NoInterNet: separating line interloper contributions in the angular power spectrum

Laboratoire d'Annecy-le-Vieux de Physique Théorique

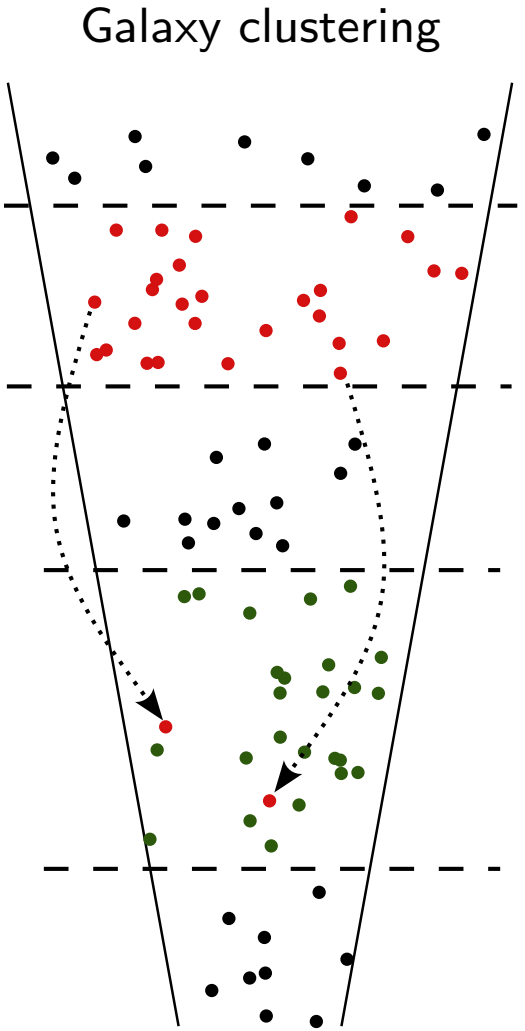
Marina S. Cagliari

Collaborators:
Z. Gao, A. Moradinezhad

LIM25 - LAPTh - 06/06/2025

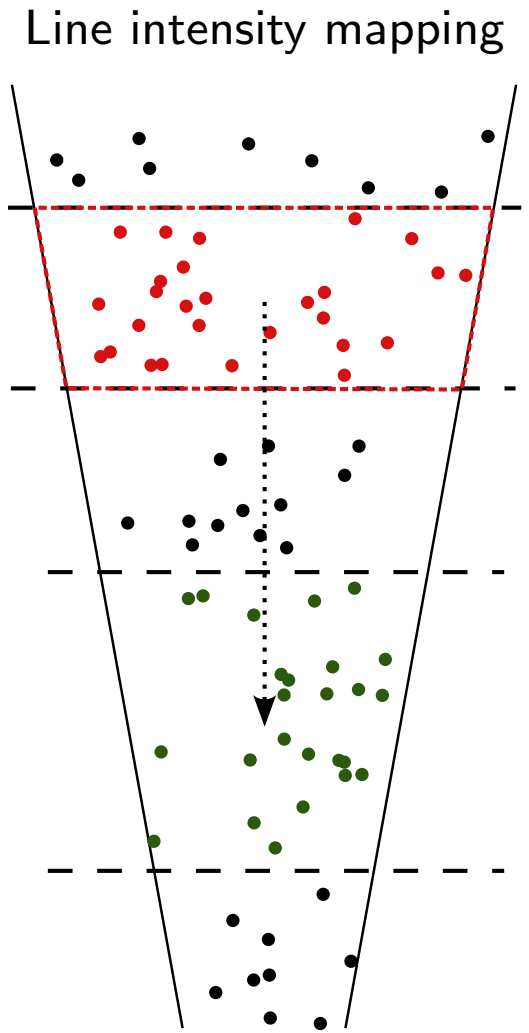
Interlopers

- Interlopers: objects not within the redshift of interest that have a distinct spectral feature that will fall in the observed frequency frame
- Not taking into account interloper contamination may lead to biased cosmological inference
- Spectroscopic galaxy clustering: object-wise contamination



Interlopers

- Interlopers: objects not within the redshift of interest that have a distinct spectral feature that will fall in the observed frequency frame
- Not taking into account interloper contamination may lead to biased cosmological inference
- Line intensity mapping: population-wise contamination

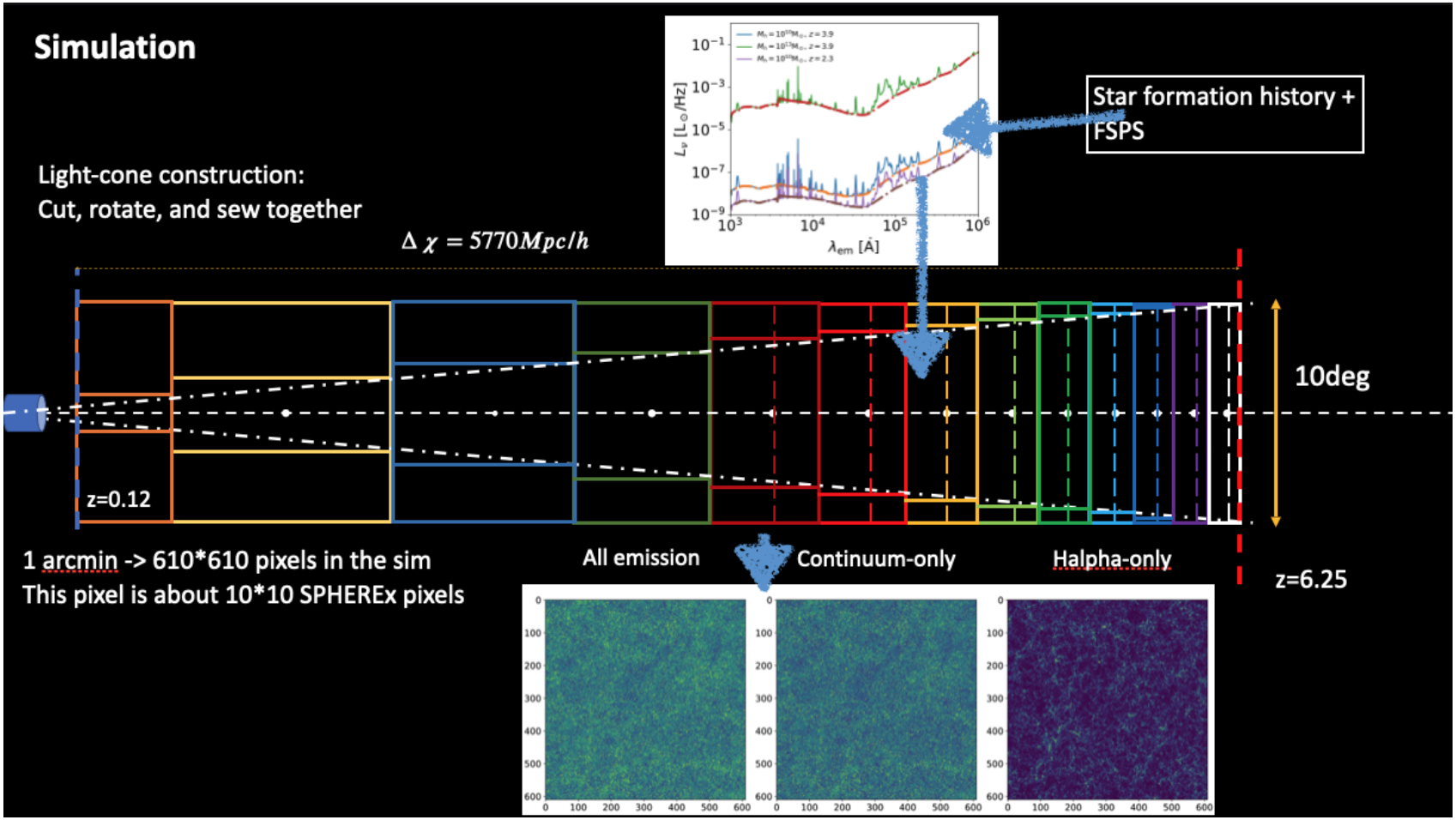


No Interloper Network

Cagliari, Moradinezhad, and Villaescusa-Navarro (2025)

- We developed an algorithm to remove the line interloper contribution in (slitless) spectroscopic galaxy clustering (e.g. *Euclid* or Roman)
- NoInterNet is a neural network that:
  - takes as input the interloper contaminated $P(k)$
  - outputs a multiplicative correction to remove the contamination from the observed $P(k)$, the interloper fraction, and the corresponding errors
- In this work, we **apply the same method to LIM**

Simulating line intensity maps



Credits to Z.Gao

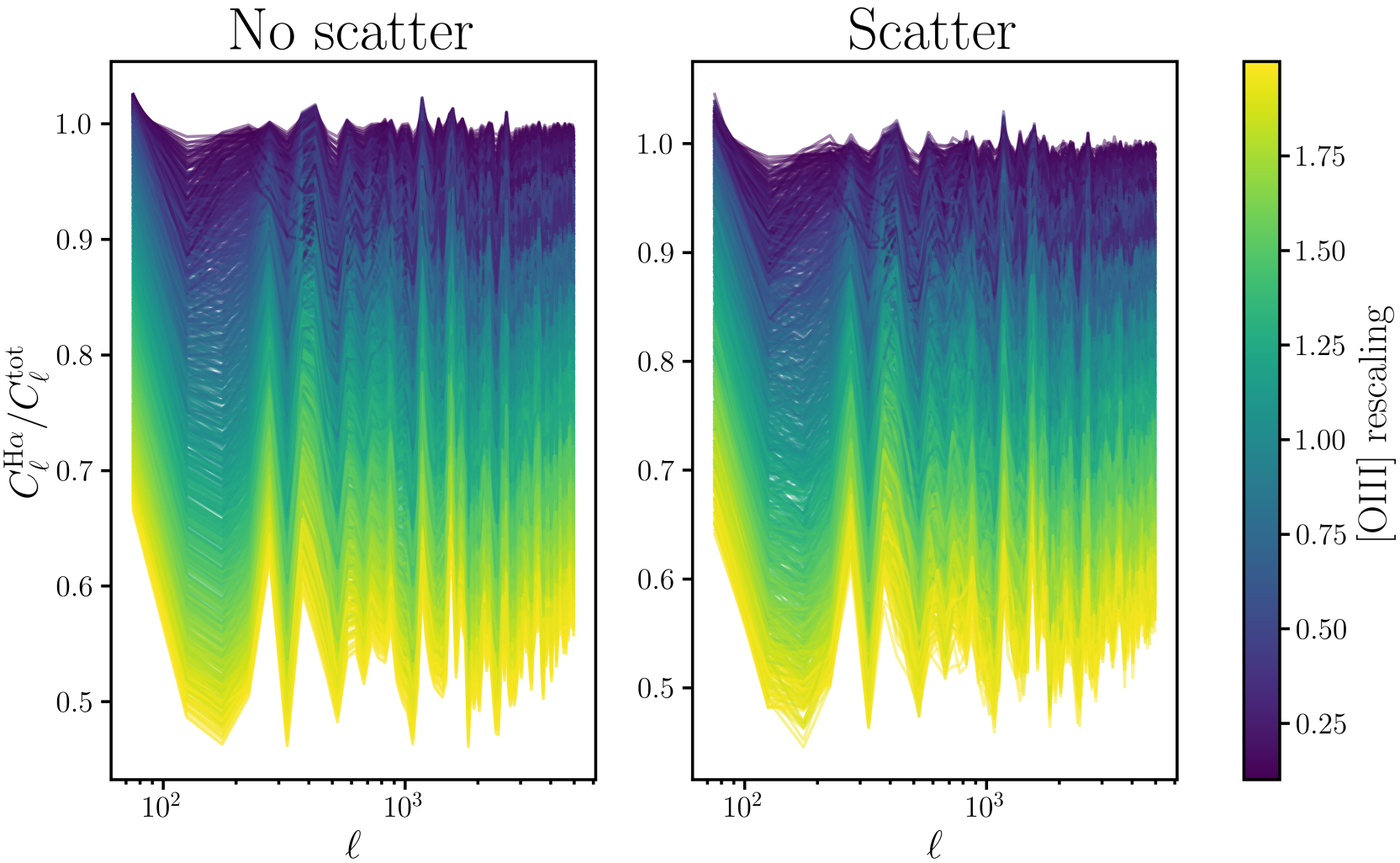
Building contaminated maps

- Maps on SPHEREx frequencies
- Target: Hα
- Contaminants: [OII] and [OIII]
- Simulations run with or without scatter at the pixel level

Redshift of the lines in the frequency channel of interest:

- Hα: $z \sim 1.2$
- [OII]: $z \sim 2.8$
- [OIII]: $z \sim 1.8$

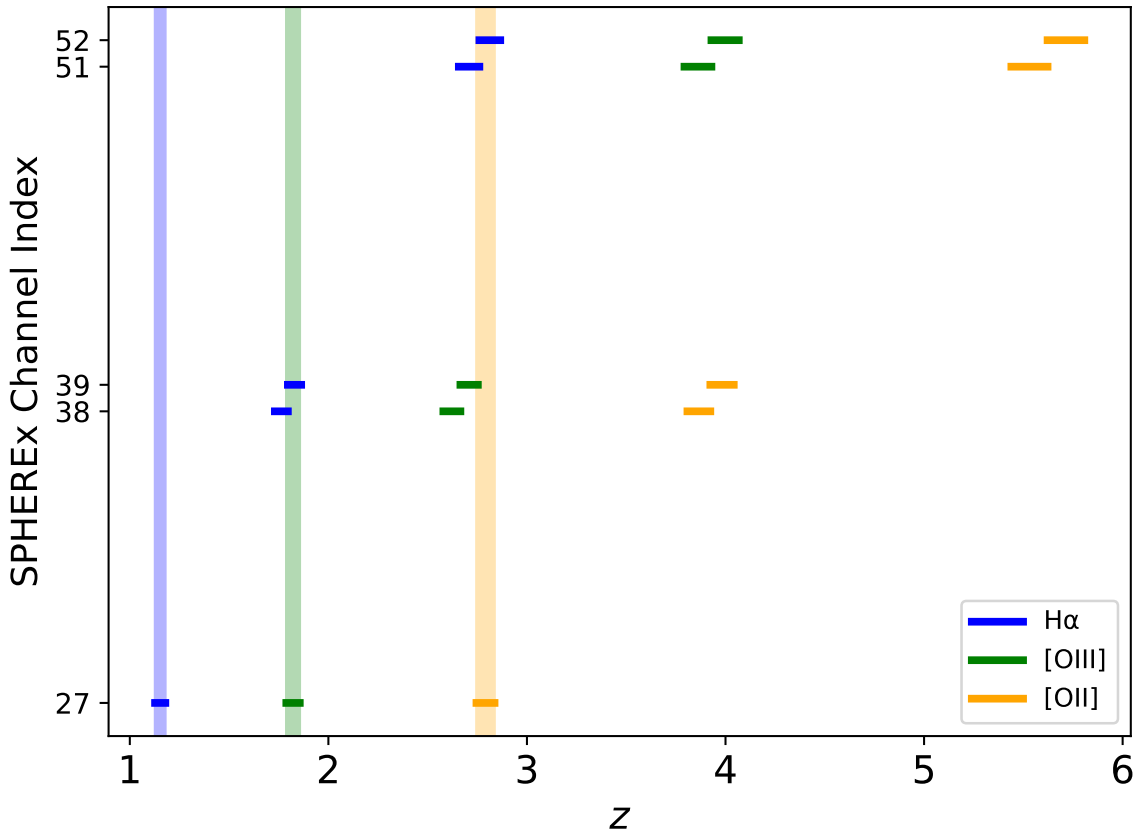
The effect of contamination



NoInterNet applied to LIM

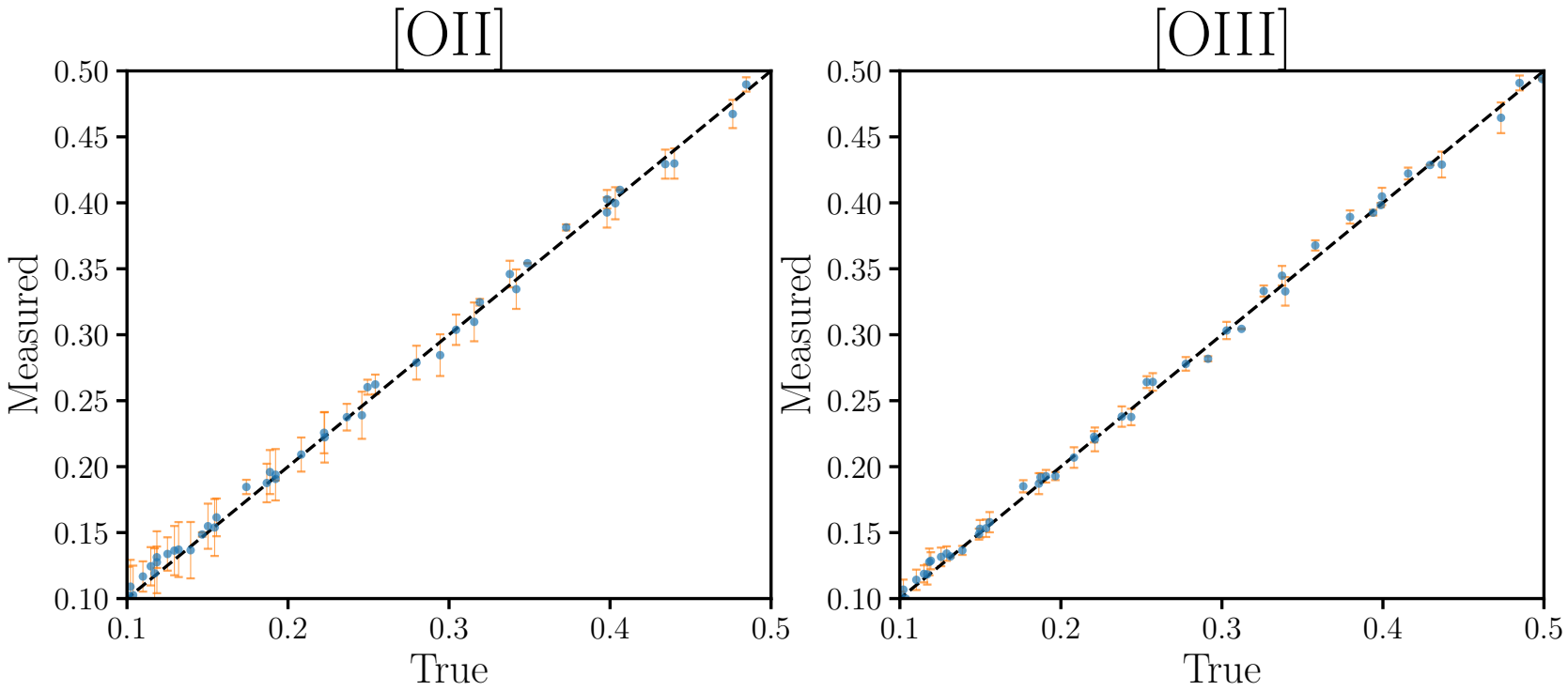
- Inputs: two cases
  1. The **auto-**C_ℓ of the channel of interest
  2. The **auto- and cross-**C_ℓ of the channel of interest and the channels where Hα cross-correlate with the contaminants
- Outputs:
  1. contaminant rescaling factors
  2. correction to the total C_ℓ to extract the three components
  3. the corresponding errors
- Loss: A modified mean-squared error loss with the added condition that the **correction sum should be 1**

Channel choice



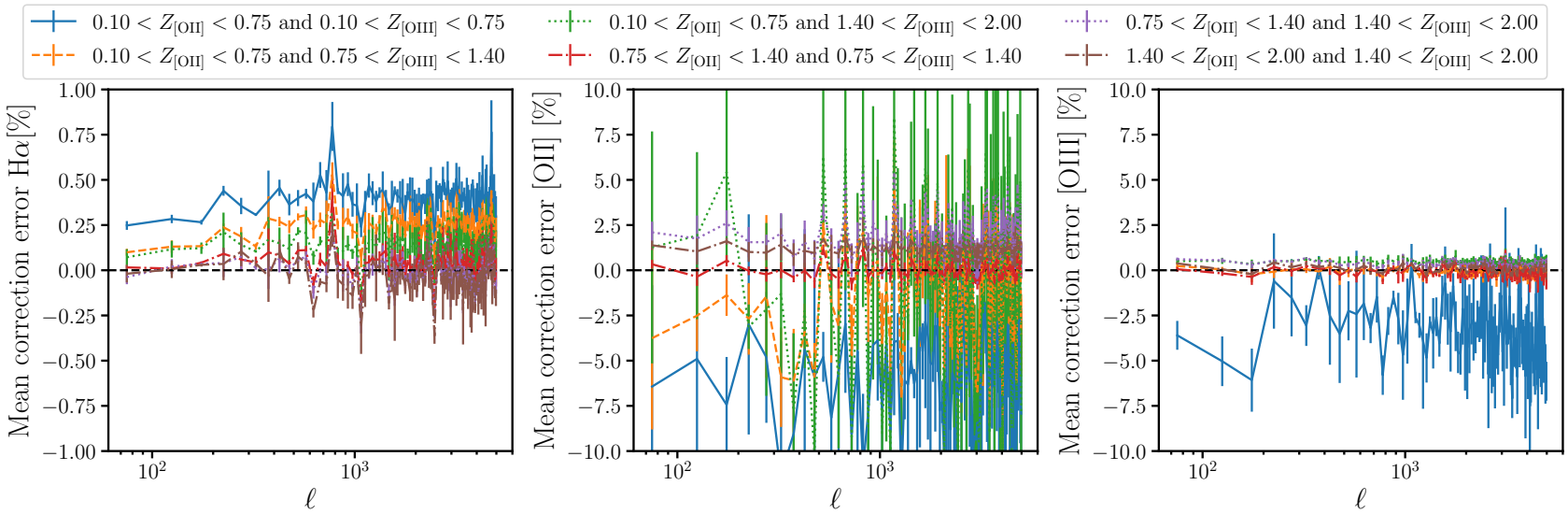
Credits to Z.Gao

No scatter: single-channel information



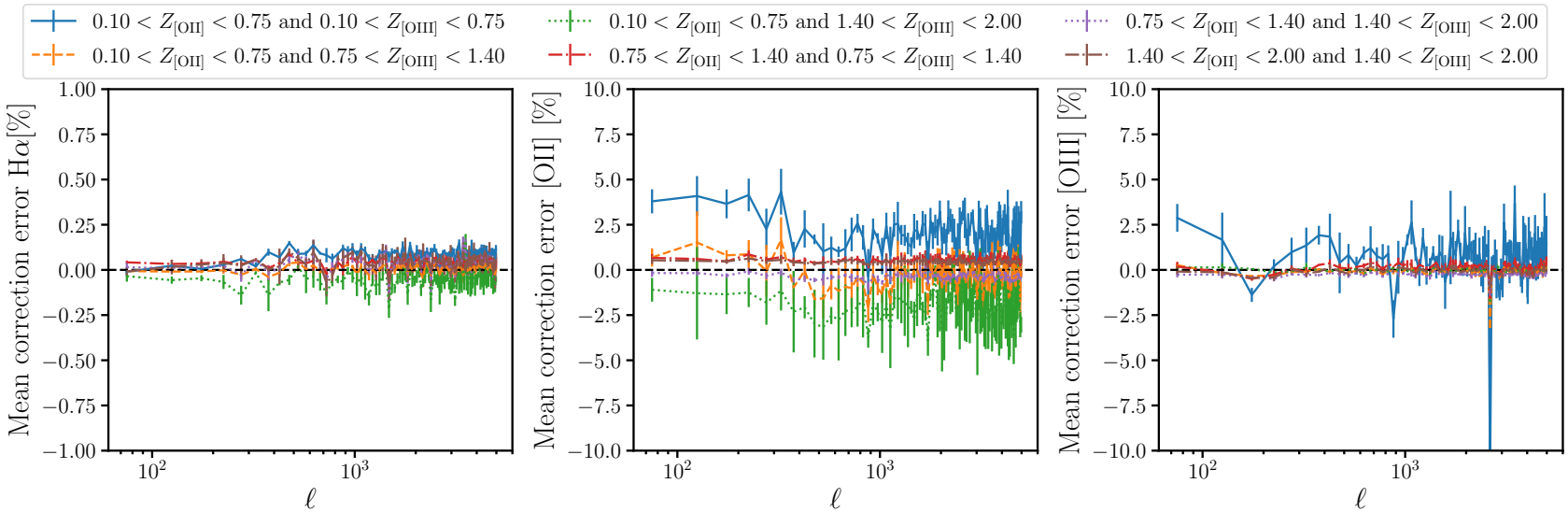
$$\mathrm{MSE} = 0.00016$$

No scatter: single-channel information



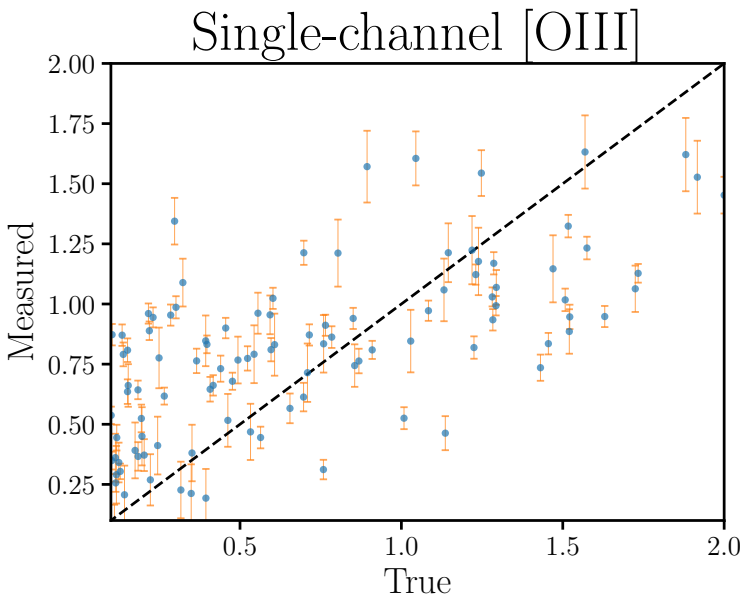
The NN recovers Hα with 0.5% error, but has more difficulty with [OII] and [OIII]

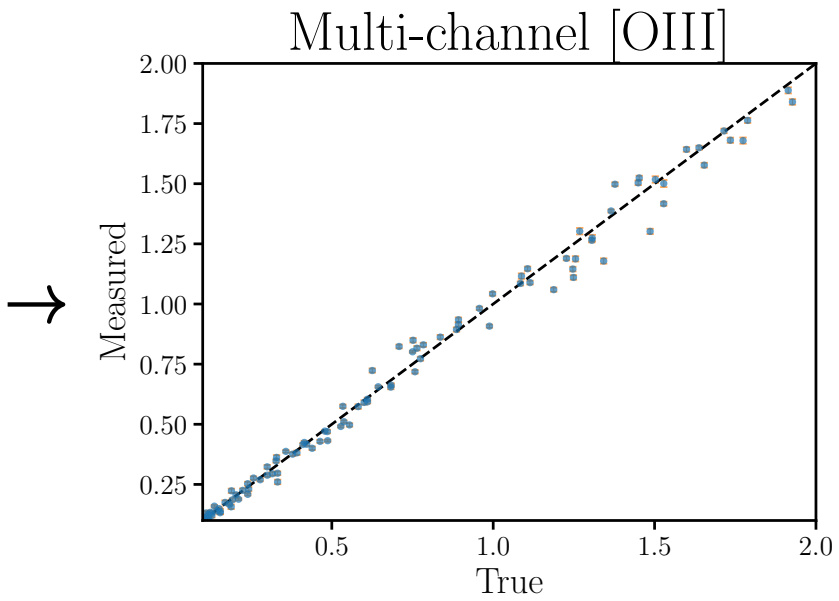
No scatter: multi-channel information



The NN recovers Hα with 0.2% error, [OII] with 5% and [OIII] with 2.5%

Scatter: single- vs multi-channel information

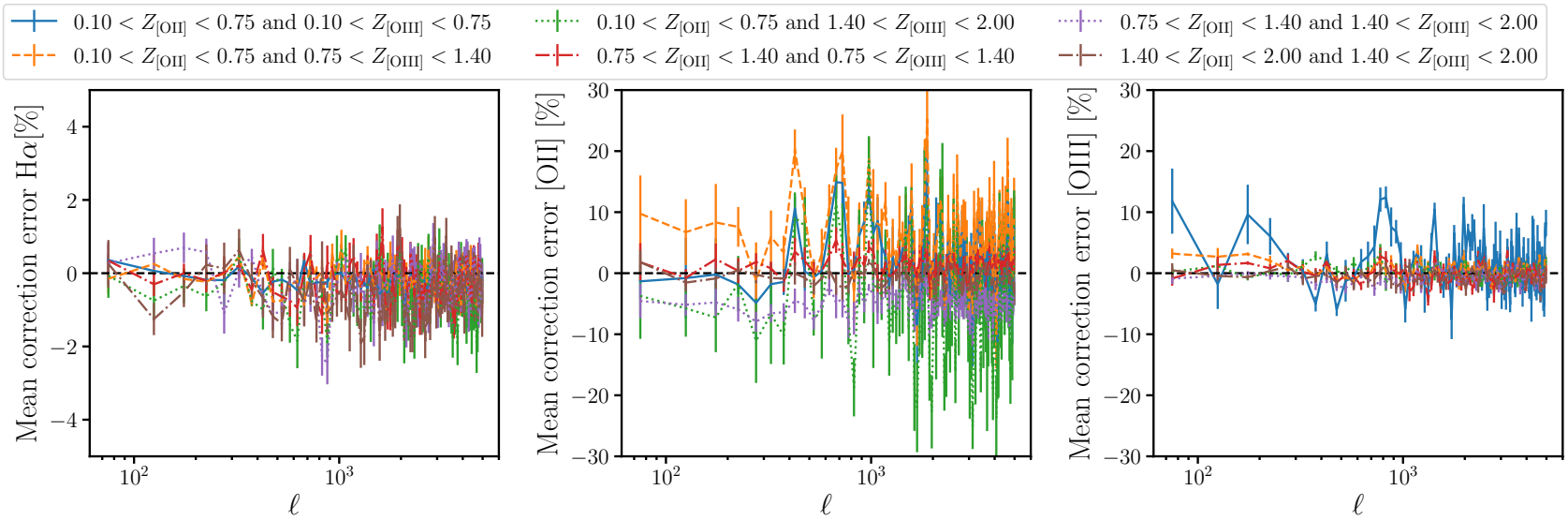




MSE = 0.16

MSE = 0.0026

Scatter: multi-channel information



The NN recovers Hα with 2.5% error, [OII] with 20% and [OIII] with 10%

Conclusions

- No scatter: with multi-channel information, we observe a residual error of $\mathbf{0.2\%}$ on $C_\ell^{\mathrm{H}\alpha}$ and $< \mathbf{5\%}$ for the contaminants
- Scatter:
  - we **need multi-channel information** to clean the observed C_ℓ
  - we reach a residual error of f $\mathbf{2\%}$ on $C_\ell^{\mathrm{H}\alpha}$, $\sim \mathbf{20\%}$ for [OII], and $< \mathbf{10\%}$ for [OIII]
- Next steps:
  - test the algorithm with the continuum in the maps
  - test the algorithm with instrumental noise in the maps

Thanks for your attention!

NoInterNet for galaxy clustering:
2504.06919

Contacts:
marina.cagliari@lapth.cnrs.fr
github/mcagliari