Optical linear polarimetry of galaxies

Santiago González-Gaitán

centra

TÉCNICO LISBOA

Correcting reddening intelligently for Supernova Probes

A. Mourão, **L. Galbany**, A. Krone-Martins, B. Pereira, **A. Afonso**, A. Razza, **C. Gutiérrez**, T de Jaeger, J. Anderson, F. Forster

1. Determine extinction from the SN through a) photometry, b) spectral lines and c) polarimetry
2. Determine extinction from the host galaxy through a) continuum/photometry, b) spectral lines and c) polarimetry

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Host galaxy extinction

I. Methodology: 1.5D IFU fitting to SSP

II. Obtaining Rv from IFU data

III. Optical linear polarimetry of nearby galaxies

1. Methodology: 1.5D IFU fitting

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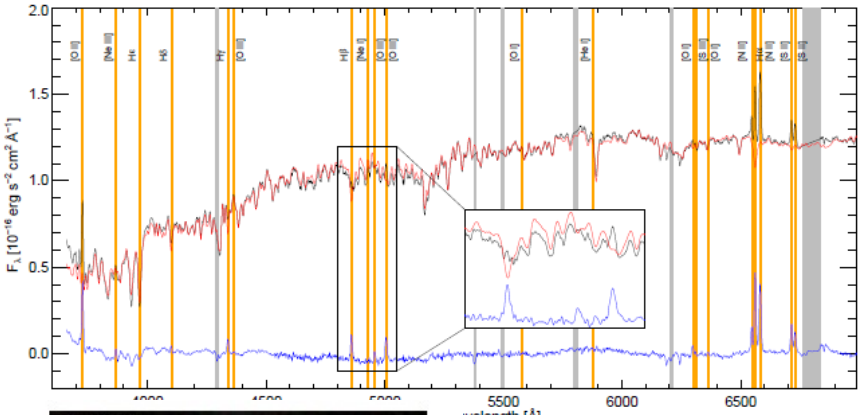
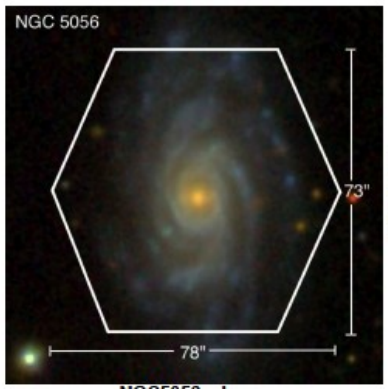
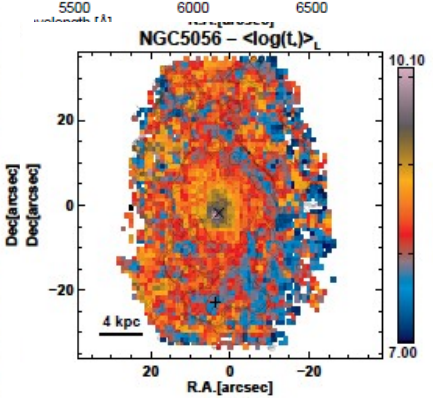
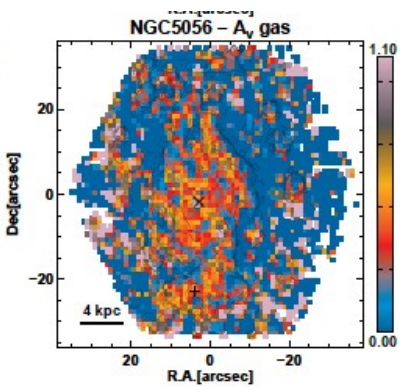
Traditional stellar population fitting to IFU data









I. Methodology: 1.5D IFU fitting

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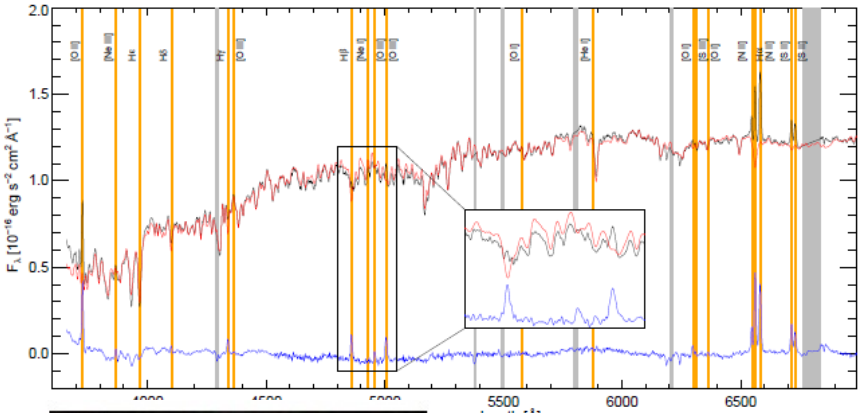
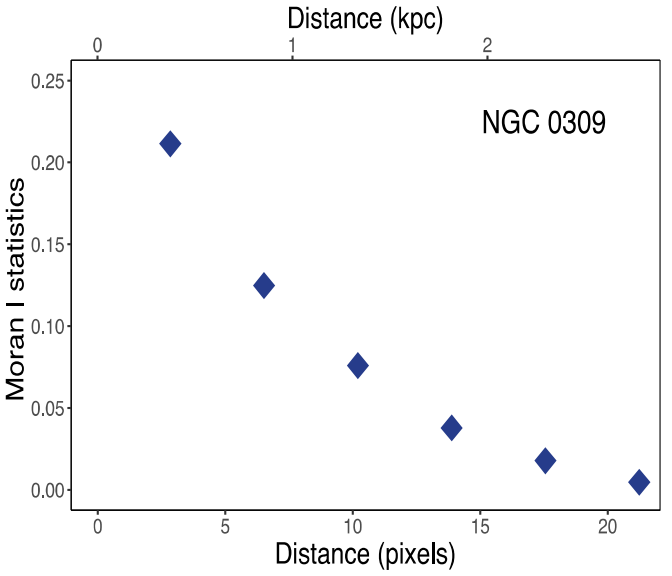
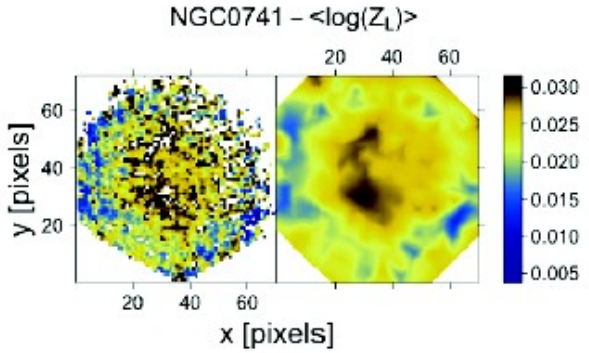


Spatial correlations



I. Methodology: 1.5D IFU fitting

INLA: statistical technique to treat spatial correlations in a map of a given quantity



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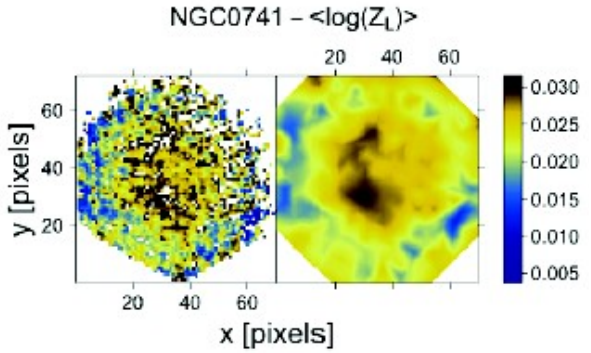

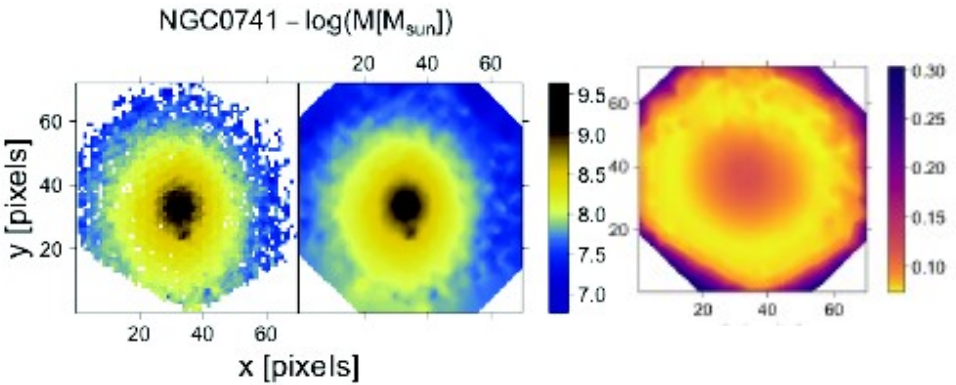

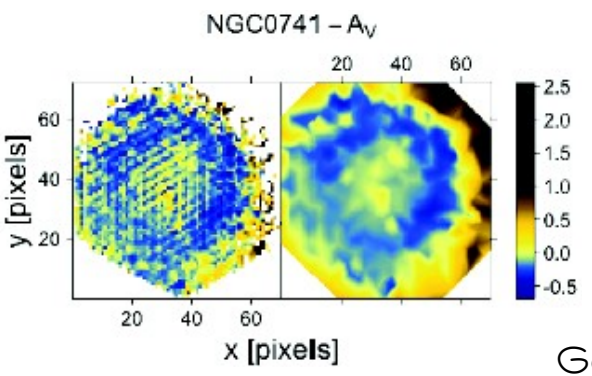

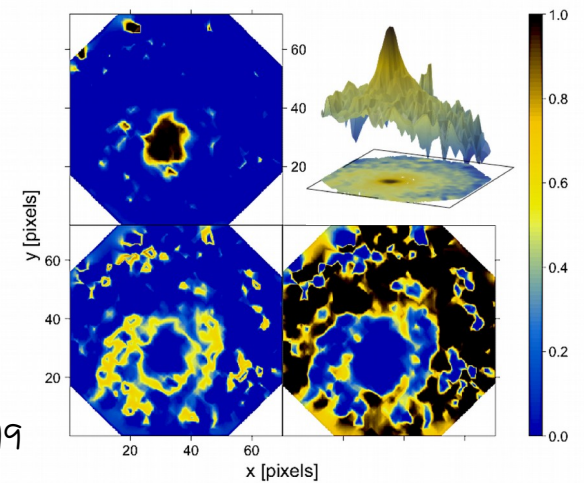

Gonzalez-Gaitan et al. 2019

COIN Cosmostatistics Initiative

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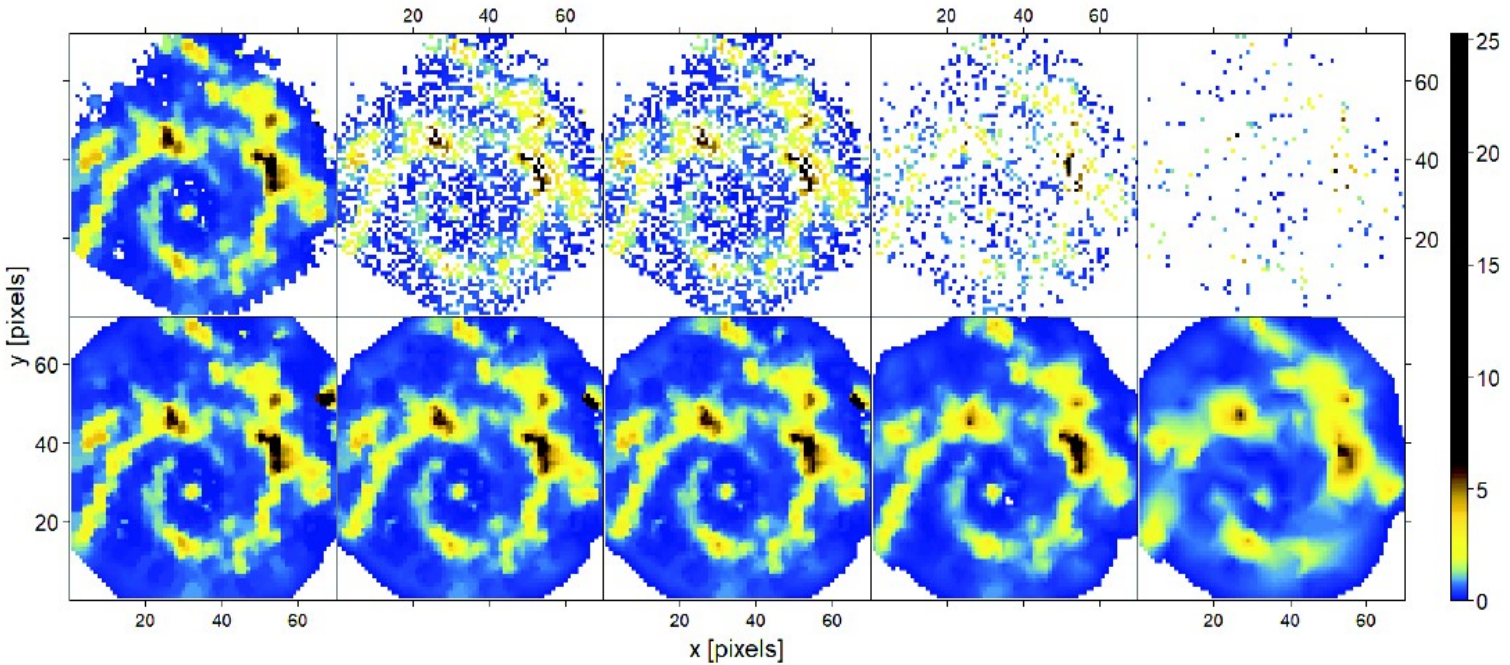

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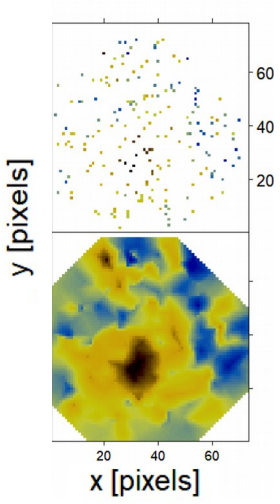
COIN
Cosmostatistics Initiative

I. Methodology: 1.5D IFU fitting

1.5 fitting: Do iterative process between SSP fits and INLA



SSP fits of small percentage of data

reconstruct full map with INLA

Use INLA output as prior guess into SSP fits

convergence

II. Obtaining Rv from IFU data

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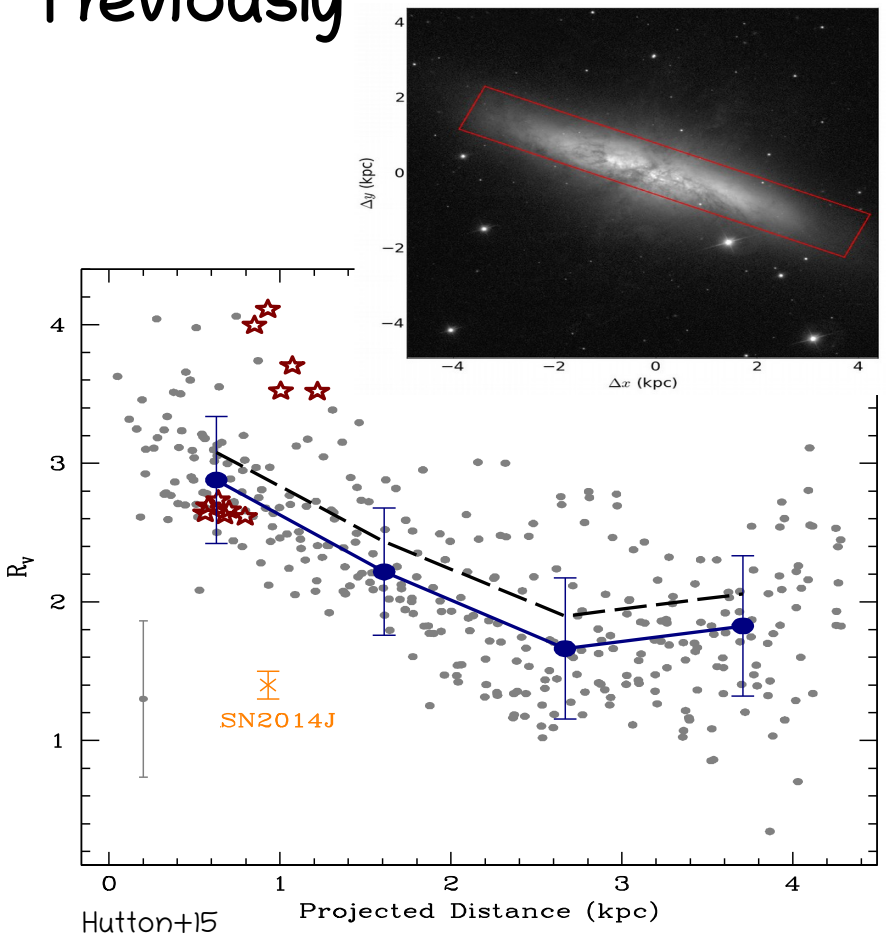
Previously



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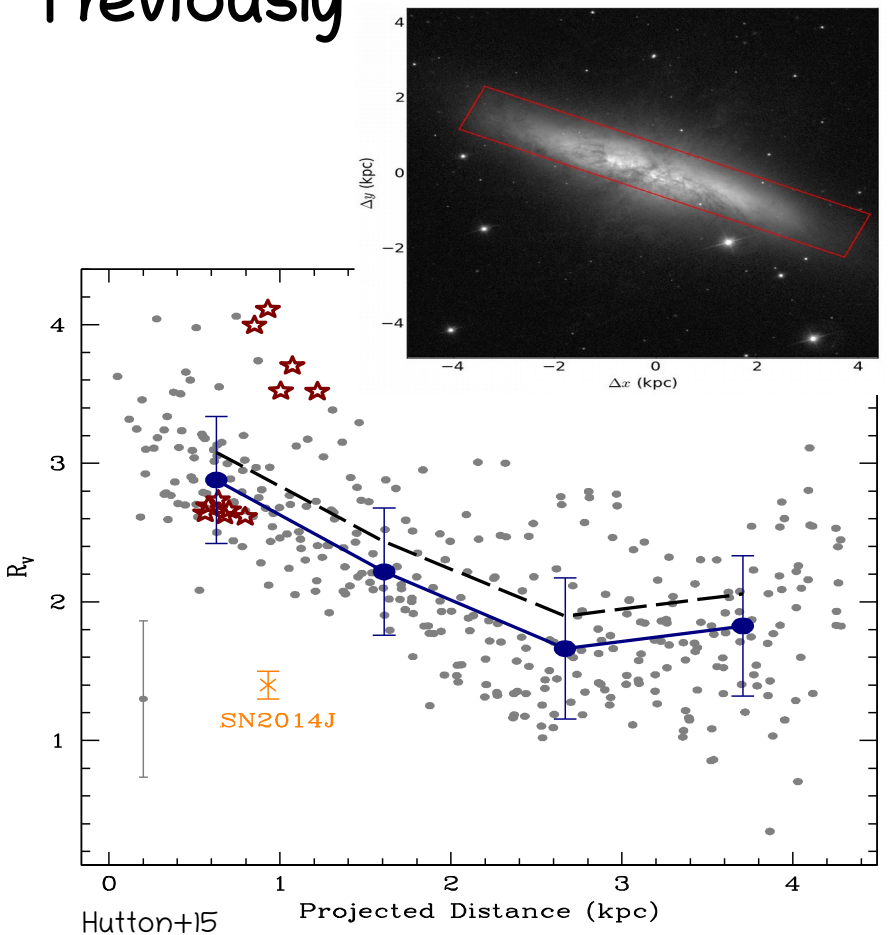
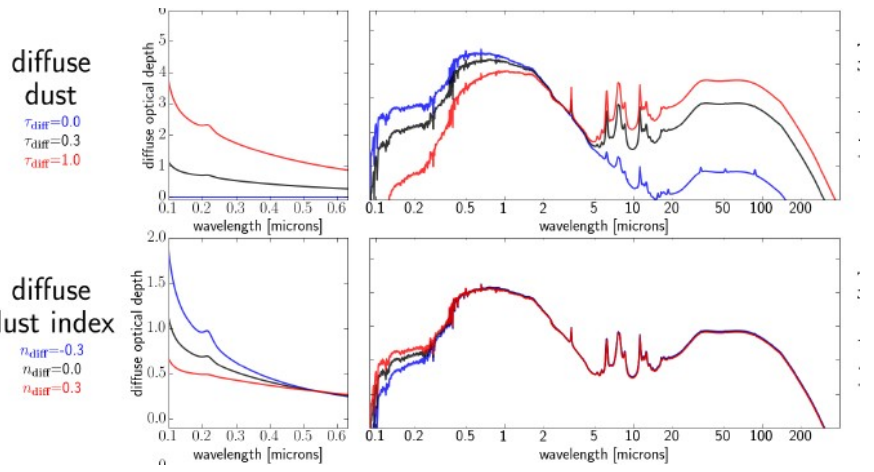


Hutton+15

Currently

- AMUSING IFU galaxies
- Photometry in NIR and NUV
- Bayesian fitter: Prospector
- Treatment of Rv:

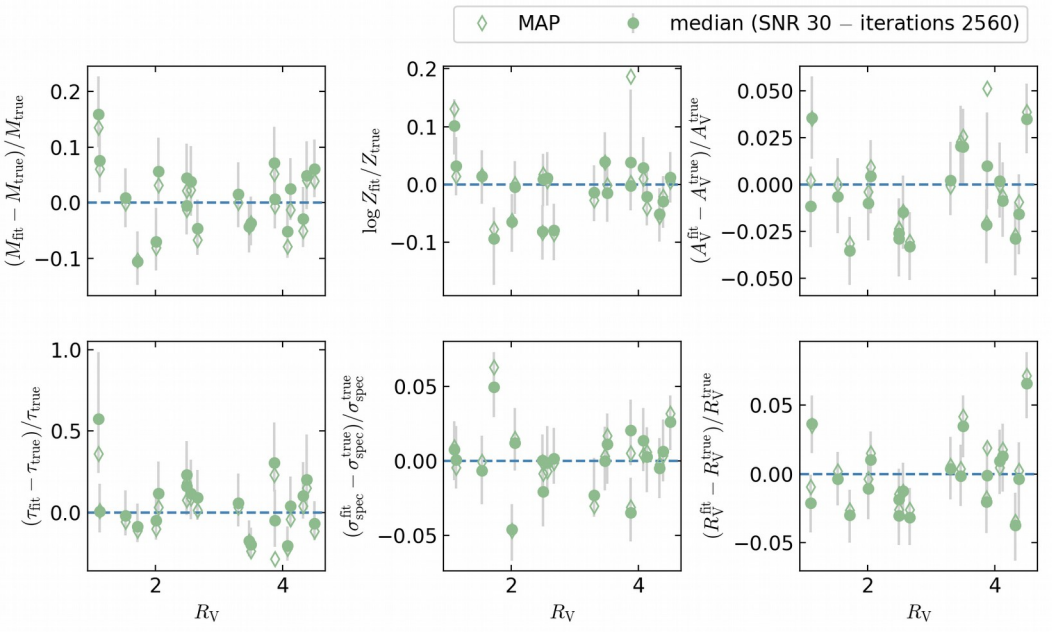
$$\hat{\tau}_{\lambda,2} = \frac{\hat{\tau}_2}{4.05}[k'(\lambda) + D(\lambda)]\left(\frac{\lambda}{\lambda_V}\right)^n$$

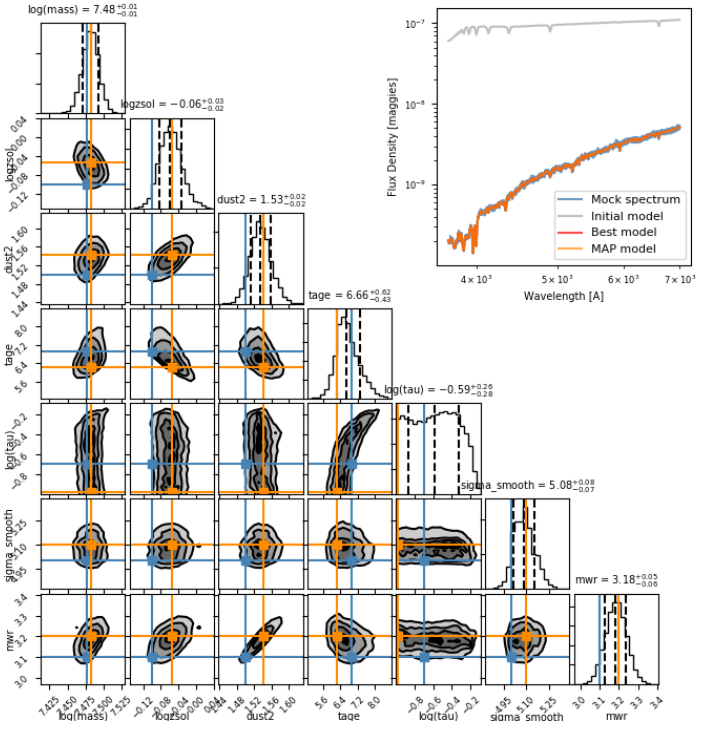


Leja+17

II. Obtaining Rv from IFU data

Extensive simulation to test the method (A. Razza)





III. Optical linear polarimetry of galaxies

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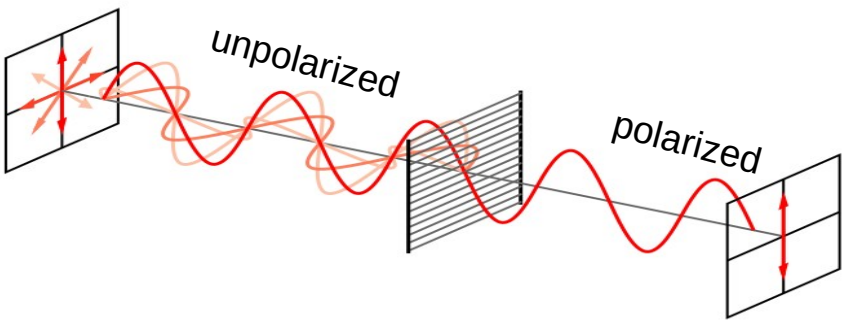
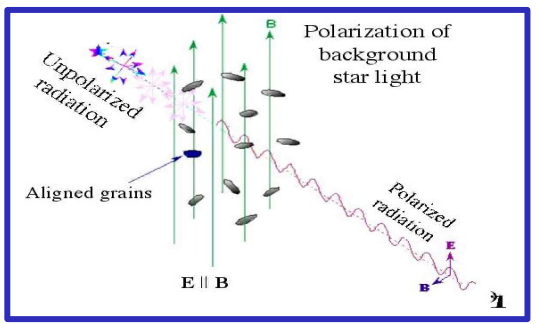
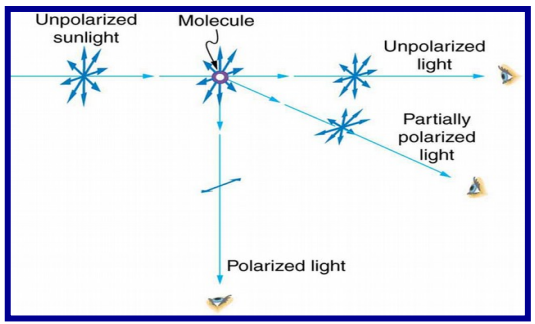
Polarization: light with preferential direction of electric field



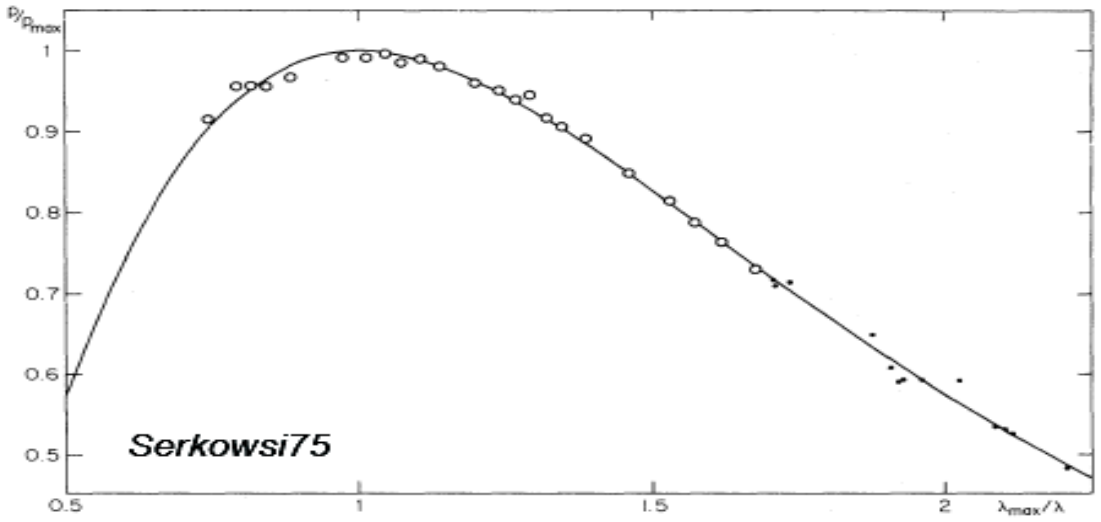
Two effects: dust alignment and dust scattering





III. Optical linear polarimetry of galaxies

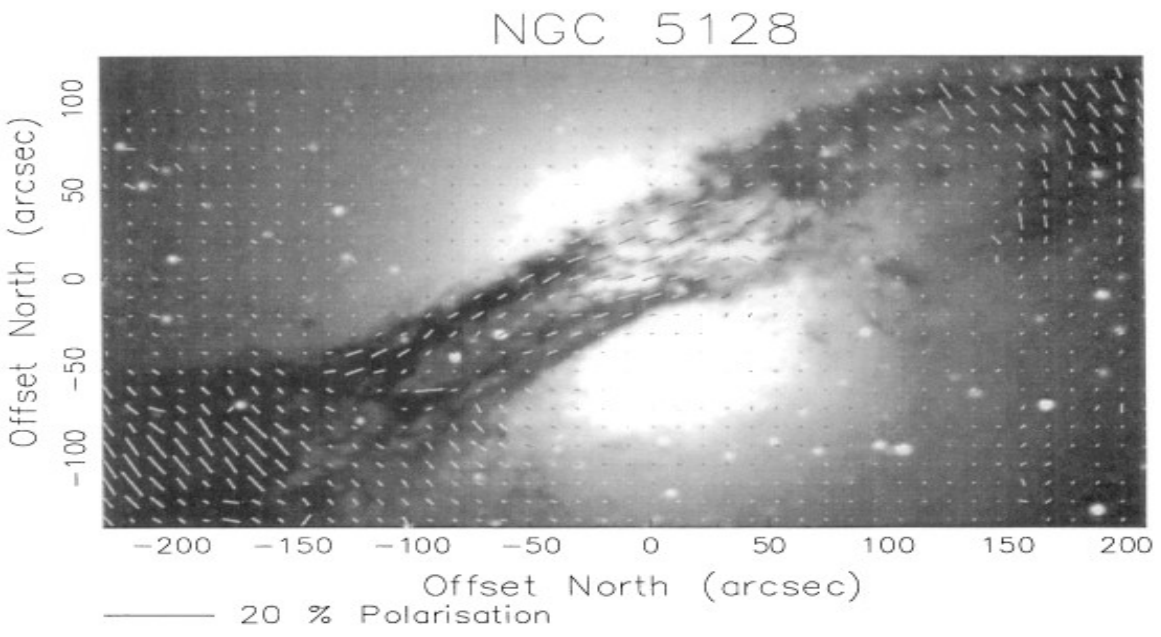
Serkowski law:



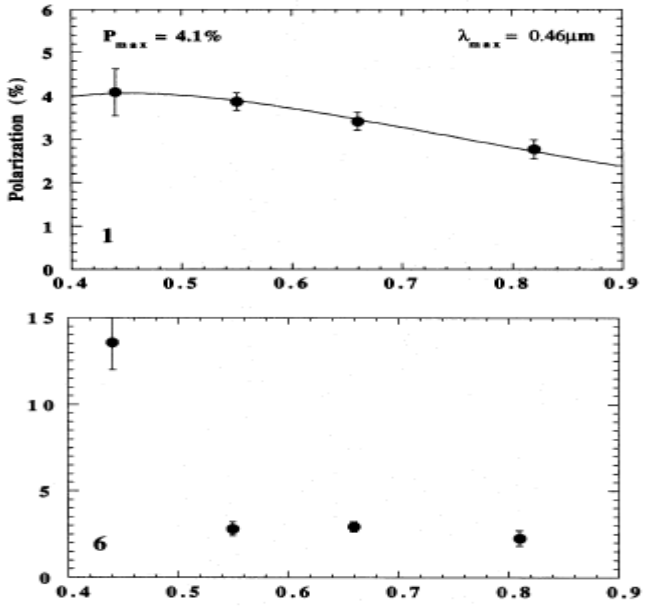
$$p(\lambda) = p_{max} \exp\left[-K \ln^2\left(\frac{\lambda_{max}}{\lambda}\right)\right]$$

$$R_V \simeq 3.67(\lambda_{max}/5500\mathring{A}) - 0.29$$

III. Optical linear polarimetry of galaxies



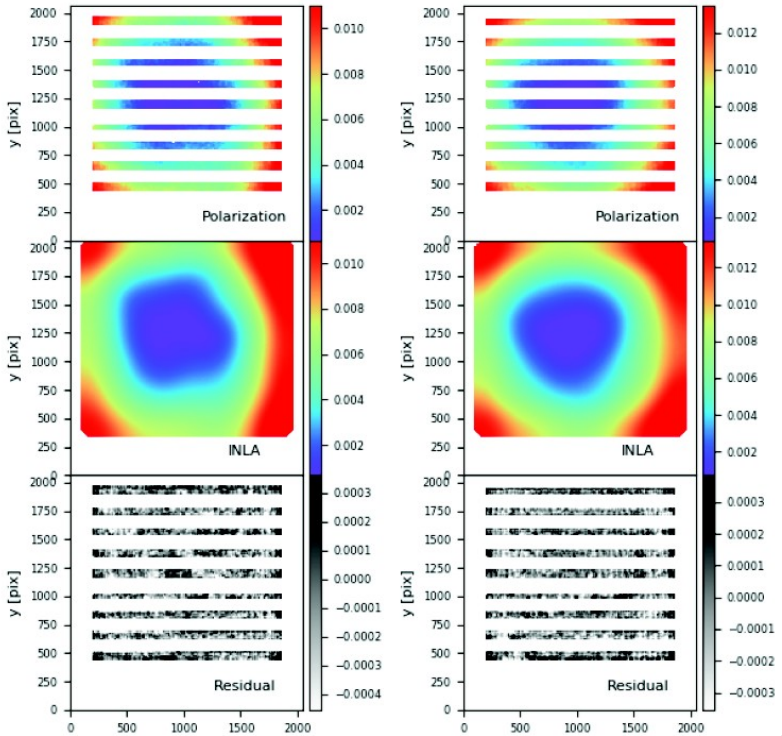
Scarrott+96

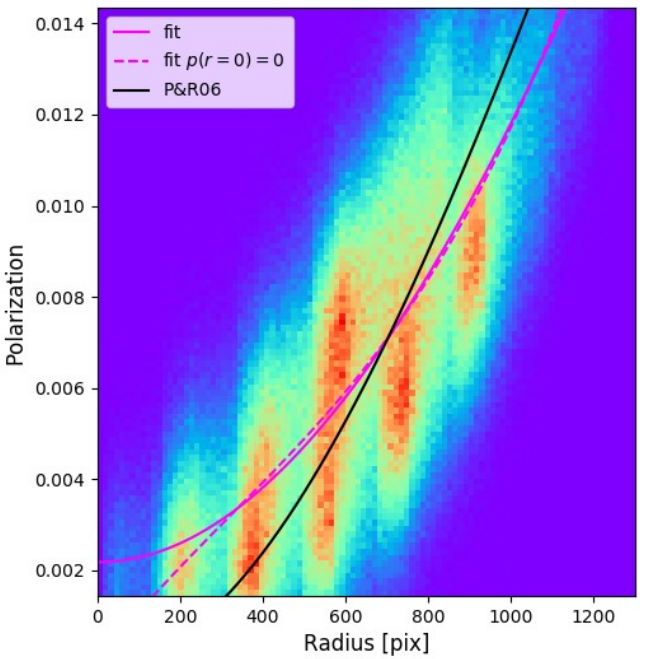


Varying Rv's and other things

III. Optical linear polarimetry of galaxies

FORS2 instrument field polarization



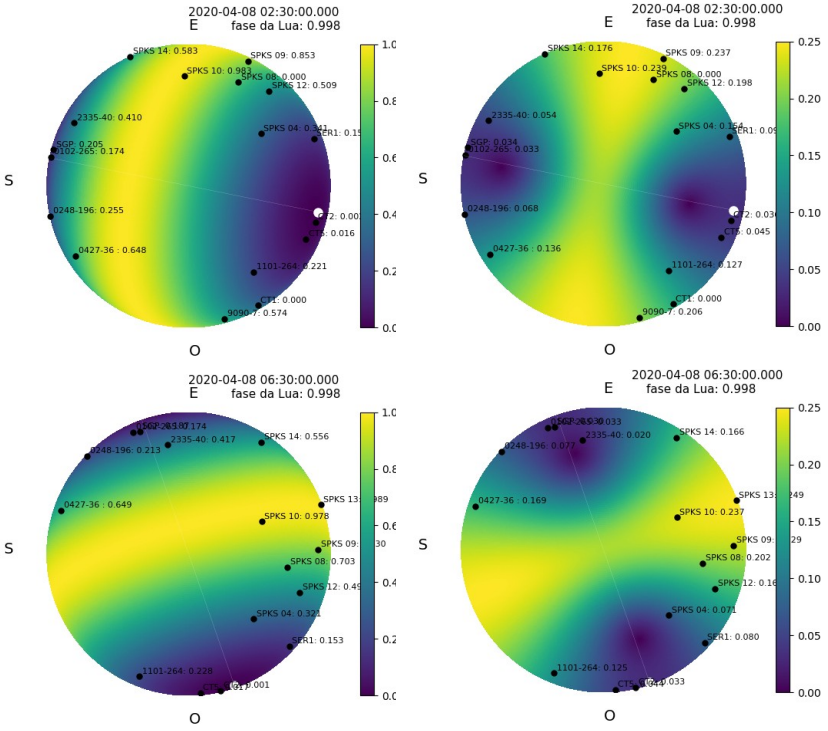


González-Gaitán et al. submitted

III. Optical linear polarimetry of galaxies

Moon background polarization (B. Pereira)

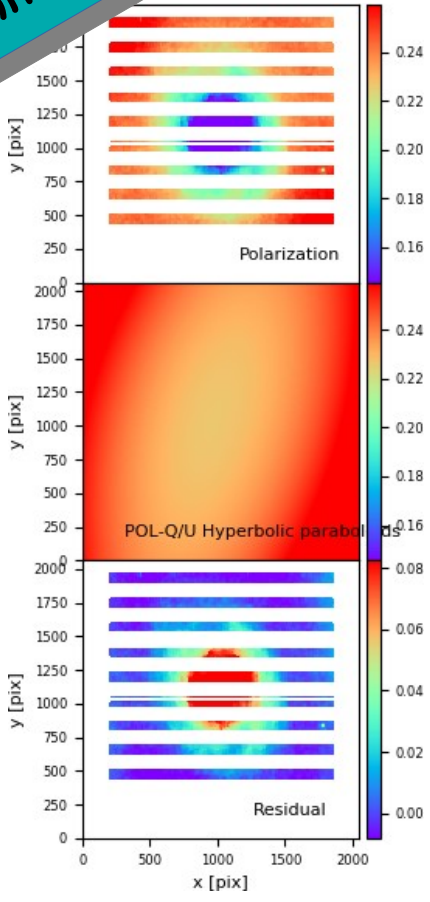
Single scattering

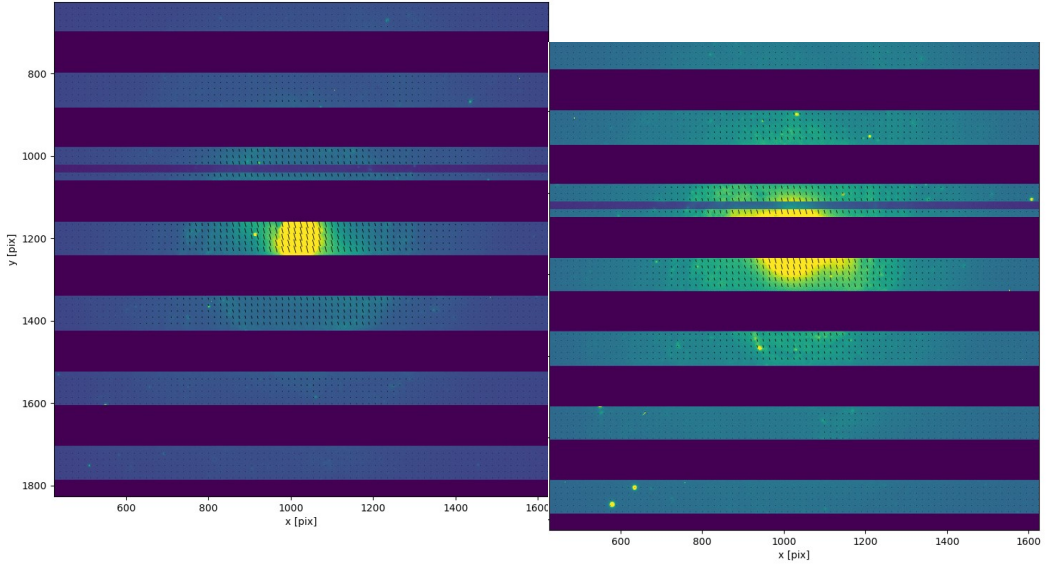


Multiple scattering

III. Optical linear polarimetry of galaxies

Preliminary

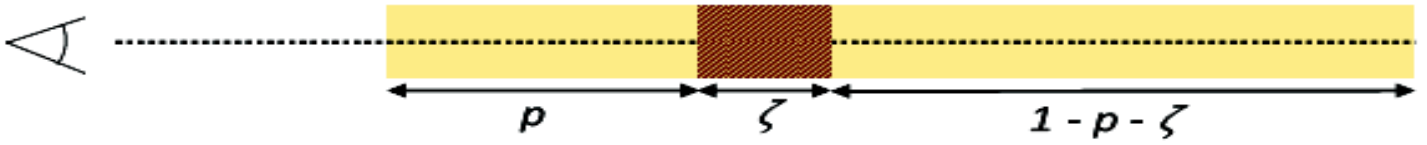


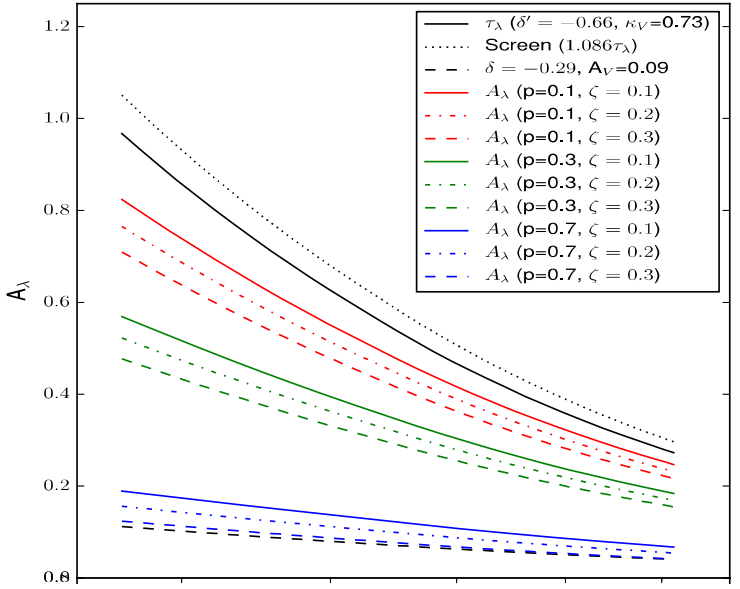


Thanks!

Host extinction: additional complication

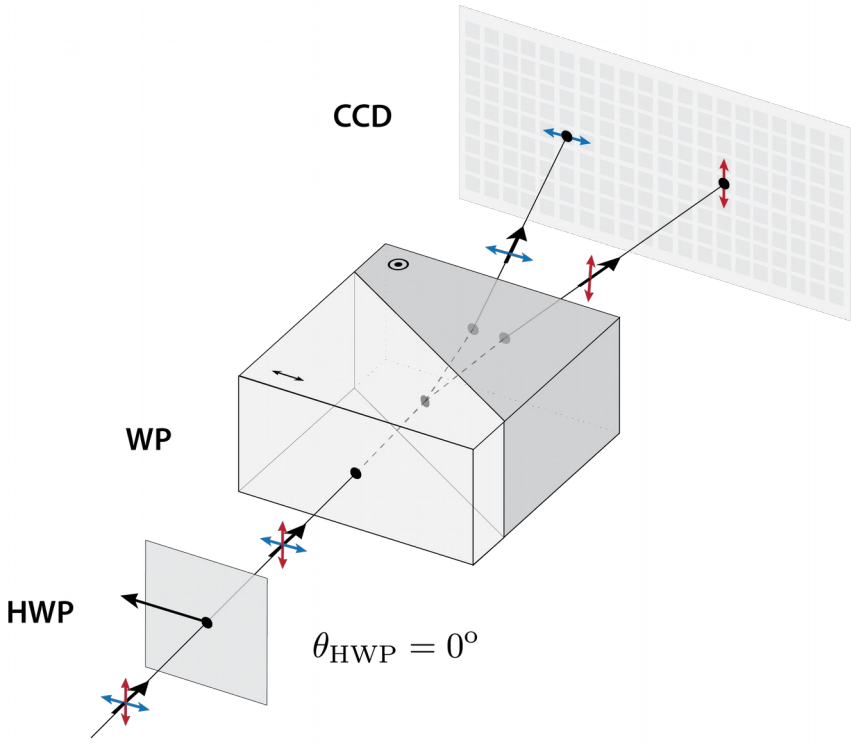
Besides star light behind dust, there may be another layer of stars in front of it:





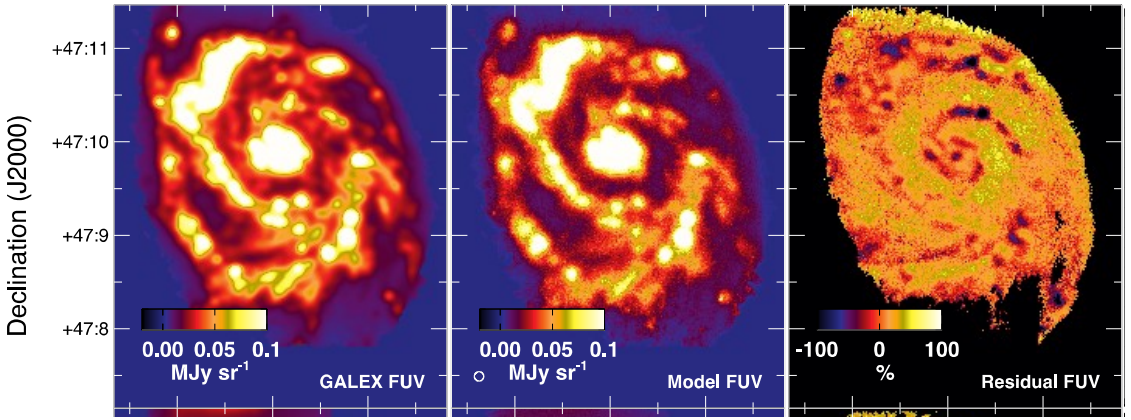
Viaene+17

Dual-beam polarimeter



Modeling of galaxies

- 3D Monte Carlo hydrodynamical radiative transfer codes
- Modeling of galaxy: brightness, temperature, Sérsic profile, number of spiral arms, etc.
- Modeling of dust composition, grain size distribution, mass and geometry
- Generate multi-wavelength maps of intensity and polarimetry



De Looze+14