Revealing the universe LSST

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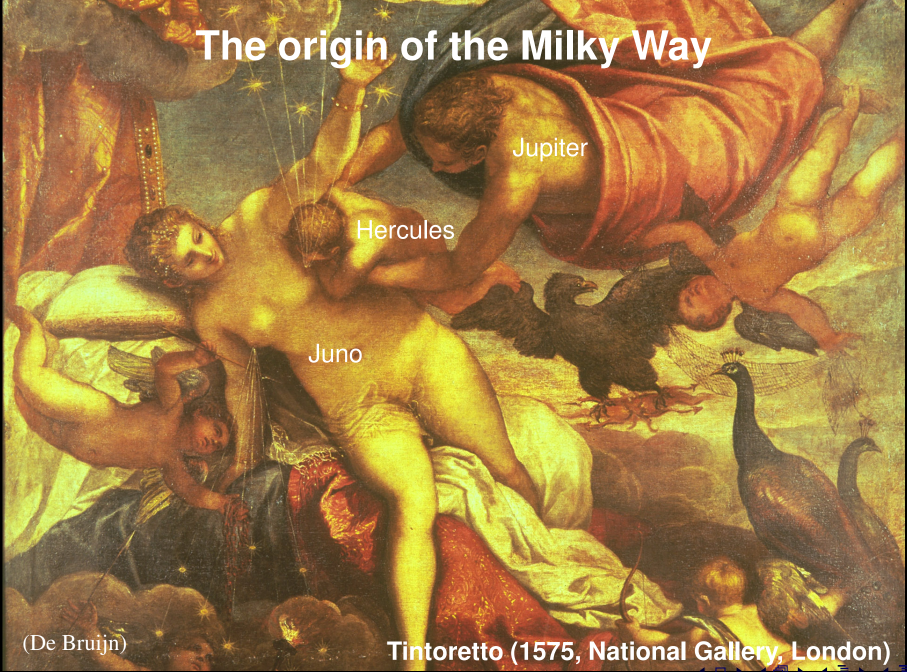
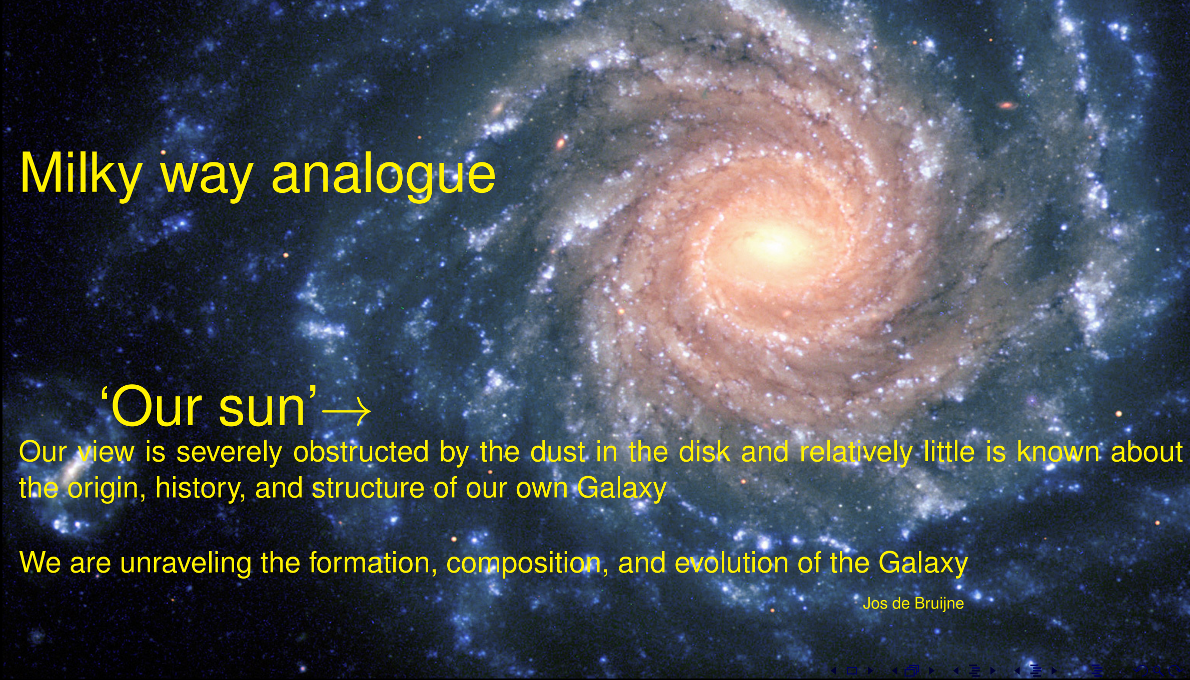
Data management
Large Synoptic Survey Telescope
Tucson, AZ USA

5th March 2019
NOAO
Tucson

The origin of the Milky Way



Tintoretto (1575, National Gallery, London)



Milky way analogue

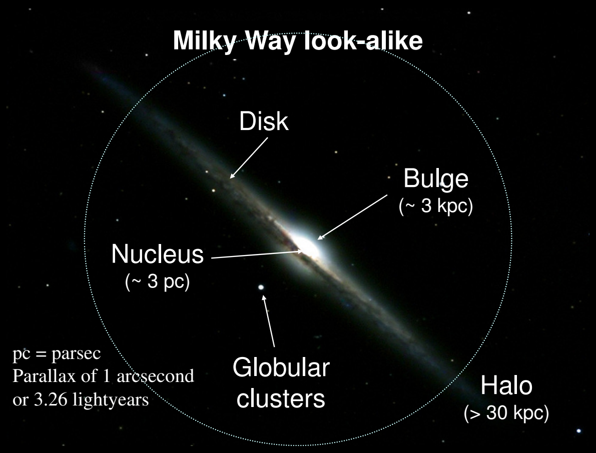
'Our sun'$\rightarrow$

Our view is severely obstructed by the dust in the disk and relatively little is known about the origin, history, and structure of our own Galaxy

We are unraveling the formation, composition, and evolution of the Galaxy

Jos de Bruijne

Another Milky way Analogue (NGC4565)



pc = parsec
Parallax of 1 arcsecond
or 3.26 lightyears

Stellar motions can be predicted into the future and calculated for times in the past when all 6 phase-space coordinates (3 positions, 3 velocities) are known for each star

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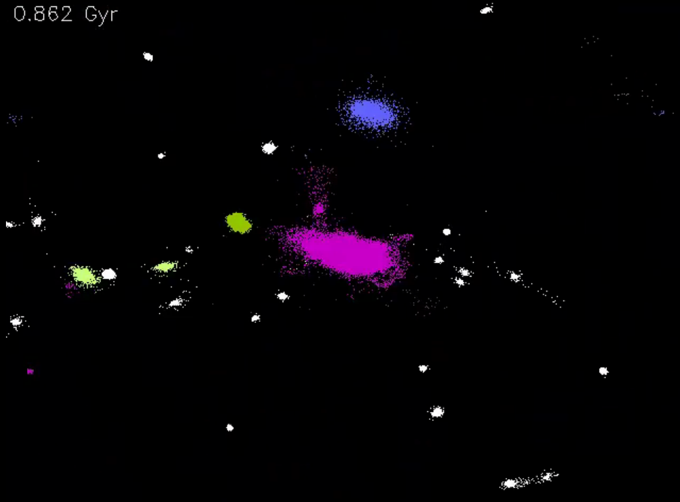
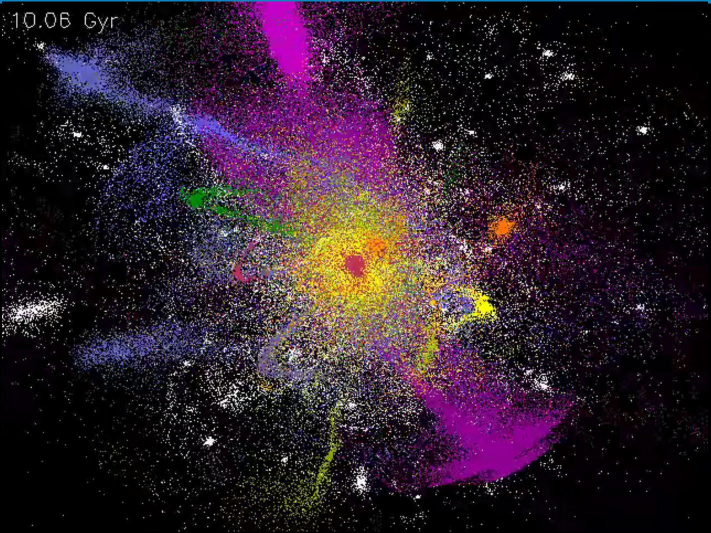
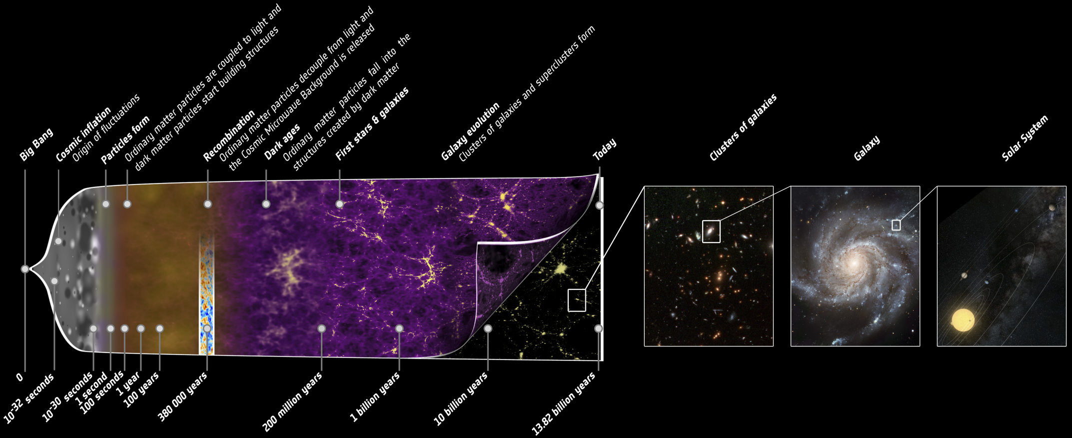
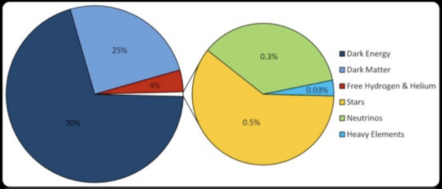
In such processes, stars got spread over the whole sky but their energy and (angular) momenta were conserved. Thus, it is possible to work out, even now, which stars belong to which merger and to reconstruct the accretion history of the halo (de Bruijne)


0.862 Gyr

Origin of the Milky Way

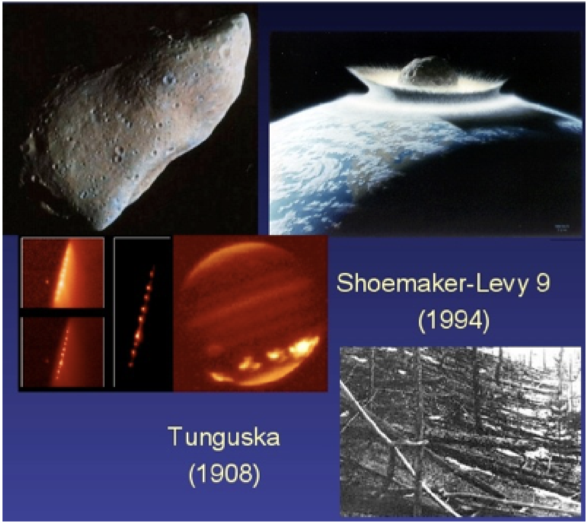




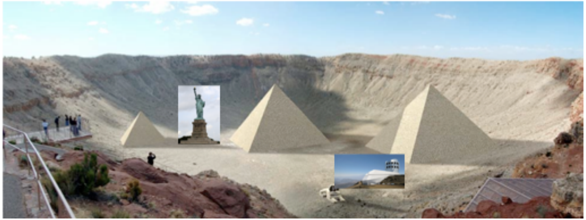


The modern cosmological models can explain all observations, but need to *postulate* dark matter and dark energy (though gravity model could be wrong, too)

Killer asteroids: the impact probability is not 0!



LSST is the only survey capable of delivering completeness specified in the 2005 USA Congressional NEO mandate to NASA (to find 90% NEOs larger than 140m)

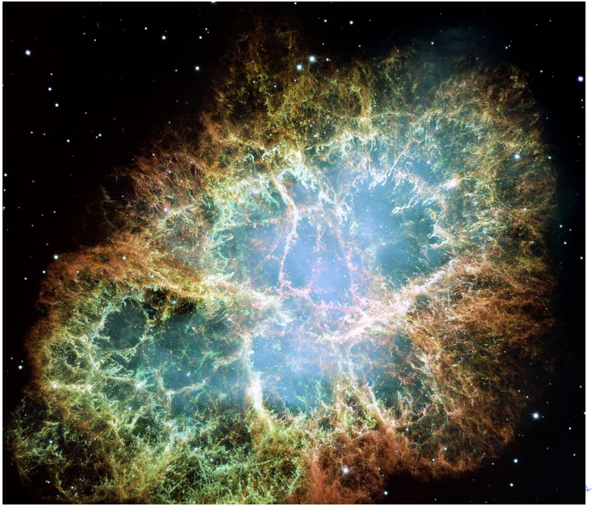


The Barringer Crater, Arizona: a 40m object 50,000 yr. ago

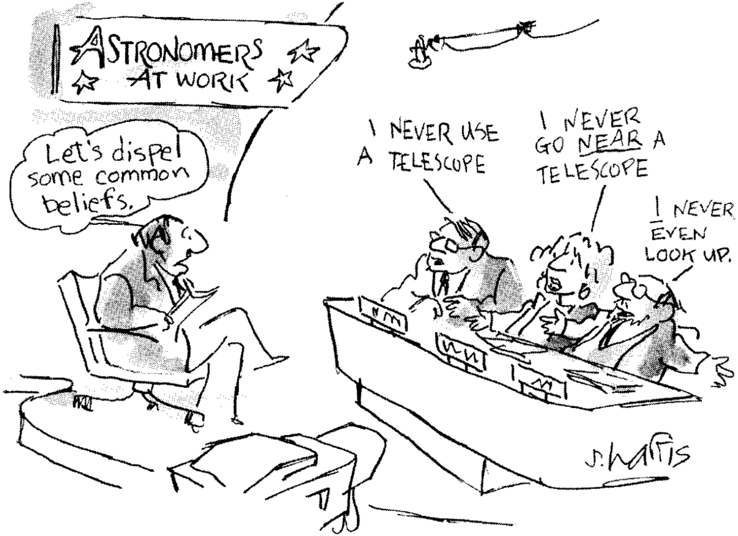
The Time Domain

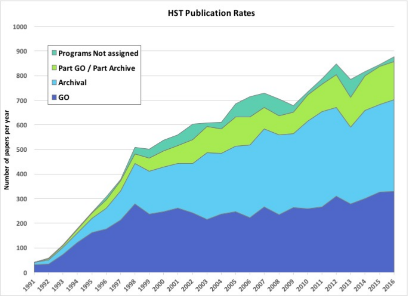
LSST scans the sky repeatedly and compares the images with templates allowing us to:

- discover new, distant transient events
- study variable objects throughout our universe
- capture rare and exotic objects
- gain new insight into known transient events:
    - new remnants of dead massive stars, including neutron star and black hole binaries;
    - variability at the heart of distant galaxies - feeding habits of the rapacious supermassive black holes at their centers;
    - catch the faint cosmological explosions



The Era Of Surveys





https://archive.stsci.edu/hst/bibliography/pubstat.html

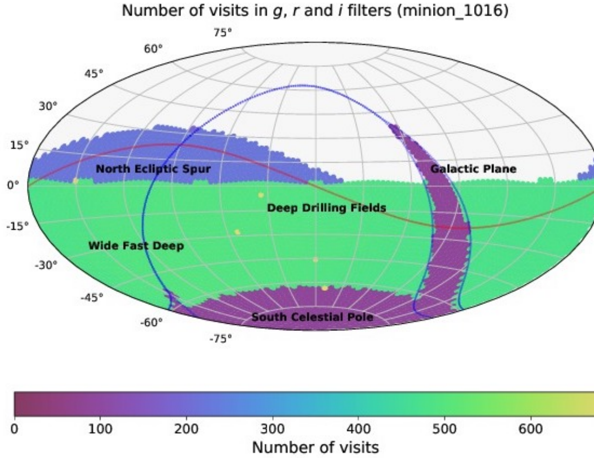
…indicates archival research probably play an important role in the scientific success of XMM-Newton?

LSST:uniform sky survey

An optical/near-IR survey of half the sky in ugrizy bands to r 27.5 (36 nJy) based on 825 visits over a 10-year period: *deep wide fast*.

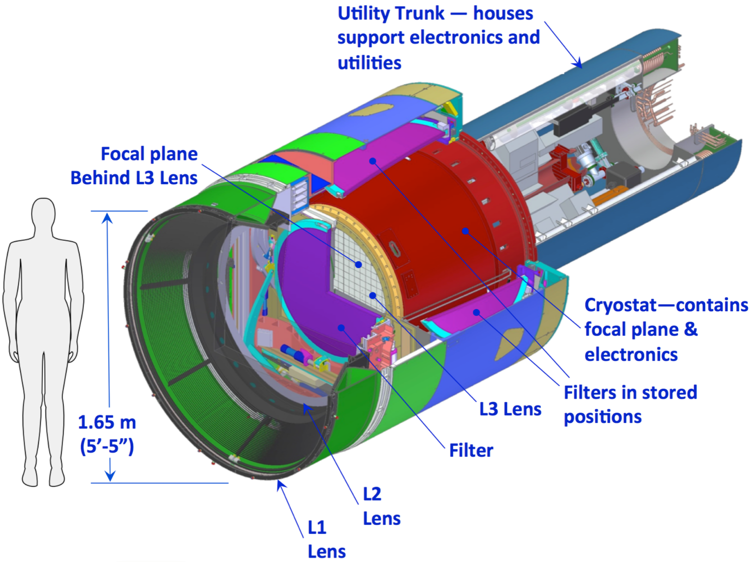
- 90% of time spent on uniform survey: every 3-4 nights, the whole observable sky scanned twice per night
- 100 PB of data: about a billion 16 Mpix images, enabling measurements for 40 billion objects!

see also `http://www.lsst.org` and Ivezic et al. (2008)-arXiv:0805.2366



10-year simulation of LSST survey: number of visits in u,g,r band (Aitoff projection of eq. coordinates)

LSST Camera



The largest astronomical camera:

- 2800 kg
- 3.2 Gpix

Data management

DM Mission :
Stand up operable, maintainable, quality services to deliver high-quality LSST data products for science, all on time and within reasonable cost.

LSST DM development is distributed across the Americas.
Plus we have partners like IN2P3

SDSS image

Nice colours Lupton et al. (2004)
$\approx 3.5'$

Image Robert Lupton

Hyper Suprime Cam (HSC) on Subaru

HSC image (COSMOS) from g,r(1.5 hrs) ,i(3 hrs) PSF matched co-add (≈ 27.5)

Processed with *LSST Stack*

`https://pipelines.lsst.io/`

Image HSC collaboration, Robert Lupton

The END

Questions?

Blast 20 Cerro Pachón April 2011.

Gaia blast off on Soyuz December 2013

http://www.lsst.org http://community.lsst.org http://www.cosmos.esa.int/web/gaia

Acronyms I

Acronym	Description
AURA	Association of Universities for Research in Astronomy
DM	Data Management
LSST	Large Synoptic Survey Telescope
NASA	National Aeronautics and Space Administration
NEO	Near-Earth Object

References

Ivezic, Z., et al., 2008, ArXiv e-prints, ADS Link

Lupton, R., Blanton, M.R., Fekete, G., et al., 2004, PASP, 116, 133, ADS Link