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Identification of optical Orphan Gamma-Ray Burst Afterglows in Rubin LSST data with the alert broker FINK

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Gamma-Ray Bursts (GRBs) 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 afterglows in Rubin LSST data, we plan to use the characteristic features of their light curves which depends on several parameters
defined by the chosen model. In this work, we generated a population of short GRBs and simulated their afterglow light curves with the afterglowpy package using a statistical distribution for each of the studied parameters. We then used the rubin_sim package to simulate pseudo-observations of these orphan afterglows with Rubin LSST and we found that about 4% of the afterglows will be observable orphan afterglows. These results are used to study the correlations between the parameters of the GRBs afterglow model and the features of the pseudo-observed orphan afterglow light curves, and will ultimately allow us to implement a filter in the alert broker FINK.

Auteur principal: MASSON, Marina (LPSC)

Orateur: MASSON, Marina (LPSC)

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