Proposal for Observing Supernova GRB171205A/SN2017iuk with CFHT/MegaCam

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1 Scientific Rationale

The discovery of GRB171205A/SN2017iuk represents a unique opportunity to investigate the nature of long-duration gamma-ray bursts (GRBs) associated with supernovae. GRB171205A, identified on 5 December 2017, is possibly one of the closest GRBs ever detected.

This proximity allows for an exceptionally detailed study of its light curve, which could provide new insights into the physical mechanisms powering GRBs and their associated supernovae (SNe). Obtaining and monitoring light curves is one of the essential estimates, which allow us to derive the energy of the explosion, the nature of the progenitor star, and the properties of the circumstellar environment.

Furthermore, the transition from the initial GRB afterglow to the supernova's own emission is key to understanding energy transfer processes in these events.

Therefore, we would like to observe the recently exploded SN2017iuk due to its particular scientific interest and value in understanding the nature of long-period GRBs.

Figure 1: Chart of the sky, generated using the Aladin Lite software. The red rectangle displays the main target, blue rectangles denote the support targets (See Table 1). The FoV is 1° width, which is consistent with the FoV of CFHT/MegaCam instruments.

2 Targets

The main target of the following proposal is the SN2017iuk, also associated with the GRB171205A, located at DEC(J2000) $= -12^\circ 35' 08.5''$, RA(J2000) $= +11^{\mathrm{h}} 09^{\mathrm{m}} 39.46^{\mathrm{s}}$.

Next, we suggest several support targets similar to the magnitude of SN2017iuk, queried from the Panoramic Survey Telescope & Rapid Response System catalogs (Pan-STARRS, PS2)[1]. All three targets are in the range of $5'$ from the main target and thus do not require separate observations. Simultaneous observations of both main and support targets will allow us to perform accurate photometric measurements.

Table 1 displays the basic information about the targets, e.g. names, right ascension (RA) and declination (DEC), fluxes in several Sloan Digital Sky Survey (SDSS) filters (ugriz photometric system). Figure 1 presents the finding chart with the targets presented, generated via the Aladin Lite software[2].

[1] `https://catalogs.mast.stsci.edu/panstarrs/`

[2] `https://aladin.cds.unistra.fr/AladinLite/`

3 Facilities requested

We request the periodic photometric observations of listed targets via the Canada France Hawaii telescope (CFHT) MegaPrime/MegaCam instrument[3], in SDSS filters to create and analyze a detailed light curve of the SN2017iuk, capturing the photometric drop of the SN2017iuk afterglow over a period of 30 days, starting from day 8 post-burst. We require this instrument, due to its particular field of view (FoV) and high sensitivity, which would let us choose several standards to perform accurate photometry and receive precise flux measurements in g, r, i, and z-filters. We aim to gain high-quality photometric data, to precisely fit the lightcurve in each filter, and to compare with the existing simulations.

Additionally, we request observations from Hawaii due to favorable weather conditions and observability of the main target, which help ensure consistent data collection throughout the observation period and the absence of such instruments in our state, while the target should be observed as soon as possible due to the rapid processes going there.

4 Observing requirements

At the CFHT, we would like to use MegaPrime/MegaCam instruments with g, r, i, and z-filters, binning 1×1. Assuming the flux of supernovae of $magAB = 19 - 21$, we ask for 5×15 seconds exposures (SNR of $10 - 100$) in g, r, i, z-filters daily, starting on December 13, 2017, and finishing on Figure (see Table 3). The SNR calculations were performed by the MegaCam exposure time calculator[4].

Overheads for a CFHT for the non-moving target are the following: the time estimated for the telescope slew and focusing can take up to $3 - 4$ minutes at the beginning of the daily observational sequence. The camera overhead time is estimated to be 50 seconds for the pre-exposure tasks and readout, 20 seconds for selecting a new filter, and 3 seconds for software routines[5].

[3] https://www.cfht.hawaii.edu/Instruments/Imaging/MegaPrime/

[4] https://etc.cfht.hawaii.edu/mp/

[5] https://www.cfht.hawaii.edu/Instruments/Imaging/CFH12K/Summary/CFH12K-Overheads.html

5 Observing plan

We require photometric observations of SN2017iuk with the requested setup. We also require standard flats, biases, and dark frames. The observation of support targets is not required due to their location in the FoV, close to the target. For each day, starting December 13, 2017, and finishing Figure, we ask for the single series of 5×15 seconds of observations in g, r, i, and z-filters of the MegaCam instrument.

6 Scheduling requirements

We request for dark or gray time.

7 Appendix

Table 1: Lokalizacje oraz jasności w filtrach SDSS badanego obiektu oraz gwiazd porównawczych.

Type Obj	Main Target	Support Target
Obj. Name	**SN2017iuk**	**PSO J167.4407-12.6161**
RA	167.41442	167.44073
DEC	-12.58570	-12.61610
g	$\sim 19-21$	17.134 ± 0.004
r	$\sim 19-21$	16.794 ± 0.003
i	$\sim 19-21$	16.662 ± 0.003
z	$\sim 19-21$	16.642 ± 0.004

Table 2: Kontynuacja Tabeli 1 1

Type Obj	Support Target	Support Target
Obj. Name	**PSO J167.3848-12.6141**	**PSO J167.3803-12.6142**
RA	167.38478	167.38029
DEC	-12.61407	-12.61423
g	18.594 ± 0.011	18.243 ± 0.008
r	18.056 ± 0.008	17.886 ± 0.004
i	17.832 ± 0.006	17.759 ± 0.004
z	17.770 ± 0.015	17.779 ± 0.005

Table 3: SNRs for each filter for several magAB and dark(D)/gray(G) sky options. Results of exposure time calculator for CFHT/MegaCam instrument, assuming the following conditions: point source, exposure time of 75 s, aperture photometry, optimal aperture, airmass of 1.2, transparency of 1.0, seeing of 1.5″.

filter	$magAB = 19$		$magAB = 20$		$magAB = 21$	
	SNR_G	SNR_D	SNR_G	SNR_D	SNR_G	SNR_D
g	215.02	248.43	102.63	125.64	45.38	58.48
r	166.33	182.99	77.09	87.48	33.33	38.73
i	97.16	97.16	42.05	42.05	17.41	17.41
z	35.32	35.32	14.54	14.54	5.87	5.87