Status report of Pix2LSST

from **Pix**el **to** **L**arge **S**cale **S**tructure with Vera Rubin **T**elescope

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Pix2LSST Members

CPPM: D. Fouchez, J. Bautista, B. Racine, J. Cohen-Tanugi

LAM: S. Arnouts, O. Ilbert, R. Ait-Ouahmed, J. Pasquet

K. Kraljic, M. Treyer, R. Arango-Toro, T. Moutard

a long term collaboration: OCEVU, ANR DEEPDIP, iPhU - CLASS

Galaxy Evolution

- **Deep :** exploring the high redshift universe
- **Wide** : a unique view on the growth of cosmic structures

  —> Revealing the Cosmic Web at high z
- **Big Data :** extend to ML techniques for Photo-z and galaxy's physical parameters

Cosmology

- **Cosmic shear** : constraints on the mean redshift measurements
- **SNe** : extend the Hubble diagram with photo-z

Synergy

- HSC <->Vera-Rubin - Euclid - Roman

2 LSST tickets used to contribute on Vera Rubin science

* **Funding 2022** : 1/2 by PNCG / **1/2 by IPhU**
* **Funding 2023** : 1/2 by PNCG / **1/2 by IPhU —> IPhU contribution = 7000 E / yr**

with associated participants : R. Ait-Ouahmed, R. Arango-Toro (PhD)

T. Moutard (Postdoc)

Highlights on recent works in Vera Rubin perspectives

<u>Photometric Redshift developments</u> (collaboration LAM -IN2P3)

- SED fitting code Le Phare (O. Ilbert and J. Cohen-Tanugi)
- CNN photo-z code DEEPz (see **Reda's talk**)

<u>HSC-CLAUDS analysis</u>

- SFR functions (V. Picouet, G. Desprez)

<u>Large Scale Structure analysis</u>

- Cosmic Web analysis in 2D (L. Herscouet)
- SDSS CNN photo-z (M. Treyer)

Development for Le Phare photo-z code

—> Le Phare++ (O. Ilbert and J. Cohen-Tanugi)

* Strong collaboration with Johann Cohen-Tanugi (IN2P3) to work on a new version of Le Phare in C++
* Development of a tool oriented toward large-scale surveys (git versioning, doxygen doc, etc)
  —> one version publicly available: **https://gitlab.lam.fr/Galaxies/LEPHARE/-/releases**
* Work in collaboration with MPE (Mara Salvato) to improve the AGN template-fitting part for LSST

—> LSST Open call (Sep 21): Le Phare++ will be used for the LSST survey

https://community.lsst.org/t/pz-lor-a-summary-of-the-proposed-pz-estimators-dm-shortlist/6308

LOR for the LePhare PZ Estimator

Contributors

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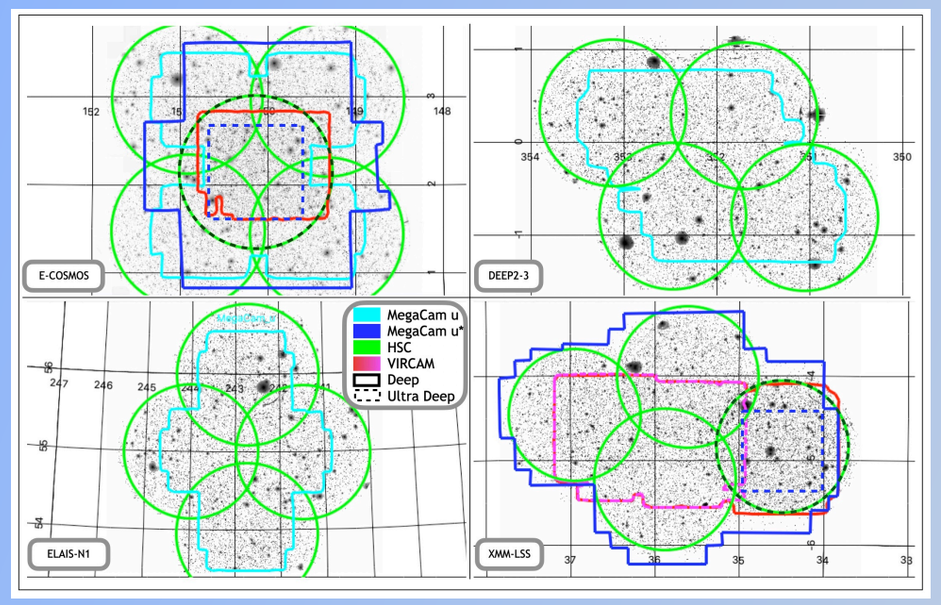
Co-signers: , Clotilde Laigle (IAP)

* Five codes able to meet the scientific performance & technical aspects:
  GPz, DEmP, DNF, LePhare, and BPZ.
* Additional codes, such as CNN would be appropriated for the task

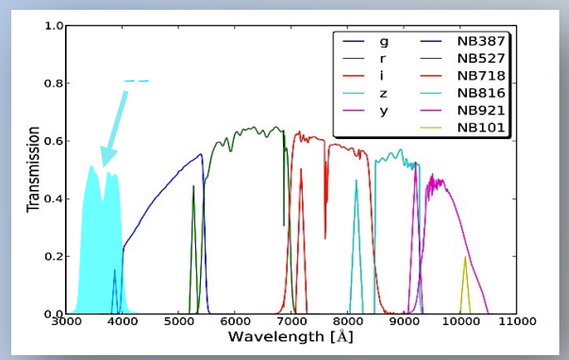
Prepare LSST with CLAUDS - HSC Deep

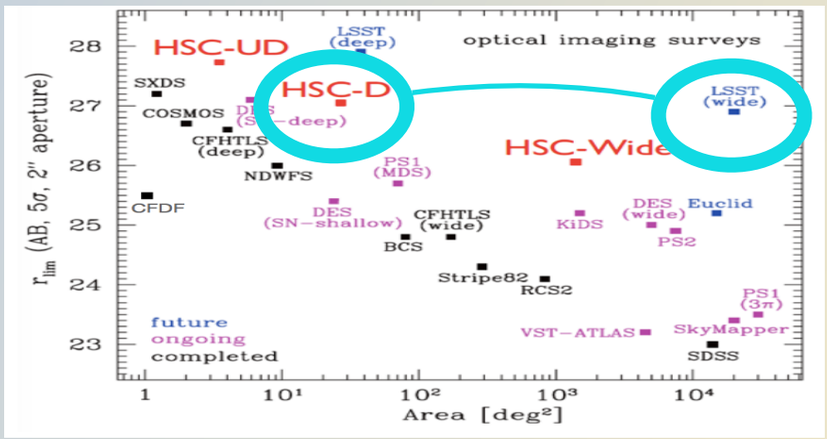
—> Photometric catalogues + Photo-z release

Desprez et al., 2023 (A&A in press)



we used LSST pipeline
to combine multi-band data

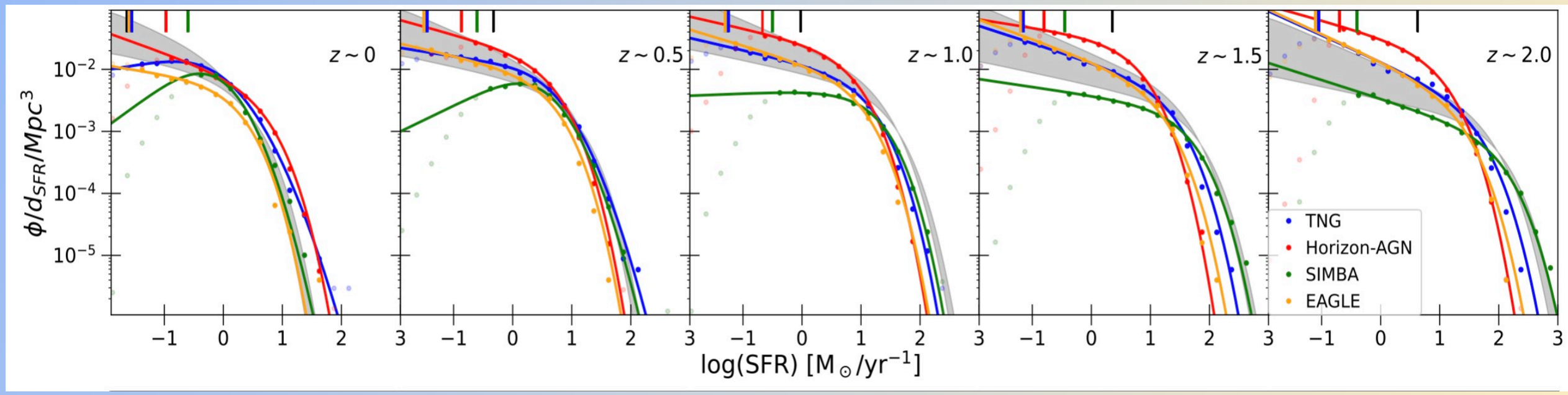




CLAUDS+HSC : A unique dataset until LSST-10yr

—> SFR functions with HSC-CLAUDS survey

Picouet et al., 2023 (A&A submitted)

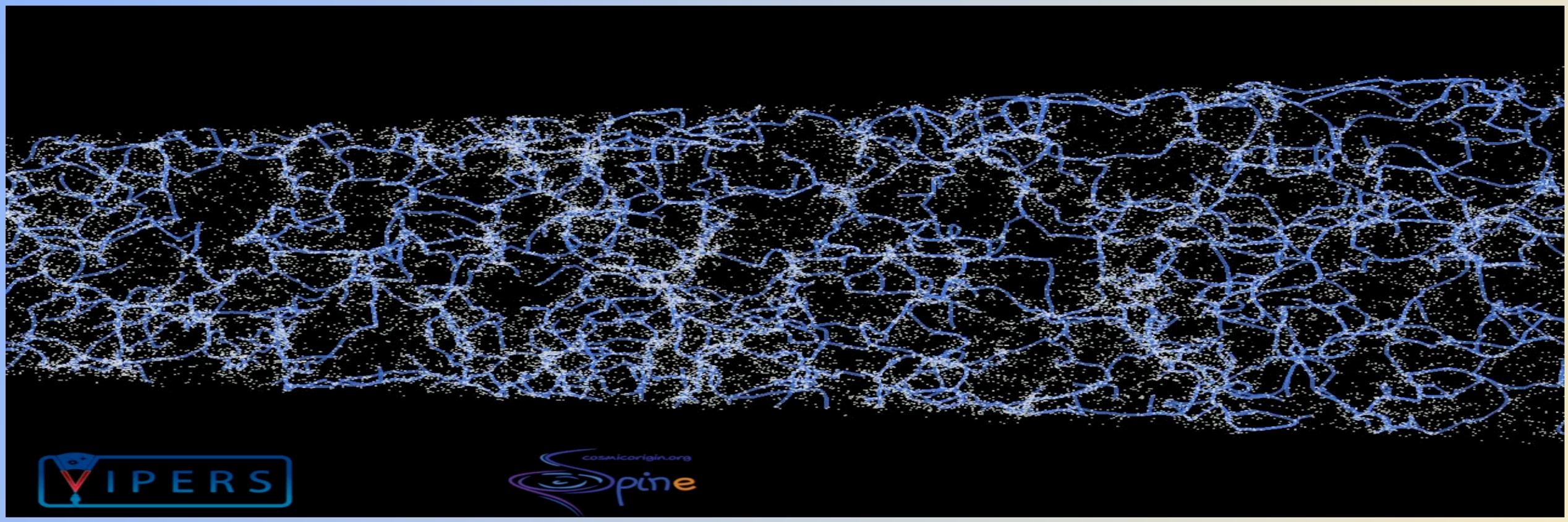


Comparison with 4 state-of-the-art hydro-dynamical simulations

Revealing the Cosmic Web in 3D and 2D

—> Spectroscopic surveys revealed Cosmic Web with exquisite details

Malavasi+2017 ; **Kraljic+**18



—> Influence of the CW on galaxy properties

- A natural metric to interpret galaxy evolution

—> Analyses convincingly extended in 2D *(Laigle + 2018)*

- A major interest for LSST.

- Depends on photo-z accuracy

Photo-z with Convolutional Neural Network

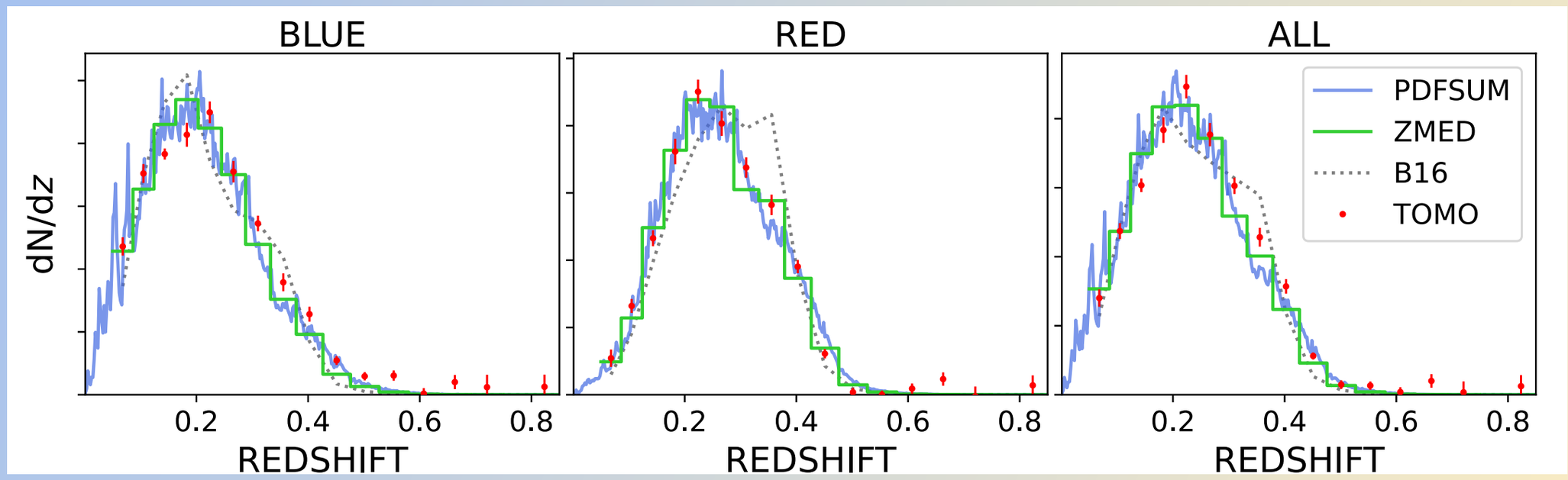
—> CNN photo-z's in SDSS r<18: σ=0.0083 η=0.18% **Pasquet et al., 2019**

—> SDSS extended to r<20 with GAMA+BOSS training set **Treyer** et al. (2023 submitted)

Expected accuracy
σ<0.015
η<3%

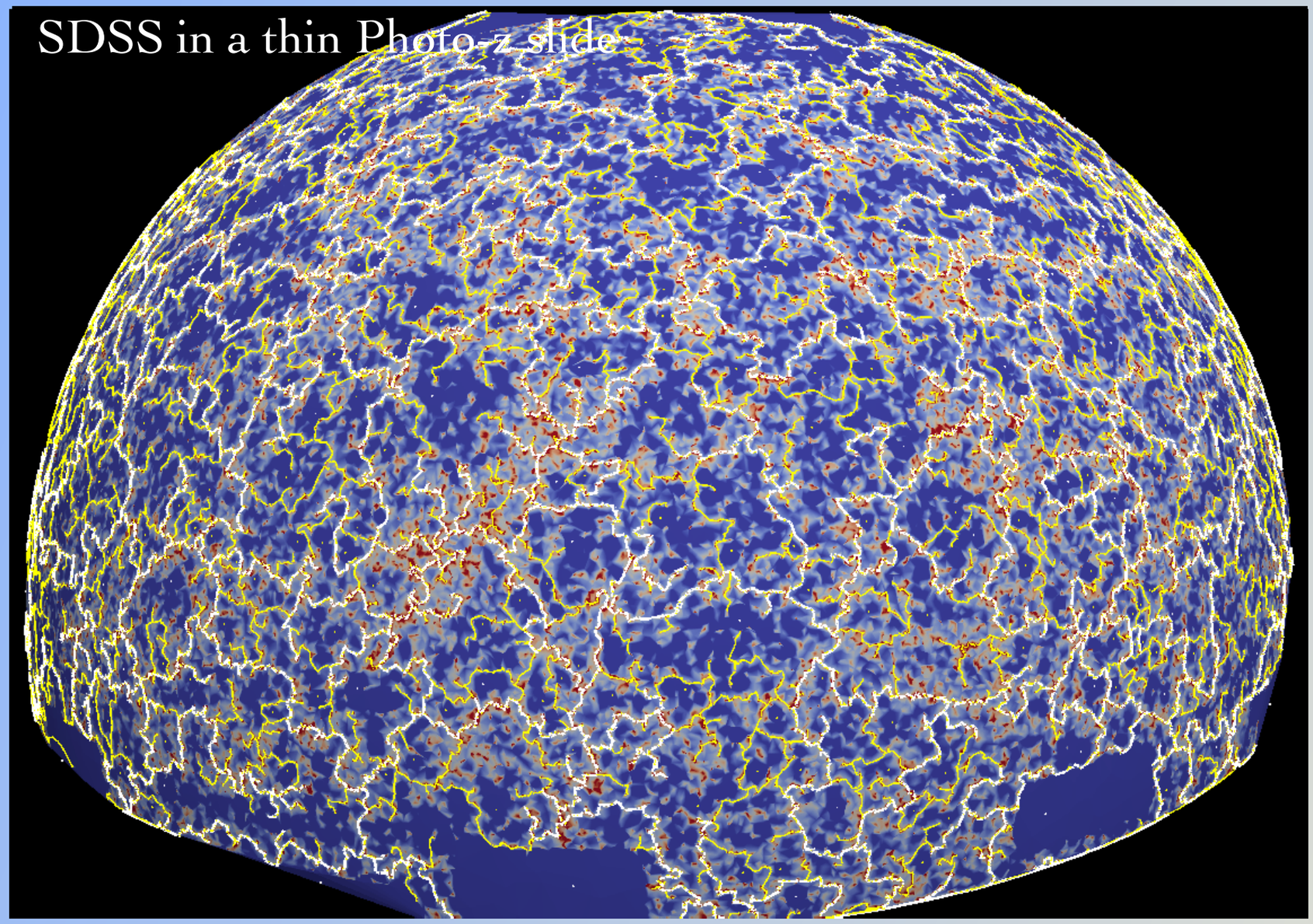
Release:
15 millions Z_{CNN}

Comparisons of the N(z) with clustering redshift technique



—> HSC-CLAUDS photo-z : Similar accuracy expected down to i~24 **Reda's talk**

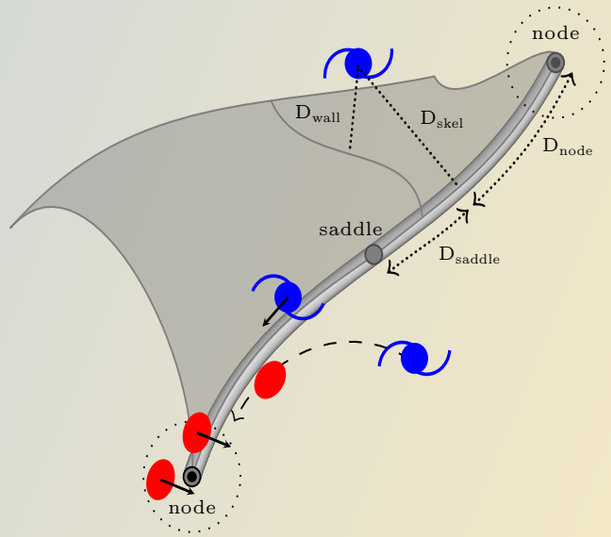
Revealing the Cosmic Web in photo-z redshift slides



* **internship Lea Harscouet**

-> adapted DisPerSE inputs to work on 2D sphere

-> measured distances and useful quantities on 2D sphere



CW filaments and peaks :

* Influence on Galaxy properties
* Spin alignment (IA)

Connectivity (number of filaments/peak)

* Group/clusters assembly *(Darragh Ford + 2019; Sarron+19)*
* Connectivity increases with DM halo mass and evolves with time in a cosmological dependent way *(Codis+18)*

Planning for the next two years

- ✦ Final version of LePhare++ code + Test the performance on LSST simulated catalogues (O. Ilbert & J. Cohen-Tanugi)
- ✦ Physical parameters with imaging surveys based on SOM and CNN networks
  + Test with LSST simulated catalogues/images and Horizon-AGN simulations (R. Arango-Toro)
- ✦ Estimates of the N(z) and mean redshifts with LSST and Horizon-AGN simulations with two approaches (SED fitting and CNN) (O. Ilbert & S. Arnouts)
- ✦ Reconstruction of the cosmic web in redshift slides
  - Test connectivity with different cosmological simulations
  - Application with the SDSS data (K. Kraljic & M. Treyer)
- ✦ Release the CNN photo-z's for the HSC-CLAUDS surveys (R. Ait-Ouahmed)
- ✦ Propagation of the CNN photo-z accuracy in the SN science (D. Fouchez)