Investigating different populations of astrophysical sources with SVOM/ECLAIRs

The French-Chinese Space-based multi-band Variable Object Monitor (SVOM) mission launched in June 2024 is dedicated to the study of high energy (HE) transient sky in synergy with multi-wavelength follow-up observations for the detected events. Amongst the various known populations of HE transients, compact object (white dwarfs, neutron stars and black holes) driven transients (e.g. Gamma-ray bursts, tidal disruption events, active galaxy nuclei, X-ray binary bursts, magnetar flares, novae, etc.) are of prime interest for SVOM (see Figure 1). They signal either the violent birth of compact objects, their destruction or their feeding through accretion of matter. Such transients are in general very energetic and therefore they transfer a large amount of energy in their surroundings leading to some significant impacts on their host evolution. Some of them like Gamma-ray bursts could serve as probe to study the early Universe contents.

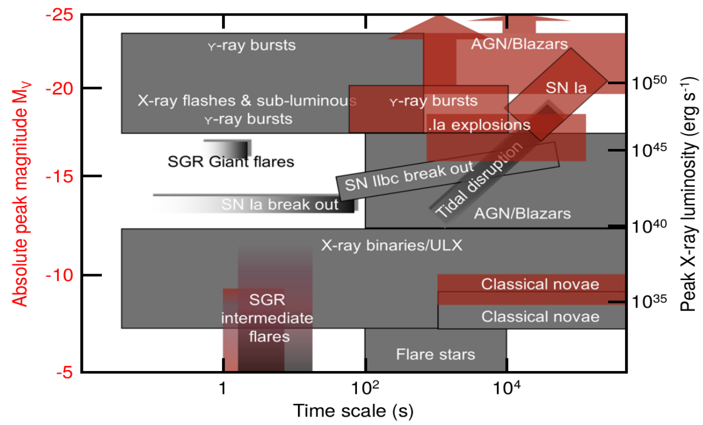

Figure 1 – Various high energy transients as a function of their timescale and brightness in X-rays and visible.

To study these objects, the SVOM spacecraft embarks a suite of 2 wide-field high-energy instrument and 2 narrow-field instruments in X-rays & visible. This space segment is complemented on ground with a dedicated network of robotic wide-/narrow-field telescopes in optical and/or nIR (see Figure 2).

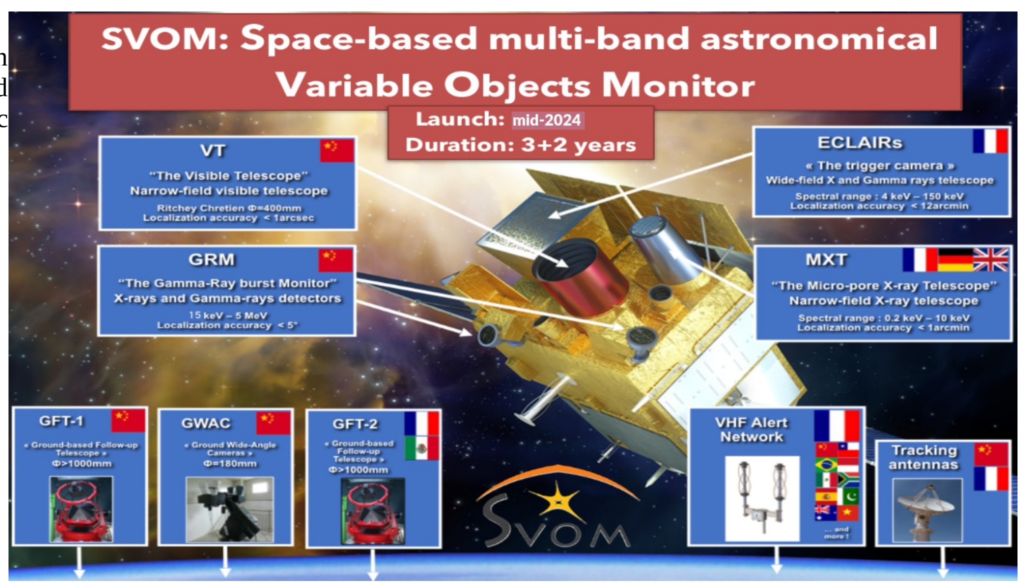

Figure 2 – The SVOM mission with its space science payload and ground network of robotic telescopes.

The prime instrument onboard SVOM is the ECLAIRs camera (see Figure 3) in charge of autonomously detecting Gamma-ray bursts and other high-energy transients within its field of view (FoV) and providing their first localisation thanks to dedicated onboard trigger algorithms. It was built as a collaboration between several French labs (IRAP, CEA and APC) under the science lead of IRAP and a supervision by the French space agency CNES. ECLAIRs is a 2-D wide field (~2 sr i.e. 89 x 89 sq. deg.) coded mask camera working in the 4 – 150 keV.

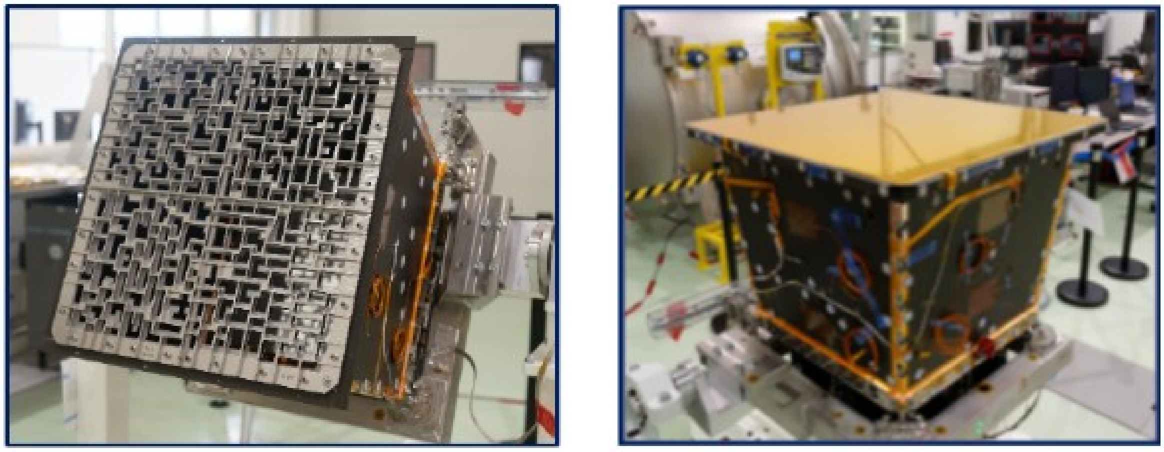

Figure 3 – Pictures of the ECLAIRs flight model. ECLAIRs is a coded-mask camera with a wide field of view (FoV) of 89 x 89 sq. degrees. The instrument is made of a coded mask placed at ~46 cm in front a pixelated CdTe detection plane (80 x 80 pixels). The ECLAIRs mask pattern has been designed in such a way that depending on its position with respect to the instrument optical axis a bright X-ray source within the instrument FoV will project a unique shadow onto the detection plane (called a shadowgram). Deconvolution of the measured shadowgram by the mask pattern enables to reconstruct a sky image in which the source position could be retrieved.

The aim of the internship is to study some of the HE transients detected by ECLAIRs and to derive their main properties as well as searching for multi-wavelength counterparts.

During the internship, the student will learn more about the fascinating, rich and complex physics of GRBs, compact objects and accretion/ejection processes thanks to a collaborative work within the SVOM group at IRAP. He/she will learn about space missions and acquire solid skills in coding in Python and analysis of multi-wavelength data. The intern will also discover and participate to the life of a research laboratory.

If you are interested in applying to this internship, please contact me at ogodet@irap.omp.eu.

References

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