

# The Frontiers of computational Physics

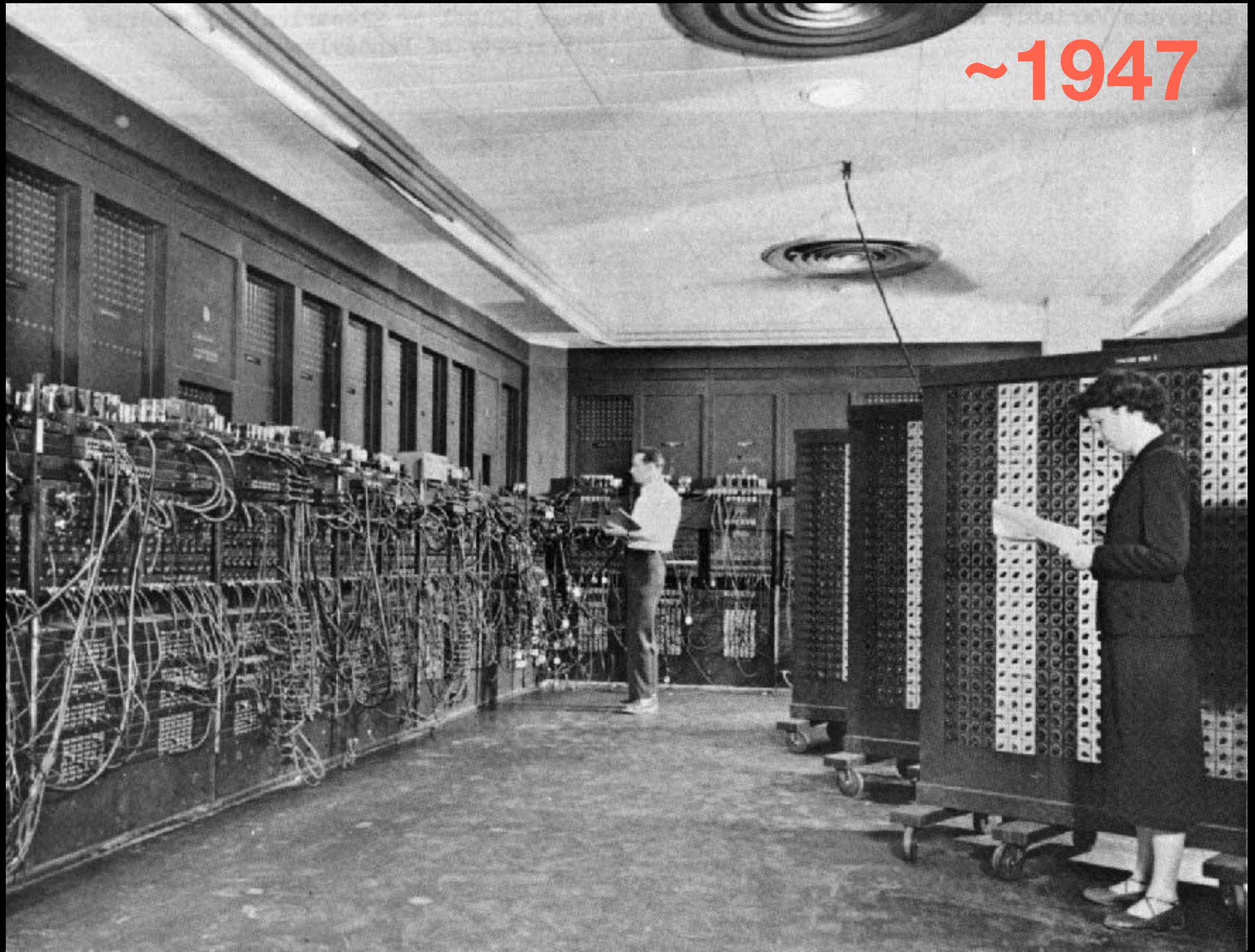
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2025-10

# Computing

From here



~1947

To here



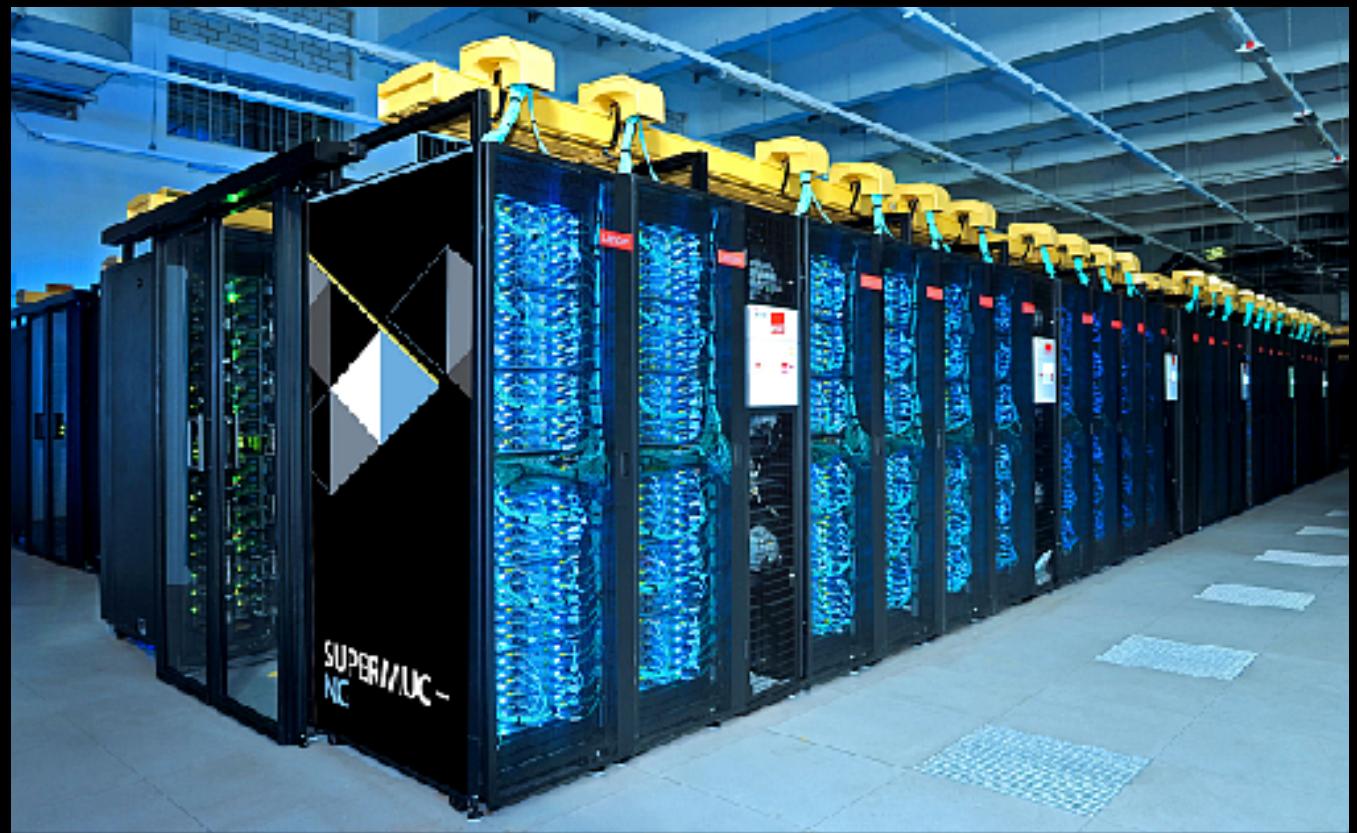
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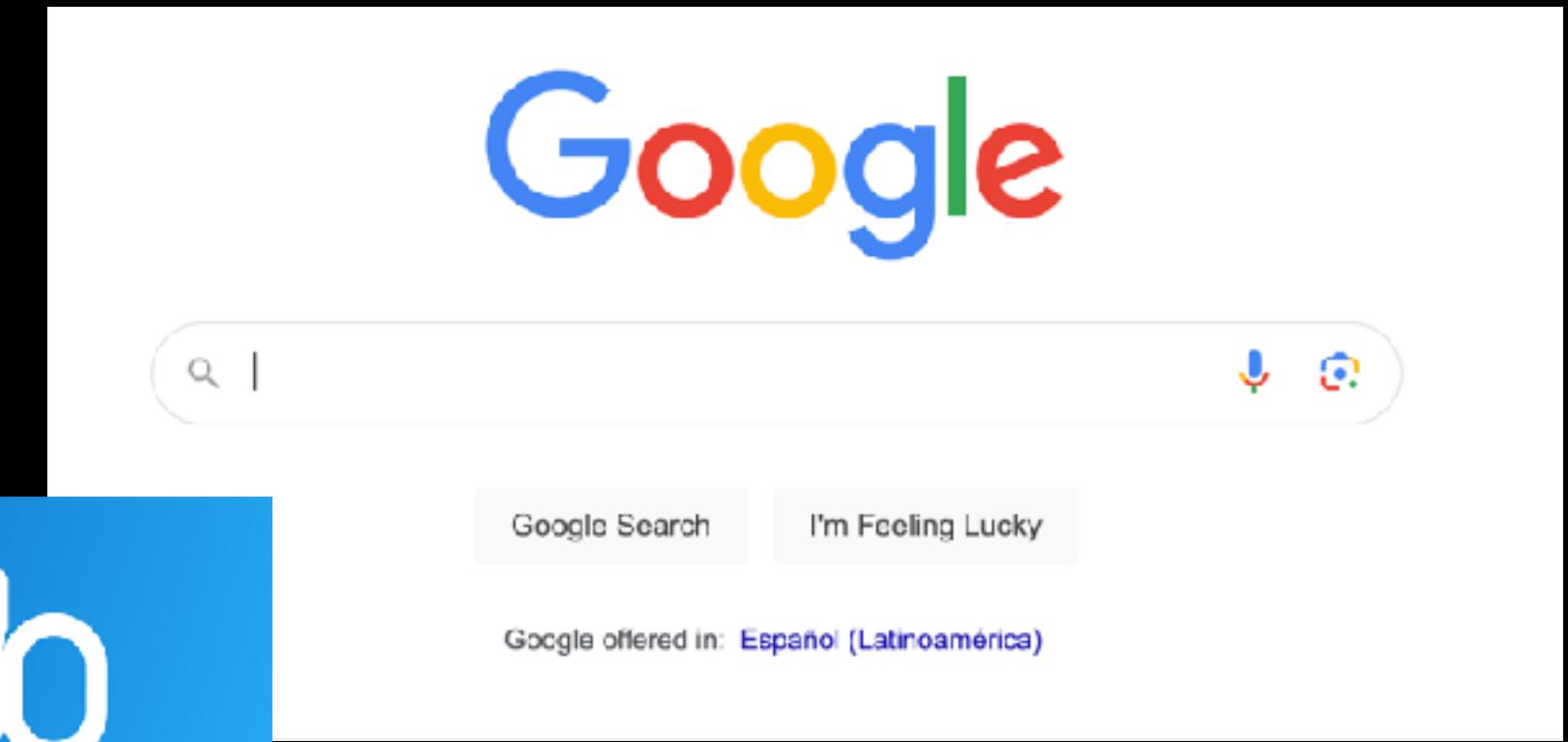
[ENIAC](#) (Electronic Numerical Integrator And Computer) in [Philadelphia, Pennsylvania](#).

# Today

## Science



## Every day life



NETFLIX



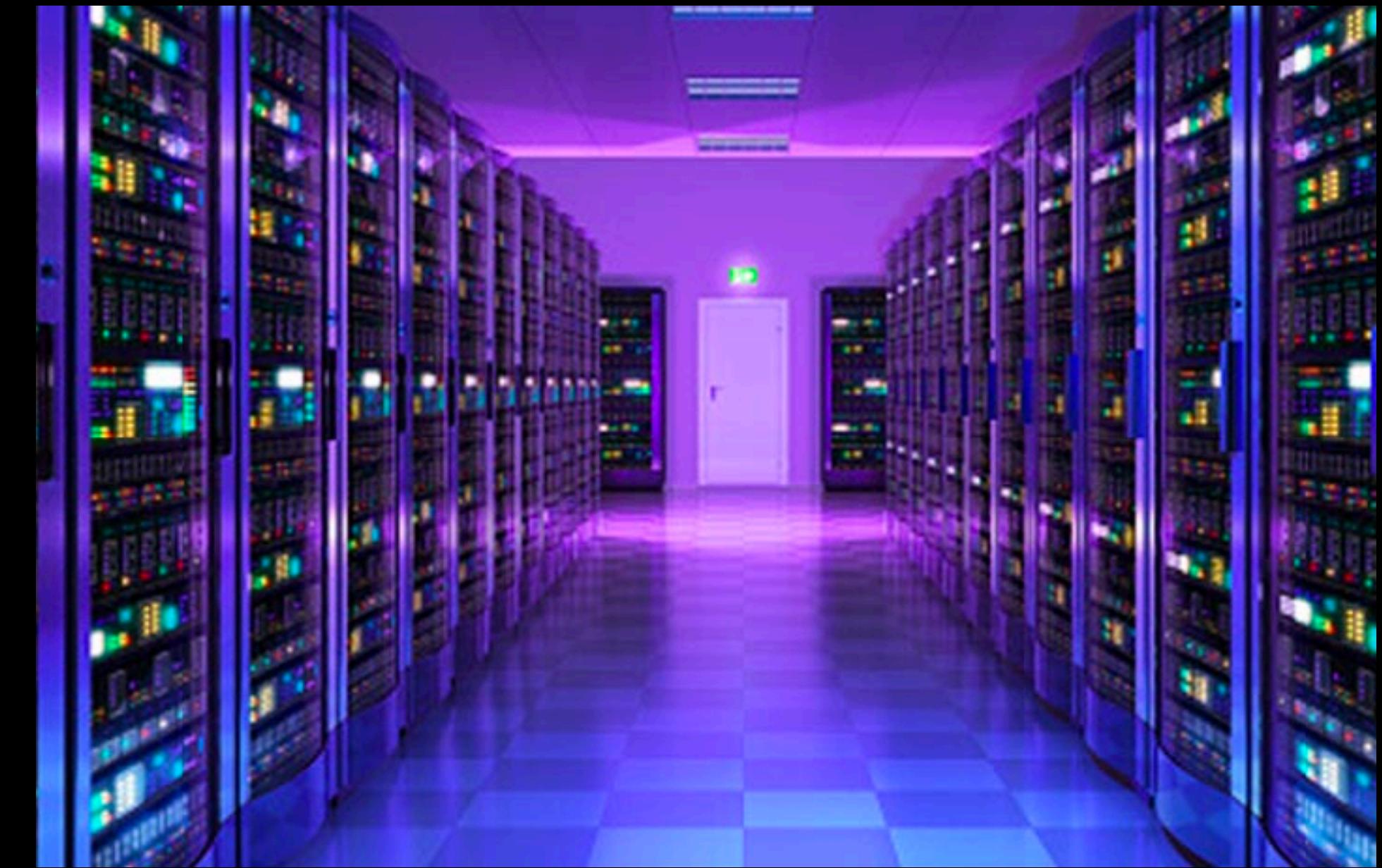
# What is computational physics ?

# Computational physics

Instrumentation  
Telescopes, detectors



Computation  
(PCs, cluster computers, etc.)



Software tools  
(Programming languages, computers)



Supercomputing  
(Thousands of processors, parallel code, high performance)



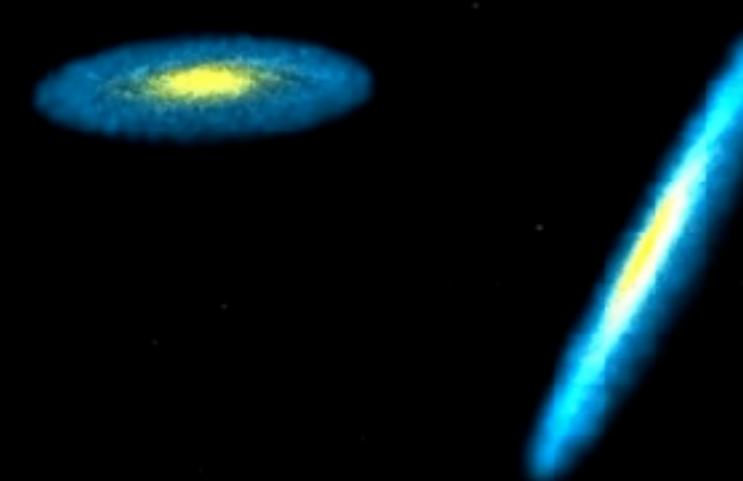
# Computational physics - theory

Observations motivating simulations

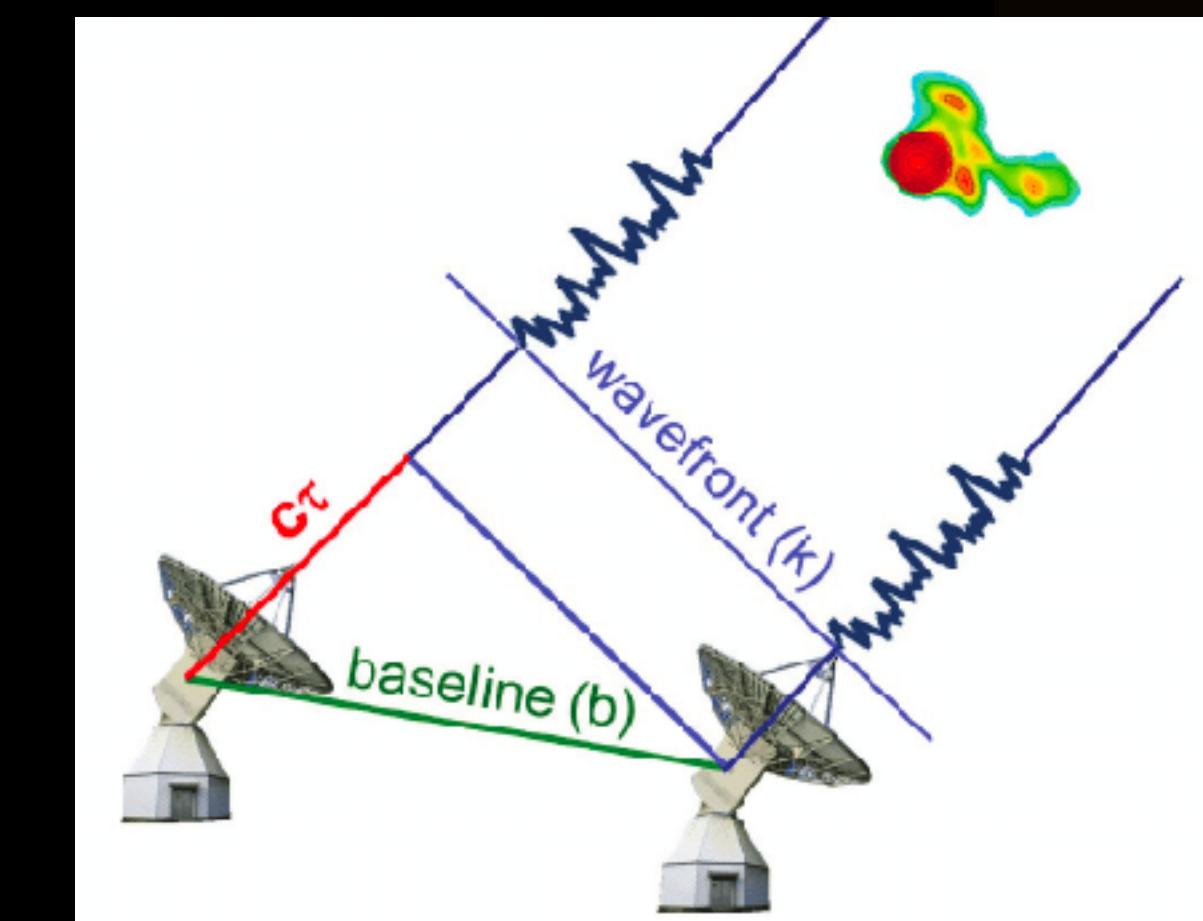
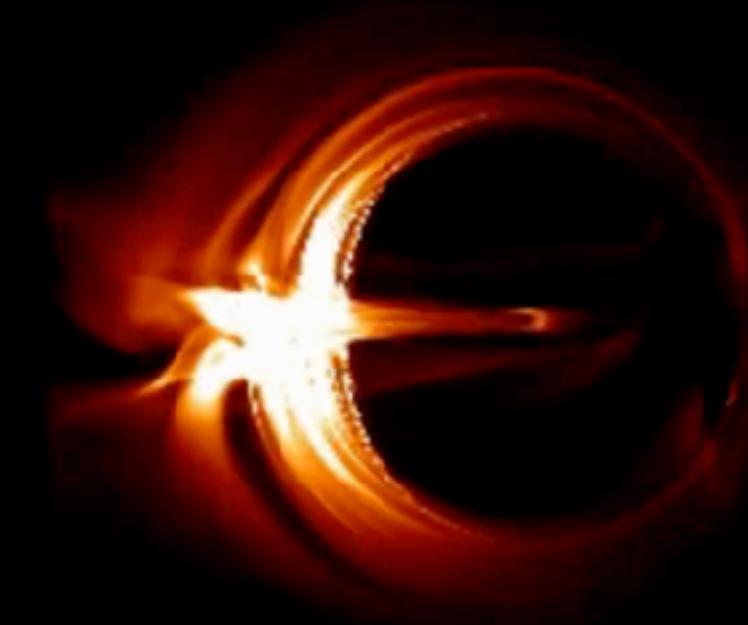


Butterfly galaxy, Gemini Observatory

Merging galaxies

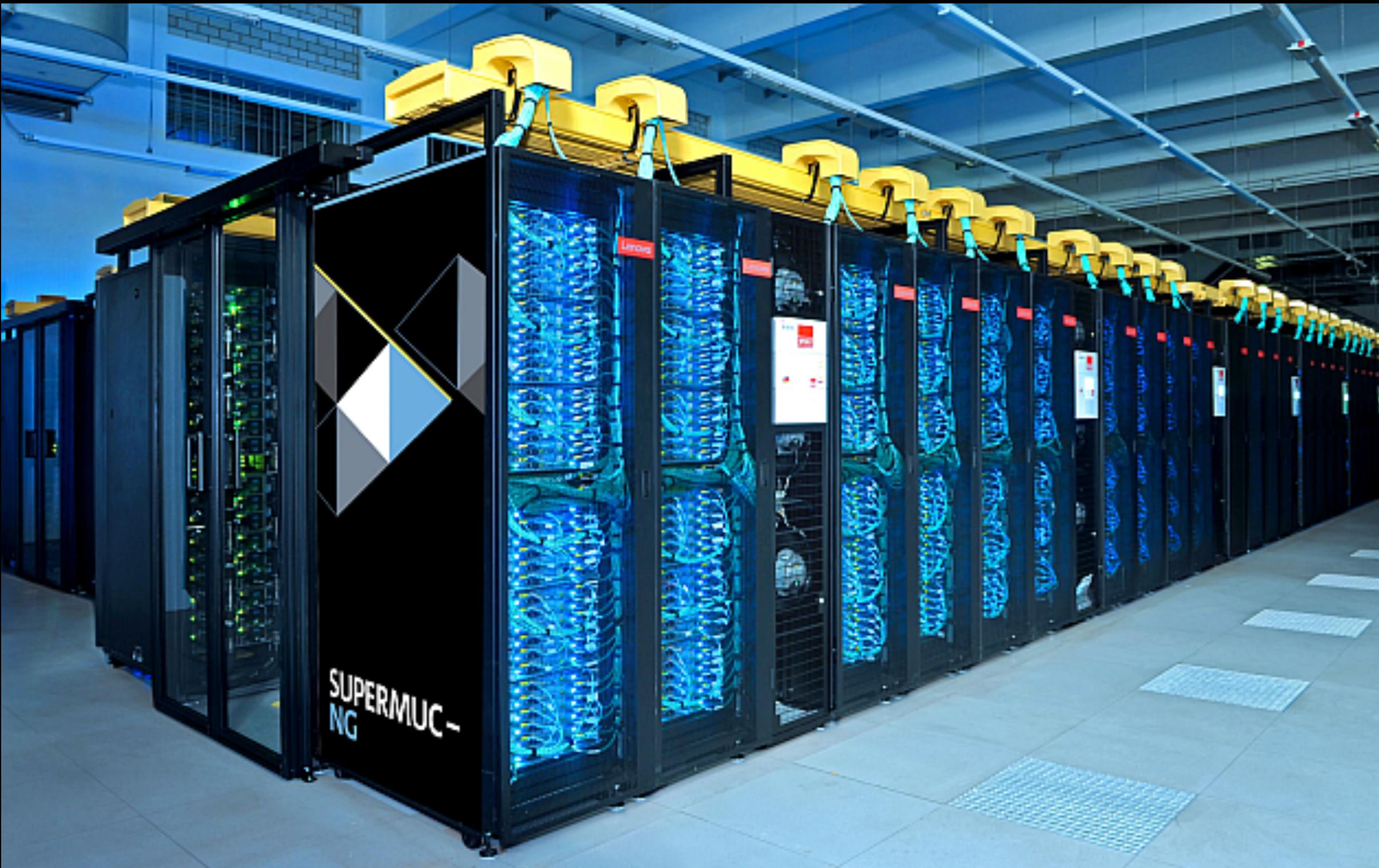


Simulations motivating observations



# Supercomputers - Theoretical physics

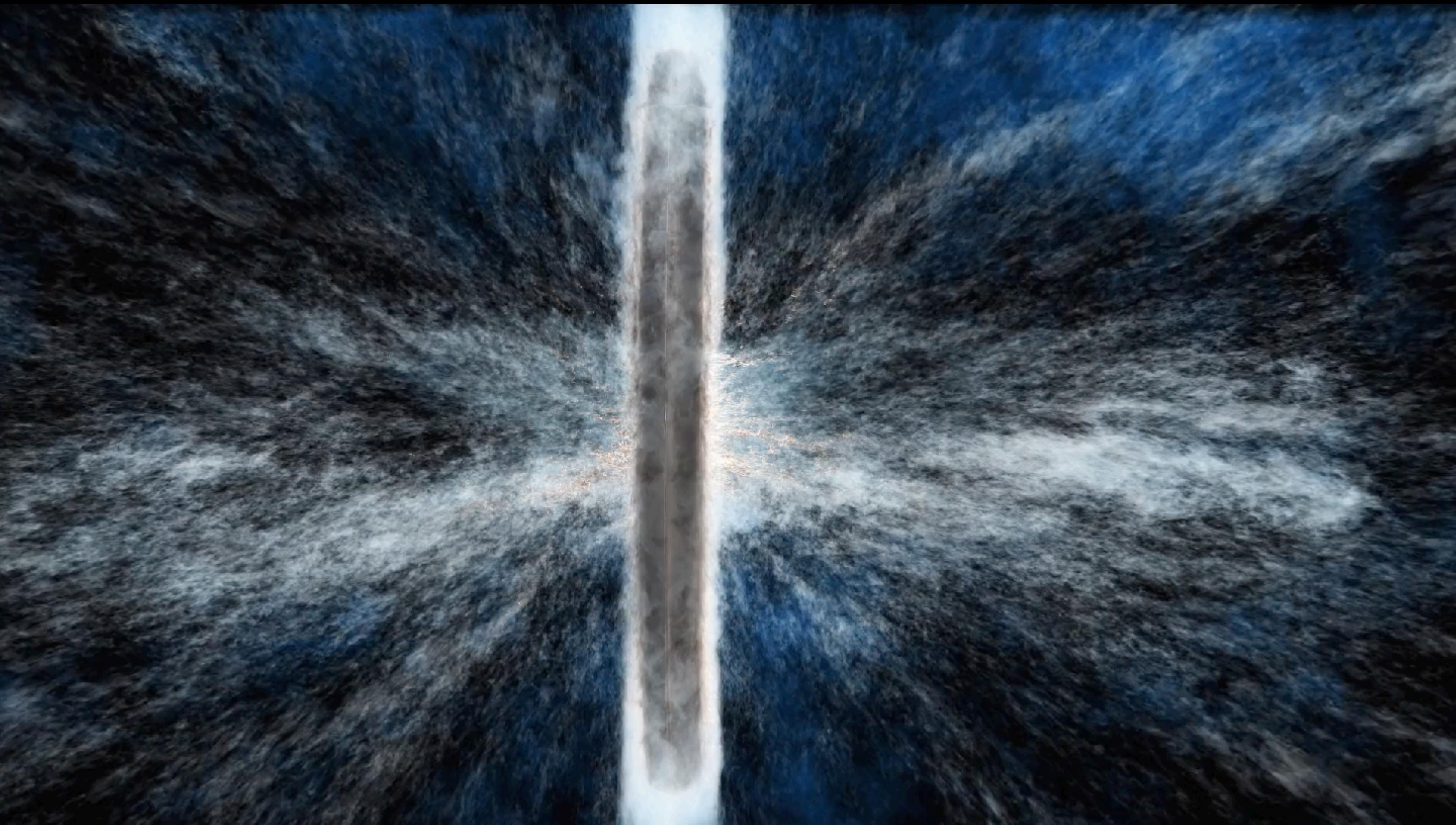
SuperMUC in Germany  
Powering computer simulations of scientists  
and industry



Pawsey Centre in Australia  
Powering some of the largest radio  
telescopes in the world

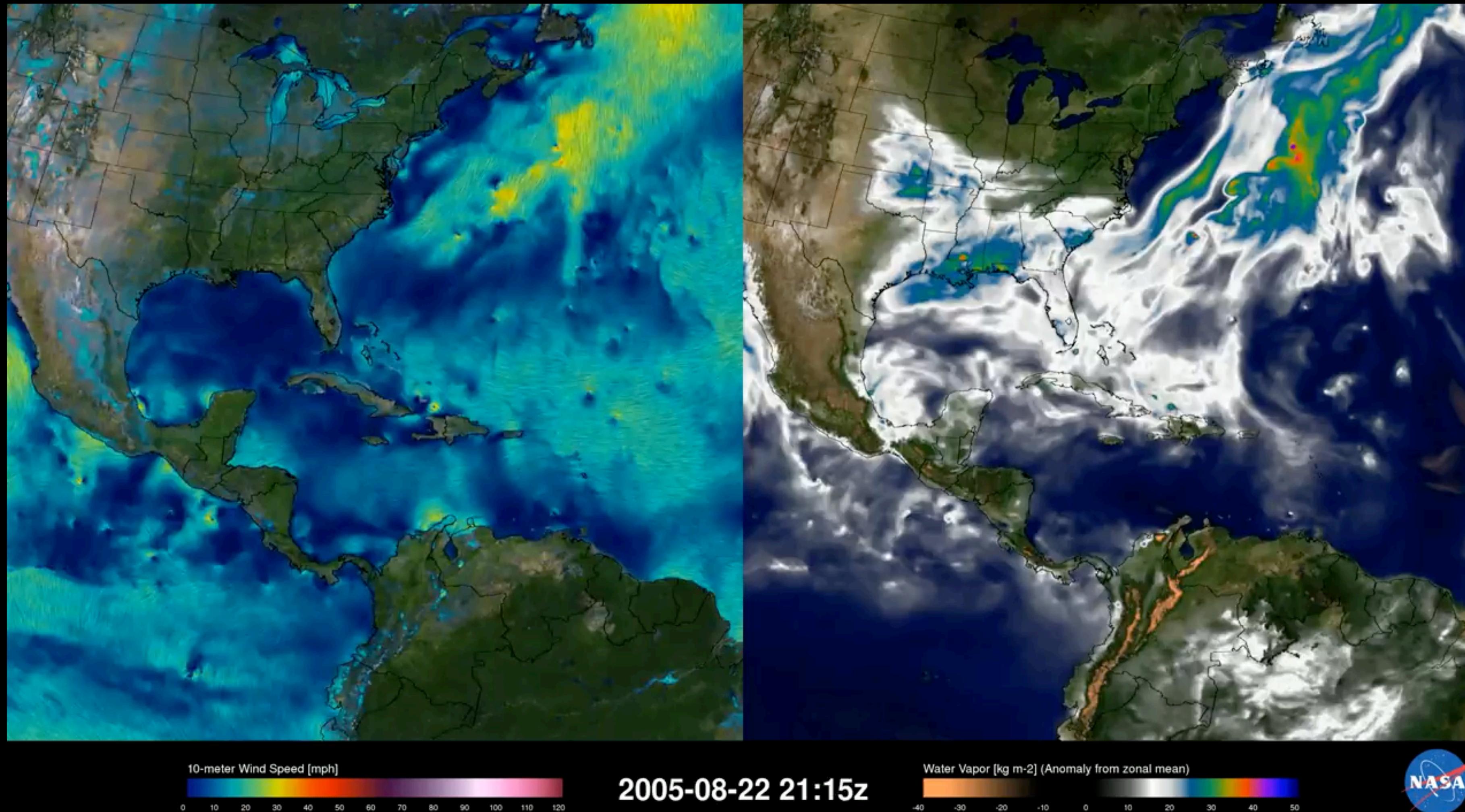
# Large scale structure

# Outflows In galaxies



# GEOS-5 Simulation of Hurricane Katrina

## Weather modelling



High resolution weather and climate simulations generate peta-byte scale data.

<https://www.youtube.com/watch?v=p-3aB9hJ8Hc>

# Supercomputers - Experimental Physics

The brain of these telescopes is a supercomputer

- + another supercomputer to process all the data from them
- + One to analyse the data that they produce

**FAST: The Five Hundred Meter Aperture Telescope  
(China)**

**The ASKP Telescope in Australia**



# Experimental Physics: Telescopes

The brain of these telescopes is a supercomputer

- + another supercomputer to process all the data from them
- + One to analyse the data that they produce



The ASKP Telescope in Australia  
The antennas

**The correlator**  
Processes and combines all the signal from the  
antennas

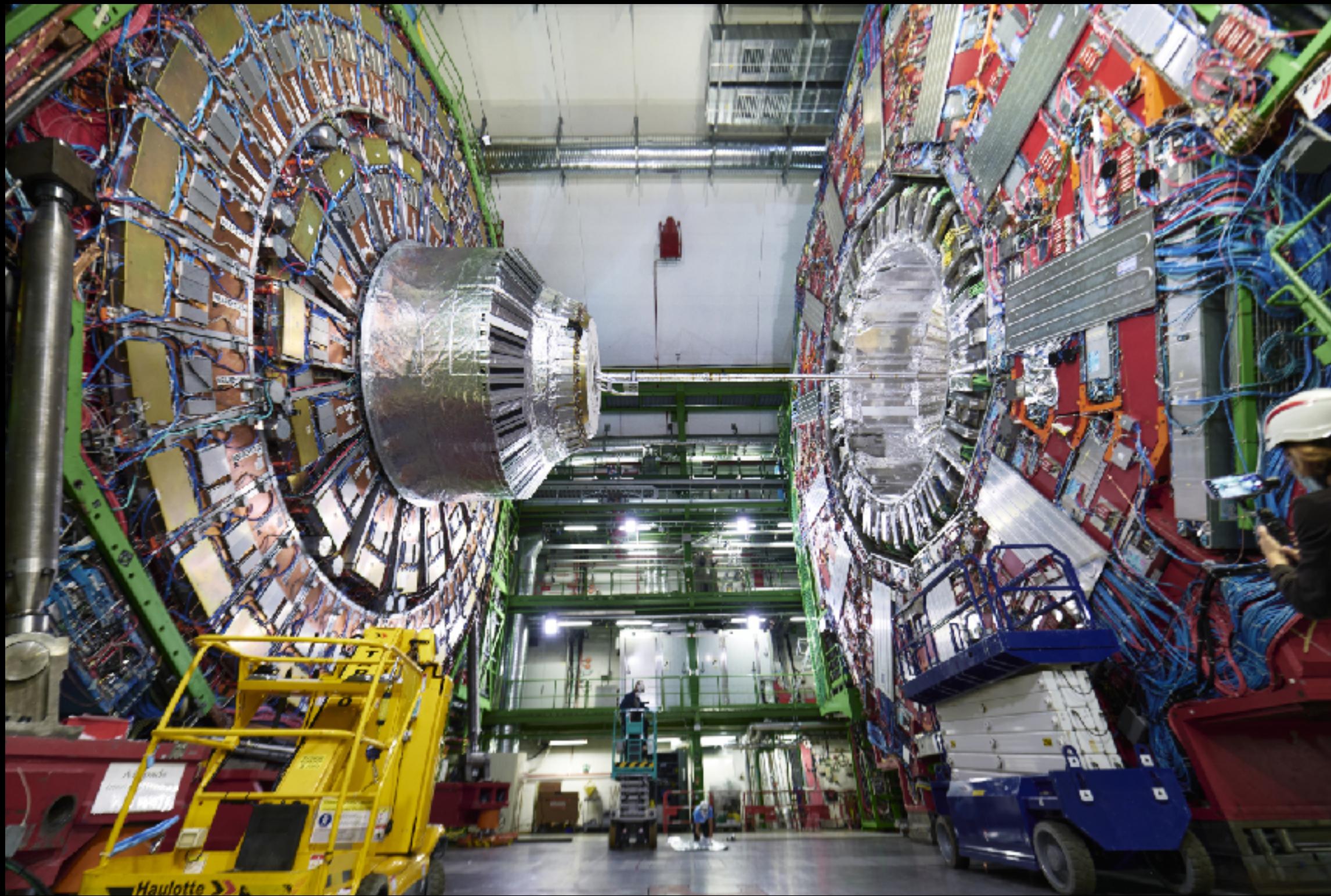


# Experimental Physics: Telescopes

The HI4PI survey of Hydrogen in the Milky Way

# Experimental Physics: Particle physics

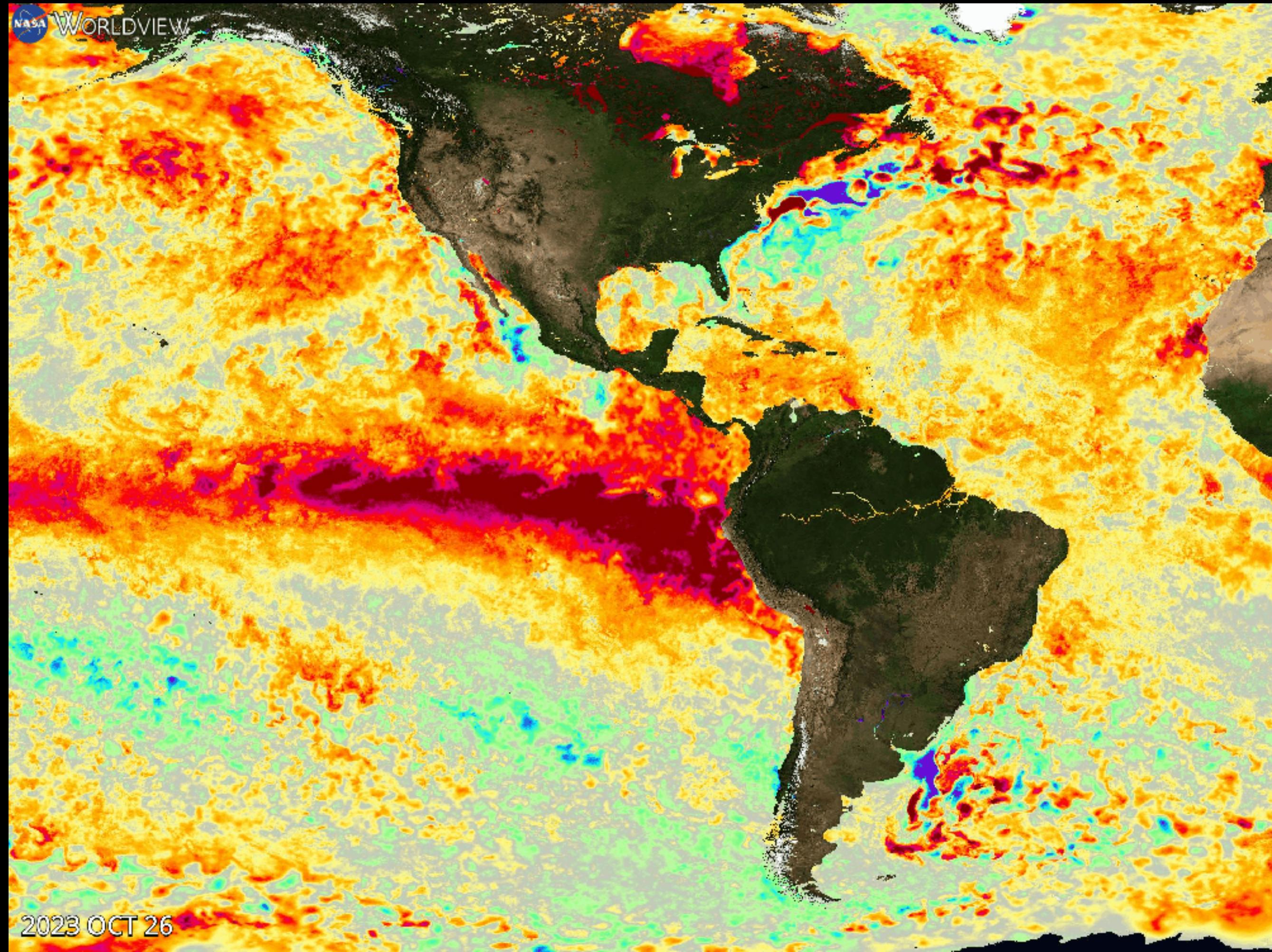
Particle physics experiments generate petabytes of data from measurements while searching for new particles.



**More than 5 petabytes** of open data are currently available from CERN's experiments, primarily from the Large Hadron Collider (LHC).

# Experimental Physics: Climate science

The current total volume of Earth observation satellite data collected annually is estimated to be over **100 petabytes (PB) per year**.



# What can you do with computational physics ?

# Why computational physics?

A good understanding of physics + mathematics + computing -> critical thinking, problem solving, good communication skills -> open many doors in:

Working in academia:

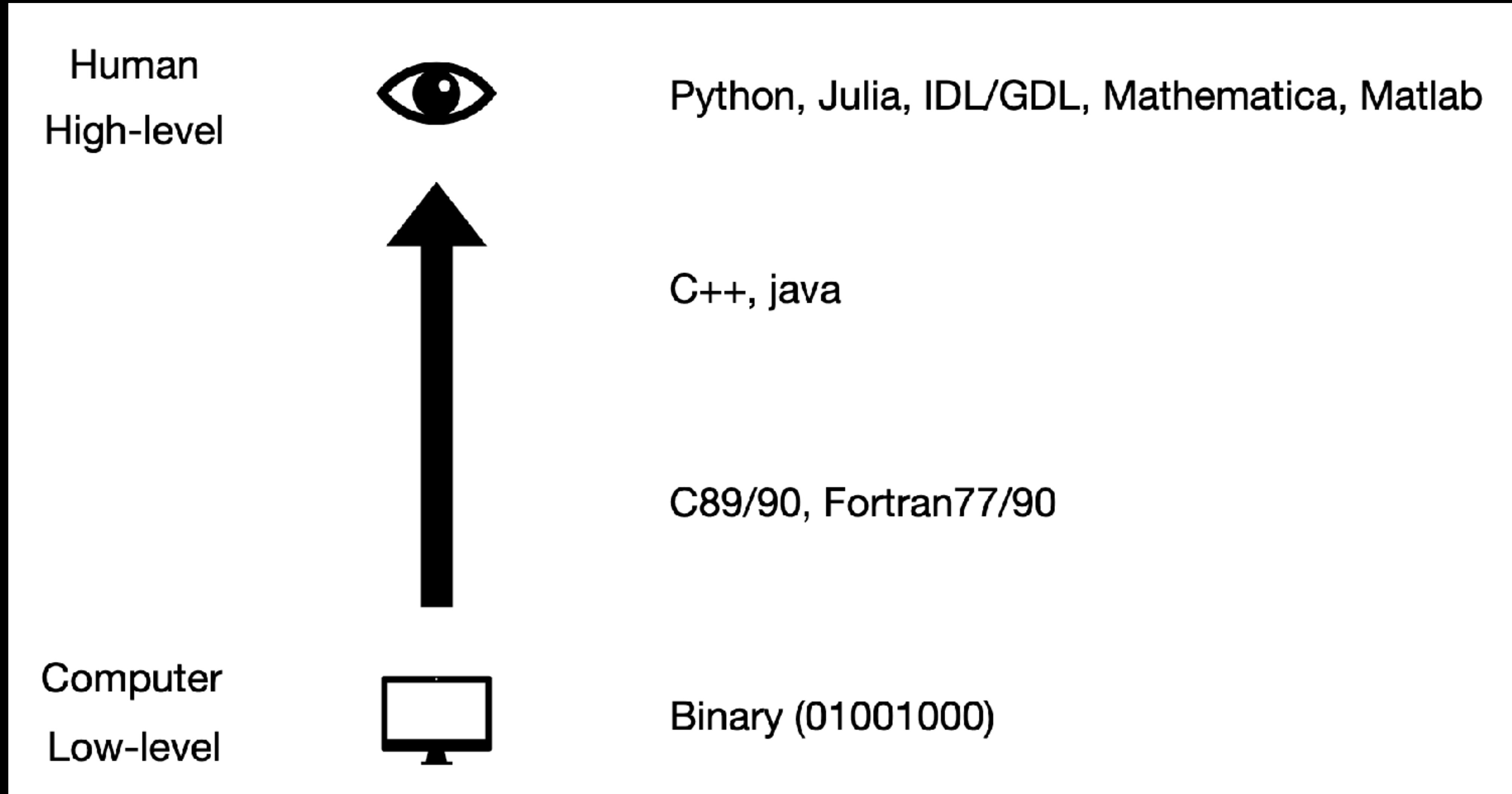
- Universities
- Research institutes

Working in industry:

- Data science
- Government
- Industry development



# High-level vs. low-level languages



# High-level vs. low-level languages

Roughly speaking, computers **can only execute programs written in low-level languages.**

Programs written in a high-level language **have to be processed** before they can run. This **extra processing takes some time**, which is a small disadvantage of high-level languages.

Low-level programs can run on only one kind of computer and **have to be rewritten to run on another.**



Thank you!