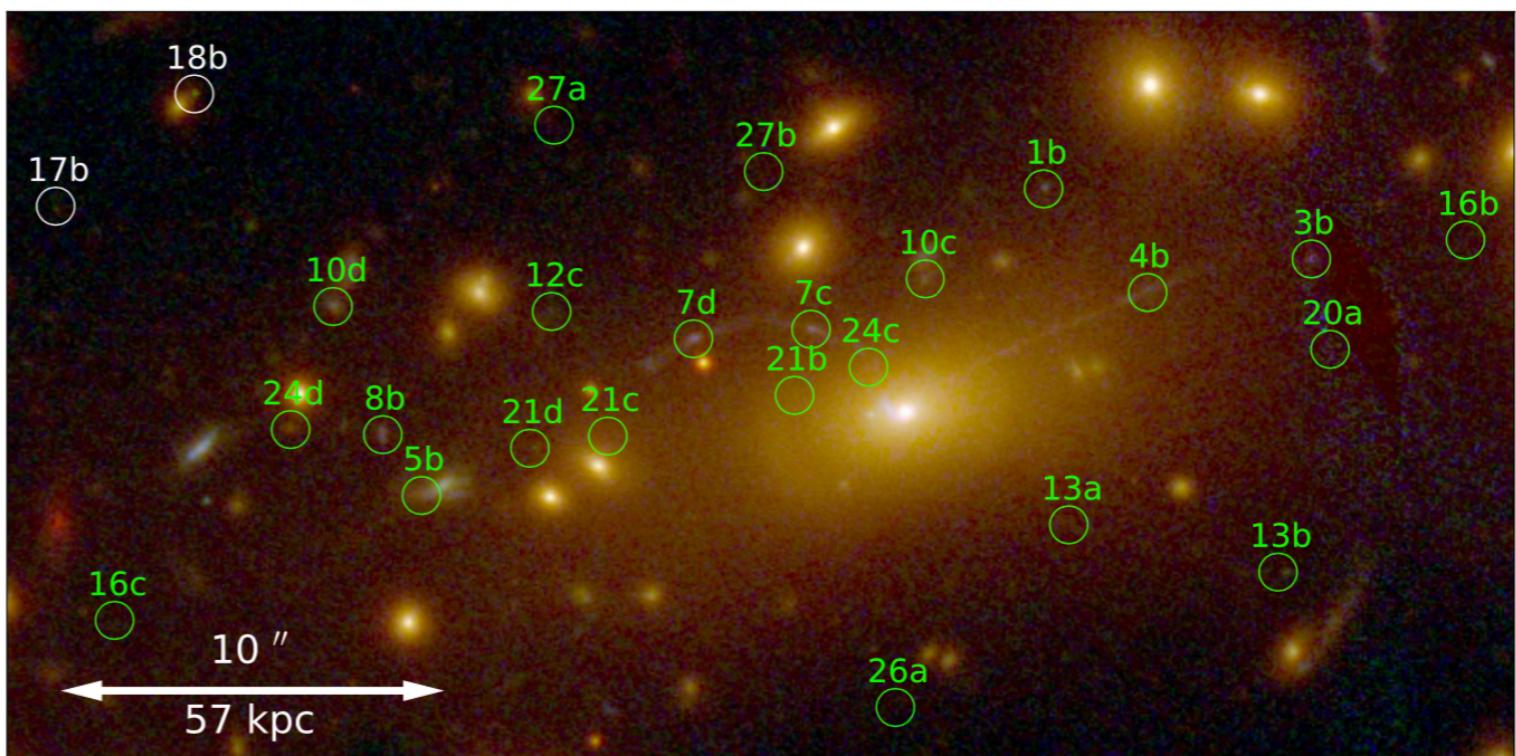
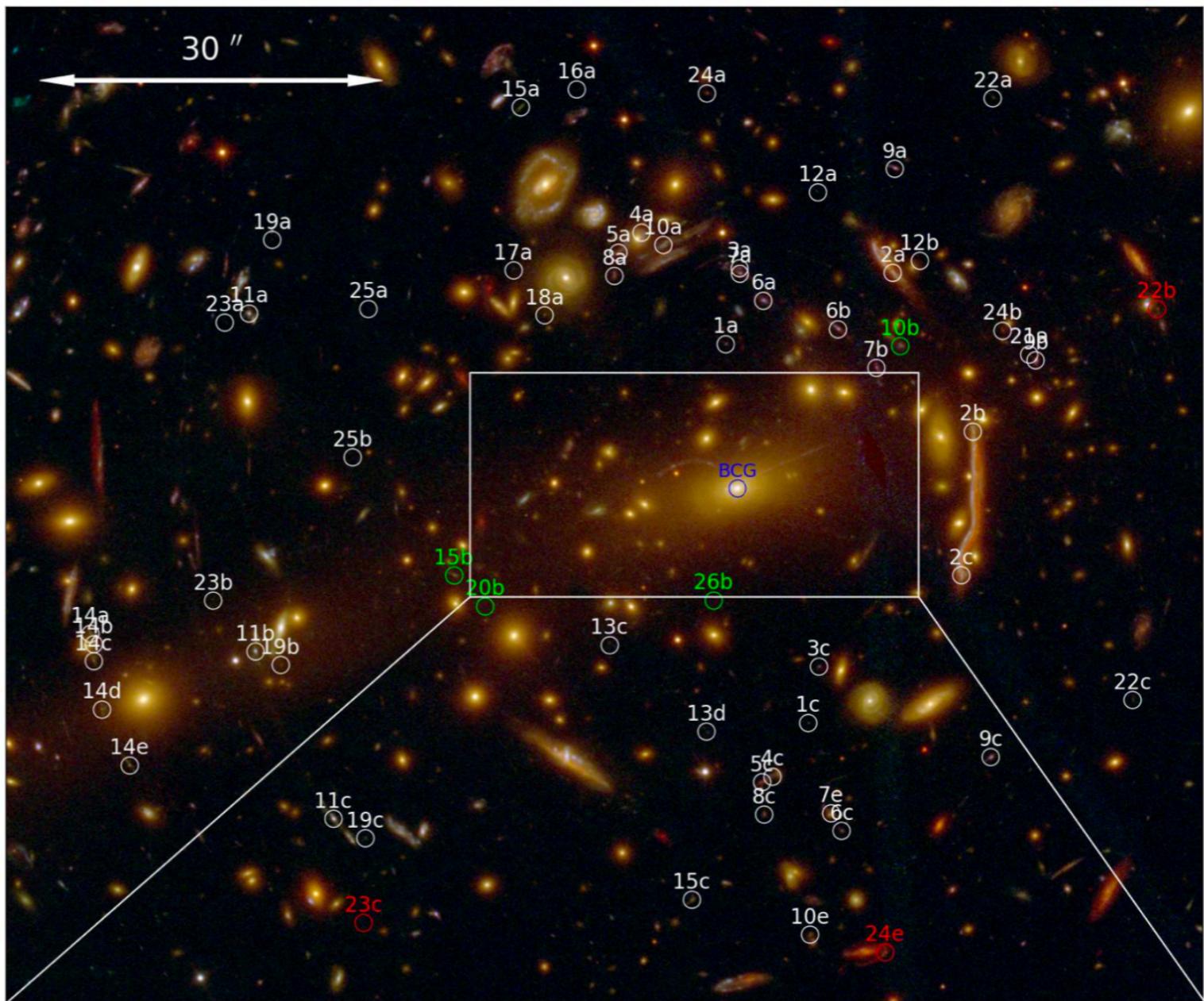
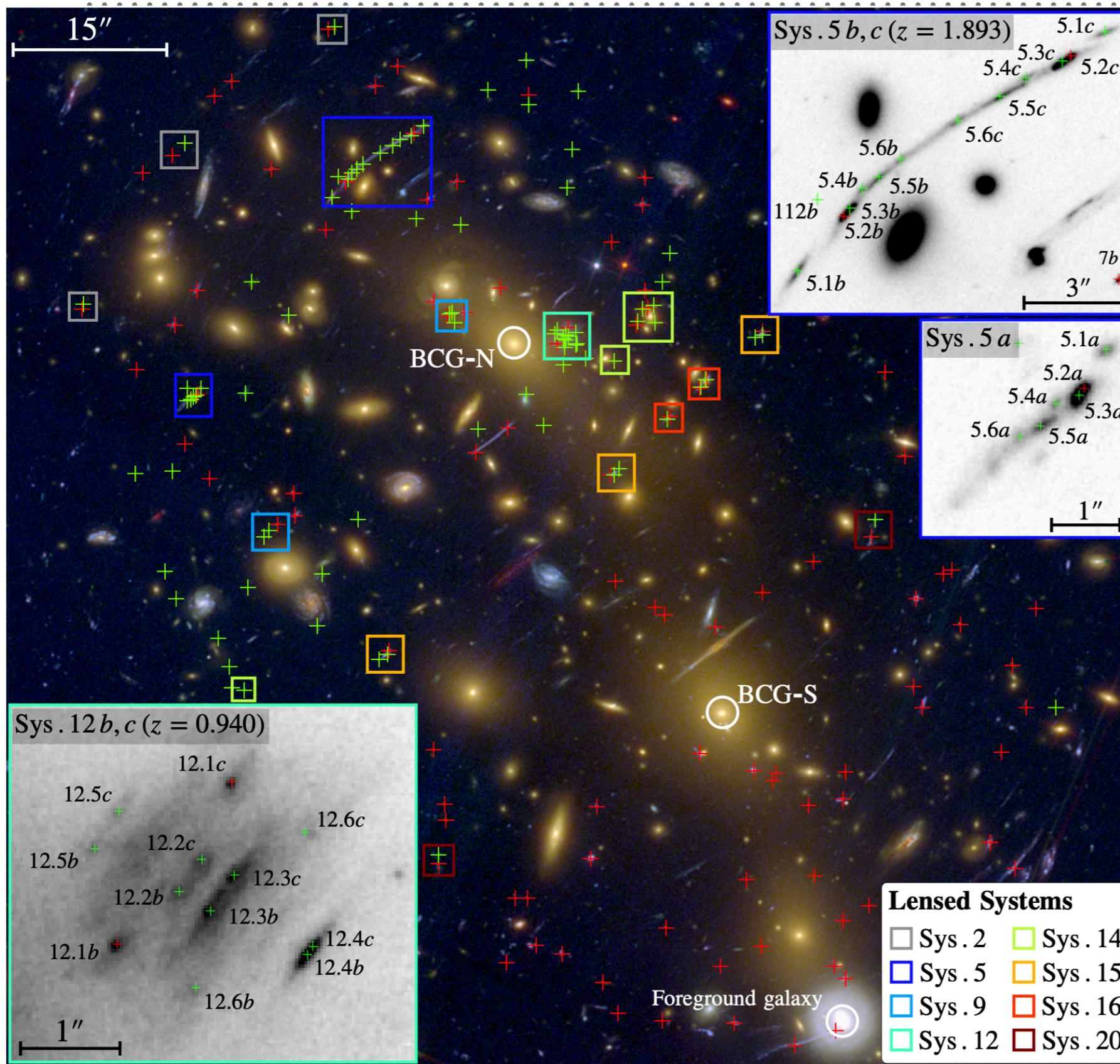


MACSJ1206

- 27 families of multiple images; 82 multiple images in total
- $z=[1.0-6.1]$
- Cluster redshift: $z=0.44$



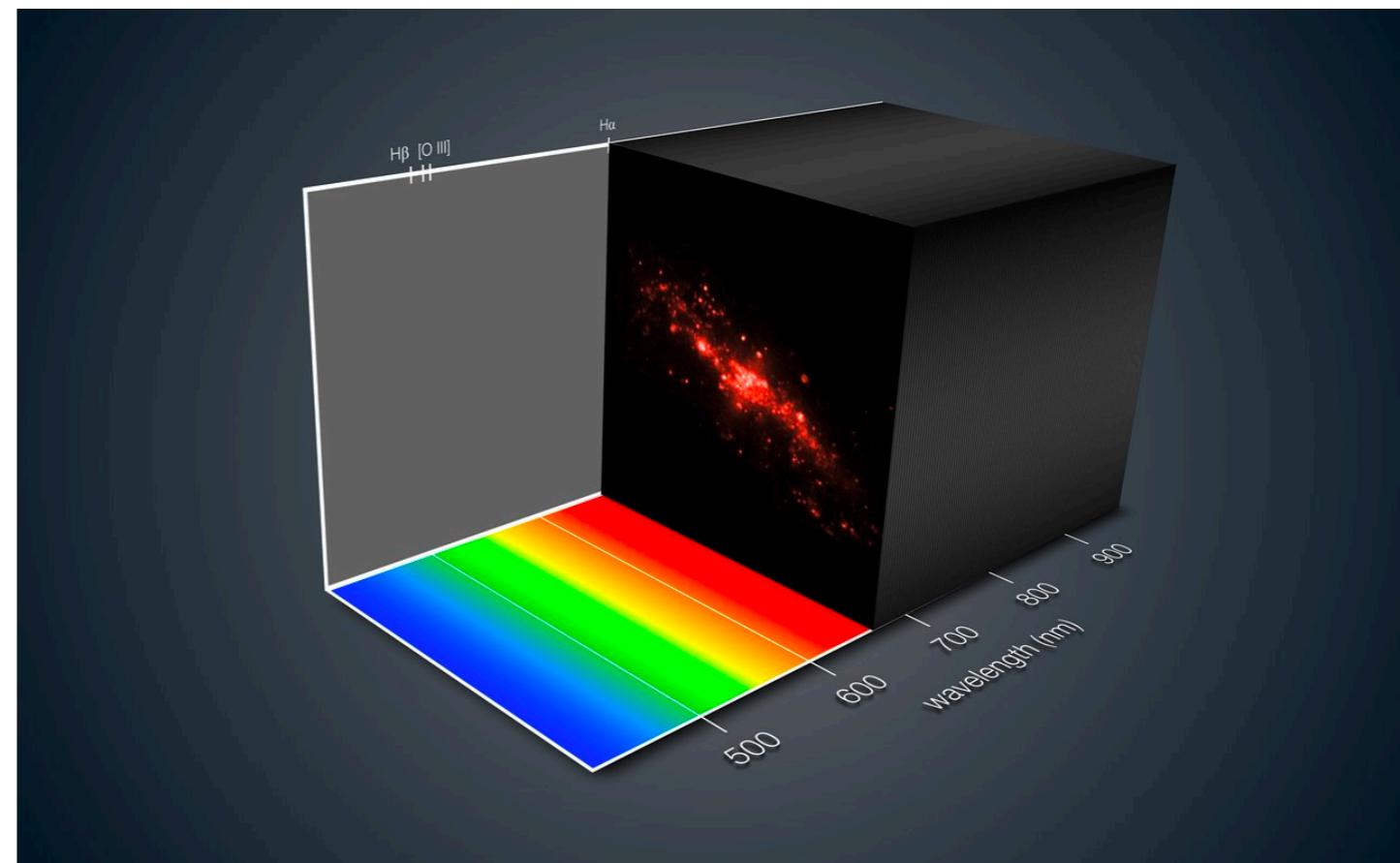
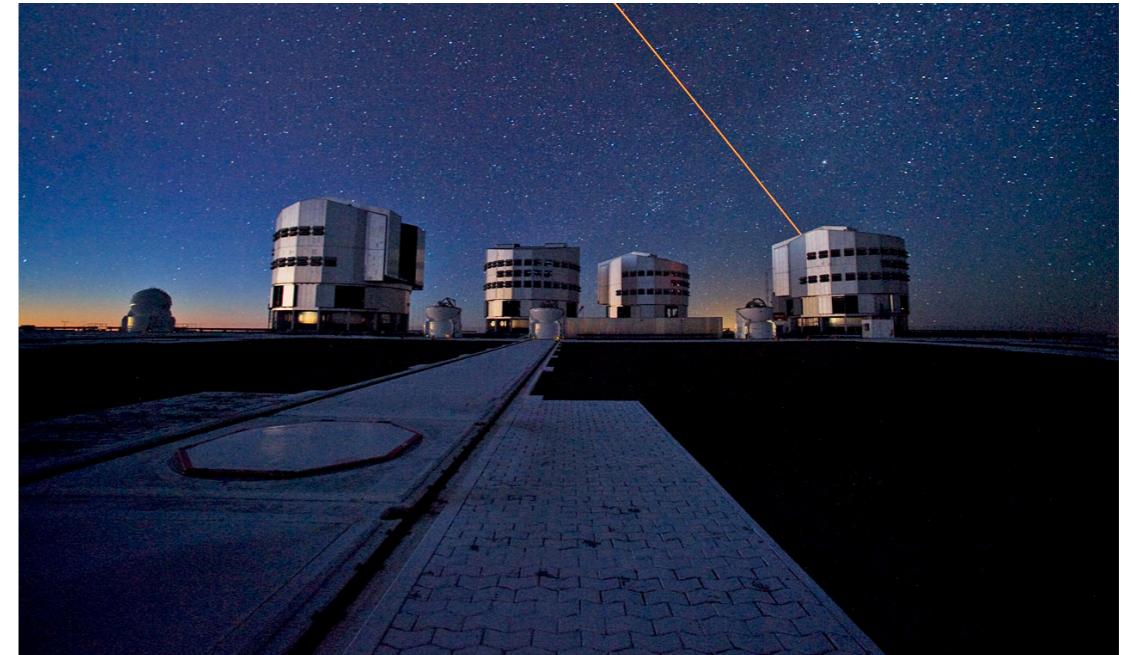
MULTIPLE KNOTS IN THE SAME SOURCE



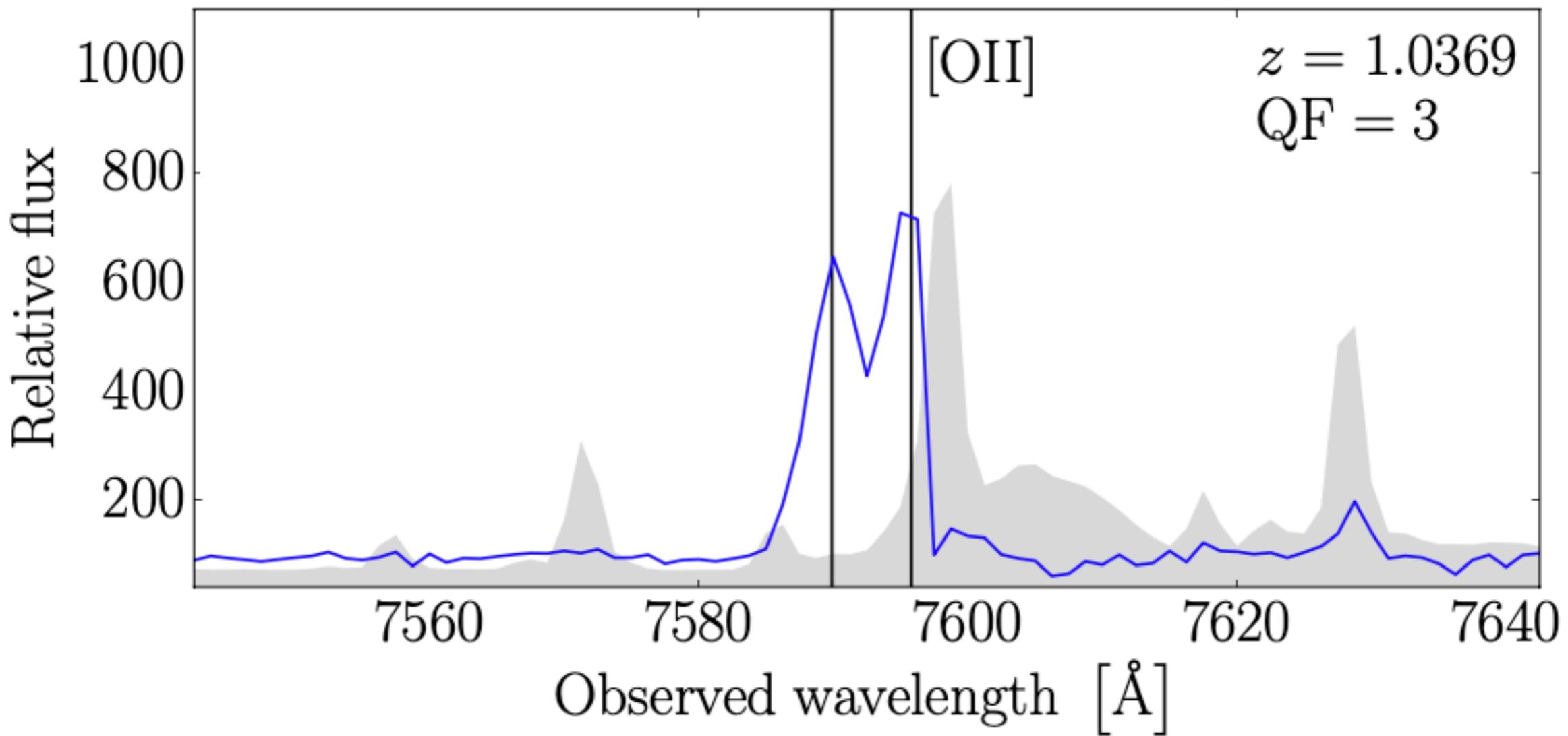
Knots (e.g. compact star formation regions, globular clusters, etc) within the same source can be used as additional constraints to build the model

RECENT ADVANCEMENTS: MUSE (THE MULTI-UNIT SPECTROSCOPIC EXPLORER) @VLT

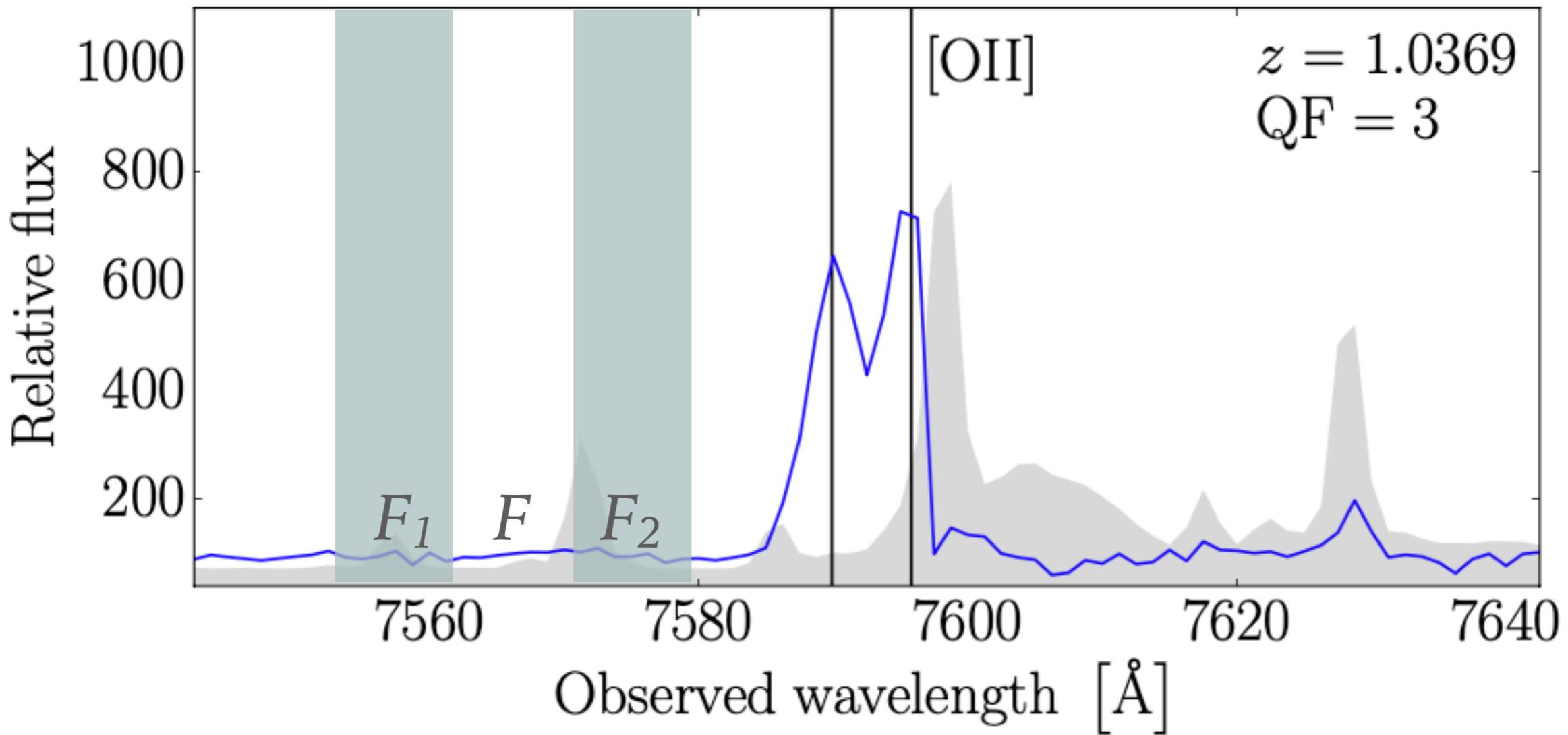
- an Integral Field Spectrograph located at the Nasmyth B focus of Yepun, the VLT UT4 telescope.
- It has a modular structure composed of 24 identical IFU modules that together sample, in Wide Field Mode (WFM), a near-contiguous 1 squared arcmin field of view.
- Spectrally the instrument samples almost the full optical domain with a mean resolution of 3000.
- Spatially, the instrument samples the sky with 0.2 arcseconds spatial pixels in the currently offered Wide Field Mode with natural seeing (WFM-noAO).
- E.g. Ly-a emission up to $z=6.5$



EXAMPLE

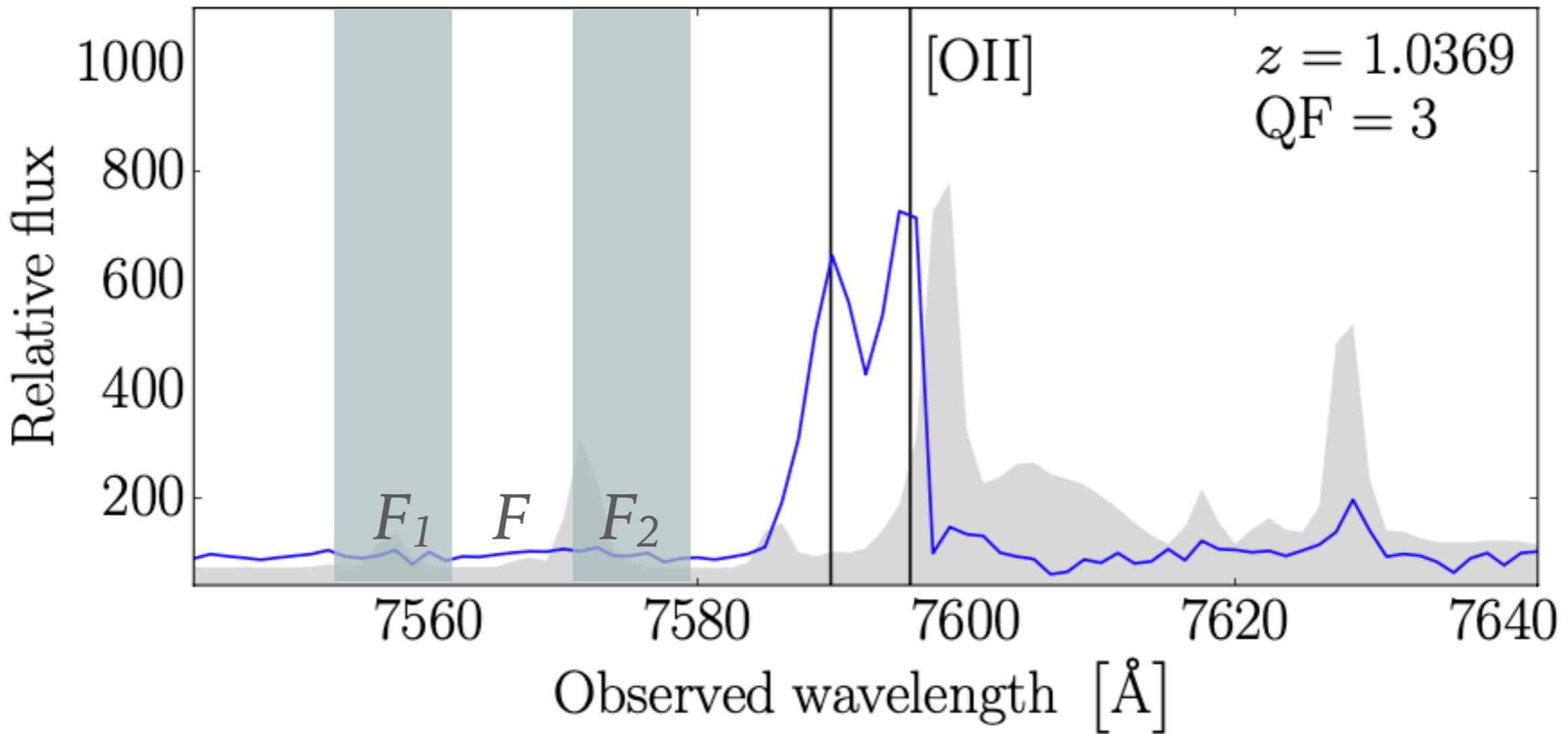


EXAMPLE



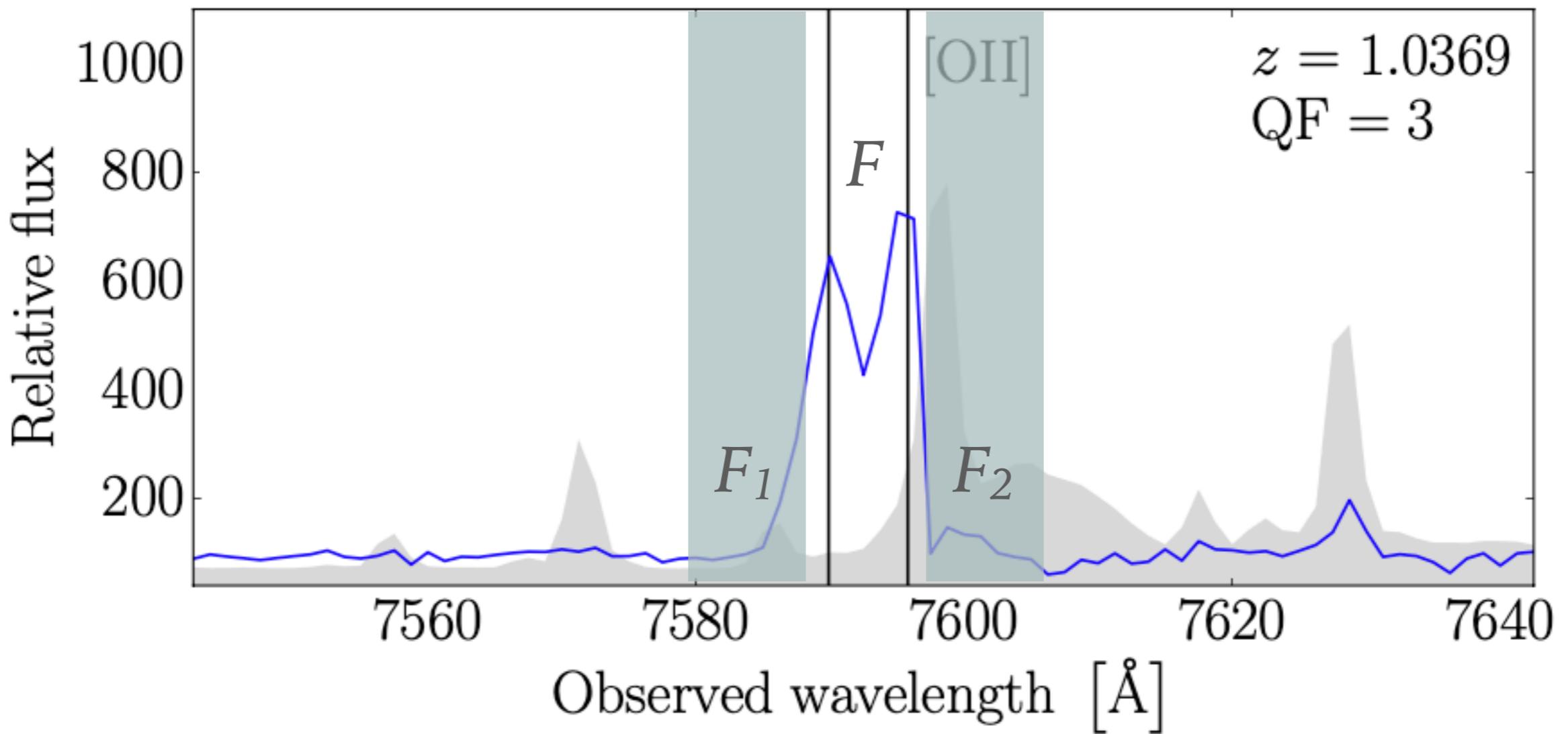
$$F - \frac{(F_1 + F_2)}{2} \approx ?$$

EXAMPLE



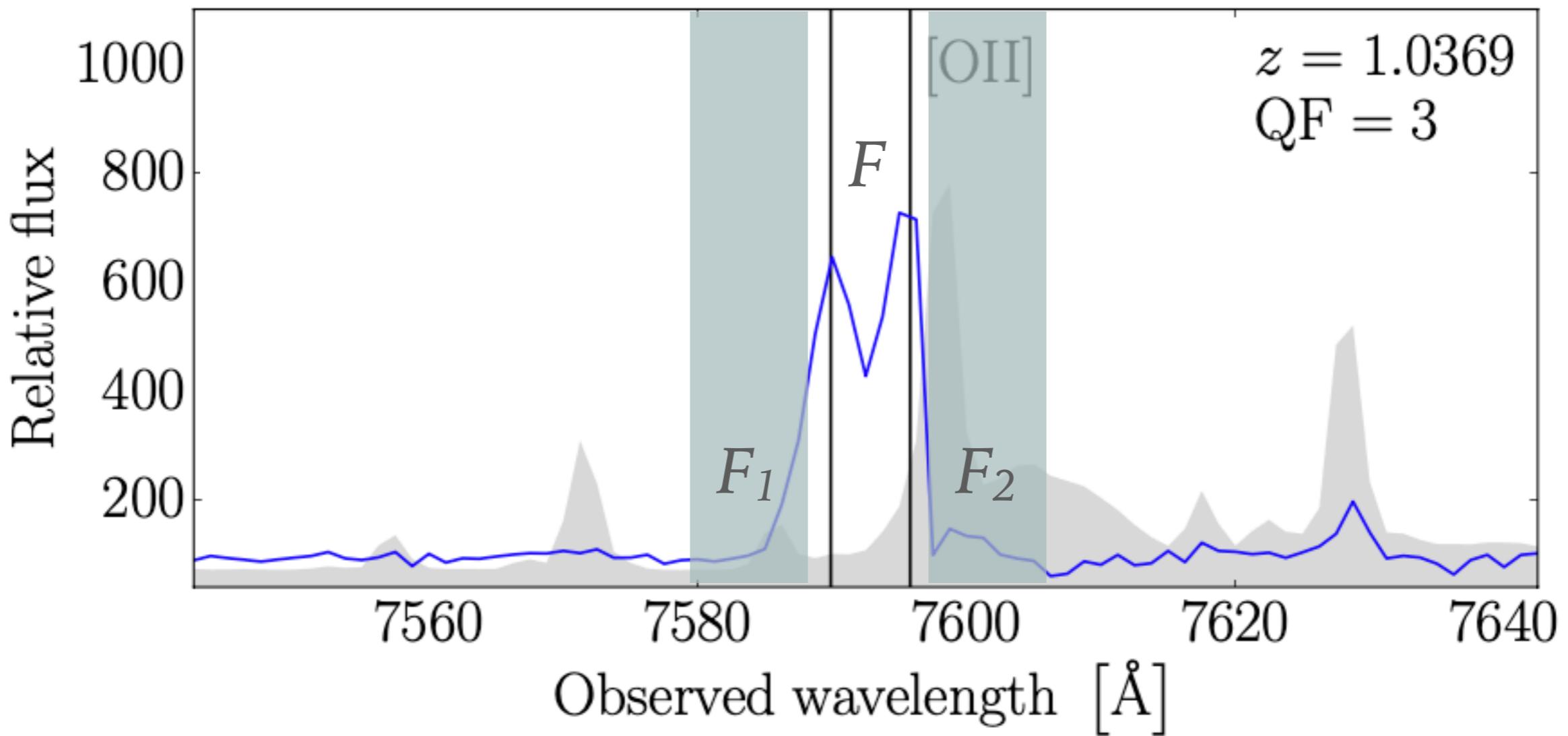
$$F - \frac{(F_1 + F_2)}{2} \approx 0$$

EXAMPLE



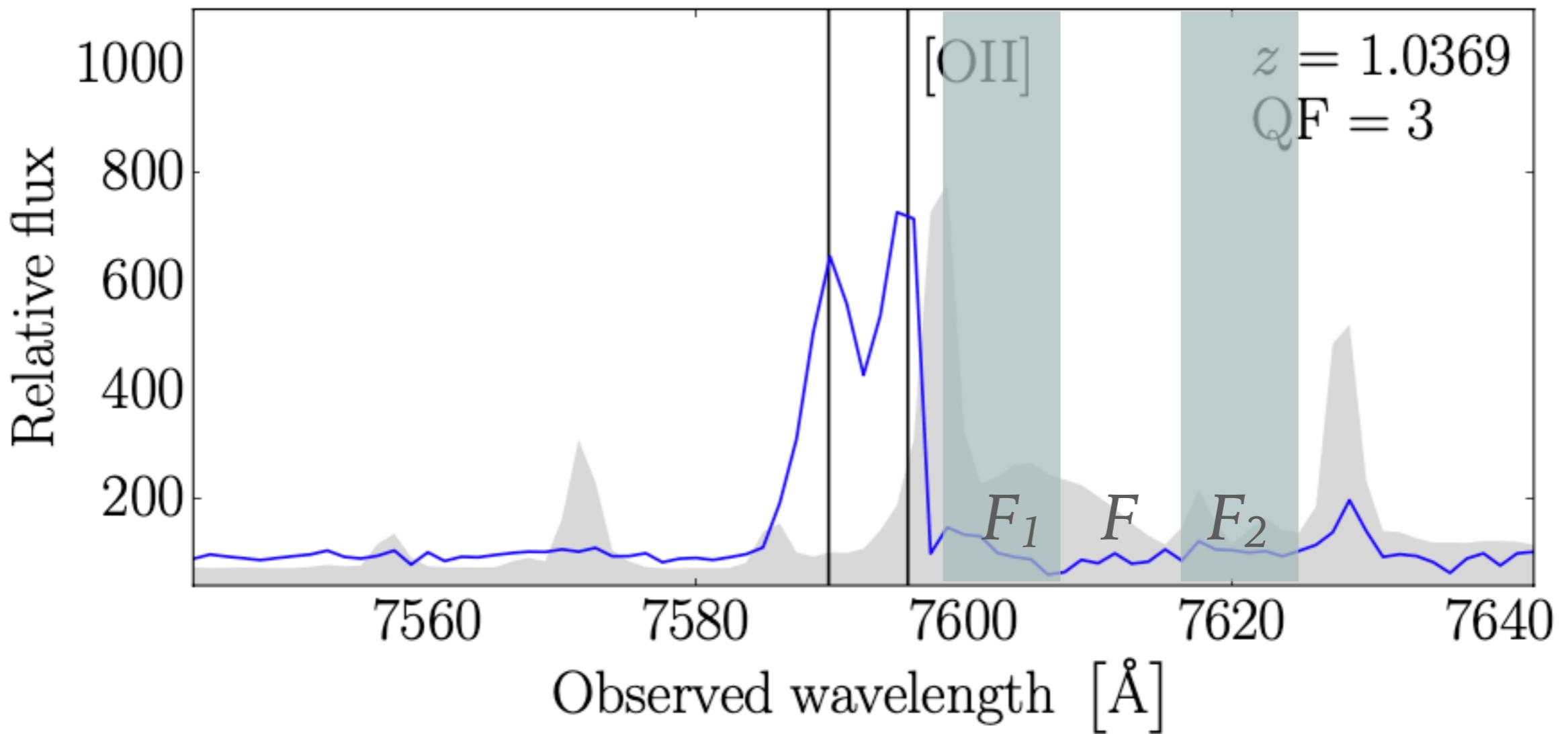
$$F - \frac{(F_1 + F_2)}{2} \approx ?$$

EXAMPLE

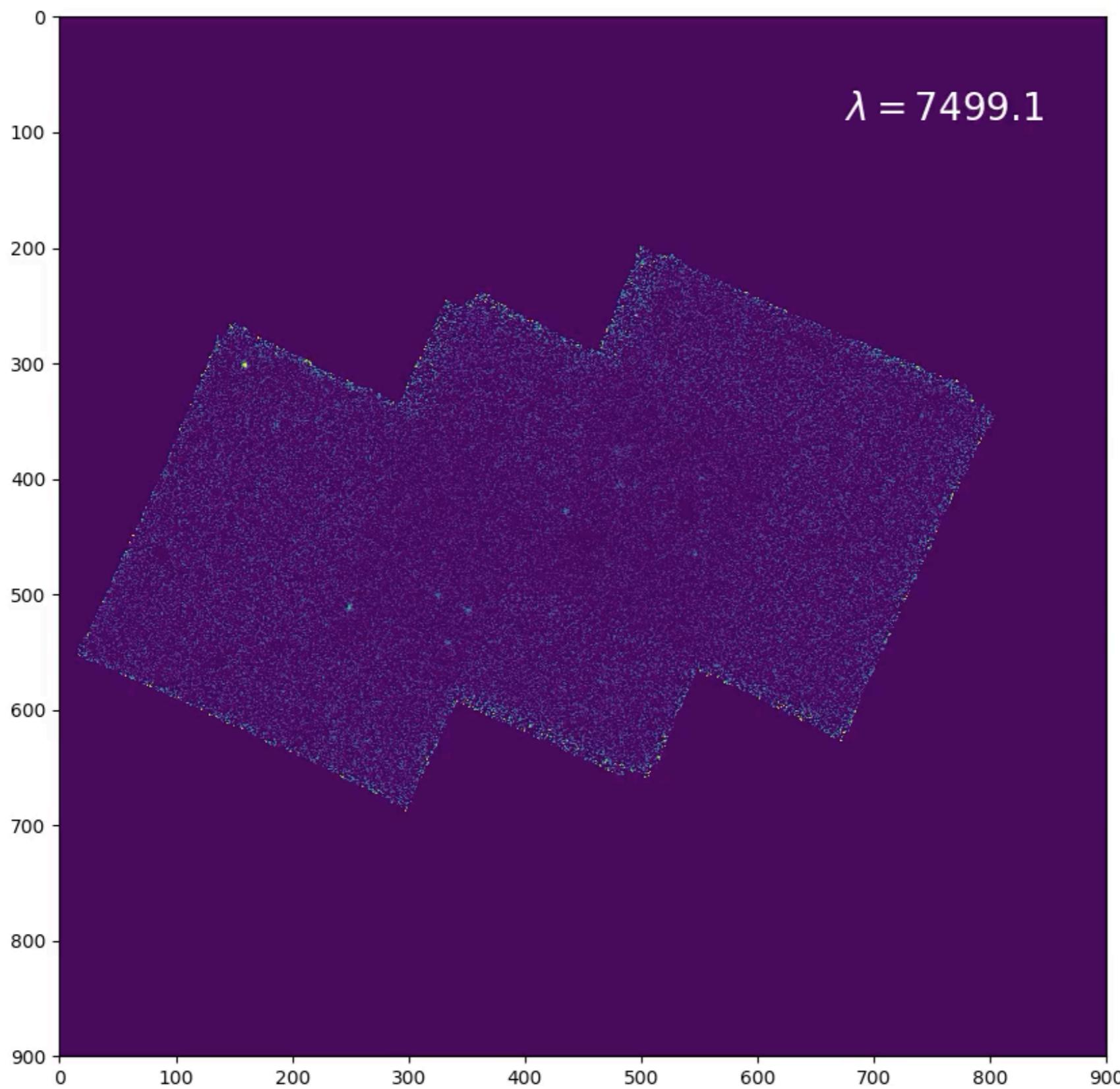


$$F - \frac{(F_1 + F_2)}{2} > 0$$

EXAMPLE



$$F - \frac{(F_1 + F_2)}{2} \approx 0$$

$\lambda = 7499.1$ 



BUILDING THE MASS MODEL

As explained in the previous lessons: Hierarchy of mass components and combined potential.

$$\Psi(\vec{x}) = \sum_{i=1}^{n_{smooth}} \Psi_{smooth,i}(\vec{x} - \vec{x}_{smooth,i}) + \sum_{i=1}^{n_{sub}} \Psi_{sub,i}(\vec{x} - \vec{x}_{sub,i}) + \Psi_{ext}$$

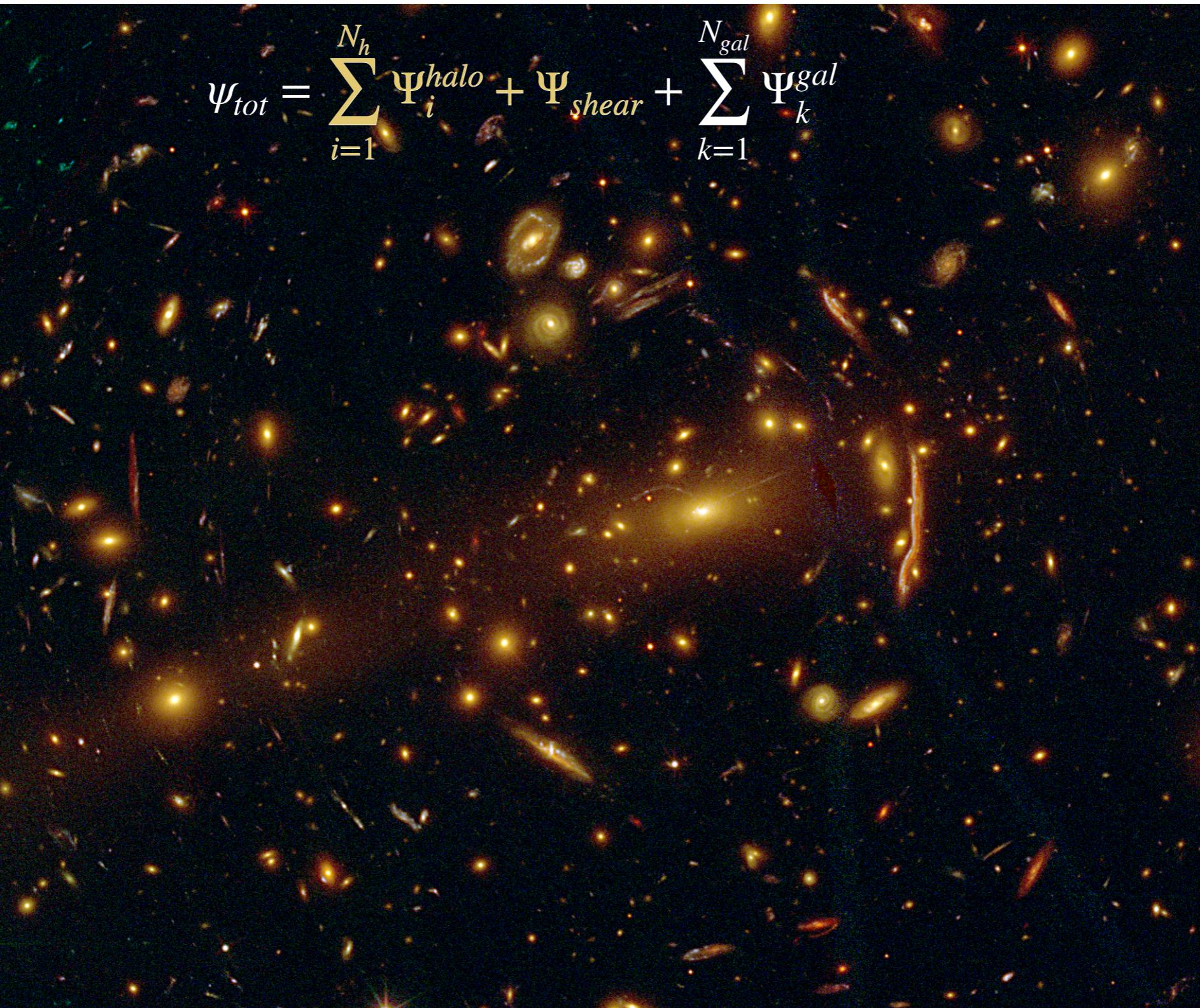
Main halos

Substructures

*External
perturbations*

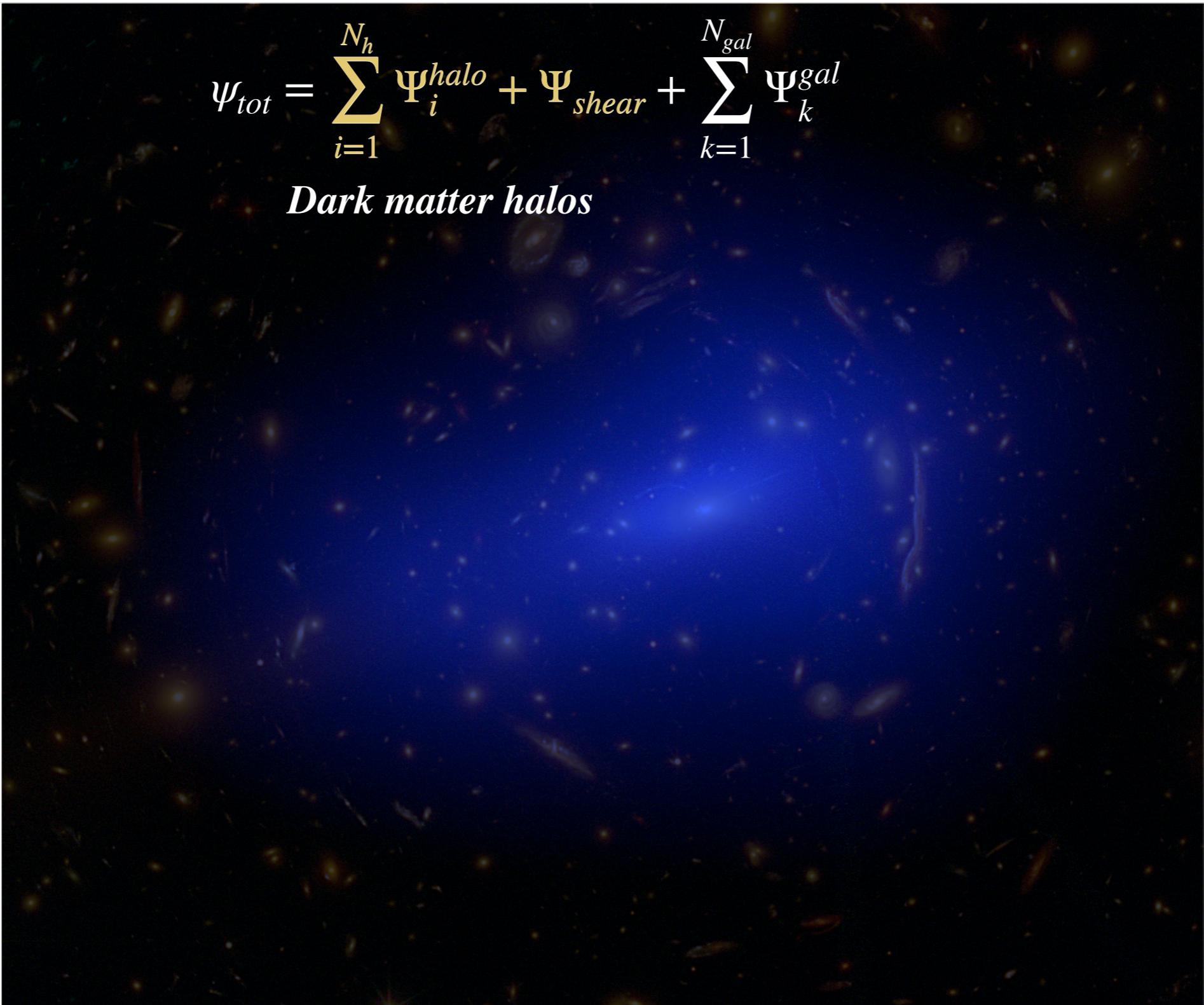
PARAMETRIC LENS MODELLING

$$\psi_{tot} = \sum_{i=1}^{N_h} \Psi_i^{halo} + \Psi_{shear} + \sum_{k=1}^{N_{gal}} \Psi_k^{gal}$$



MACSJ1206 @ $z=0.439$ (Bergamini et al. 2019, Bonamigo et al. 2018, Caminha et al 2017)

PARAMETRIC LENS MODELLING



MACSJ1206 @ $z=0.439$ (Bergamini et al. 2019, Bonamigo et al. 2018, Caminha et al 2017)

PARAMETRIC LENS MODELLING

$$\psi_{tot} = \sum_{i=1}^{N_h} \Psi_i^{halo} + \Psi_{shear} + \sum_{k=1}^{N_{gal}} \Psi_k^{gal}$$

Galaxies

3 dPIEs + Shear

$$\rho_{dPIE}(r) = \frac{\sigma_0^2}{2\pi G} \frac{r_{cut} + r_{core}}{r_{core}^2 r_{cut}} \frac{1}{(1 + r^2/r_{core}^2)(1 + r^2/r_{cut}^2)}$$