

Disseminating *Galacticus* data through online platforms



Andrew Benson



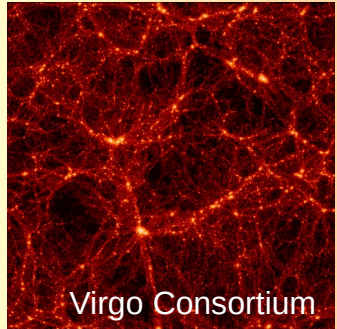
CARNEGIE
SCIENCE

The Carnegie Observatories

SAM Workflow



Initial data

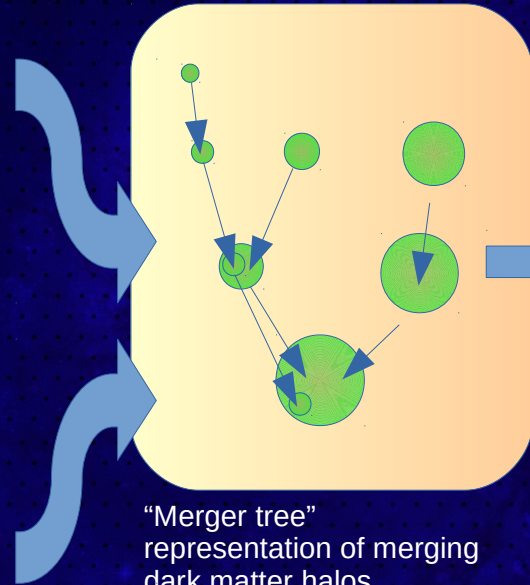


Virgo Consortium

Cosmological N-body
simulation of dark matter



Monte Carlo tree generator



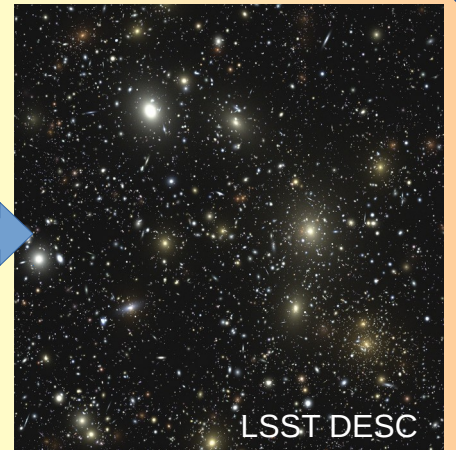
"Merger tree"
representation of merging
dark matter halos

Processing

$$\frac{dy}{dt} = f(t, y)$$

ODE solver operates along
each branch of tree to
evolve galaxy properties

Output data



LSST DESC

Catalog of galaxies with broad
range of physical and
observable properties

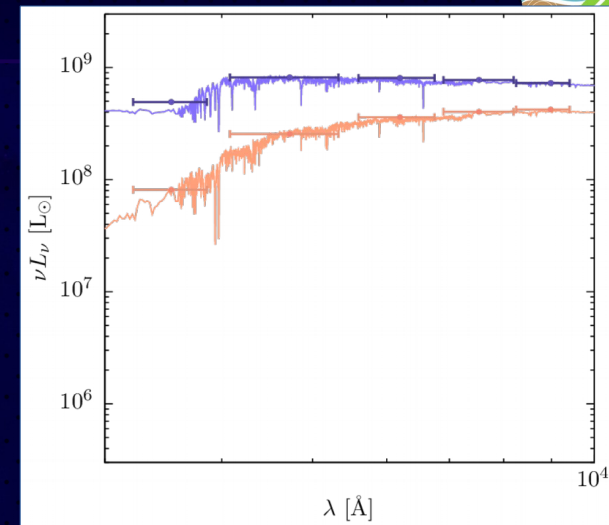
Current Platforms



- LSST DC2 (used as input library)
- Theoretical Astrophysical Observatory
- CosmoSim
- github.com/galacticusorg/galacticus

Challenges

- Understanding user needs
 - User needs often unknown, evolve!
 - Types of data
 - Physical properties (masses, SFR, etc.)
 - Observed properties (broad-band magnitudes [which?], SED [what resolution?], emission lines, etc.)
 - Metadata (halo/galaxy IDs, etc.)
 - Resolution, volume, depth (redshift)



Challenges

- Validating for user needs

- How does a user know if this simulation is sufficient for their needs?

- Users don't know the limitations and idiosyncrasies of each simulation (nor should they have to)
 - Built-in tools to construct one-point functions (e.g. luminosity functions) and validate against a dataset (DESCQA – Mao et al. 2018)
 - Intelligent warnings if a selection includes points close to the resolution limit?; some “reliability” property?

2021-05-03_9 :: EmlineLuminosityRatios

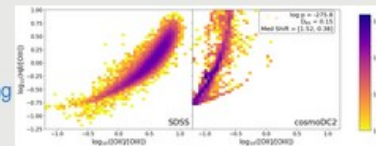
Tests completed: `cosmoDC2_v1.1.4_small` **VALIDATION_TEST_FAILED**

Summary outputs:

`Emline_Lum_Ratio_Summary.txt`

`config.yaml`

`cosmoDC2_v1.1.4_small_emline_ratios.png`



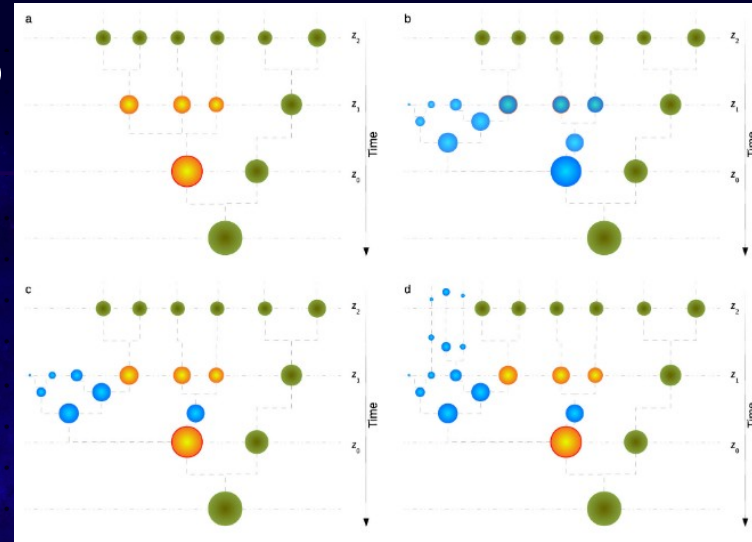
Challenges



- Data inhomogeneity

- Can be useful to support subsets of galaxies having different data, e.g.:

- A subsample for which full RT dust emission spectra are included (computationally expensive)
- A mix of N-body and Monte Carlo merger trees (the latter to fill in low mass galaxies below the N-body resolution limit)



Challenges

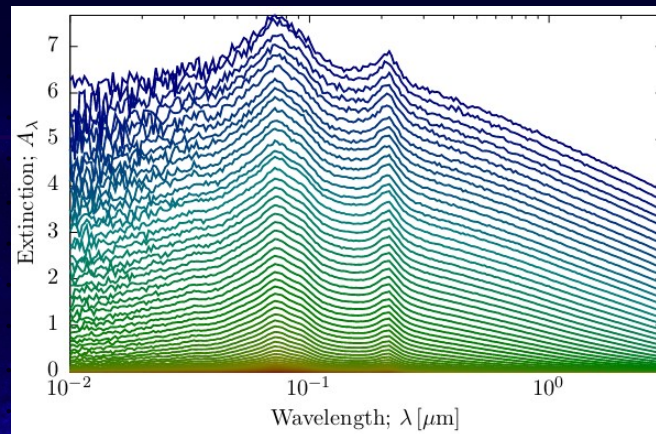


- Pre- vs. post-processing

- Ability to post-process eases the burden of guessing user needs in advance, e.g.:

- Apply (user-supplied) dust attenuation curve to luminosities/spectra
 - Compute magnitudes in user-supplied filters

- Post-processing requires (substantial?) server-side computing



Challenges



- Custom models
 - Ability to adjust parameters and generate a new model
 - Substantial server-side computing
 - Complex parameters to control
 - Parameter hierarchy
 - Validation of parameter values

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