Illustris TNG simulation

DESI - DESC

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LSST France meeting - 12 June 2024

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Context

- **DESI**
  - Y3 data set secured, Y1 in publication
  - End of DESI aimed near end 2026
  - DESI will probably conducted an extended program until 2028 (DESI-ext)
- **DESI-II**
  - Will start near 2028
  - Potential hardware improvements are still discussed
- High potential synergies between DESC and DESI/DESI-II on the common area

DESC DESI-II white paper

- **DESC project:** https://confluence.slac.stanford.edu/display/LSSTDESC/DESI-DESC+Coordination
- **Overleaf:** https://www.overleaf.com/4482999617cfqpyymhcrnq#5950d0
- **Envisioned synergies:**
  - Time-domain
  - LSS/Lensing combination
  - Kinematic lensing
  - Photo-z calibration
  - Mitigation of intrinsic alignment
  - Clusters
 - Dark matter from low-z galaxy dynamic and stellar spectroscopy

Illustris TNG simulation

SNIa host redshifts from DESI, DESI-II and 4MOST

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SNe Ia host redshift project

- **Project**: Impact of redshift host measurements from DESI and DESI-II on supernovae cosmology - Time domain, Survey coordination, DESI-DESC

- **Objectives:**

  1. Number of host spectroscopic redshift measured by DESI, DESI-II, 4MOST-CRS, 4MOST-4HS

  2. Optimal strategy for DESI-II in terms of SNe Ia

  3. Improvement in term of SNe Ia cosmology (dark energy constraints)
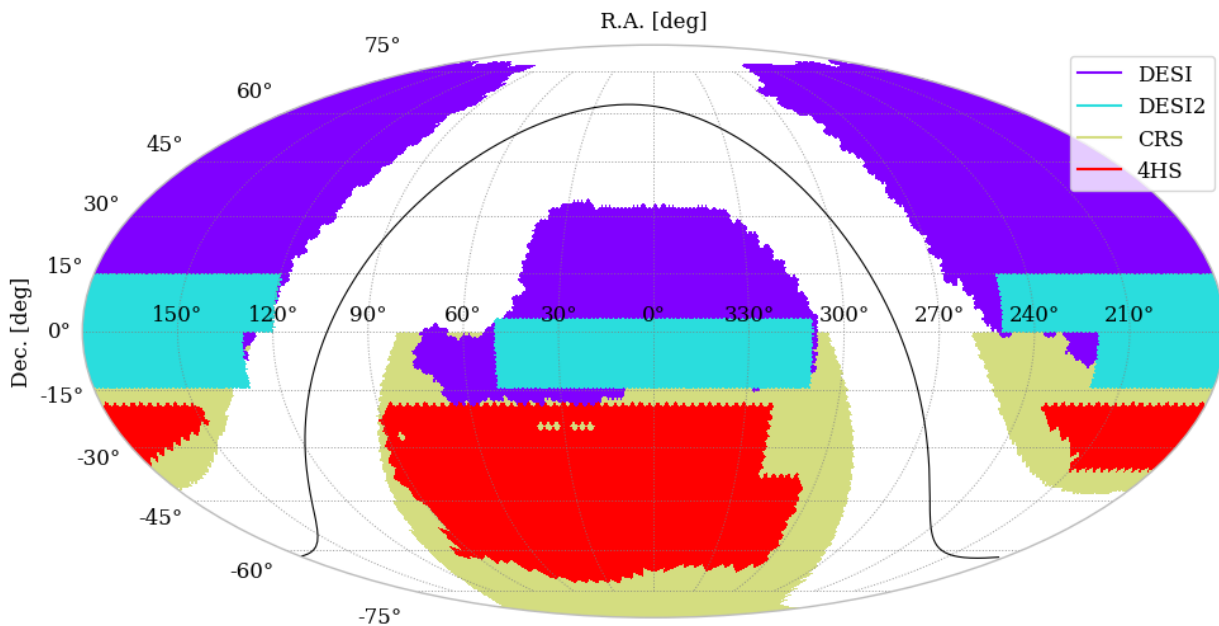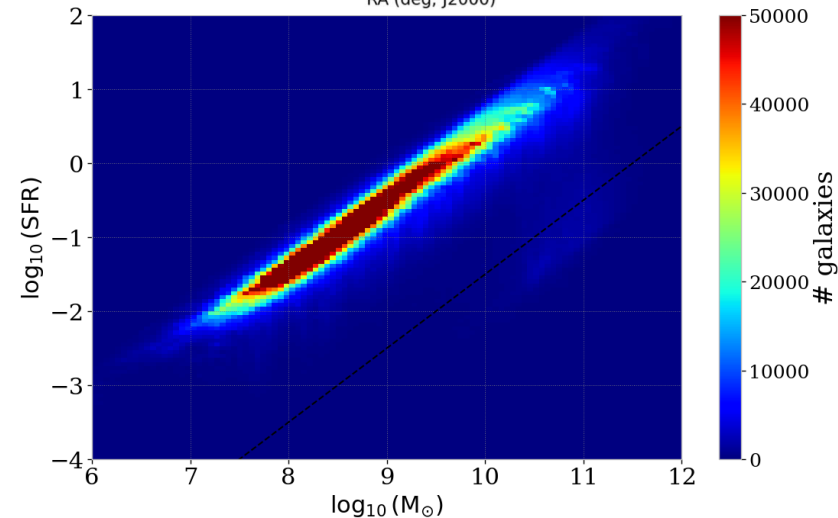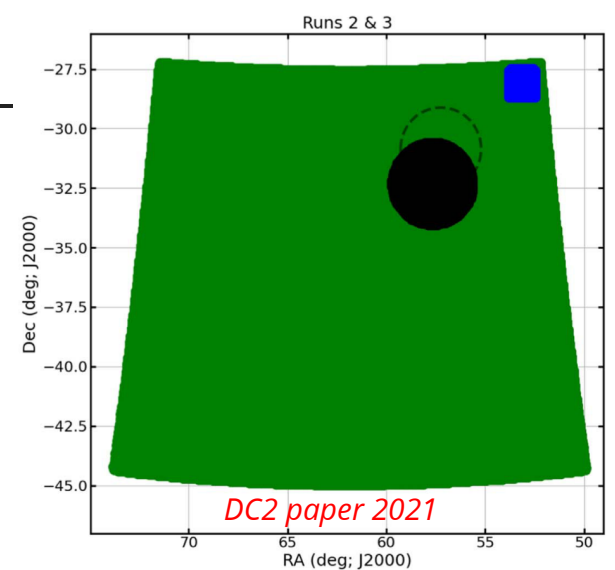
SNe Ia host properties

Methodology:

- Galaxy field from cosmoDC2
- Rubin-Roman catalog: *Troxel et al. 2023*
  - SFR, Stellar mass
  - Galaxy magnitudes (LSST, SDSS, IR with Roman bands)
- Rate + SNIa weights model:

Mannucci et al. 2005   **(Now extended to SNII and Ia pec by Damiano !)**

$$R_{\mathrm{Ia}}^{A+B}\left(M_*, \mathrm{SFR}\right) = A \times M_* + B \times \mathrm{SFR}$$

Host properties for SNe Ia in DC2

DC2 paper 2021

SNe Ia host redshift efficiency
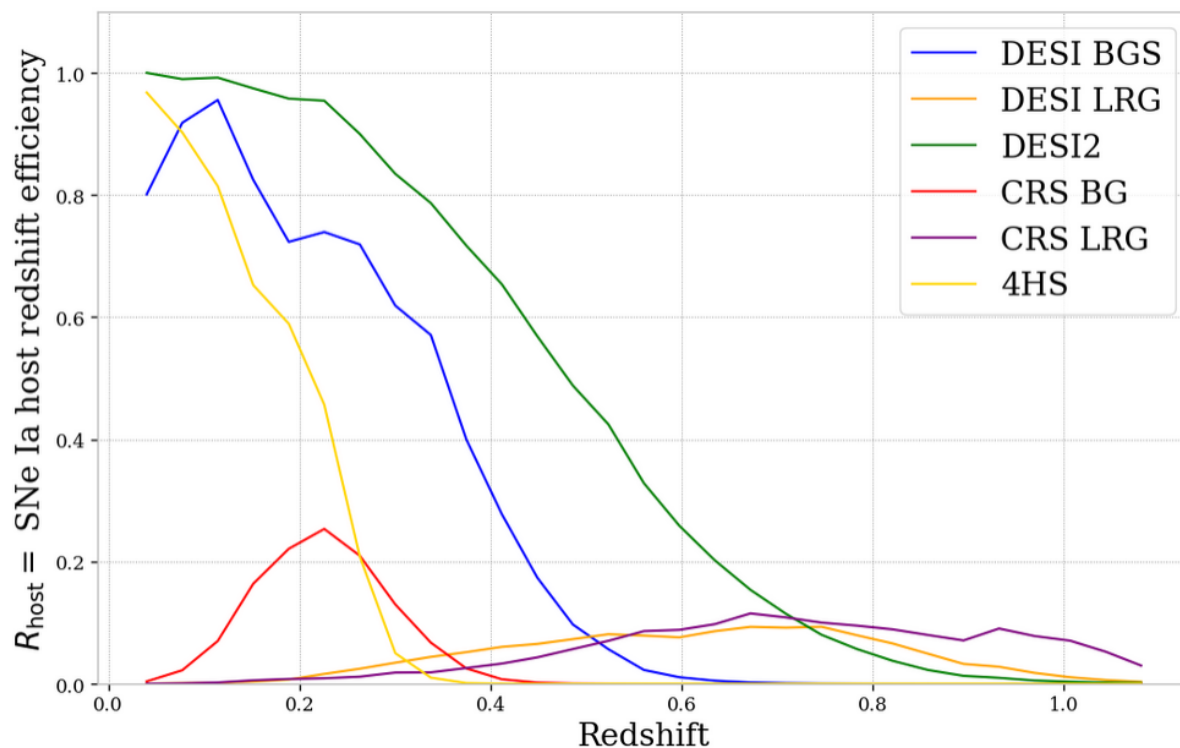
- Target selection cuts of DESI/DESI-II/4MOST applied to cosmoDC2 galaxies

Spectroscopic survey redshift efficiency

$$R_{\mathrm{spectro}}(z) = \frac{N_{\mathrm{gal}}(z)_{\mathrm{survey}}}{N_{\mathrm{gal}}(z)_{\mathrm{dc2,cut}}}$$

$$R_{\mathrm{SNIa}}(z) = \frac{N_{\mathrm{host}}(z)_{\mathrm{dc2,cut}}}{N_{\mathrm{host}}(z)_{\mathrm{dc2}}}$$

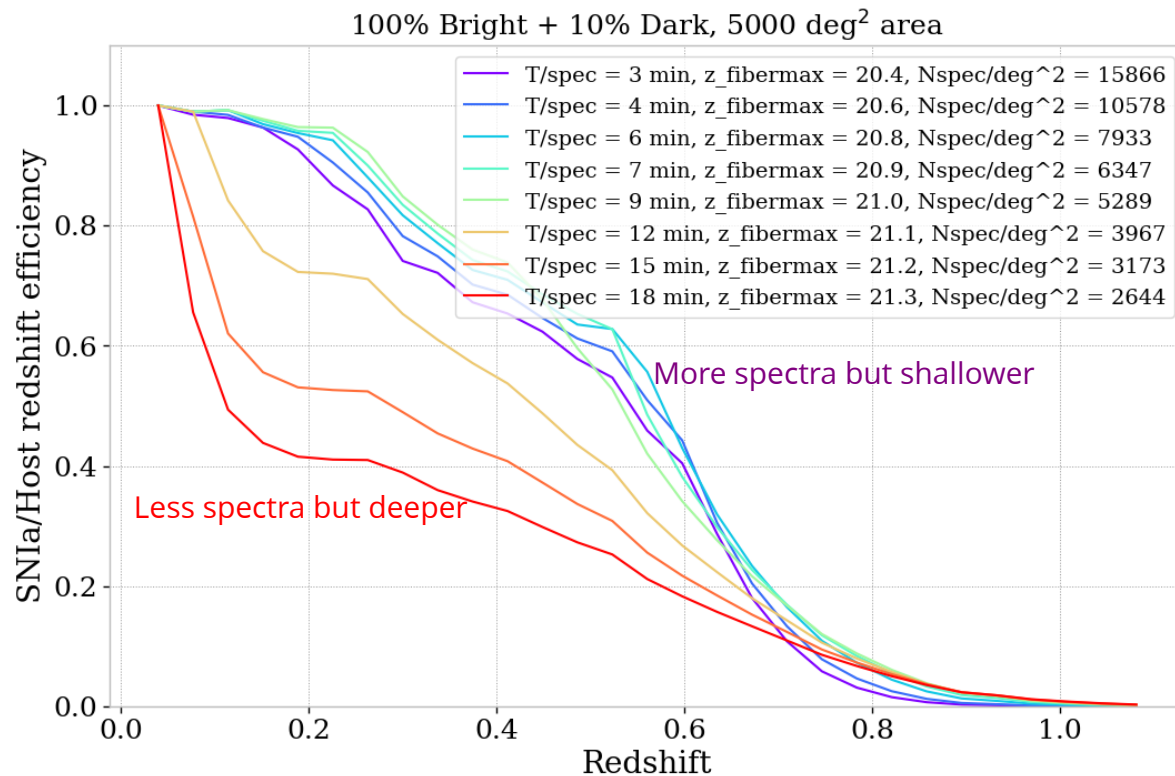SNe Ia proportion located in the targeted host

⚠ Proportion, not absolute number ⚠

$$R_{\mathrm{host}}(z) = R_{\mathrm{spectro}}(z) \times R_{\mathrm{SNIa}}(z)$$
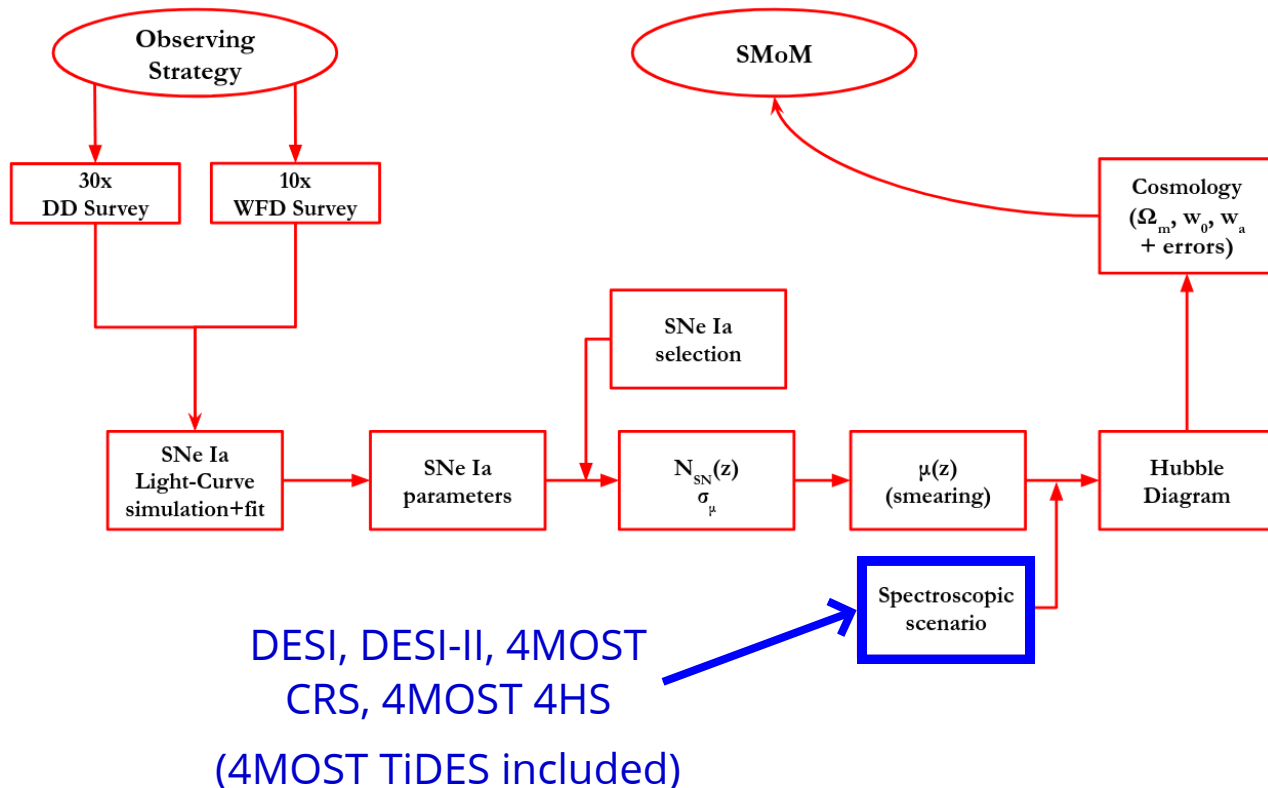
DESI-II strategy variation

- **From the work of Noah Weaverdyck**: DESI-II strategies for a low-z complete galaxy sample, with fixed amount of observation time

- Variation on maximal magnitude targeted, density and exposure time per spectrum

100% Bright + 10% Dark, 5000 deg^2 area

Legend:
- T/spec = 3 min, z_fibermax = 20.4, Nspec/deg^2 = 15866
- T/spec = 4 min, z_fibermax = 20.6, Nspec/deg^2 = 10578
- T/spec = 6 min, z_fibermax = 20.8, Nspec/deg^2 = 7933
- T/spec = 7 min, z_fibermax = 20.9, Nspec/deg^2 = 6347
- T/spec = 9 min, z_fibermax = 21.0, Nspec/deg^2 = 5289
- T/spec = 12 min, z_fibermax = 21.1, Nspec/deg^2 = 3967
- T/spec = 15 min, z_fibermax = 21.2, Nspec/deg^2 = 3173
- T/spec = 18 min, z_fibermax = 21.3, Nspec/deg^2 = 2644

More spectra but shallower

Less spectra but deeper

Impact on SNIa dark energy constraints

- **SMoM**: metric to evaluate the impact of observation strategy on SNIa (w0,wa) constraints

- Changing the spectroscopic scenario in **sn_pipe** pipeline

Gris Regnault et al. 2022, Gris et al. 2024

DESI, DESI-II, 4MOST CRS, 4MOST 4HS

(4MOST TiDES included)

- **Baseline:** redshifts from 4MOST TiDES and Subaru (in COSMOS XMM DDF)
- Photo-z not considered here
- One DESI-II strategy
- 50 % increase in SMoM with DESI and DESI-II
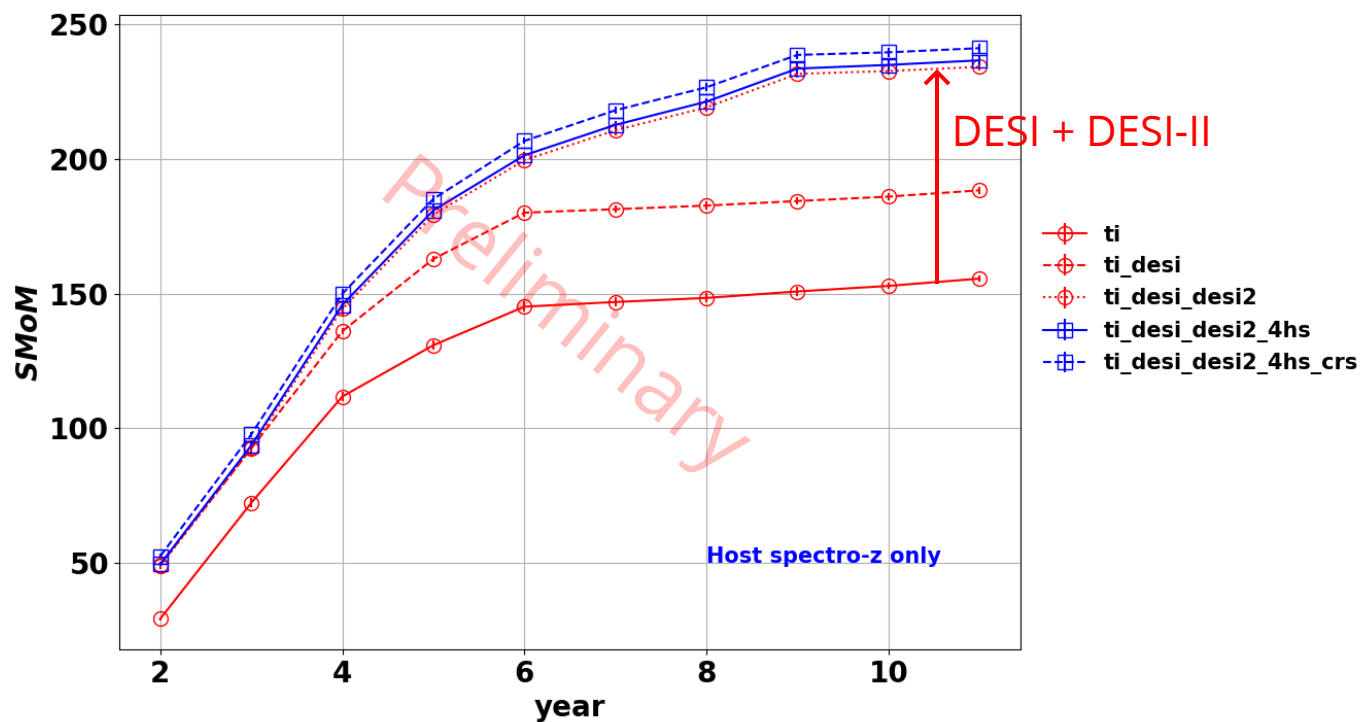
Impact on SNIa growth rate constraints

- **Work of Damĭano Rosselli**
- 8 OuterRim simulations with LSST SNe Ia generated with SNsim, and observation strategy 3.0
- Measurement of fσ8 with SNe Ia peculiar velocities
- Inclusion of different spectroscopic scenarios
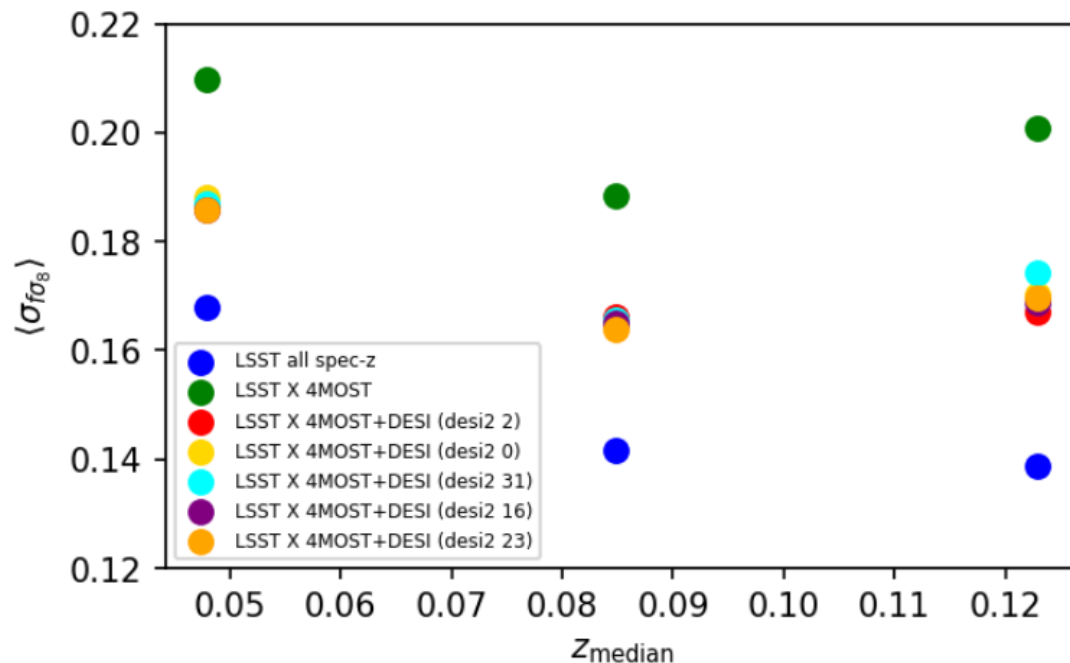
Measurement improved by DESI (~4 %), not much by DESI-II (~0.5%)

DESC - DESI synergies discussion

SNIa

- **Host redshift:** Presented project
- **Spectroscopic typing:**
  - 4MOST-Tides already aims to obtain ~35 k SNe Ia spectra
 - Potential DESI SNe Ia spectra with spare fibers ?

Photo-z

- **Photo-z calibration with DESI spectra**
- **Galaxy cluster :** spectro-z for cluster and members, velocity dispersion, mass from shear and magnification of spectro sample….

Lyman-Break Galaxies

- DESI-II key tracers : probes 2 < z < 4 Universe, for inflation and neutrino mass
- Clustering, x-correlation with CMB lensing
- **Target selection:**
  - Use the flux decrement bluewards the Lyman limit
  - Decrement visible in the u-band at z > 2.5
- **Needs wide ugr-imaging:** CFIS-u from UNIONS in NGC dec > 30 + SGC dec > 30

Lyman-Break Galaxies
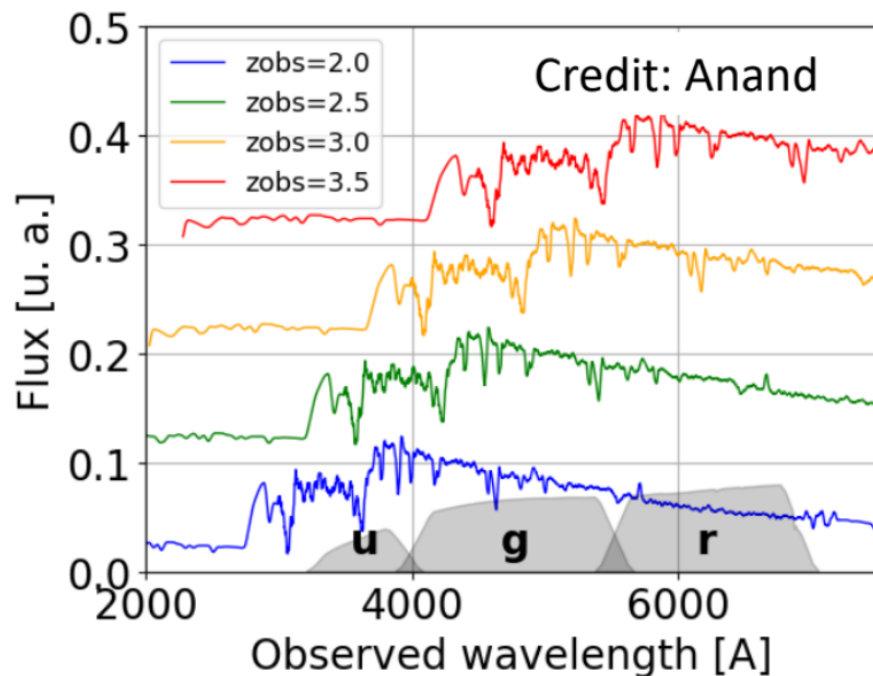
- **Plans with Rubin LSST ?**
  - Common footprint with DESI: 5,7k deg2
  - SGC, Dec in [-30, 0] & NGC Dec in [-20,10]
  - LSST depth u(Y1)=24.5 u(Y10)=25.5
- Already pilot DESI observations on COSMOS/XMM (4 deg2)
  - Deep CLAUDS+HSC photometry
  - promising results with shallower depth à-la UNIONS (≃ LSST Y1)
- **New topical team in DESC #desc-lbg**
  - **Goal** : LSS x CMB cosmology, cluster magnification...
  - For now focus on metrics for LSST observing strategy