**European Organisation for Astronomical Research in the Southern Hemisphere**

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# APPLICATION FOR OBSERVING TIME

PERIOD: **95A**

## Important Notice:

By submitting this proposal, the PI takes full responsibility for the content of the proposal, in particular with regard to the names of CoIs and the agreement to act according to the ESO policy and regulations, should observing time be granted.

## 1. Title

Category: **X–0**

Very late time Near Infrared observations of Type Ia Supernovae

## 2. Abstract / Total Time Requested

### Total Amount of Time:

The luminosity of Type Ia supernova is powered by the radioactive decay of $^{56}$Ni and its daughter nuclei. At very late epochs, escape of $\gamma$ rays implies that the total energy is dominated by the positron decay channel. Thus, the very late time light curve allows us to place constraints on the amount of positron trapping and hence, the nature of the weak magnetic field at late times. Due to the faintness of the explosion, there have been very few observations of SNIa at such late epochs. We aim to observe nearby objects at close to 2 years after explosion to obtain the late time pseudo-bolometric light curves

## 3. Run

| Run | Period | Instrument | Time | Month | Moon | Seeing | Sky | Mode | Type |
|---|---|---|---|---|---|---|---|---|---|
| A | 95 | FORS2 | 4h | may | n | 0.8 | PHO | s | |
| A/alt | 95 | FORS2 | 3n=2x1+2H2 | may | n | 0.8 | PHO | v | |
| B | 95 | VIMOS | 2n=2x1 | jun | n | 0.6 | CLR | v | |
| C | 95 | EFOSC2 | 3n | aug | n | 0.8 | THN | v | |
| D | 95 | NACO | 0.4n | may | n | 0.8 | THN | v | |
| E | 95 | VIMOS | 1h | apr | n | 1.4 | THN | s | |
| F | 95 | VIMOS | 1h | apr | n | n | THN | s | |

## 4. Number of nights/hours

| | Telescope(s) | Amount of time |
|---|---|---|
| a) already awarded to this project: | NTT | 4n in 93.B-1234 |
| b) still required to complete this project: | UT2 | 20h |

## 5. Special remarks:

This macro is optional and can be commented out.

## 6. Principal Investigator: JSMITH999

## 6a. Co-investigators:

| | | |
|---|---|---|
| L. | Maçon | 1098 |
| R. | Menéndez | 1098 |
| S. | Bailer-Brown | 1154 |
| K.L. | Giorgi | 1339 |

*Following CoIs moved to the end of the document ...*

7. Description of the proposed programme

A – Scientific Rationale: Type Ia supernovae have been normalized to be used as distance indicators

B – Immediate Objective: The immediate objective of the proposal is to obtain multi-band observations of SNIa at close to 2 years after maximum light. Using these multi-band observations, we would construct a pseudo-bolometric light curve. Comparing the decline rate to the energy deposition from $^{56}$Co allows us to determine the amount of positron escape and hence place constrains on the nature of the weak magnetic field and the structure of the ejecta.

7. Description of the proposed programme and attachments

Fig. 1: A caption for your figure can be inserted here.

References can also be included using MakeCaption. For example:
References:

8. Justification of requested observing time and observing conditions

Lunar Phase Justification: For our objects, we require observations during the new moon phase.

Time Justification: (including seeing overhead) Provide a careful justification of the requested number of nights or hours for each observing run here. ESO Exposure Time Calculators exist for all Paranal and La Silla instruments and are available at the following web address:
http://www.eso.org/observing/etc .
Links to exposure time calculators for APEX instrumentation can be found in Section 7 of the Call for Proposals.

8a. Telescope Justification:

Observations of SNIa at late epochs ($> +200$ days) require 8-m class telescopes since they are very faint in the NIR and the optical. Hence, we have requested for observations on FORS2 and HAWK-I

8b. Observing Mode Justification (visitor or service):

Justification for the observing mode requested (visitor or service).

8c. Calibration Request:

Standard Calibration

9. Report on the use of ESO facilities during the last 2 years

9a. ESO Archive - Are the data requested by this proposal in the ESO Archive (http://archive.eso.org)? If so, explain the need for new data.

No, the requested data in

9b. GTO/Public Survey Duplications:

Specify whether there is any duplication of targets/regions covered by ongoing GTO and/or Public Survey programmes. If so, please explain the need for the new data here. Details on the protected target/fields in these ongoing programmes can be found at:
GTO programmes: http://www.eso.org/sci/observing/teles-alloc/gto.html
Public Survey programmes: http://www.eso.org/sci/observing/PublicSurveys/sciencePublicSurveys.html
This macro is optional and can be commented out.

10. Applicant's publications related to the subject of this application during the last 2 years

s s s s s

11. List of targets proposed in this programme

| Run | Target/Field | $\alpha$(J2000) | $\delta$(J2000) | ToT | Mag. | Diam. | Additional info | Reference star |
|---|---|---|---|---|---|---|---|---|
| A | NGC 5139 | 13 26.8 | -47 29 | 5.0 | 6.12 | 1 deg | Omega Cen | |

Target Notes: A note about the targets and/or strategy of selecting the targets during the run. For APEX runs please remember to specify the PWV limits for each target under 'Additional info' in the table above.

## 12. Scheduling requirements

This proposal involves time-critical observations, or observations to be performed at specific time intervals.

**1. Run Splitting**

| Run | splitting |
|---|---|
| B | 1,10s,1 |
| C | 2,10s,2,20w,2,15s,4H2 |

**2. Link for coordinated observation**

| Run 1 | | Run 2 | delay |
|---|---|---|---|
| B | after | A | 10 |
| C | after | B | |
| E | simultaneous | F | |

**3. Unsuitable period(s) of time**

| Run | from | to | reason |
|---|---|---|---|
| A | 15-jul-15 | 18-jul-15 | Insert explanation of unsuitable time here. |
| B | 15-jul-15 | 18-jul-15 | Insert explanation of unsuitable time here. |
| C | 20-jul-15 | 23-jul-15 | Insert explanation of unsuitable time here. |

## 12. Scheduling requirements contd...

**4. Specific date(s) for time critical observations:**

| Run | from | to | reason |
|---|---|---|---|
| A | 12-may-15 | 14-may-15 | Insert reason for time-critical observations. |
| D | 1-may-15 | 2-may-15 | Insert reason for time-critical observations. |
| D | 17-may-15 | 18-may-15 | Insert reason for time-critical observations. |
| D | 23-may-15 | 24-may-15 | Insert reason for time-critical observations. |

13. Instrument configuration

| Period | Instrument | Run ID | Parameter | Value or list |
|---|---|---|---|---|
| 95 | FORS2 | A | Detector | MIT |
| 95 | FORS2 | A | IMG | ESO filters: provide list HERE |
| 95 | VIMOS | B | IFU 0.33"/fibre | LR-Blue |
| 95 | EFOSC2 | C | Imaging-filters | EFOSC2 filters: provide list here |
| 95 | NACO | D | IMG 54 mas/px VIS-WFS | provide list of filters HERE |
| 95 | VIMOS | E | IFU 0.33"/fibre | LR-Blue |
| 95 | VIMOS | F | IFU 0.33"/fibre | LR-Blue |

6b. Co-investigators:

*...continued from Box 6a.*

| | | |
|---|---|---|
| S. | Lichtman | 1377 |