

Heavy Ions at the Large Hadron Collider: Fundamental Science at the Forefront of Technology

Paolo Parotto, Israel Portillo

College of NSM

Department of Physics

P.I. Dr. Claudia Ratti

pparotto@uh.edu

iportillovazquez@uh.edu



Research Themes

- How does matter behave at very high temperatures and densities?

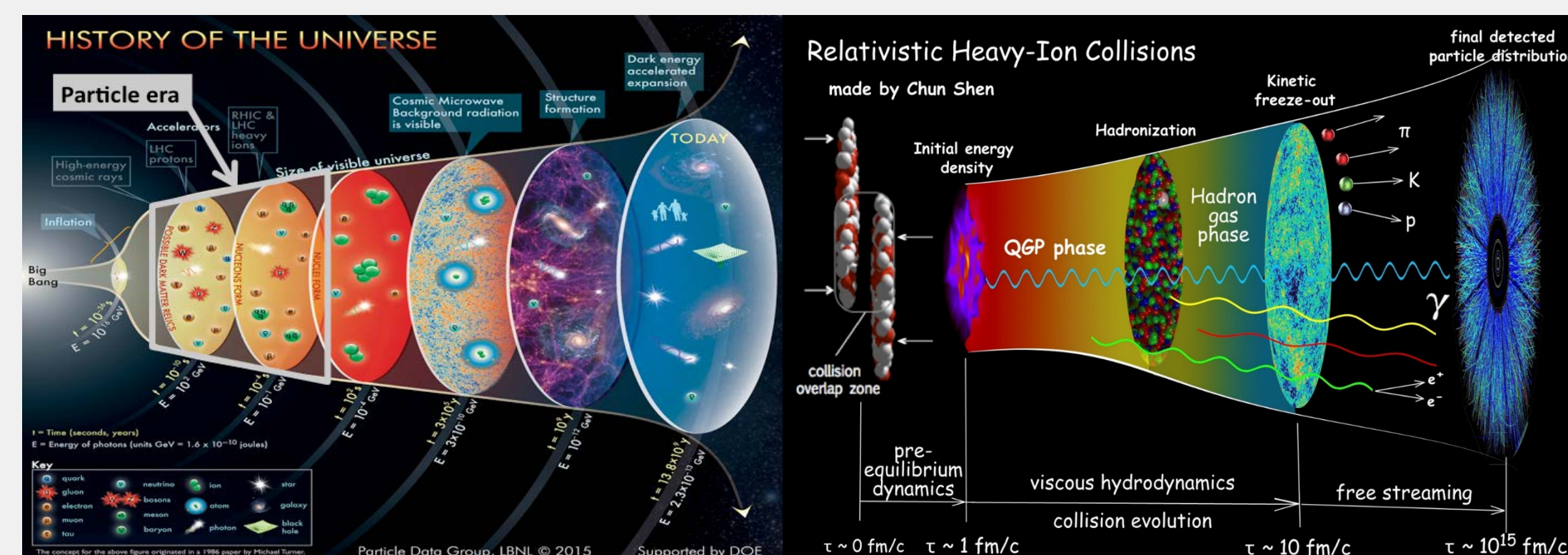
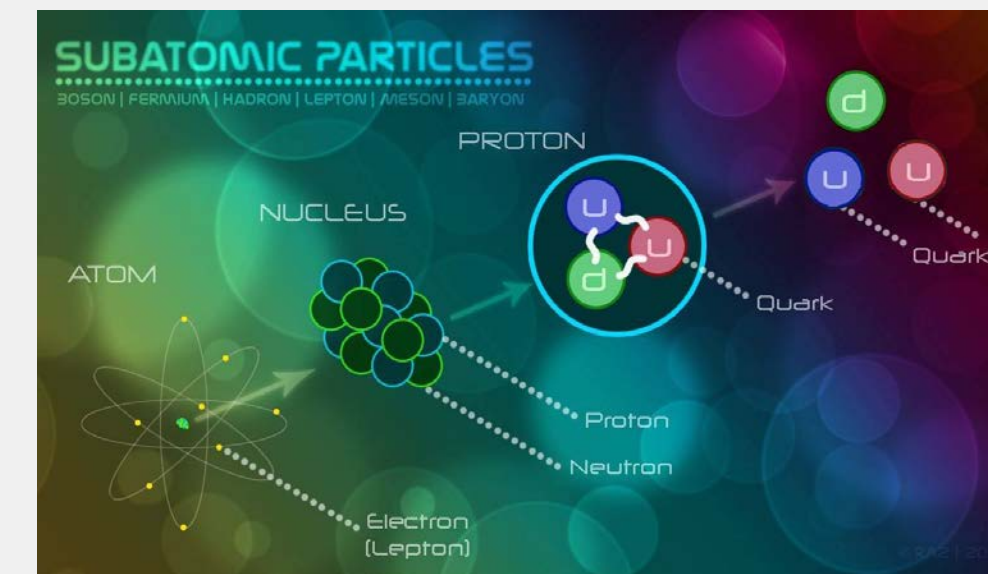
→ Atoms dissolve into a new phase of matter: the Quark Gluon Plasma (QGP).

- How did the Universe begin?

→ The QGP was present microseconds after the 'Big Bang'.

- Can we observe the QGP today?

→ The QGP can be created on Earth in particle accelerators like LHC or RHIC, and it is predicted to exist inside compact stars.



Issues

- Creation of new states of matter

→ Cutting edge instruments are needed to characterize this extremely short-lived system (10^{-23} s).

- Origin of particle masses

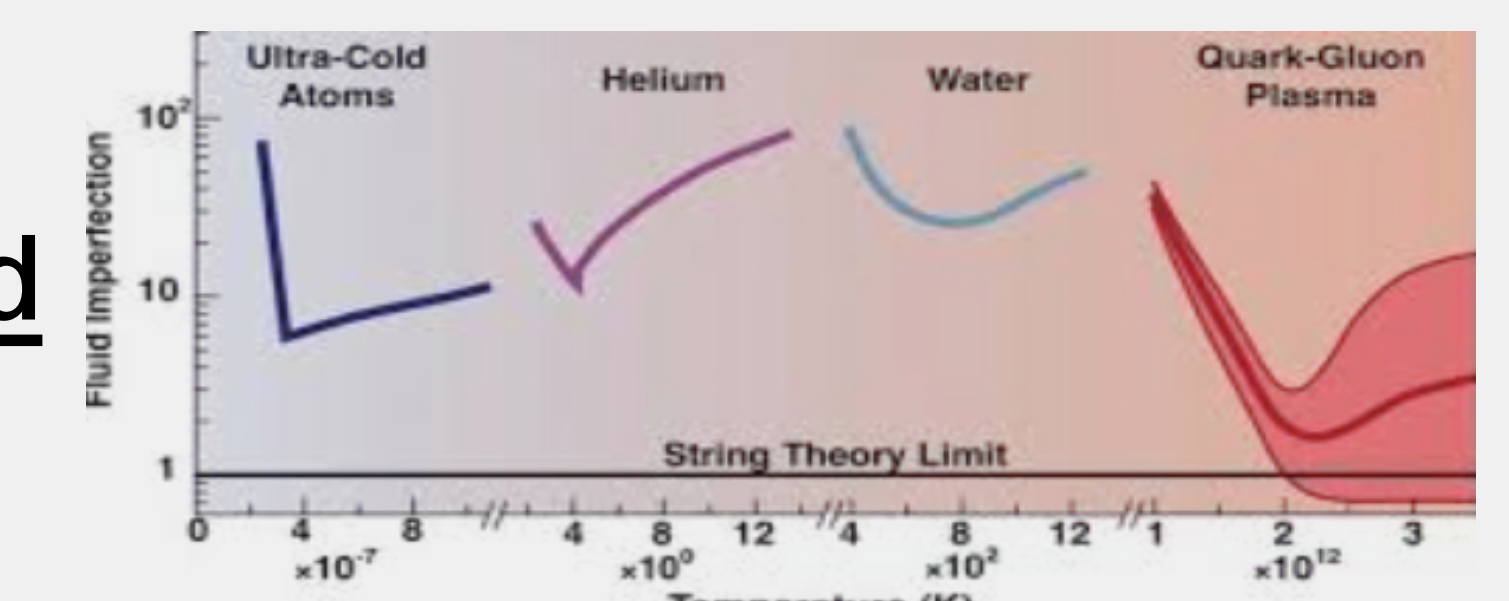
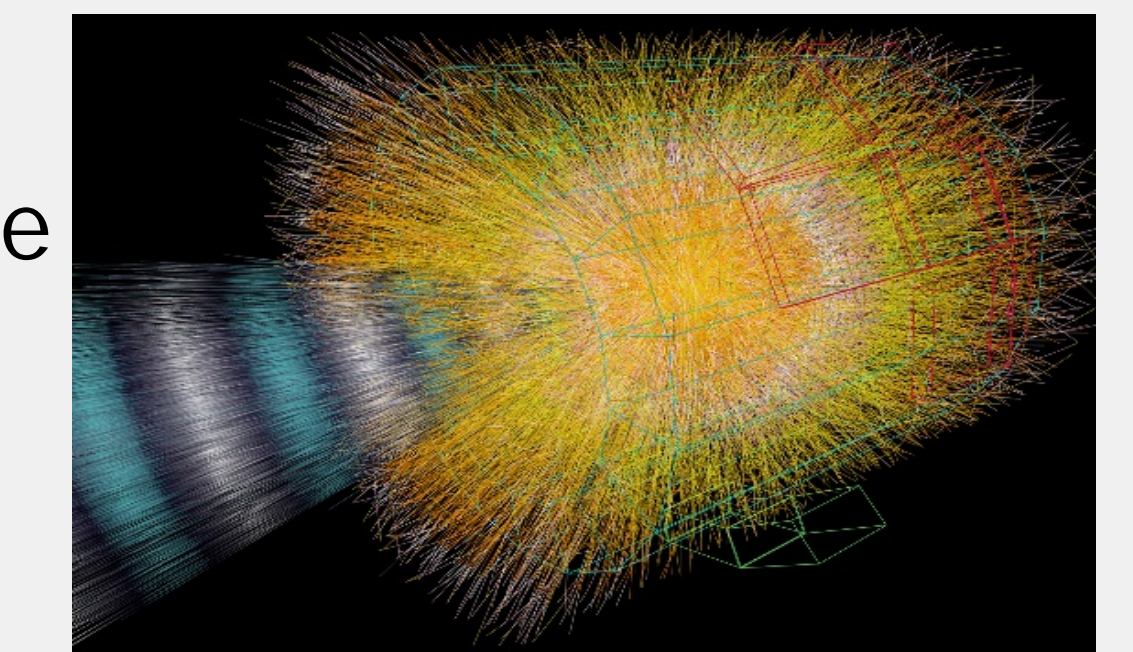
→ Synergy of experiment and theoretical calculations on the Lattice.

- A plasma that behaves like a superfluid

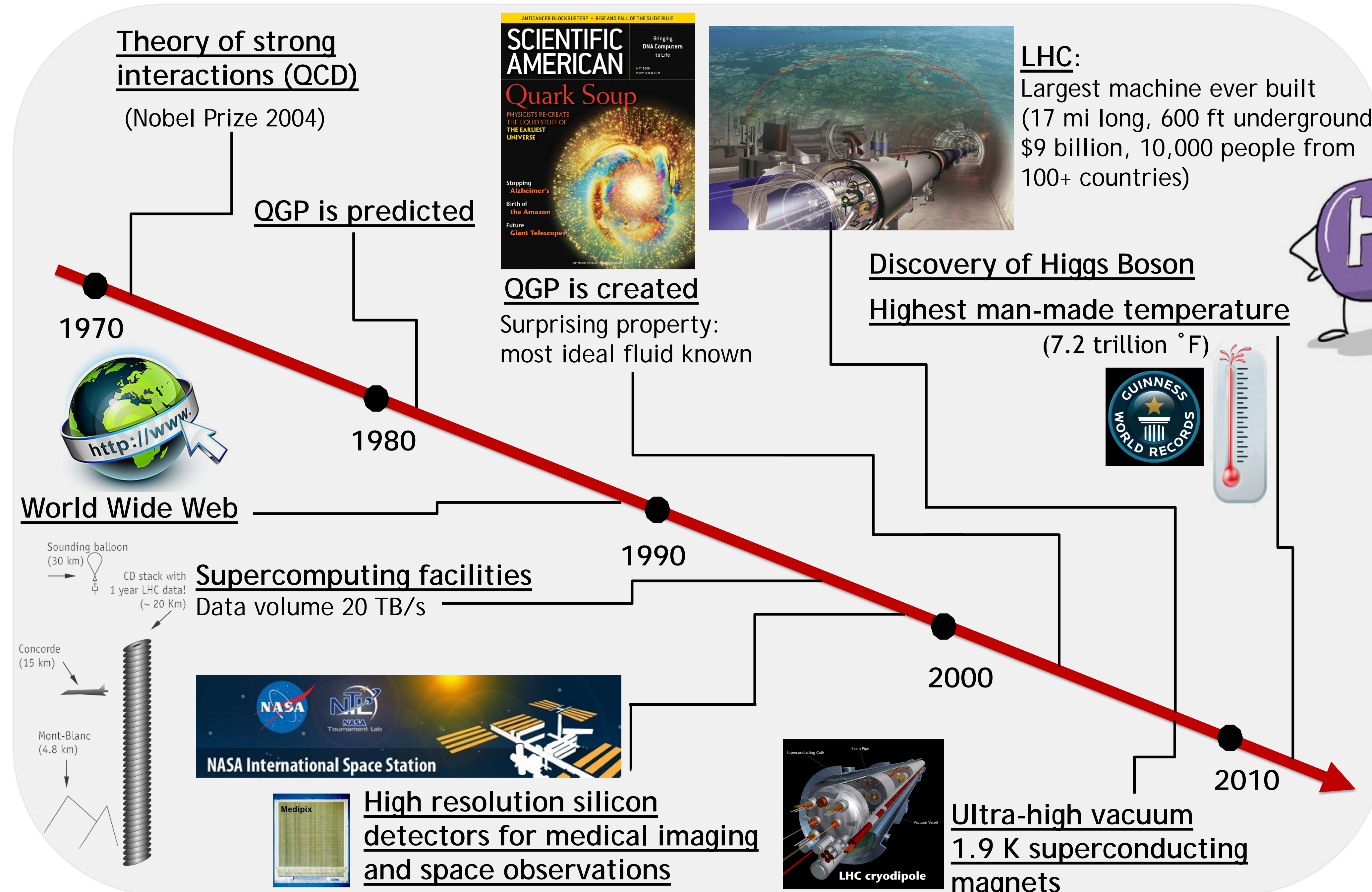
→ It is the hottest, most perfect fluid known to human kind.

- Data processing on the exa-scale:

→ Computer simulations run on three of the five largest supercomputers in the world.

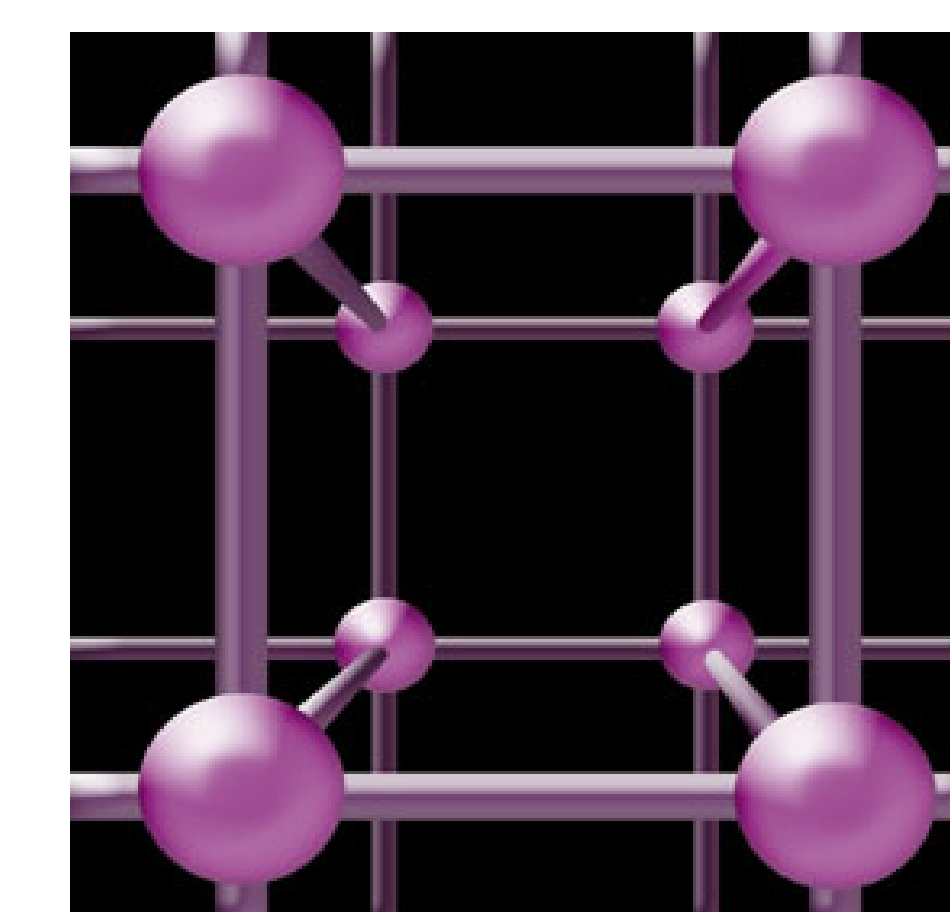


Accomplishments/Value

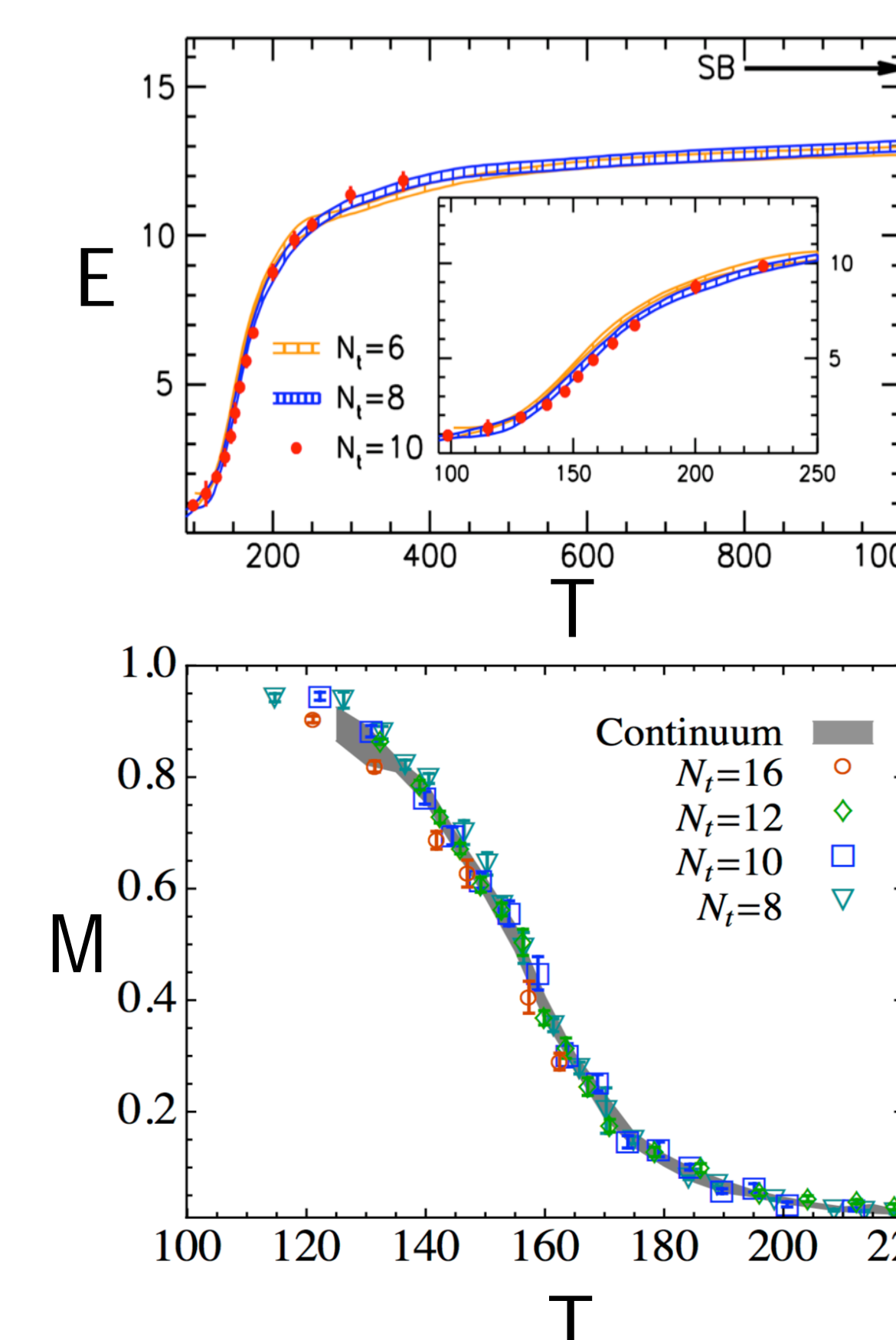


Lattice QCD calculations

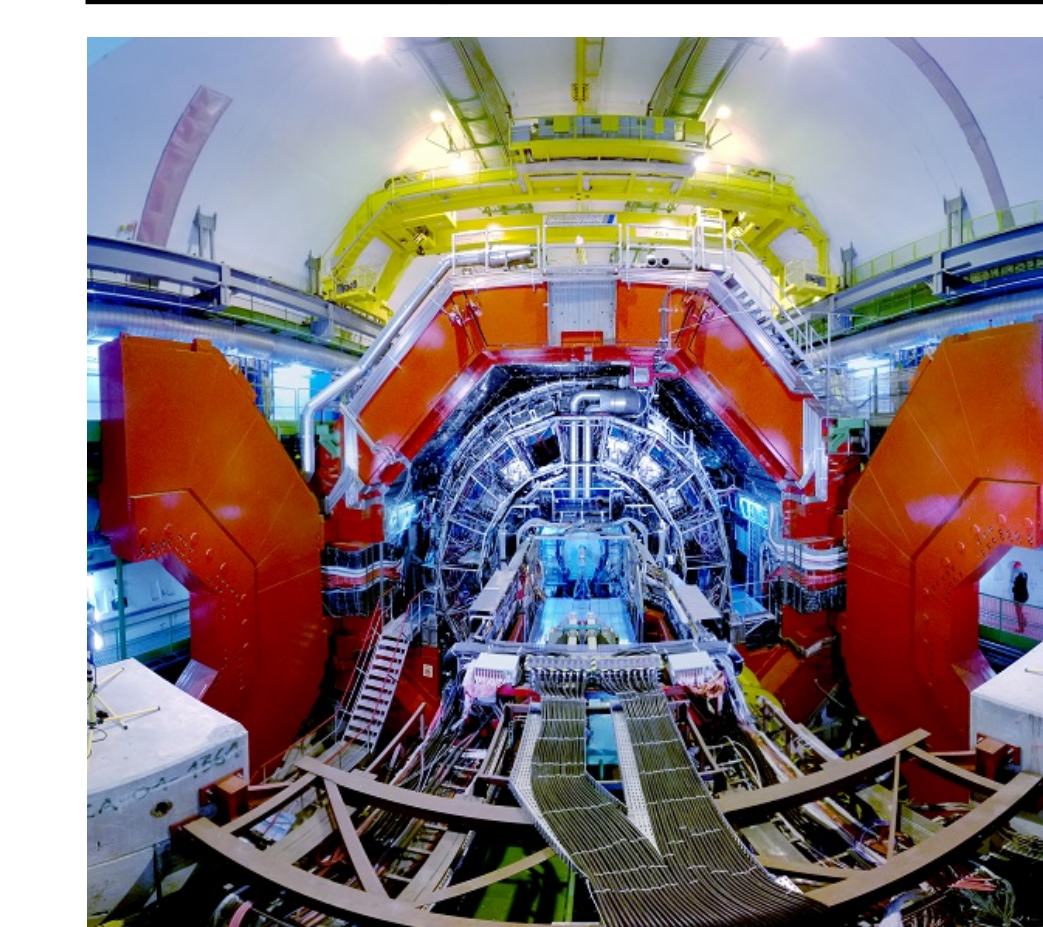
Put quarks and gluons on a lattice to calculate their interactions and particle/mass production



Fine lattices require about 200 million core hours/year



ALICE experiment at LHC



Compact stellar objects

