

First Rubin/LSST alerts and tidal disruption events: classifiers, real-time visualisation and TeV gamma-ray analysis tools

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Context

The Vera C. Rubin Observatory (LSST) now delivers millions of alerts per night. Among them are tidal disruption events (TDEs), stars torn apart by supermassive black holes, which are powerful laboratories for accretion physics and, in some cases, for particle acceleration up to very-high-energy (VHE) gamma rays. Finding TDEs early requires machine-learning classifiers running in alert brokers such as Fink, and exploiting them requires that alerts reach the community quickly, with the right context, and can trigger follow-up observations.

Our group leads the TRACER project, which builds a chain from LSST alerts (classified in Fink) to multi-wavelength follow-up managed via Astro-COLIBRI, a platform with web and smartphone apps that aggregates multi-messenger alerts and can trigger H.E.S.S. and CTAO observations. The internship prepares and complements this work on real data.

Project

The intern will work on three connected topics and will be guided towards the one that matches her/his interests best:

- **Review of the first LSST alerts.** Retrieve LSST alerts and Fink classifications (in particular the TDE classifier(s)), and assess their behaviour on the first data: purity, completeness and timeliness compared with known TDEs from ZTF and other surveys, typical failure cases and contaminants (e.g. AGN variability, supernovae), and the light-curve information available at the time of the alert.
- **Representation in Astro-COLIBRI.** Study how TDE candidates are currently retrieved and displayed in Astro-COLIBRI (alert lists, light curves, host and nuclear-position context, visibility from gamma-ray sites), and propose and prototype improvements such as filtering options, classifier-score display, or observation-planning aids. Depending on interest and background, this can involve backend (Python) or app development (Flutter).
- **Archival H.E.S.S. analysis.** Learn the VHE gamma-ray analysis tools by analysing archival H.E.S.S. observations of transient phenomena (including TDEs where data exist): data selection, background modelling, detection significance and flux upper limits, and a first comparison with model predictions. This prepares the systematic, alert-triggered follow-up planned in the coming years.

The internship is designed to give a complete first view of the real-time multi-messenger chain: from the raw alert, to its classification, display and global distribution, to the gamma-ray data analysis. The results can feed into the Fink and Astro-COLIBRI developments and, depending on their quality, into a publication or conference contribution.

Profile and practical information

We are looking for a Master 2 (or equivalent) student in astrophysics, astroparticle physics, physics or data science, with a good command of Python. Familiarity with astronomical data, machine learning, or app/web development is a plus but not required, and we welcome curiosity and willingness to learn across these areas. The internship takes place at IRFU/DPhP, CEA Paris-Saclay, within a group of PhD students and postdoctoral researchers working on multi-messenger and time-domain astrophysics, and with the possibility to interact with the Fink team at IJCLab and with the H.E.S.S. and CTAO collaborations. The internship is compensated according to French regulations. It can serve as preparation for a PhD project on TDEs, Astro-COLIBRI and the link to LISA that starts in autumn 2027; the two positions are however independent.

How to apply: please send a CV, a short motivation letter and your Master transcripts to Fabian Schüssler, fabian.schussler@cea.fr. More information: <https://www.multimessenger-astronomy.com>