VST images processing facility @ Naples: first astronomical applications to wide field archive data

Aniello Grado

&

Luca Limatola

Summary

- HW
- SW
  - VST-Tube: a friendly wide field pipeline
  - VST-Tube in action: some tough examples
- Conclusion

VST dedicated HW

Beowulf cluster:

over 100 cores for Wide Field Image processing and analysis

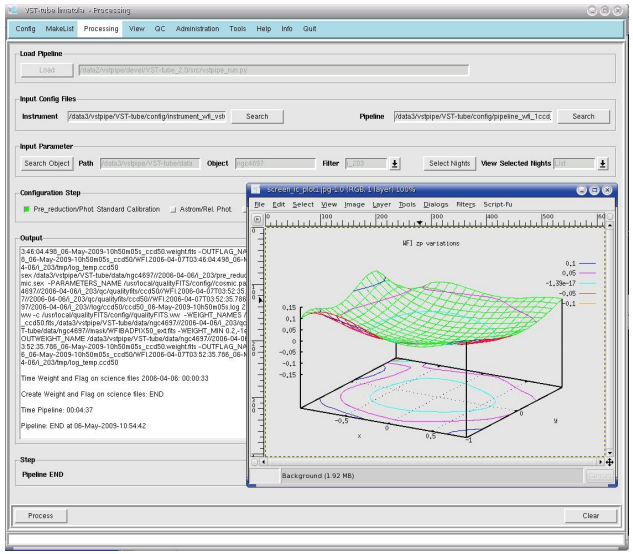
Aggregated 214 GB RAM

Data storage:

80 TB (very high availability-reliability from EMC^2)

What is VST-Tube?

- an automated tool to go from raw astronomical images to fully calibrated co-added images
- an automated tool to extract catalogs with aperture (Sextractor) and PSF (Stetson tools based) photometry
- a set of tools to administrate data and check the quality of intermediate and final results (partially done with QualityFits kindly provided by Terapix)
- a GUI to make configurations and actions easy and intuitive



VST-Tube features

Written in Python, C, + external astronomical packages

Flexibility:

- Pipeline works without DB
  - all the intermediate and final data are distributed in a intuitive directories tree
- Easy to adapt to peculiar data reduction model
- Easy to test new algorithms
- Full control on SW

In VST-Tube 2.0 the eclipse Fits library replaced with Efits

A. Grado, M. Pavlov and L. Limatola, 2007, "Efits: A New Efficient and Flexible FITS Library ", The 2007 ESO Instrument Calibration Workshop. Ed. Springer, p. 217

Unique characteristics: e.g. true noise map propagation

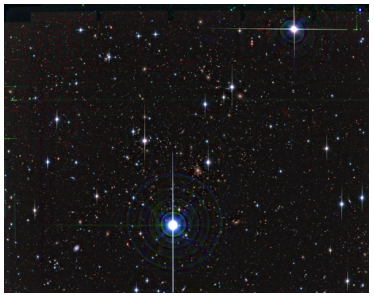
VST-Tube in action

Multi-nights multi-bands

Analyze
fix
QC0
classify

Chose recipes

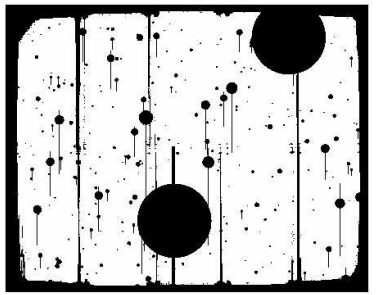
Chose final product



Instruments supported and tools

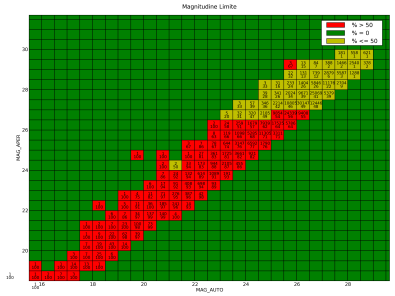
Presently supported instruments:

WFI, SUPRIME, CFHT12K, FORS1, PNS



VST-Tube: a pipeline but also a growing collection of tools. Some examples:

- Aperture and PSF (S. Zaggia) photometry
- MAgliM (completeness vs magnitude and surface brightness)
- Mask (~automatic halo/spike mask)
- VSTSim (images simulator)
- Surface brightness profile tool



Done/Ongoing projects

- **CFHT12K** image processing for VIMOS collaboration (Lamareille et al. 2009 A&A **495**,53)
- S. Zaggia, A. Grado et al., Tidal Tails in Globular Clusters. The case of NGC2808 (A&A, in preparation) **WFI**.
- A complete characterization of the bulge Globular Cluster NGC 6723. V. Ripepi (INAF-OAC), M. Zoccali (PUC, Chile); M. Dall'Ora, A. Grado, L. Limatola, M. Marconi, I. Musella (INAF-OAC); G. Clementini, M.I. Moretti (INAF-OABO) **WFI**.
- From Molecular Cores to Planet-Forming Disks: A Spitzer Legacy Survey Optical follow-ups (Alcala' et al.): **WFI** (R, I, Z, Hα, λ856, λ914) (INAF-OACn, OACatania, OAArcetri)
- Surface brightness profile of Nearby Galaxies… (A. Grado et al. in preparation) **WFI**

VST-tube
Ongoing projects

- Stellar population and variable stars in the Hercules UFD, . P.I. G. Clementini (INAF-OABO), Co-I. M. Dall'Ora, L. Grado, L. Limatola, M. Marconi, I. Musella, V. Ripepi (INAF-OAC), M.I. Moretti (INAF-OABO) **WFI**
- Mass estimation of galaxies cluster

  M. Radovich, A. Grado, E. Puddu, Z. Huang*, L. Fu*, L. Limatola, F. Getman (INAF-OAC); M. Meneghetti, S. Ettori (INAF-Bologna); L. Moscardini, A. Donnarumma (Univ. Bologna); Romano, R.Maoli, P. Mazzotta, I. Formicola (Roma La Sapienza, Tor Vergata); R. Scaramella (INAF-OARoma) **SUPRIME**.

VST-Tube versatility: an example

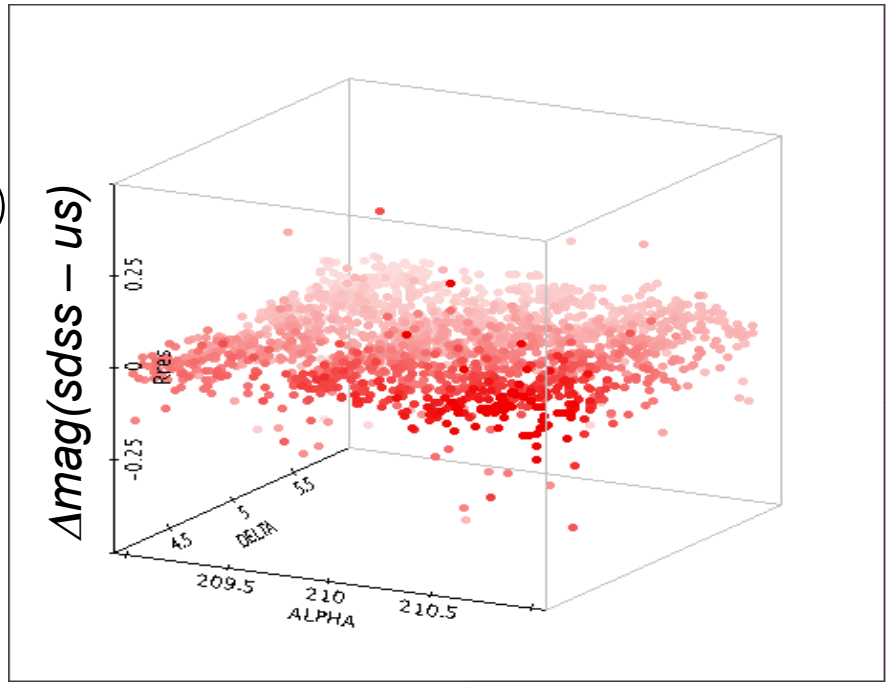
VST-Tube adapted to the reduction of CFHT12k images (VIRMOS collaboration)

4 deg^2 distributed over 51 nights reduced with VST-Tube

(Lamareille et al. 2009 A&A 495,53)

Photometric comparison with SDSS as function of celestial coordinates

Typical σ < 0.1 mag



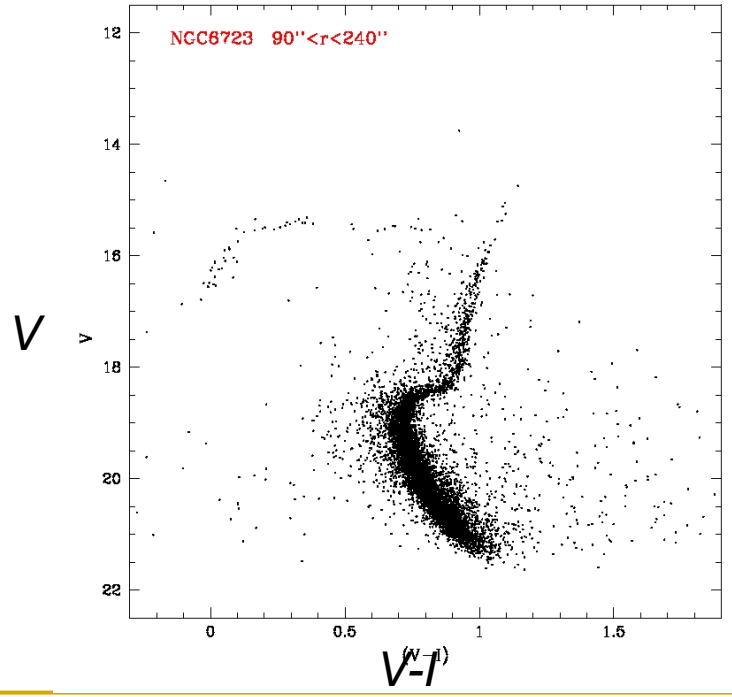
VST-Tube: Stellar applications

A complete characterization of the bulge Globular Cluster NGC 6723.

P.I. V. Ripepi (INAF-OAC)

Co-I. M. Zoccali (PUC, Chile); M. Dall'Ora, A. Grado, L. Limatola, M. Marconi, I. Musella (INAF-OAC); G. Clementini, M.I. Moretti (INAF-OABO)

- *Aims: CMD, variable stars, chemical composition*
- *WFI@2.2 archival data (10 V images and 7 I)*
- *WFI@2.2 and FEROS@2.2 collected in May-June 2010*



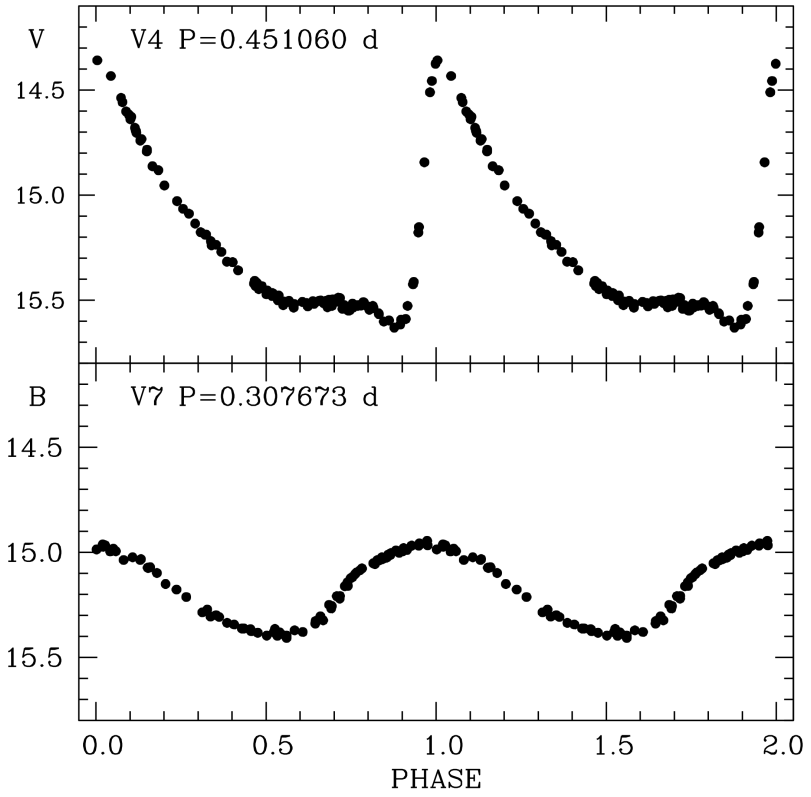
VST-Tube: Stellar applications

A complete characterization of the bulge Globular Cluster NGC 6723.

P85 observations @ ESO 2.2 (WFI)
11 half nights
Data reduced and catalogues extracted ***automatically***

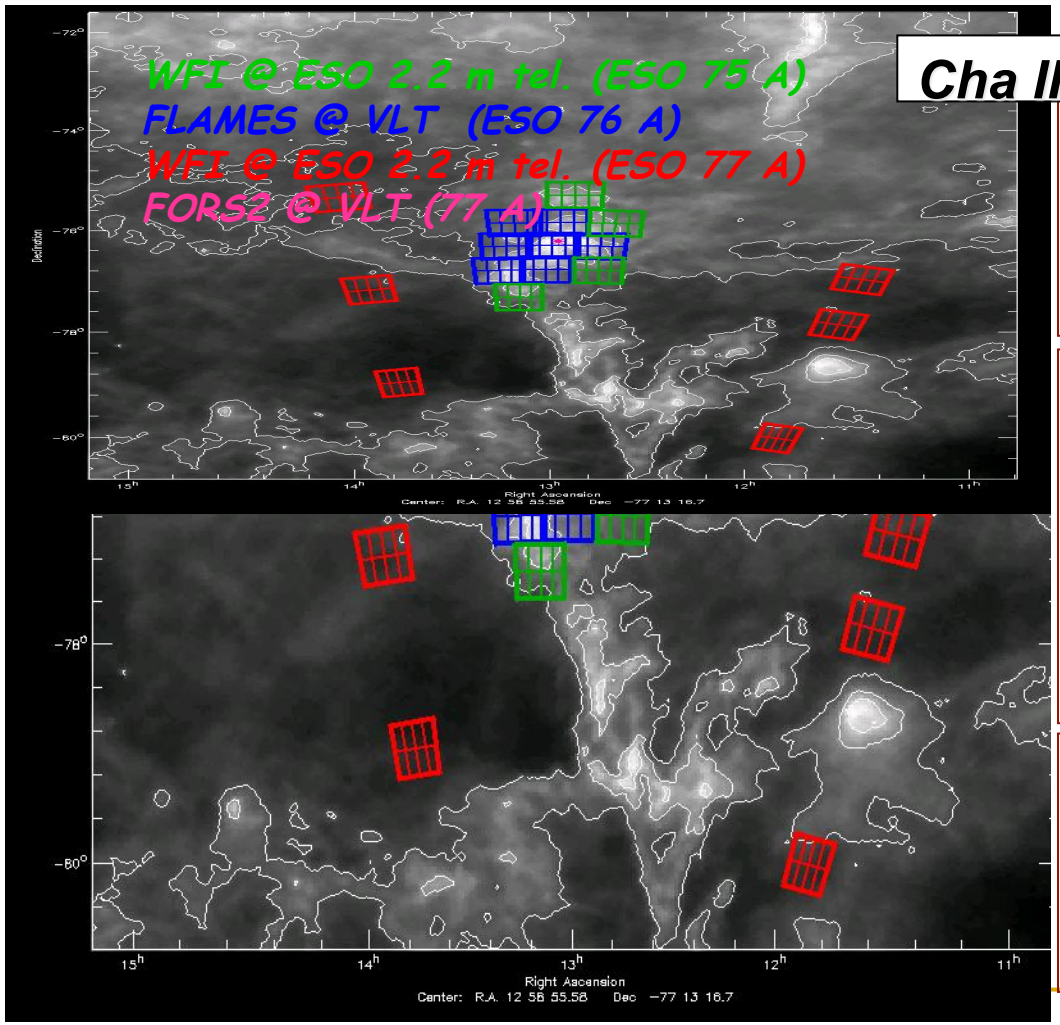
BVI 120 phase points for each band

Preliminary results
*RMS residuals < **0.01 mag***



From Molecular Cores to Planet-Forming Disks: A Spitzer Legacy Survey

(Evans et al. 2009 ApJs, 181, 321: www.peggysue.as.utexas.edu/SIRTF)



Optical follow-ups (Alcala' et al.):

- WFI (R, I, Z, Hα, λ856, λ914)
- FLAMES
- FORS2

Goals:

- Census: Young stellar objects
- young planetary mass objects
- circumstellar disks (SEDs)
- star formation rate & History
- IMF, down to sub-stellar regime

Italian CoIs:

- OAC-Napoli
- OA- Catania
- OA- Arcetri

VST-Tube processing capability: Nearby Galaxies

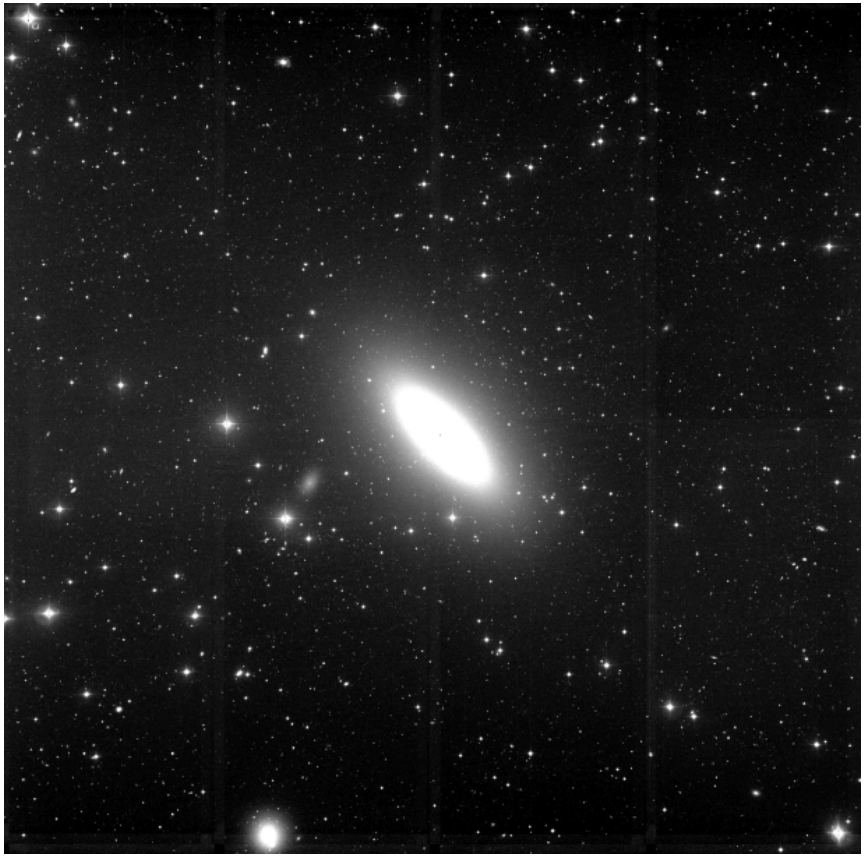
NGC3115 observed with WFI@2.2m

Problems:

- No data to produce a suitable superflat
- Huge object covering large part of the field

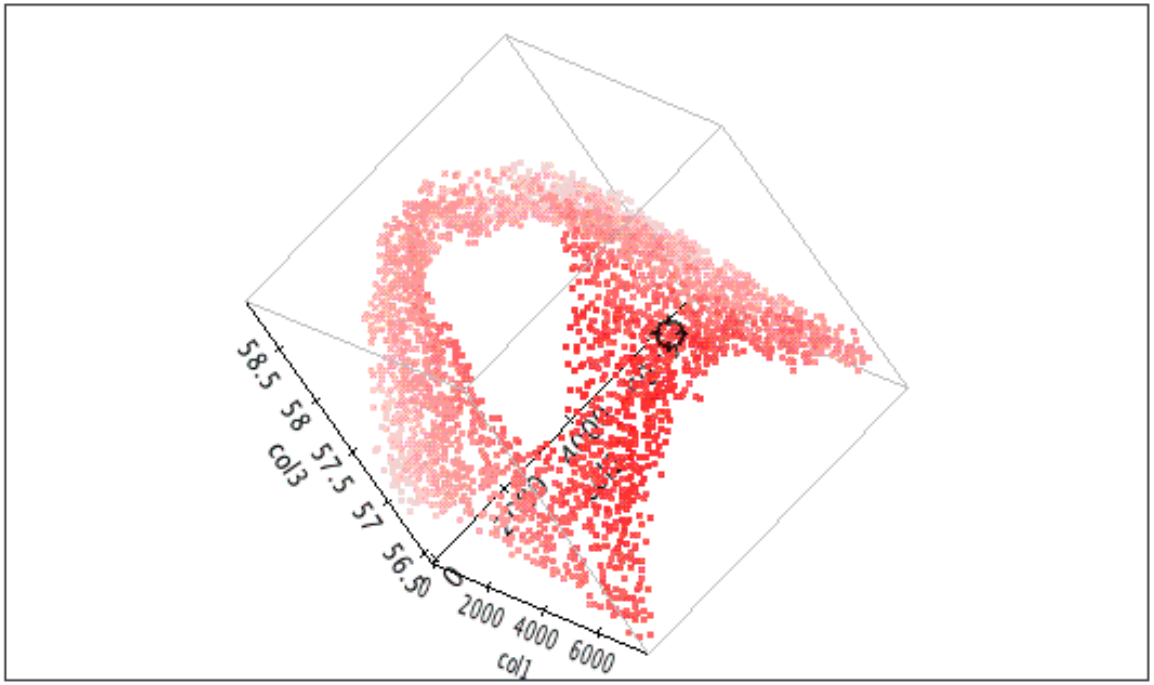
Very difficult to harmonize the CCD gains

VST-Tube processing capability: Nearby Galaxies



VST-Tube processing capability: Nearby Galaxies

NGC3115 observed with WFI@2.2m



VST-Tube Processing capability: NGC3115

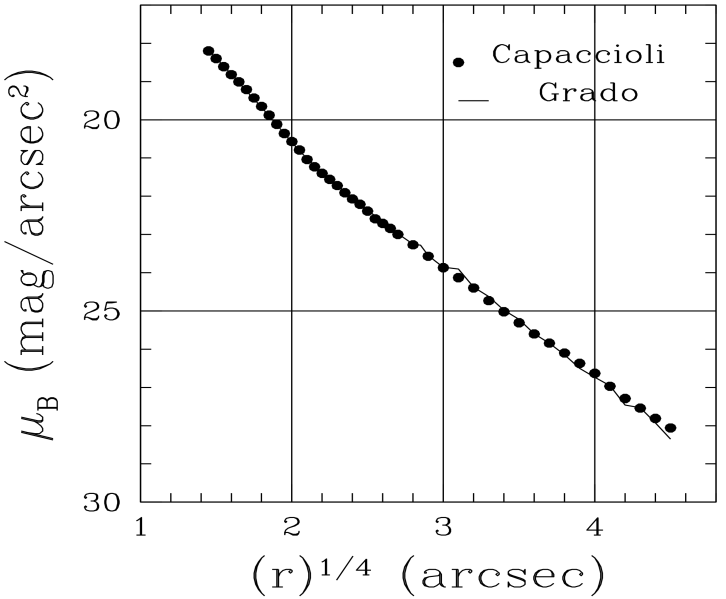
Surface brightness profile:

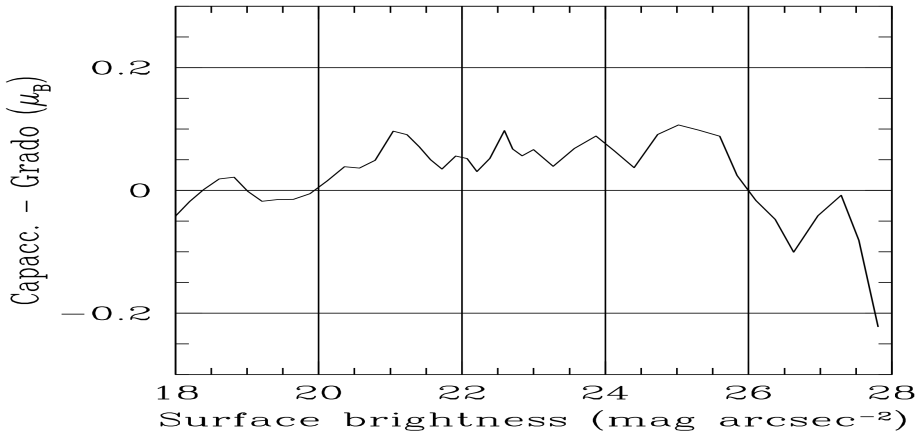
Comparison with Capaccioli et al. 1987

exp.time = 34 Ks

With WFI + VST-Tube (Grado et al. in preparation)

exp.time = 4.2 Ks B



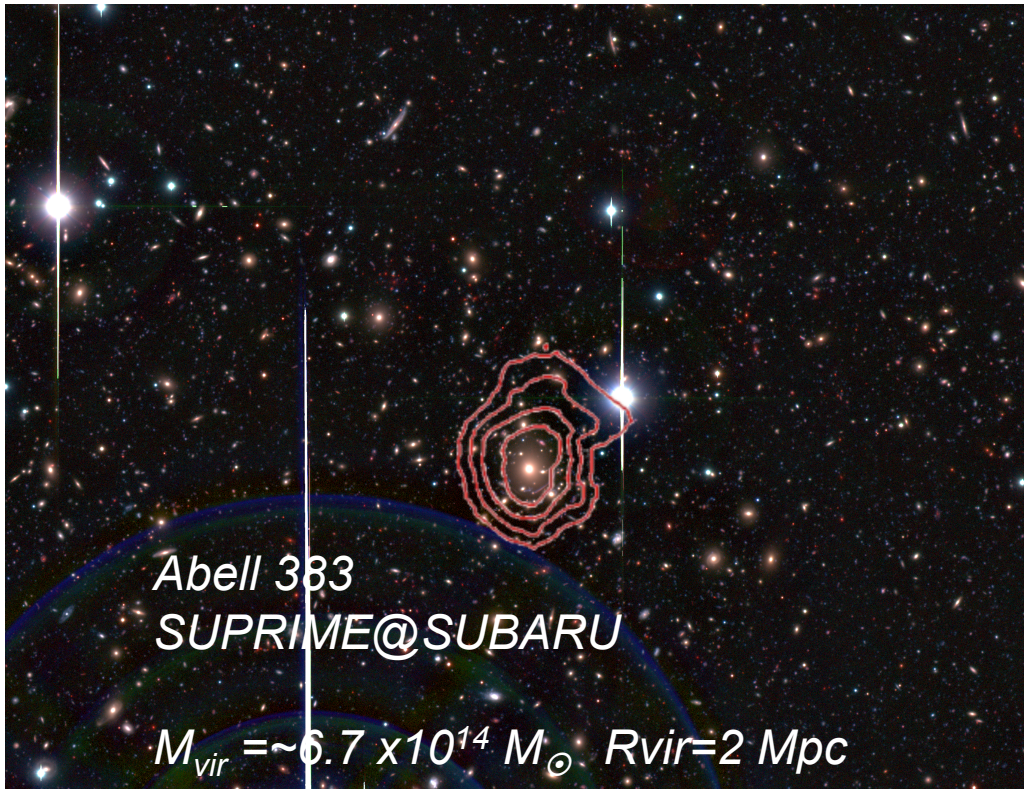


VST-Tube Processing capability
Extragalactic field (Weak Lensing)

Mass estimation of galaxies cluster
INAF-OAC, INAF-Bologna
Roma La Sapienza, Tor Vergata
INAF-OARoma

Suprime@Subaru
B 6000s
V 6120s
R 7800s
I 3600s
z 1500

Radovich et al. in preparation



Conclusion

- We developed VST-Tube a pipeline to process wide field images
- The SW was extensively tested
- It meets the requirements of a WIDE range of science cases
- An independent pipeline such as VST-Tube is useful to crosscheck VST data reduction