New Efforts in Photo-z Calibration

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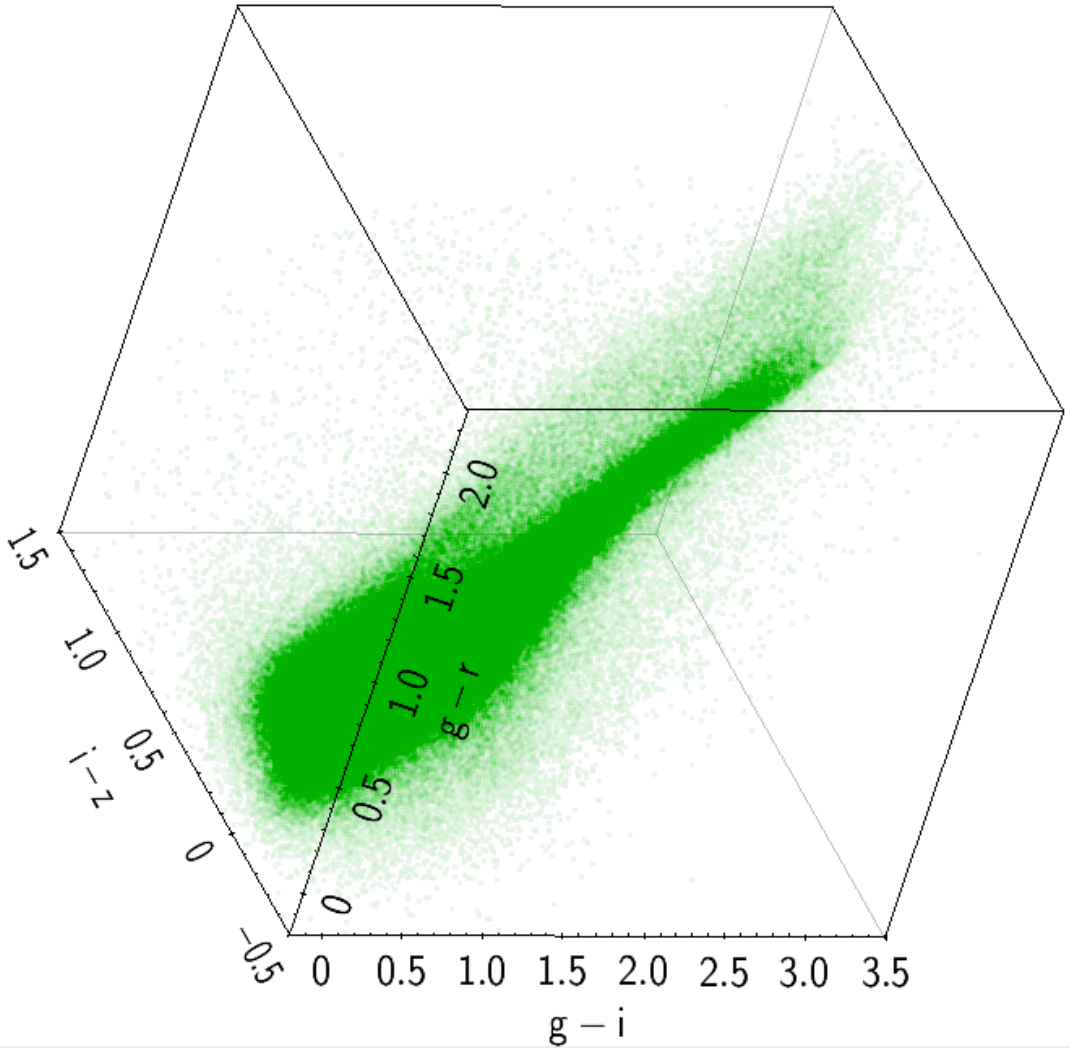
Why Do Photometric Redshifts Work?

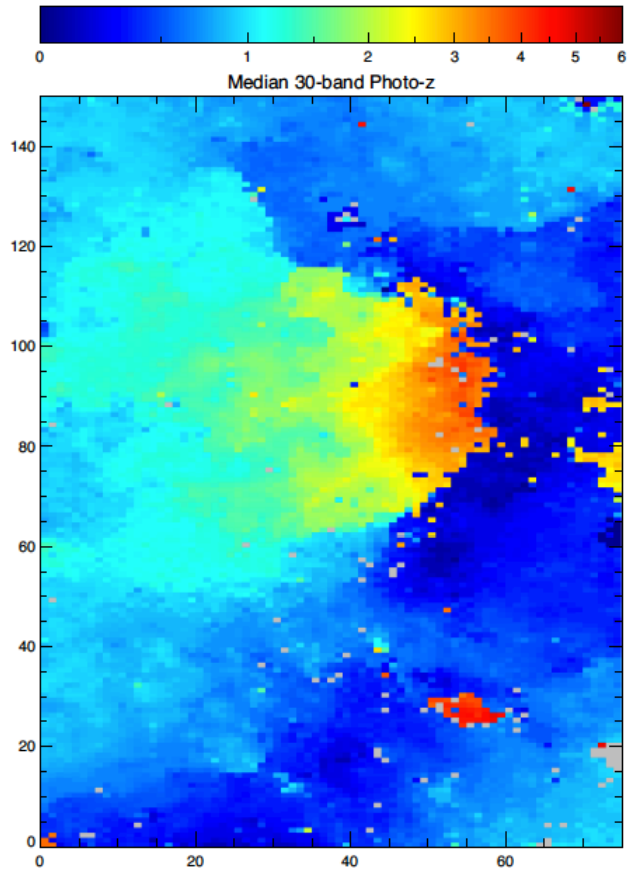
- Galaxies are very similar in many ways
  - Same physics
  - Cluster in color space
- Photo-z is a map of the color space manifold to redshift
  - High dimensionality
  - Complex manifold
    - Not monotonic
  - Lots of ways to do this mapping
- Error distributions and systematics are important



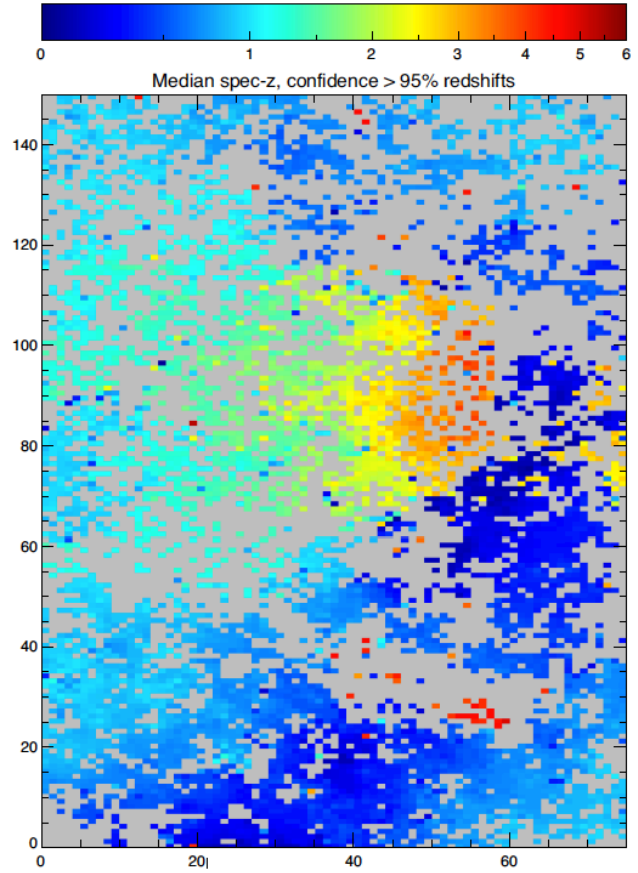
Mapping the Color-Redshift Relation

- Can visualize the 7-dimentional color data
- Test if the analytic model fits
- Test where the data driven model is valid
- Target grey areas with spectroscopy

Analytic (Template) Model

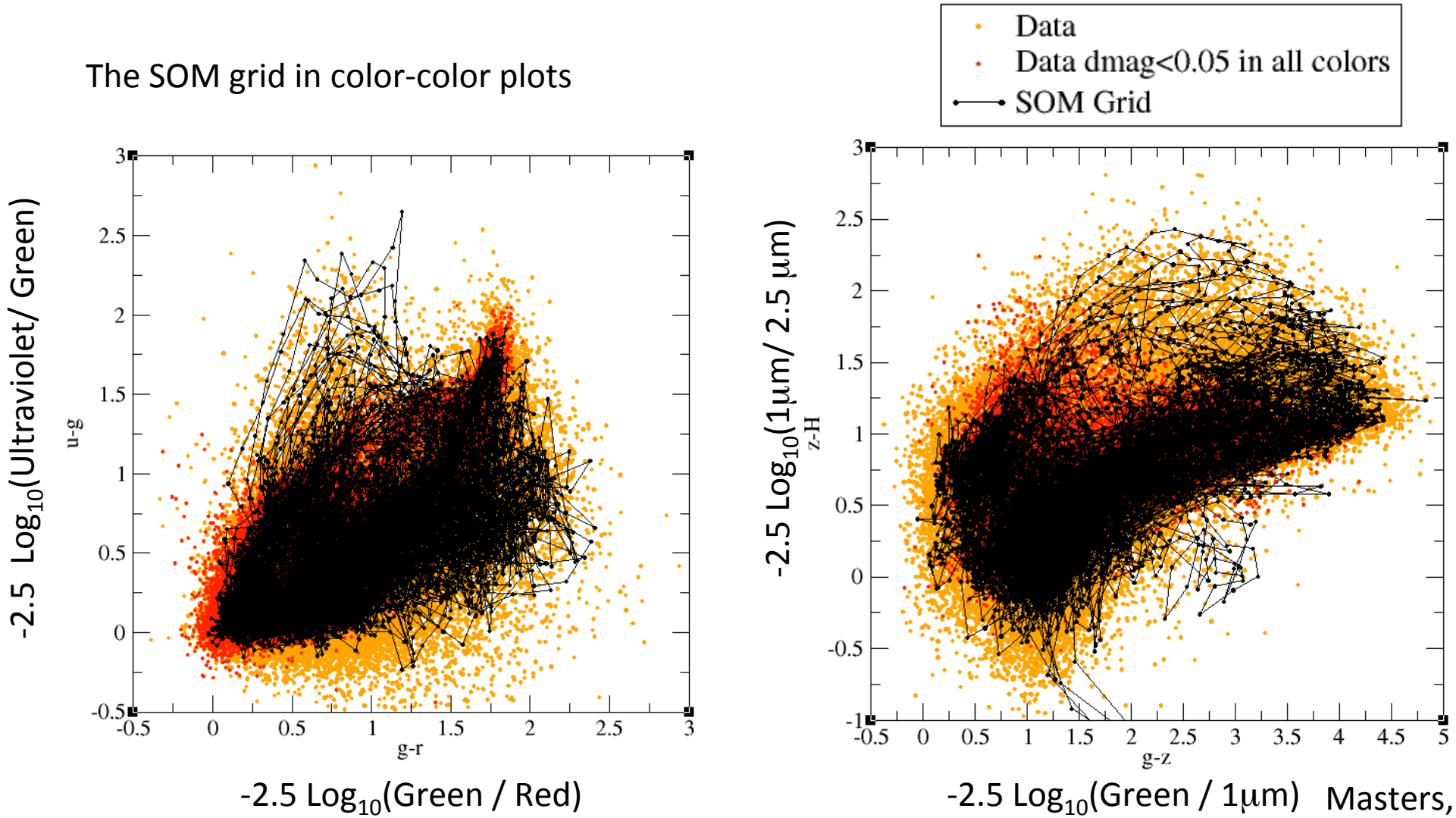


Data (spectra) Driven Model



Mapping the Color-Redshift Relation

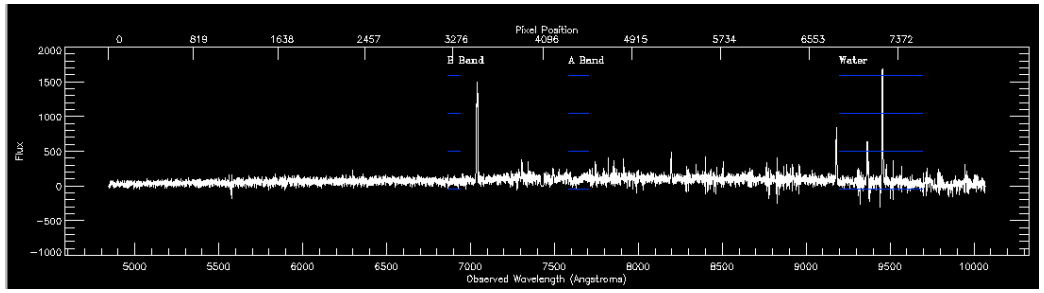
The SOM grid in color-color plots

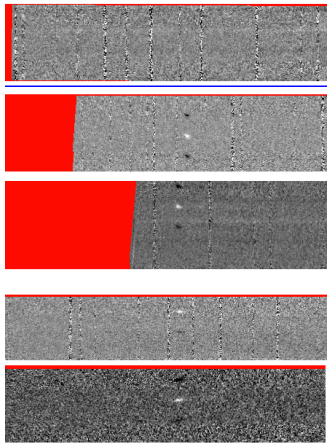


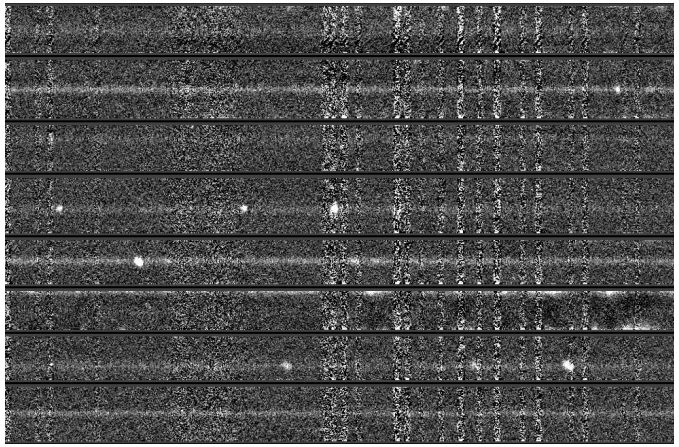
Masters, Capak et al. 2015

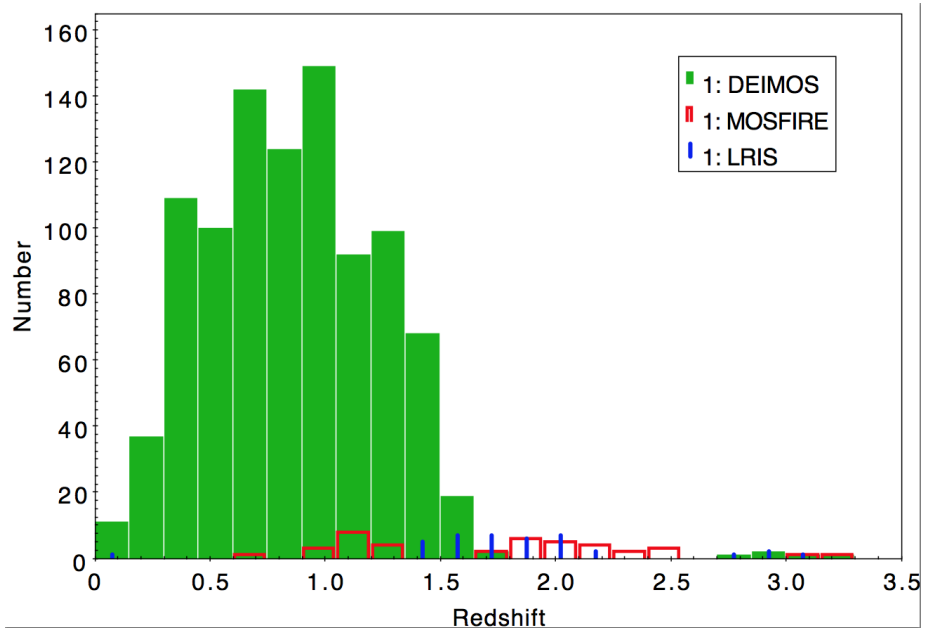
C3R2

- Aim to fill in the color-redshift map for Euclid
- Not a typical redshift survey
  - Have an expectation of what we are looking for
  - Multiple instruments, variable exposure times
  - Keep going until we have a redshift
- ~40 nights on Keck with multiple instruments
- Will go a long way to measuring the LSST/WFIRST mapping
- Could use much more data!
  - PFS, DESI, ect.



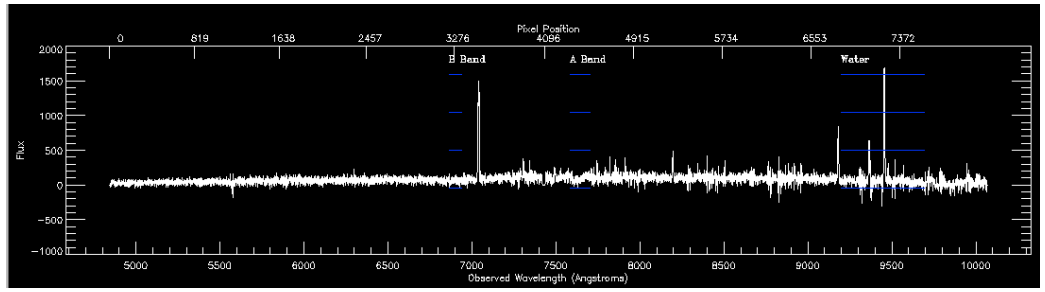


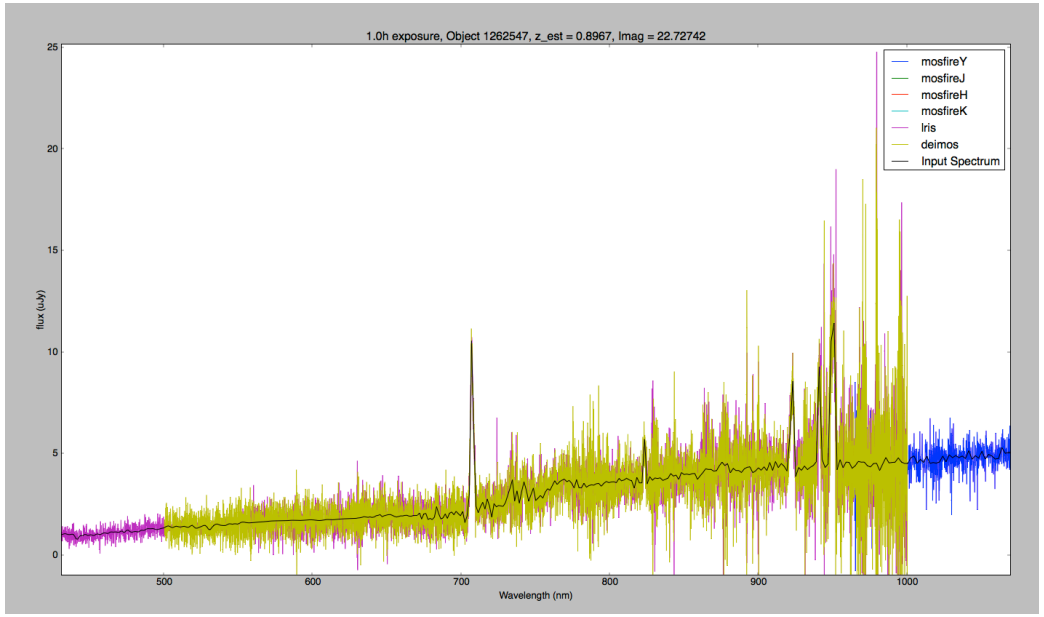




C3R2 Simulating Spectra

- Using SED fits from COSMOS + CANDELS
- Based on SPHEREx interpolative simulations
- Using Brown et al templates
- Predict actual emission line properties to 0.2 dex
- Continuum SNR to 20% for Keck
- Could be used for DESI targeting



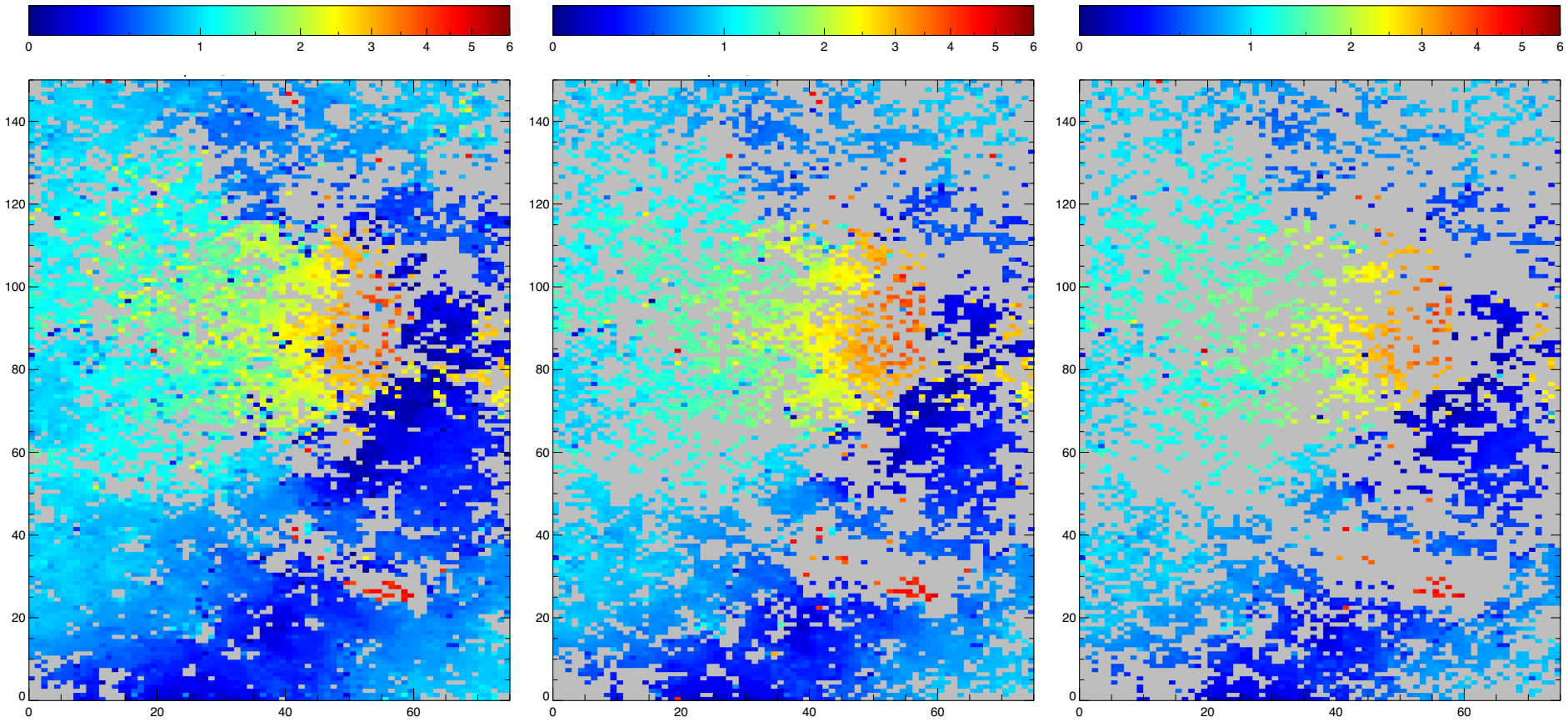


Spec-z's across the shallower *Euclid* map at different confidence levels

Conf. ≥ 2 redshifts
31% un-sampled

Conf. ≥ 3 redshifts
51% un-sampled

Conf. = 4 redshifts
64% un-sampled

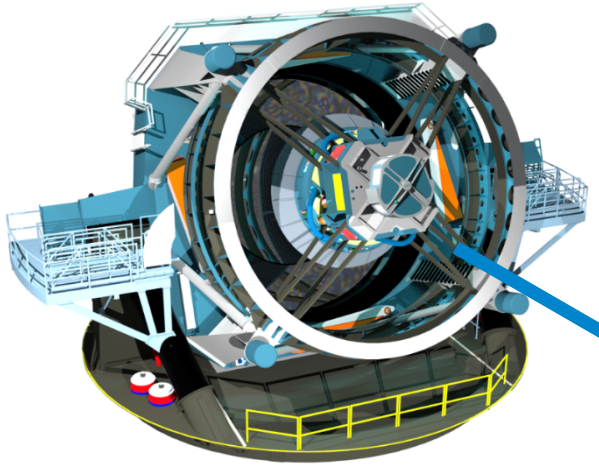


At low confidence there appear to be very few Unknown-Unknowns. Main problem is getting high-confidence redshifts.

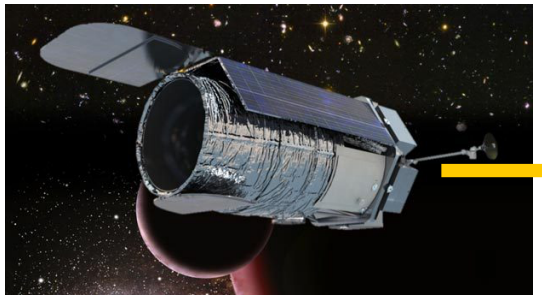
Higher Dimensions

- Generate model with one data set
- Expand it to higher dimensions with another

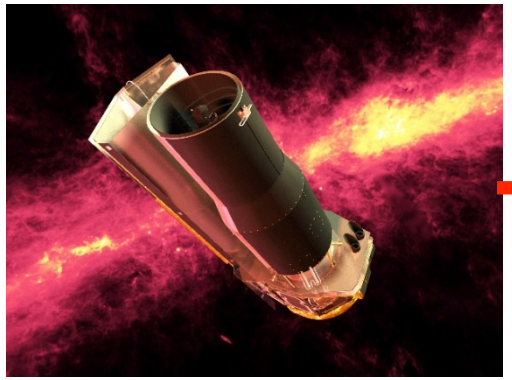
LSST

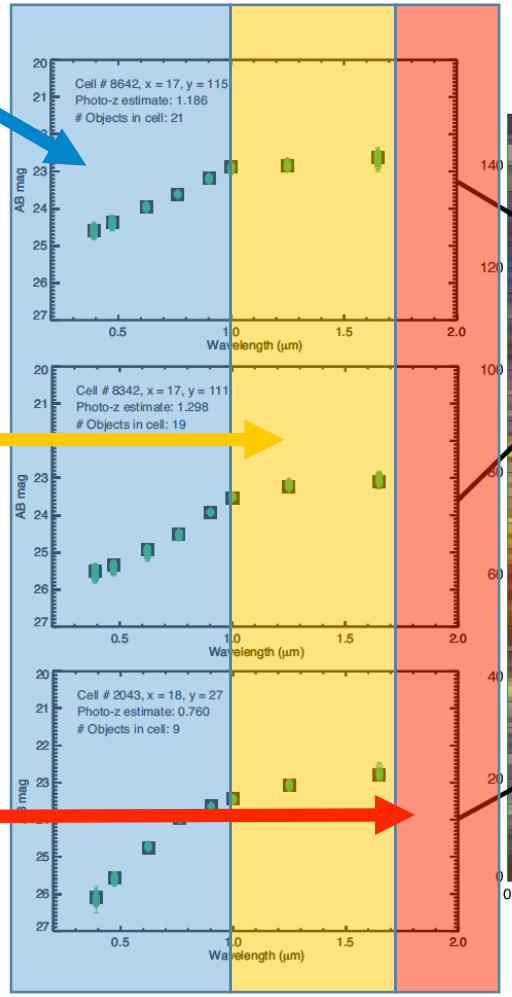


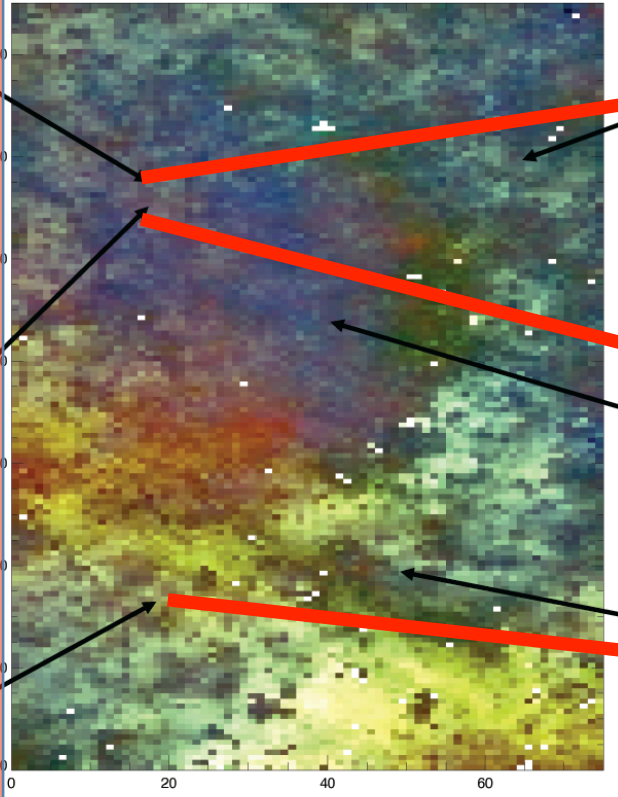
WFIRST



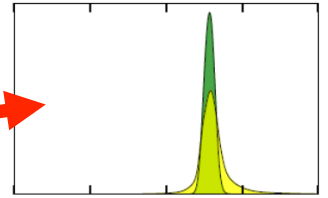
Spitzer



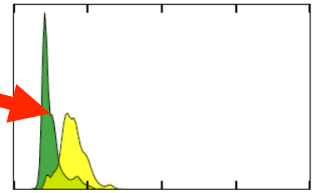




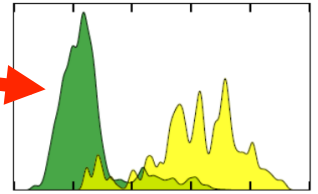
Uniform Cell



Bifurcated popula

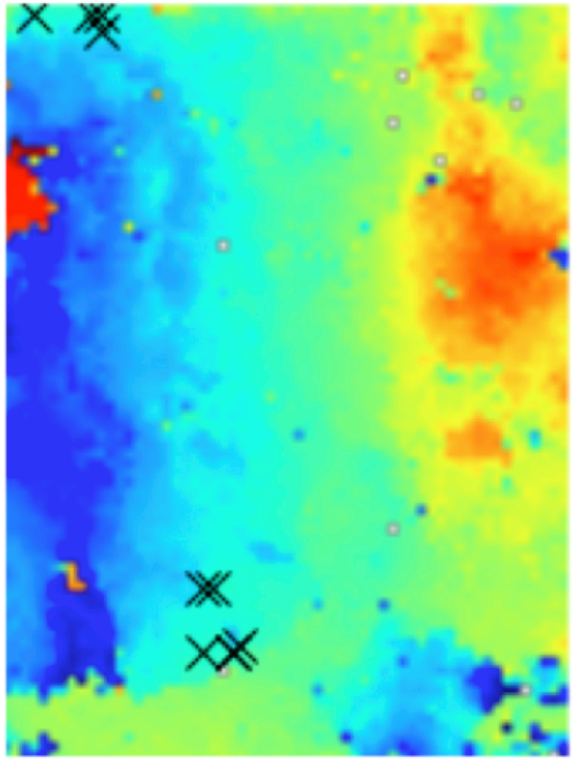


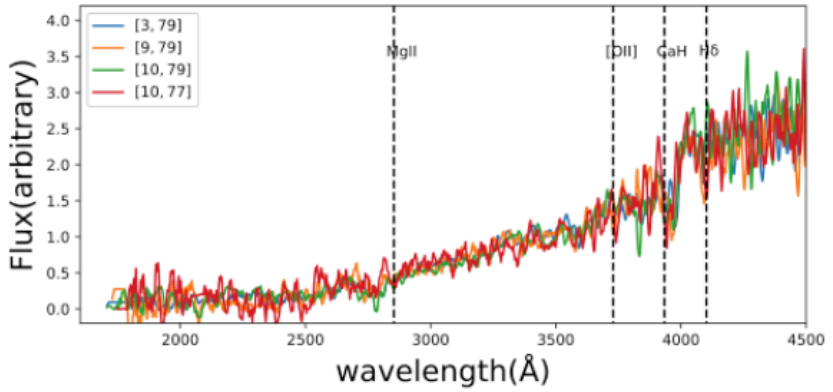
Non-Uniform Cell

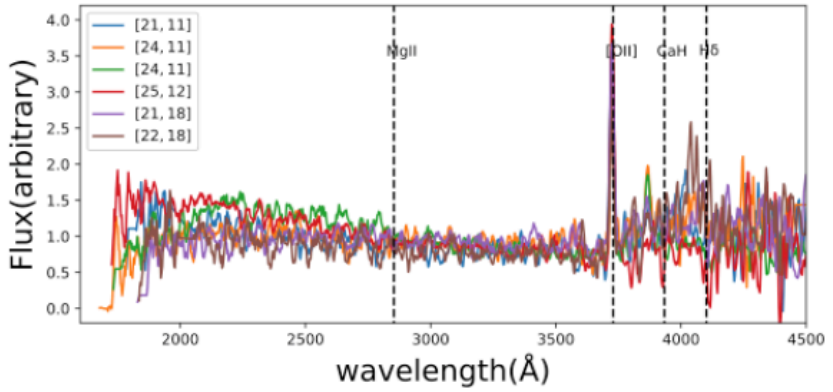


Higher Dimensions - Spectra

- Can look to see how similar spectra are across color space
- Most regions are similar

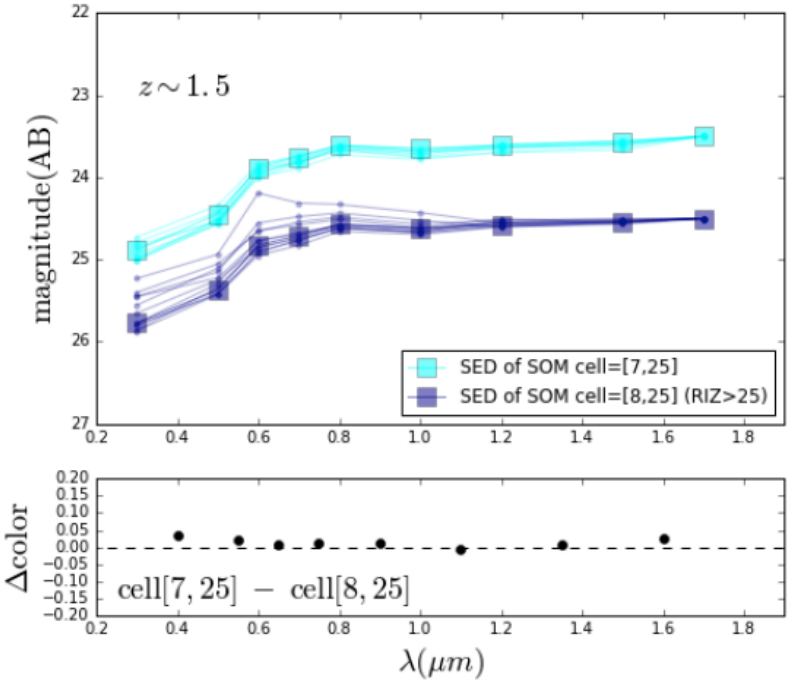


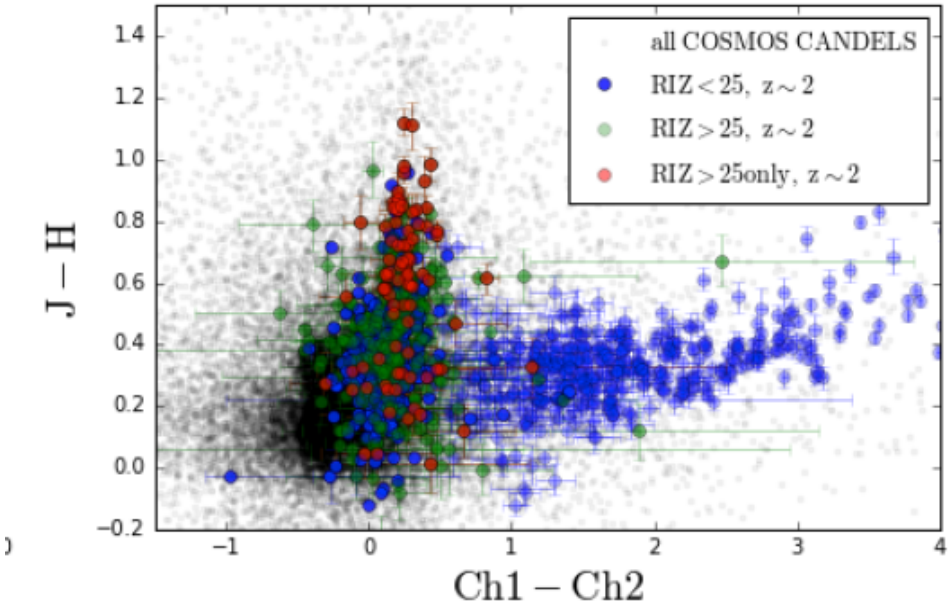




Higher Dimensions - Colors

- Can use deep multi-wavelength data to check how diverse the galaxy population is at fixed LSST/ Euclid/WFIST color
- Most regions have similar SEDs across the color space
  - Some are distinct and need to be investigated
- Can find outliers in the data its self



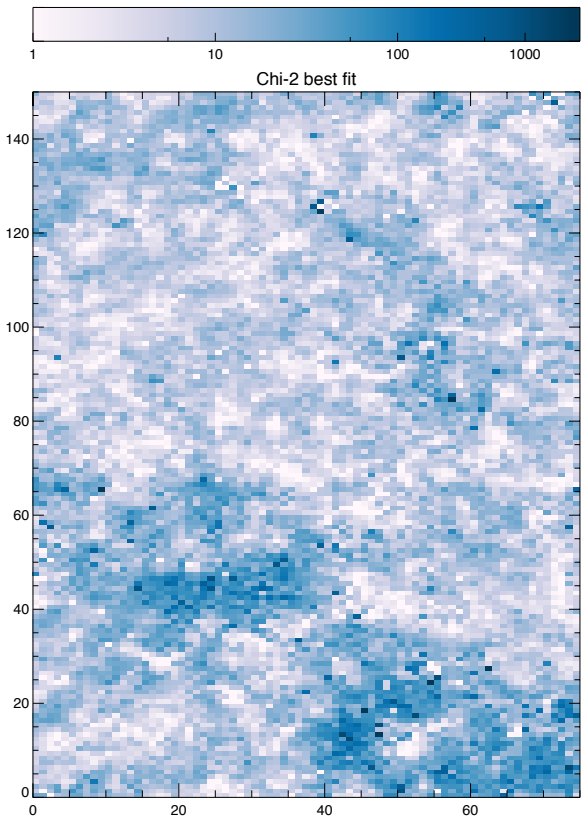


Higher Dimensions – Model Fits

Some Photo-z are bad because we do not correctly model red galaxies

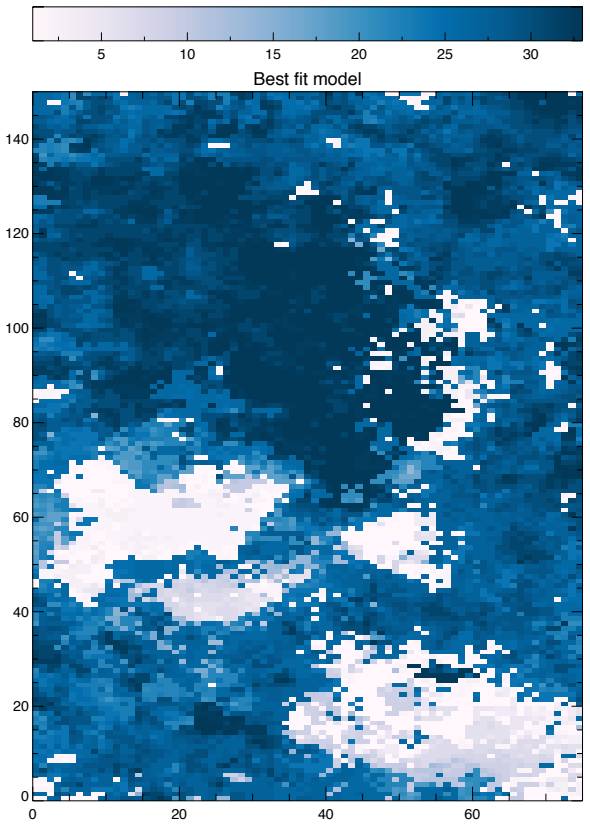
Goodness of fit

Good Bad



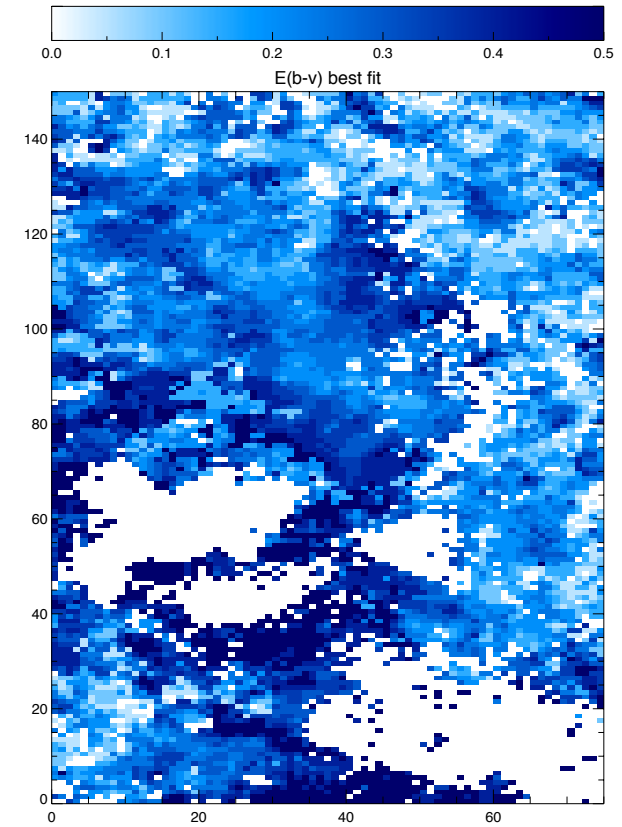
Model

Red Blue



Dust Obscuration

Blue Red



Questions

- How will this effort enhance our current knowledge of dark energy?
  - It will improve our control over a major systematic
- How does the idea complement other efforts?
  - We propose to add multi-wavelength data and spectra to existing deep fields
  - We propose to share deep fields
- Cost estimate
  - TBD, some use of existing facilities, some new surveys
- Timeline
  - Now
- What are the key technical and logistical obstacles (if any)?
  - Coordinating competing projects
  - Getting galaxy evolution community to agree on fields