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: **D–5**

MUSE observations of Type Ia supernova environments: constraining progenitor properties, and refining distance calibration techniques

2. Abstract / Total Time Requested

Total Amount of Time:

SNe Ia are used as accurate cosmological distance indicators which has led to the discovery of the accelerated expansion of the Universe. However, the nature of their progenitors is still unclear. Constraining progenitors is important to both understand SNe Ia, but also to evaluate systematic effects which may limit the accuracy of SN Ia to distinguish cosmologies. SN Ia properties correlate with global host galaxy characteristics such as Hubble type and mass, giving hints to progenitor diversity. Only recently have studies started to investigate the properties of the environments of SNe Ia *within* hosts where one can obtain more detailed information on parent stellar populations. Here we propose to further these studies using MUSE observations in order to 1) constrain SN Ia progenitor systems, 2) further refine distance calibration techniques. The large field of view and IFU capabilities of MUSE allows such detailed environment studies for the first time.

3.

Run	Period	Instrument	Time	Month	Moon	Seeing	Sky	Mode	Type
A	95	MUSE	99h	any	n	n	THN	s	

4.

Number of nights/hours	Telescope(s)	Amount of time
a) already awarded to this project:		
b) still required to complete this project:		

5. Special remarks:

This project is proposed as a ‘filler’ program, with the understanding that only part of the observations may be completed. Targets are across the full RA and DEC range, and are observable in THN and bad seeing conditions. We also note two separate proposals which have some overlapping co-Is. MUSE proposals will be submitted investigating core-collapse SN hosts (P.I. Kuncarayakti), and specifically type ‘Iax’ SN hosts (P.I. Lyman). Those require much better conditions than for the current proposal, as they are looking at smaller samples and wish to resolve individual stellar clusters to get more accurate progenitor constraints.

6. Principal Investigator: janderso

6a. Co-investigators:

L.	Galbany	1822
H.	Kuncarayakti	1822
S.	Sanchez	1774
T.	Kruehler	1261

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

7. Description of the proposed programme

A – Scientific Rationale: Studies of the host galaxies of supernovae (SNe), can provide constraints on their progenitor properties, and help us understand specific transient features in relation to their environment. Type Ia SNe (SNe Ia) are found to explode in both early and late type galaxies, and their presence in the former constrains (at least a fraction of) their progenitors to be evolved systems. However, the exact range of ages from which progenitors explode, the delay time distribution, is not well constrained. Neither is its relation to progenitor metallicity. Indeed, a strong debate exists as to whether SNe Ia arise from accretion onto a single white dwarf (WD) star, or from the coalescence of two WDs. These questions are particularly pertinent given the use of SNe Ia in many other areas of astrophysics. Their use as primary high redshift distance indicators led to the discovery of the accelerated expansion of the Universe, while SNe Ia are the main iron producers in the Universe, hence driving chemical evolution of galaxies. The continued use of SNe Ia in these distinct fields demands a more precise understanding of their progenitors and explosions mechanisms.
Light-curve correlations are used to calibrate SNe Ia as distance indicators. Luminous, slower declining SNe are more often found in star-forming galaxies (where the rate per unit mass is also higher than in ellipticals) hinting at a progenitor trait driving diversity (e.g. Hamuy et al. 2000). These results may be related to progenitor age and/or metallicity, both of which are parameters of the Universe which evolve with redshift (and hence at distinct redshifts we observe distinct populations of SNe). Hubble diagrams are formed once correlations between SN absolute magnitude and light-curve morphology/SN colour have been applied. Residuals that exists on such diagrams (assuming some cosmology) also correlate with host galaxy properties (see e.g. Sullivan et al. 2010), and hence understanding these correlations is of utmost importance. Host investigations have concentrated on global galaxy properties. However, within spiral galaxies many distinct stellar populations exist. Hence, one may expect to further constrain SNe Ia by studying more immediate environments within which they are found. In Anderson et al. (in prep.) we present a study of the environments of SNe Ia in star-forming galaxies. It is found that SNe Ia best follow the B-band light of their hosts, and 'redder' SNe occur both closer to star-forming regions/within more central environs (see Fig. 1). This follows other work (e.g. Rigault et al. 2013), where environments are also observed to correlate with SNe Ia properties, including Hubble residuals. However, the conclusions from these works are complicated and unclear. This is due to the types of host observations (generally photometry, or analysis of single emission lines) and the number of objects observed (Stanishev et al. 2012). The installation of MUSE at the VLT promises to rapidly change this picture. MUSE provides multi-colour, multi-spectral line analysis over the full spatial extent of SNe Ia hosts in an efficient manner, enabling simultaneous analysis of e.g. stellar population age, metallicity, and line of sight extinction properties.

B – Immediate Objective: We propose to obtain MUSE observations of a large database (99) of SN Ia host galaxies, where we already have detailed photometric and spectroscopic data on the SNe themselves through the Carnegie Supernova Project (CSP, P.I. Mark Phillips). This will allow an unprecedented study of how SN Ia are linked to the environment in which they explode. MUSE observations will provide both global host galaxy properties in addition to spectral information on the immediate environments of SNe. The power of an IFU instrument will allow us to analyse parent stellar populations in a manner that has not been previously possible. While previous studies have either estimated properties such as metallicity at specific SN locations or integrated over full galaxies, our proposed observations will allow a statistical analysis of where within the distribution of e.g. spaxel metallicities each SN lies. In the case of metallicity this will constrain whether there is a metallicity floor, below which nature does not produce these explosions (as predicted by Kobayashi et al. 1998). Extinction towards SNe Ia in the line of sight and its relation to intrinsic SN colour is also a key issue in SN Ia research (see discussion in e.g. Phillips et al. 2013). Host extinction maps will be produced using MUSE data, and comparing this to SN colour and spectral absorption features will be extremely revealing in determining the true source of SN colour diversity. The above are just two examples of the type of analysis possible with these data. Many more avenues of research will be possible to further elucidate the SN Ia progenitor problem. The immediate goals of this proposal are:
1) Obtain the largest SN Ia host galaxy Integral Field Spectroscopy (IFS) database yet produced.
2) Use the power of high spatial resolution IFS to produce host galaxy maps of: age (through both stellar population modeling and equivalent width measurements), metallicity (through emission line ratios, population modeling, and absorption line ratios when the S/N allows), and extinction (from Balmer decrements and sodium absorption).
3) Compare environmental information to light-curve and spectral properties, to constrain progenitor diversity, and use correlations to further refine SN Ia distance calibration techniques.
These data are also extremely useful for studies of galaxy dynamics, stellar populations, and chemical evolution. Our team is comprised of world leaders in the fields of SN environments, SN Ia follow-up and cosmology, and galaxy IFS studies, meaning that data reduction, analysis and subsequent publications will be achieved in a timely manner, in several distinct fields. Indeed, we recently obtained MUSE SV data (P.I. L. Galbany), and in Sanchez et al. (submitted, see Fig. 2) we present one of the largest ever catalogues of H II regions obtained for a single galaxy. We are also preparing a paper on environments of the four SNe which occurred within that galaxy, where the analysis techniques will serve as a pilot study to the current statistical sample.

7. Description of the proposed programme and attachments

Description of the proposed programme (continued)

With this proposal we will obtain MUSE observations of 99 SN Ia host galaxies. The target list is formed from SNe which have been followed photometrically and spectroscopically by the CSP, from which we extract standard SN Ia parameters: light-curve morphology, colour, and spectral velocities. From the CSP we select hosts which fall within the field of view (FOV) of MUSE in order to analyse their full spatial extent. This has the added bonus that it restricts the majority of our sample to be in the Hubble flow, where one can perform Hubble residual studies, and further constrain effects on SN Ia calibration techniques. Our sample is also restricted to star-forming hosts, to enable consistent analysis of properties derived from emission line measurements.
Above we outlined our main goals and the possibilities now available through such studies enabled with MUSE. However, this is merely the tip of the iceberg. MUSE opens the era of 'big data' in spectroscopic terms, and these data will breed many new avenues for research in the field of SN environments and beyond.

References: Hamuy, M., et al., 2000, AJ, 120, 1479; Sullivan, M., et al., 2010, MNRAS, 406, 782; Rigault, M., et al., 2013, A&A, 560, 66; Stanishev, v., et al., 2012, A&A, 545, 58; Kobayashi, C., et al., 1998, ApJ, 503, 155; Phillips, M., et al., 2013, ApJ, 779, 38; Galbany, L., et al., 2014, A&A accepted, arXiv 1409.1623

Attachments (Figures)

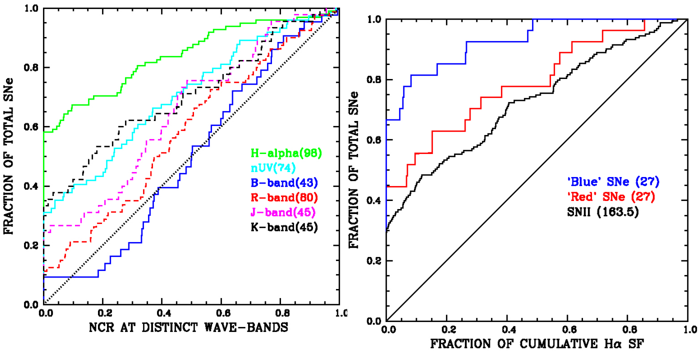

Fig. 1: **Left:** multi-colour SN Ia host galaxy pixel statistics presenting cumulative distributions of the association of SNe Ia to their host light as traced by different filters. The SN Ia population best traces the B-band light hinting at a relatively young age dominating the progenitor population. **Right:** pixel statistics of SN Ia with respect to Hα emission showing that 'redder' SNe more often occur close to star-forming regions. ***It is important to note here is that these results were obtained through many hrs of telescope time using specific photometric filters. Proposed MUSE observations will simultaneously obtain all of this environment information (and much more) in a very efficient manner.***

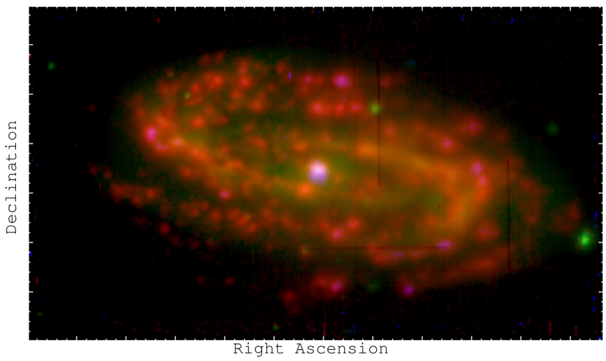

Fig. 2: Example of MUSE Science Verification data of the galaxy NGC 6754. This is an RGB color image of NGC 6754 created using line intensity maps of [O III] Å5007 (blue), V -band (green) and Hα (red) extracted from datacubes (Sanchez et al. submitted). From these data ~400 H II regions were extracted: a much larger number possible than through any previous IFS, enabling constraints on the mixing scale length and hence constraints on metal mixing within galaxies.

8. Justification of requested observing time and observing conditions

Lunar Phase Justification: Our targets can be observed in any lunar phase.

Time Justification: (including seeing overhead) Our proposed MUSE observations aim to detect and measure the strength of H II region emission lines throughout target galaxies (galaxy continuum will be used for comparison to stellar population modeling, but this is of secondary importance). However, before execution the brightness of H II regions within these galaxies is unknown. Therefore, to estimate exposure times we assume a typical r-band surface brightness of 21 mag per arcsec^2 for faint HII regions (taken from James et al. 2004). We then use the MUSE ETC with the following parameters to estimate our required exposure times. Given that many of our targets will almost fill the MUSE FOV, we assume an 'Infinitely extended source'. The HII region template is used (at a redshift of 0.05) together with an r-band surface brightness of 21 mag per arcsec^2 (see above). As our proposal is submitted as a bad weather 'filler' we set conditions to: 7 days from new moon; airmass 1.4; seeing 1.5$''$. With a set of 3×800 second exposures the ETC gives a S/N of $\sim$7 *in the continuum*, which translates (from the figure provided by the ETC) to a S/N of more than 100 for all the emission lines we wish to detect (e.g. Hα, [NII], [O III], Hβ). (Note, in many galaxy regions we envisage that we will obtain much higher S/N in the continuum, and this will allow more detailed analysis modelling stellar populations, and using absorption line indices as an indicator of stellar metallicities in the place of gas phase values.) Together with a 600 second sky exposure, plus overheads this equates to around 1 hr per galaxy. Hence, in total we require 99 hrs to observe our sample of 99 host galaxies. *We recall that this is a 'filler' proposal, where any amount of data obtained will be beneficial to our project.*

As noted previously, we have recently obtained MUSE SV time, where we observed the galaxy NGC 6754 within which four SNe had been discovered. These data were obtained with very similar conditions/observing strategy as that outlined above, and show that with those exposure times we can measure our desired parameters. Therefore, we are very confident that we will achieve all science goals with the proposed data.

Within our team are world experts on the reduction, analysis and interpretation of IFS galaxy observations (Co-Is: Sánchez, Falcón, Perez, Galbany, lead much of the analysis from the extremely successful CALIFA program: the state of the art before the advent of MUSE). Indeed, Galbany et al. (2014) presented a CALIFA IFS study of SN environments, concentrating on star-forming regions. However, that sample lacked SNe with complementary follow-up data (unlike the current sample), and hence separating SNe by transient features becomes more difficult. In addition, co-I Kruehler is the MUSE instrument fellow. Hence, while IFS data and their analysis can sometimes prove somewhat daunting, our team provides all the required knowledge to fully exploit the gold mine of data provided by MUSE.

8a. Telescope Justification:

MUSE at the VLT is the only currently available instrument that enables a FOV of sufficient size to cover the majority of our targets, while at the same time having high spatial resolution, and being extremely efficient, hence enabling targets to be observed in a relatively small amount of time.

We stress here that even in relatively bad seeing conditions (in which the data will sometimes be observed, given the 'filler' nature of our proposal) we will still have the potential to unravel kinematic and populations substructure in these galaxies over a large FoV. Indeed, even in bad seeing conditions these data will still be in a better position to probe SN environments and galaxy characteristics than any current or past IFU survey (SAURON, ATLAS3D, CALIFA, SAMI, MaNGA).

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

Targets are observable throughout the semester, and as this is a 'filler' program, service mode is required.

8c. Calibration Request:

Standard Calibration

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

091.D-0482: 11h SM SINFONI; program carried over, data reduced and analysis underway, paper in preparation (PI: Anderson);
093.D-0318: 3n VM SINFONI/VIMOS; Data obtained, paper in preparation (PI: Kuncarayakti);
292.D-5042: 3h SM FORS2; Data obtained, paper in preparation (P.I. Anderson);
094.D-0358: 2.2h SM FORS2; Data not yet acquired (P.I. Bufano);
094.D-0283: 47h SM FORS2; Data not yet acquired (P.I. Anderson)
094.D-0290: 2n VM VIMOS, 7.5hrs SM SINFONI; Data not yet acquired (P.I. Kuncarayakti);
60.A-9344: 2hr SV MUSE; data reduced and analysis underway (P.I. Kuncarayakti);
60.A.9329: 2hr SV MUSE; data reduced, 1 paper submitted (P.I. Galbany)

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.

Are the data requested in this proposal in the ESO Archive (http://archive.eso.org)? No.

9b. GTO/Public Survey Duplications:

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

Anderson J.P., et al. 2014, ApJ, 786, 67: Characterizing the V-band Light-curves of Hydrogen-rich Type II Supernovae

Anderson J.P., et al. 2014, MNRAS, 441, 671: Analysis of blueshifted emission peaks in Type II supernovae

Anderson J.P. & Soto M., 2013, A&A, 550, 69: On the multiplicity of supernovae within host galaxies

González-Gaitán, S., et al., 2014, ApJ accepted, arXiv 1409.4811: Defining Photometric Peculiar Type Ia Supernovae

Sánchez, S., et al., 2014, A&A, 563, 49: A characteristic oxygen abundance gradient in galaxy disks unveiled with CALIFA

Phillips, M., et al., 2013, ApJ, 779, 38: On the Source of the Dust Extinction in Type Ia Supernovae and the Discovery of Anomalously Strong Na I Absorption

Stritzinger, M., et al., 2014, A&A, 561, 146: Optical and near-IR observations of the faint and fast 2008ha-like supernova 2010ae

Galbany, L., et al., 2014, A&A, accepted, arXiv 1409.1623: Nearby supernova host galaxies from the CALIFA Survey: I. Sample, data analysis, and correlation to star-forming regions

Kuncarayakti, H., et al., 2013, AJ, 146, 31: Integral Field Spectroscopy of Supernova Explosion Sites: Constraining the Mass and Metallicity of the Progenitors. II. Type II-P and II-L Supernovae

Kuncarayakti, H., et al., 2013, AJ, 146, 30: Integral Field Spectroscopy of Supernova Explosion Sites: Constraining the Mass and Metallicity of the Progenitors. I. Type Ib and Ic Supernovae

Hsiao, E., et al., 2013, ApJ, 766, 72: The Earliest Near-infrared Time-series Spectroscopy of a Type Ia Supernova

Förster, F., et al., 2013, ApJ, 772, 19: On the Lira Law and the Nature of Extinction toward Type Ia Supernovae

11. List of targets proposed in this programme

Run	Target/Field	α(J2000)	δ(J2000)	ToT	Mag.	Diam.	Additional info	Reference star
A	SN2004ef	22 42 11.0	+19 59 49	1			UGC12158	
A	SN2004ey	21 49 07.0	+00 26 50	1			UGC11816	
A	SN2004gs	08 38 24.0	+17 37 53	1			M+03-22-20	
A	SN2005ag	14 56 43.0	+09 19 42	1			anon	
A	SN2005be	14 59 32.0	+16 40 11	1			anon	
A	SN2005bg	12 17 17.0	+16 22 18	1			M+03-31-93	
A	SN2005gj	03 01 11.0	-00 33 13	1			anon	
A	SN2005hc	01 56 48.0	-00 12 45	1			M+00-06-03	
A	SN2005hj	01 26 48.0	-01 14 16	1			anon	
A	SN2005ir	01 16 43.0	+00 47 40	1			anon	
A	SN2005ku	22 59 42.0	-00 00 49	1			anon	
A	SN2005lu	02 36 04.0	-17 15 50	1			M-03-07-40	
A	SN2005M	09 37 33.0	+23 12 11	1			NGC2930	
A	SN2005na	07 01 37.0	+14 08 11	1			UGC3634	
A	SN2006br	13 30 02.0	+13 24 59	1			NGC5185	
A	SN2006bt	15 56 34.0	+20 03 08	1			M+03-41-04	
A	SN2006D	12 52 35.0	-09 46 34	1			M-01-33-34	
A	SN2006ef	02 04 19.0	-08 44 08	1			NGC809	
A	SN2006ej	00 39 00.0	-09 00 52	1			NGC191A	
A	SN2006eq	21 28 37.0	+01 13 41	1			anon	
A	SN2006et	00 42 45.0	-23 33 40	1			NGC232	
A	SN2006fw	01 47 10.0	-00 08 49	1			anon	
A	SN2006gt	00 56 18.0	-01 37 33	1			anon	
A	SN2006hx	01 13 57.0	+00 22 18	1			anon	
A	SN2006is	05 17 34.0	-23 46 54	1			anon	
A	SN2006lu	09 15 17.0	-25 36 00	1			anon	
A	SN2006ob	01 51 48.0	+00 15 50	1			UGC1333	
A	SN2006os	02 55 01.0	+16 00 44	1			UGC2384	
A	SN2006ot	02 15 05.0	-20 46 04	1			E544-G31	
A	SN2006py	22 41 42.0	-00 08 12	1			anon	
A	SN2007al	09 59 19.0	-19 28 23	1			anon	
A	SN2007as	09 27 42.0	-80 10 46	1			E018-G18	
A	SN2007ba	15 16 42.0	+07 23 49	1			UGC9798	
A	SN2007bc	11 19 17.0	+20 48 48	1			UGC6332	
A	SN2007cg	13 25 34.0	-24 39 08	1			E508-G75	

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Target Notes: All targets above are SN Ia host galaxies where the spatial extent of each galaxy fits within the MUSE FOV. The SN name is given in the first column, followed by the RA and Dec of its host galaxy. When available the galaxy name is also listed.

12. Scheduling requirements

13. Instrument configuration

Period	Instrument	Run ID	Parameter	Value or list
95	MUSE	A	WFM-NOAO-E	-

6b. Co-investigators:

…continued from Box 6a.

S.	Gonzalez-Gaitan	1822
E.	Hsaio	1909
M.	Stritzinger	1909
F.	Förster	5667
P.	James	1134
M.	Hamuy	1822
M.	Phillips	1086
J.	Falcón-Barroso	1393
E.	Perez	1392
E.	Aquino	1261
J.L.	Prieto	9147
C.	Ashall	1134

11a. List of targets proposed in this programme

Run	Target/Field	α(J2000)	δ(J2000)	ToT	Mag.	Diam.	Additional info	Reference star
	...continued from box 11.							
A	SN2007hj	23 01 48.0	+15 35 01	1			NGC7461	
A	SN2007hx	02 06 27.0	-00 53 58	1			anon	
A	SN2007mm	01 05 46.0	-00 45 31	1			anon	
A	SN2007ol	01 37 23.0	-00 18 43	1			anon	
A	SN2007S	10 00 31.0	+04 24 25	1			UGC5378	
A	SN2007so	02 47 44.0	+13 15 19	1			NGC1109	
A	SN2007ux	10 09 19.0	+14 59 32	1			anon	
A	SN2008ae	09 56 03.0	+10 29 54	1			IC577	
A	SN2008ar	12 24 38.0	+10 50 21	1			IC3284	
A	SN2008bc	09 38 31.0	-63 58 25	1			anon	
A	SN2008C	06 57 12.0	+20 26 15	1			UGC3611	
A	SN2008cf	14 07 32.0	-26 33 06	1			anon	
A	SN2008ff	20 13 56.0	-44 21 05	1			E284-G32	
A	SN2008go	22 10 44.0	-20 47 17	1			anon	
A	SN2008hj	00 04 01.0	-11 10 27	1			M-02-01-14	
A	SN2009aa	11 23 41.0	-22 16 14	1			E570-G20	
A	SN2009ad	05 03 33.0	+06 39 26	1			UGC3236	
A	SN2009D	03 54 25.0	-19 11 25	1			M-03-10-52	
A	SN2009I	02 45 10.0	-04 42 39	1			NGC1080	
A	SN2014cd	04 23 47.0	-51 35 58	1			NGC1578	
A	CSP14abn	13 56 04.0	-43 35 09	1			anon	
A	PS1-14rx	12 46 53.0	+14 47 50	1			anon	
A	LSQ14bjj	14 20 49.0	-05 15 02	1			anon	
A	LSQ14bbv	19 59 33.0	-56 59 27	1			anon	
A	SN2014at	21 46 15.0	-46 31 07	1			NGC7119B	
A	LSQ14ahc	13 43 48.0	-32 54 35	1			anon	
A	CSP14aar	05 48 23.0	-66 47 30	1			anon	
A	CSP14aaq	06 13 48.0	-67 55 15	1			anon	
A	LSQ14ie	12 55 33.0	-32 56 40	1			anon	
A	LSQ13dsm	03 33 13.0	-26 12 24	1			anon	
A	CSP13abl	06 38 07.0	-75 43 37	1			anon	
A	LSQ13dkp	03 10 10.0	-36 37 45	1			anon	
A	LSQ13dhj	02 12 34.0	-37 20 23	1			anon	
A	CSP13aaq	04 19 47.0	-63 43 22	1			anon	
A	CSP13aao	05 58 30.0	-63 33 38	1			anon	
A	LSQ13dcy	04 55 16.0	-20 00 05	1			anon	
A	CSP13aam	05 14 48.0	-66 50 29	1			anon	
A	CSP13aad	01 46 09.0	-67 28 00	1			anon	
A	SN2013fy	21 37 28.0	-47 02 09	1			E287-G40	
A	SN2013bz	13 26 51.0	-10 01 32	1			anon	
A	SN2013az	05 39 53.0	-40 30 45	1			E306-G16	
A	SN2013as	11 52 52.0	-18 59 19	1			anon	
A	SN2013ao	11 44 44.0	-20 31 41	1			anon	
A	CSP13Q	02 02 22.0	-65 44 09	1			anon	
A	SN2013U	10 01 12.0	+00 19 46	1			CGCG008-023	
A	LSQ12hzs	04 01 53.0	-26 39 50	1			anon	
A	LSQ12hxx	03 19 44.0	-27 00 26	1			anon	
A	LSQ12hvj	11 07 39.0	-29 42 41	1			anon	
A	LSQ12hnx	02 35 18.0	-30 57 49	1			anon	
A	LSQ12gzm	02 40 43.0	-34 44 26	1			anon	

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11a. List of targets proposed in this programme

Run	Target/Field	α(J2000)	δ(J2000)	ToT	Mag.	Diam.	Additional info	Reference star
	…continued from previous page.							
A	CSP12J	06 07 02.0	-69 21 17	1			anon	
A	SN2012gm	23 17 37.0	+14 00 04	1			NGC7580	
A	LSQ12fxd	05 22 17.0	-25 36 27	1			ESO487-G004	
A	LSQ12fuk	04 58 16.0	-16 17 58	1			anon	
A	LSQ12cid	10 03 57.0	-06 14 38	1			anon	
A	LSQ12cfx	13 59 42.0	-25 22 43	1			ESO510-G034	
A	CSP12N	12 38 16.0	-15 06 32	1			anon	
A	LSQ12agq	10 17 42.0	-07 24 54	1			anon	
A	LSQ12aor	10 55 18.0	-14 18 01	1			anon	
A	LSQ12ca	05 31 04.0	-19 47 59	1			anon	
A	SN2012G	12 39 36.0	+16 35 16	1			anon	
A	SN2012E	02 33 23.0	+09 36 06	1			NGC975	
A	SN2011jt	14 53 23.0	+02 58 00	1			CGCG048-051	
A	LSQ11pn	05 16 41.0	+06 29 29	1			anon	