



Utilizing Astroinformatics to Maximize the Science Return of the Next Generation Virgo Cluster Survey

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- $g = 25.7, SB = 27.7, M_B \sim -5$
- Photometric, 104 deg^2
- $1.6 \times 10^4 - 3.5 \times 10^6$ galaxies
- PI: Laura Ferrarese @ HIA
- 40 people at at 23 institutions in Canada, France, Hawaii, US, UK, and Italy.

HOME THE SCIENCE THE SURVEY THE DATA THE TEAM FOLLOW-UPS INTERNAL

THE NEXT GENERATION VIRGO CLUSTER SURVEY

THE NGVS: A CFHT LEGACY

The Next Generation Virgo Cluster Survey (NGVS) is an approved Large Programme for the Canada French Hawaii Telescope (CFHT). The NGVS will use 771 hours of CFHT time (approx. 140 nights), spread equally over the 2009A-2012A semesters, to image the Virgo Cluster – the dominant mass concentration in the local universe and the largest collection of galaxies within ≈ 35 Mpc – from its core to virial radius, in five filters (u,g,r,i,z), to unprecedented depths.

The NGVS will be the state-of-the-art optical survey of a low-redshift cluster environment for years to come. It will also offer a wealth of synergistic opportunities with the many on-going and planned surveys of the Virgo Cluster at longer and shorter wavelengths. The purpose of this web-page is to initiate such opportunities by providing some basic information about the NGVS. As the survey progresses, this webpage will be expanded to include real time information about the data acquisition and processing.

The NGVS team comprises 45 members at Universities and research institutes across North America and Europe.

Left: A north-western portion of the Virgo Cluster, showing two of its brightest early-type galaxies, M84 and M86. At $\approx 1.1'' \times 0.6''$, the image is $1/160$ th the area proposed to be mapped by the NGVS (credit: NOAO/AURA/NSF).

Top Right: A Hubble Space Telescope/ACS image of NGC 4526 (credit: ACSVCS team).

Bottom Left: M87, the galaxy at Virgo's dynamical center, and its famous optical synchrotron jet, powered by a 3 billion solar masses black hole (credit: ACSVCS team).

Bottom Right: the 3.6 metre Canada French Hawaii Telescope (CFHT) on Mauna Kea, Hawaii.

Click on the image to the left to see a flyby movie through the core of the Virgo cluster (32 MB) [Credit: CFHT, CEA, NRC/HIA, CADC and the NGVS Team].





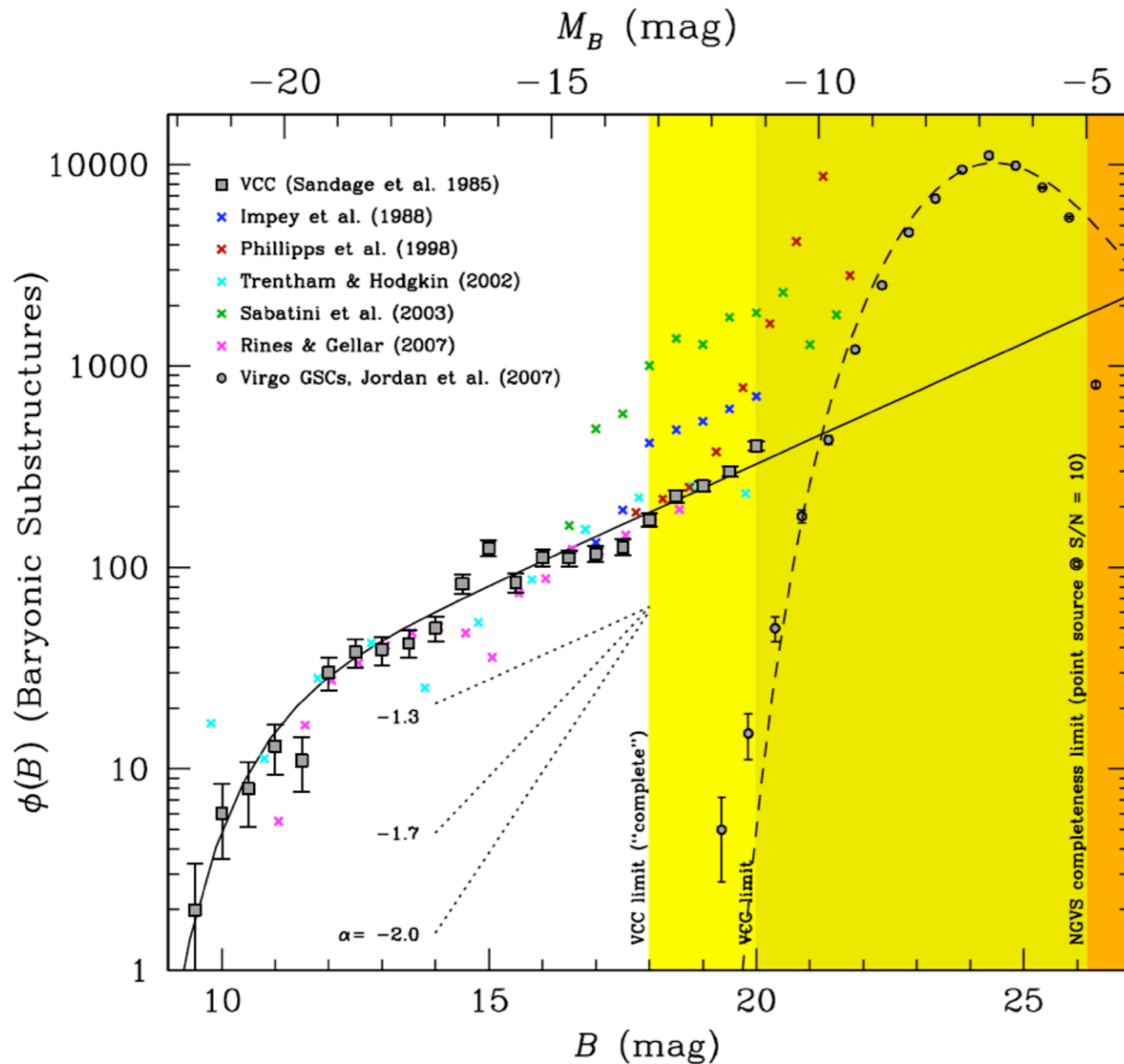
- A definitive measurement of the faint-end shape of the cluster galaxy luminosity function
- Characterization of galaxy scaling relations over a factor 10^7 in mass
- Stellar nuclei in galaxies and their connection to supermassive black holes
- Connection between the cluster, galaxies and the intracluster medium
- Fossil record of star formation and chemical enrichment in dense environments

NGVS Science Goals



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Virgo cluster
luminosity
function

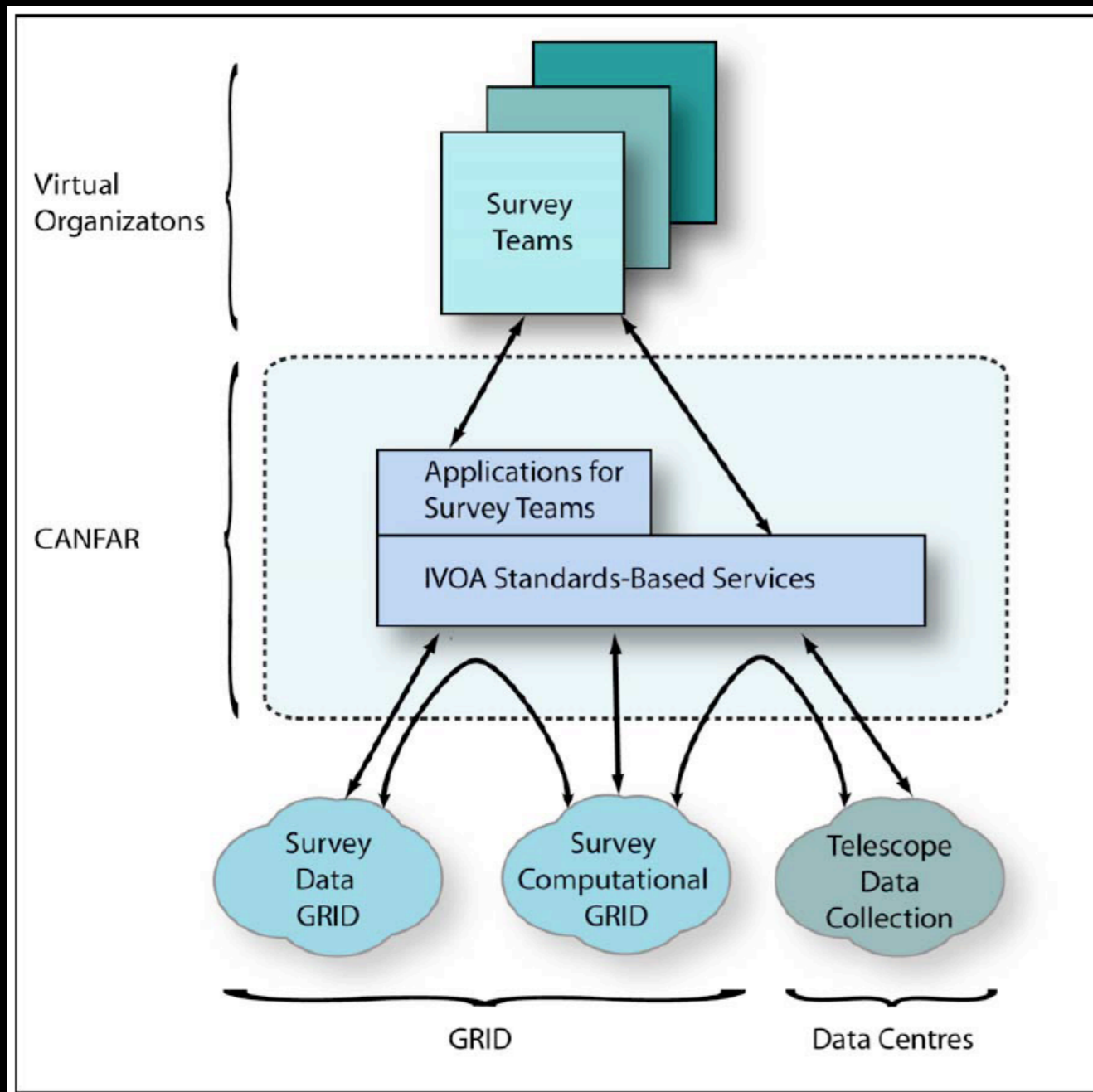


- CADC is one of the world's largest astronomy data centres
- ~500T of data
- Uses IVOA standards
- Staffed by astronomers and computer specialists





- Canadian Advanced Network for Astronomical Research
- Combines cluster job scheduling with cloud computing resources
- Users manage their own virtual machines



CANFAR infrastructure



- A **tool** to enable data-intensive astronomy
- Telescopes -> data -> ??? -> science
- IVOA KDD-IG guide: <http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/IvoaKDDguide>



- Canada-France-Hawaii telescope
- Elixir preprocessing
- MegaPipe/TERAPIX processing
- 2.6T FITS files
- Catalogues
- Large, but not intractable

I.e.



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- The NGVS is an ideal survey on which to use the methods of astroinformatics, without their use being the subject of the research itself
- (Although one still needs expertise in the subject!)



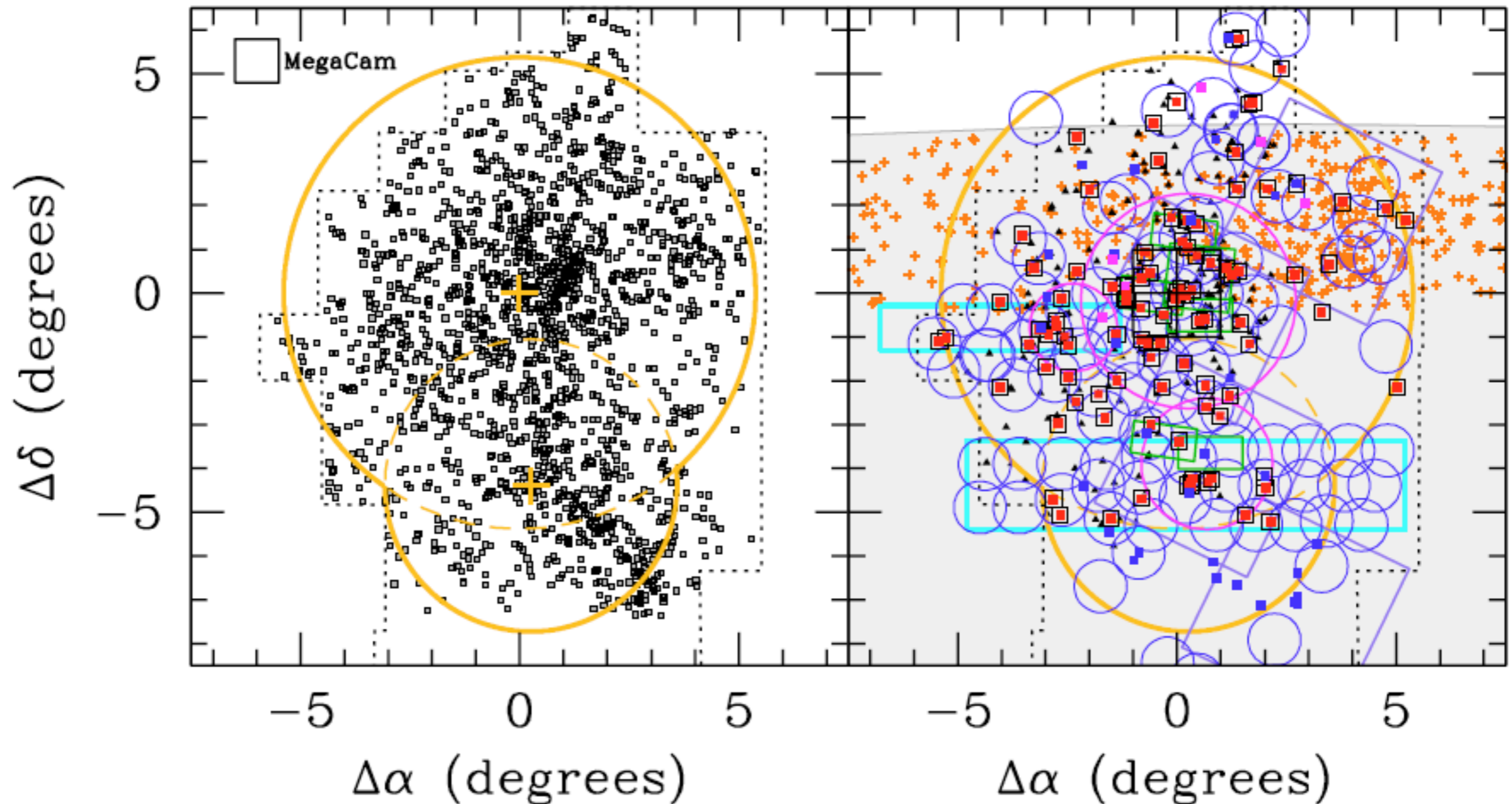
- Object detection and classification
- Virgo cluster membership
- Missing data
- Photometric redshifts
- Multi-wavelength data
- Field-to-field variation
- Completeness(mag, SB, etc. etc.)



Low
surface
brightness
galaxies

- ---- Virgo Cluster Catalog (Binggeli et al. 1985)
- + A and B subcluster centers
- ACS Virgo Cluster Survey (ACVCS), AMUSE–Virgo
– ACS, WFPC2, NIC1, WIRCam, KPNO, Keck, Gemini
– Chandra, Spitzer, VLA
- Spitzer Infrared Nearby Galaxies Survey (SINGS)
- SCUBA2 Nearby Galaxies Survey
- + Arecibo Legacy Fast ALFA Survey (ALFALFA) DR1
- ▲ SHiVir Survey (ULBCam, WIRCam, KPNO, Palomar)

- GALEX (MIS, NGS, GI programs)
- Virgo Intracluster Light Survey (Burrell Schmidt)
- Arecibo Galaxy Environment Survey (AGES)
- Herschel Virgo Cluster Survey (HeViCS)
- UKIDSS/LAS (UKIRT Infrared Deep Sky Survey)
- VirgoFIR (Spitzer/MIPS)
- Next Generation Virgo Survey (NGVS) Pilot
- NGVS Survey – R_{200} for Subclusters A and B





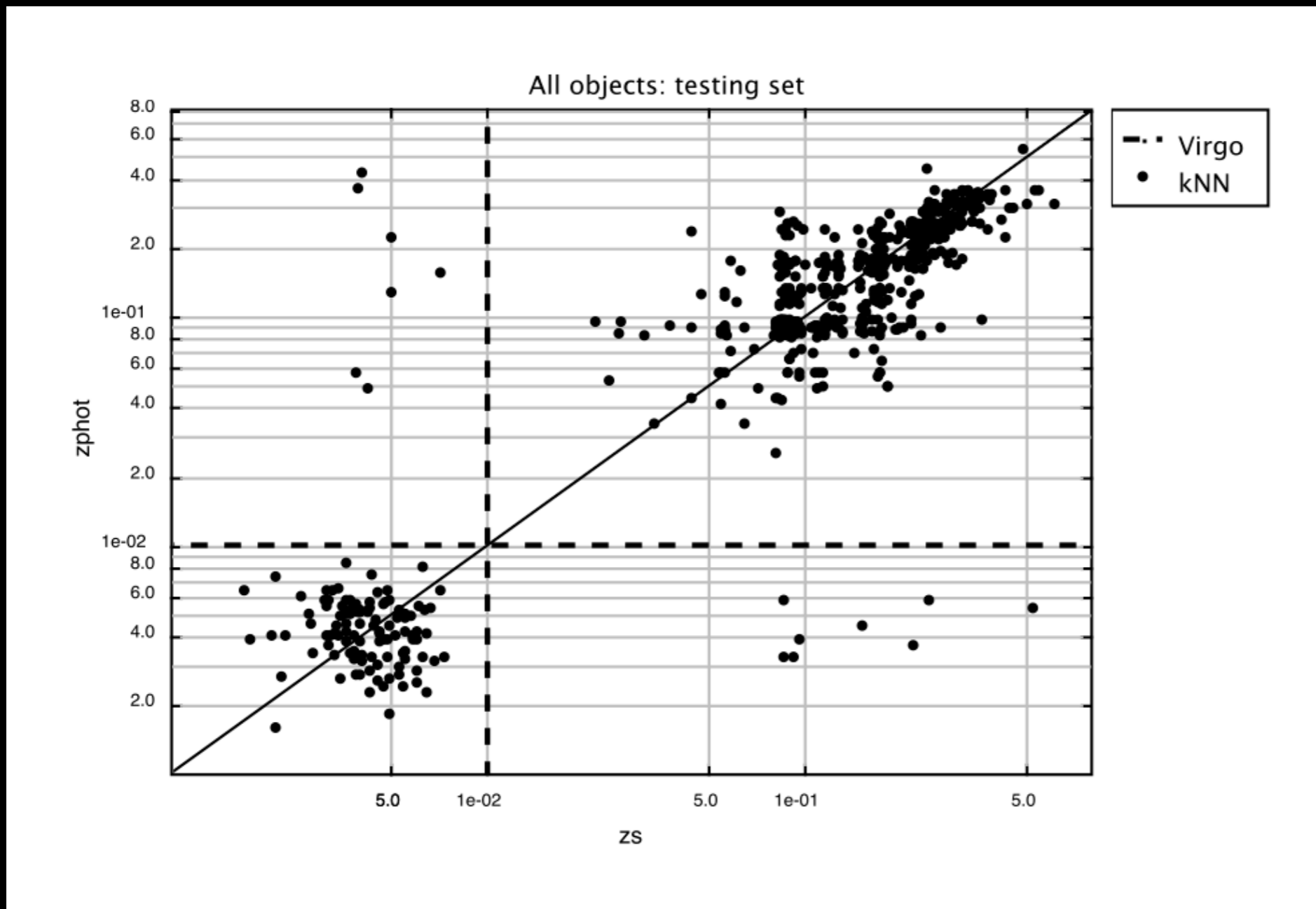
- Has been difficult to construct a catalogue
- Separating Virgo from the background
- Template-based photo-z codes fail below $z \sim 0.1$
- Empirical photo-z works but requires training set

Results



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- Rapidly speeds analysis compared to a desktop
- E.g., survey extinction corrections, simulated galaxies for the LF faint end
- Many more uses planned
- VOSpace for storing/distributing working files to collaboration



- Want data mining infrastructure in analogy to CANFAR
- Must be generic tools, and scale as $N \log N$ or better
- Tests with SkyTree software confirm it scales with large astronomy data
- Plan to compare to open-source, e.g., TMVA, SPR



- NGVS is an ideal project for astroinformatics and astrostatistics
- CADAC + CANFAR is an ideal setting on which to implement this
- Still need to be expert in it, but can get science using astroinformatics without it becoming the subject of the research itself