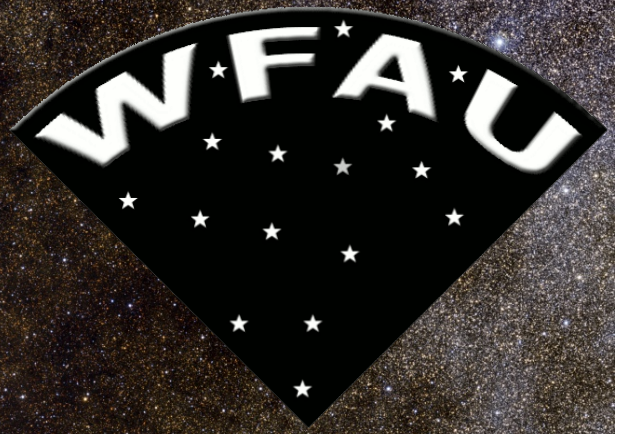

WFAU Science Archives: Facilitating Survey Astronomy

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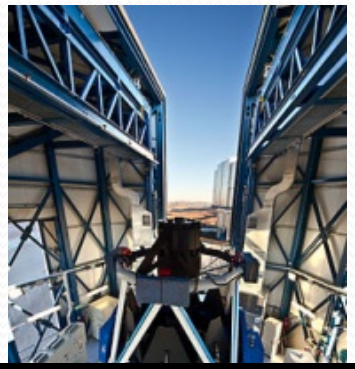
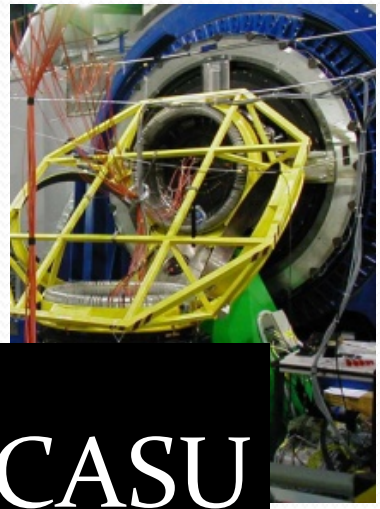
WFAU Science Archives



EARLIER PROCESSING AT CASU

See Gonzalez-Solares talk

WFCAM Science Archive

VISTA Science Archive

OmegaCAM Science Archive

Gaia ESO Survey

WFAU

Roles of the Science Archive

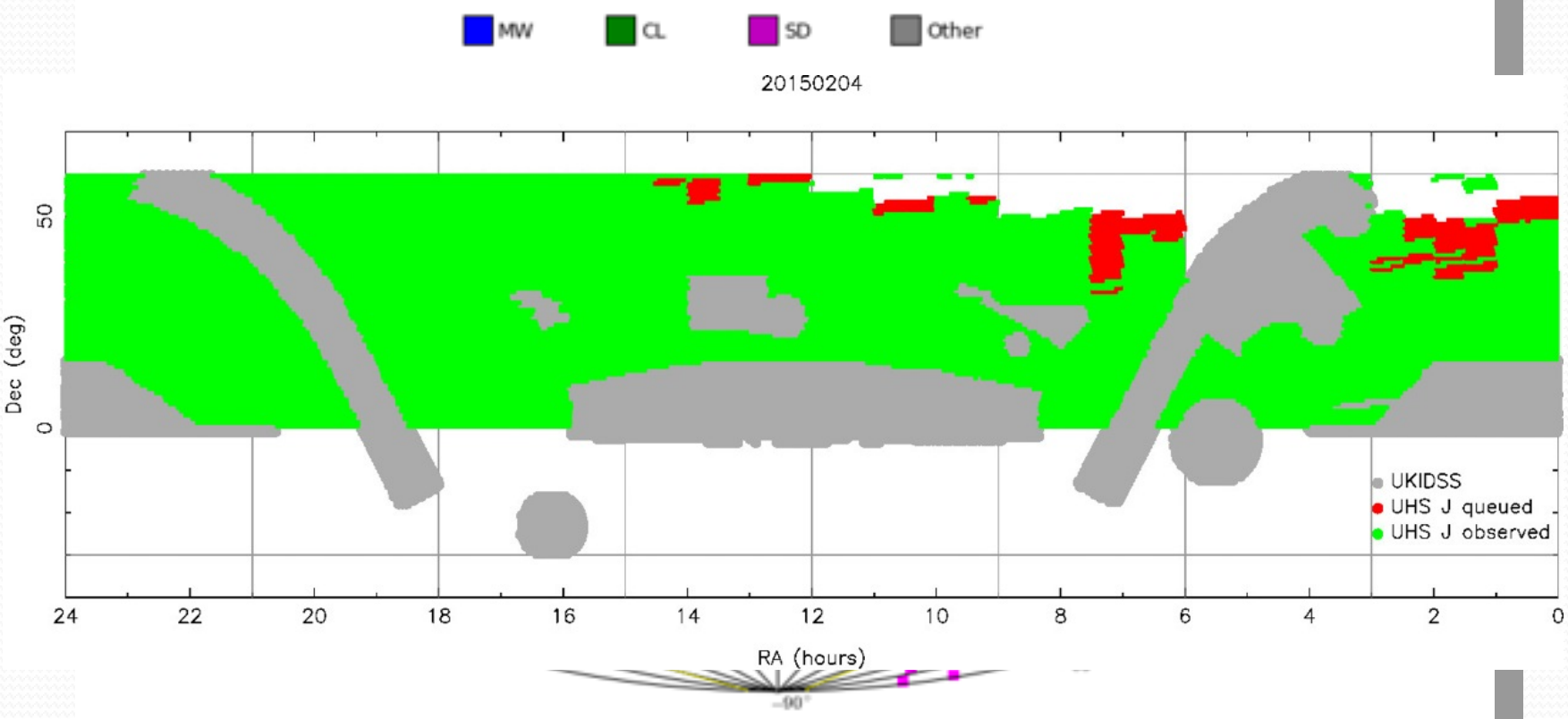
- Repository of (e.g. VISTA) data from reduced images to complex, catalogue products.
- Interface to do science – select data.
- Interface for teams to check data for quality control.
- Requires both:
  - a continuously updated dynamic main-DB: new data, better calibration, reprocessing, quality control, higher order products.
  - Static, well documented release-DBs that can be referred to in publications.

Common Design

- WSA, VSA, OSA developed through VDFS – VISTA Data Flow System
- MS-SQL database system based on SDSS SkyServer
- Similar inputs: FITS files generated by CASU
- Common software architecture, data pipeline, user interfaces, hardware architecture.
- GES is significantly different: spectroscopic, wider range of data from multiple groups, different interfaces

Surveys

WF VST: ATLAS, [VPHAS+] [ING, VIDEO



Archives: http://surveys.roe.ac.uk/

Imaging Surveys Pipeline

- Ingest from CASU (and teams)
- Provenance - link related images
- Quality Control: Automated + input from teams.
- Process data for semester - done per programme:
  - Produce and ingest deep stacks/tiles/mosaics + catalogues
  - Merge pass-band catalogues to create source tables
  - Create neighbour tables to link external catalogues
  - Link multi-epoch data and calculate variability statistics
- Release a documented, static data product to users
- Convert data to ESO format and copy to ESO (VISTA, VST)

Gaia-ESO Spectroscopic Archive

- Spectroscopic survey of ~100,000 stars, covering all major components of MW using VLT-FLAMES
- Archive includes:
  - list of targets with photometry used in the target selection
  - spectra processed by CASU
  - atomic and molecular line lists
  - Recommended astrophysical parameters derived by various working groups:
    - T_{eff}, log(g), abundances …
  - Neighbour tables to other surveys: SuperCOSMOS, VST-ATLAS, 2MASS, VISTA-VHS
- No public release yet. 3rd internal data release.

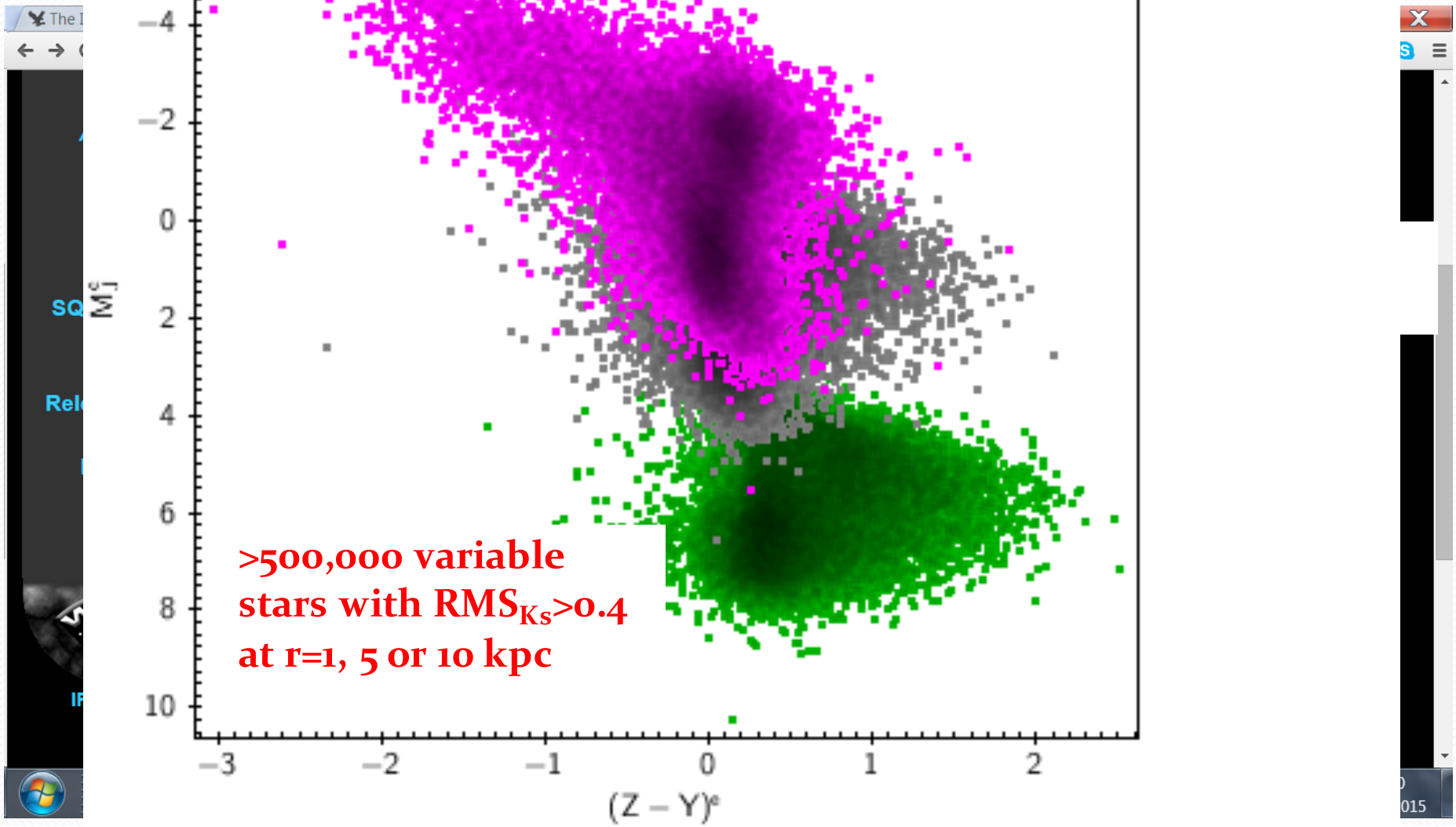
Value Added Data

- Data created by science teams:
- VMC :
  - PSF catalogues
  - Variable types (Cepheid, Eclipsing Binary)
- VVV:
  - 3D extinction maps
  - PSF catalogues (multi-band 1 epoch) + DIA light-curves [Discussions with Javier Alonso-Garcia and Eamonn Kerins]
  - Proper motion + Parallax [Not yet delivered]
- GES:
  - Wide range of parameters from multiple working groups.
- Work to improve connections of team generated data with CASU/WFAU generated to maximise usefulness.

3D Extinction Maps

- Included VVV extinction maps of bulge (Chen et al. 2013)
- Match to vvvSource.
- Filter conversions for VISTA, UKIRT, VST, Spitzer and WISE filters
- Will add in more (IPHAS, PanSTARRS …)

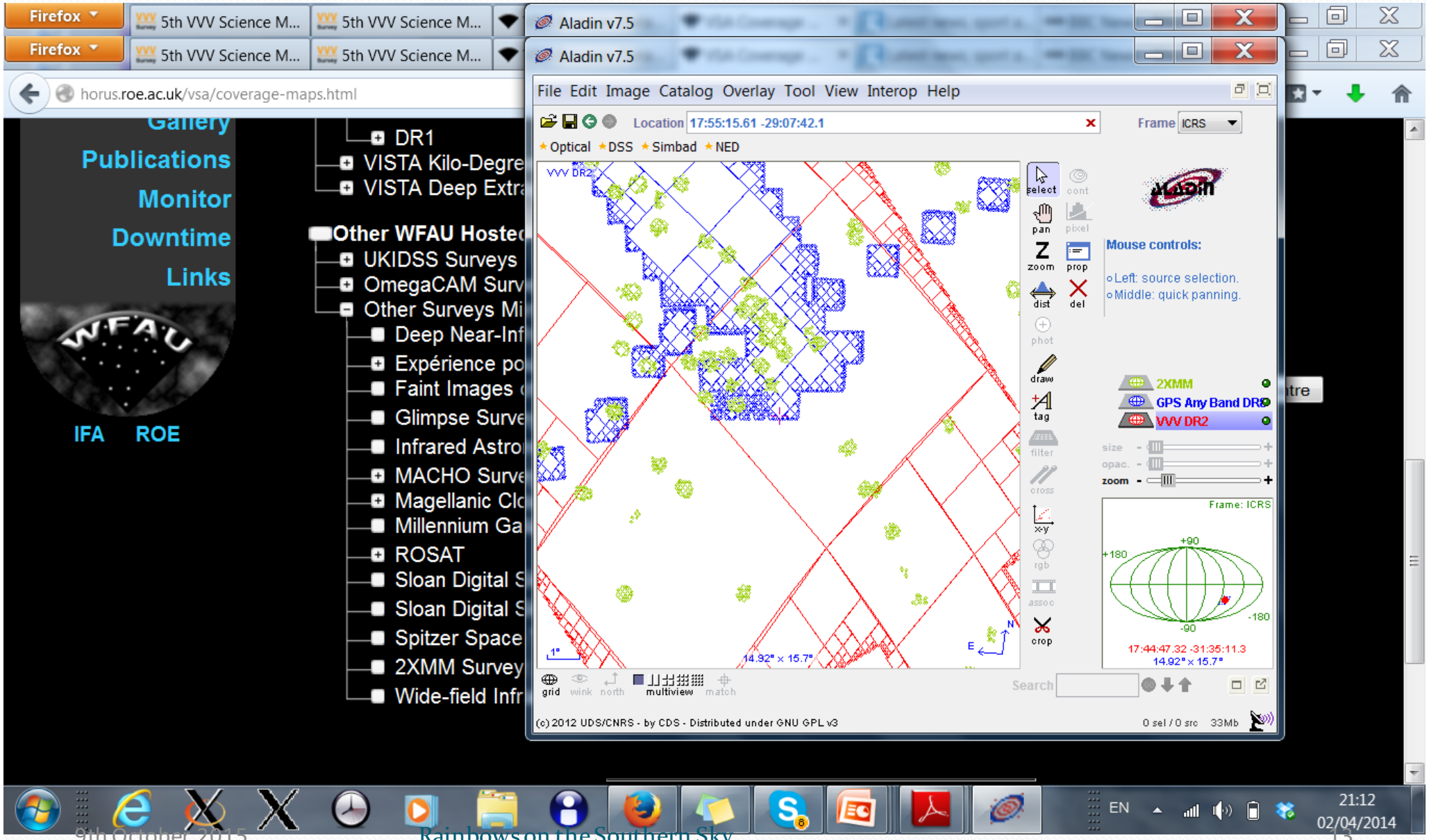
3D


1 : r = 1.
1 : r = 5.
1 : r = 10.
−6
−4
−2
0
2
4
6
8
10
M_J^e
−3
−2
−1
0
1
2
$(Z - Y)^e$
>500,000 variable
stars with RMS_{Ks}>0.4
at r=1, 5 or 10 kpc

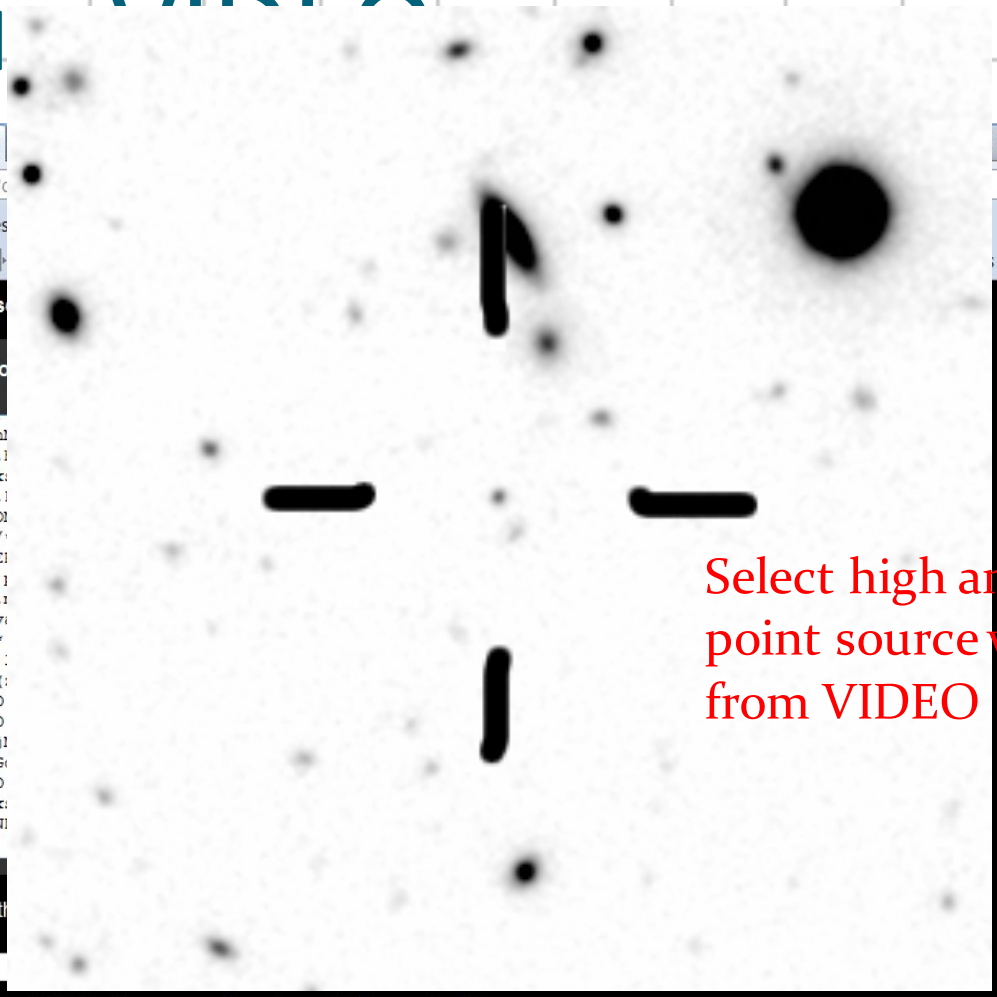
Survey Interfaces

- Coverage Maps – Multi-Order Coverage
- Archive Listing - Image/Flat file download
- GetImage / Multi-GetImage – Image cutouts
- Region – Cone search
- CrossID – Catalogue matching
- Freeform SQL – Most powerful catalogue query tool
- ADQL (OSA only so far) – Astronomical Data Query Language. To do distributed queries between archives (e.g. Gaia, PanSTARRS, LSST)
- Firethorn – MyDB works with ADQL for distributed multi-wavelength work (Under development)

Coverage Maps



An Example: Selecting point source variables i

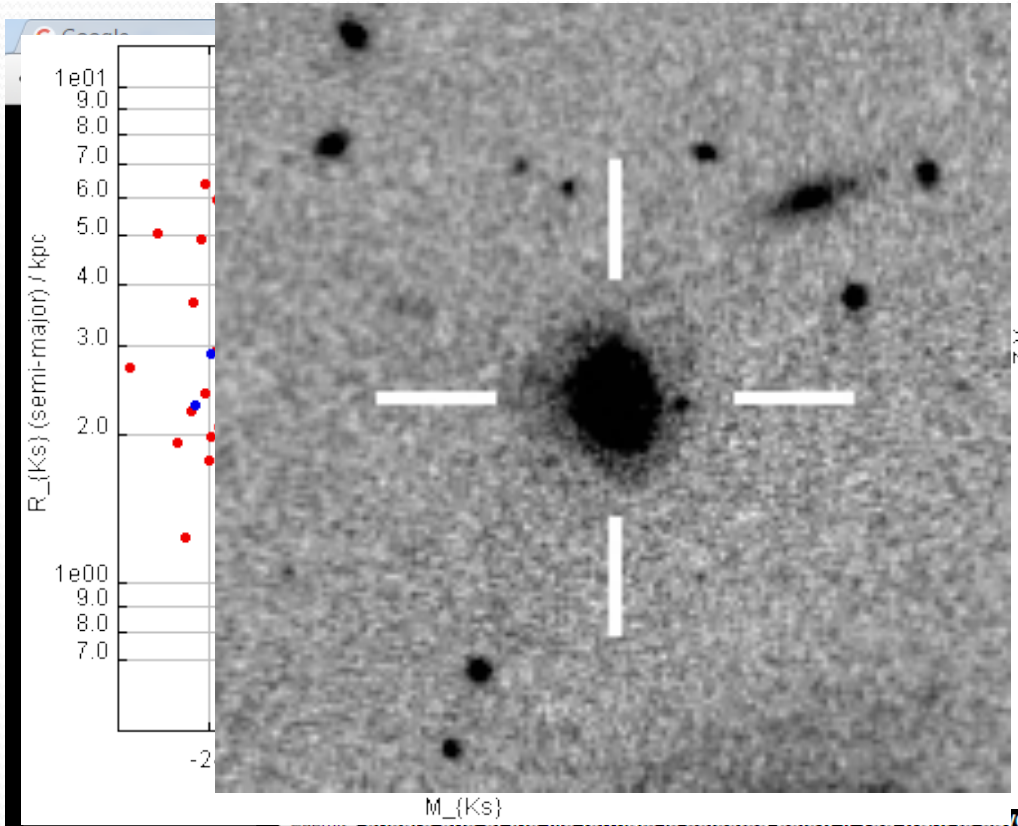


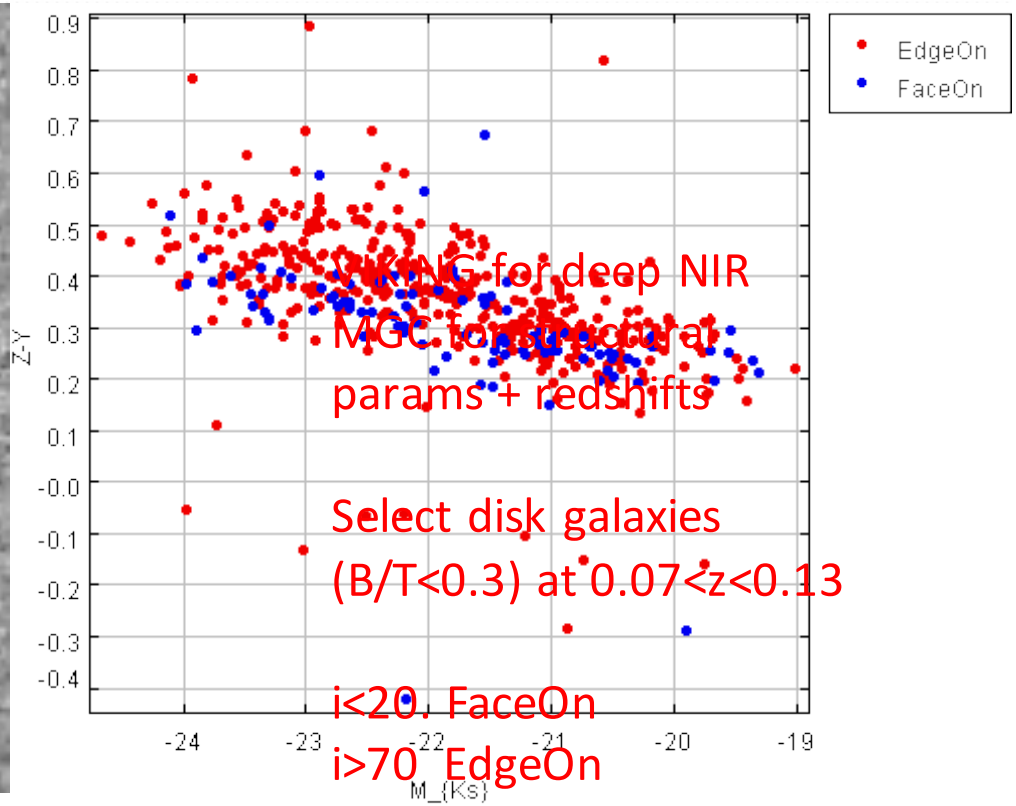
Select high amplitude point source variables from VIDEO

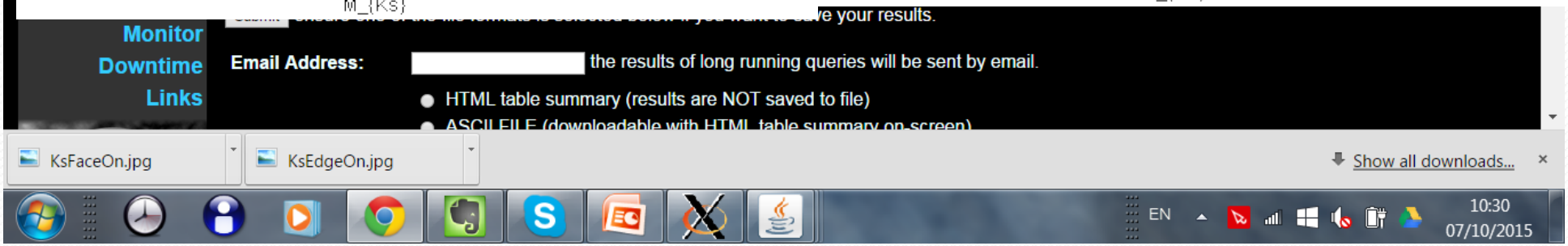
Surveys are not independent entities

- Importance of multi-wavelength astronomy
- Common survey fields
  - VIKING and KiDS
  - VST-ATLAS and VHS
  - UKIDSS LAS/UHS and SDSS
  - VVV, GPS, IPHAS, VPHAS+
- Need for data integration
  - Cross-neighbours tables, publishing to VO
    - ADQL + Firethorn to be able to link to any published.
  - Matched aperture photometry

External Datasets







Data Volumes

- Images:
  - WFCAM 1720 raw image frames a day (4 2kx2k)
  - VISTA 580 raw image frames a day (16 2kx2k)
  - VST 100 raw image frames a day (32 4kx2k)
  - ~1PB of image data
- Catalogues:
  - VVV completely dominates: combination of high source density, short exposure time.
  - Next VVV release will be 45TB (Few weeks away)
  - 55 billion detections.
  - Largest astronomical SQL database?
  - Final VVV+VVVX (?) >100TB

WFAU VDFS Publications

Hambly et al. 2008, MNRAS, 384, 637 (WSA)

Cross et al. 2009, MNRAS, 399, 1730 (Multi-Epoch processing)

Cross et al. 2012, A&A, 548A, 119 (VSA)

Various other technical documents:
http://surveys.roe.ac.uk/vsa/publications

Future work – some highlights

- Matched Aperture Pipeline:
  - imcore_list & SExtractor
  - Between surveys, inter survey, user defined
- Variable Star Selection:
  - Add in improved indices for variable selection
- Much more value added data
- MOC driven cone-searches
- MOONS?

Archive Usage