DC2 Introduction

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DC1 Reminder

Parameter	Value	Notes
Image area	40 square degrees	Extra sensors removed
Bands	r only	
Cadence	OpSim WFD	
Sky Model	"PhoSim" or "Central" ESO/ Project sky model in imSim	Non varying sky set by central pointing for imSim. No clouds
Dithering	Rotation + Translational, or natural rotation only.	Non-dithered imSim version available.
Number of visits	800-2400	**Both** Un-dithered and dithered datasets available.
Sensors	e-image only. No BF or tree rings.	Sensor saturation in PhoSim. Also PhoSim magnitude limit of 10 for bright stars.

→ **Bigger, more bands, more realistic!!**

DC2 - History

- After DC1 we asked all of the WGs to think about what projects they wanted to do with DC2. We showed you a simple baseline plan to consider.

- Then we asked you to write abstracts for those projects and to make wish-lists for any features that were missing that you would need for your project.

- The DC2 team worked with you to understand and satisfy your requests. If it still isn't obvious if your project's requirements are being met, please ask.

DC2 – Some terminology

- N-body simulations and follow-up programs are use to make an **extragalactic catalog**. That catalog is also loaded in to CatSim which is used to make instance catalogs. Those are ingested by imSim and PhoSim to produce **images**. Those are processed by DM and make DM **Data Products**. These are supplemented with **catalogs and tables** stored in dataframes and databases.

- For DC2 we will undertake a staged approach.
  - Run 1.0 small test run to test all the components (now)
  - Run 1.1 validation run designed to be tested by the WGs.
  - Run 2.0 Final production run.

These tables make up the executive summary of

DC2 PLANNING DOCUMENT

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ABSTRACT

In this note we describe and document the configurations used for the second DESC data challenge (DC2) including the validation metrics for certification of suitability for the science studies described in the 2017 DESC Science Roadmap document (LSST DESC 2017). We provide brief descriptions of the simulation tools used and the outputs that will be provided to the working groups for their DC2 projects. We lay out the schedule for a two-stage production approach and an estimate for the required computing resources.

Table 1. Extragalactic Catalog Characteristics

Property	Description/Value
Area	5000 sq deg *Note larger than image area.*
Inpainting method	Galacticus and Monte Carlo sampling methods
Galaxy information	Identifier (a unique integer); location (RA, Dec); indicator for central or satellite; scale radius of the disk and bulge components, luminosities.
Stellar Mass	Disk, bulge, and total galaxy components.
Redshift information	Cosmological redshift, observed redshift due to both the Hubble flow and the galaxy's peculiar velocity.
Lensing information	Shear 1, shear 2; convergence; magnification; lensed position.
Magnitudes	AB magnitudes of the disk, bulge and total galaxy components in the SDSS $ugriz$ filters, the LSST $ugrizY$ filters and a set of narrow-band top-hat filters designed to provide an approximate SED for each component. Both absolute magnitudes in the galaxy rest-frame and apparent magnitudes in the observer frame are provided for the SDSS and LSST filters. Magnitudes for the top-hat SED filter set are provided in the rest frame only. Magnitudes extincted by host galaxy dust and emission-line strengths are computed in post-processing. *Magnitudes with and without host galaxy dust.*
Star Formation Rates	Star formation rate of the disk and bulge components and total galaxy components; Integrated star formation rate; integrated time-Weighted star-formation rate.
Stellar Metallicity	Mass of metals in stars found in the disk, bulge and total.
Black-Hole information	Mass of the supermassive black hole; accretion rate of the supermassive black hole.
Halo information	FOF and M_{200c} for host halos *We will try to propagate so they can be used w/images*
Information necessary for IAs (currently being added)	Density fields; halo shapes and angular momentum

Table 2. CatSim Summary

Parameter	Value	
		See talk by Zeljko
Stars	Milky Way model [Bond et al. (2010, ApJ 716, 1), Also see SSim 2017/10/17 meeting]	
Transients & variables	AGN (damped random walk, independent bands); SNe type Ia; M-dwarf flares; RR-Lyrae; "Main sequence variability" (Kepler light curves)	
Asteroids	None	
Dust	Milky Way dust model described by SFD model	
Proper Motion and Parallax	Removed as not currently handled by DM resulting in astrometric errors. Nutation etc still included	

Table 3. Cadence and Survey options

Main Survey:	
Image area	300 sq deg
Campaign length	10 years
Cadence	`minion_1016` WFD proposal visits
Number of Visits	$(ugrizy) = (56, 80, 184, 184, 160, 160) \times 30$ fields $\sim 27,000$ total
Input	See Table 1 and 2, plus (stretch goal): natural density of core-collapse SNe, lensed AGN and lensed SNe
Field Location	Offset but just including the Extended Chandra Deep Field South Deep Drilling Field
Dithering	Realistic large dithers and rotations
Ultra-DDF:	
Image area	~ 1.25 sq deg (3 rafts, 27 sensors, 4600 sq arcmin, 15% of a full FoV), embedded in one corner of the main survey region
Campaign length	10 years
Cadence	`minion_1016` DDF proposal visits (re-arranged from year to year to emulate enhanced cadences), including visits labeled WFD from the `minion_1016` WFD proposal *Will include visits from both proposals*
Number of Visits	$\sim 20,000$ total
Input	See Table 1 and 2, plus: over-abundance of lensed AGN ($\gtrsim 1000$, 0.2/sq arcmin) and lensed SNe ($\gtrsim 1000$, 0.2/sq arcmin), and: $\sim 6\times$ over-abundance of SNe Ia (25000, 5/sq arcmin), core-collapse SNe (similar)
Field Location	Extended Chandra Deep Field South Deep Drilling Field
Dithering	WFD visits dithered and rotated (since these are also main survey visits). DDF visits to have small (chip-scale) dithers, and realistic rotations (same as for WFD).

Table 4. Image production options

Parameter	Value
Bands	*ugrizy*
Galaxy Morphology	Compound Sersics from inpainting model. imSim only: random walk knot model for realistic morphology. New feature! Realistic knotty morphology.
Lensing	Lensing and magnification applied to galaxies Now with lensing.
Sky Model	PhoSim: PhoSim sky model, imSim: ESO sky model with twilight, both include moon light (Krisciunas and Schaefer model)
Weather (clouds + sky glow etc)	PhoSim skyglow (based on 2MASS Airglow Experiment and clouds (extinction only), imSim: None.
Atmospheric PSF	Ray traced atmosphere
Optics PSF	PhoSim: Full optical raytracing, imSim: Aberrated optics phase screen
Differential Chromatic Refraction	Applied
Applied Sensor Effects	Brighter-Fatter, Tree-rings (for imSim mixed focal plane), cosmic rays, bleeding, and x-talk. Hot columns and defects handled by masking.
Readout type	Both E-image and amplifier readout available

Realistic amplifier readout with sensor effects and artifacts.

Table 5. Final Output Format

Parameter	Value
Output format	DM output products,Tables in qserve prototype (at least for transients) and Dask/Pandas based dataframes
Output products	All DM output including shape measurement on coadds in databases/dataframes, Truth tables for stars and galaxies, final matched catalog with truth information.
Non-Default columns	Several photometry magnitudes and fluxes with associated errors in micro-Janskeys.
Matched truth metadata	Important items will include: Extincted and non-extincted true magnitudes, Halo mass, peculiar and Hubble velocity

DM Products +
DM measurement algorithm output in tables matches with truth information.

Table 6. Rough User timeline

Parameter	Value
R1.1 Production Start	Mid/End January
R1.1 Data Release and Introduction	Beg/Mid February (SLAC Collaboration Meeting)
R1.1 Validation period	Start preparing validation tools now! Presentations after one month of work by WGs in mid March
R2.0 Production starts	End of March
R2.0 Data release	Mid/End of June
R2.0 Early Analysis	Mid July (Collaboration Meeting)

More detailed timeline is under construction in table 9.

More resources

- **The DC2 Planning document itself**
  https://www.overleaf.com/read/jwbjvjnszkzf

- **Extra galactic Catalog Information**
  https://confluence.slac.stanford.edu/display/LSSTDESC/Extragalactic+Catalog+Development+for+DC2

  (especially DC2-prototype-catalog_release_2.1.pdf)

- **Find information on the catalog validation tests here**:
  https://github.com/LSSTDESC/descqa/issues/50

Conclusion

- DC2 will be a large step up from DC1. ~ 30 times the data in WFD along with an embedded DDF with a comparable number of visits and a new extra-galactic catalog.

- We need use to test and validate the reduced data set. We need both catalog and image/table based validation tests to be developed (**by you!**).

- We worked hard to incorporate your suggestions. Let's get ready to use the simulated data.