Redshift Calibration for the UNIONS/CFIS

Anna Wittje

working with the UNIONS Collaboration
and H. Hildebrandt, A. H. Wright, J. L. van den Busch

AIRUB
Astronomisches Institut
RUHR-UNIVERSITÄT BOCHUM

GCCL
GERMAN CENTRE FOR COSMOLOGICAL LENSING

RUHR
UNIVERSITÄT
BOCHUM
RUB

UNIONS (Ultraviolet Near Infrared Optical Northern Survey)

- combination of **CFIS (Canada France Imaging Survey)**, Pan-STARRS, Subaru HSC

- ongoing observations with goal of ~ **4,800 $\mathbf{deg^2}$** of multi-band imaging ugriz
- current status: **> 3500 $\mathbf{deg^2}$ of r band** alone and > 800 deg^2 of ugriz
- CFIS r band with 0.65 arcsec median seeing
- two shape measurements: Lensfit and ShapePipe

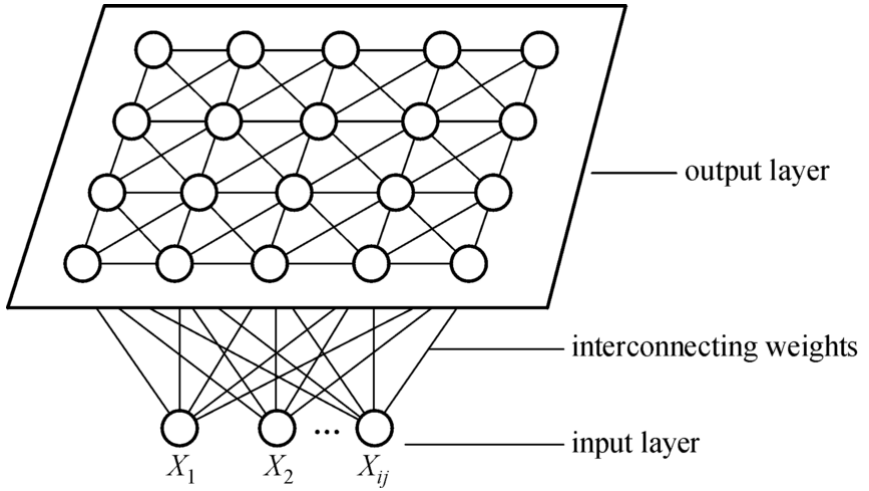
- **first cosmological analyses: 2D cosmic shear measurements over CFIS area**

Redshift Calibration using SOMs

- to estimate cosmological parameters from cosmic shear, we measure **distances of the sources** using **Self-Organising Maps** (SOMs)
- match self-similar galaxies in magnitude/colour space
- projects n-dimensional vector space on **2D map** while preserving topology

→ dimensionality reduction

→ map out magnitude/colour space where there is no representative calibration data



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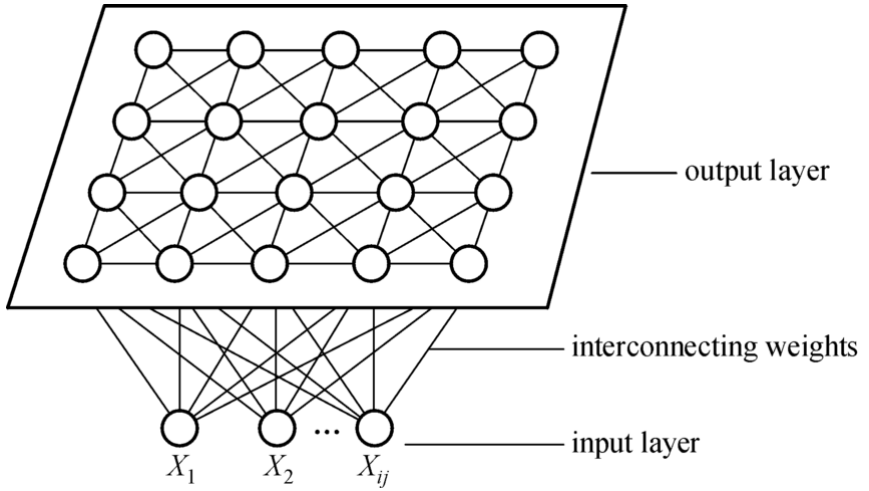
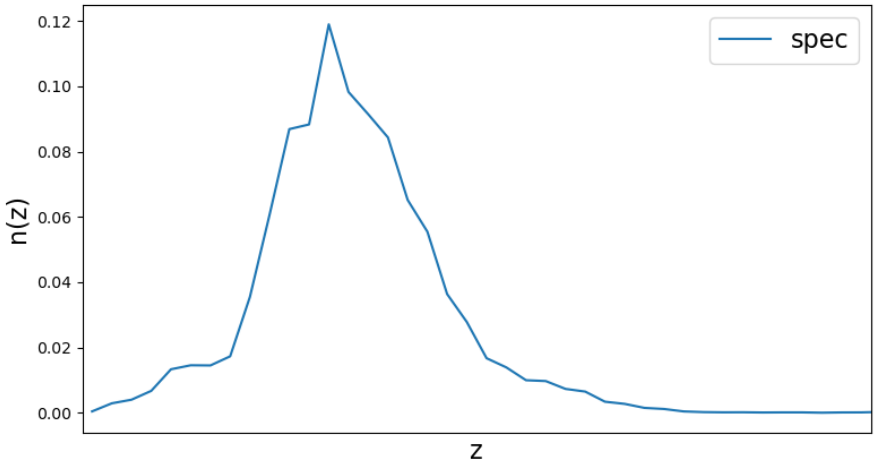
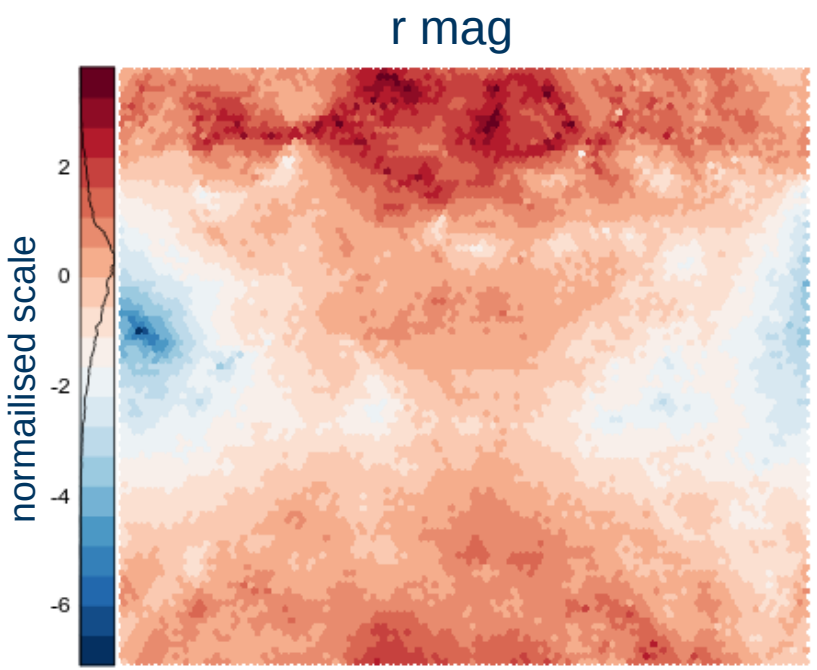
- **requires same multi-band photometry for weak lensing sources and for calibration sample**
- for CFIS: exploit overlap with **CFHTLenS** fields



1. Training the SOM

- train with galaxies with CFHTLenS ugriz photometry of spectroscopic samples (**DEEP2, VVDS, VIPERS**)





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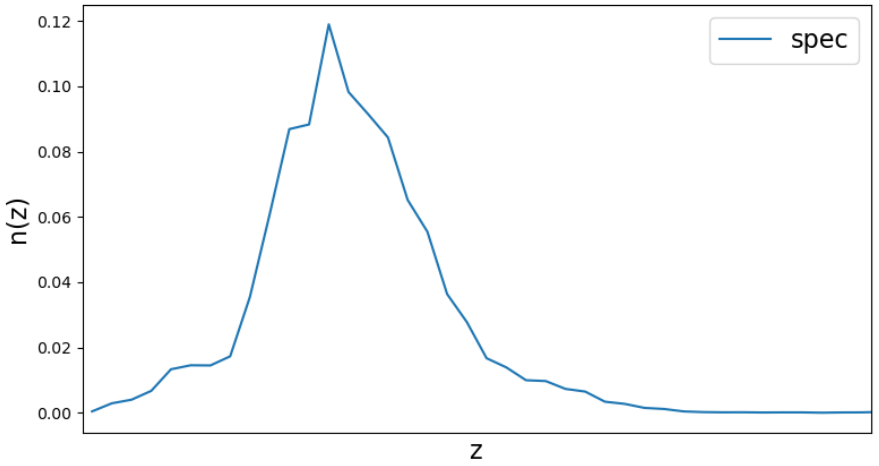
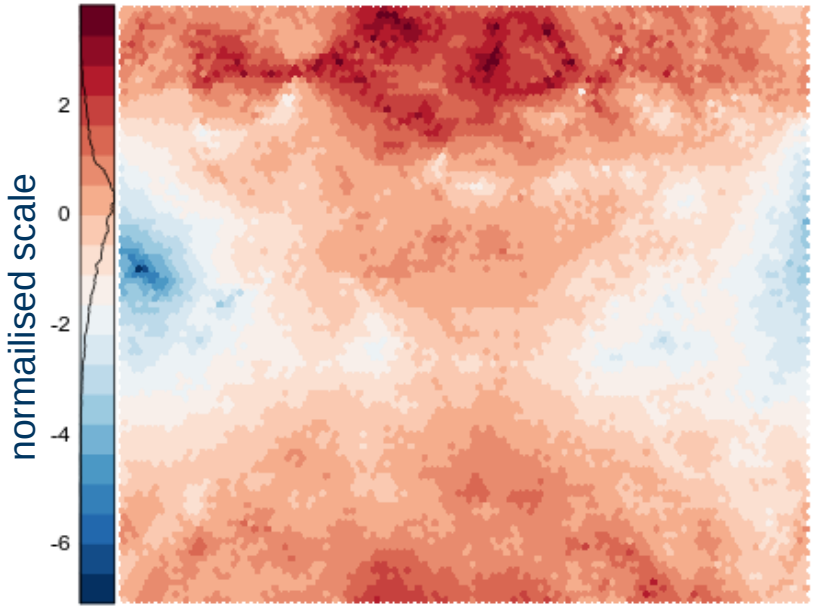
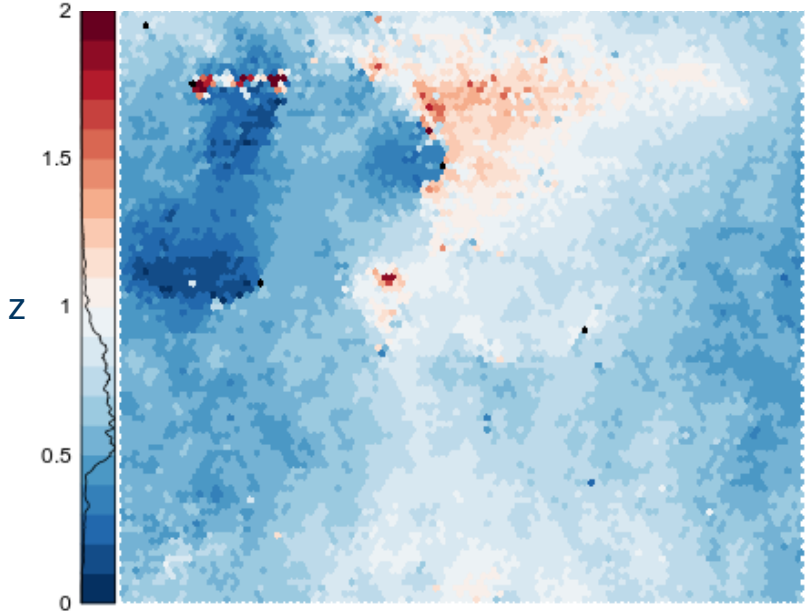


r mag



mean spec-z of calibration data



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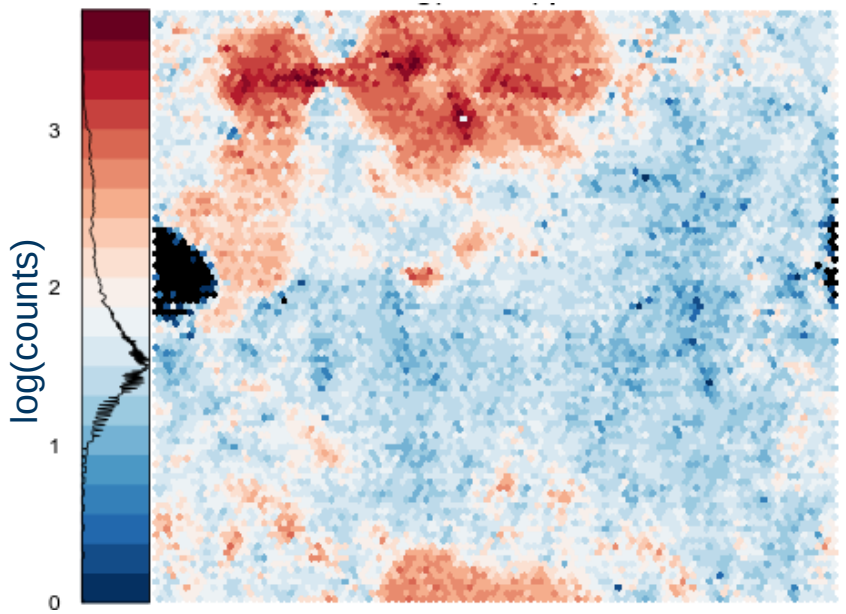
2. Populate the SOM with CFIS shear sample

- insert all CFIS galaxies with CFHTLenS photometry
- CFIS/CFHTLenS subsample is assumed to be representative for all CFIS galaxies

number of CFIS galaxies per cell



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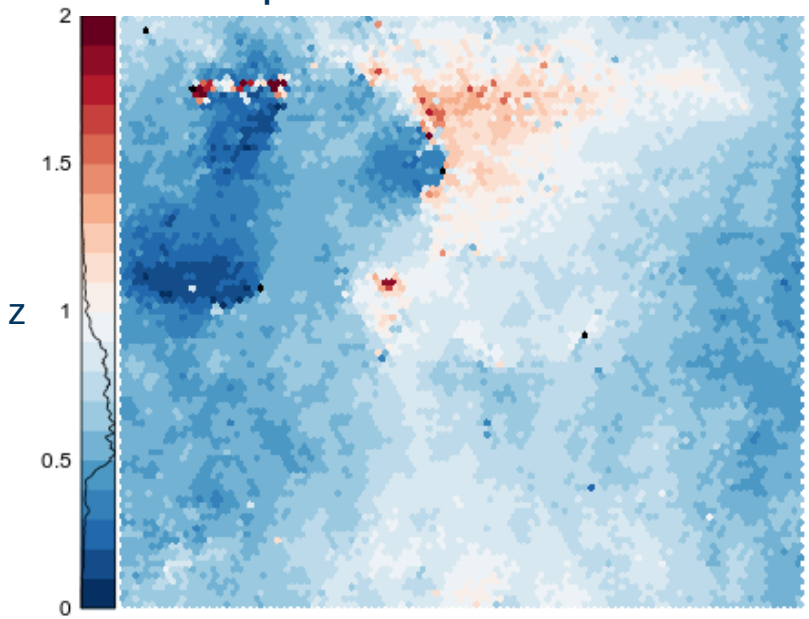
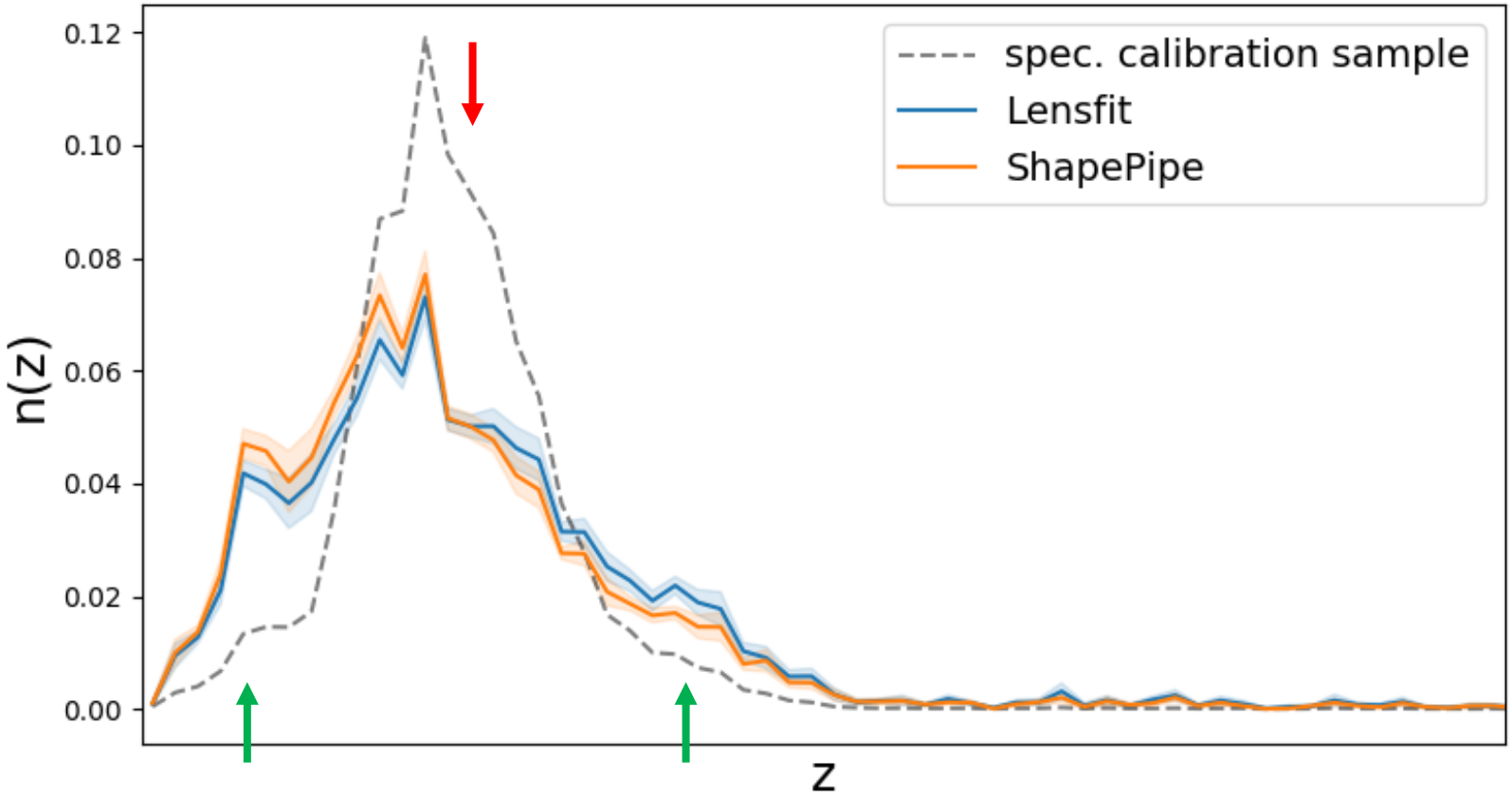


3. Reweighting the redshift distribution

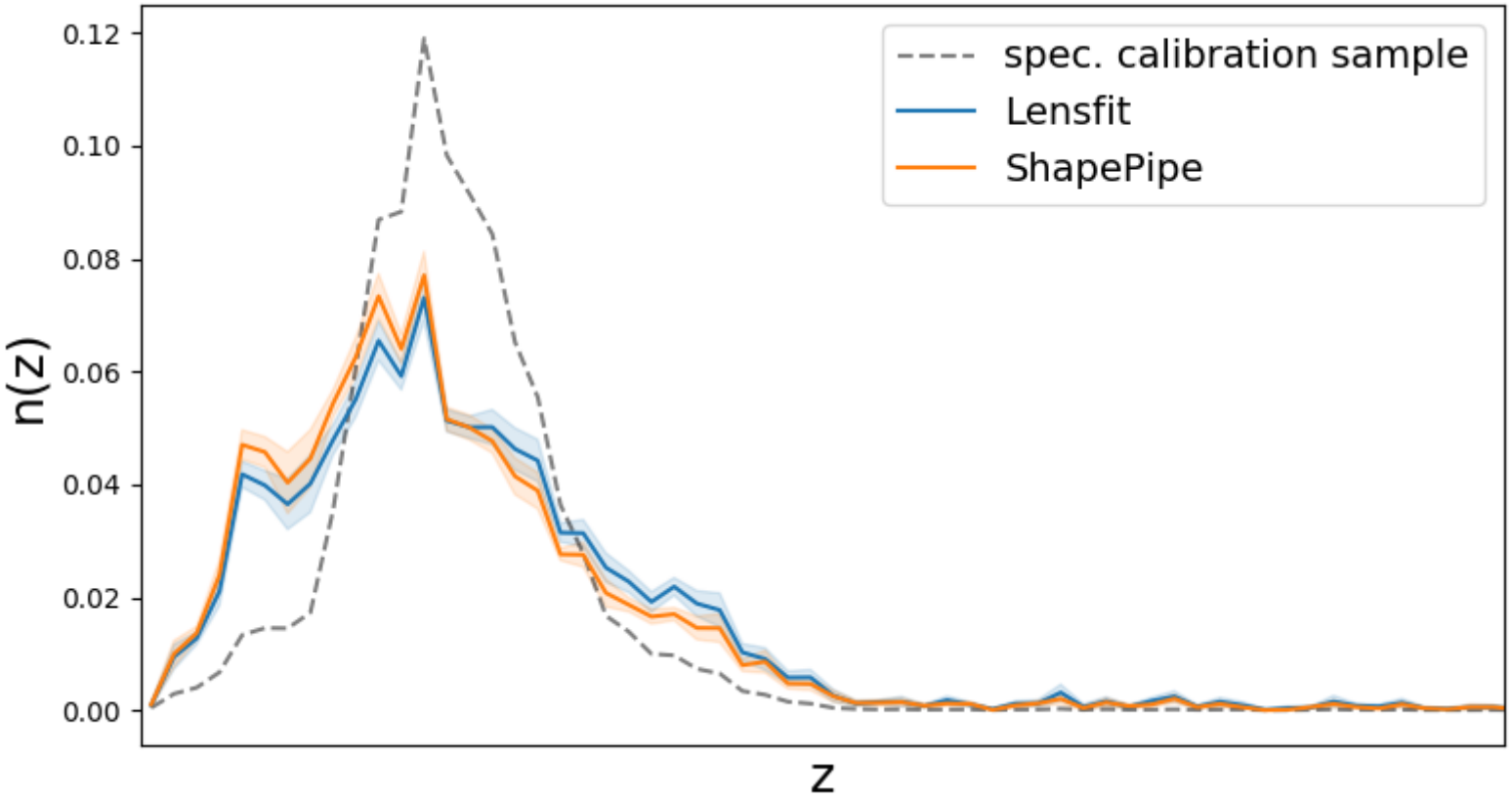
extract CFIS redshift distribution:

- weight per cell i: **ratio of sum of shape weights over number of spec. objects**
- the weighted combination of spectroscopic redshift distribution is estimates the true n(z) of CFIS



4. Resulting n(z) for CFIS

- uncertainties from bootstrap realisation
- test systematic effects of method with different SOM settings
- passes a number of robustness tests at the $\mathbf{\Delta z_{mean} < 0.01}$ level



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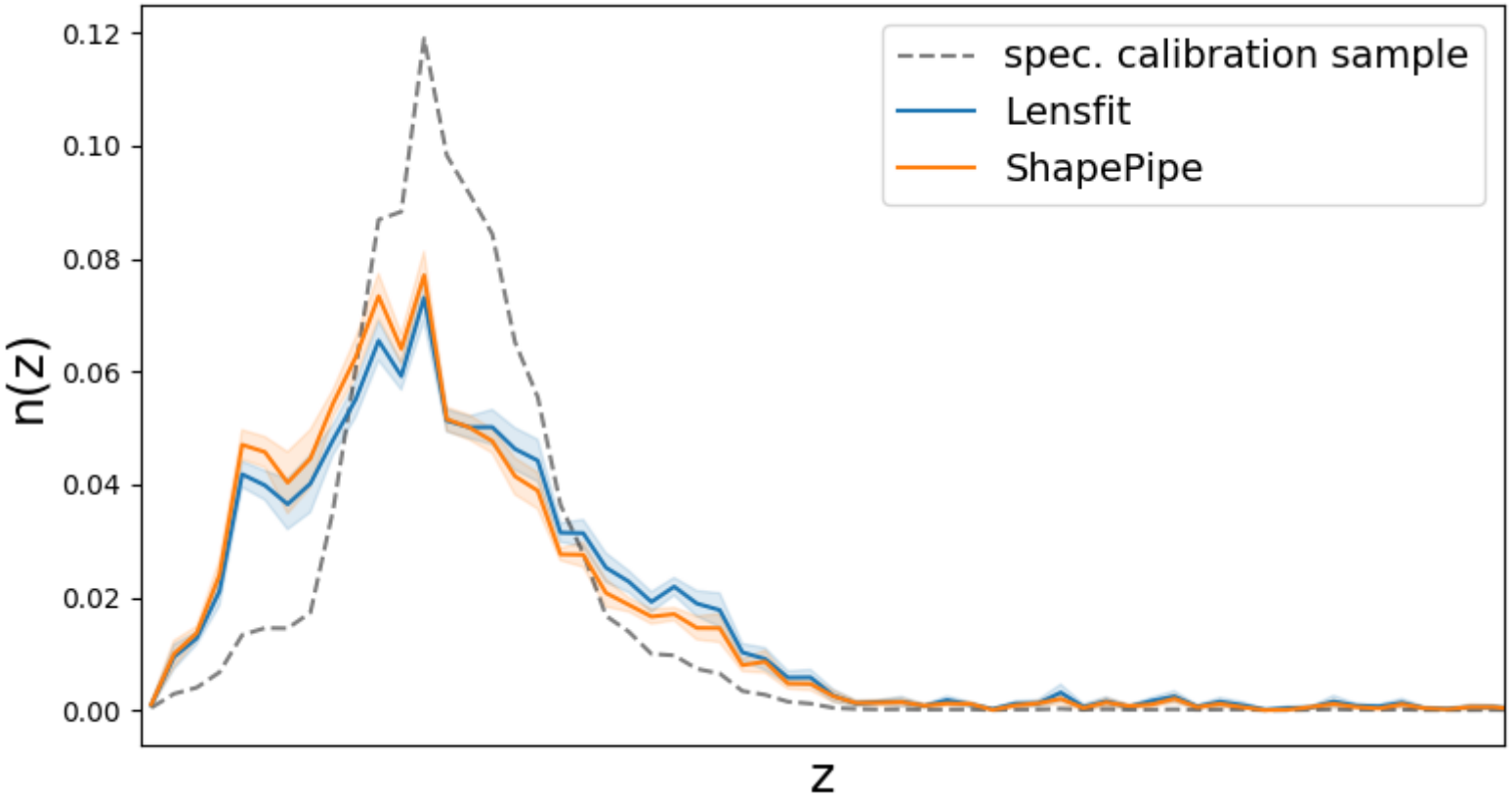


Blinding procedure:

→ cosmological analyses require unbiased handling of the data

→ strategy: three different redshift distributions (2 manipulated ones)

Summary & Outlook

- **accurate** redshift distribution important for current and future surveys
- cosmological analyses will not be constraint by statistics but by systematics
- CFIS n(z) can be robustly constrained with SOM method

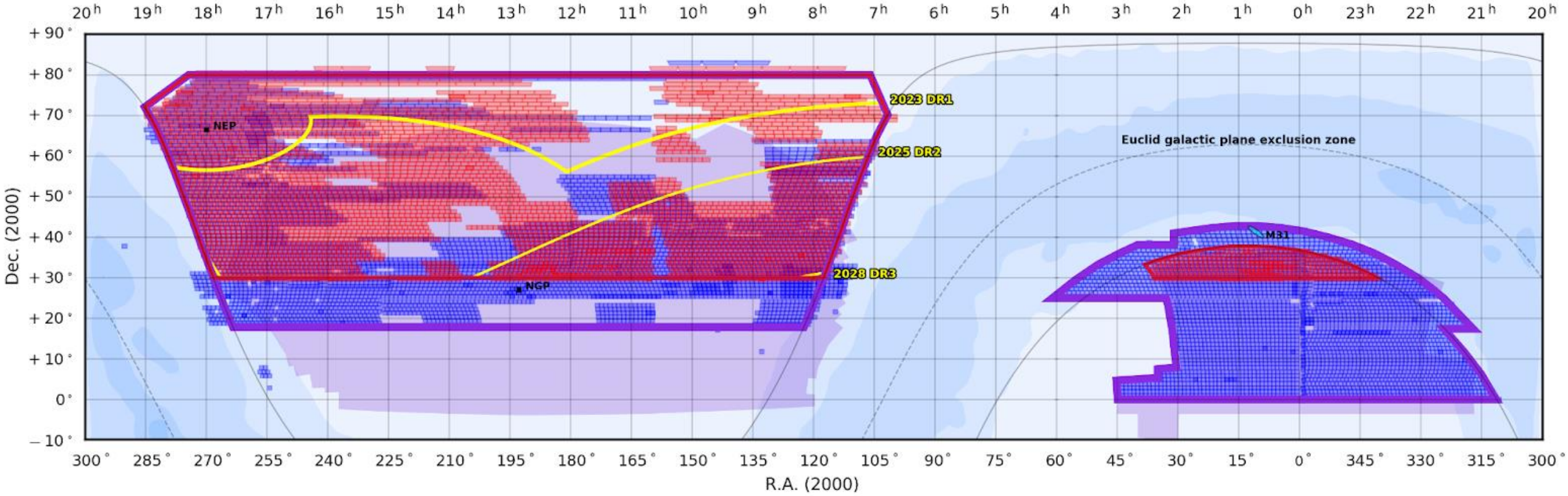
- **First results will be:** 2D cosmic shear of minimum 3000 deg^2
- **Afterwards:** tomographic cosmic shear measurements and 2-point statistics on multi-band area

→ with all the data, we expect tightest pre-Stage-IV, weak lensing-based constraint on S8

Thank you

Additional slides

CFIS Observations

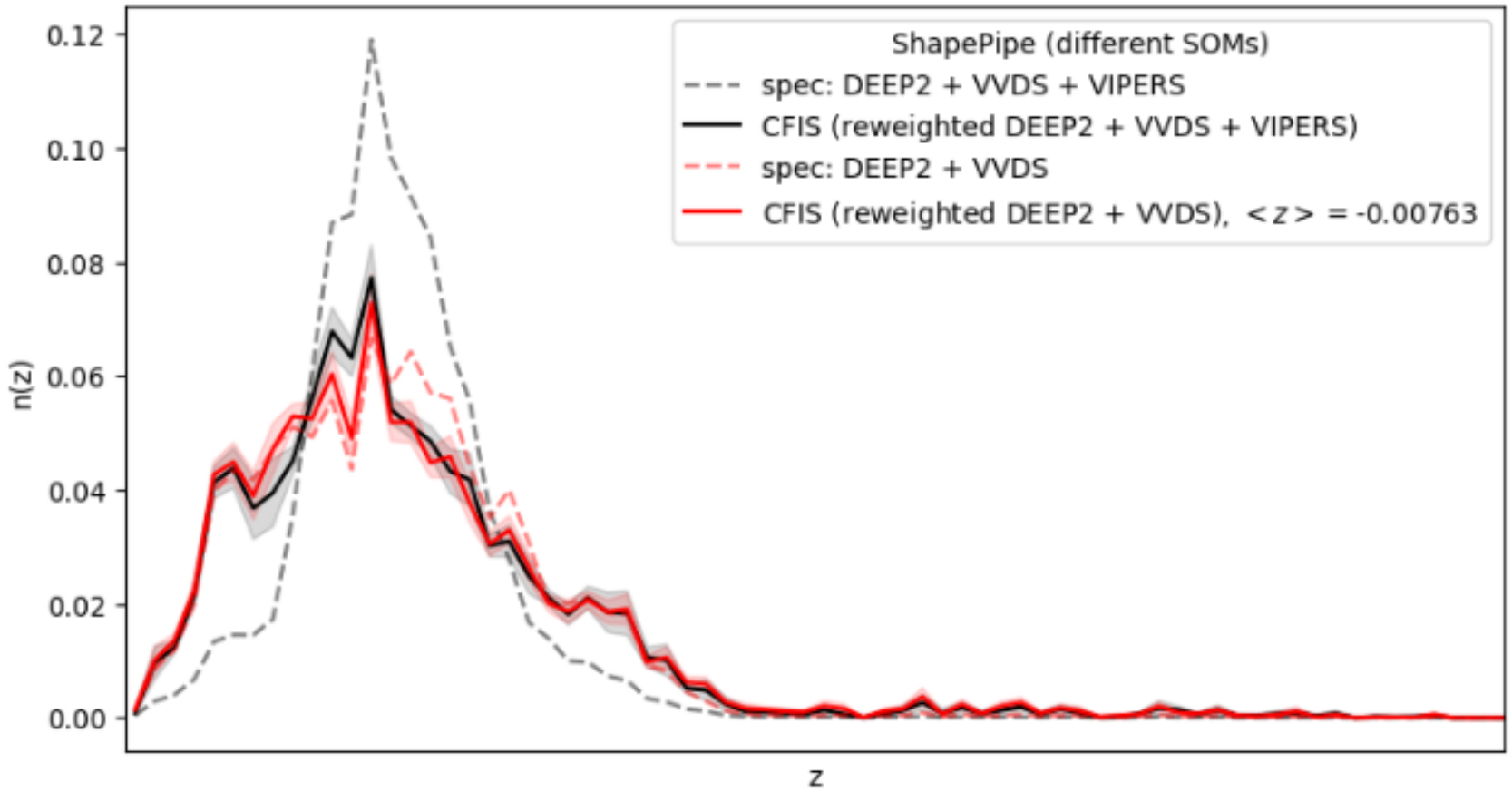


CFIS sky coverage goal with current completion (May 2022) and the minimal Euclid DR1 region

- Galactic plane
- BOSS
- CFIS−u area goal : 9,000 deg.^{2}
- CFIS−r area goal : 4,800 deg.^{2}
- CFIS−u covered with 3 exposures (full depth) : 6724 deg.^{2}
- CFIS−r covered with 3 exposures (full depth) : 3840 deg.^{2}

Systematic tests

changing the calibration data, e.g. removing VIPERS



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