VST Science in Napoli

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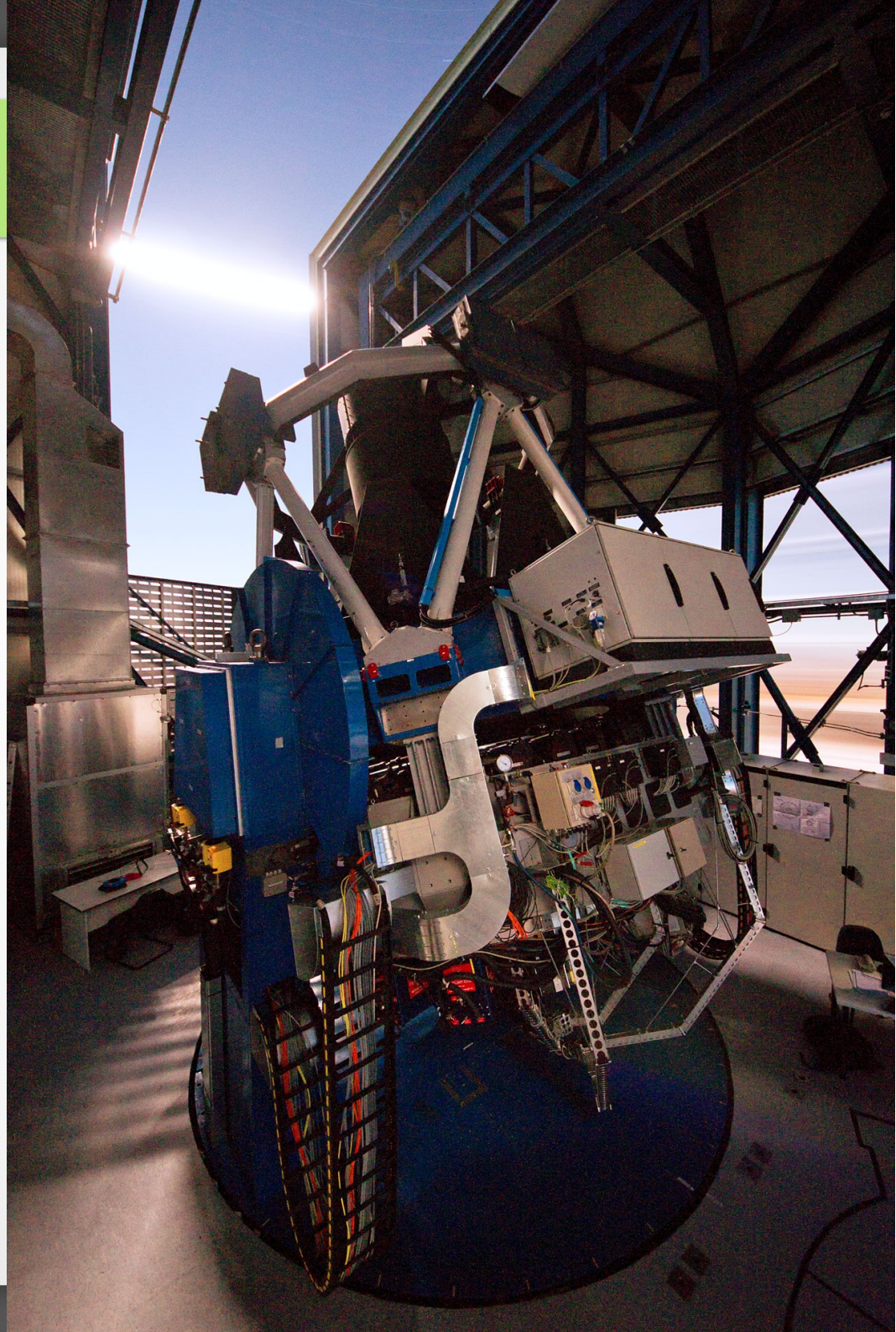
www.eso.org

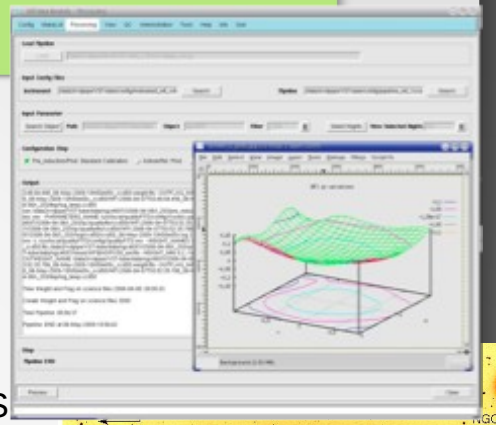
Outline

- Current GTO Projects in Naples
- KIDS "side" projects
- ATLAS and KIDS

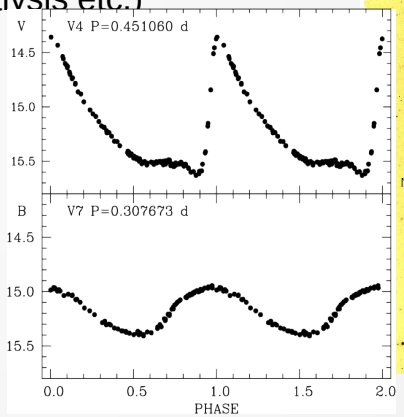


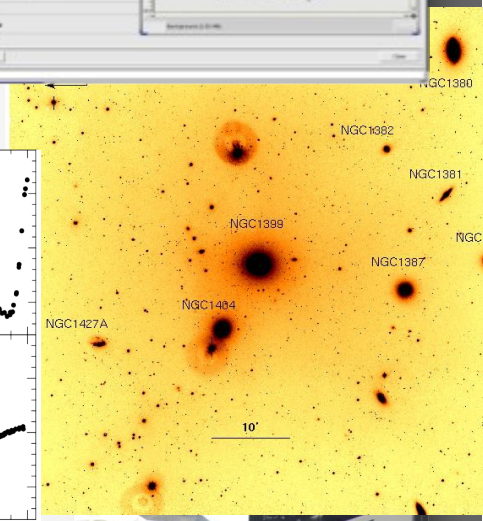
Our Pipeline

INAF-OACn: A. Grado, L. Limatola



VST-Tube highly flexible built “on house” packages coadded/calibrated images; Sextractor; PS analysis; built-in tools (masks, aperture and PSF phot (Zaggia), mag lim, SB analysis etc.)





- *From raw to fully calibrated images (multi-instrument support)*
- *Tailored on surveys needs*
- *GUI to facilitate processing and administration*
- *Includes a growing set of analysis tools*
- *Supported surveys: VEGAS, ACCESS, SUDARE, VOICE, STEP, STREGA, COSMOS (Chilean GTO)*

Beowulf cluster + Data Storage

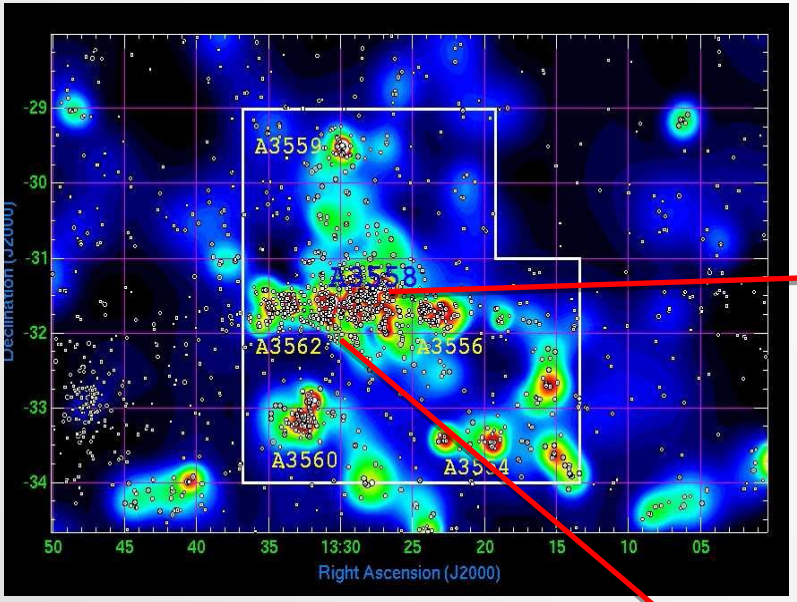
- over 100 cores for Wide Field Image processing and analysis
- 80 TB (very high availability-reliability from EMC2)

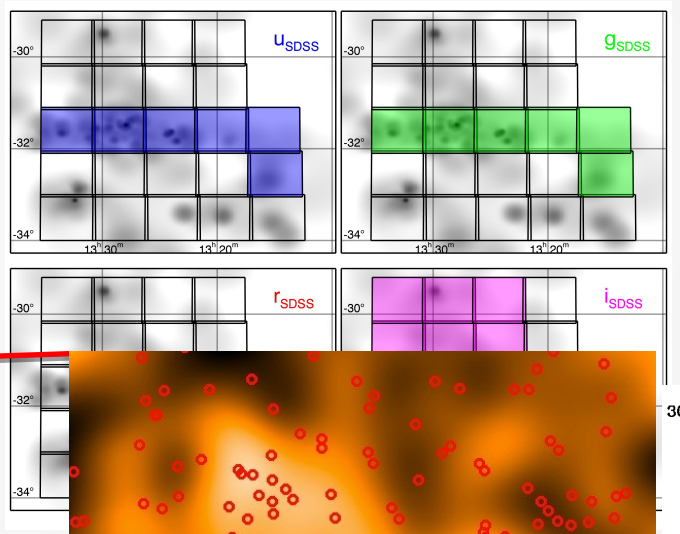
VST-ACCESS: Complete CEnsus of Star-formation in Shapley

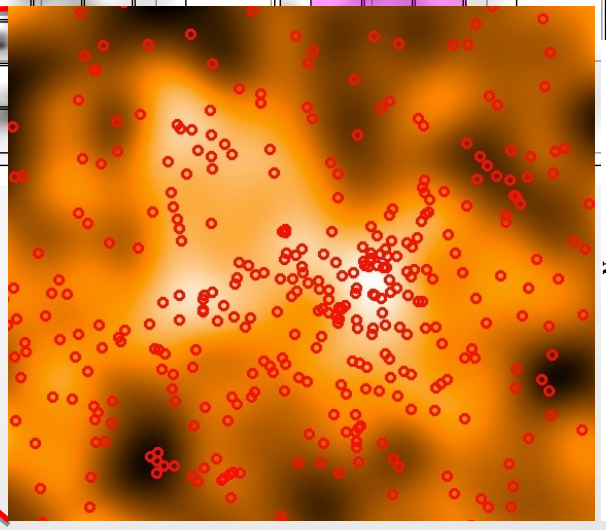
PI: P. Merluzzi

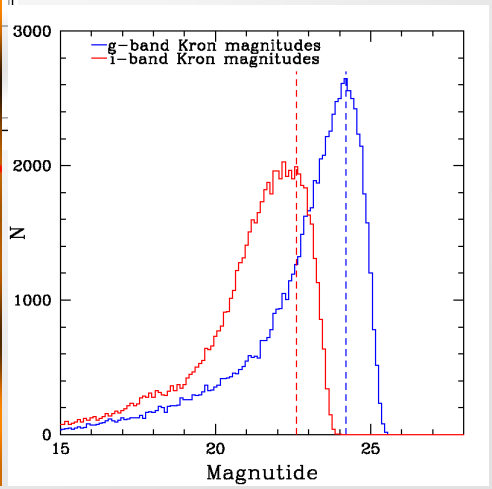
Science Aims

The VST survey complemented with spectroscopic data, NIR and MIR will constitute a unique data-set to investigate the relative importance of nature and nurture on galaxy evolution as a function of environment and galaxy mass, through:









FIRST WL MAP (A3558) with VST

(P. Merluzzi and N. Okabe, private communication)

STREGA@VST: STRucture and Evolution of the GAlaxy

PI: M. Marconi

Science Aims

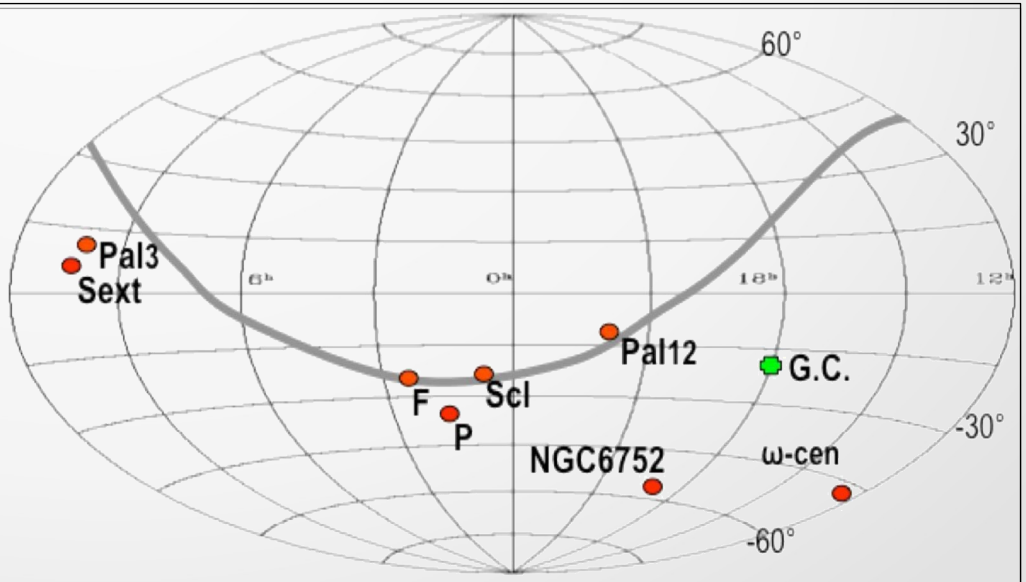
- To study the formation of the Galactic halo and the interaction of the Milky Way with the satellite systems
- To derive constraints on the formation history of Galactic globular clusters and on the nature of the satellite dwarf spheroidal galaxies.
- To characterize the properties of variable stars, White Dwarfs and Interacting Binaries as a function of the Galactic latitude.

i) tracing tidal tails and halos around stellar clusters and galaxies;

ii) mapping extended regions of the southern portion of Fornax orbit ;

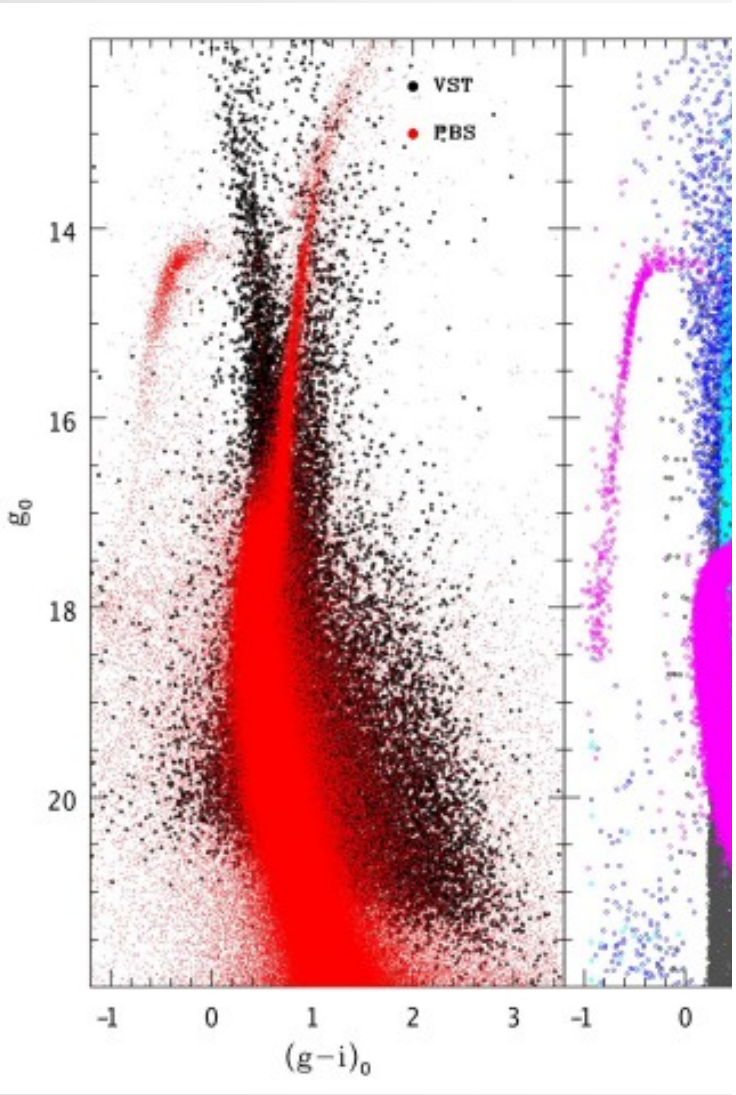
iii) searching for new very faint stellar systems successful SDSS experience

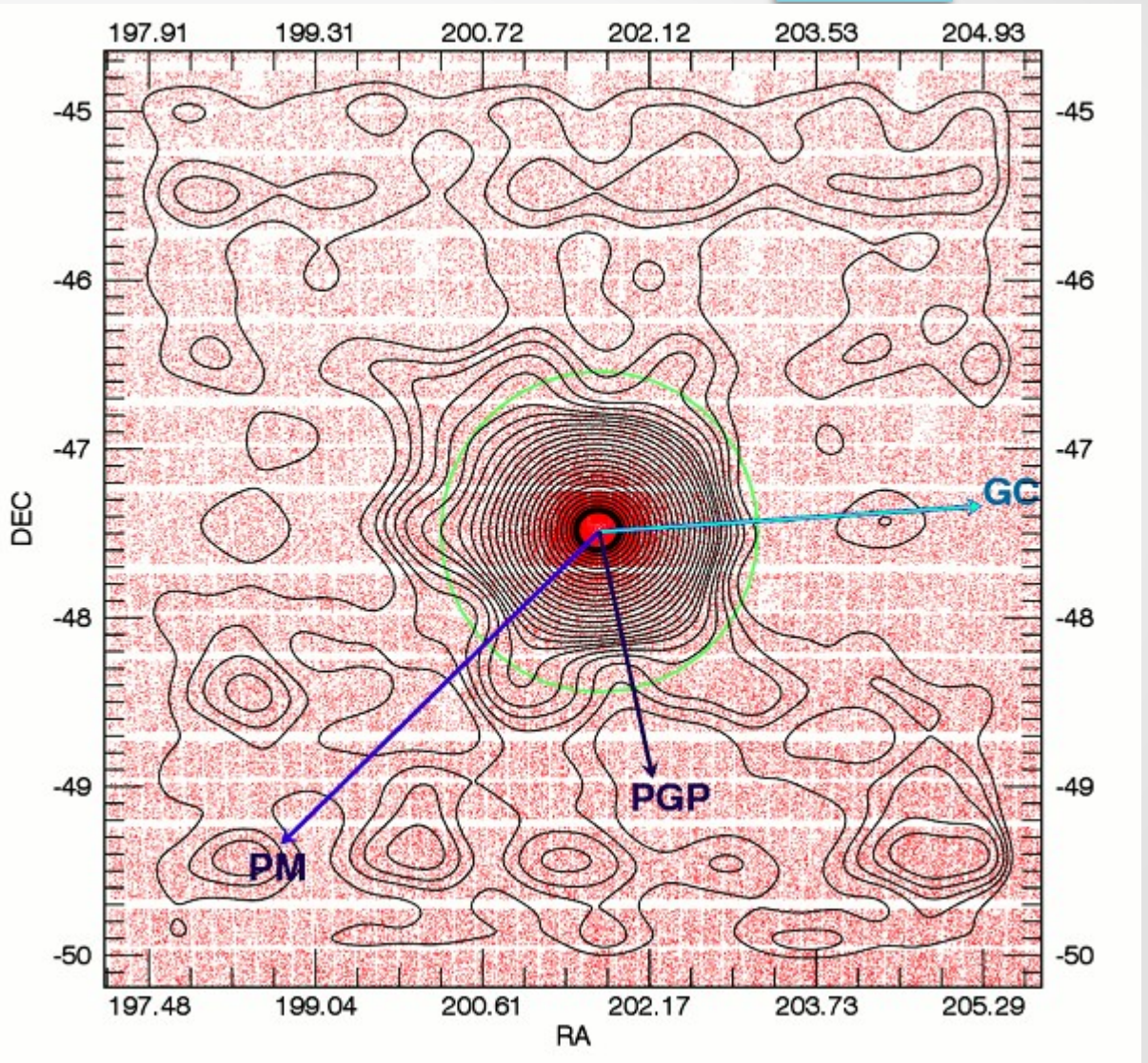
The adopted stellar tracers will be Variable (RR Lyrae and Long Period Variables), Turn-off (TO) and Main Sequence (MS) stars.



Omega Centauri and STREGA

M. Marconi et al., *submitted*





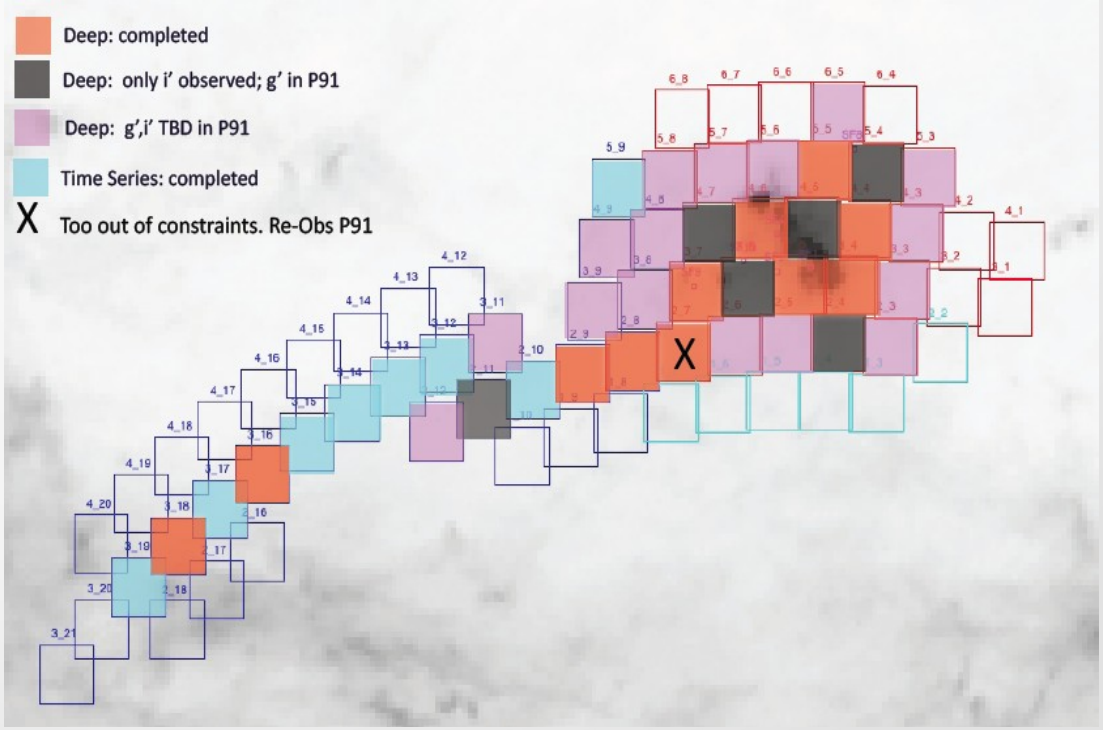
STEP: SMC in Time-Evolution of a Prototype interacting late-type dwarf galaxy

PI: V. Ripepi

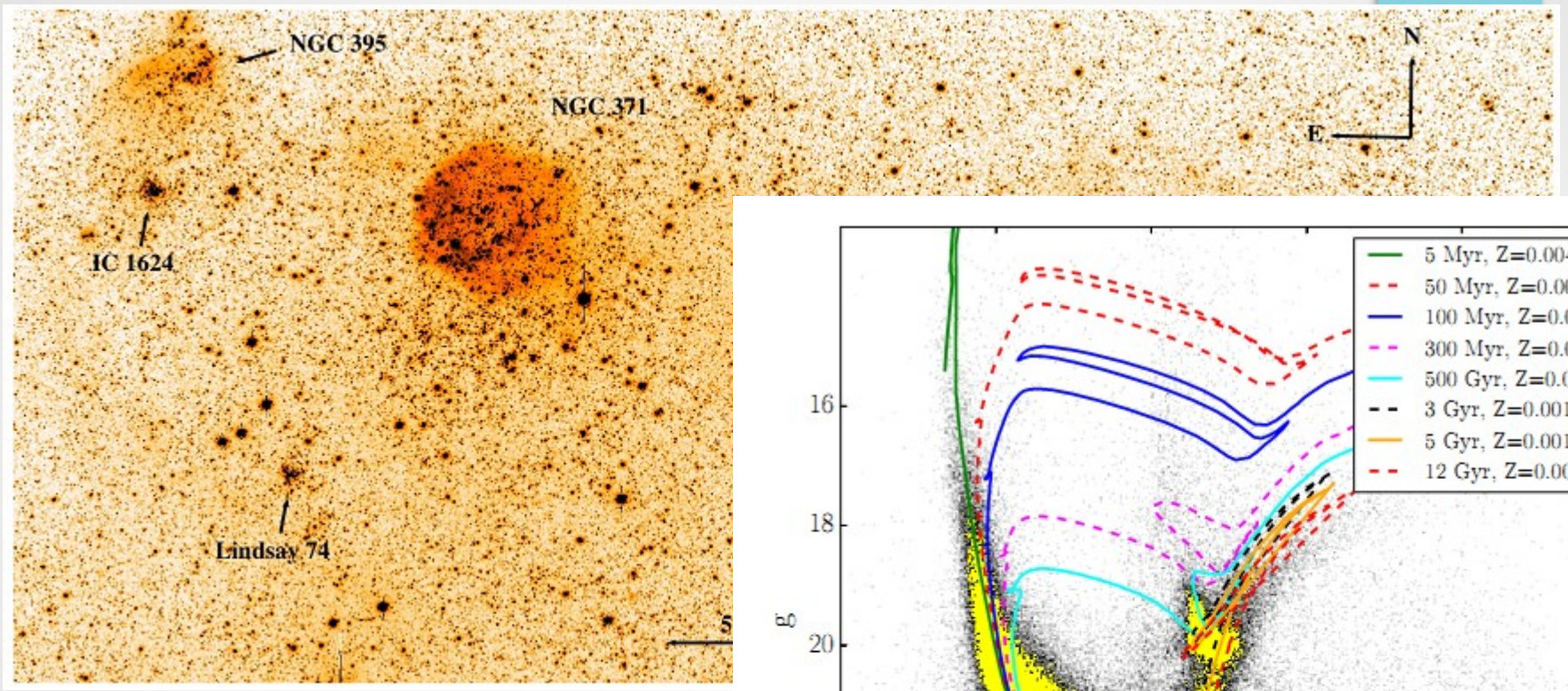
Use the wide field of view and good resolution of VST to carry out the first deep and homogeneous photometric survey of the entire SMC body as well as time-series photometry of the Bridge (65 sq. deg in total) to test against the current galaxy formation scenario.

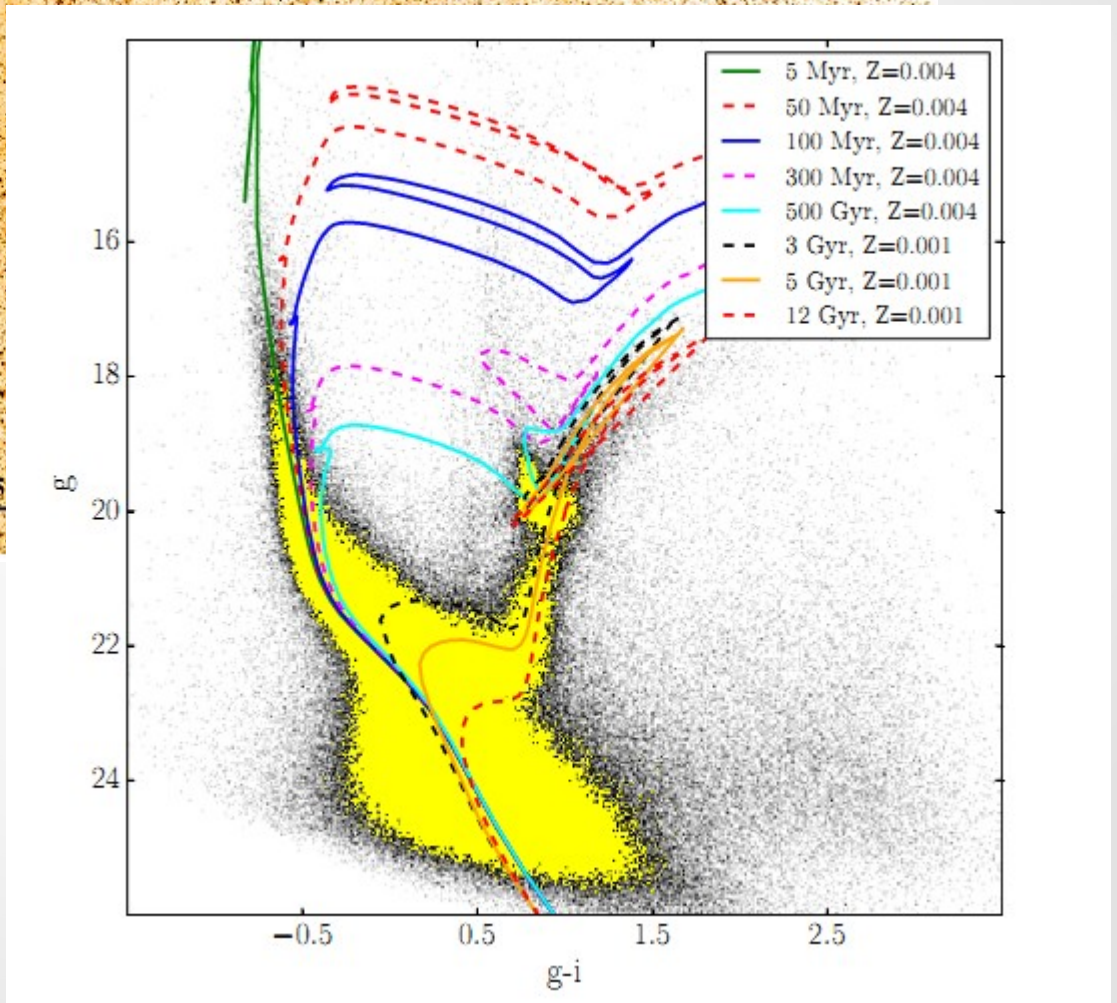
Complementary data/programs:

- HST/VLT photometry/spectroscopy of selected fields/clusters.
- VMC@VISTA survey (P.I: M.R. Cioni): YHKs photometry of the Magellanic System (LMC, SMC, Bridge, Stream): 184 sq. deg. at Ks=20.3 mag in five years.
- FLAMES/FORS2@VLT follow up planned



First Results





Ripepi et al, *submitted*

SUDARE@VST: SUpernova Diversity And Rate Evolution

PI: E. Cappellaro (INAF – Observatory of Padua)

Science Aims

Aim of the project is to measure SN rate and test a possible evolution of the SN diversity with redshift.

The supernova statistics is an important cosmological probe that only recently began to be fully exploited.

The rate of occurrence of SNe as function of the cosmic time is linked to some of the basic ingredients of the galaxy evolution such as mass, star formation history (SFH), metallicity and environment.

Limiting magnitude *r* = 24.5 in 30-45 min depending on the moon phase.

To allow for removal of cosmic rays and bad pixels, the exposure will be split in three jittered 10-15min exposures.

We wish to obtain one exposure every other day excluding +/-5d around full moon.

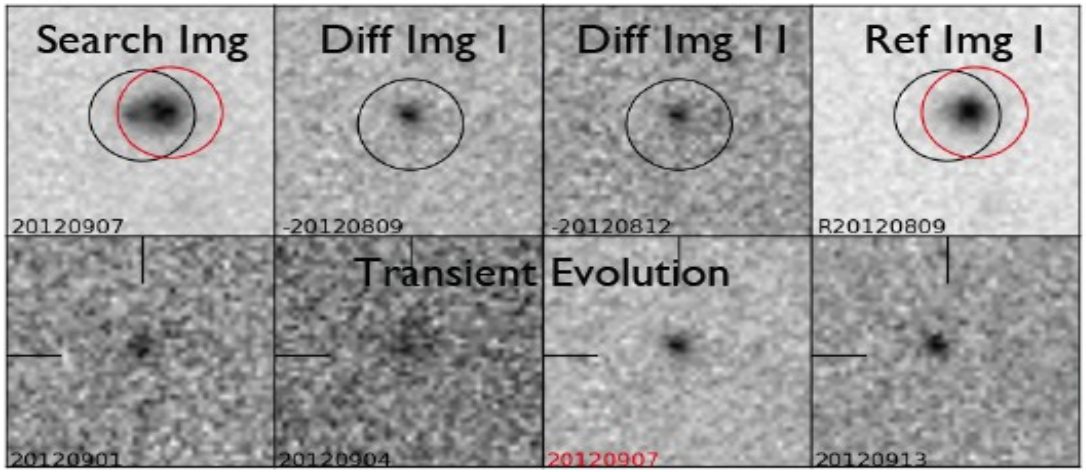
The g and *i* exposures, also with a limiting magnitude of ~24.5, will be acquired once a week, i.e. twice for each lunation if we exclude bright time.

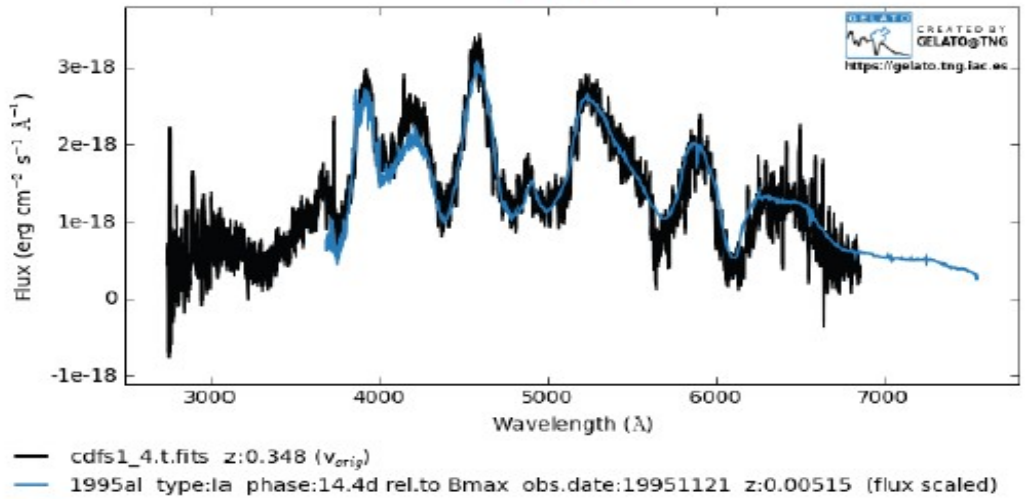
SN 2012ez (Ia) z=0.35

#4 RA= 3:35:16.368 DEC=-27:29:49.21 [105]

	xc	yc	fwhm	fl rad	mag auto	mag aper	cl star
dif1	2551.37	10730.98	4.78	2.59	22.84	22.85	0.93
dif2	2551.30	10730.99	4.27	2.27	23.48	23.39	0.71
_ref	2556.61	10731.65	8.07	3.97	20.69	20.76	0.02

d= 0.35
z= ---





First confirmed SN candidates (CBET 3236)

SN 2012ez A in VOICE-CDFS-1 field

2012 UT	R.A.	Decl.	Mag.	Offset
Sep. 8.30	3:35:16.368	-27:29:49.21	23.2	1".1 E, 0".1 S

A spectrogram of 2012ez, obtained on Sept. 14.28 UT with the ESO Very Large Telescope Antu (+ FORS2; range 370-920 nm, resolution 10 nm), shows the typical features of a normal type-Ia supernova. Adopting a redshift z =0.348, as measured from a number of narrow lines of the host galaxy, the best fit with the GELATO tool (Harutyuyan et al. 2008, A.Ap. 488, 383) in a library of supernova spectra is with SN 1995al at fourteen days past maximum (Anupama et al. 1997, A.J. 114, 2054). The ejecta expansion velocity, derived from the position of the Si II doublet, is 11300 km/s.

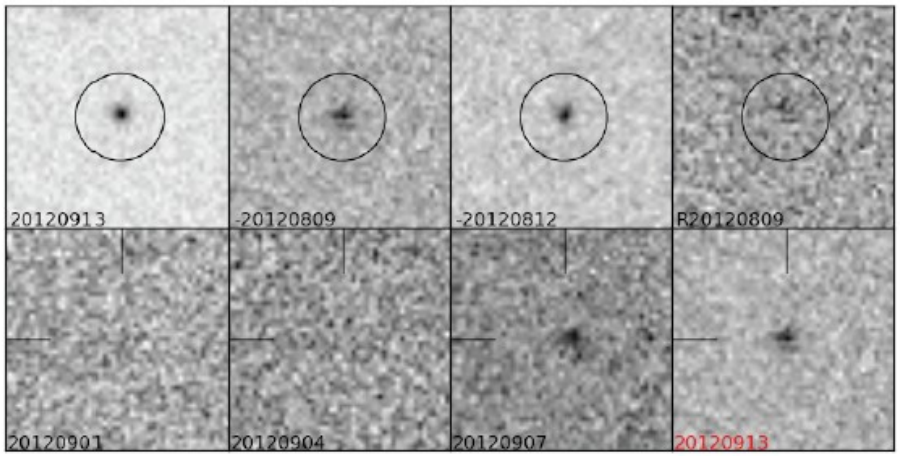
Courtesy: Cappellaro, Vaccari

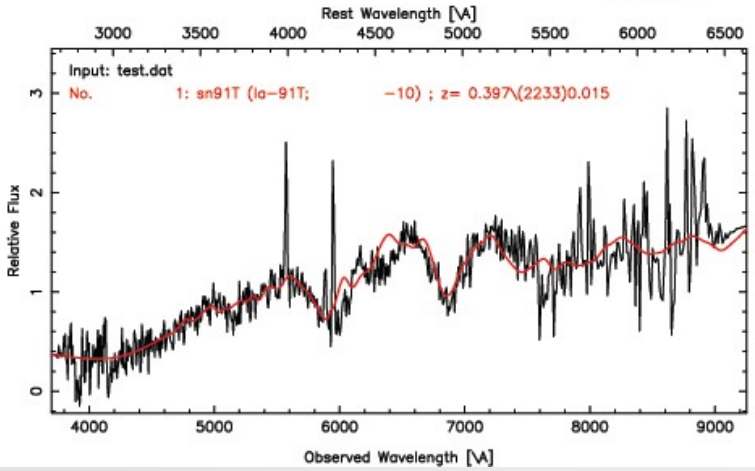
SN 2012fa (Ia) z = 0.4

#27 RA= 3:34:59.022 DEC=-27:51:55.43 [60]

	xc	yc	fwhm	fl rad	mag auto	aper	cl star
dif1	3666.64	4419.02	4.66	2.36	23.42	23.39	0.94
dif2	3666.74	4419.63	3.92	1.92	23.55	23.41	0.96

d= ---
z= ---





First confirmed SN candidates (CBET 3236)

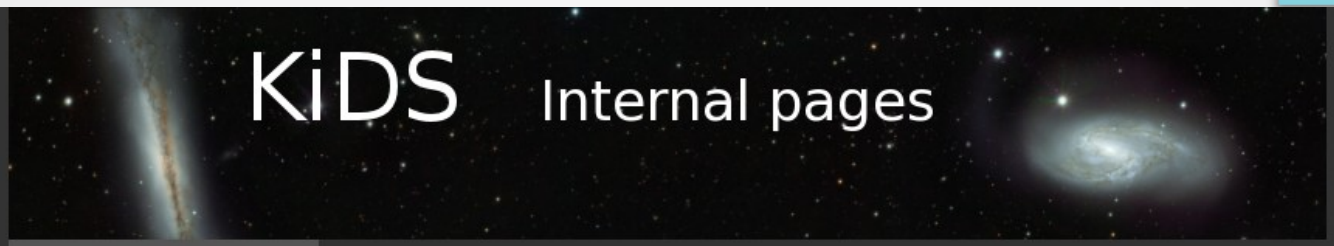
SN 2012fa in VOICE-CDFS-1 field

2012 UT	R.A.	Decl.	Mag.	Offset
Sep. 14.24	3:34:59.022	-27:51:55.43	23.4	--

A spectrogram of 2012fa, which is located at the center of a very faint galaxy, was obtained on Sept. 15.27 (as above). Cross-correlation with a library of supernova spectra using the Supernova Identification tool (SNID; Blondin and Tonry 2007, Ap.J. 666, 1024) shows that the object is very similar to the bright type-Ia supernova 1991T at ten days before maximum (Ruiz-Lapuente et al. 1992, Ap.J. 387, L33) when placed at a redshift, z, of about 0.4. As for SN 1991T at this phase, the Si II doublet is barely visible.

Courtesy: Cappellaro, Vaccari

KIDS Projects



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- List of papers

Team
- KiDS team
- External collaborators

My KiDS

Stellar radial density profile of the MW halo

Project details

PI:	Berenice Pila-Diez Leiden University piladiez@strw.leidenuniv.nl
Administrator:	Berenice Pila-Diez Leiden University piladiez@strw.leidenuniv.nl
Start date:	Nov 2013
End date:	Nov 2014
Members:	Massimo Dall'Ora (INAF - OACN Naples) Jelte de Jong (Leiden Observatory)
External collaborators:	
Description:	We want to measure the radial density profile of the Milky Way's stellar halo along different KiDS directions. In particular, we want to compare these profiles to previous studies in the galactic northern hemisphere and to the predictions by Galaxy models.
PhD project:	Yes: Berenice Pila-DÃez
Project status:	ACTIVE

Cancel your membership of this project

Papers

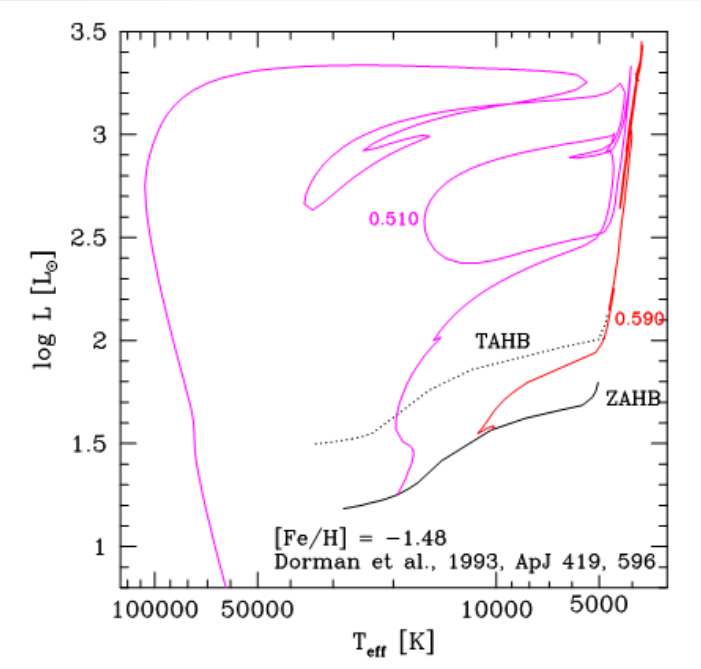
100%

Mining the MW Halo: why KIDS?

- KIDS reaches r = 25.2 mag at the 5σ level with 2"
- A wealth of stellar population tracers at our disposal
- Possibility to detect the old populations MSTO at (m-M) ~ 21.5 mag, 200 kpc
- Possibility to detect the HB and the RR Lyrae variables at (m-M) ~ 24.5 mag, up to the M31 group...

Hot Helium dwarfs: tracing the Galactic Halo Structure

- Helium burning core of about 0.5 M⊙: genuinely old stars --> tracers of old populations
- Relatively numerous
- Abundances patterns pristine for Teff <11,000 K



- RR Lyraes and BHB/EHB are easy to find: RR Lyr due to color/ variability; BHB/EHB due to blueness (at medium to high Galac tic latitudes)
- Distances readily derivable
- Luminous stars, accessible beyond the boundaries of the Galaxy
- Unvaluable tool for: spotting overdensities, Halo kinematics, chemical enrichment history...
- The first step is to find them...

Halo stellar density profile with MSTO stars

Selection of near- Main Sequence turn-off stars:

$$0.2 < g - r < 0.3$$

$$g > 17 \;\&\; 17 < r < 22.5 \;\&\; i > 17$$

$$5 \text{ kpc} < Dist < 35 \text{ kpc}$$

For which you also need to know:

u => [Fe/H], metallicity
ugri

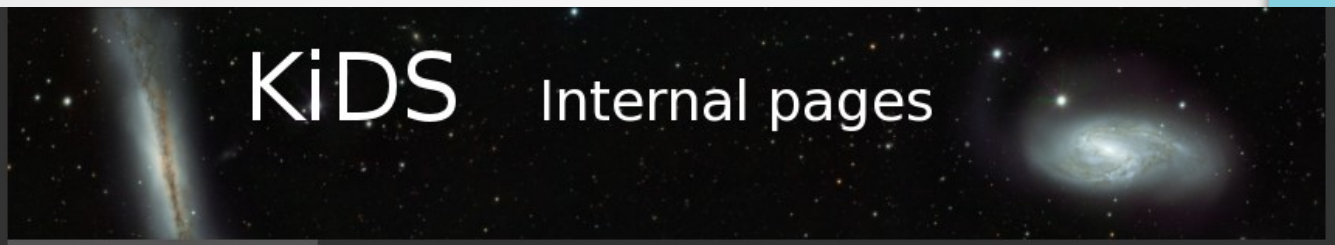
=> M_r => *Dist*

Photometric parallax relation

Ivezić et al. 2008

Bond et al. 2010

KIDS Projects



Hunting for the MW Halo satellites

Project details

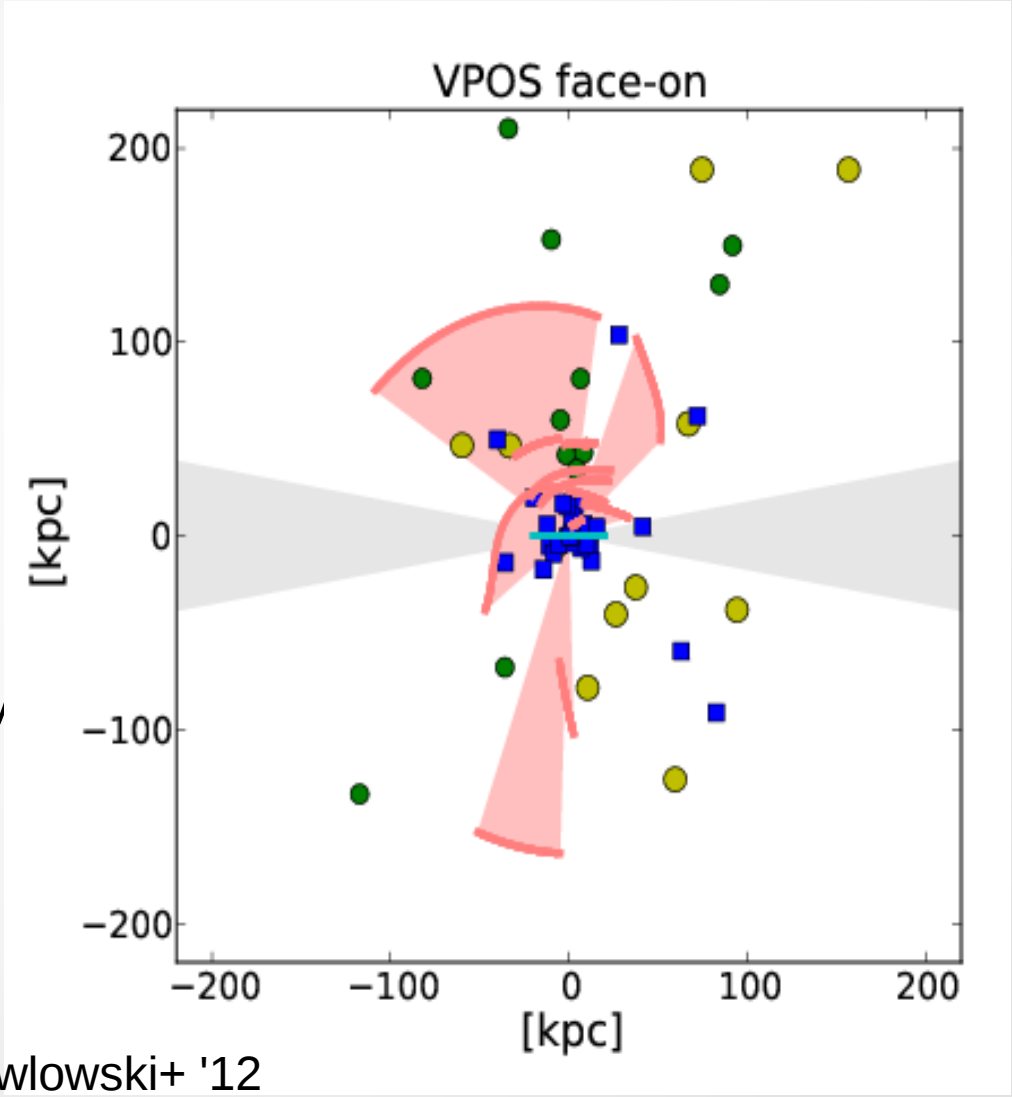
PI:	Massimo Dall'Ora INAF - OACN Naples dallora@na.astro.it
Administrator:	Massimo Dall'Ora INAF - OACN Naples dallora@na.astro.it
Start date:	Feb 2014
End date:	Feb 2015
Members:	Massimo Capaccioli (Uni. Naples - Physics) Jelte de Jong (Leiden Observatory) Berenice Pila-Diez (Leiden University)
External collaborators:	
Description:	We propose to accurately mine the KIDS catalogs, in order to detect possible substructures (dwarf satellites, stellar streams and overdensities) by means of well-suited data analysis techniques and stellar tracers.
PhD project:	No:
Project status:	ACTIVE

Edit project details

Papers

Seeking the Invisible

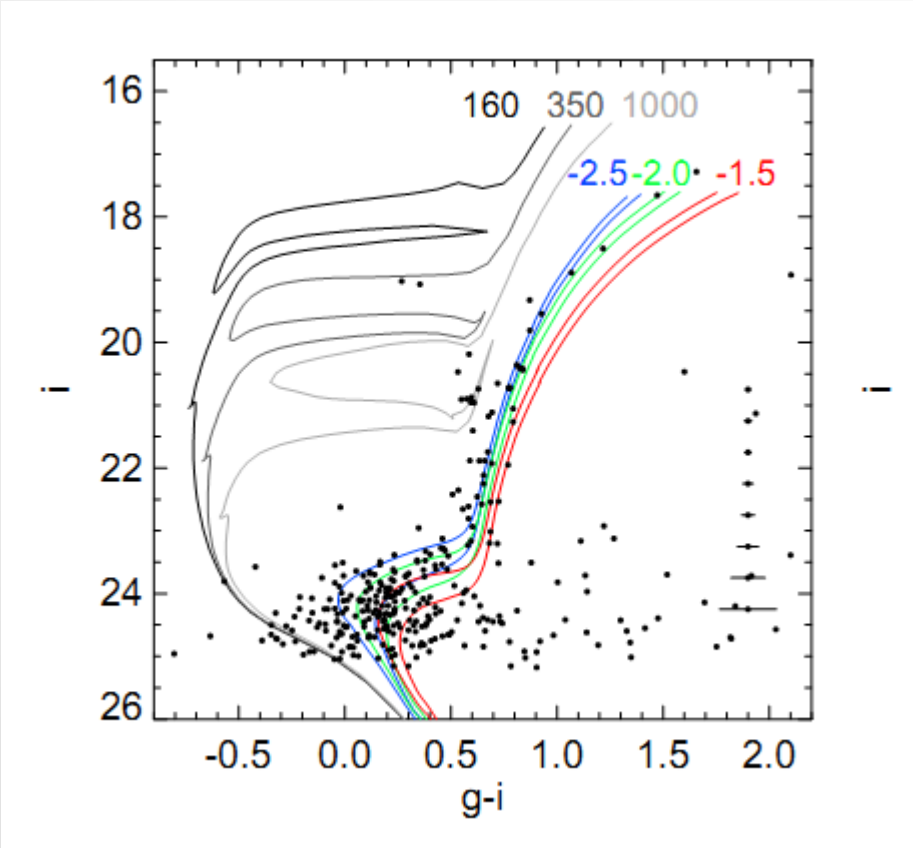
- More than 15 Ultra-Faint Dwarfs (UFD) discovered in the SDSS survey, in the northern emisphere. What about South?
- KIDS is deeper than SDSS
- Census of the UFD to be completed: total number, distribution, stellar populations
- Formation of the MW Halo
- Impact on the LCDM Cosmology

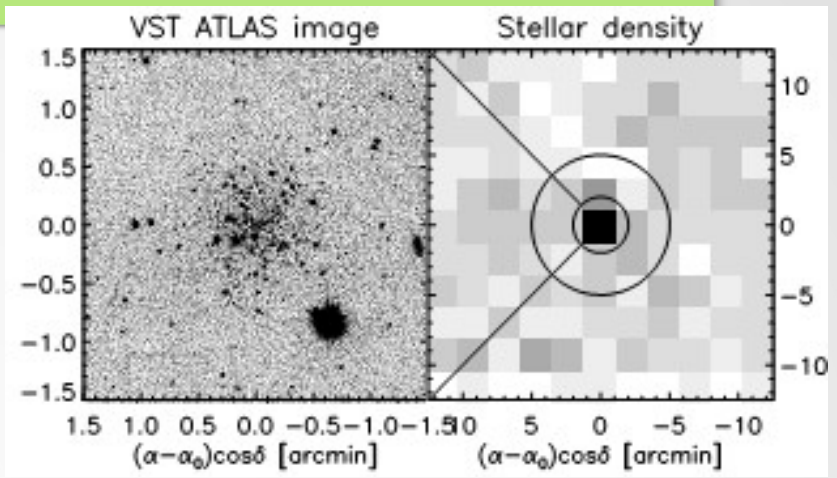


Pawlowski+ '12

Feasible? Yessss...

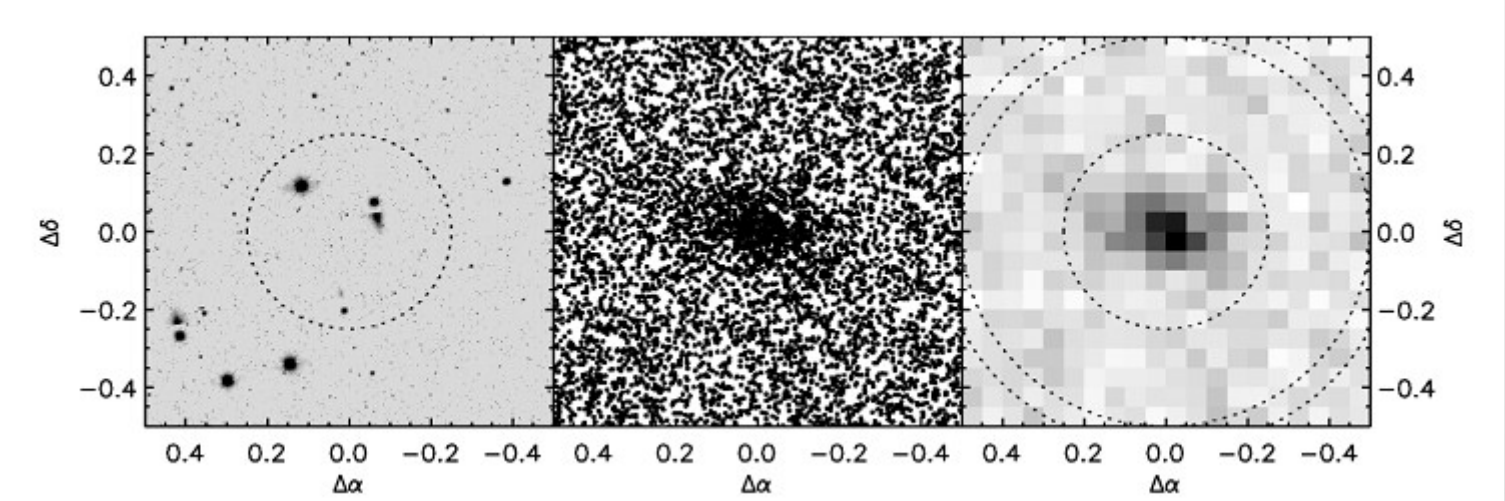
First detection of a MW Satellite in Crater, on ATLAS data (Belokurov+, astro-ph/1403.3406)



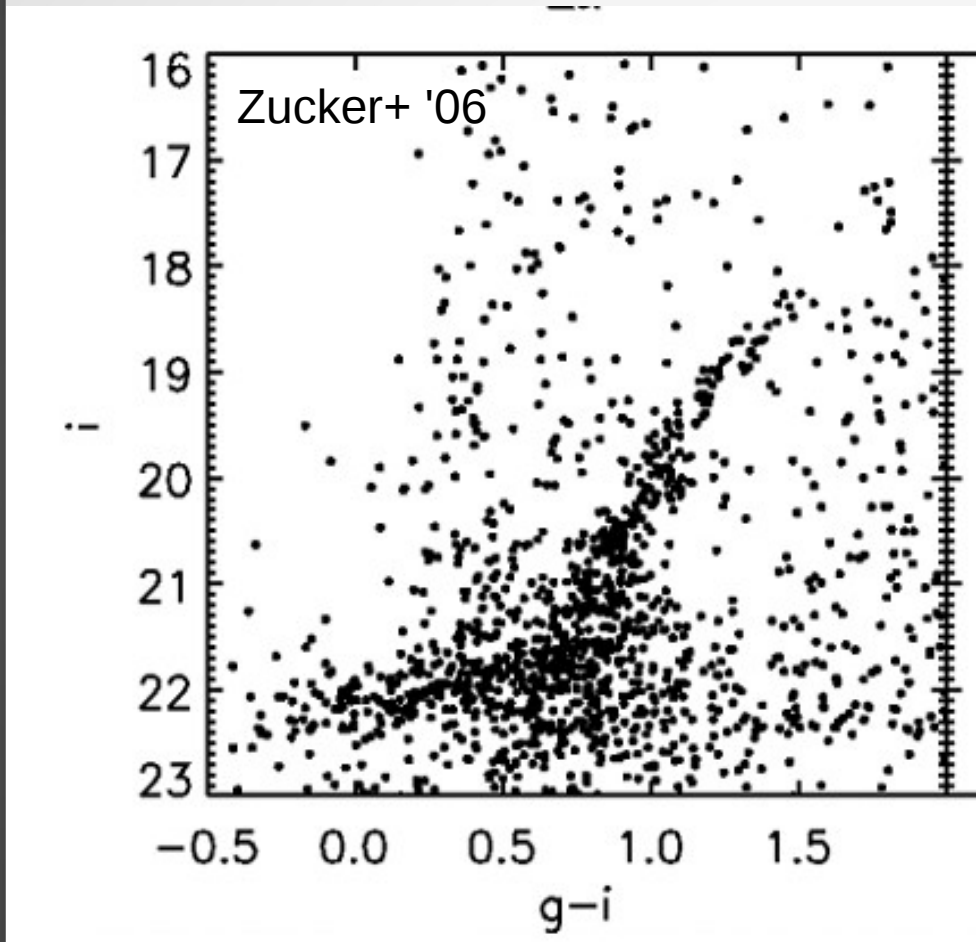


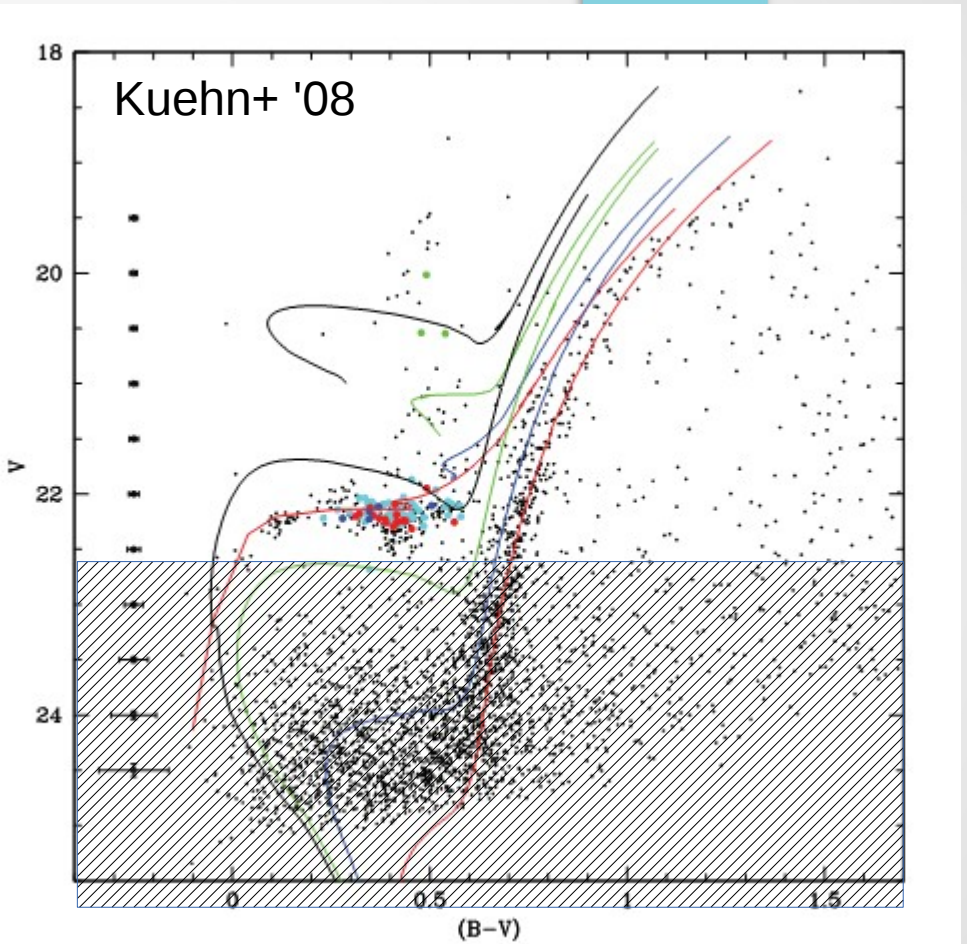
Case Study I: Canes Venatici I

- CVn I was discovered by Zucker+ '06
- $(m\text{-}M)_0 = 21.7$
- Only the HB and the RGB are detectable
- "Easily" detectable on SDSS images, $M_V = -8.6$ mag (similar to Ursa Minor dSph)



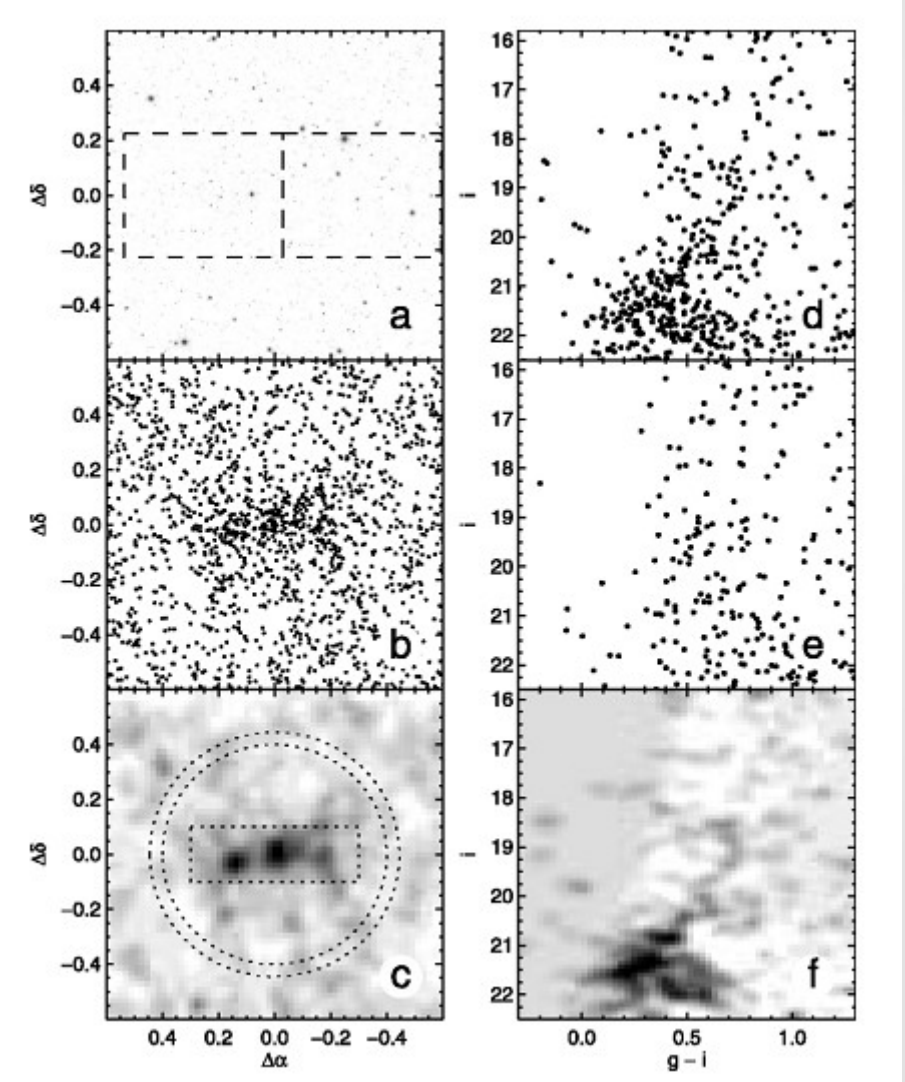
Case Study I: Canes Venatici I





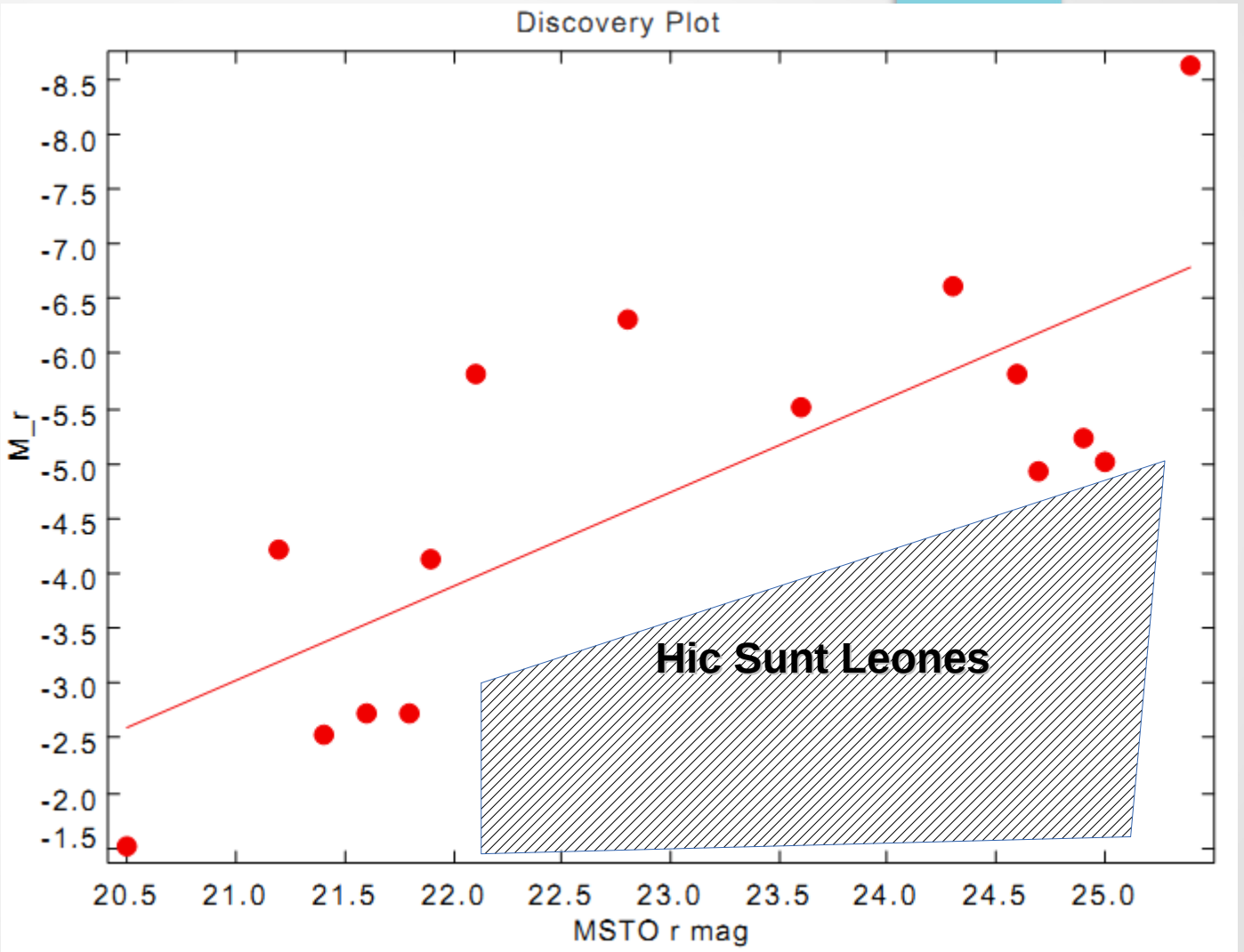
Case Study II: Ursa Major II

- Discovered by Zucker+ '06
- Distance (m-M) = 17.7 mag (Dall'Ora+ '12; ~ 35 kpc)
- Only the MSTO and the SGB region are clearly visible
- Subaru observations needed to explore the MS
- No RGB or HB clearly visible: Would have been detected at the CVn I distance?



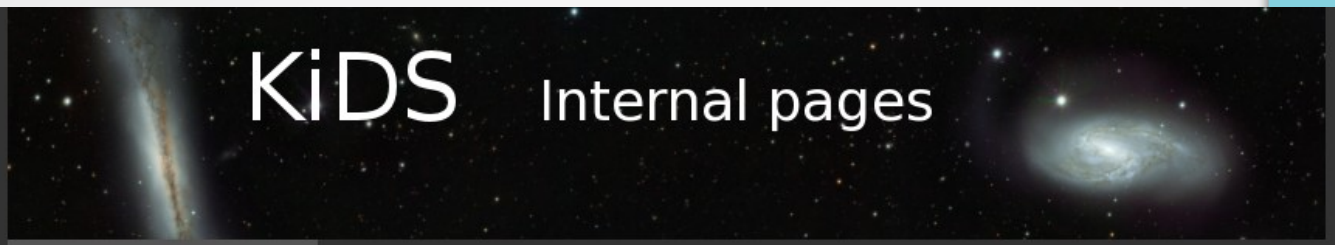
So, what we could miss?

- Main Sequence is an appealing tracer for stellar population, since: a) the TO region has bluer colors than the MW field; b) it is the most populated region in the CMD
- With SDSS we reach r ~ 22 mag → we can detect old pupulations TOs up to (m-M) ~ 18 mag (40 kpc)
- With KIDS we could see Tos at 200 kpc...



Data from McConnachie 2012

KIDS Projects



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Project registration
List of papers

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KiDS team
External collaborators

My KiDS

Mining the Solar System

Project details

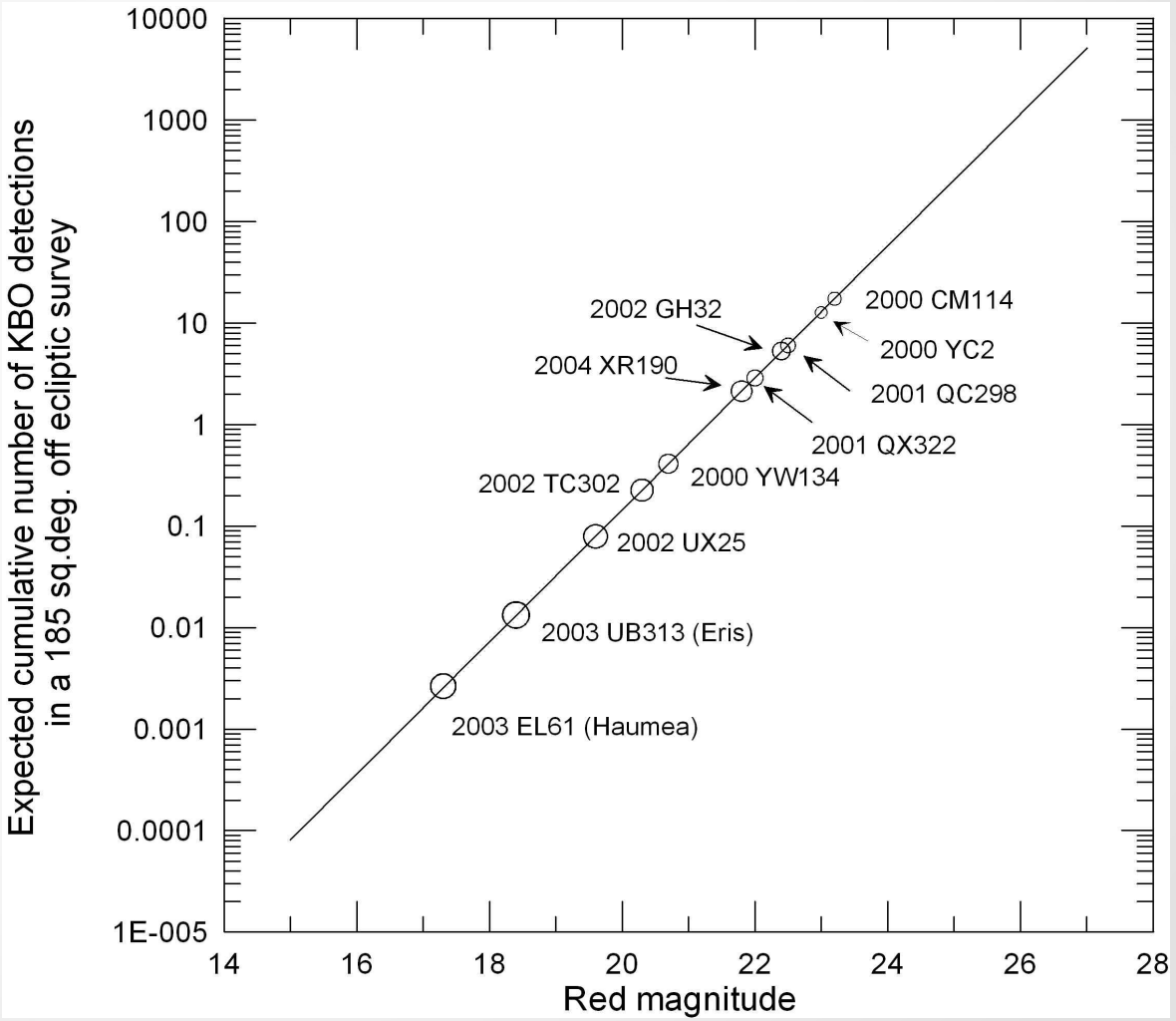
PI:	Massimo Dall'Ora INAF - OACN Naples dallora@na.astro.it
Administrator:	Massimo Dall'Ora INAF - OACN Naples dallora@na.astro.it
Start date:	Jun 2014
End date:	Jun 2015
Members:	Massimo Capaccioli (Uni. Naples - Physics) Pedro Lacerda (Max Planck Institute for Solar System Research)
External collaborators:	Elena Mazzotta Epifani (INAF-OACN); Davide Perna (Observatoire de Paris)
Description:	We propose to mine the images/catalogs of KIDS to search for Solar System minor bodies. In particular, we will focus on: 1) known Kuiper Belt objects, in order to provide multi-band photometry, still lacking for most of them; 2) known Main Belt asteroids, to update their photometric database; 3) spot astrometric transients, on individual ditherings, searching for unknown small bodies.
PhD project:	Yes: Sebastian Lorek (MPS); Rosita Kokotanekova (MPS)
Project status:	PENDING

Main (Observational) Drivers

- Photometric and astrometric catalogue of all the already known objects:
  - Main Belt Objects
  - Kuiper Belt Objects
  - Centaurs
  - Oort Comets
- Astrometric transients: new objects

An example: Kuiper Belt Objects

- Classical KBOs (hot and cold population, depending on the inclination *i*)
- Resonant KBOs
- Scattered KBOs
- Photometric characterization desperately needed for most of the already known objects
- Search for new objects: very poorly investigated high-*i* south-latitude sky



Conclusions

- VST Data can (and will) make the difference in our knowledge of the southern sky
- ATLAS can (and will) produce a SDSS-like Legacy:
  - First detection of a MW satellite
  - First detection of a stellar stream
- KIDS is deeper of two magnitudes in the 33% of the ATLAS field:
  - MSTO and EHB/HB stars available to trace the MW halo up to 200 kpc
  - More faint satellites possibly available → something to add to the missing satellites problem? Is the VPOS definitely confirmed?
- A combination of the ATLAS spatial extension and of the KIDS depth has an enormous potential.