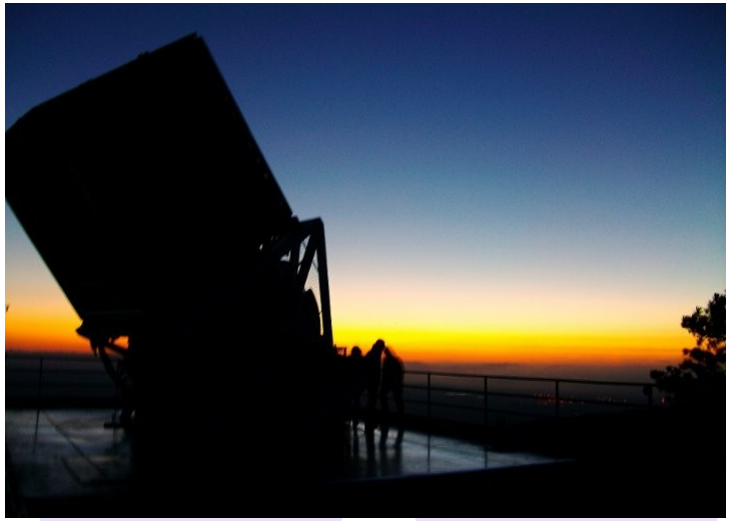

A Method For Producing Matched Aperture Photometry Using Radial Profiles

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Supervised by Bob Nichol, Claudia Marason

In collaboration with Kevin Bundy, Janine Pforr

University of Portsmouth

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Surveys I

SDSSIII

- As of DR8, 14,555 sq. Deg of u,g,r,i,z photometry
- Depth of r_{lim}~23.3

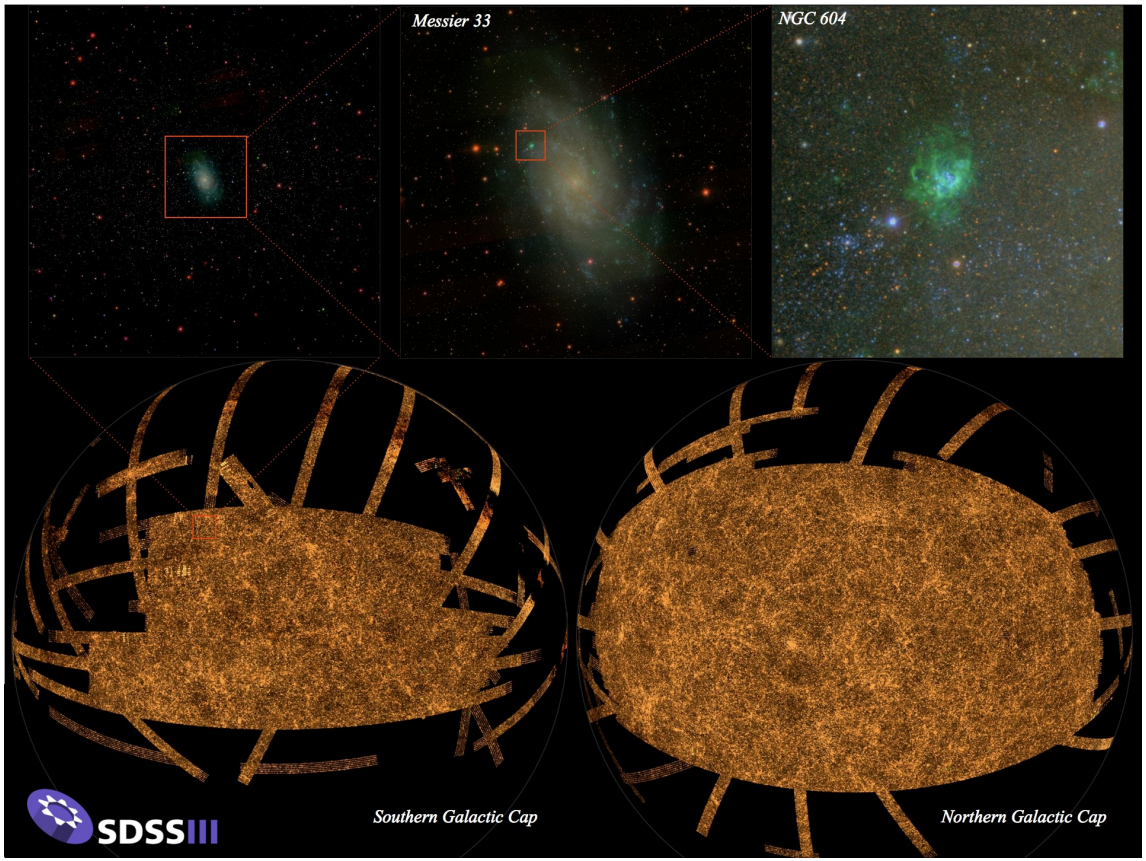

Image credit: SDSS3 Press release

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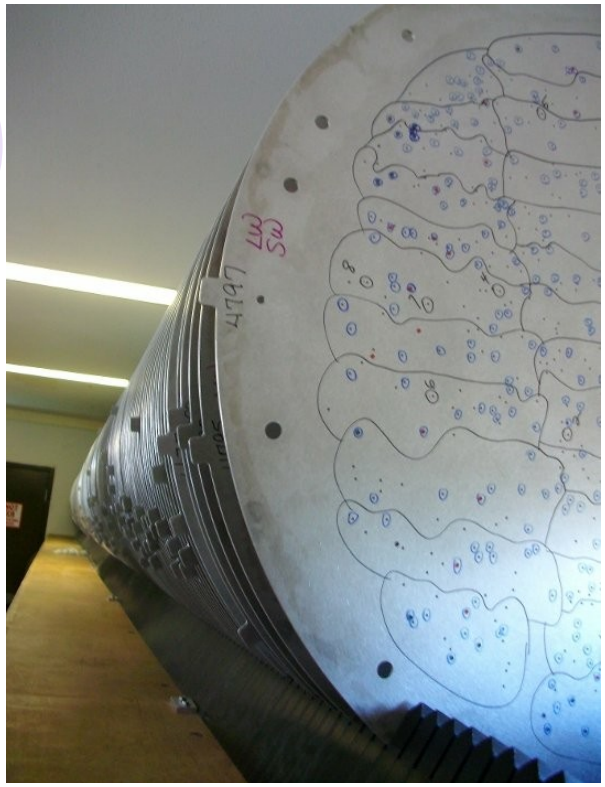
Surveys II



- BOSS
  - 1.5 million Massive Galaxies at redshift 0.7
    - Also doing Lya Forest QSO measurements
  - 10,000 deg^2 of sky
  - Provide % level cosmological constraints
  - Huge galaxy sample
    - Massive impact on galaxy evolution

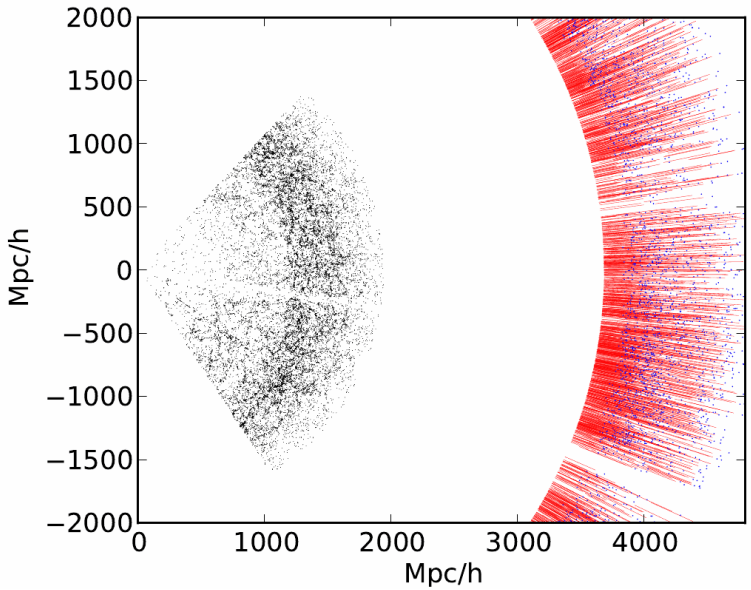
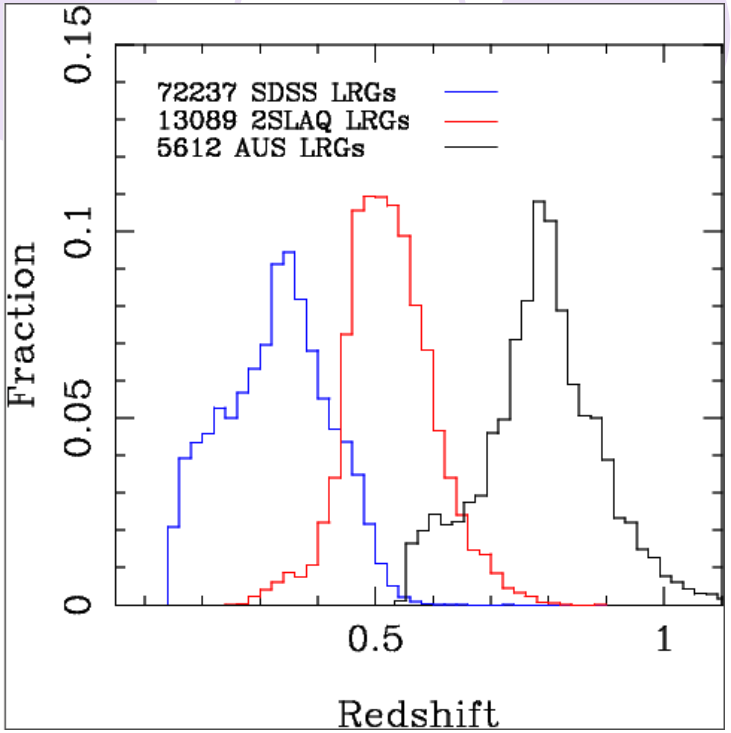


Image credits: me (top), slozar et al 2011 (bottom)

Surveys III

- AUS survey
  - Redshift survey using AAOMega on AAO
  - Thousands of LRGs at redshifts up to 1.2
  - ~150 square degrees of equatorial fields
  - Use of AUS+BOSS/2SLAQ+SDSSII gives redshifts from 0.2—1.2



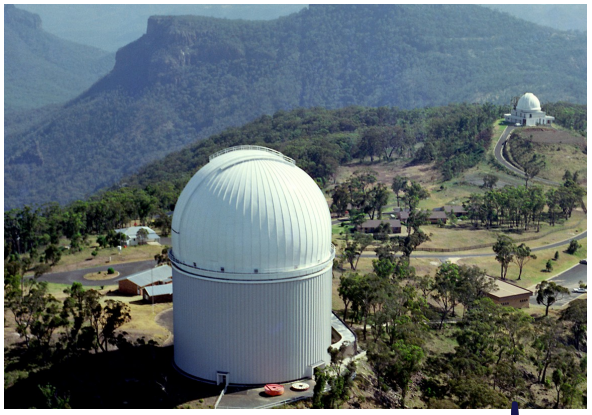


Image Credits: David Wake (top), David Malin (bottom)

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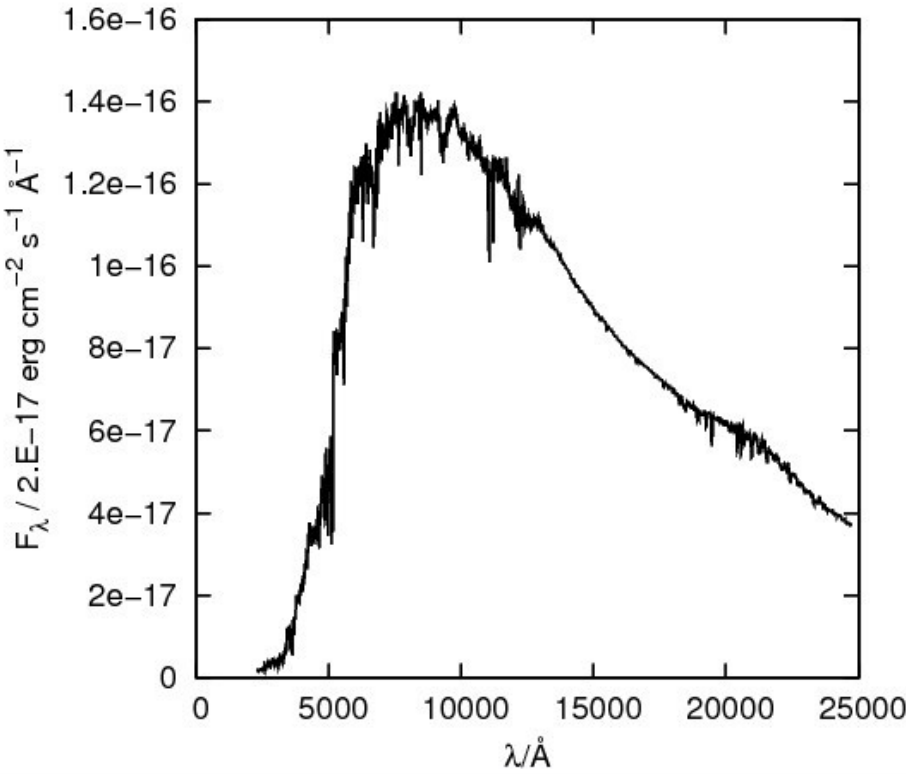
Problems

- Spectroscopic surveys pushing to higher redshifts
  - By redshift 0.6, 4000Å break is in r band
  - By redshift 1, it is in z
    - Higher redshift galaxies don't have much observer's frame optical flux
- Degeneracies:

  Template fitting has many parameters
  - Age
  - Dust Reddening
  - Metallicity
  - SFR
- Get Degenerate Solutions
  - NIR photometry helps



Maraston et al. 2009 LRG template

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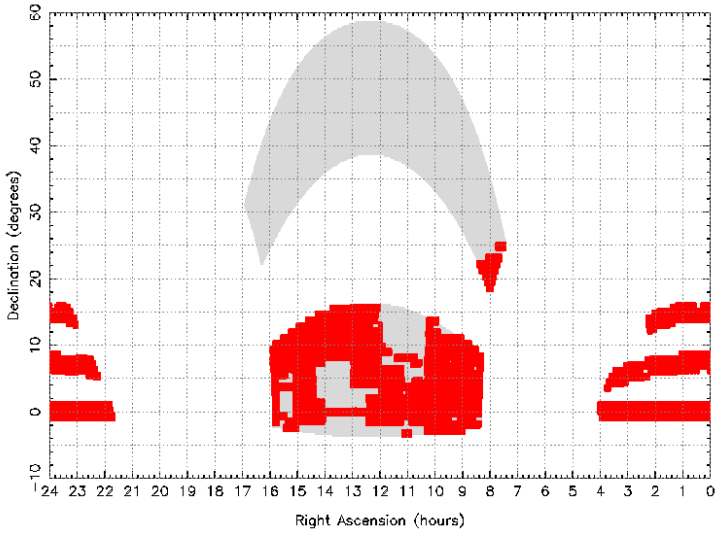
Surveys IV

UKIDSS Large Area Survey

- Y, J, H and K band photometry to depth of K=20.3
- Large overlap with BOSS, Aus
  - Get much better determination of galaxy SED



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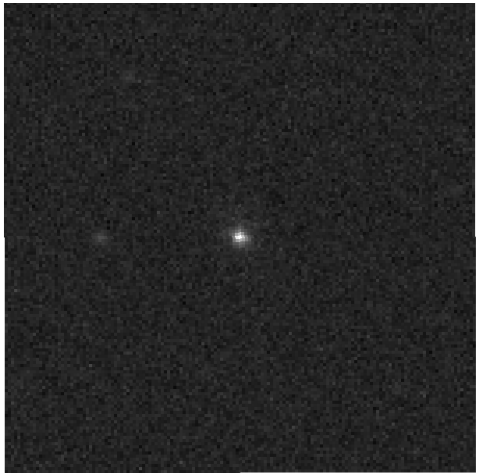
Photometric Catalogues

- Galaxy photometry
  - SDSS
    - Modelmag
    - Petrosian
    - Fibermag
  - UKIDSS
    - Petrosian
    - Sersic mag
    - Circular Apermags
    - 0.5”< r <12”
  - Matched photometry hard from these!

r-band defined

H-band defined



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Photometric Catalogues

- Ideal solution is full re-extraction from images
  - Download all imaging data
  - Degrade to standardised PSF
  - Integrate within same aperture across all bands
- Hill et al 2010 did this for GAMA fields
  - R-band defined Kron aperture photometry and 2” PSF
- “Correct” method, expensive though
  - Time
  - Computationally
    - 4 hours to create 20GB mosaic
    - “a few days” to create catalogue for each mosaic in dual image mode

Hill et al MNRAS 2010

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Alternative Approach

- Short cut for LRGs
  - Small observed sizes
  - Relatively simple properties
    - Radial profile
    - Stellar populations etc
- Can use alternative catalogue data to pre-derived magnitudes
- Use GAMA fields and compare to their matched photometry
  - 1300 SDSS+GAMA galaxies
  - 2700 BOSS+GAMA galaxies

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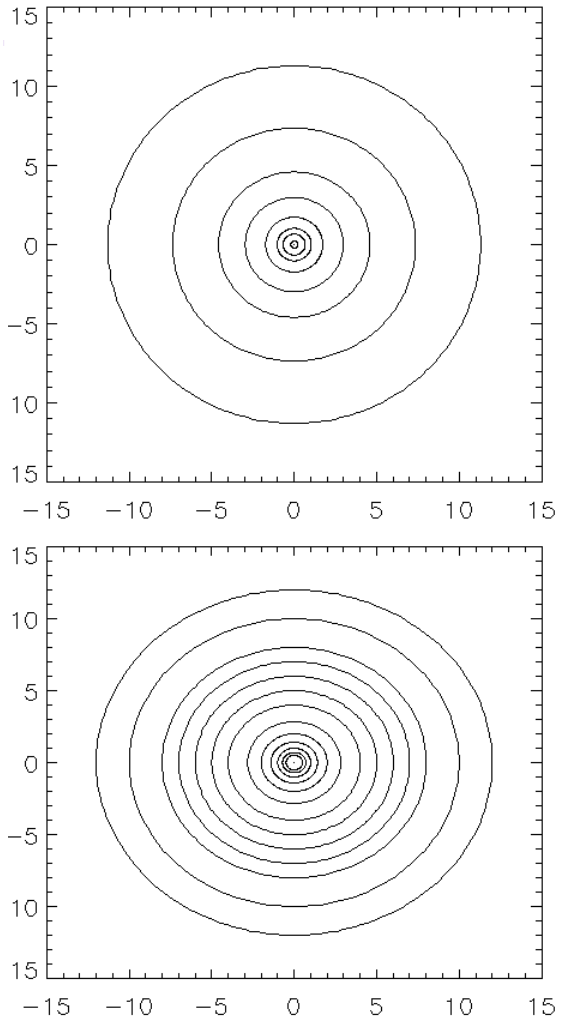
Our Method

Obtain galaxy radial profile

- SDSS photoprofile
  - Flux densities within annular bins
- UKIDSS Apermag photometry
  - Subtract off interior flux within each apermag
  - Get flux densities within annular bins too



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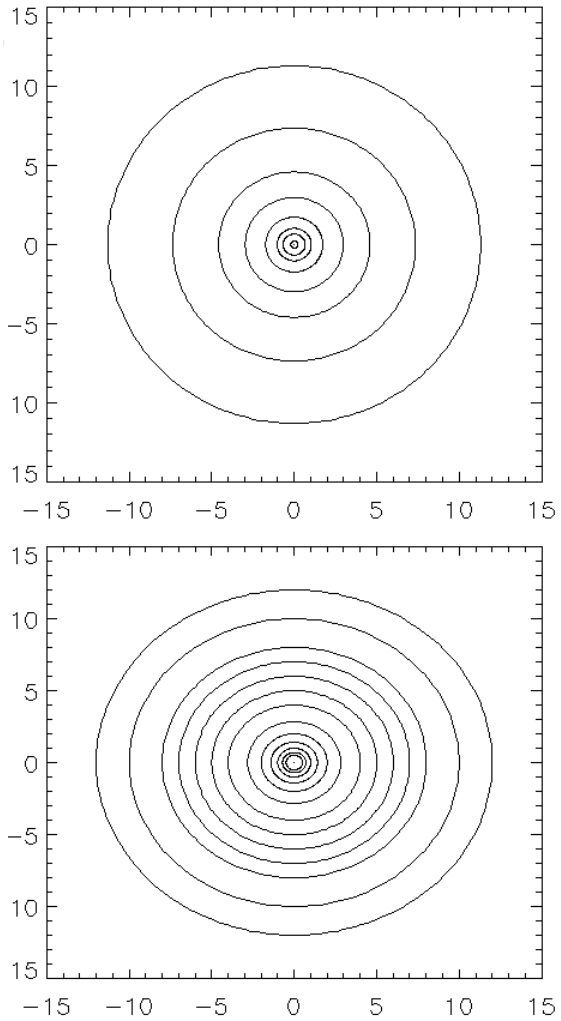

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Our Method II

- Take observed radial profile for each band
  - Interpolate with cubic spline
  - Project in 2D at a finer pixel scale
  - Convolve mock image with gaussian to give standardised seeing
  - Integrate within same aperture on all bands
    - Matched aperture photometry!

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Tests

- Simulated data created
  - Take pure De Vaucouleurs profile
  - Convolve to SDSS-like seeing
    - Take aperture photometry
  - Measure photoprofile
  - Add noise
  - Feed into method
    - Take aperture photometry

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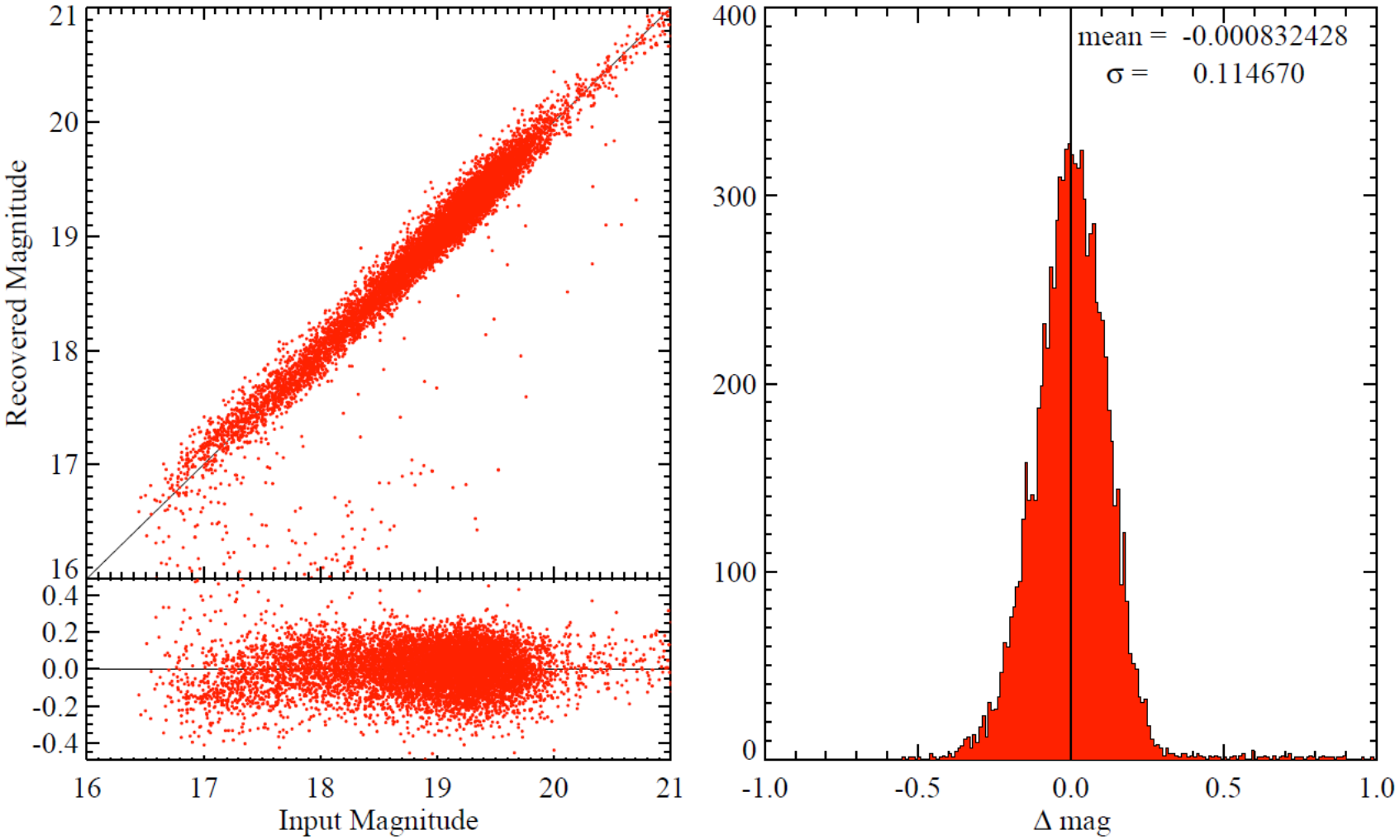
Results



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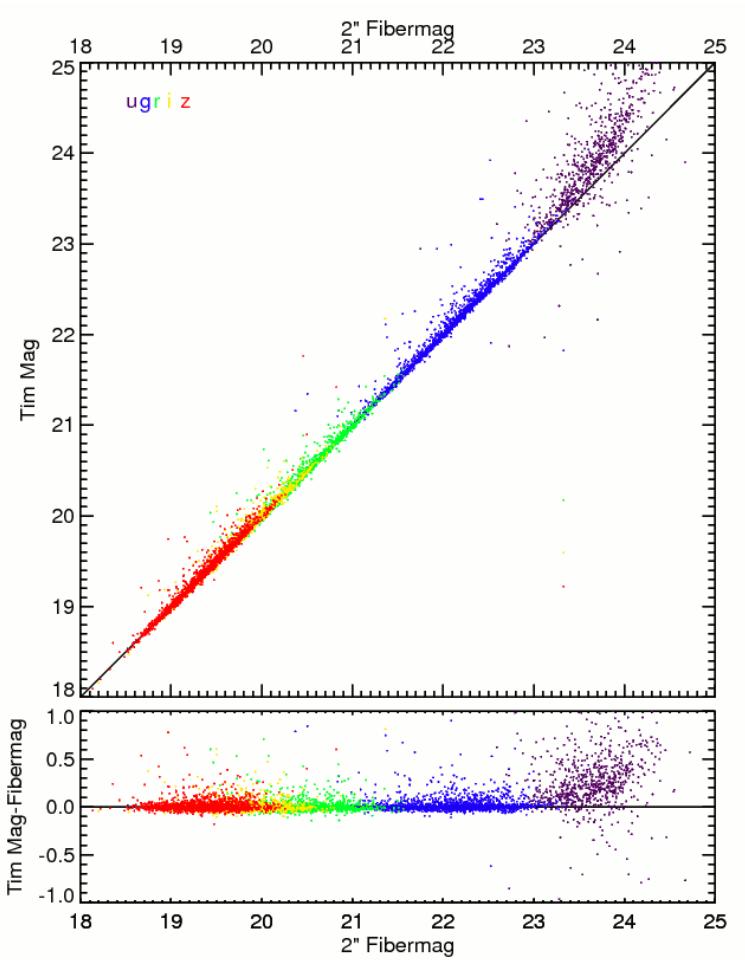
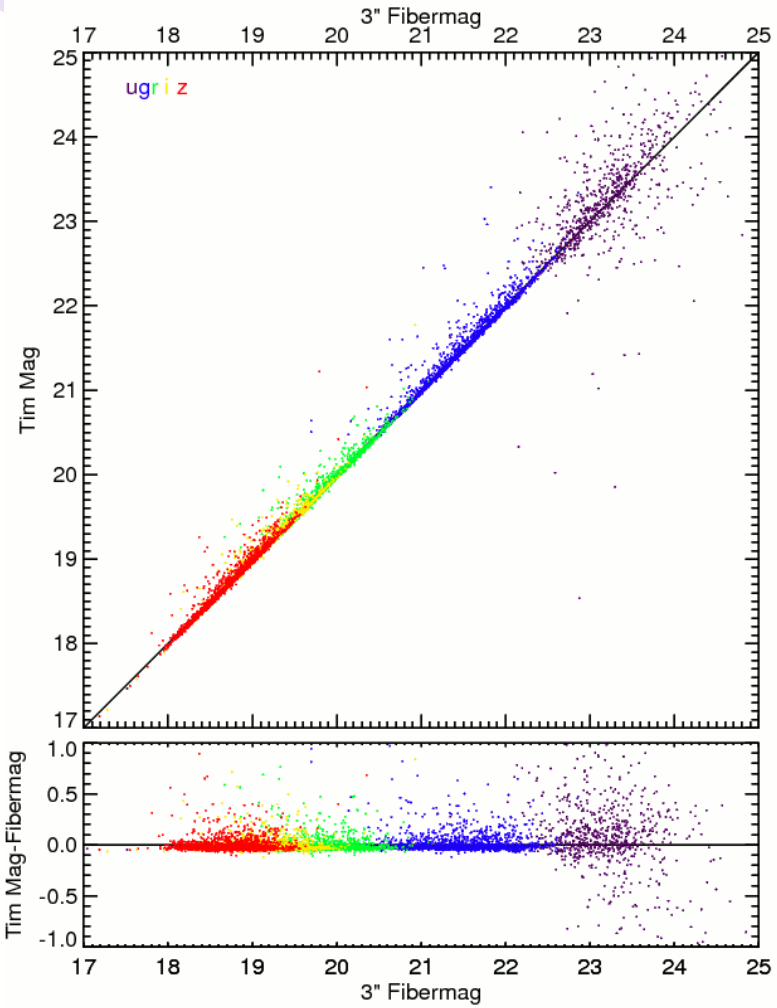
Results II – Reproducing Fibermags





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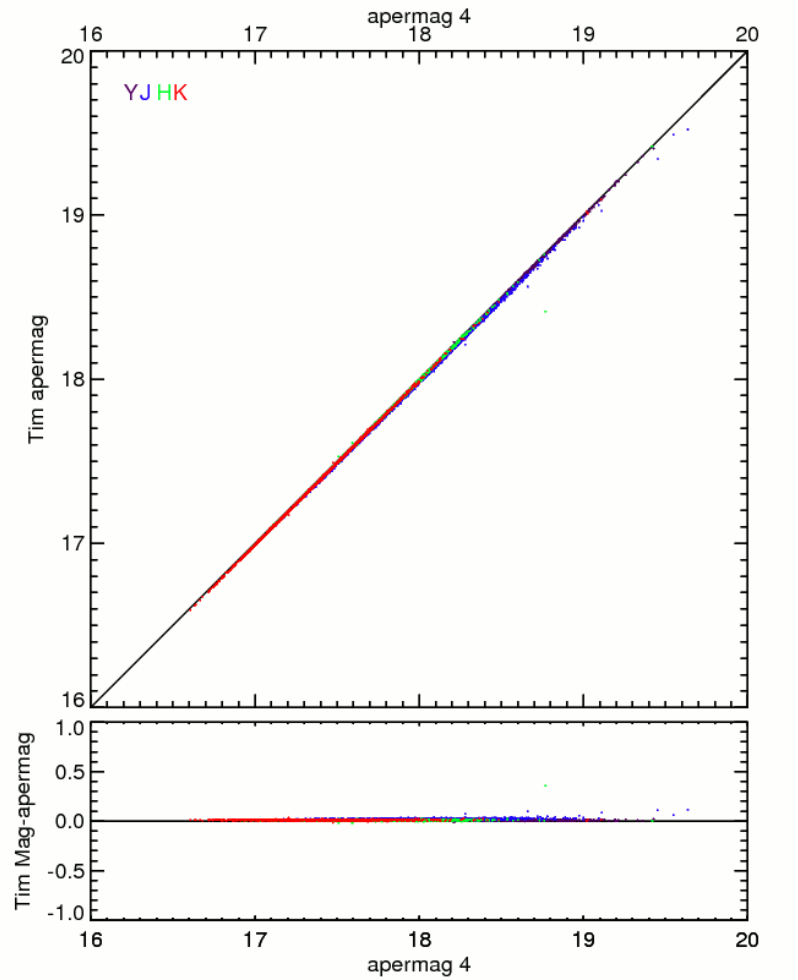
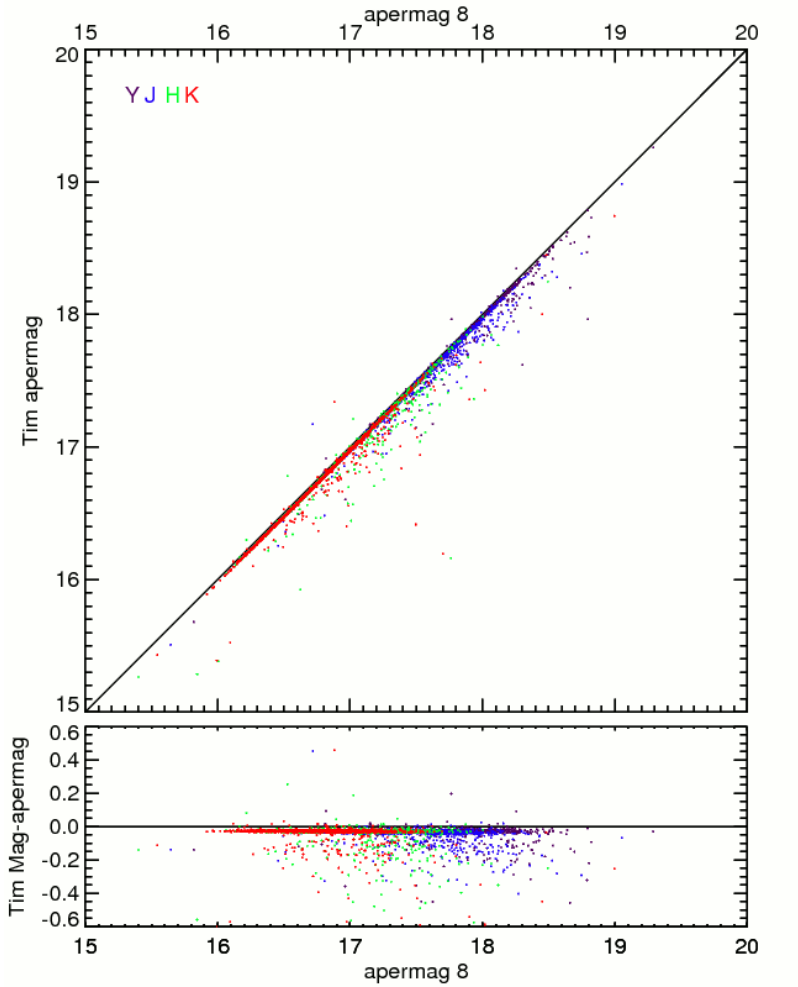
Results III – Reproducing Apermags





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Tests – Template Fits

- To test against GAMA, magnitudes dependant upon the aperture
  - Instead, use template fits
    - Sensitive to colours and total flux
    - Good test of matching
    - Compare best fit template fits for GAMA and our photometry

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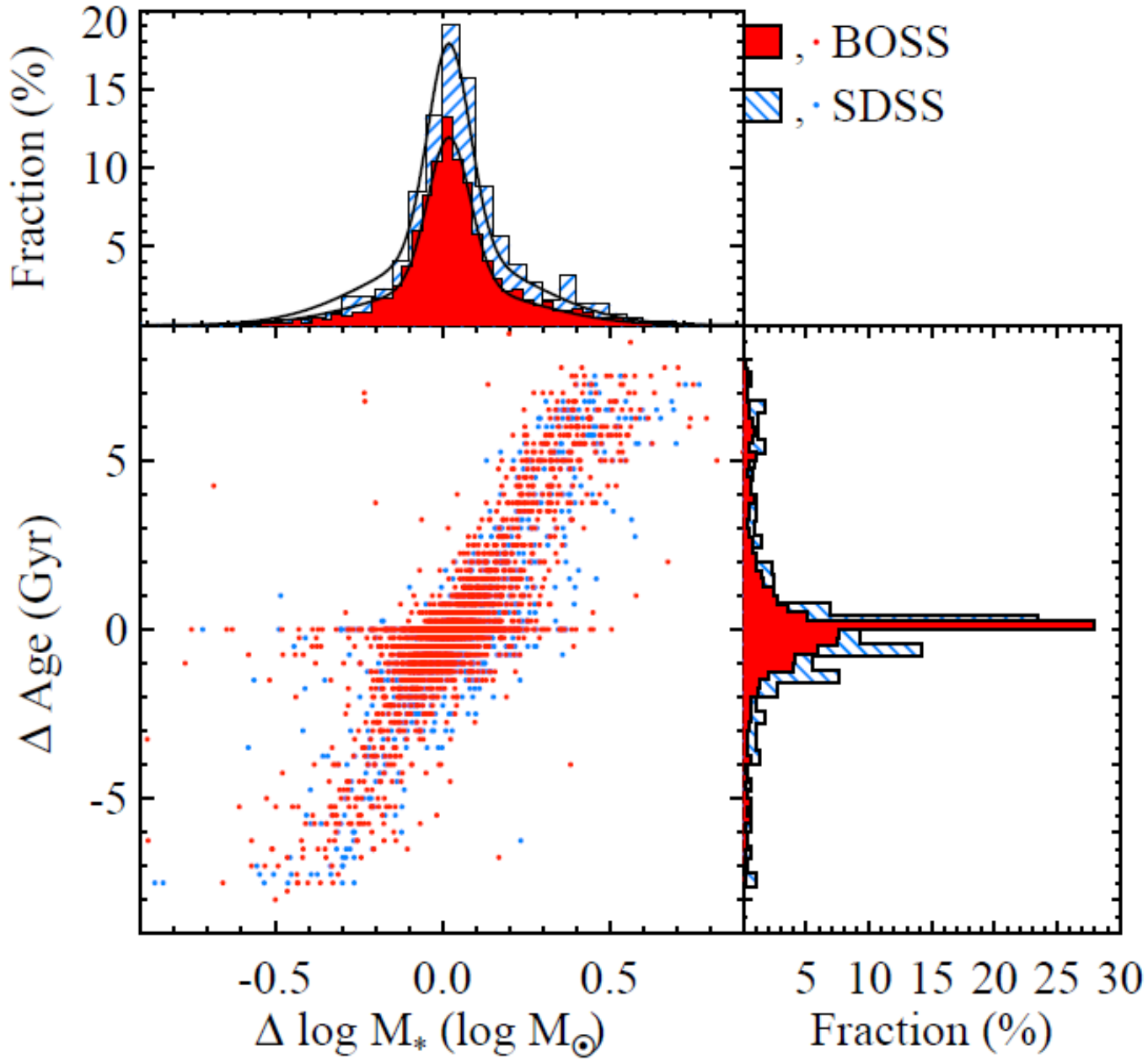
BOSS
SDSS
Fraction (%)
20
15
10
5
Δ Age (Gyr)
5
0
-5
-0.5
0.0
0.5
Δ log M* (log M⊙)
5 10 15 20 25 30
Fraction (%)

Performance

- Generally performs well
  - Stellar masses and ages generally consistent
  - Some age errors which then translate into stellar mass errors
    - Interpolated profile
    - Goes wrong sometimes
    - Colour error from upward bump in interpolation
      - Can remove these by comparison with catalog magnitudes' colours
- Takes 15 mins to do 9 bands of photometry for 2700 galaxies

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Conclusions

- Can create a simple matched aperture SDSS-UKIDSS catalogue
- results looking good
  - Can recreate simple apertures with good agreement
  - On average, a 20kpc radius aperture is consistent with elliptical Kron apertures
  - Stellar masses are close
    - Scattered around a zero offset
    - Some age errors causing outliers

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