

Constructing galaxy SEDs from SDSS, GALEX and UKIDSS data

part of the ADASS XX tutorial

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Overall plan for the tutorial

- 13:30 – 13:45 Introduction, setup
- 13:45 – 14:30 Science case #1: Galactic X-ray sources x-ID
- 14:30 – 15:25 Science case #2: Building SEDs of nearby galaxies
- 15:25 – 15:30 Concluding remarks



Case 2

Building FUV-to-NIR SEDs of nearby galaxies

<http://bit.ly/cEpwV2>

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Data resources used

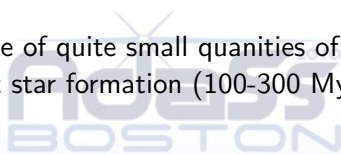
- 1 SDSS is a 5-band wide-field optical survey with very well described calibrations, it has also a large spectroscopic part (1 million spectra)
- 2 GALEX satellite produced a (almost) full-sky catalogue in two UV bands
- 3 UKIDSS is an ongoing near-IR survey with the UKIRT telescope. UKIDSS Large Area Survey has a similar footprint to the SDSS imaging, the YJHK imaging is several magnitudes deeper than 2MASS

Scientific motivation

There are very well calibrated models of galaxies (stellar populations, chemical evolution etc.) in optical bands.

NIR bands have low sensitivity to the age of stellar populations and to the internal extinction in a galaxy, therefore they can be used to estimate the stellar mass.

UV bands are sensitive to the presence of quite small quantities of young stars. NUV is an indicator of a recent star formation (100-300 Myr).



Step 1. SDSS CasJobs query

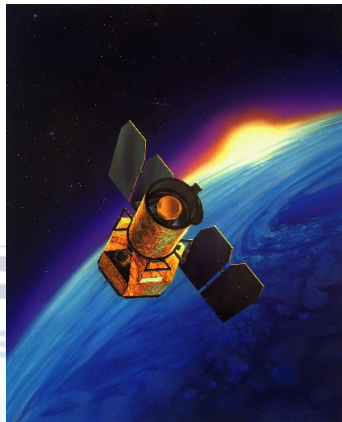
- Selecting all galaxies (*specClass=2*) from the SDSS Stripe 82 in the redshift range $0.03 < z < 0.28$
- Stripe 82 is the deepest SDSS scan at the moment



SLOAN DIGITAL SKY SURVEY

Step 2. x-ID with GALEX

- Cross-identification against the GALEX GR4/5 catalogue using GALEX CasJobs
- Search radius: 3 arcsec
- Note: GALEX spatial resolution is very similar to SDSS



Step 3. x-ID with UKIDSS

Cross-identification against the UKIDSS DR4 Large Area Survey catalogue. “Real” VO case.

- 1 Finding the DR4 MultiCone service end-point in the Astrogrid registry – let’s skip this point
- 2 Use *STILTS* for the format conversion and upload the table to the UKIDSS DR4 MultiCone service using a standard HTTP client (*CURL*)
- 3 Use *STILTS* to convert UKIDSS magnitudes (Vega) into the AB system used in GALEX and SDSS. Zero-point transformations from Hewett et al. (2006) ← one of the future VO tasks

Joining the catalogues

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- Use STILTS to create a combined catalogue containing photometry for 18000 galaxies in (up-to) 11 bands
- Have we just constructed a catalogue of galaxy SEDs and one of the IVOA dreams has come true?
- **NO!!!** Unfortunately, some additional steps have to be undertaken.

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What did we forget?

- 1 Galactic extinction. Easy to handle using STILTS and $E(B-V)$ values from the tables



What did we forget?

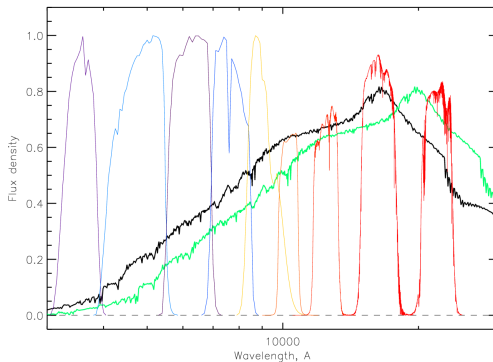
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- 2 UKIDSS surface brightness correction. Galaxy fluxes were estimated in Petrosian apertures which are surface brightness dependent. We found an empirical solution after some investigation...



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- 2 UKIDSS surface brightness correction. Galaxy fluxes were estimated in Petrosian apertures which are surface brightness dependent. We found an empirical solution after some investigation...
- 3 k -corrections. Redshift causes the effective shift of the photometric bands with respect to a galaxy spectrum. Traditionally, SED fitting was used to calculate k -corrections. Recently (CMZ10), we have found that at low redshifts they can be approximated by low order polynomials. Let's compute and apply them! Use our online service:
<http://kcor.sai.msu.ru/>

k -corrections

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What can we learn now?

Use TOPCAT to manipulate the final dataset

- 1 Building a 'standard' colour–magnitude diagram M_r vs $(g - r)$: we see the 'red sequence' and the 'blue cloud'



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- 1 Building a 'standard' colour–magnitude diagram M_r vs $(g - r)$: we see the 'red sequence' and the 'blue cloud'
- 2 The same using NIR – very low age dependence and effects of internal extinction – luminosity–metallicity relation
- 3 Adding a NUV- g to the $g - r$ as the third dimension. Bingo! All galaxies even those from the blue cloud have a very tight relation in the 3d space – we see a surface. This property has a high potential for the photometric selection of intermediate redshift galaxies.

Universal colour-colour-magnitude relation

