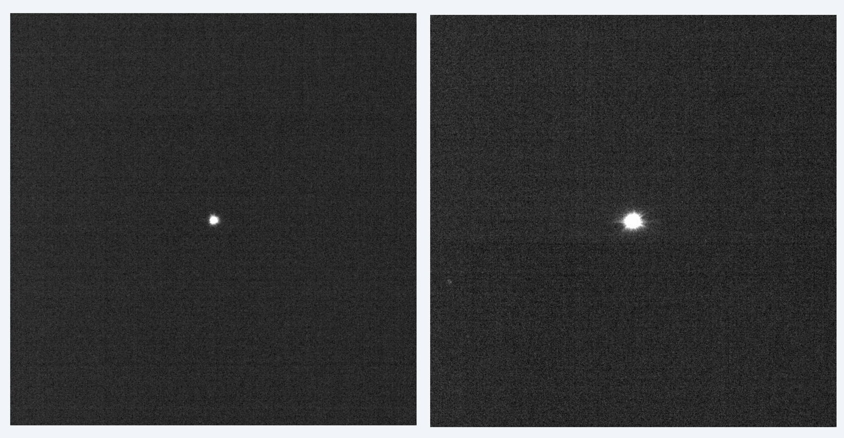
The arc of the Milky Way photographed by Stéphane Guisard in this photo of the OAN-SPM 2.1-m telescope building, in Ensenada, México.



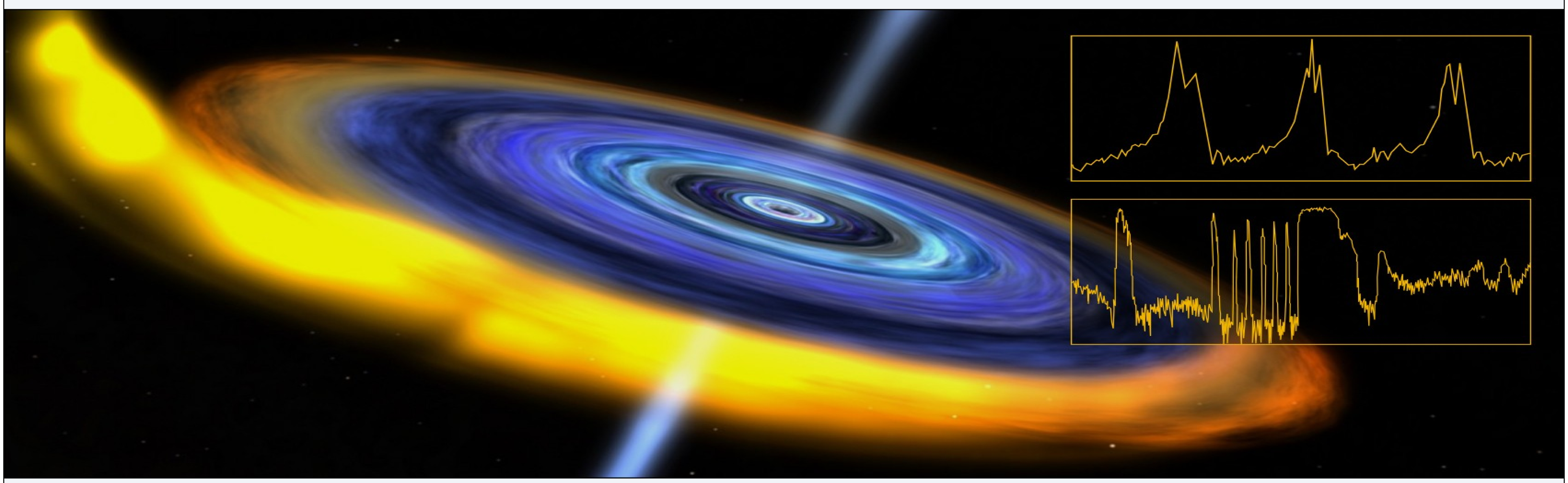
Design of the OPTICAM optical layout showing the major optical components: the dichroics (D1 and D2), optical cameras (C1, C2 and C3), filter exchangers (FE1 and FE2) and sCMOS cameras (sCMOS1, sCMOS2 and sCMOS3).



The optomechanical structure of OPTICAM. In the above figure are shown three detectors (Andor Zyla 4.2-P sCMOS; brown boxes), the filter exchanger mechanism (in green), and the lenses and dichroic beam splitters (in gray).



Bright stars Betelgeuse (left) and Sirius (right) were imaged - without filter - during a preliminary test of our self-developed software using a 12-in Meade LX200 telescope with exposure times of 0.2 and 1 ms, respectively.



Due to its unique optical and timing capabilities, OPTICAM will allow us to perform strictly simultaneous triple-band observations of a wide variety of astronomical objects with dynamical times-scales ranging from seconds in white dwarfs (WDs) to milliseconds in neutron stars and galactic black holes, among other astrophysical phenomena. Image credits: NASA.

https://www.southampton.ac.uk/opticam