A sky survey competitive with space
The Kunlun Infrared Sky Survey (KISS2)

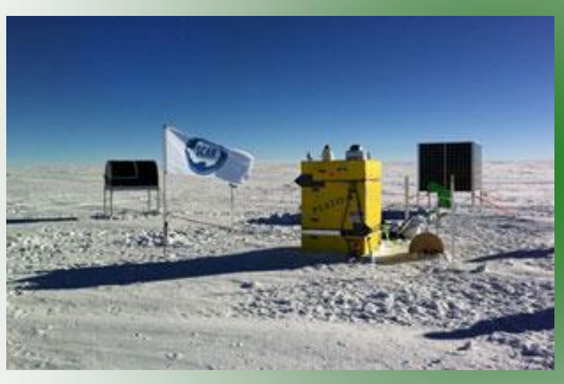
Summary

KISS2 is a southern hemisphere deep survey and an exploration of the time varying Universe in the IR. Located at the Chinese Kunlun Station at Dome A. The Southern sky is available for the duration of the Antarctic winter. KISS2 is a sky survey with KDUST, the Kunlun Dark Universe Survey Telescope. KISS2 is complementary to Euclid in that it is 2 microns and time sensitive. The Antarctic site provides a resolution better than our current high z supernova search, DECamERON, the Dark Energy Camera Epoch of ReiONization Survey.

KISS Partners: Swinburne University, Purple Mountain Observatory, Australian National University, University of NSW, Texas A&M University, Sydney University, Australian Astronomical Observatory, Caltech, Nanjing Institute of Astronomical Optics

China–Australia Collaboration

We have demonstrated Antarctic plateau = best site on Earth for infrared and submillimetre astronomical observations.
By establishing Kunlun Station (Dome A), our Chinese colleagues have provided an opportunity to exploit this scientifically.
NCRIS funds would allow us to build an infrared camera for KDUST.



2012: AAL signed MoU on Antarctic astronomy with
Division for Basic Research of Chinese Academy of Sciences.
2013: Australian Government signed an MoU with Chinese Academy of Sciences.
2013: Implementation plan agreed to progress scientific opportunities offered by: Chinese telescopes at Dome A + Complementary observations using Australian telescopes.

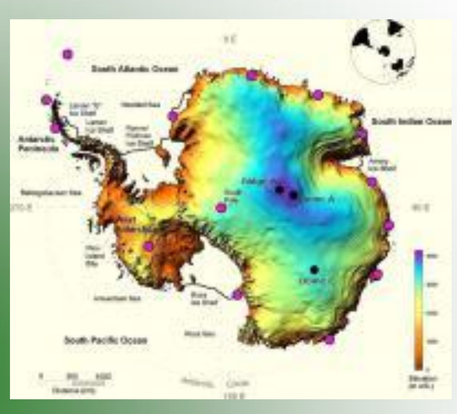
Antarctic Advantages

The Antarctic advantages are

- almost diffraction limited images
- wide field isoplanatism
- low 2 micron background (~100 x < temperate sites)

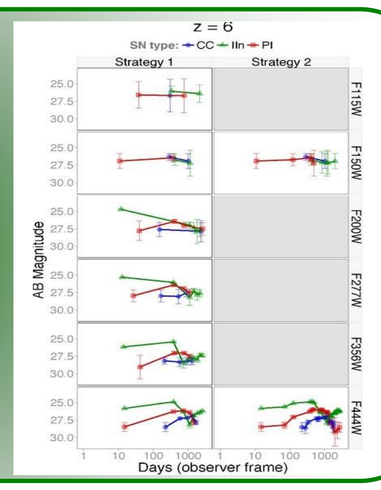
This combination is only available from the Antarctic plateau, high altitude balloons and space.

High photometric precision
High time cadence



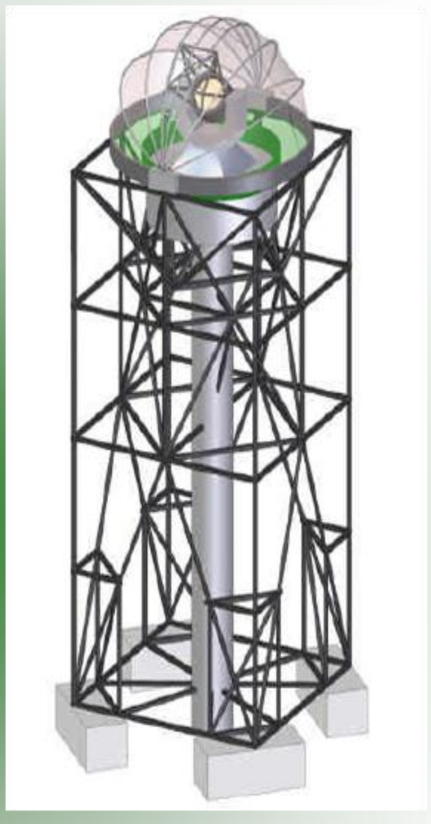
The Dark Ages

De Souza et al (MNRAS 442) show that ≈100 SNe , depending on the accuracy of the classification, are sufficient to discriminate between Salpeter and flat mass distribution for high-redshift stars with high confidence.



KDUST

KDUST is a proposed Chinese Academy of Sciences 2.5m telescope at Dome A (http://kdust.org).
This facility would have significant advantages over existing 2 micron survey telescopes, such as VISTA. A full science case for a very deep survey is under development and itemized below.



Infrared science case for KDUST

- Spatial variation galaxy LF at z = 6
- Weak lensing cosmology parameters
- IMF from 0.1 to 0.01 M_Θ
- Pair Instability SN at z > 4
- Kuiper belt census and properties
- Cool white dwarfs & the Milky Way
- Planetary transits
- Clusters of galaxies at z > 2
- Lyman alpha emitters at z > 9
- Formation of the first SMBH
- Formation globular clusters
- Y band dropouts at z = 10

DECamERON

Our current deep field is DECamERoN, the Dark Energy Camera Epoch of Reionization survey, which takes advantage of the high sensitivity of DECam at 1 micron.
DECamERoN's goal is AB = 25 mag in grizY with deeper cuts at gr over a 10 sq degree area. It is a complementary project to OzDES and SUDSS.
15000s in Y band on the 3 sq deg New Southern Field of SUDSS yielded the angular correlation function shown here.
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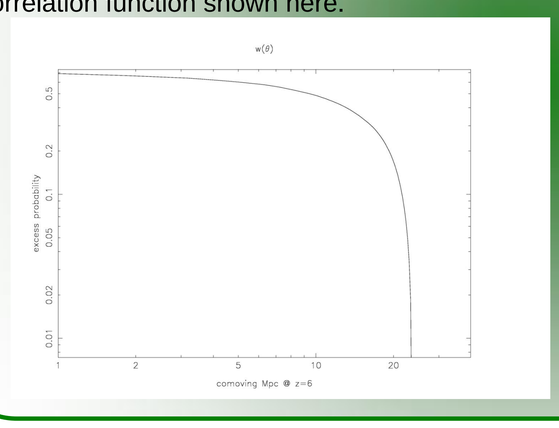

Objects with Y < 26 and
-1<z-Y<1 and i-z > 2

Prioritized science case for KISS2

	Priority	Field size	Comp--etitor	K limit	Method and comments	Vol Gpc^3	Dist	Speed ratio	Theme
Spatial variation galaxy LF at z = 6	B	>>HDF	VLT	25	HAWK-I has 7.5′ field			1	E
Weak lensing cosmology parameters	A	15000	Euclid		GPC				D
IMF from 0.1 to 0.01 $M_\odot$	B	10 fields	VLT		see WFIRST science case			1	G
Pair Instability SN at z > 4	B	100	VLT	26		3.7		1	T
Kuiper belt census and properties	C	20000	LSST/PS		GPC				T
Cool white dwarfs & the Milky Way	B	20 fields	VLT	27.5	see WFIRST science case		10*	1	G
Planetary transits	A		Kepler		low scintillation photometry				T
Clusters of galaxies at z > 2	A	100	SPT	26	followup redshifts helpful			2.3	E
Lyman alpha emitters at z > 9	?		VLT		narrowband				E
Formation of the first SMBH	C		JWST		AGN at z > 6				E
Formation globular clusters at z > 6	C		JWST		resolve galaxies at z > 6				E
Y band dropouts at z = 10	B	100	VLT	26	combine w PSNe survey	3.9		1	E

Speed ratio is D/p(B), assuming no fov difference, where D is telescope diameter and B is background.
GPC = Gigapixel CCD camera
"Theme" is evolving universe, dark universe, transient universe, galactic, see http://www.caastro.org
Anything VLT accessible is priority B, but should be reassessed if 100 sq deg is really required for 3 of the projects
Note that none of the present KDUST collaborators have ESO member VLT access
Field is in sq deg except where stated otherwise.
We assume the KDUST IR camera has a 8.5 arcmin field.
Volume refers to a one mag range in luminosity distance
The SDSS SN rate is 27000 SNe/yr/Gpc3 (Dilday et al 2010). Massive star SNe may be rarer than that by (m/10)−4 simply from IMF considerations.
Units in the distance column are kpc.
WFIRST science case: Green et al (2011) and Spergel et al (2013).

KISS2 Camera Design

The design is by Jon Lawrence of AAO.
The simplest option (plan A) for the focal plane uses Teledyne HgCdTe 2048 x 2048 chips.
ANU has delivered two 2x2 format cameras to Gemini Observatory (McGregor etal 2004,1999).
The KDUST focal plane scale is appropriate without change.
JHK and Kdark filters would be required.

Plan B is for a Sofradir SATURN SW HgCdTe SWIR or a Selex detector.
Sofradir detectors have 150 e- read noise, requiring long exposures to beat readout noise.
Nevertheless they are feasible Plan B detectors for broadband survey work.
Mosaicing many detectors is also acceptable for survey work, and, after focal plane mosaicing , plan A and plan B detectors are fairly similar in cost.

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PILOT PATHFINDER FOR AN INTERNATIONAL LARGE OPTICAL TELESCOPE
CAASTRO ARC CENTRE OF EXCELLENCE FOR ALL-SKY ASTROPHYSICS
SWINBURNE UNIVERSITY OF TECHNOLOGY