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## A new era for the blazar multi-wavelength studies with Rubin and CTAO

Both Rubin Observatory and CTAO will be collecting data by 2026, marking a new era in optical and gamma-ray astronomy. Compared to predecessors like ZTF, H.E.S.S., MAGIC, and VERITAS, their enhanced sensitivity will extend extragalactic observations to at least redshift of  $\sim 2.5$ . This advancement offers fresh insights into non-thermal astrophysical sources, particularly blazars - radio-loud AGN with jets aligned with our line of sight. The 3-night cadence monitoring with Rubin in one of each six filters will produce blazar light curves that, when combined with targeted in-depth observations from CTAO, could help distinguish acceleration and radiative models, which are still under debate. Existing data from ZTF and Fermi-LAT, though less sensitive, offer preliminary insights into what Rubin and CTAO may achieve. However, the real-time processing of the immense data stream coming from Rubin/LSST presents a major challenge.

Addressing this challenge is the work of brokers such as Fink, which we develop for multi-messenger astrophysics. Fink processes data in real-time before sending relevant information to other observatories like CTAO. In this contribution, I will present how we characterize the optical variability of blazars that emit in the gamma-ray range down to ZTF sensitivity, with timescales spanning from the intra-night to multi-years, both in the temporal and Fourier domains. We identify properties in the resulting parameter space that not only enable the identification of blazar-like sources, but also characterize the continuum of states. I will describe our fast identification of these transitions from one state to another, enabling the trigger of observations in the gamma-ray band when the blazar is flaring and of spectroscopic observations with the goal to measure the redshift of the source when the jet becomes faint and the host galaxy may become detectable. Finally, I will review the communication channel we set from ZTF to CTAO via Fink for blazars and discuss its outlook in light of the Rubin Observatory. This method is also applicable to other astrophysical sources and helps lay the groundwork for a fruitful era for time-domain astronomy.

### Collaboration(s)

CTAO, LSST

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