

Simulations

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<http://swift.dur.ac.uk>

DiRAC

<https://diarac.ac.uk>

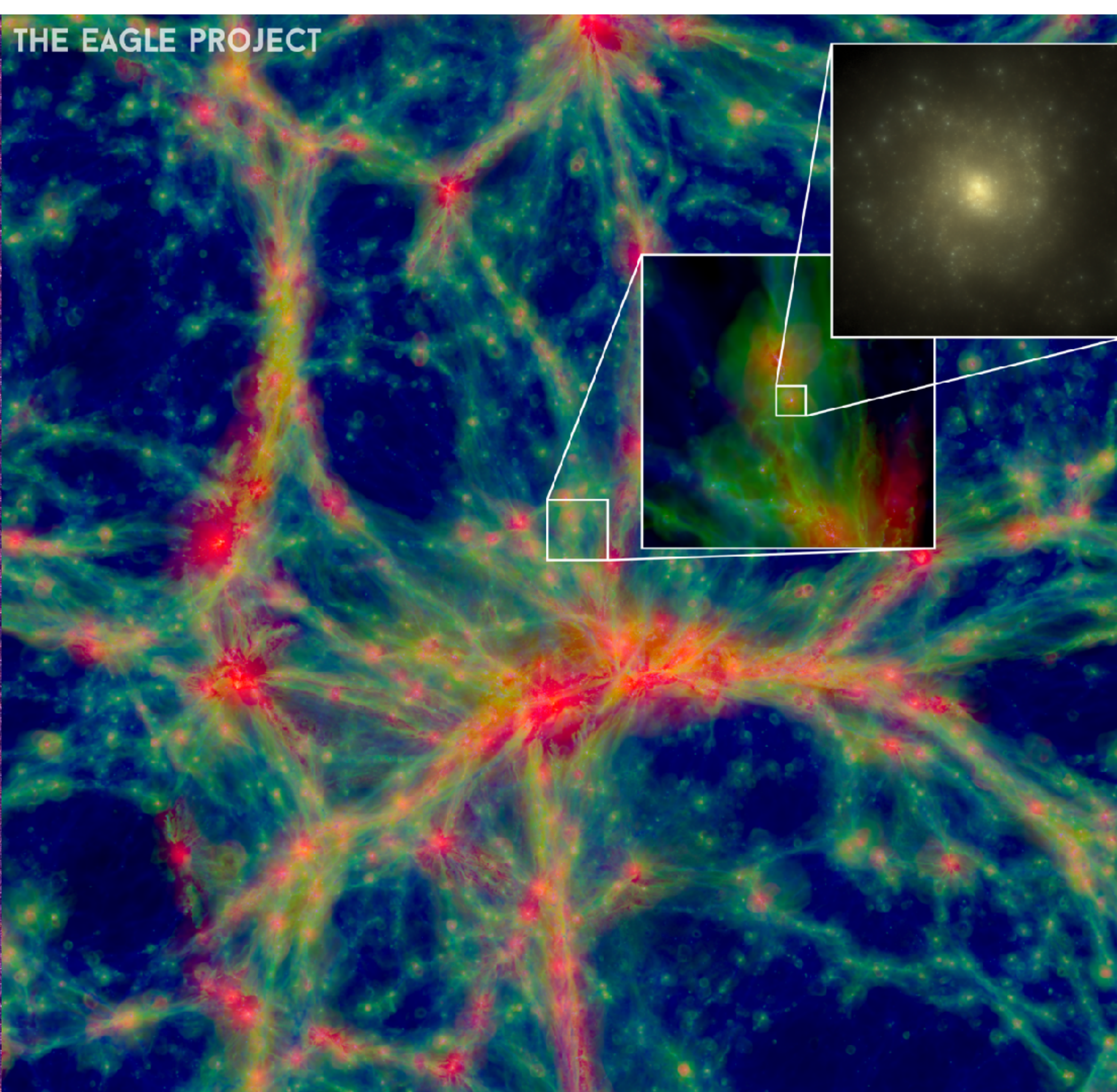
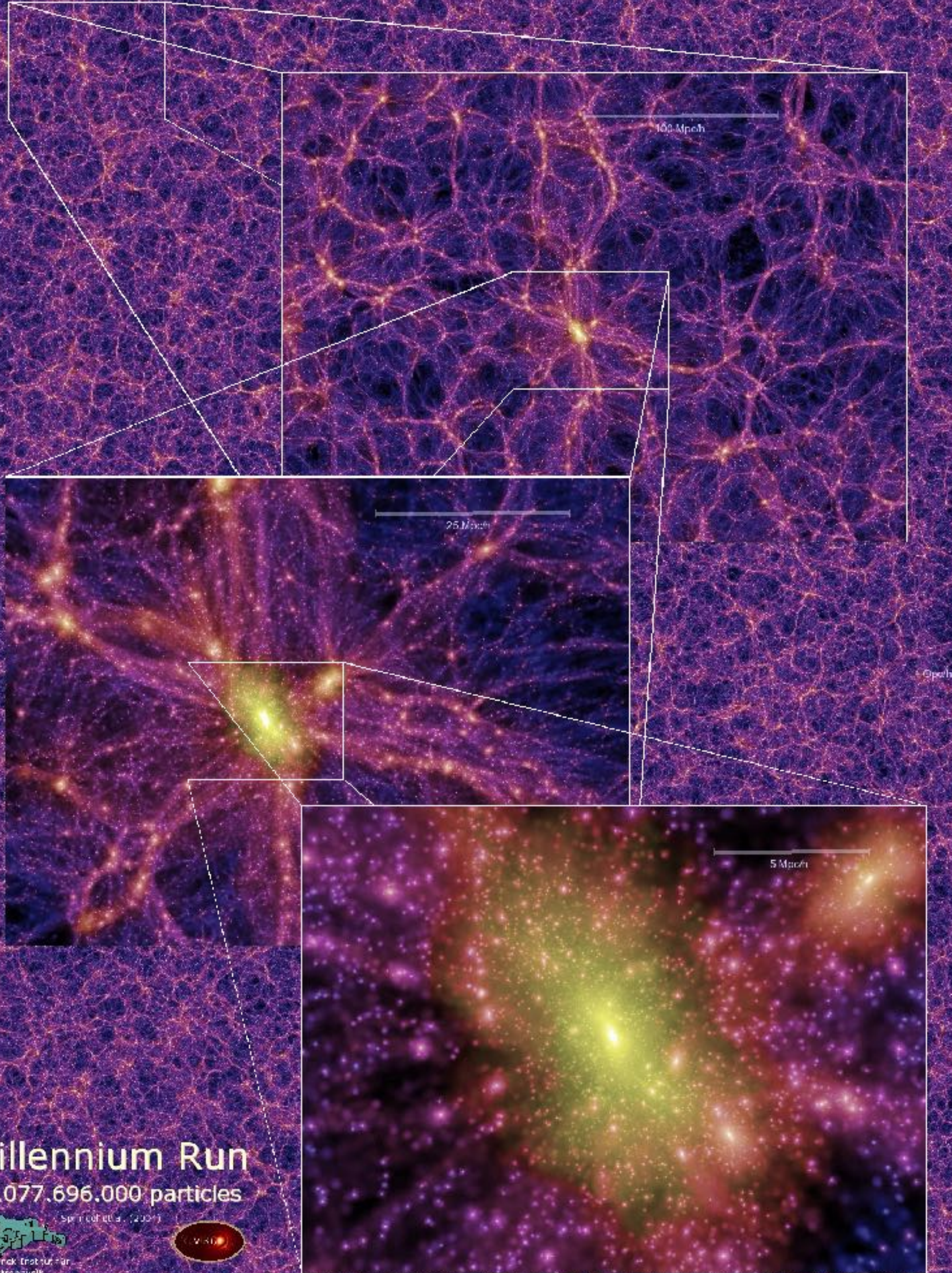
Simulations at the ICC

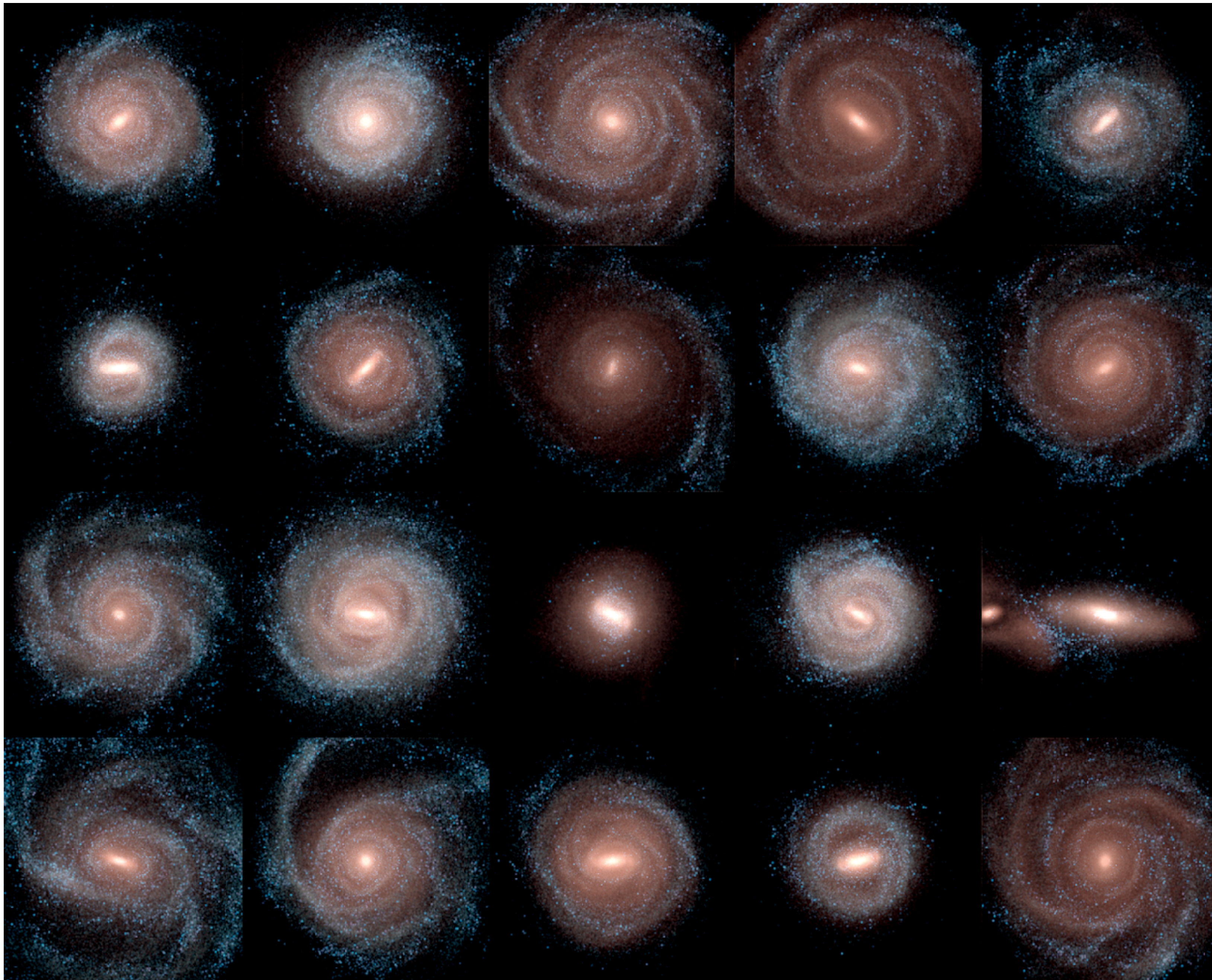


17 academic staff members - 7 joint with Centre for Extragalactic astronomy

- Simulations of cosmological structure formation
- What are dark matter and dark energy? - how do galaxies form and evolve?
- Analysis of cosmological simulations
- Simulations used to develop methods for analysing observational data
- Planet simulations - using the SWIFT code (Eke, Massey)

THE EAGLE PROJECT





Auriga project:
Grand et al 2017



SWIFT code

Example of collaborative project within Durham - ICC and Computer Science

- SWIFT is an open source hydrodynamics and gravity code for astrophysics and cosmology
- Designed around modern computer architectures - fine-grained task parallelisation
- Now running large cosmological hydrodynamical simulations with SWIFT - but also used in modelling planet-planet collisions

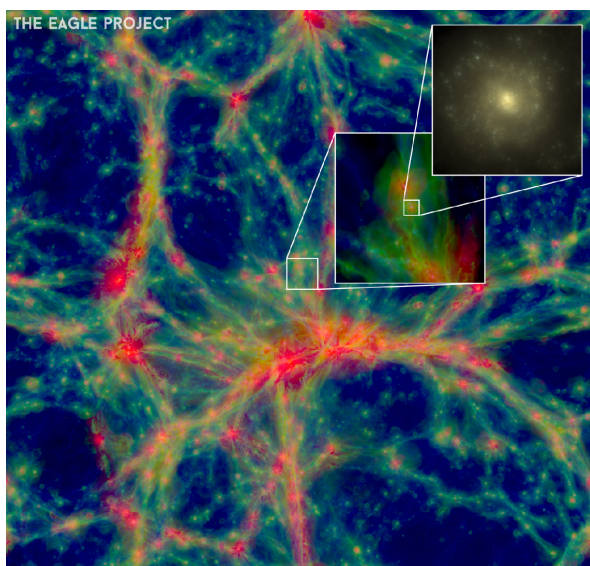
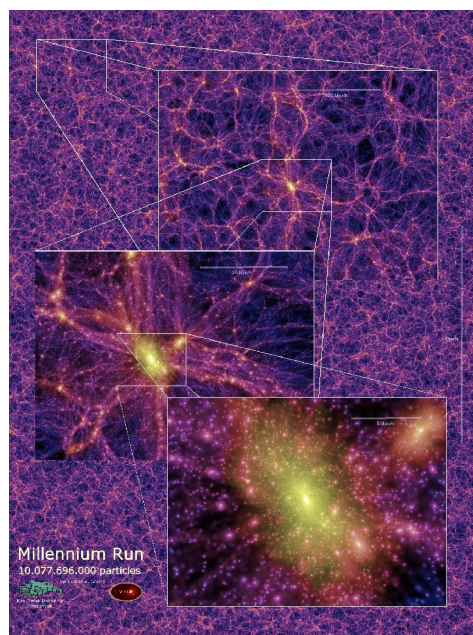


Credit: Jacob Kegerreis

Databases

Making simulation data products widely available

- Millennium simulation (2005) - built galaxy model data products on top of the N-body simulation data. Data publicly accessible via SQL server
- Eagle simulation (2015) - hydrodynamical simulations of galaxy formation - galaxy properties made accessible via SQL interface



Virgo - Millennium Database

Documentation





CREDITS/Acknowledgments

Registration

News

Databases

✚ millimil (context)



Streaming queries return unlimited number of rows in CSV format and are cancelled after 30 seconds.
Browser queries return maximum of 1000 rows in HTML format and are cancelled after 30 seconds.

There is a [partial mirror](http://gavo.mpa-garching.mpg.de/Millennium/) of this database in Munich at <http://gavo.mpa-garching.mpg.de/Millennium/>.
The Munich database does not contain all the latest GALFORM models but does contain more recent L-Galaxies models.

```
select zmax, avg(g5) as g5, stdev(g5) as g5err,
       avg(g10) as g10, stdev(g10) as g10err,
       count(*) as num
from millimil..mmfield f,
     ( select des.haloId, des.np, des.phkey, max(PROG.redshift) as zmax
       from millimil..MPAHalo PROG,
           millimil..MPAHalo DES
       where DES.snapnum = 63
           and PROG.haloId between DES.haloId and DES.lastprogenitorId
           and prog.np >= des.np/2
           and des.np between 100 and 200
           and des.haloId = des.firsthaloinfofgroupid
       group by des.haloId, des.np ,des.phkey
     ) t
where t.phkey = f.phkey
   and f.snapnum=63
group by zmax
```

Maximum number of rows to return to the query form:

Demo queries: click a button and the query will show in the query window.
Holding the mouse over the button will give a short explanation of the goal of the query. These queries are also available on [this page](#).

Mainly Halos:

Mainly Galaxies:



DiRAC national facility

STFC HPC national facility supporting theoretical research in astronomy, cosmology, particle physics and nuclear physics.

- 5 sites in the UK: Cambridge, **Durham**, Edinburgh, Leicester, UCL
- National facility established in 2012. - DiRAC-2
- Since October 2021 - DiRAC-3 facility: Durham hosts the MI (memory intensive system)
- DiRAC-3 currently funded at 60% (£5.4m at Durham). The remaining funding includes the **Data Curation Service**

ICC manages the Durham DiRAC MI system

Newest (DiRAC-3) hardware: COSMA8 (installed 2021)

- COSMA support team: **Alastair Basden, Peter Draper**, Richard Regan, Aqeeb Hussain, Paul Walker
- Data scientists: John Helly, Fawada Qaiser
- Durham DiRAC Service Management Board - chair: Adrian Jenkins

Opportunities

- SWIFT code development - funding from ExCALIBER (UKRI)
- Database development - £120k for UK cosmological database hardware (IRIS)
- DiRAC-4 - 2024 - potential to host Memory Intensive facility at Durham. The DiRAC-4 facility will probably have a wider remit than astronomy, cosmology, particle and nuclear physics
- Pre-exascale systems - limited numbers of sites in the UK - Durham could be one of them.

Limitations

- The current Durham HPC support infrastructure is close to its limits: AHDC and LHDC.
- Some recent funding opportunities - e.g. UKRI DiRAC D-Fed project - money arrives in small chunks. Difficult to find people at short notice to do the work at Durham.

Alastair Basden

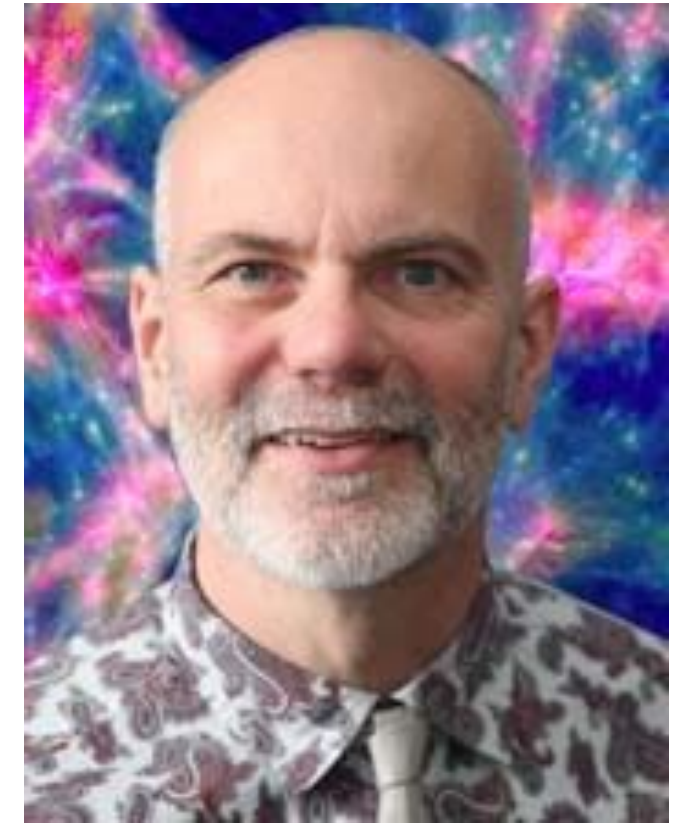


- COSMA Technical manager
- DiRAC Technical directorate
- Host of ExCALIBUR Exascale test-bed hardware
- DiRAC Technical manager

- Manager of DINE: Durham Intelligent NIC Environment - 24-node cluster for network fabric investigation - collaboration with NVIDIA and Rockport

Richard Bower

- Institute for Computational Cosmology
- PI of ExCALIBER stage-1 grant
- co-I of ExCALIBER stage-2 grant
- Large-scale hydrodynamic simulations
- SWIFT code development - was PI of Durham Intel Parallel Computing Centre



The end

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