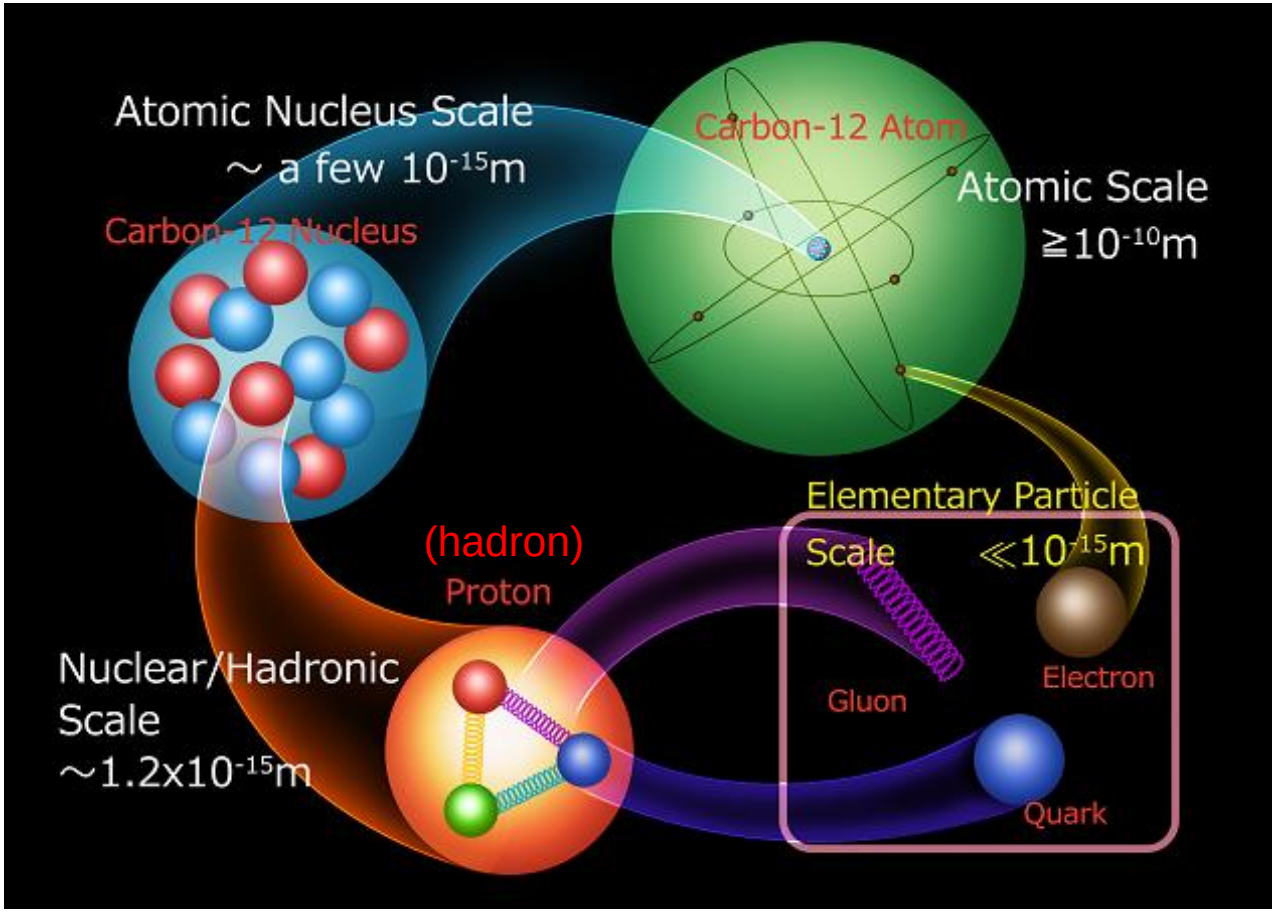
•中央研究院 物理研究所
•中高能理論組研究簡介

• Di-Lun Yang (楊廸倫), on behalf of the high energy theory group

• July 05, 2023

Elementary particles

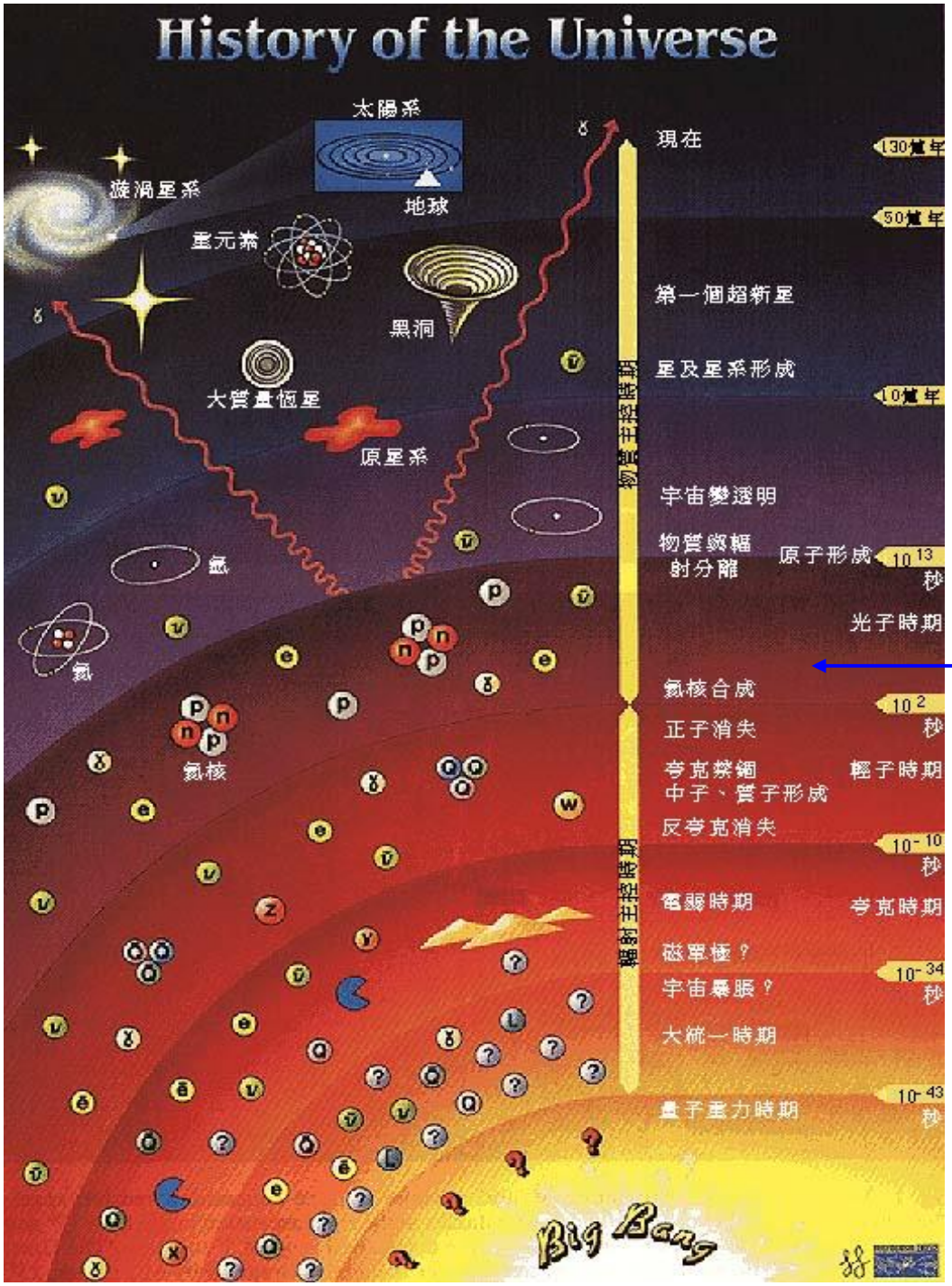
- The smallest building blocks of the nature



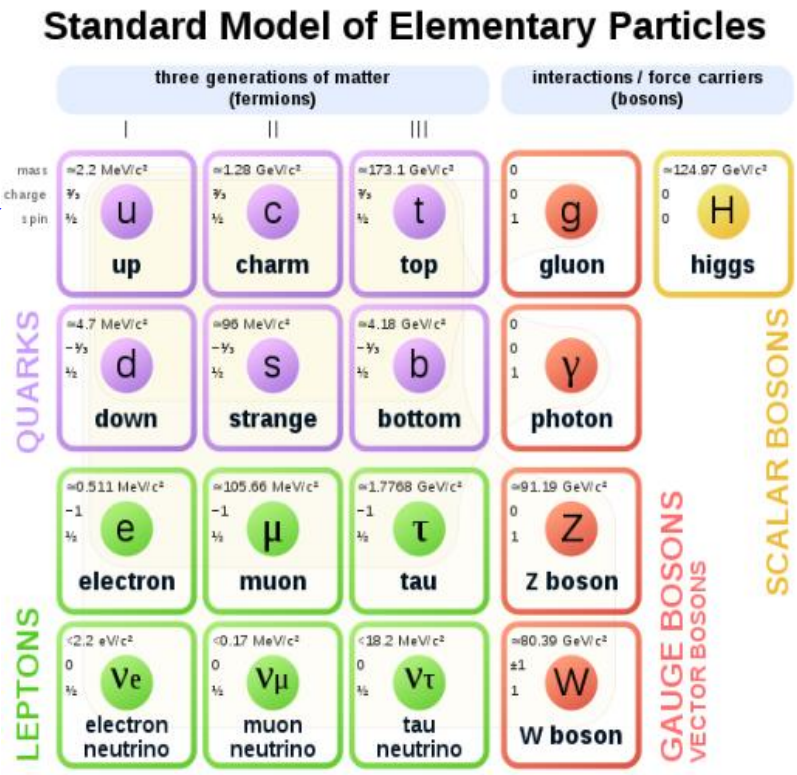
http://core-u.hiroshima-u.ac.jp/en/research-groups-en/theoretical-particle-physics-en.html

広島大学 素粒子論研究室

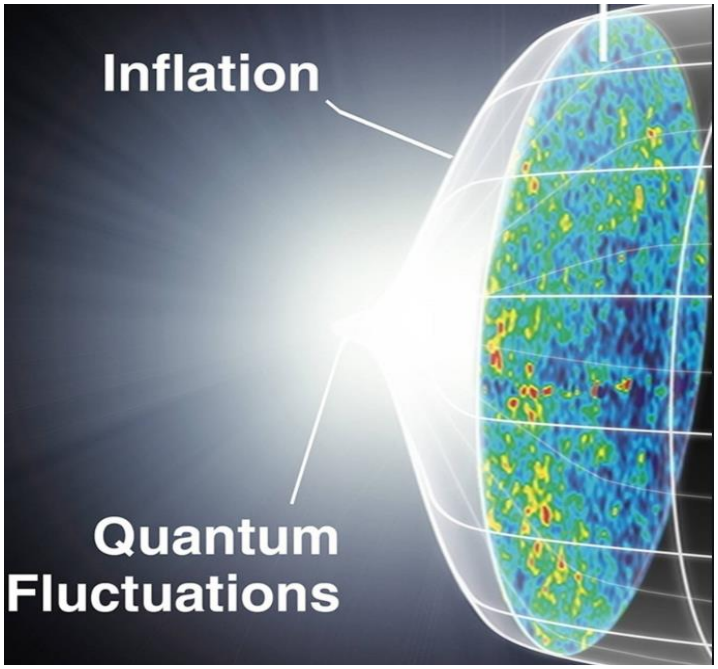
- Fundamental Interaction :
  - electromagnetism : e.g. electrons; exchange photons
  - weak int. : e.g. electrons, neutrinos; exchange massive gauge bosons
  - strong int. : quarks, gluons; exchange gluons
  - gravity : exchange gravitons

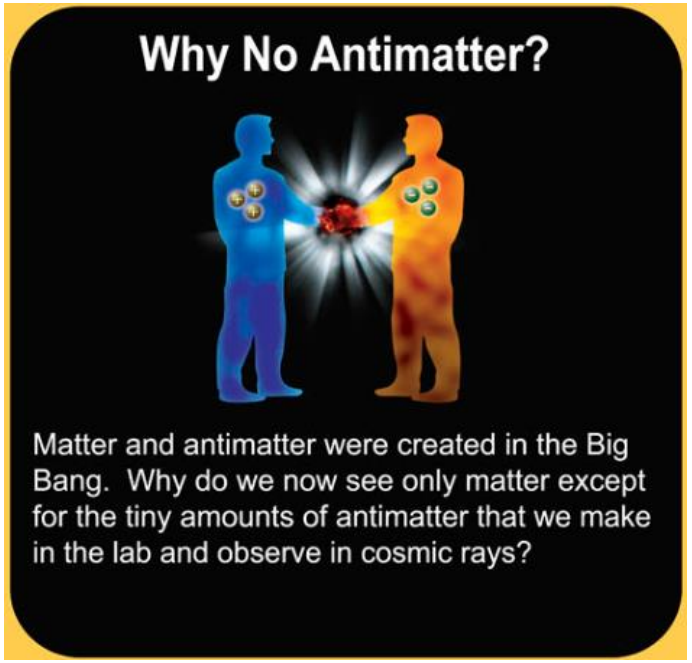


- **The evolution of the Universe is governed by the microscopic nature of fundamental physics**

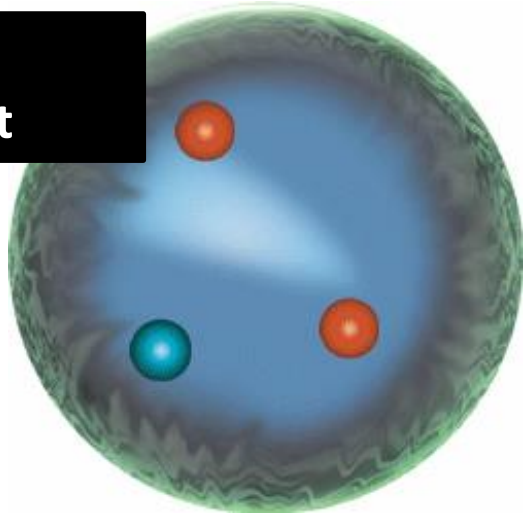


• Unsolved Mysteries in Fundamental Physics?

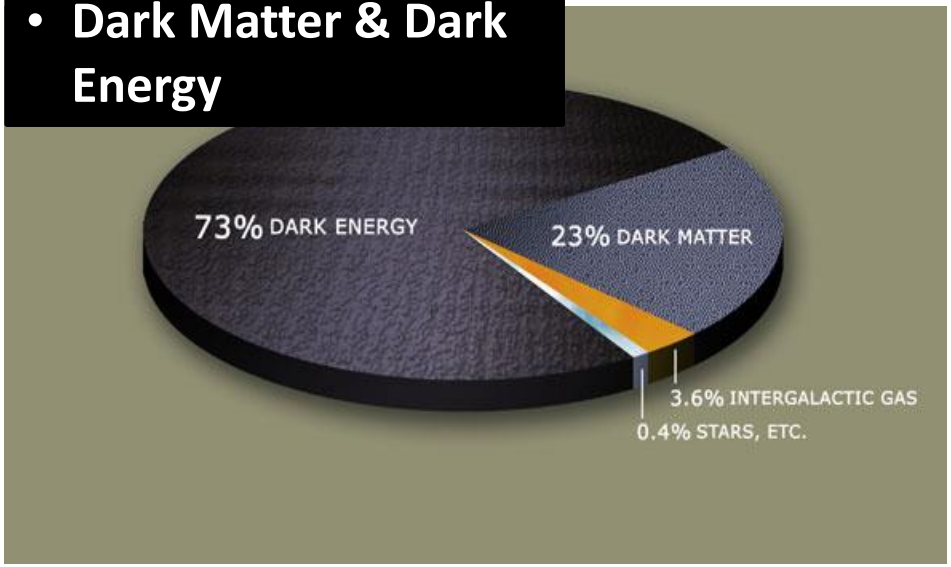




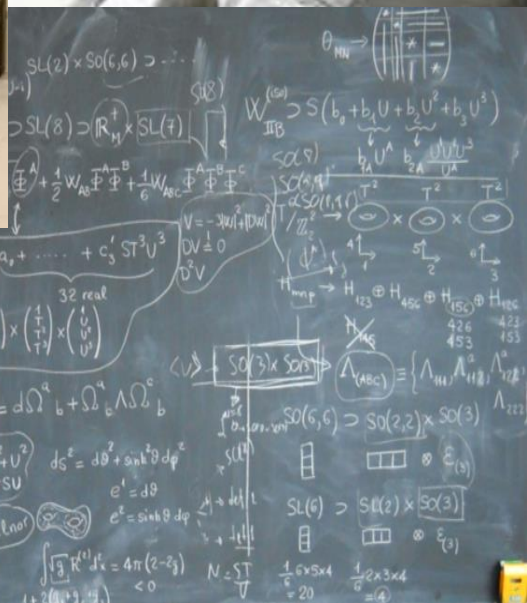
- Quark Confinement

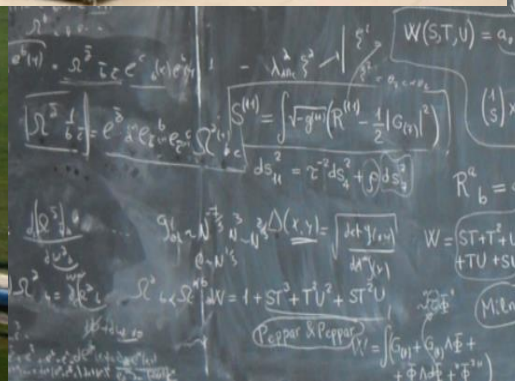


- Dark Matter & Dark Energy



• Tools to explore these questions





Institute of Physics, Academia Sinica
MHEP(Theory) – 7 Faculty Members

- **The Early Universe**
- **Inflation, primordial black holes and CMB**

- *K.-W. Ng*

- **Hadron Physics**
- **QCD, meson decays, and CP violation, heavy ion collisions**

- *H.-N. Li*

- *D.-L. Yang*

- **Collider Phenomology**
- **Signature of New Physics in Collider**

- *H.-N. Li*

- *T.-C. Yuen*

- **Dark Matter & Cosmic Structure**
- **Imprint of Dark Matter on the cosmic structure**

- *K.-W. Ng*

- **Astrophysics**
- **Exploring particle & nuclear physics nature in astrophysics**

- *M.-R. Wu*

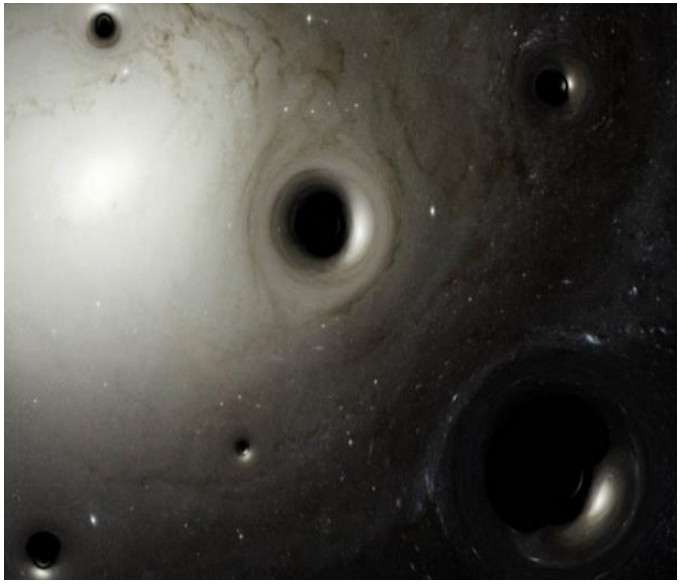
- *K.-W. Ng*

- *A. Fedynitch*

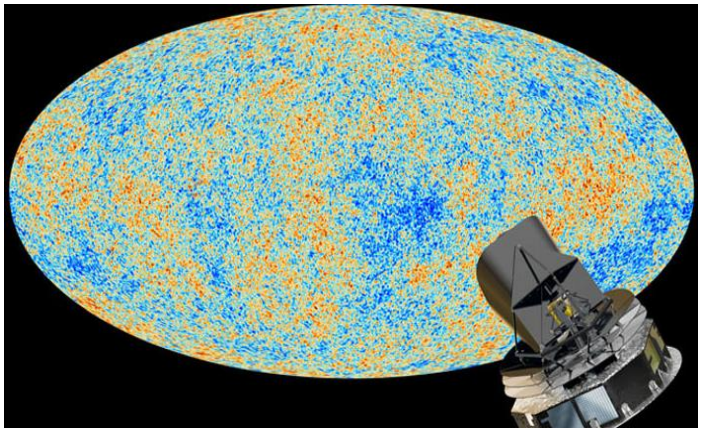
- *D.-L. Yang*

•The Early Universe

- Cosmic Inflation Models and imprints on the cosmic microwave background (CMB)
- Formation of the primordial black holes
- Gravitational waves from the early Universe



• 吳建宏

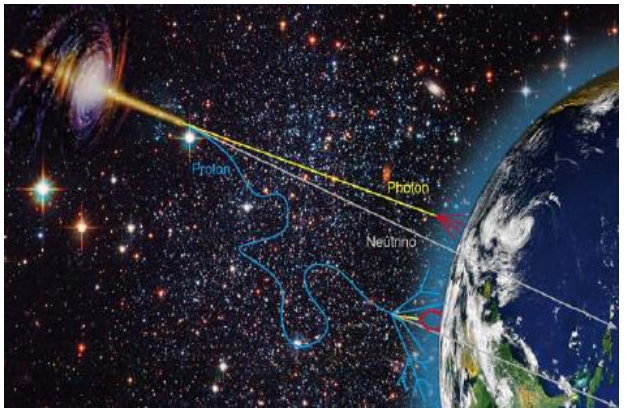


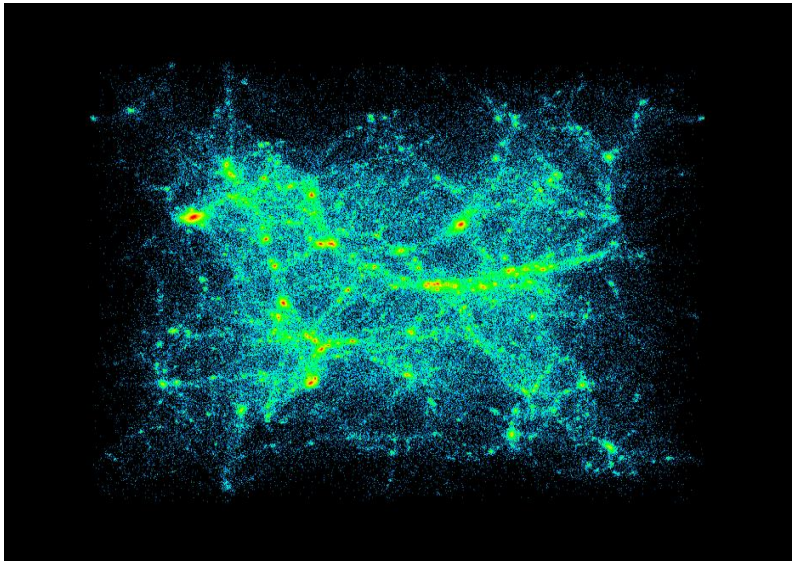
• CMB

•Dark Matter & Cosmic Structure

- Formation of the large scale cosmic structure
- 21 cm line
- Cosmic Rays & Dark Matter
- Dark Sector Physics

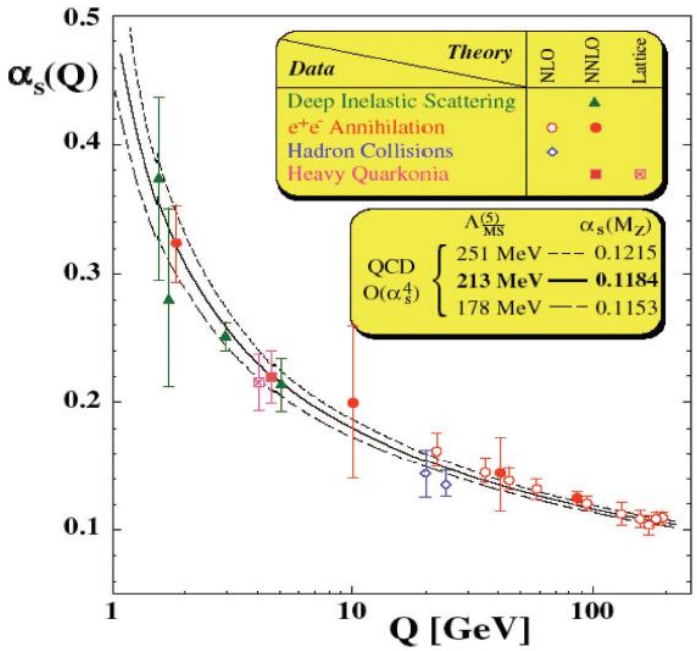
- 吴建宏



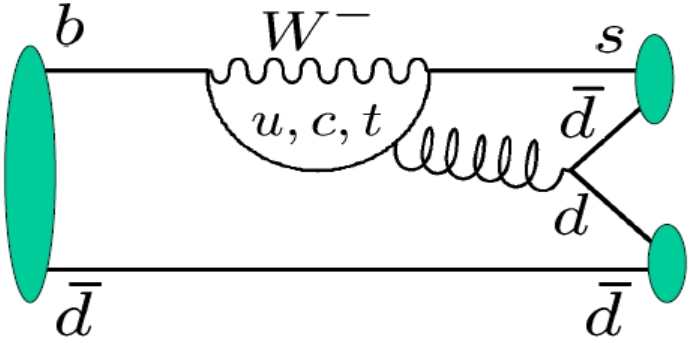


•Hadron Physics

- CP Violation ↔ The baryon asymmetry
- CP violation in B & D meson decay
- Developing theory for heavy quark physics
- Perturbative quantum chromodynamics (pQCD)



S. Bethke, hep-ex/0211012

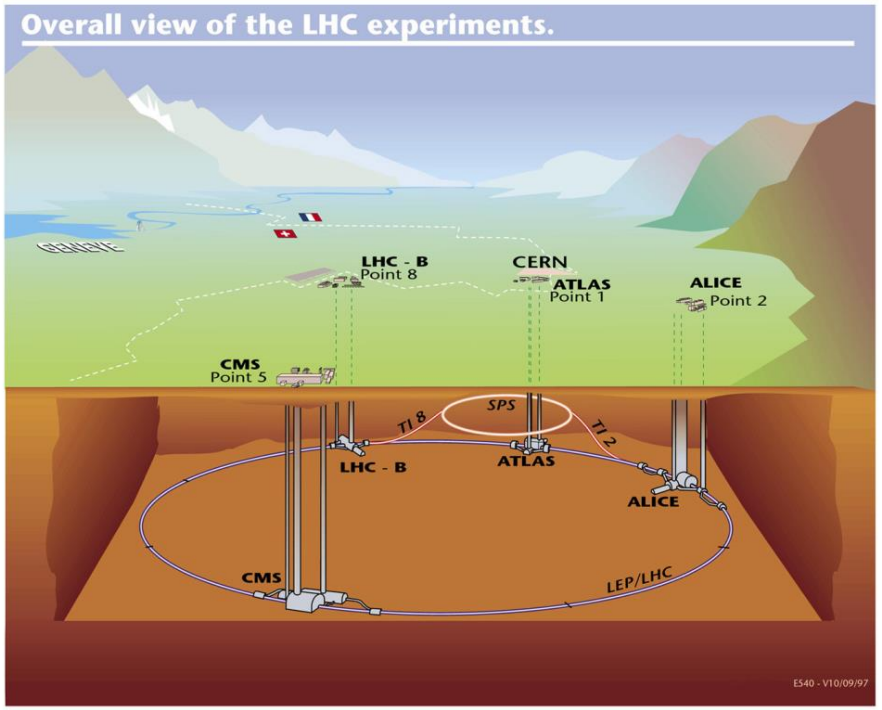


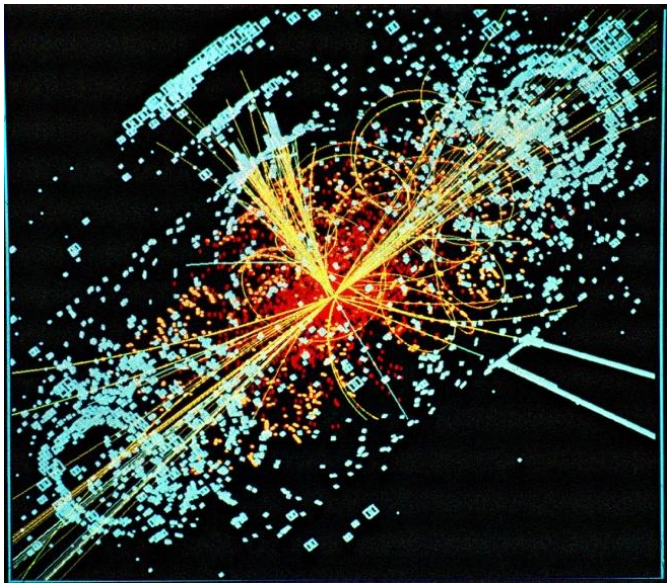
Asymptotic freedom (2004 Nobel Prize in Physics):
H. D. Politzer, D. J. Gross, F. Wilczek, 1979

- 李湘楠

•Collider Phenomenology

- Top quark, Higgs physics
- Electro-weak symmetry breaking
- Jet physics
- New Physics





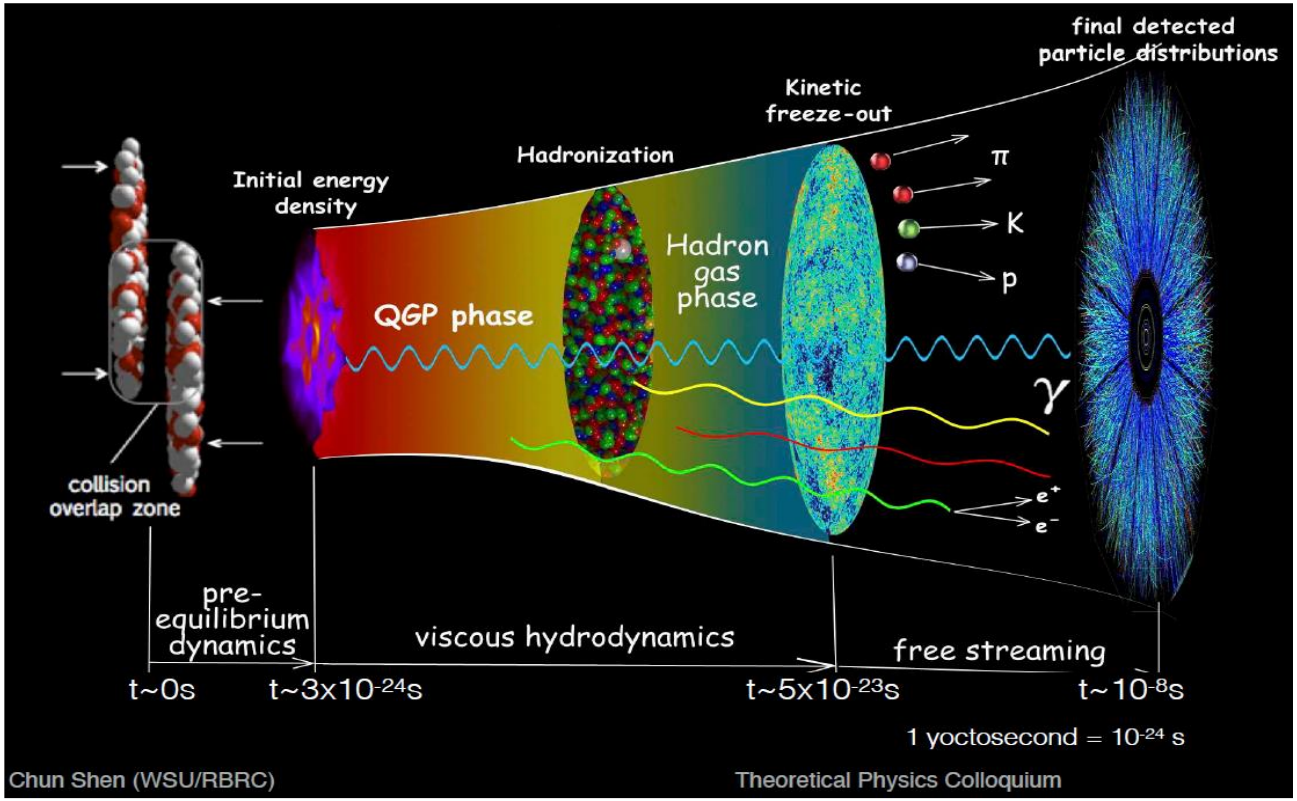
• H -> $\overline{b}$ b 事例

• 李湘楠

• 阮自強

•Heavy Ion Collisions

- Little bang from relativistic heavy ion collisions : quark gluon plasma phase
- Relativistic kinetic theory & relativistic hydrodynamics
- Quantum field theories with strong fields



- 楊廸倫

•Particle and Nuclear Astrophysics

- Neutrino physics in stars and stellar explosions
- Binary neutron star mergers and their multimessenger signals
- Neutron star structure and composition
- New Physics imprints in astrophysics
- Ultra-high energy cosmic rays and hadronic interactions

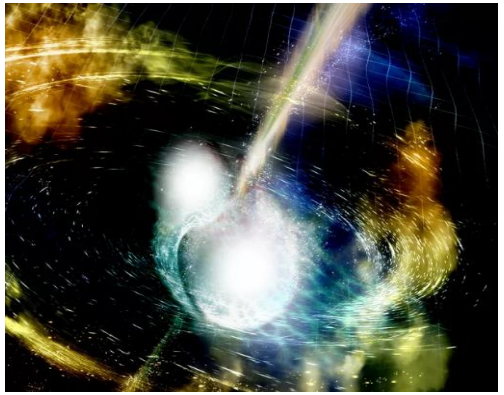
• 吳孟儒

• 吳建宏

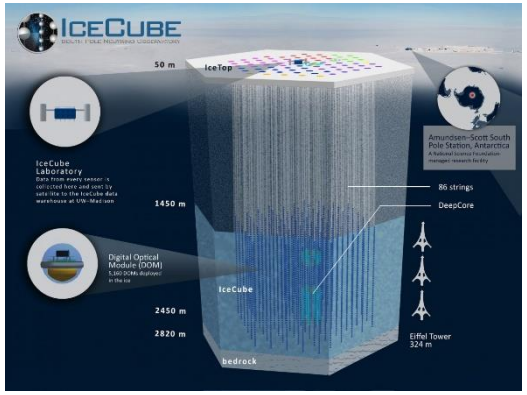
• 安納托里

• 楊廸倫

• Supernova explosion



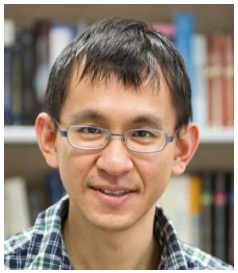
• Neutron star merger



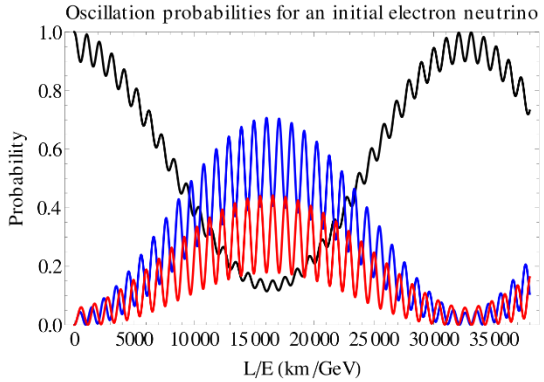
• High-energy neutrinos

•Neutrino physics

- Collective flavor oscillation



- 吳孟儒

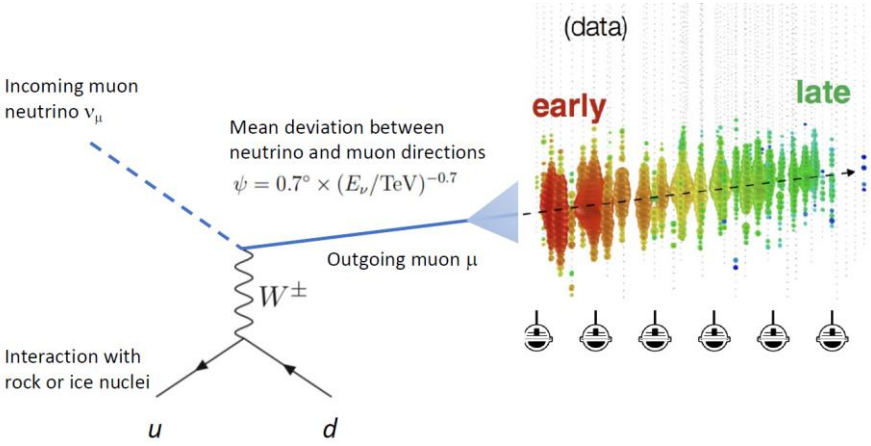


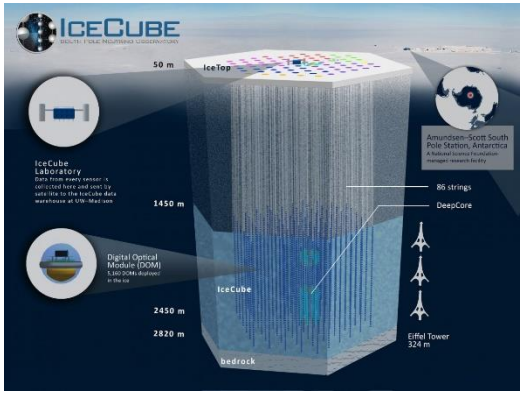
- Chiral effects in compact stars $p + e_{\mathrm{L}} \leftrightarrows n + \nu_{\mathrm{L}}$

- 楊廸倫

- High energy neutrinos & IceCube experiment

- 安納托里





- **You are welcome to join the quest to**

"BOLDLY GO WHERE NO MAN HAS GONE BEFORE"