ID de Contribution: **17** Type: **Non spécifié**

Identification of Orphan Gamma-Ray Burst Afterglows in Rubin LSST data with the afterglowpy package

mardi 17 mai 2022 10:15 (15 minutes)

Gamma-Ray Bursts (GRB) are among the most energetic phenomena in the Universe. The interaction of their blast wave with the Interstellar Medium produces an afterglow that can be observed from a larger angle, in a wide range of the electromagnetic spectrum and during more time than the prompt emission. Viewed off-axis, this emission has a negligible gamma-ray flux and is hence called "GRB orphan afterglow". Their properties make them good candidates to learn more about the GRB physics and progenitors or for the development of multi-messenger analysis, like in the case of GW170817A. According to most theoretical models, orphan afterglows should be found as slow and faint transients. This is why the Rubin Observatory shall significantly improve their detection : thanks to its limiting nightly magnitude of 24.5 and its large field of view, it should be able to detect up to 50 orphans per year. To identify orphan afterglow in Rubin LSST data, we plan to use the characteristic features of their lightcurves which depends on several parameters. In this work, we simulated afterglow light curves using the afterglowpy package to understand which combinations of these parameters lead to potentially observable transients by Rubin. We found that orphans should be more observable for low redshifts, high energies and even high angles during several months. These results will be used to generate a population of GRBs to simulate observations with the Rubin Observatory and will ultimately allow us to implement a filter in the alert broker FINK.

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Classification de Session: Science