Summary of current simulation tools

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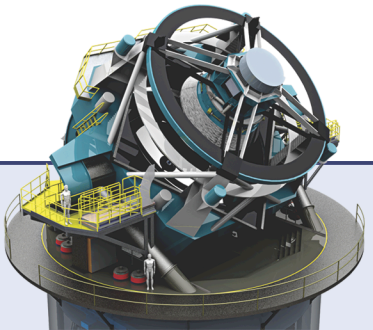
Alexandra Abate



People involved:

- LAL, Orsay
  - Reza Ansari, Marc Moniez
- LPSC, Grenoble
  - Aurelien Barrau, Adeline Choyer, Jean-stephane Ricol, Alexia Gorecki
- LPNHE, Paris
  - Sylvain Baumont
- Saclay, France
  - Christophe Magneville
- UArizona
  - AA, Lidens Cheng, Elliott Cheu, Matt Kirby
- UC Davis
  - Sam Schmidt
- UWashington
  - Andy Connolly, Zeljko Ivezic

“Direct” simulations

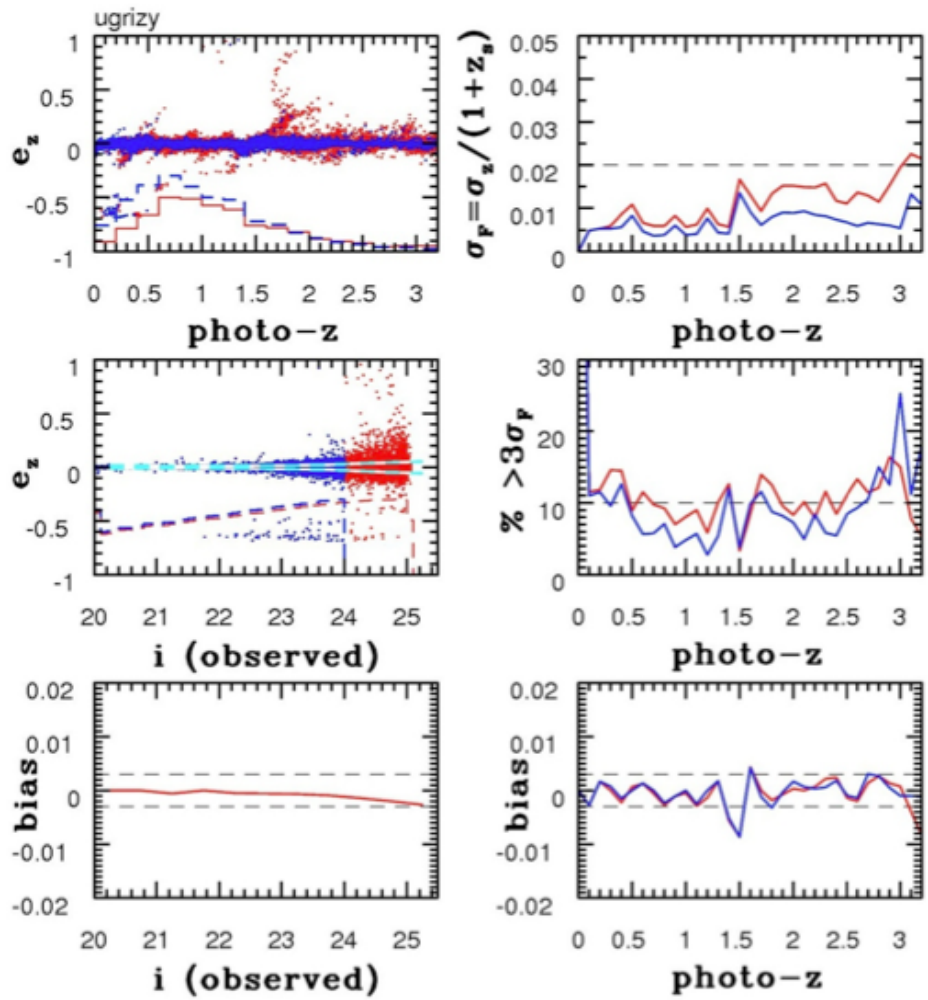
- a ``Direct” simulation:
  - distinct from CatSim efforts: faster, more flexible, can test specific aspects of photo-z estimation
  - galaxy properties (z, SED, luminosity reddening …) are drawn from empirical distributions
  - observed magnitudes simulated according to baseline LSST system properties and observing conditions
- Tools
  - “Science book” simulations
  - “FranZona” simulations

Science Book Simulations:

- Andy Connolly, Zeljko Ivezic, Sam Schmidt
- Designed to match empirical color and redshift distributions of COSMOS galaxies (by Andy Connolly)
- 181 templates from COSMOS 30-band photo-z paper (Polletta et al + BC03 templates)
- Template redshifts truncated to remain within observed colors of COSMOS (type prior added to eliminate spurious populations)
- Redshifts drawn to match COSMOS z distribution
- Magnitude errors matching 10 year LSST depth from Science Book
- No blends, no shapes, no clustering, discrete templates

Science Book Simulations

- Trim to LSST "gold" sample i<25.3 (red) and i<24 (blue)
- Apparent mag prior based on subset of data (to i~24, then extrapolated)
- All templates used (no template mismatch)

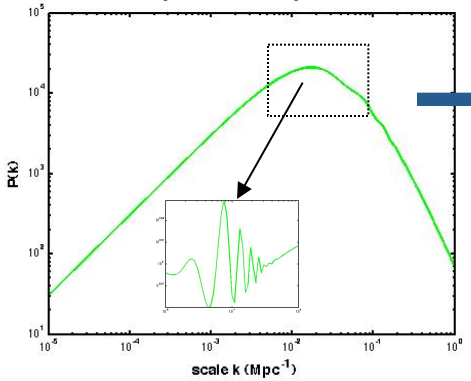


FranZona Simulation Tools (available on GitHub)

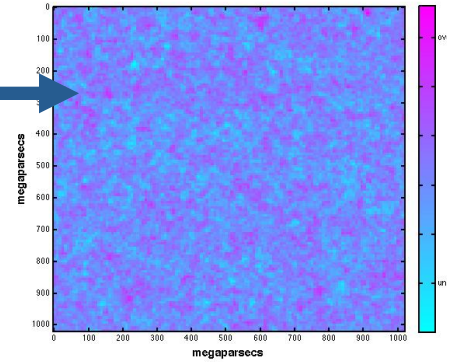
- SimpleUniverse :: *cosmological calculations*
- PkSpectrum :: *calculate linear power spectrum*
- GeneFluct3D :: *simulate over-densities on a grid (linear clustering)*
- SimBaseCatalog :: *simulates redshifts, absolute magnitudes, broad types for N galaxies (no clustering)*
- SimData :: *given z, M_x, t, ext simulates observed mag*
  - Main arguments are: SED library, filters, number of SEDs per broad galaxy type, Madau absorption preference
  - Given galaxy with z, M_x, t, ext calculates truth magnitude (w/ or wo/ IGM)
  - Given galaxy truth magnitude and number of visits generate LSST observed magnitude and error
  - Given galaxy truth magnitude and percent flux error generate generic observed magnitude and error
- SimStars :: *simulate star magnitudes (in progress)*
- LineOfSightTrans :: *calculates line of sight transmission after attenuation by IGM absorber distribution (in progress)*
- TemplatePCA :: *Find PC's of given SED library etc*

Simulation summary

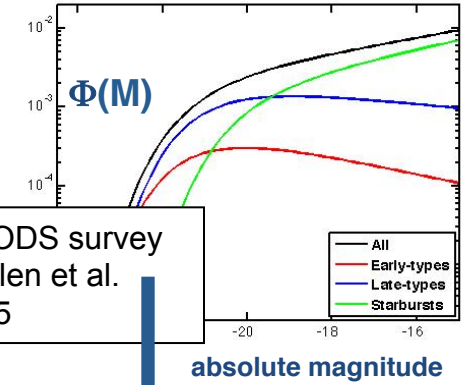
Assume cosmology -> matter power spectrum



Generate 3D cuboid volume of over-densities

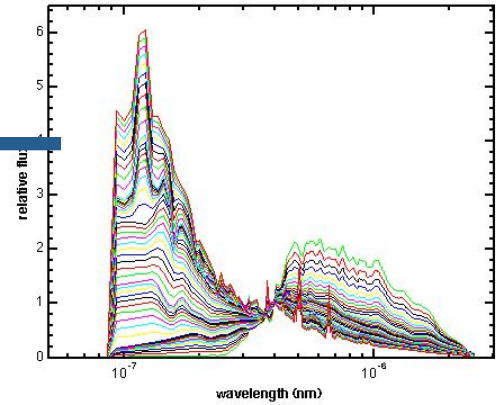


Observed galaxy luminosity functions by type



GOODS survey Dahlen et al. 2005

- Integrate total Φ(M): relate over-density to number density of galaxies
- Distribute absolute magnitudes according to Φ(M):
- Distribute galaxy types according to relative Φ(M)'s



- Using SED+absolute magnitude compute reverse K-correction
- Calculate apparent magnitude observed through each LSST filter

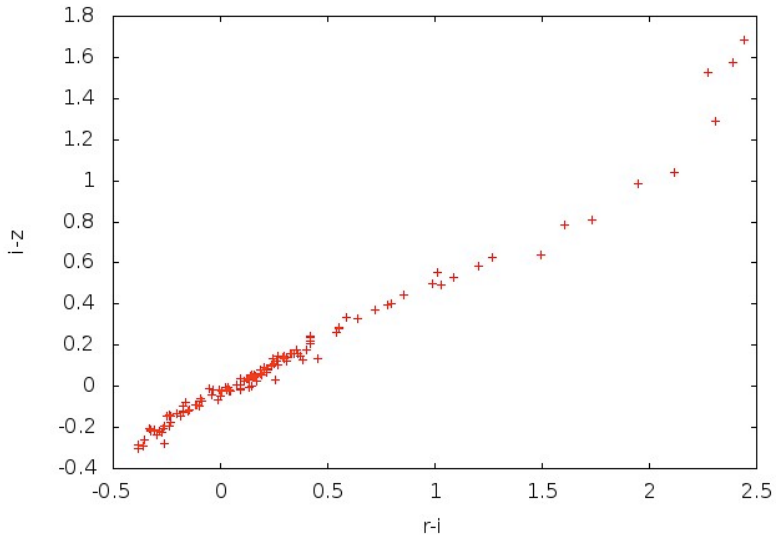
Have catalog of galaxy observations

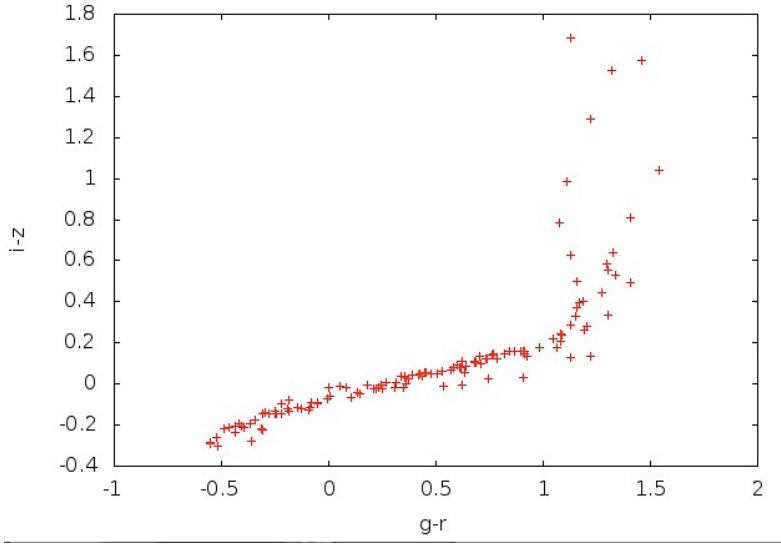
Work in progress at UA ….

- Simulating star magnitudes (Lidens Cheng)
- Stochastic IGM (Matt Kirby)

Simulating star magnitudes

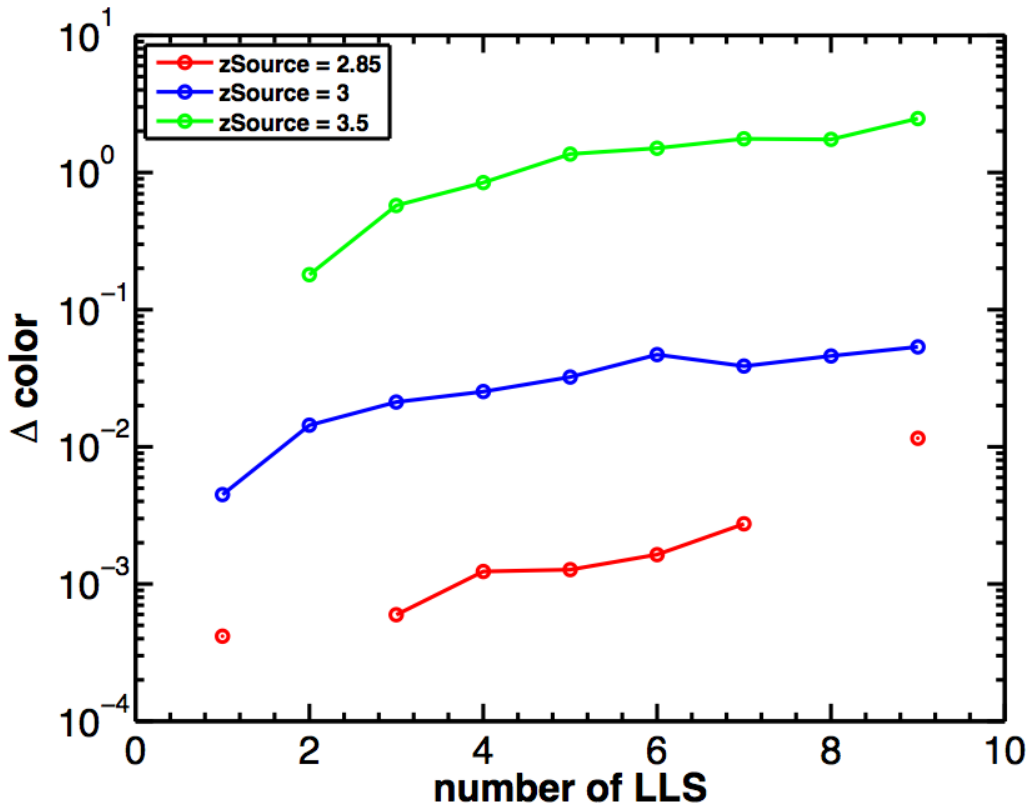
- Using A.J. Pickles' (1998) stellar spectral flux library (115-2500 nm) of 131 standard stars
  - Calculated SDSS r-i colors and LSST colors (u-g, g-r, r-i, i-z, z-y) for all these stars
- Using Bochanski et al. 2010
  - Determined Mr from their luminosity function
  - Given Mr, acquired SDSS r-i color from their plot of Mr vs r-i
- Selected closest Pickles' star with that SDSS r-i color
- Returned all LSST colors for that star
- Will focus on M-stars





IGM stochasticity

- IGM absorption effects galaxies at z>2
- Varies with line of sight
- Systematic effect: variance needs to be well understood
- Probable correlation with line of sight density
  - *possible large bias on cosmological parameters*
  - *severe for analysis that rely on signal from high-z galaxies (cosmic shear)*



Wish List of improvements

(in order of most add-able):

- Stars: draw stars and add to catalog *(in progress)*
- IGM stochasticity *(in progress)*
- Morphology/size information
- Galactic dust extinction errors
- Zero-point variation: utilize maps generated from OpSim?
- Blends: use direct catalogs as input into ImSim or GalSim
- Filter transmission function change with observing condition, filter position
- Seeing effects on possible size/surface brightness priors