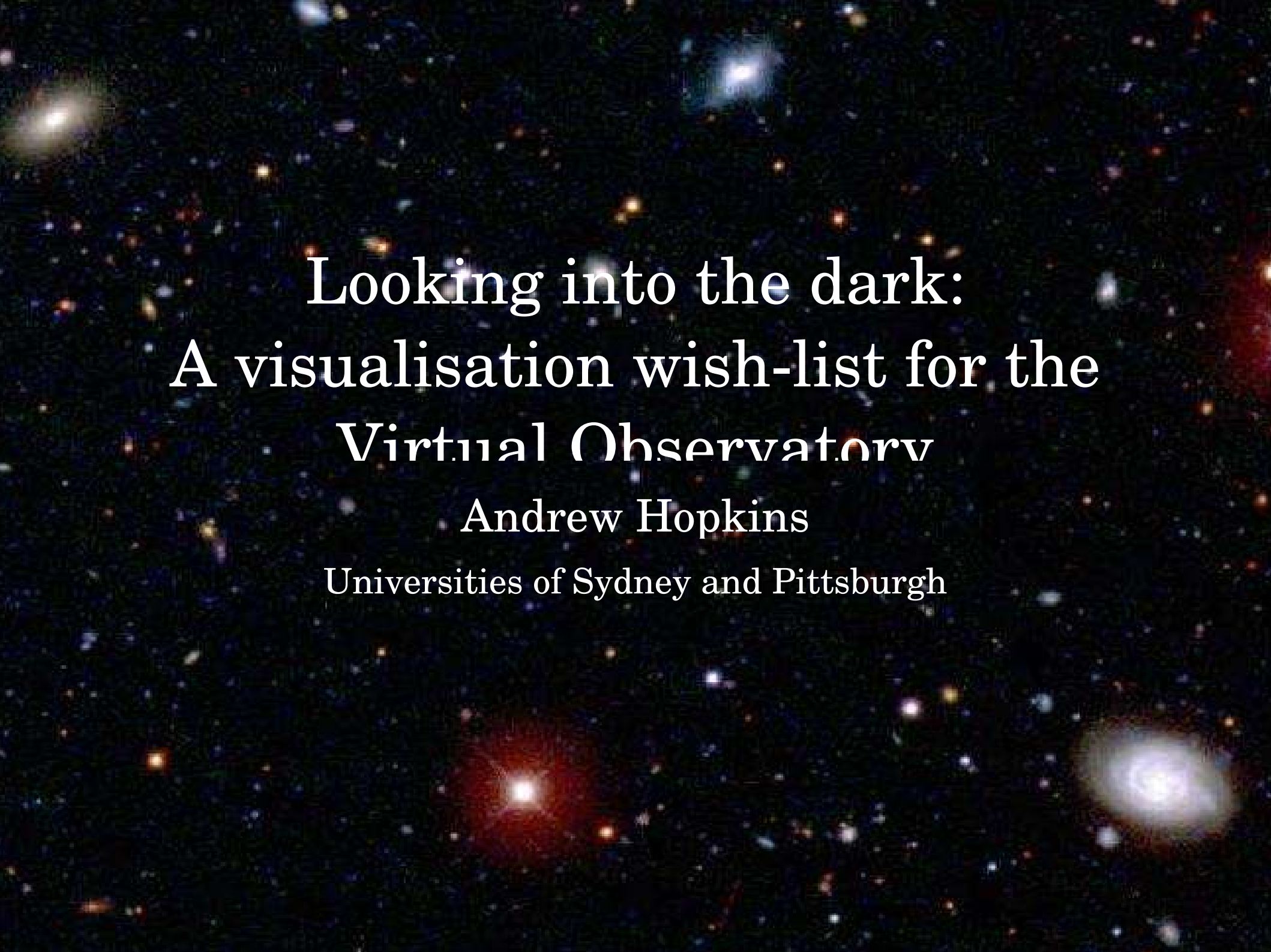

Looking into the dark: A visualisation wish-list for the Virtual Observatory

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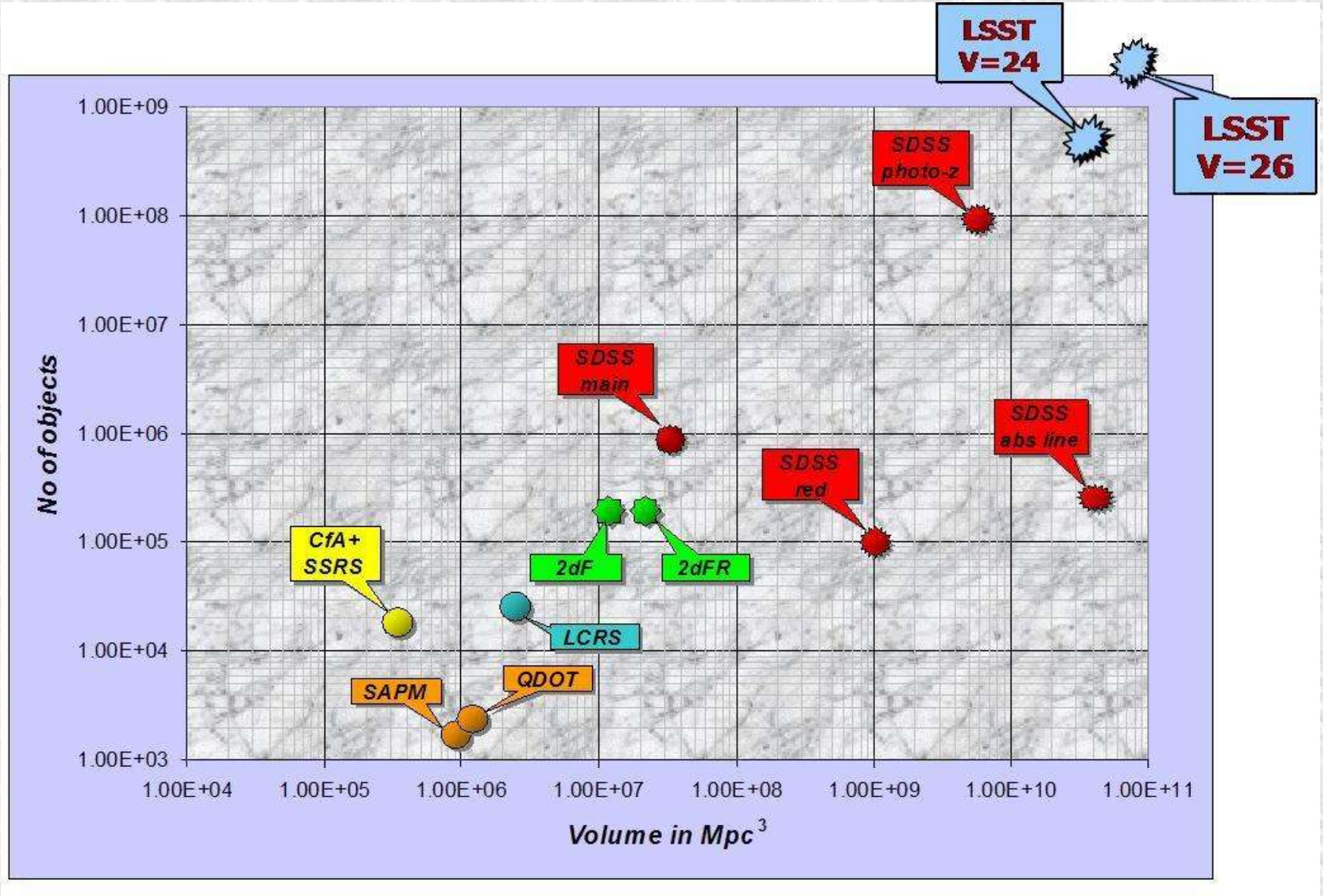
Universities of Sydney and Pittsburgh

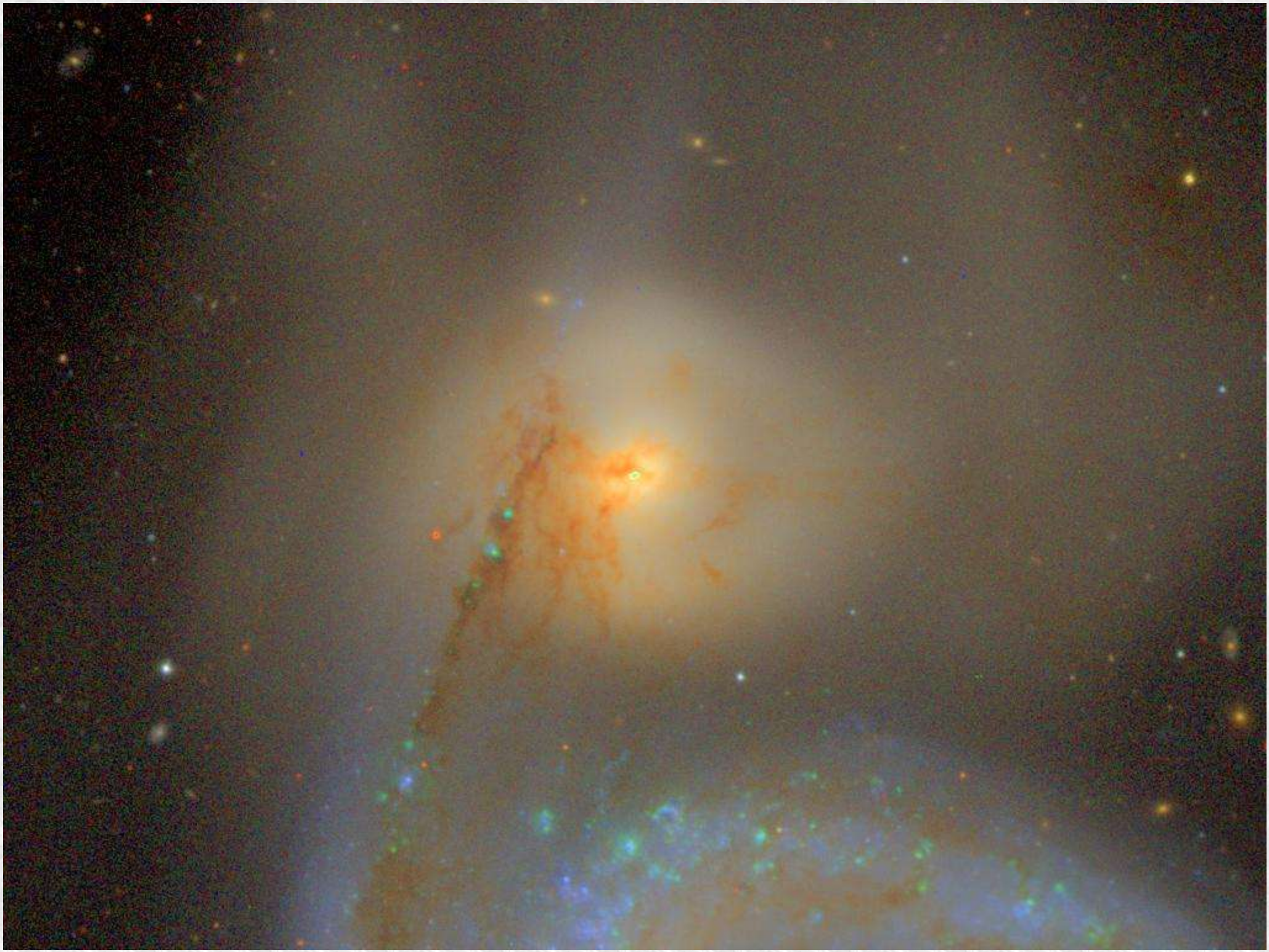
From the Macquarie dictionary:

Look: ... *-n*. ... 16. a visual search or examination.

Dark: ... *-n*. 5. absence of light;... 6. ignorance.

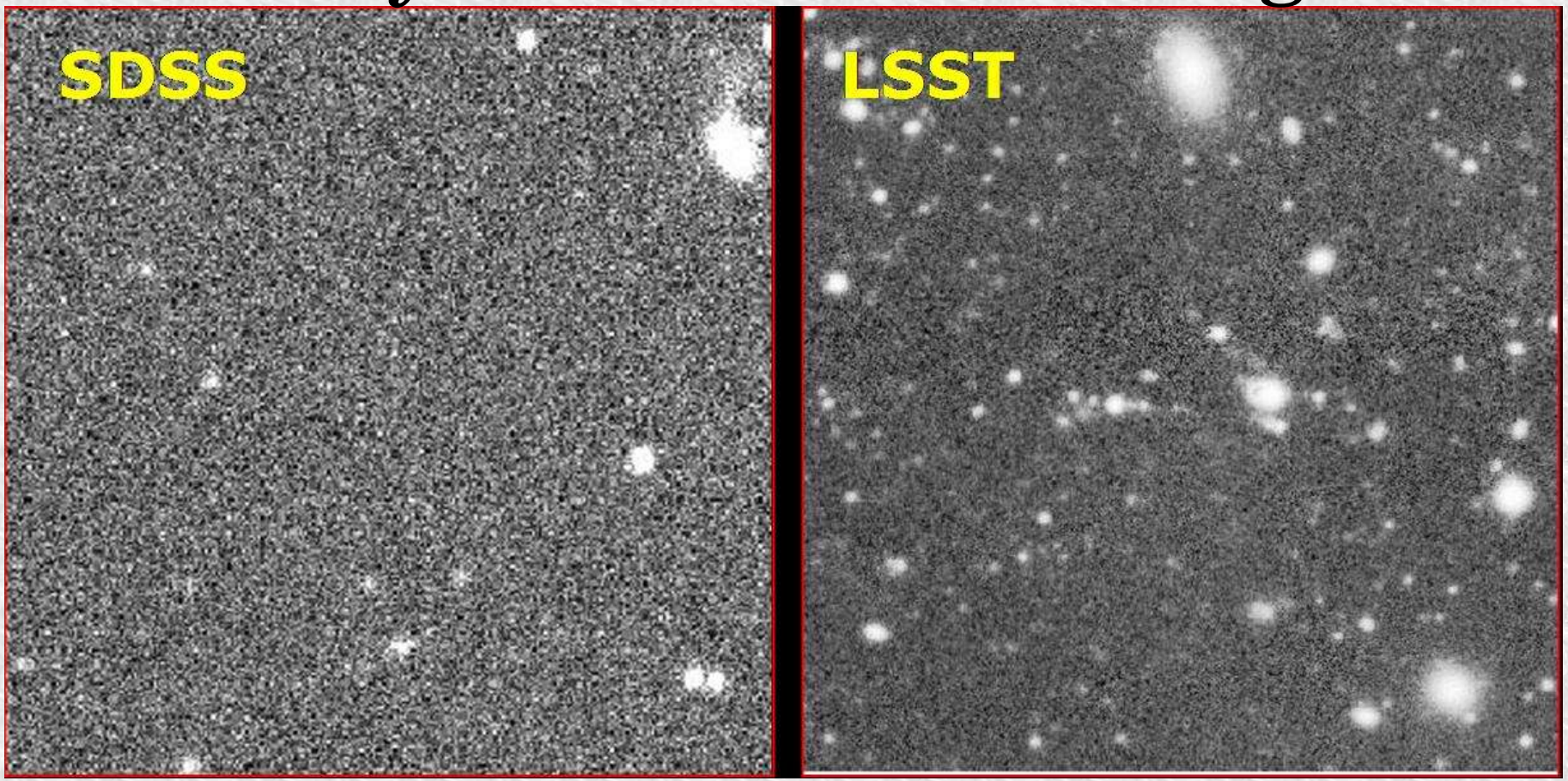
The Data Avalanche





Five years

Three nights



An incomplete list

- A few specific cases where analysis tools exist or are being developed, and good visualisation tools are necessary to support the analysis.
- Suggestions for an environment that may make some visualisation tools more accessible and easy to interact with.
- The concepts here may be able to be generalised and implemented as more widely applicable tools by clever visualisation experts.

Anomaly detection

- Bayesian classification and expectation-maximisation (EM) using high dimensional parameter space.
- Outliers can be identified as interesting for further investigation.
- Huge datasets make the straightforward process of identification and follow-up much more complex and time-consuming.
- Tools for exploring data to make this process quick and easy would facilitate research.

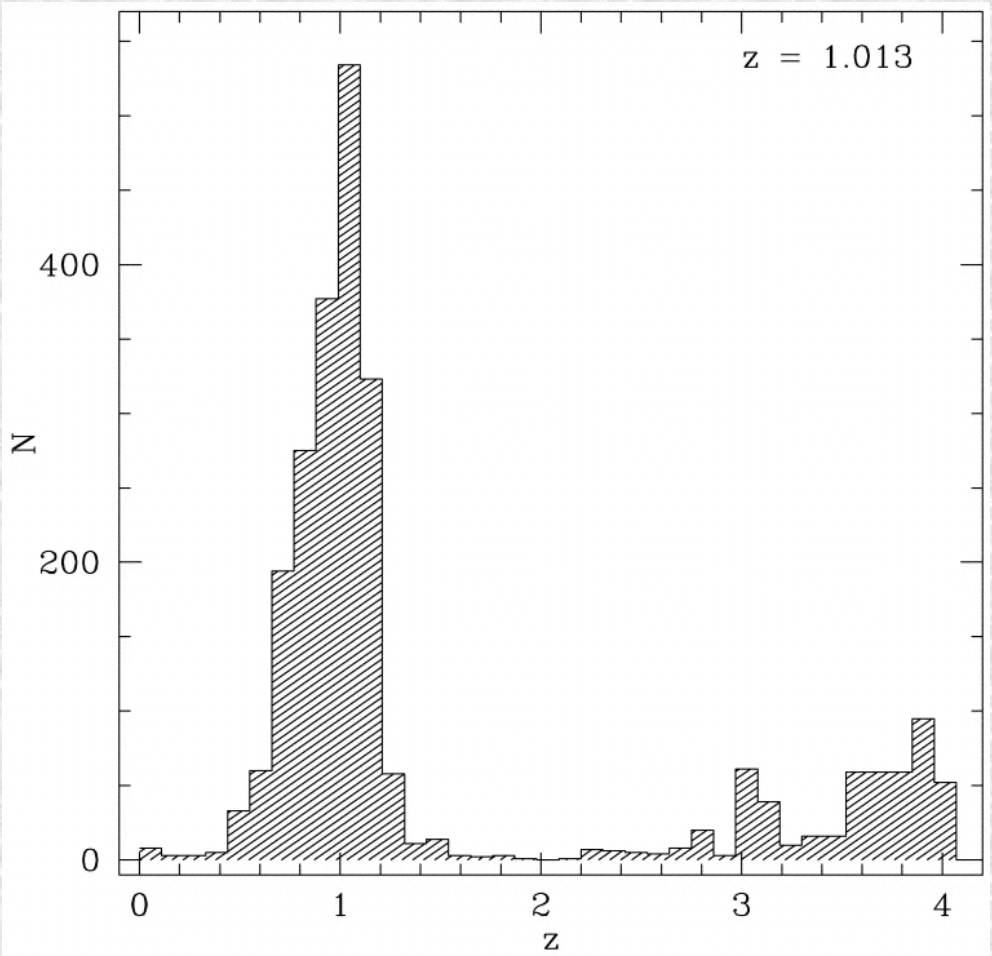
Minimum spanning trees

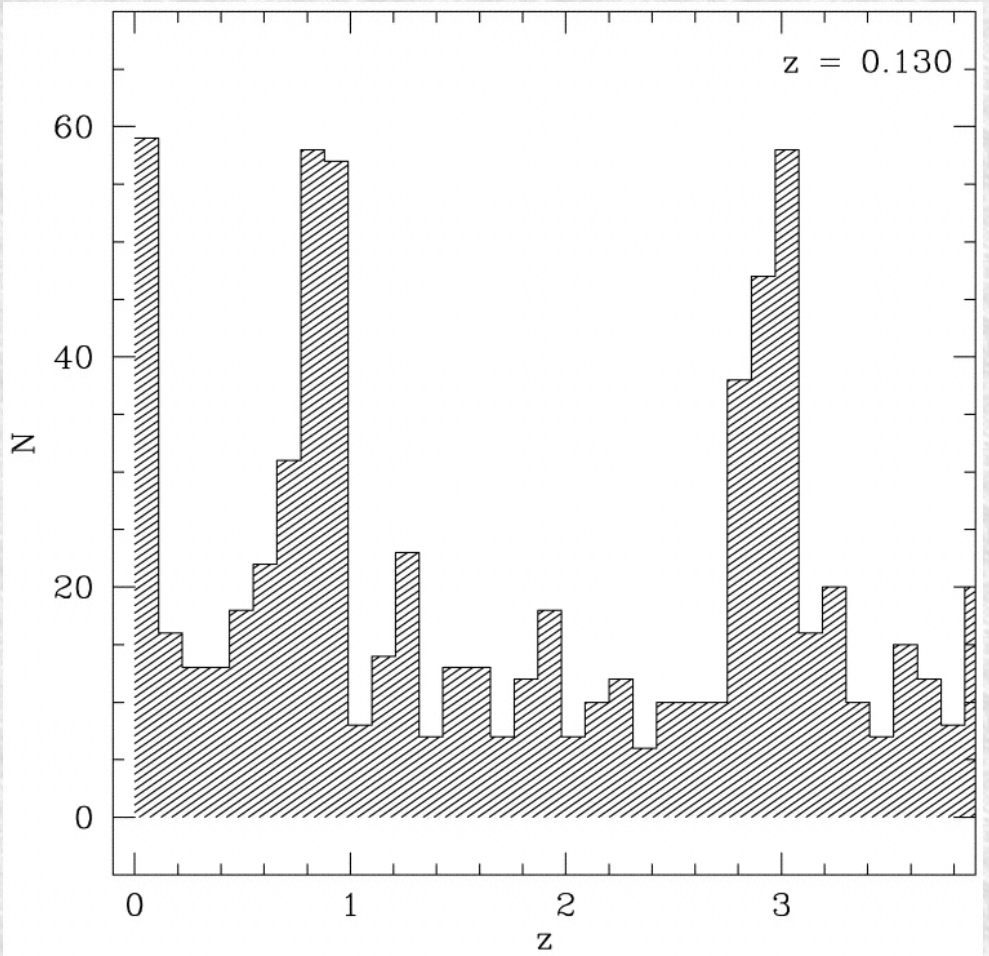
- Looks for relationships between measurements in high-dimensional parameter space.
- Varying levels of correlation between parameters is complex to display in two or even three dimensions.
- Identifying correlations within data provides valuable scientific insight into physical processes underlying measured properties.
- New tools necessary to allow this technique to be applied to existing and future survey data.

Pixel-z

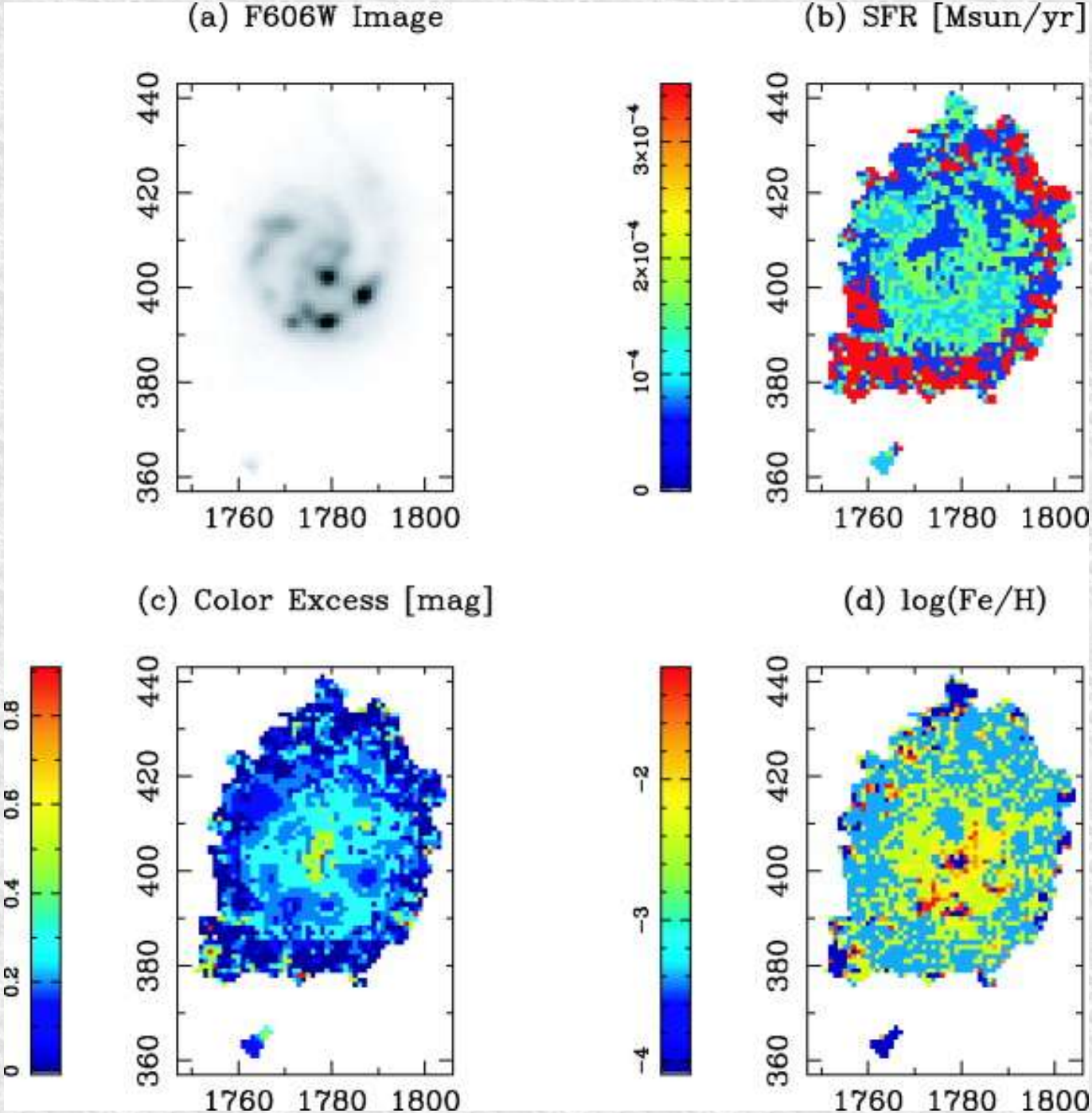
- Uses SED fitting to each pixel of a galaxy image.
- Given a library of SED templates of known age, metallicity, SFR, obscuration, these values can be determined for each pixel.
- Error images corresponding to each parameter are also generated.
- This technique can be used to generate “Fossil Images” for galaxies, by using the SED histories, to explore how galaxies may have looked at an earlier stage in their evolution.

Pixel-based redshift histograms

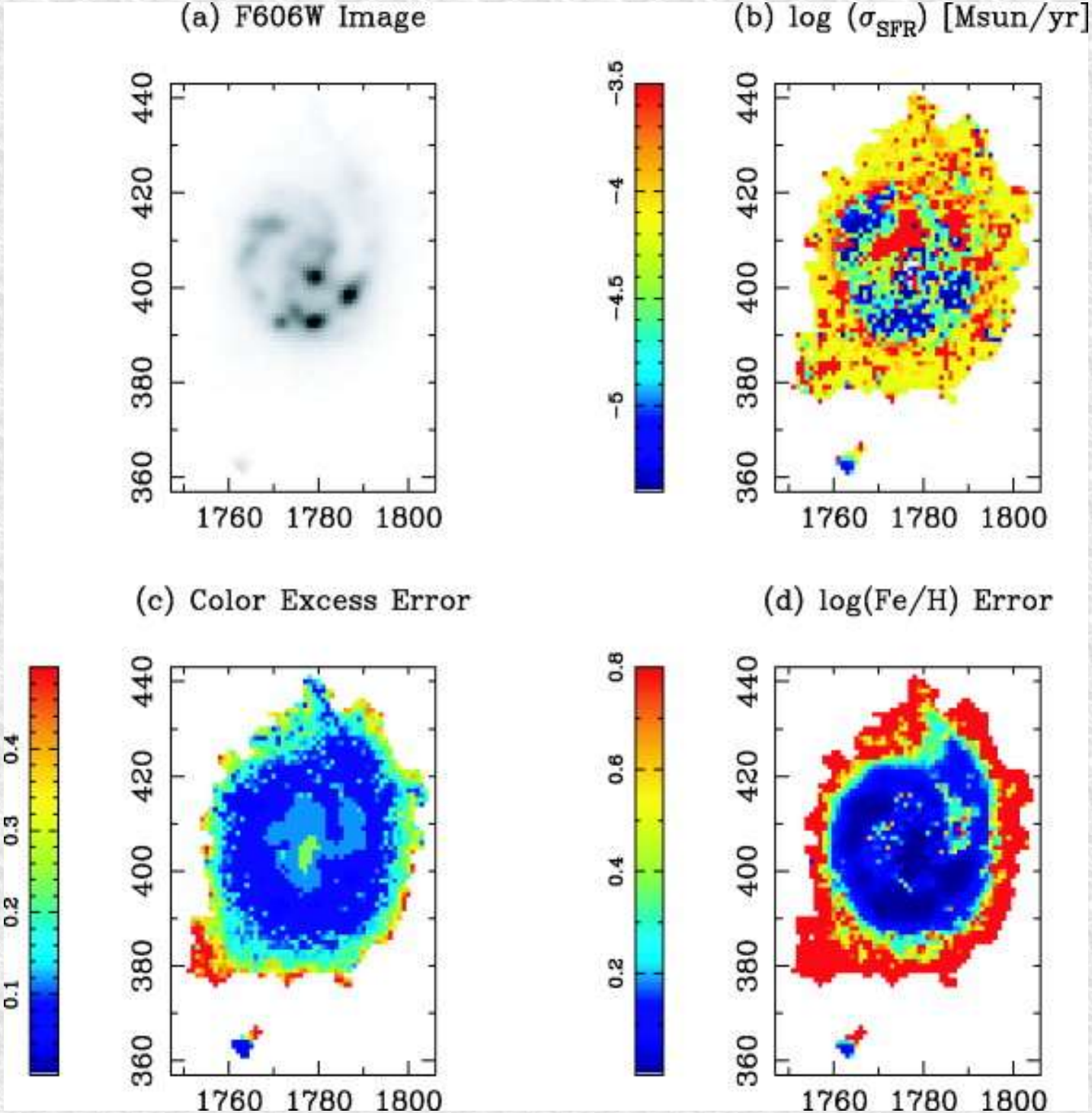




Conti et al., 2003 AJ 126, 2330

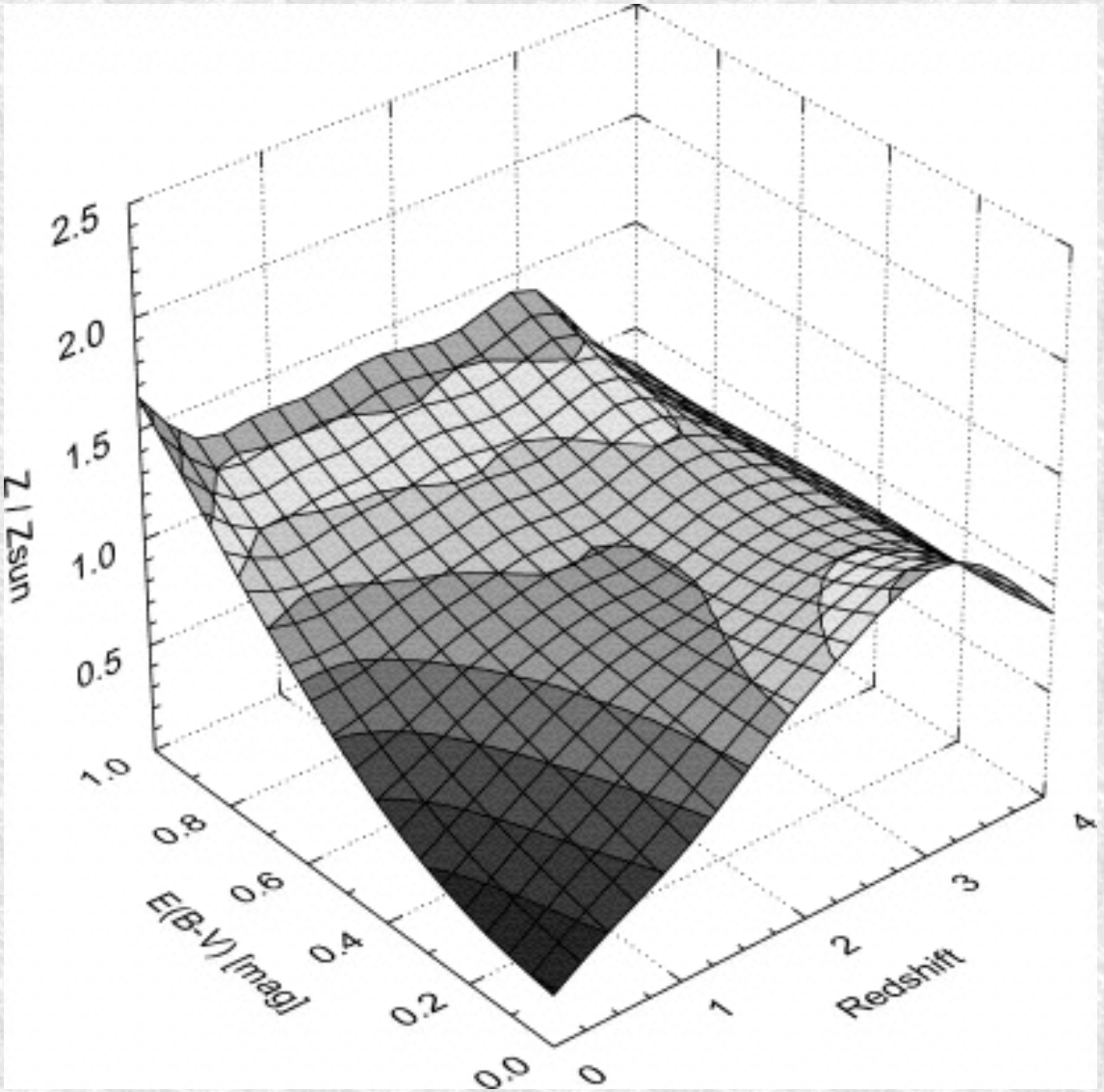


Conti et al., 2003 AJ 126, 2330



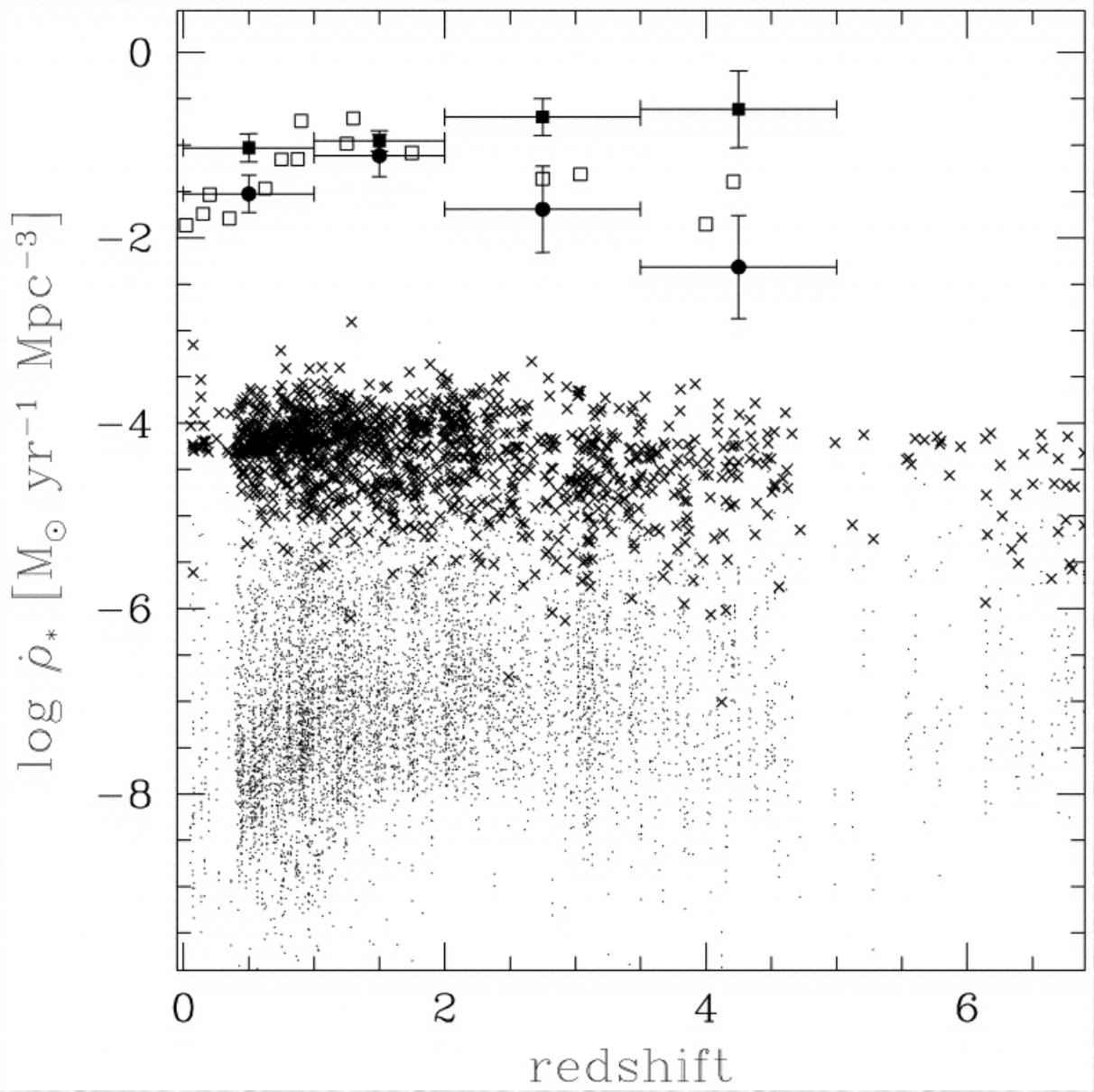
Conti et al., 2003 AJ 126, 2330

Metallicity-Obscuration vs Redshift



Conti et al., 2003 AJ 126, 2330

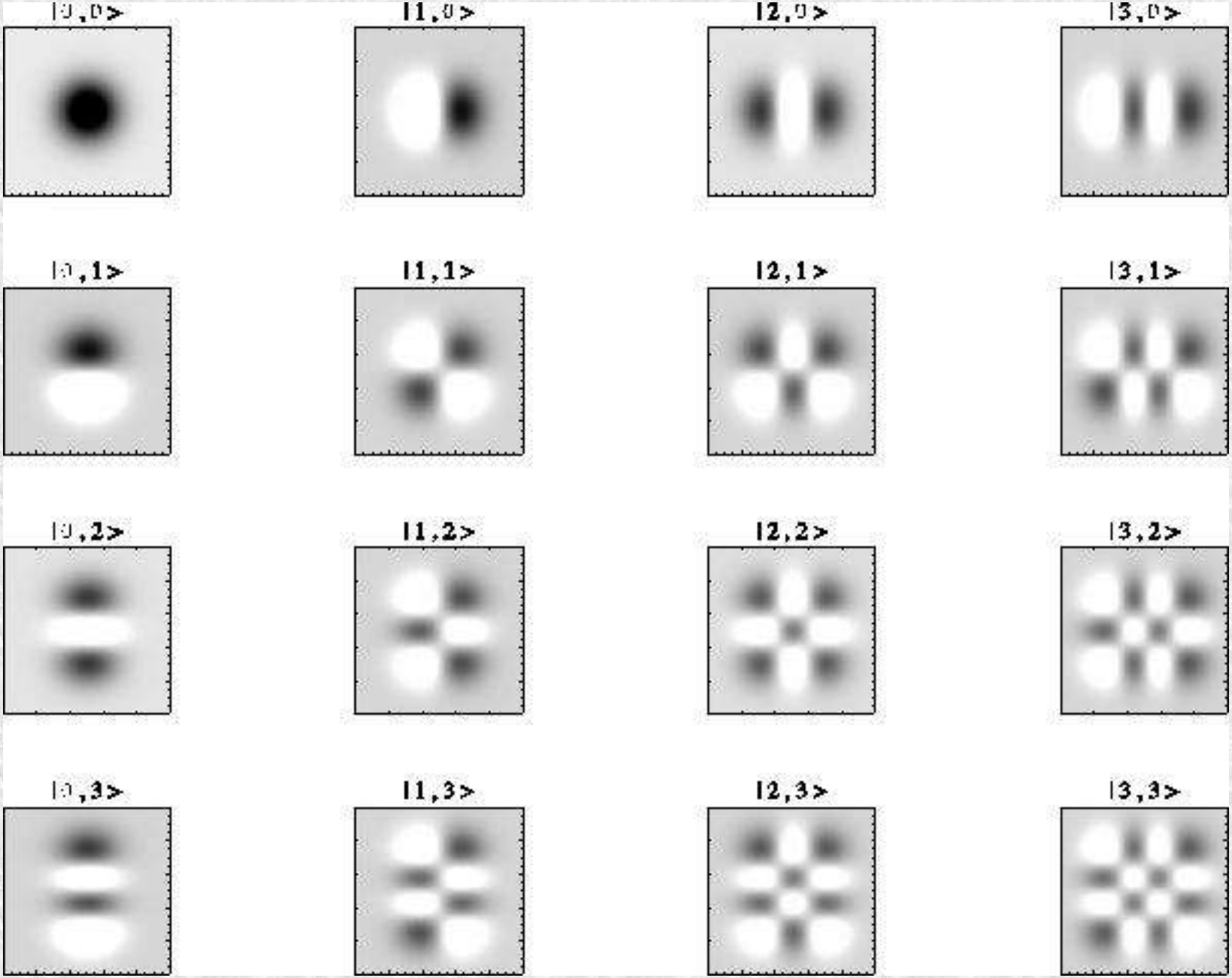
Star formation rate density vs Redshift



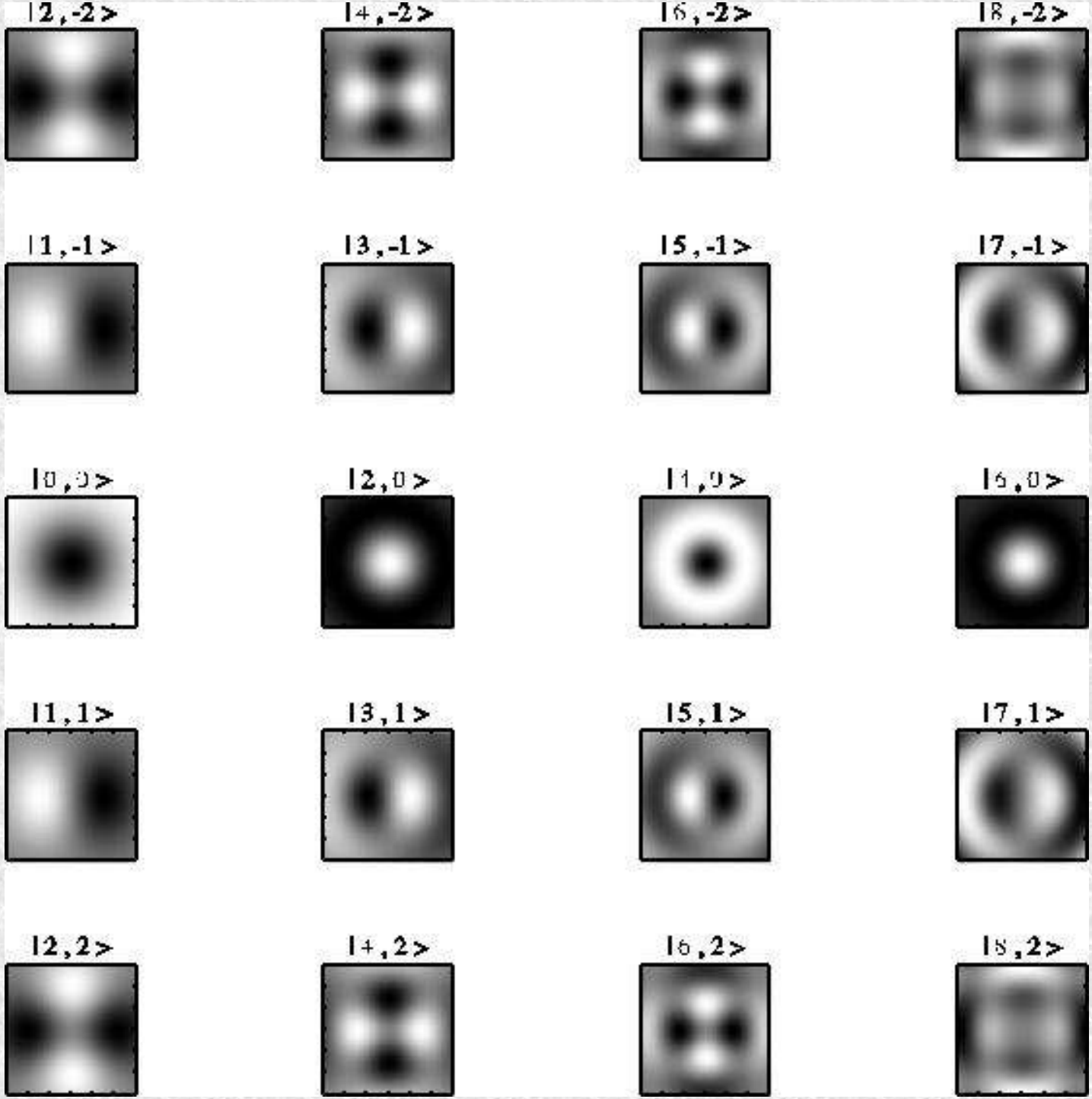
Conti et al., 2003 AJ 126, 2330

Quantitative Multiwavelength Morphologies

- Uses “shapelets” (Hermite polynomials) as a basis function for decomposing images.
- Uses multiwavelength image information.
- Uses PCA (KL-transform) to reduce the dimensionality in the final shapelet basis space. Each of the final principal components contains unique spectro-morphological information.
- Uses a gaussian mixture model to separate galaxies in the final principal component space and derive classifications.

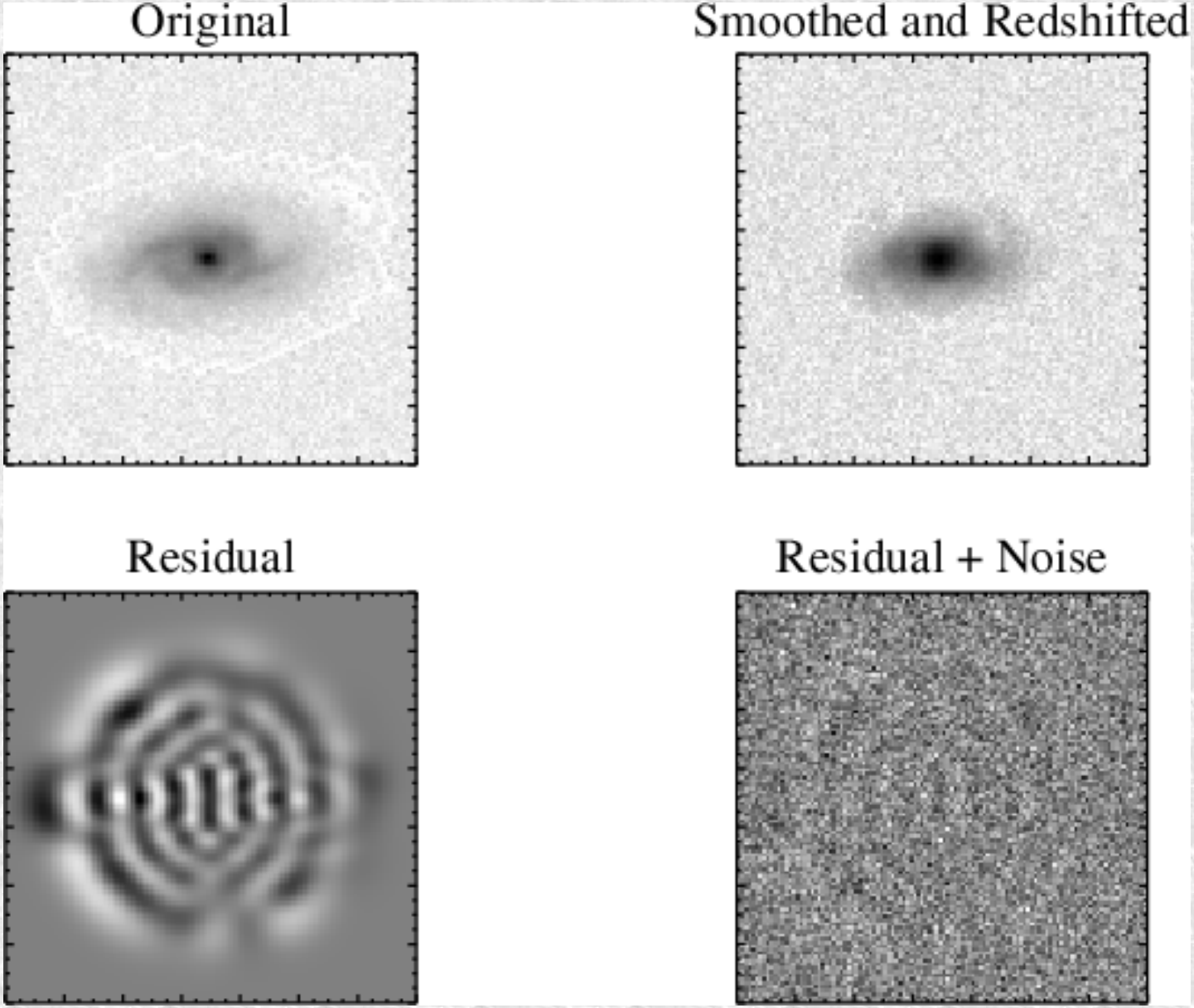


Kelly & McKay 2004, AJ, 127, 625



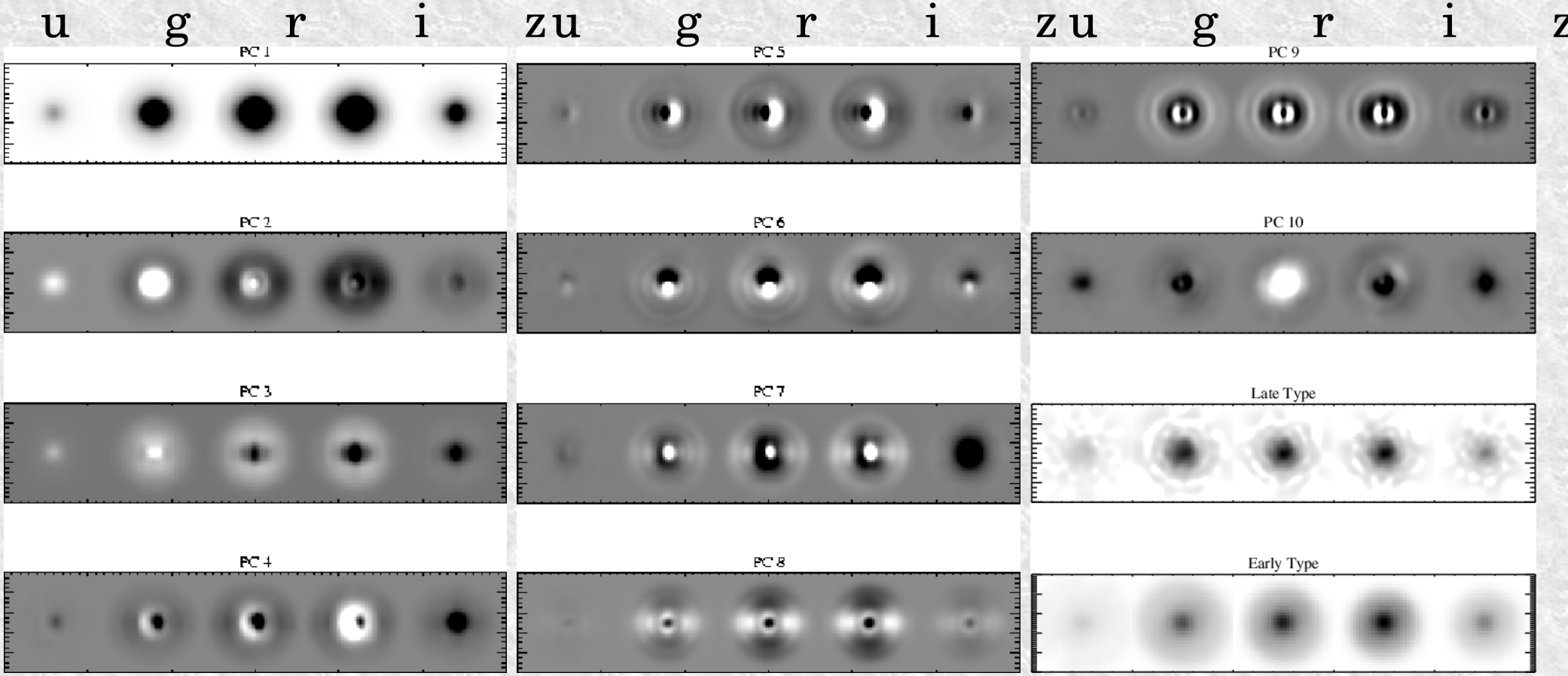
Kelly & McKay 2004, AJ, 127, 625

Galaxies resampled



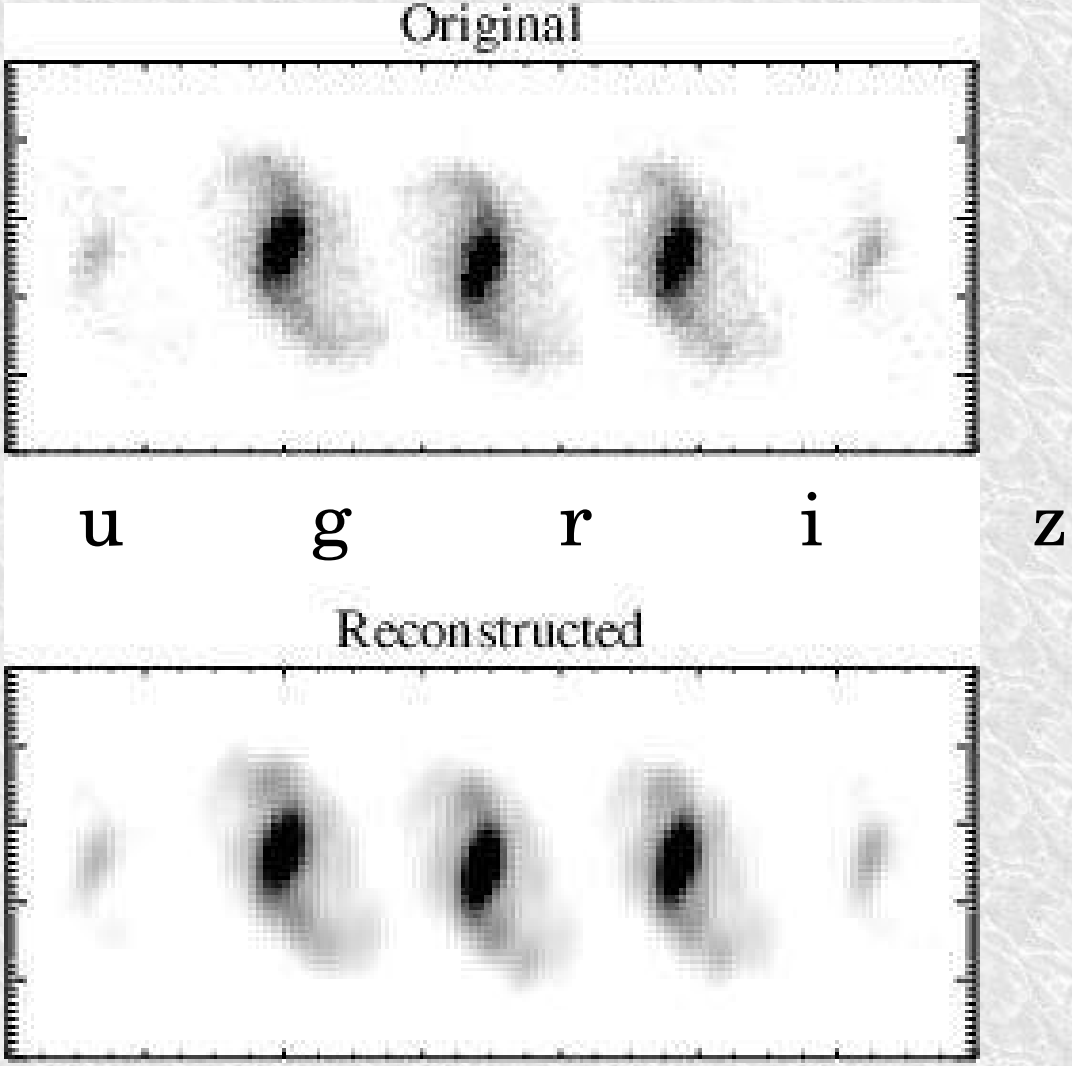
Kelly & McKay 2004, astro-ph/0401441

The first 10 “Eigenmorphologies”

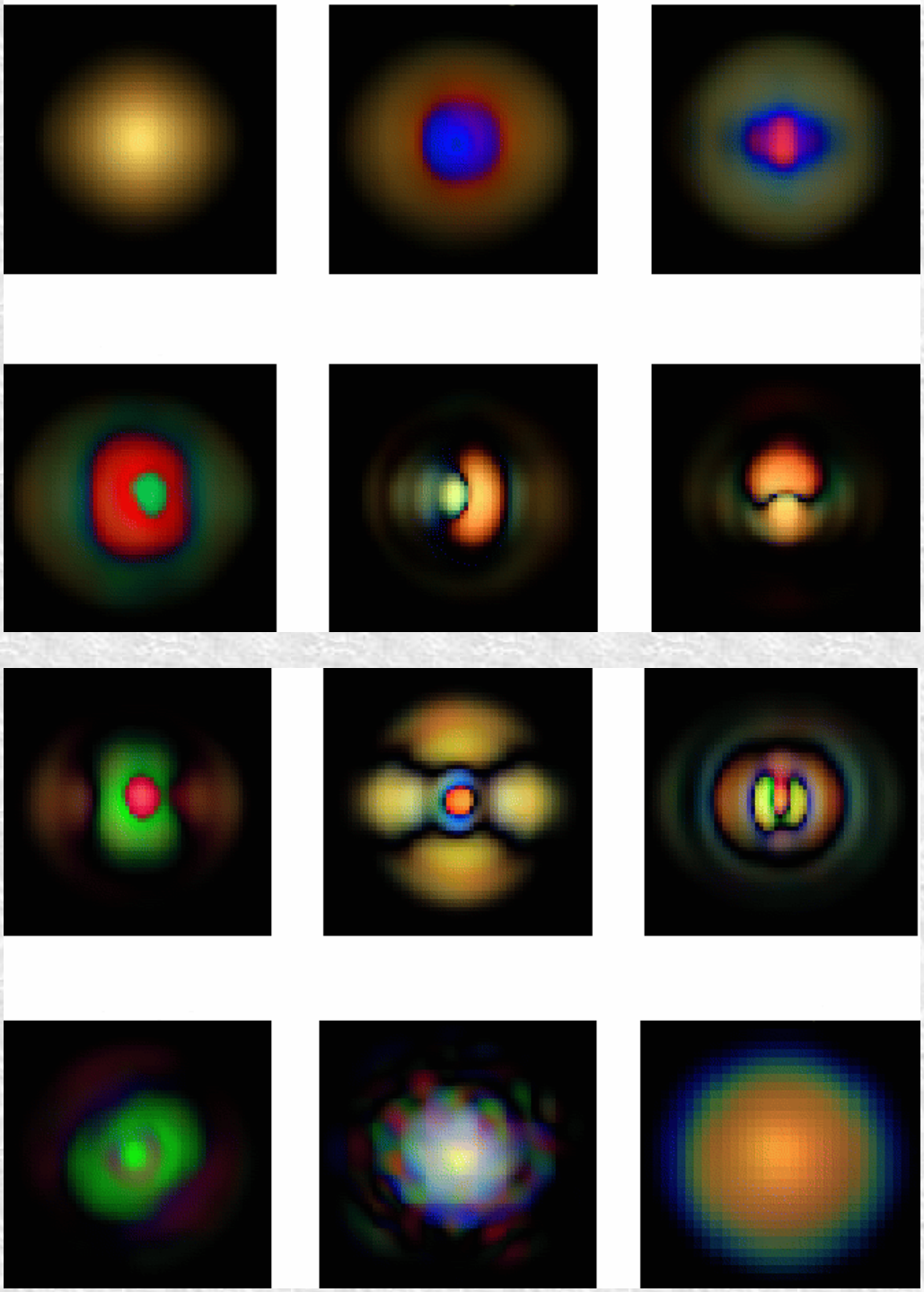


Kelly & McKay 2004, astro-ph/0401441

Image reconstruction



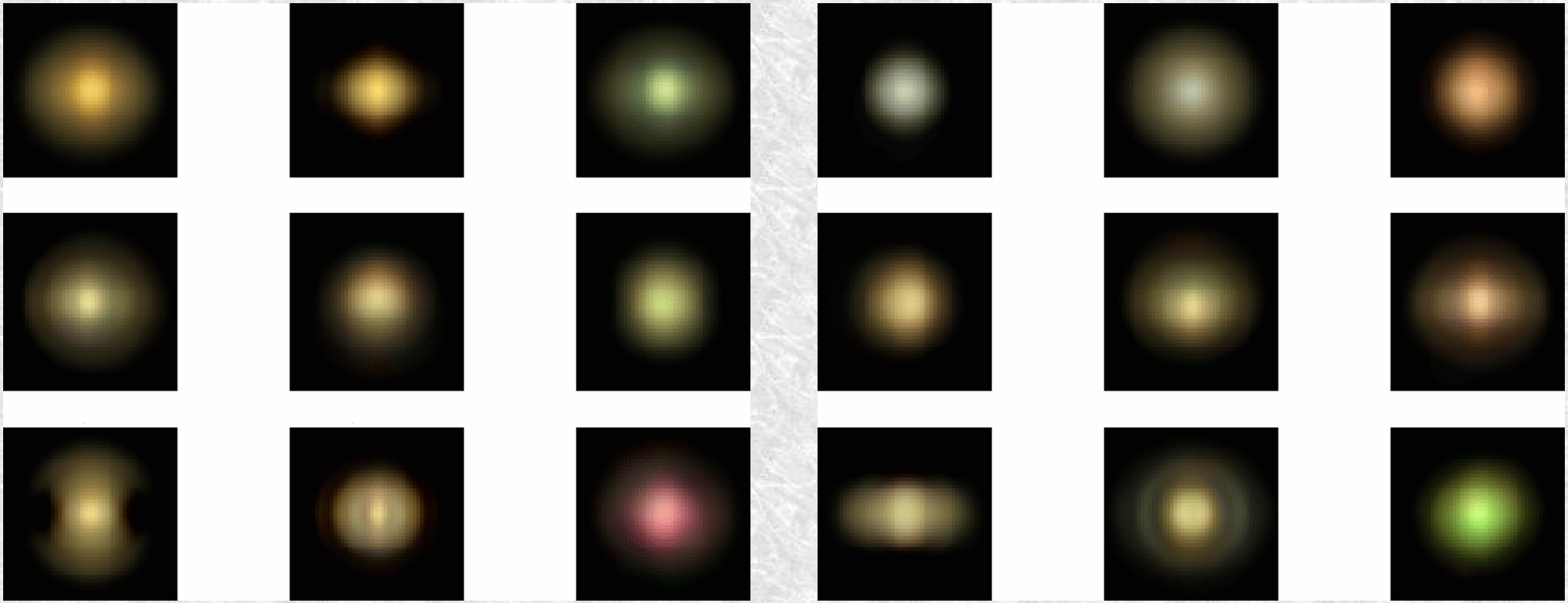
Kelly & McKay 2004, astro-ph/0401441



gri color composite images from the energy (v_i^2) for each eigenmorphology

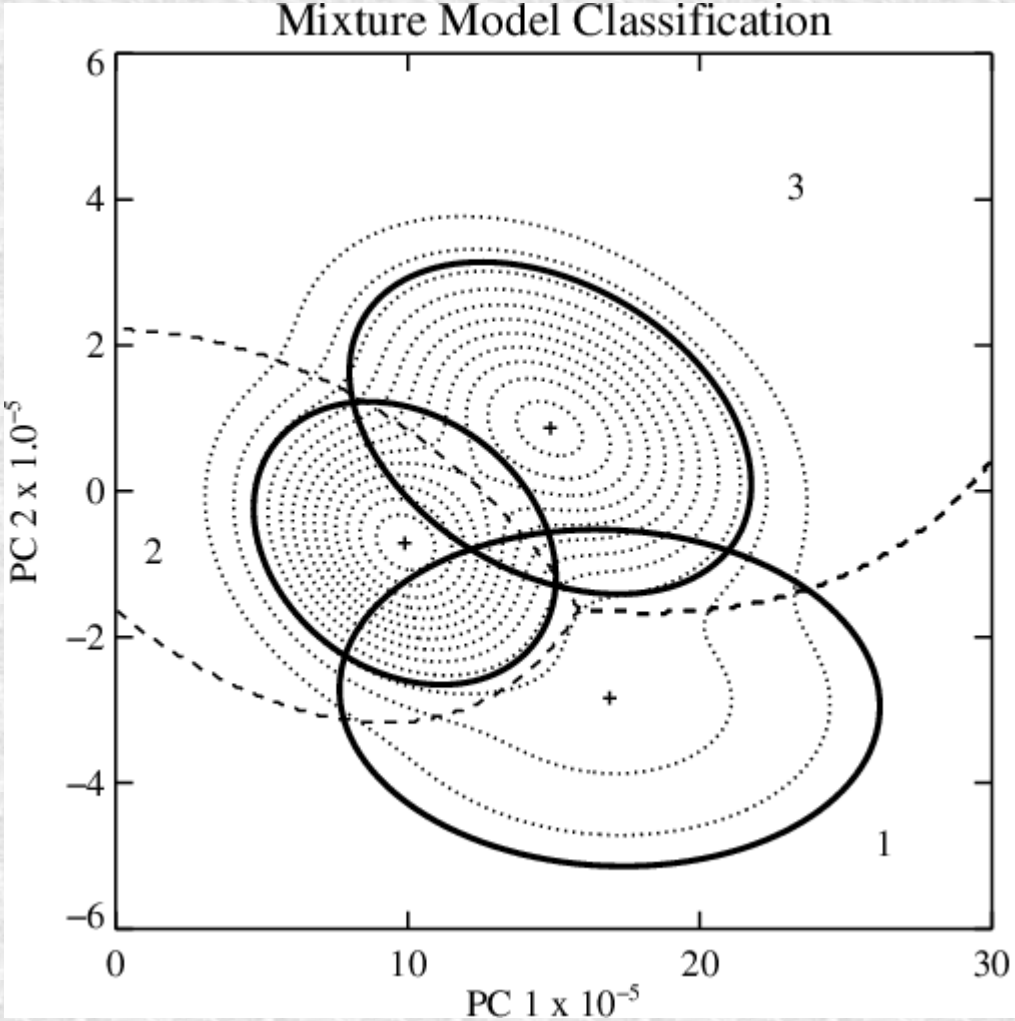
Kelly & McKay 2004, astro-ph/0401441

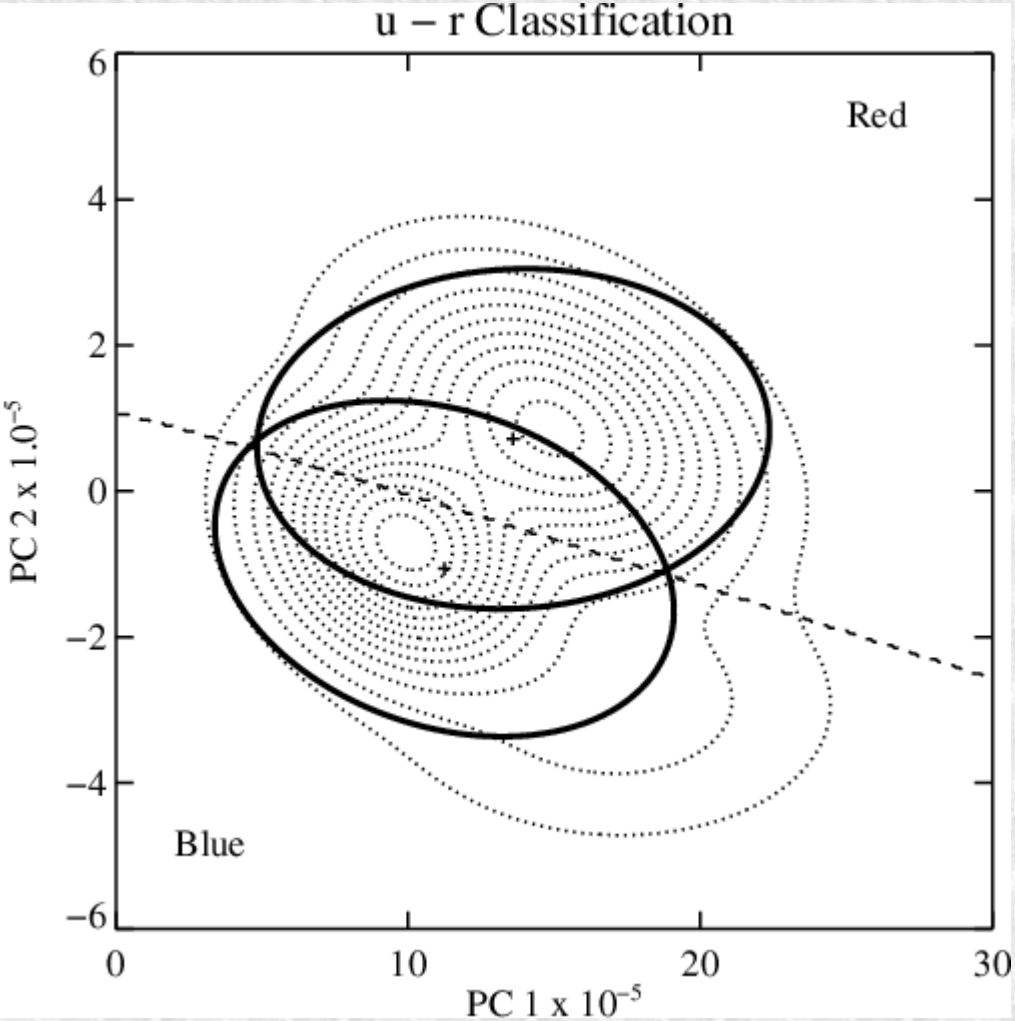
Adding and subtracting v_i to v_1



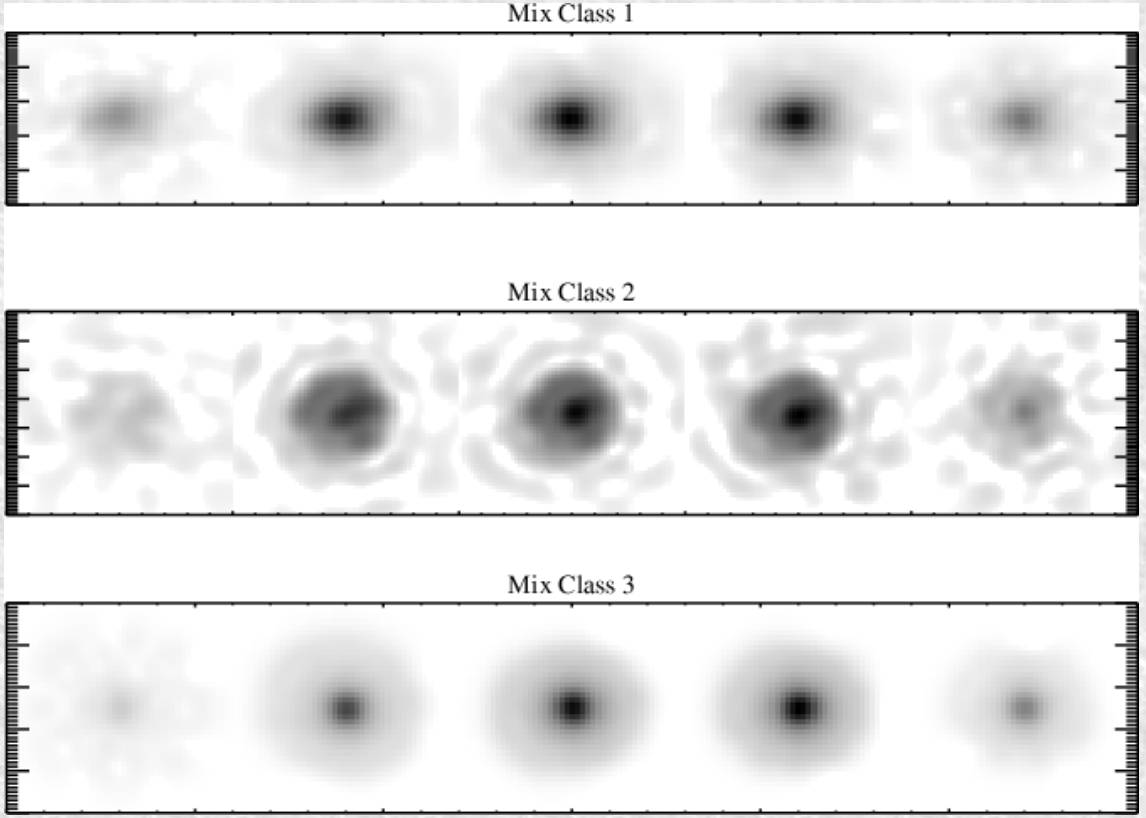
Kelly & McKay 2004, astro-ph/0401441

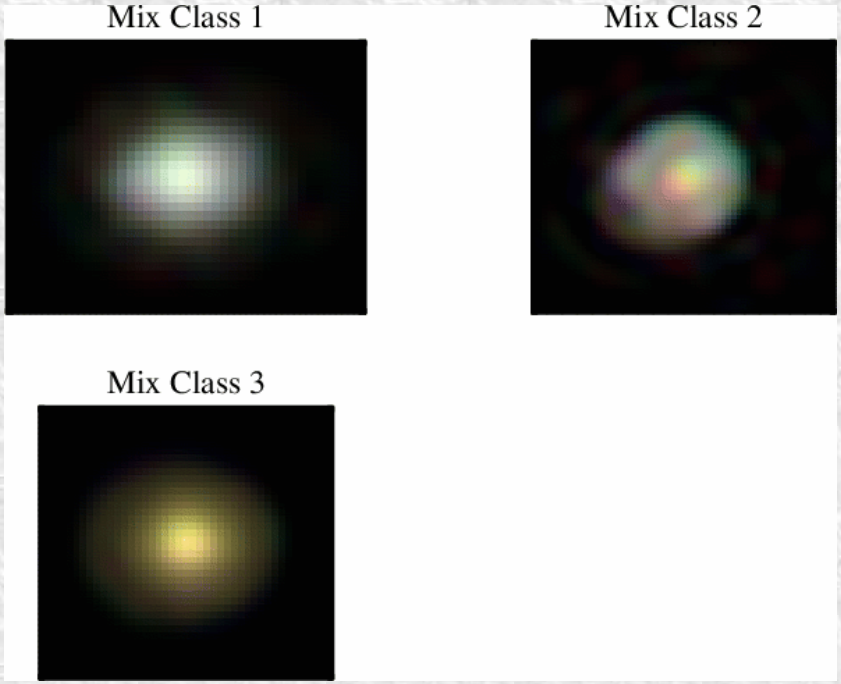
Classification





Kelly & McKay 2004, astro-ph/0401441



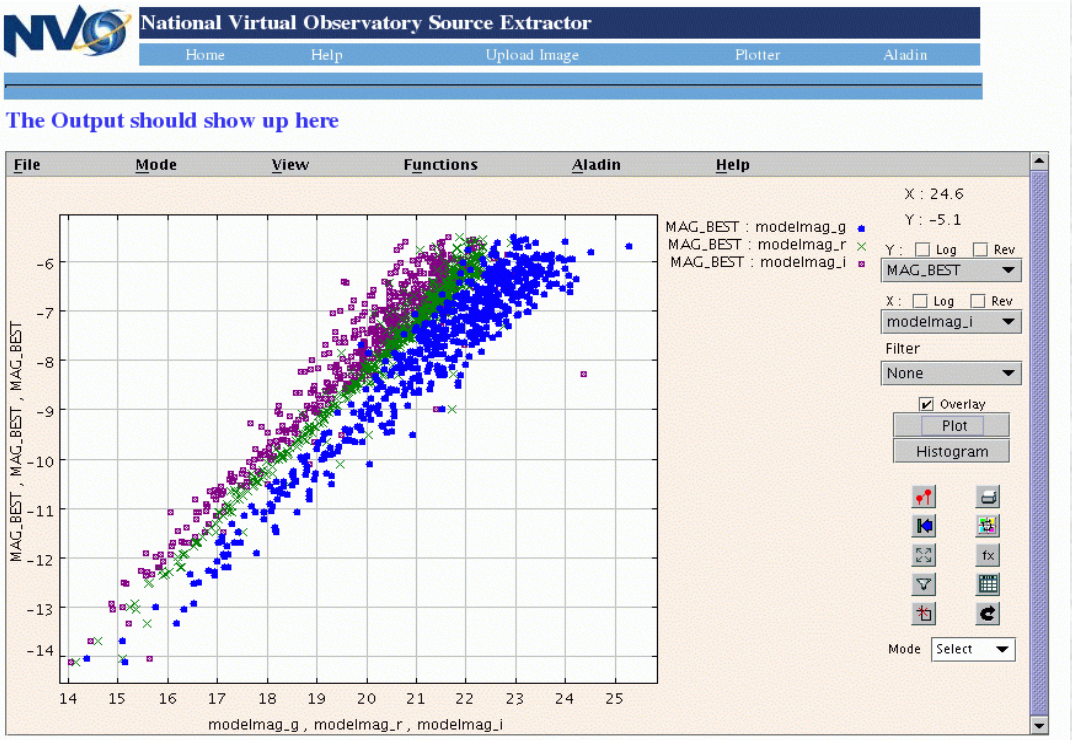


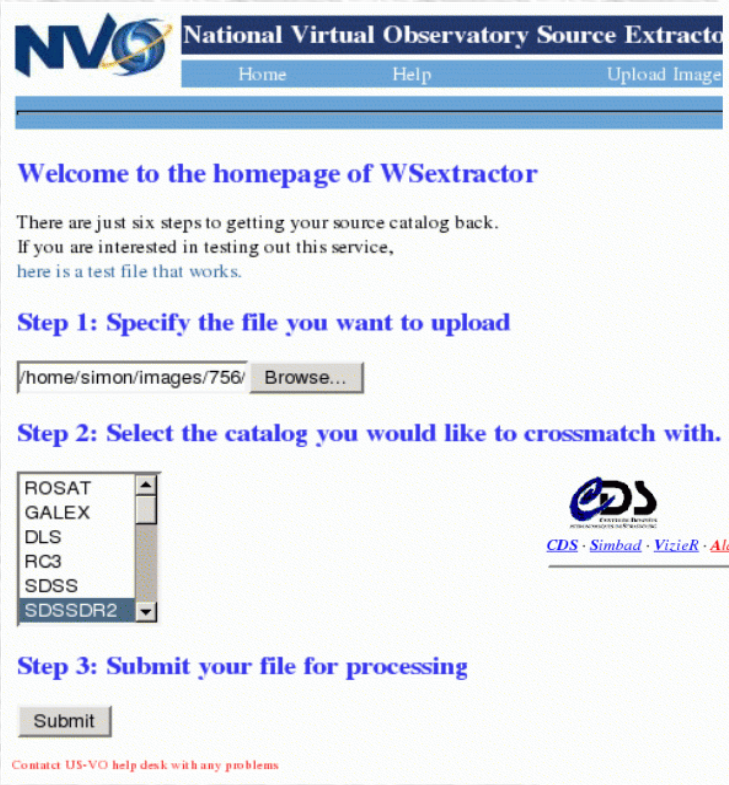
Kelly & McKay 2004, astro-ph/0401441

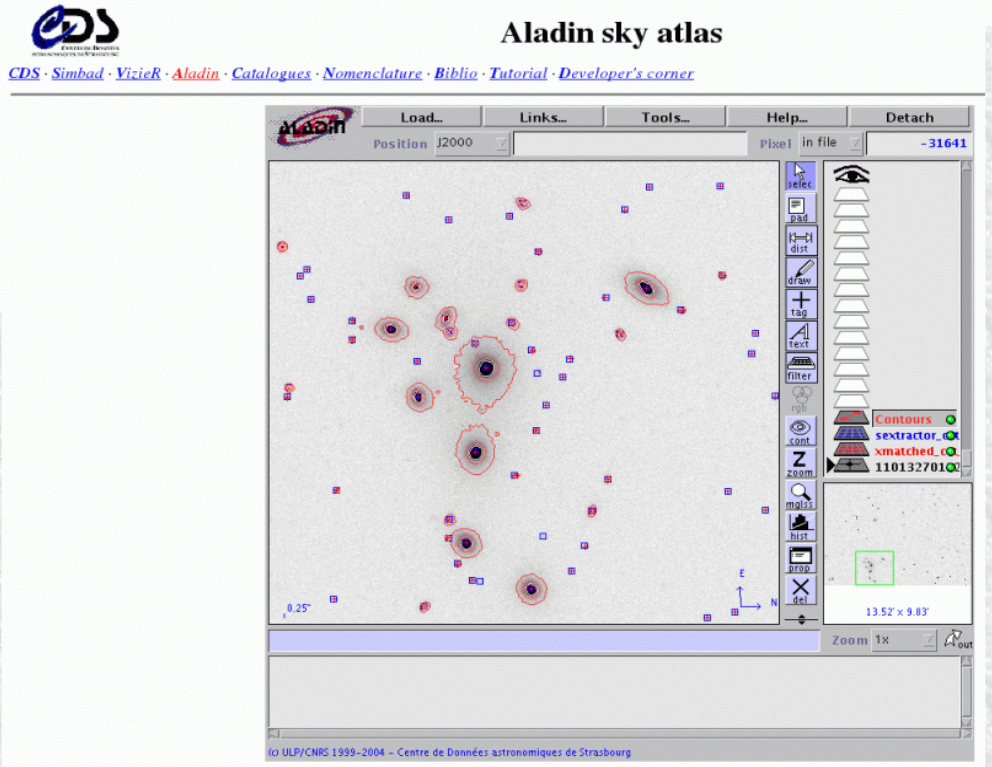
WESIX

Web-Enabled Source Identification with X-matching
http://frank.phyast.pitt.edu:8080/wsext/

- http://www.us-vo.org/projects/tools.cfm
  Developer: Simon Krughoff (simon@phyast.pitt.edu)
- Webservice that provides access to Sextractor and a crossmatching facility (openskyquery) over the internet.
- All processing is done server-side. Interactive plotting is available as is image/catalog display and manipulation through Aladin.
- Can be accessed either via the web or programmatically.



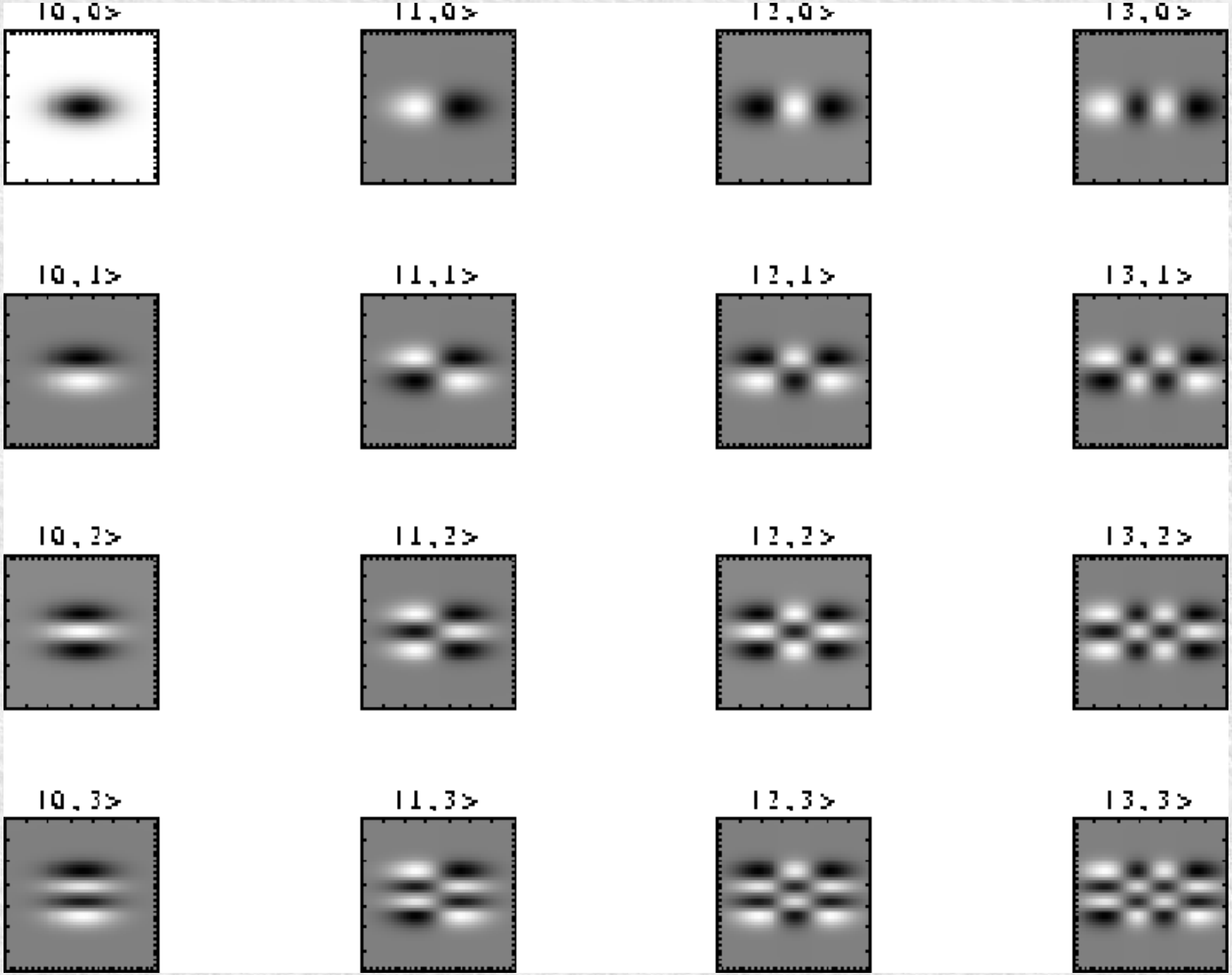




Simon Krughoff
email: simon@phyast.pitt.edu

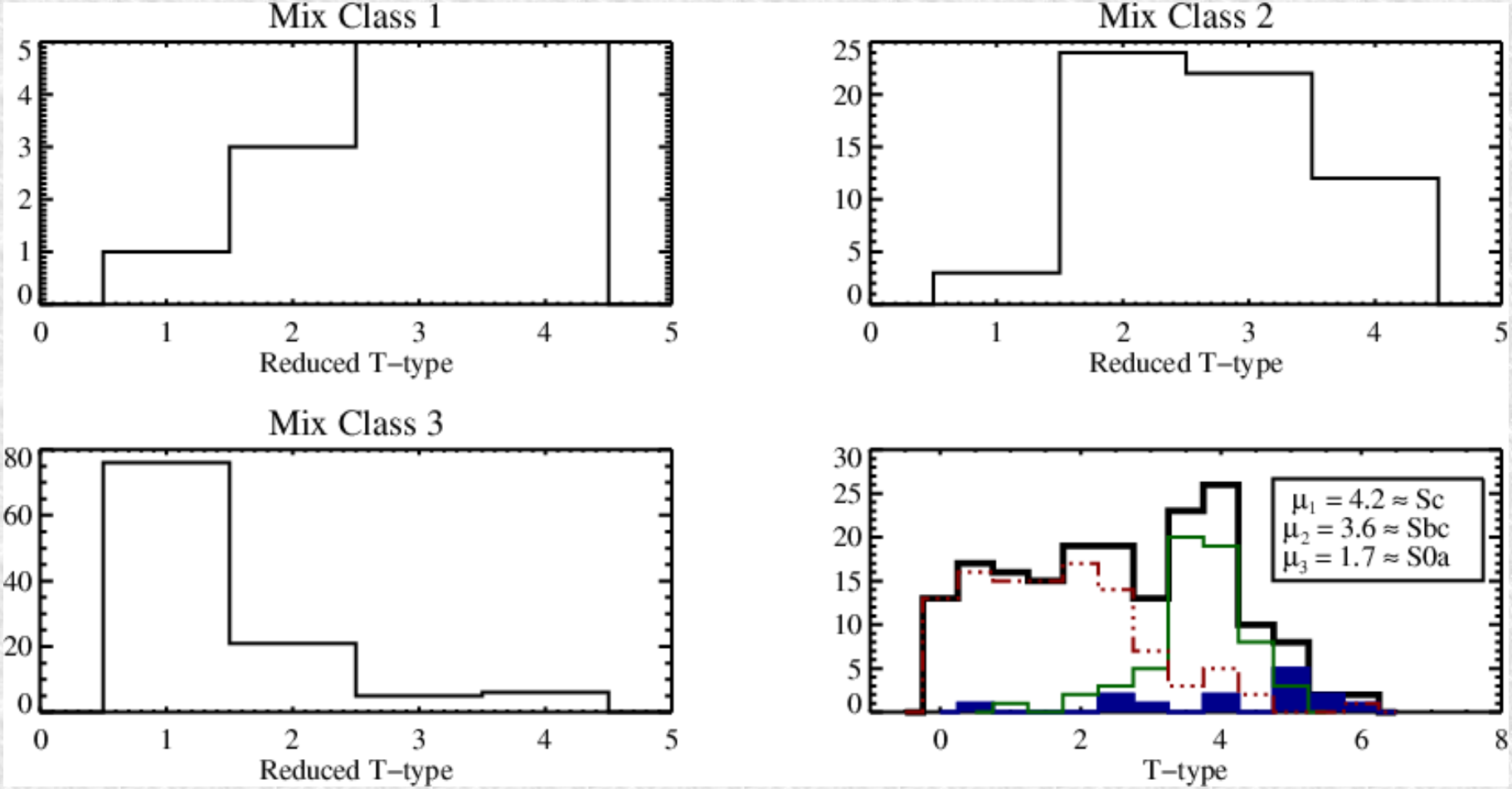
Wish-list

- Integrated tools for data-analysis (anomaly detection, minimum spanning trees) and visualisation (viewing images of anomalous outliers, examples of parameter correlations).
- New tools for visualising complex data structures (spatially distributed physical parameters, pixel-z) and morphological information (QMM).
- Make tools available as webservices, for access and interaction with existing analysis tools



Kelly & McKay 2004, astro-ph/0401441

Classification



Kelly & McKay 2004, astro-ph/0401441