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Spectroscopic Bulge-Disc Decomposition

Evelyn Johnston

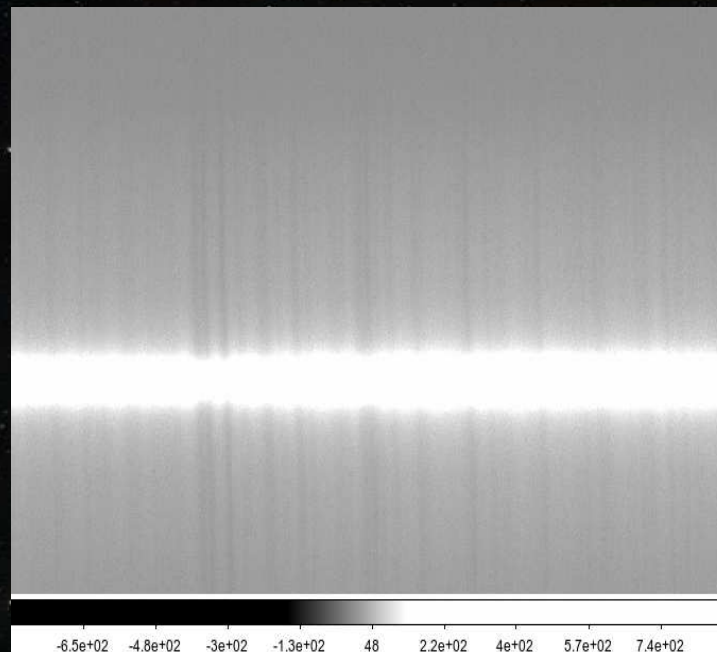
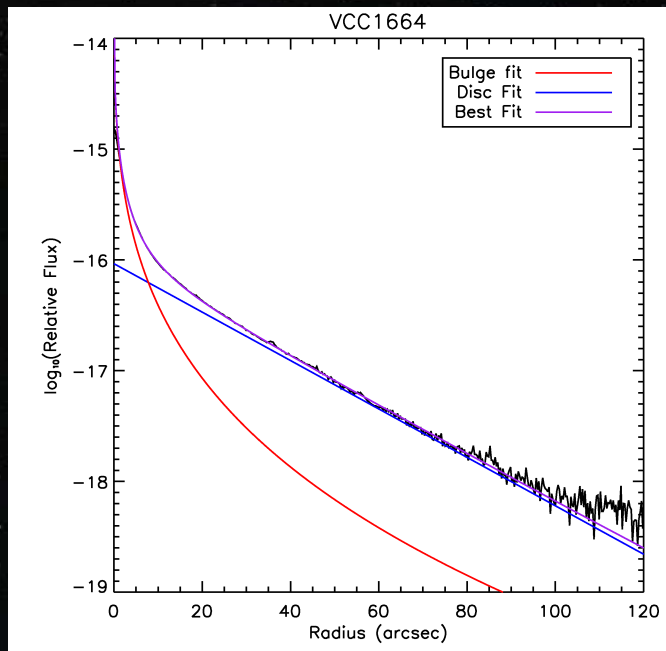
With Michael Merrifield, Alfonso Aragón- Salamanca

Motivation

- The star formation histories of the bulge and disc can tell us how these components evolved and how the galaxy formed
- By separating the spectra of the bulge and disc, we can learn more about how the galaxy was formed, how star formation was triggered and quenched etc.
- This idea has already been successfully applied to long-slit spectra of S0s in the Virgo Cluster to learn how the star formation in the progenitor spiral was quenched.
- We can learn much more using the full structural information of the galaxy

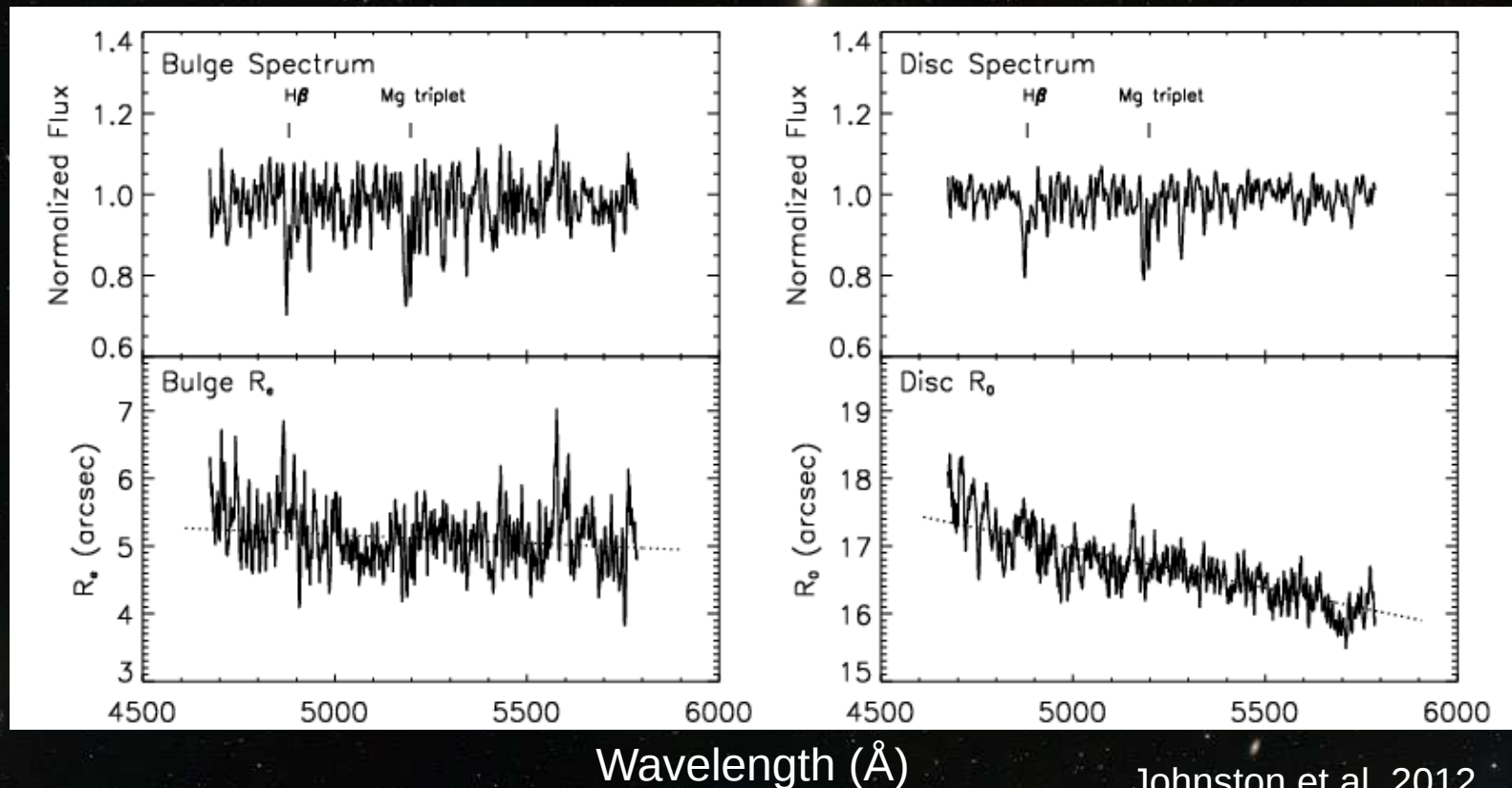
Decomposition of long-slit spectra of S0 galaxies

- Obtain a good quality long-slit spectrum of a galaxy
- Correct spectrum for kinematics
- Decompose light profile at each wavelength



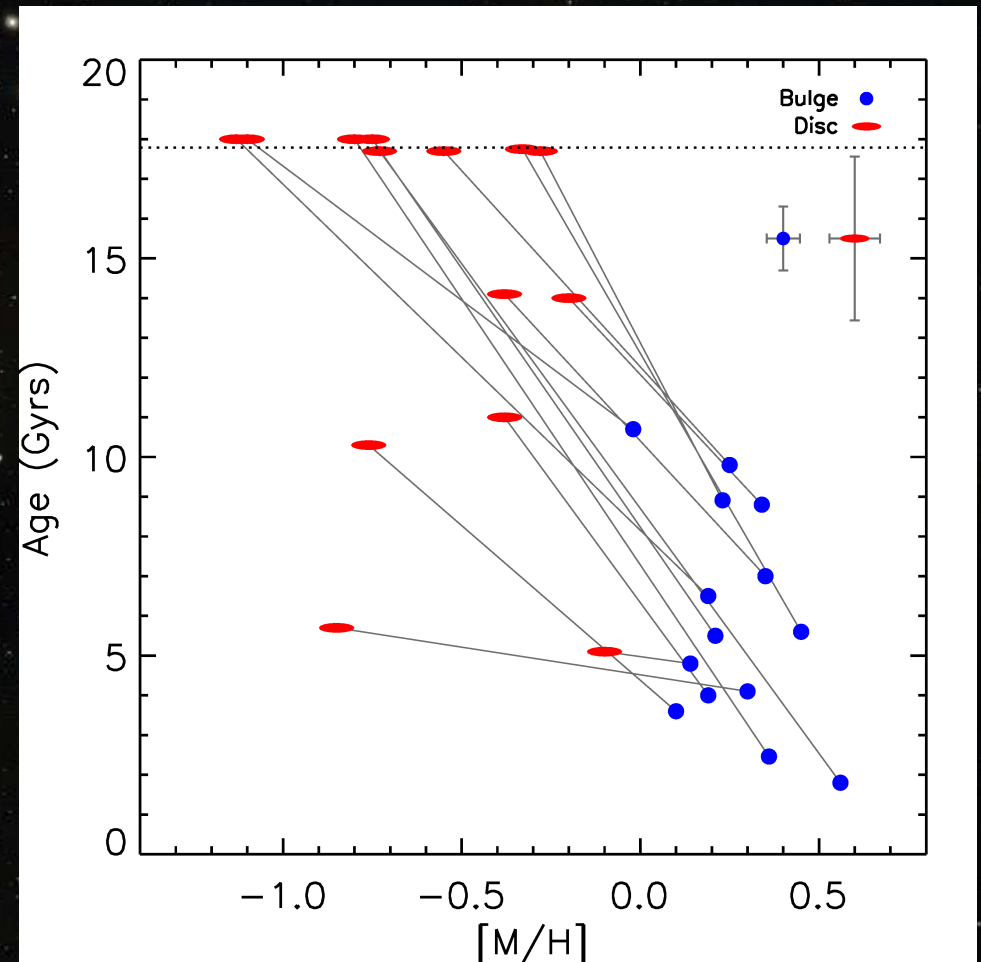
Decomposed bulge and disc spectra

- Integrate to get total light of bulge and disc for that wavelength bin
- Plot against wavelength to obtain high-quality spectra representing purely the bulge and disc light.



Examples of analysis with bulge and disc spectra

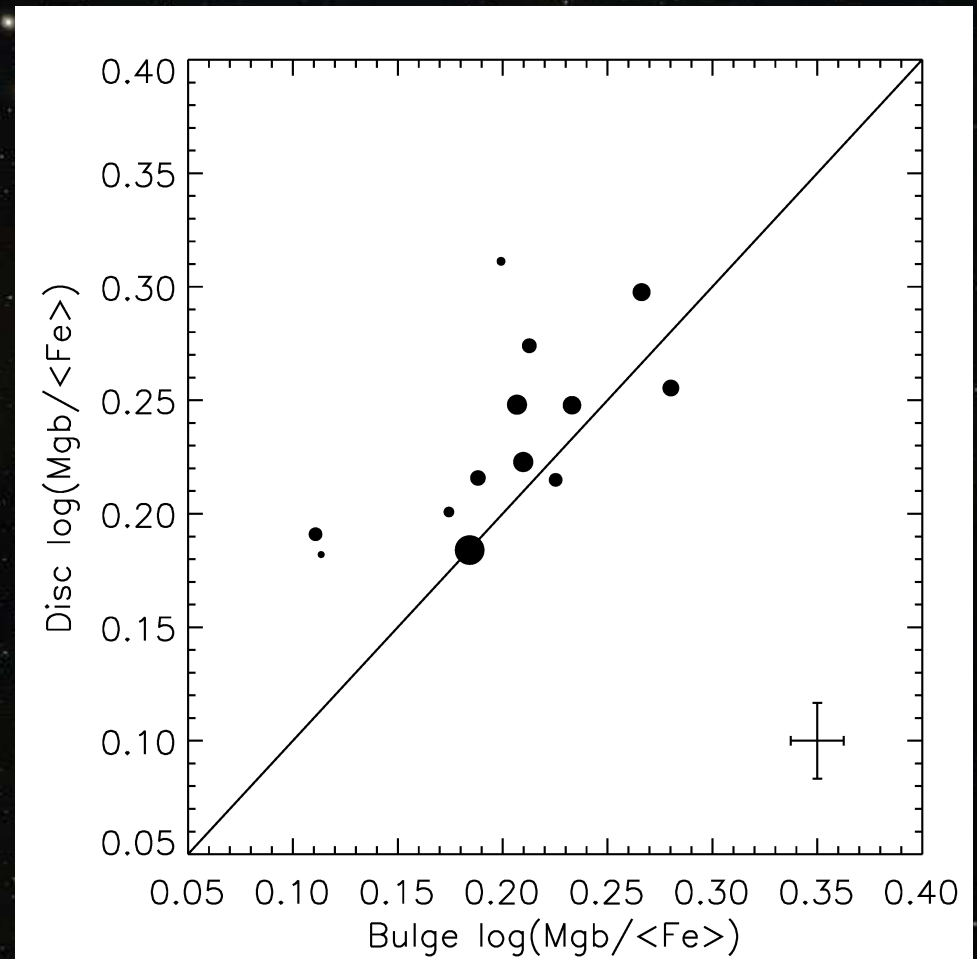
- Comparison of stellar populations
- Comparison of α -element abundances
- Colour gradients within the bulge and disc
- Age and metallicity gradients within the bulge and disc



Johnston et al, Submitted

Examples of analysis with bulge and disc spectra

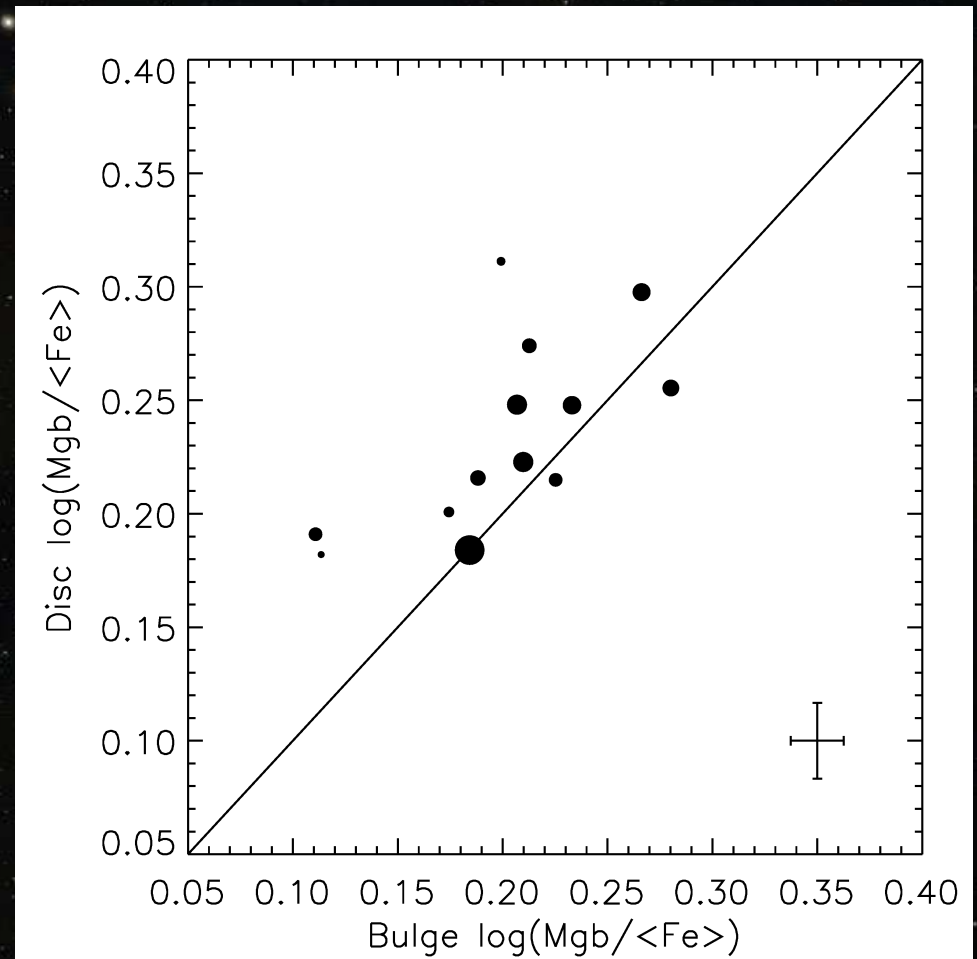
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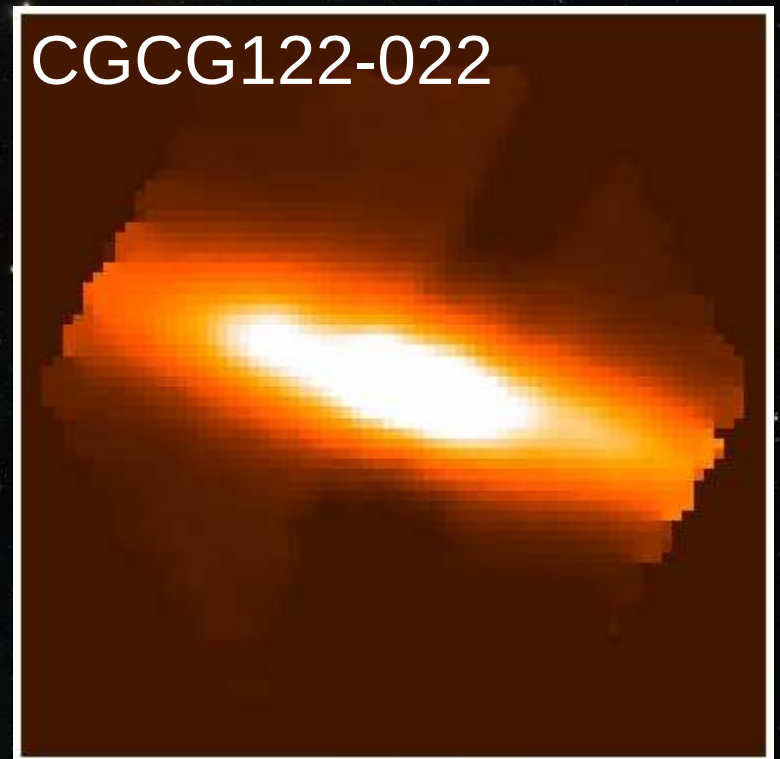


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*** But, so far these have all been limited to the major axis of highly inclined galaxies. Imagine what we can learn using the full structure of the galaxy!

Why use MaNGA spectra

- Spectral information over the whole structure of the galaxy
- Large field of view
- Long wavelength range
- Overlap with other surveys



Overall, a good data set on which to apply decomposition

Note:

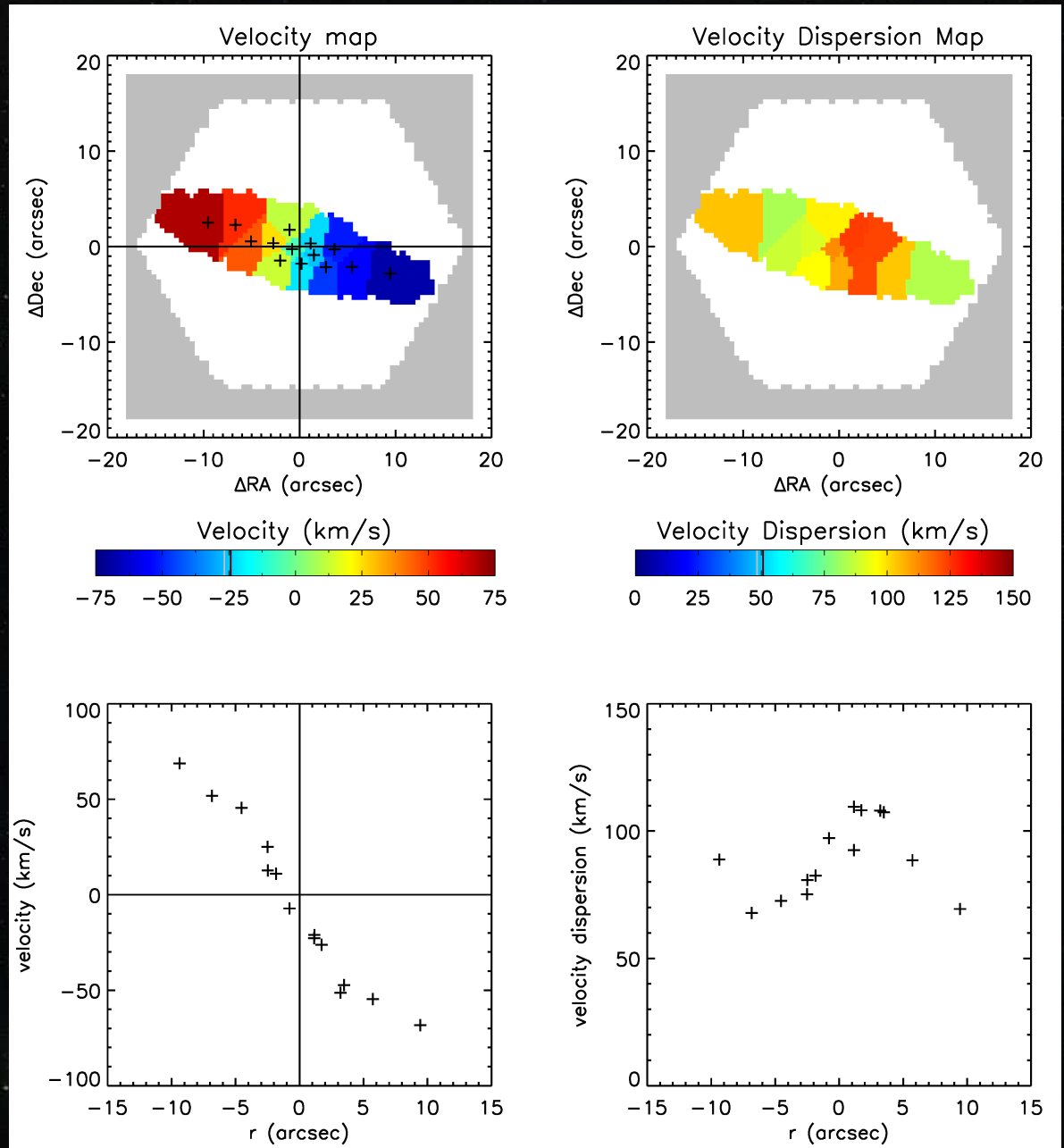
The following results are very preliminary and use many assumptions. They should be considered as a proof of concept only.



PRELIMINARY

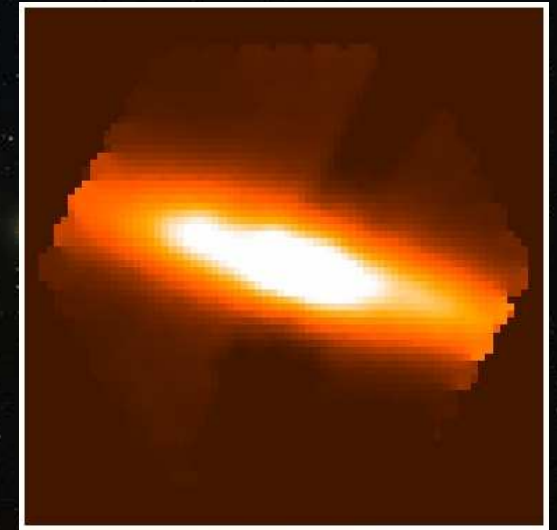
Steps to decompose IFU Spectra

- Measure and correct the kinematics over the galaxy
 - ensures each image slice is composed of spectra at the same rest-frame wavelength

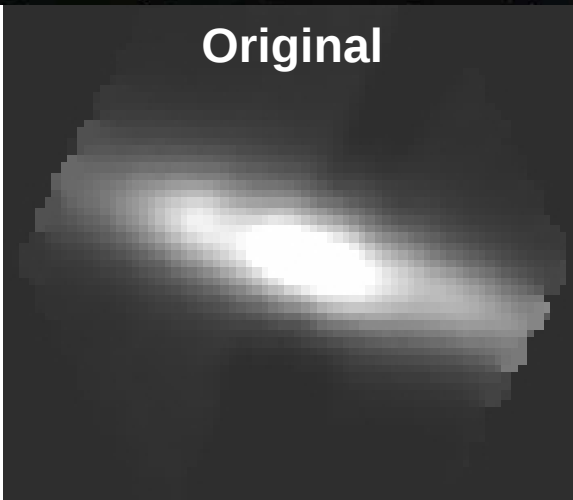


Steps to decompose IFU spectra

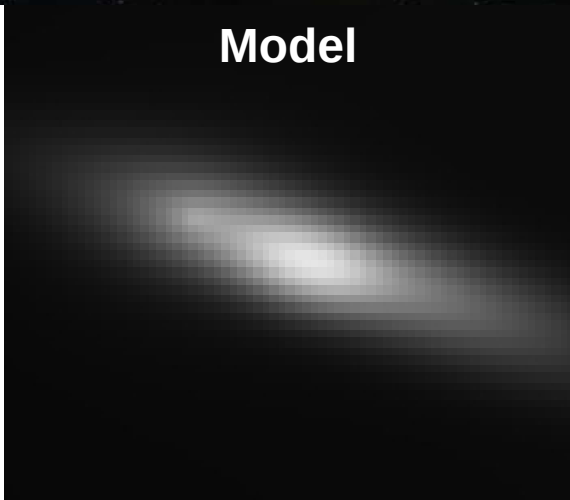
- Calculate initial parameters for the decomposition
 - Create a composite image of all the IF image slices around the wavelength region you're interested in, and decompose with Galfit



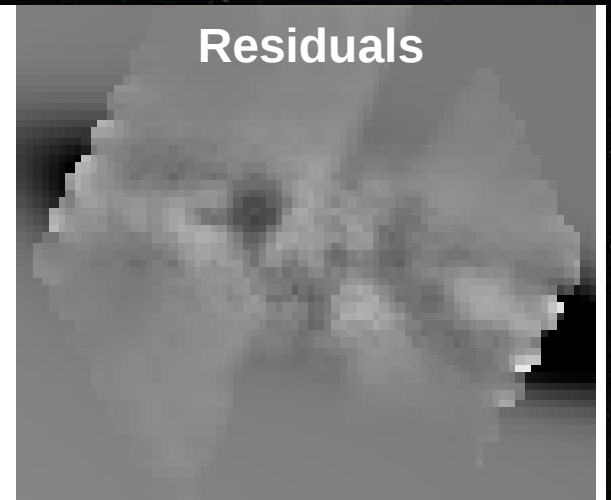
Original



Model

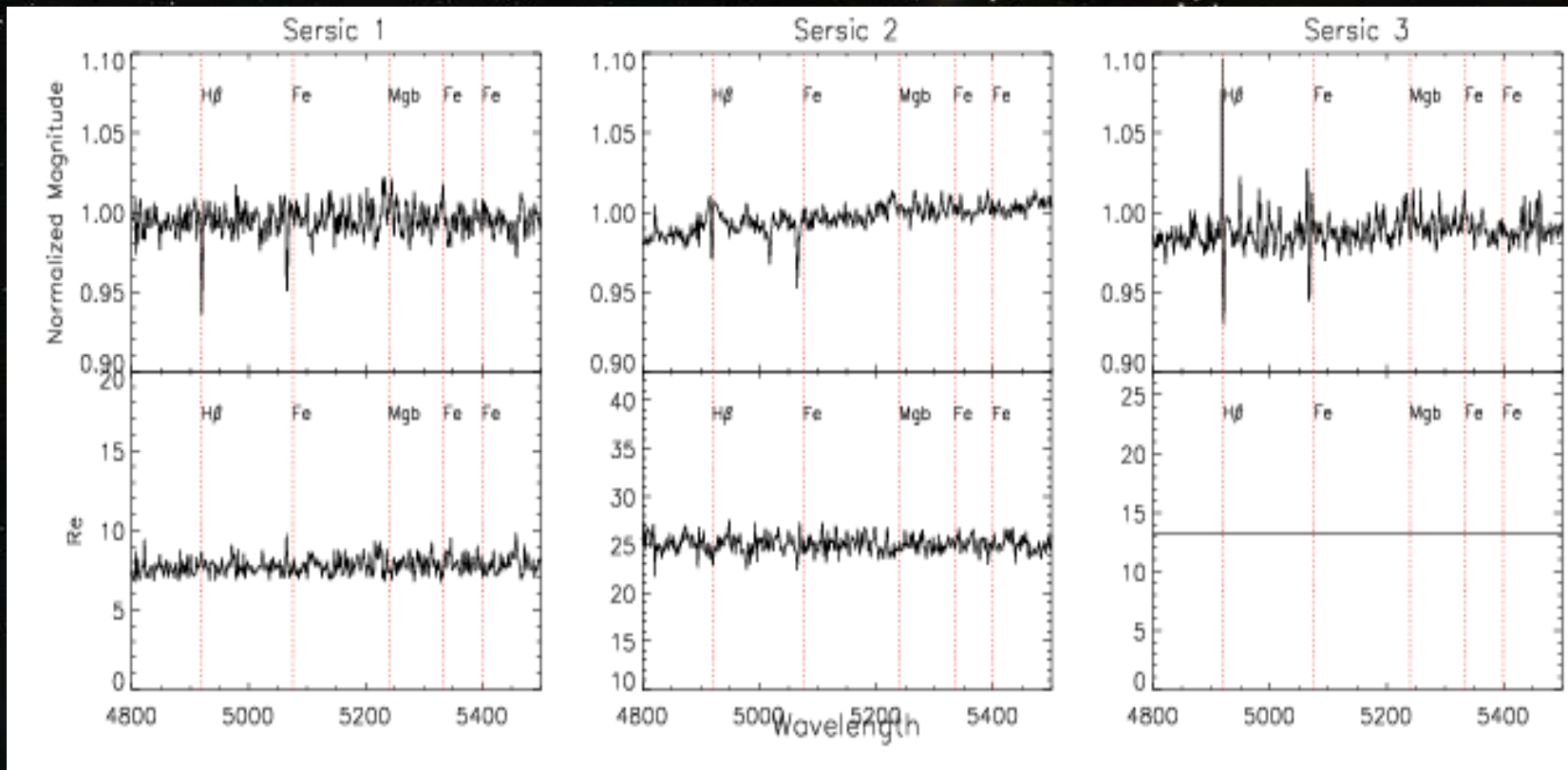


Residuals



Steps to decompose IFU spectra

- Print off image slices of the galaxy at each wavelength, and decompose using MegaMorph
- Plot the integrated magnitude and size of each component against wavelength



Achieved by holding all parameters fixed except the luminosity and size of each component, and running GALFIT on a loop for each image slice

Summary

- It is possible to decompose MaNGA spectra of galaxies into bulge and disc components to study their individual star formation histories
- The process is still at the 'proof of concept' stage
- In the future, we plan to use MegaMorph to apply the simultaneous decompositions over the full spectral range
- This method will provide new insight into the star formation histories of the bulge and disc, and thus their roles in galaxy evolution