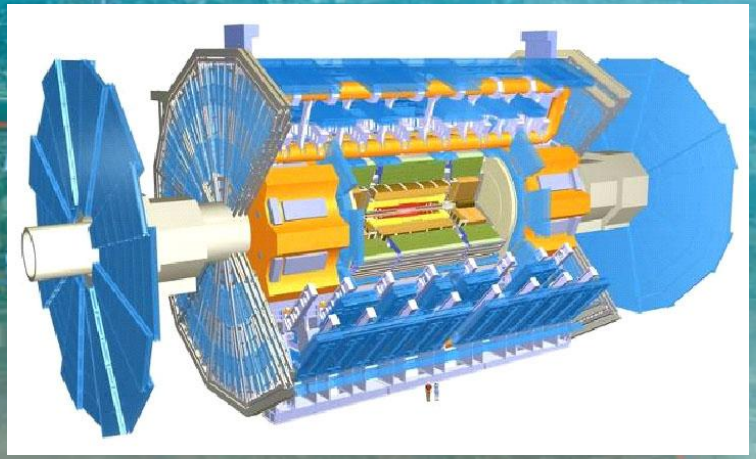
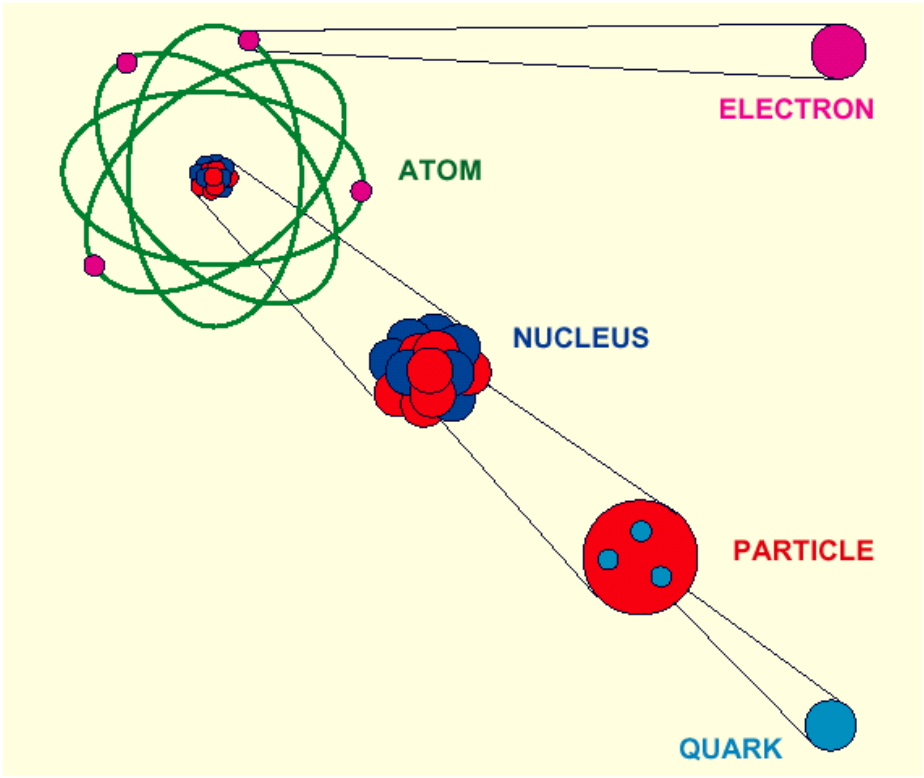
High Energy Frontier Research in Particle Physics at CERN

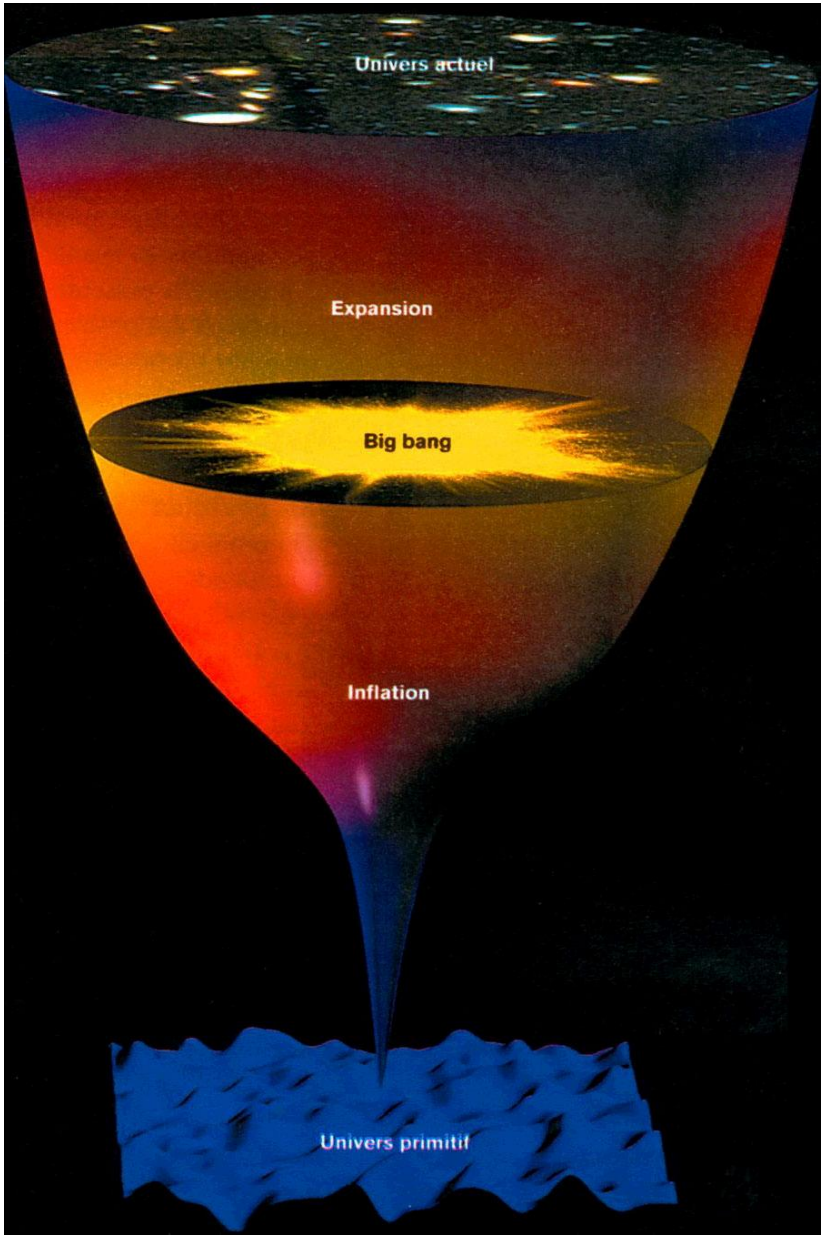
3. Jun. 2011
Presidents Council Meeting
in Geneva

The University of Tokyo
ICEPP
Tomio Kobayashi



What are the Particle Physics looking for?





- What are the Constituents of Matter?
- What are the Forces?
- What is the Mass?
- What are the Space and Time?

→ Origin of the Universe?

ICEPP

東京大学 THE UNIVERSITY OF TOKYO

International Center for Elementary Particle Physics

Director: Prof. Sachio Komamiya
Research staff: 18
Postdocs: 9
Supporting staff: 5
Students: ~25

Main activities at present: **ATLAS** experiment using **LHC** at CERN,
and some smaller experiments, R&D (MEG, ILC, ---)

Brief history:

1974 **ICEPP founded in Faculty of Science**
DASP/DORIS at DESY(Hamburg)
1977 JAPE/PETRA at DESY
1984 OPAL/LEP at CERN(Geneva)
1994 Taking a role of **Japanese center of research for high energy frontier particle physics**
OPAL/LEP-II at CERN
2004 **ATLAS/LHC** at CERN

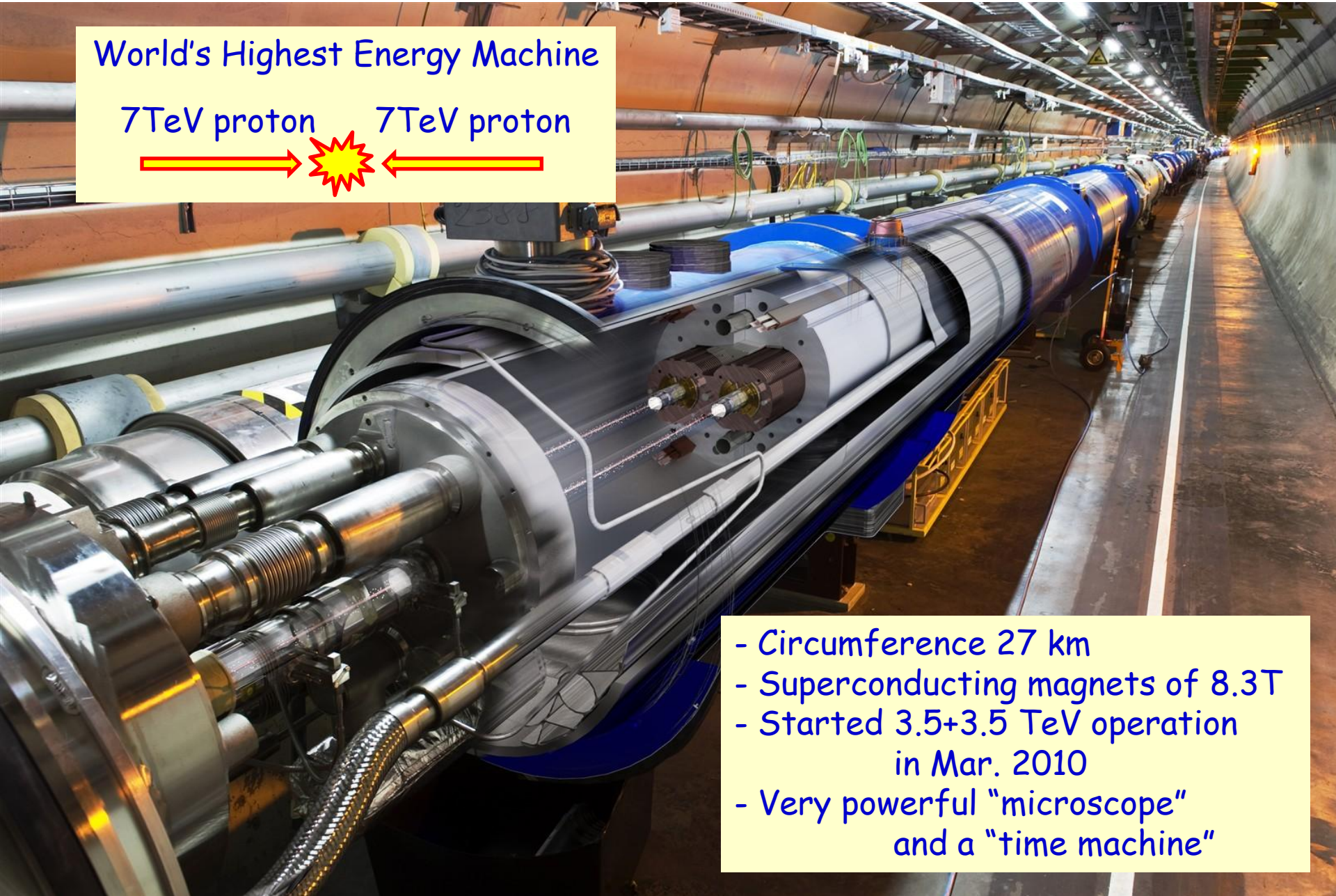
M.Koshiba

CERN

Conseil Européen pour la Recherche Nucléaire

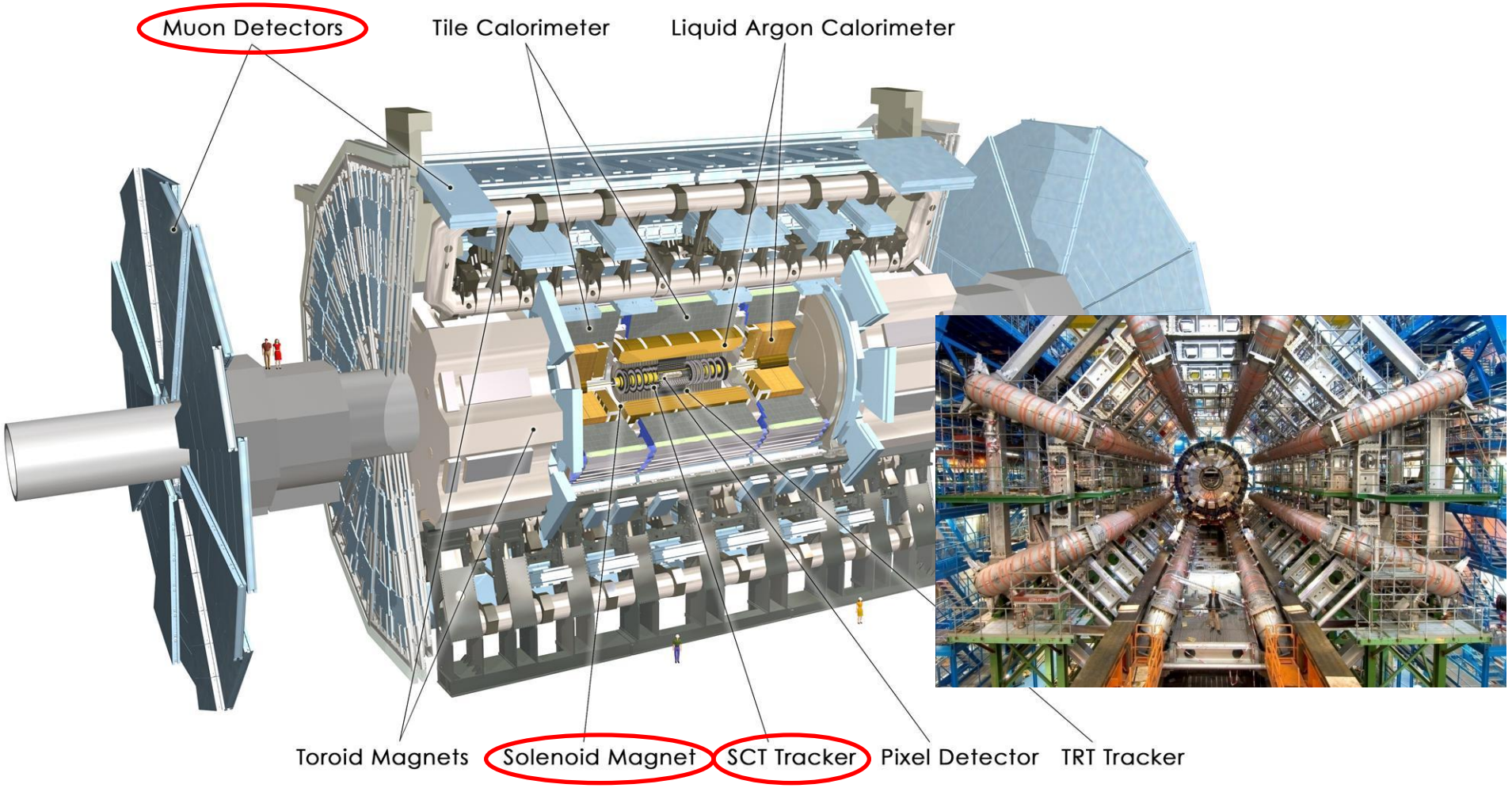
- Founded in 1954 (12 Member States in Europe
  → now 20 Member States)
- CERN Laboratory sits astride the Franco-Swiss border
  near Geneva
- Constructing and operating the highest energy
  accelerators (PS, SPS, SppS, LEP, **LHC**)
- Observer States: **Japan**, USA, Russia, Israel, India, Turkey,
  EU, UNESCO

LHC (Large Hadron Collider at CERN)



ATLAS (A Toroidal LHC Apparatus)

- International collaboration from 38 countries with ~3000 researchers
- 22m diameter, 44m length, 7000t weight
- World's biggest superconducting toroidal magnet
- Japanese participation (15 institutes, ~100 researchers)
  on muon trigger detector, inner detector, s. c. solenoid magnet, --



ATLAS Japan

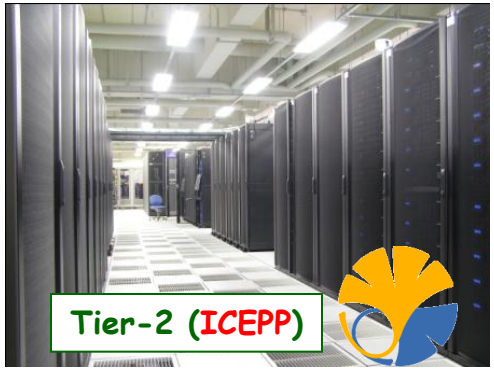
Contributions from Japan

TGC for muon triggering
(KEK, ICEPP, Kobe, Nagoya, --)

SCT (KEK, Tsukuba, --)

Solenoid (KEK)

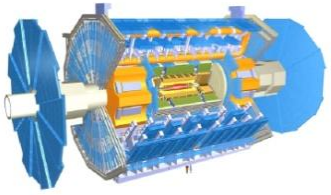
and TDAQ, Geant4

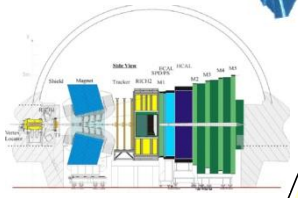


Tier-2 (ICEPP)

LHC Q-magnets (KEK)

WLCG (Worldwide LHC Computing Grid)





Tier-2s and Tier-1s are inter-connected by the general purpose research networks

Any Tier-2 may access data at any Tier-1

Tier-2

Tier-2

Tier-2

Tier-2

Tier-2

Tier-2

Tier-2

Tier-2

Tier-2

Tier-2

Tier-2

GridKa

IN2P3

TRIUMF

BNL

ASCC

CERN

Nordic

FNAL

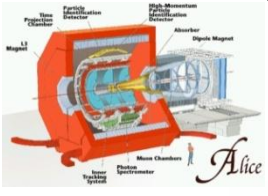
Tier-0

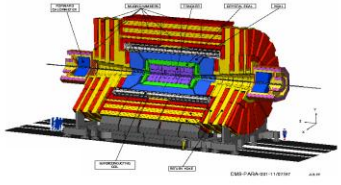
CNAF

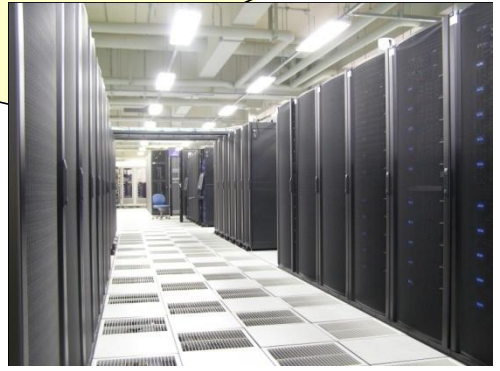
SARA

PIC

RAL

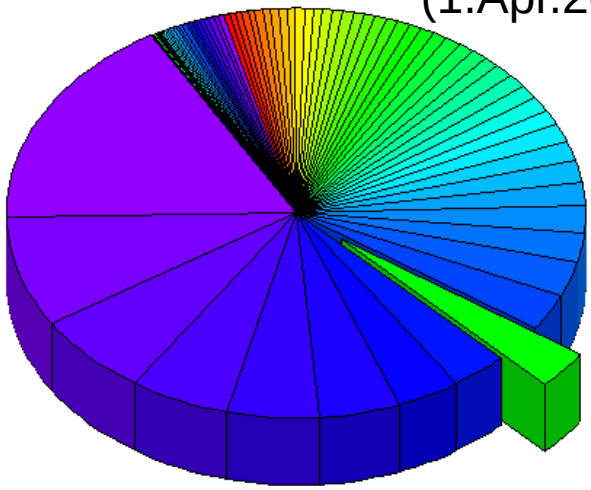






Analysis Jobs in Tier-2 Centers (Total 92 Sites)

(1.Apr.2010 ~ 31.Mar.2011)

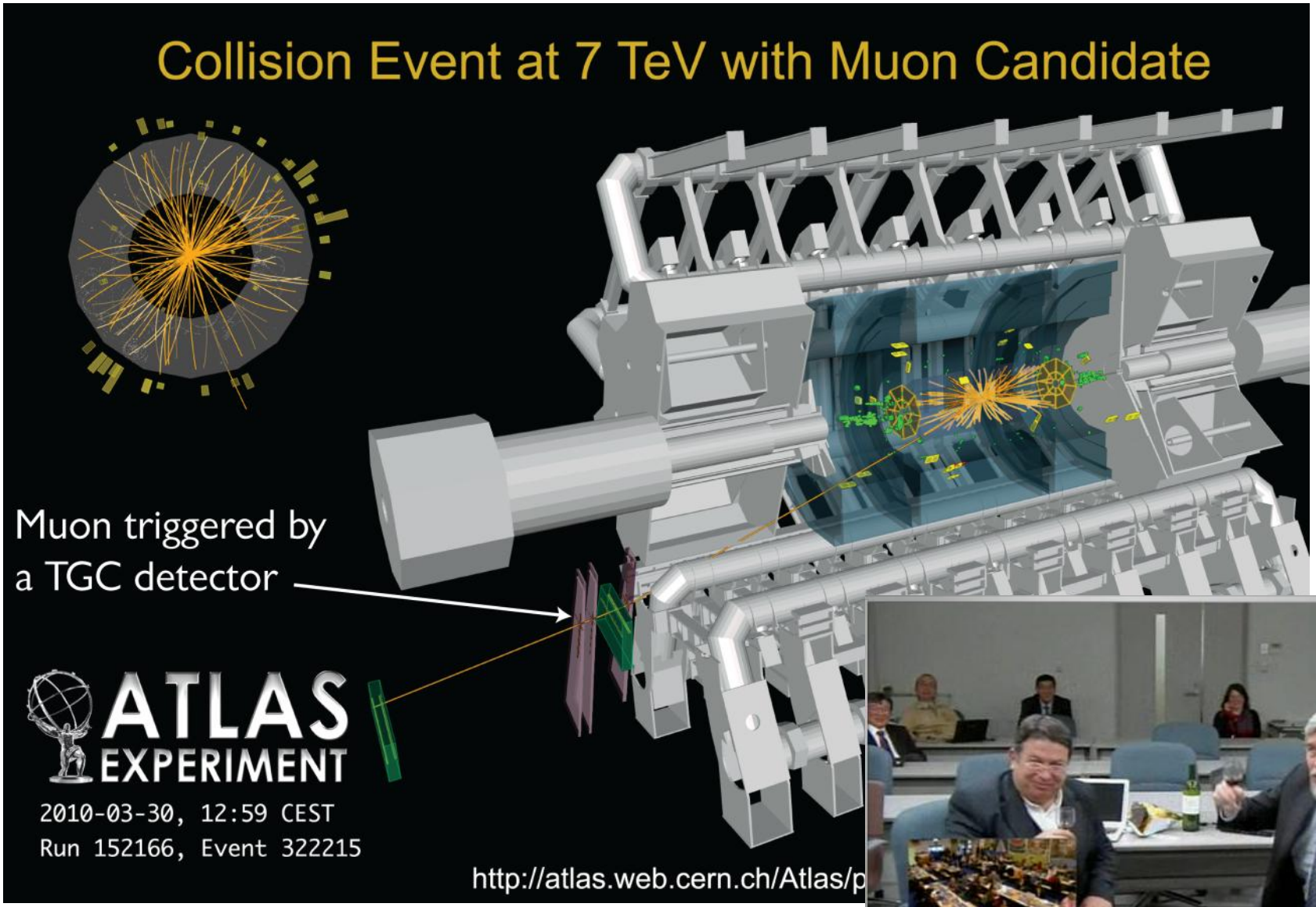


Tokyo 3.0%

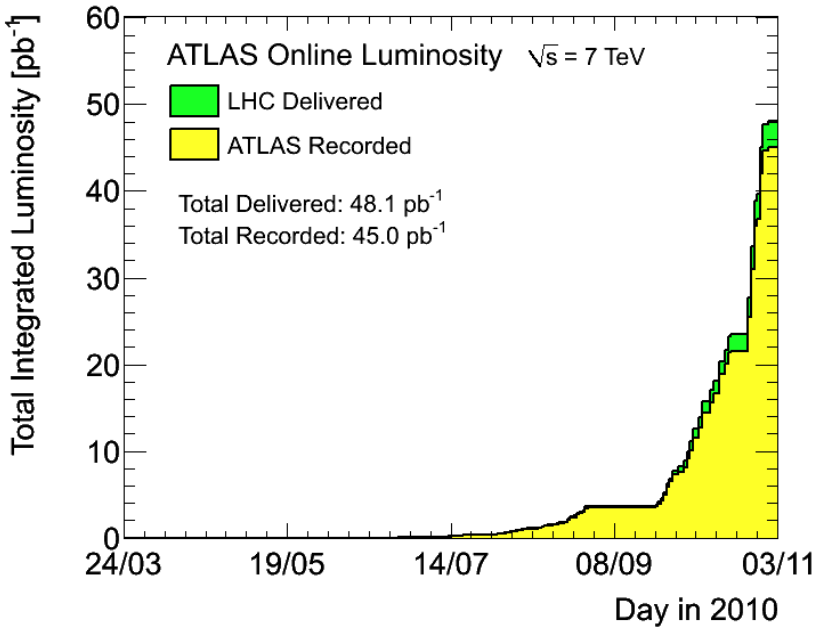
1	BNL	16.9	BNL (USA)
2	CERN	8.7	CERN (CHE)
3	AGL	6.6	Univ. of Michigan, Michigan State Univ. (USA)
4	MW	5.5	Univ. of Chicago, Indiana Univ. (USA)
5	SARA-NIKHEF	5.1	SARA, NIKHEF (NDL)
6	FZK	4.5	Karlsruhe Inst. of Technology (GER)
7	SLAC	3.6	SLAC (USA)
8	SW	3.2	Univ. of Texas at Arlington, Oklahoma Univ., Langston Univ., Univ. of New Mexico (USA)
9	TOKYO	3.0	Univ. of Tokyo (JPN)
10	NORDUGRID	2.9	NORDUGRID
11	DESY-HH	2.7	DESY (GER)
12	INFN	2.3	INFN (ITA)
13	TAIWAN	2.1	ASGC (TWN)
14	LYON	1.8	IN2P3CC (FRA)
15	TRIUMF	1.7	TRIUMF (CAN)
16	PIC	1.5	PIC (ESP)
17	LRZ	1.5	Leibniz-Rechenzentrum (GER)
18	NE	1.2	Boston Univ., Harvard Univ. (USA)
19	Wuppertalprod	1.2	Wuppertal inst. (GER)
20	DESY-ZN	1.1	DESY-Zeuthen (GER)

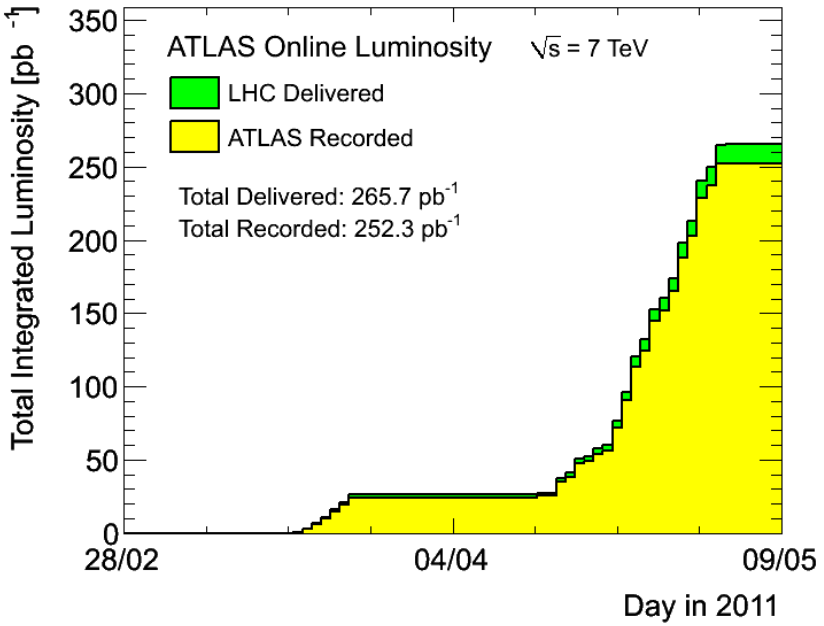
→Tokyo 5.8%,
5-th in 80 Tiear-2 proper sites

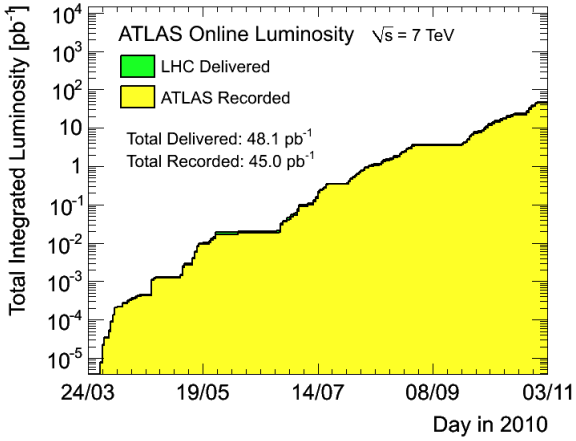
LHC started the run at 7TeV (=3.5+3.5 TeV) on 30.Mar.2010



LHC is performing very well, and ATLAS is taking good data



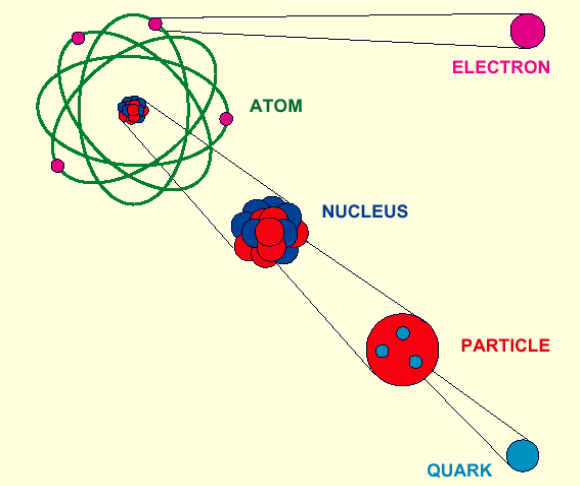


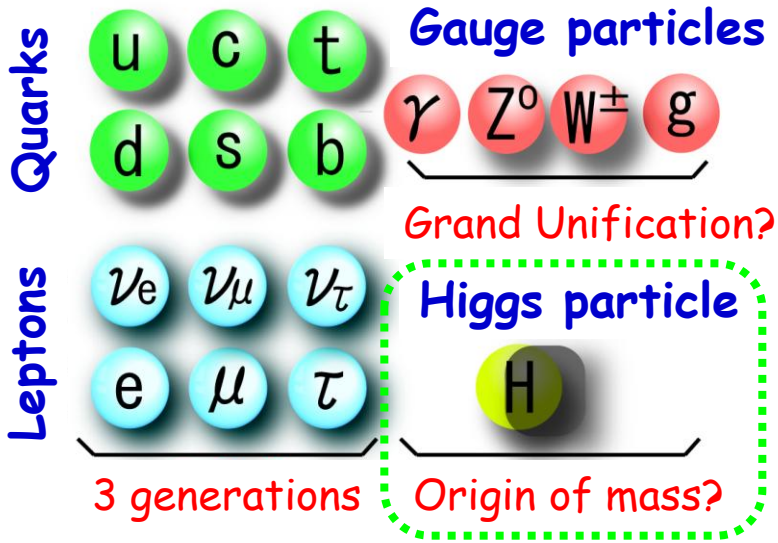


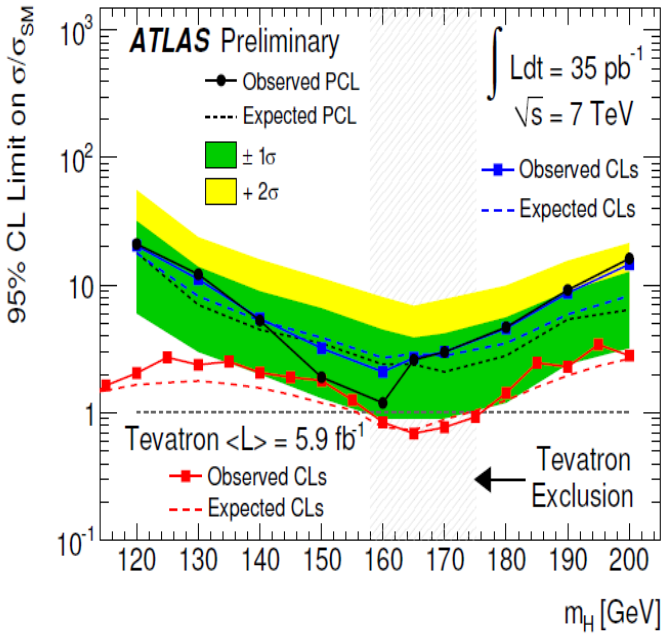
---, and producing/expecting many interesting results, such as ---

Higgs Particle

The Missing Link of the Standard Model







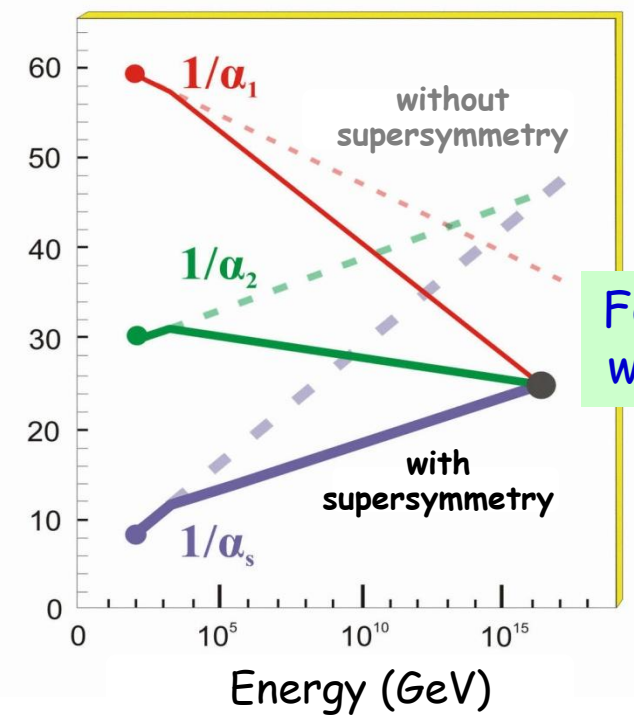
H→ WW→lνlν
with 2010 data

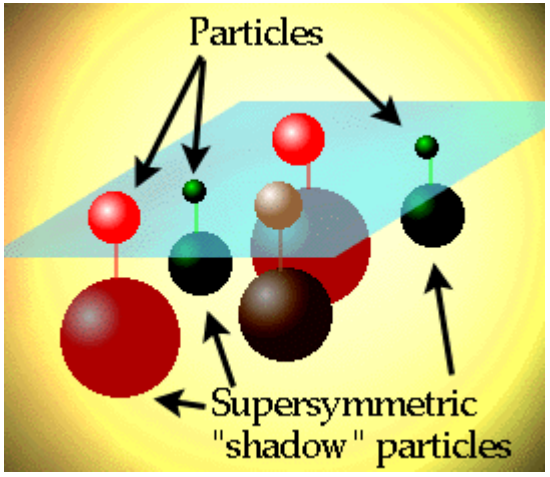
We (more or less) understood the basic constituents of **Matter** and how the **Forces** work.

Now we are very close to understand the origin of **Mass**.

Supersymmetry

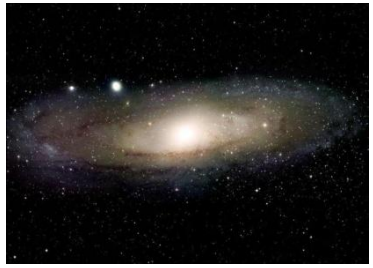
Grand Unification, Dark Matter

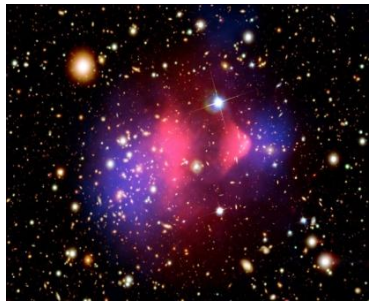


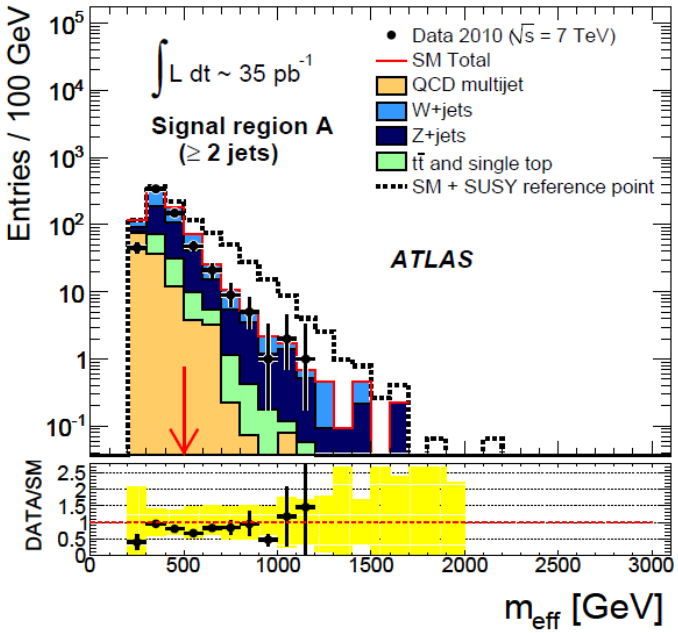


Forces can be united with supersymmetry

There is a good chance at LHC to find supersymmetry.



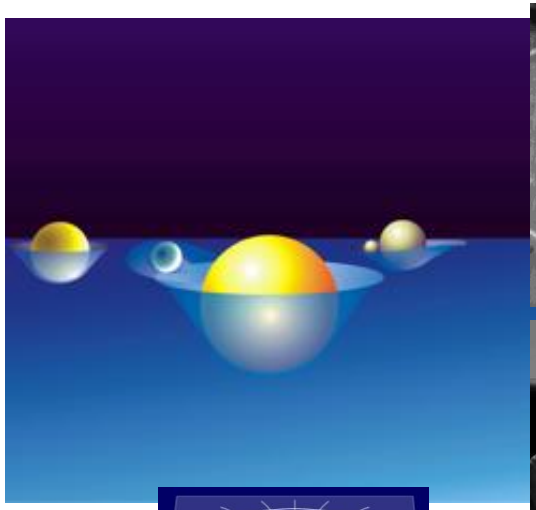


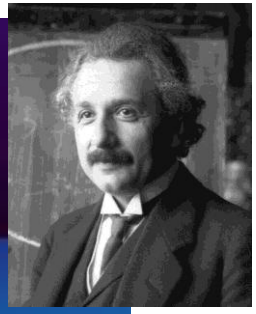


Supersymmetry provides good candidates for the **Dark Matter** of the Universe

So far no sign yet, but we will see ---

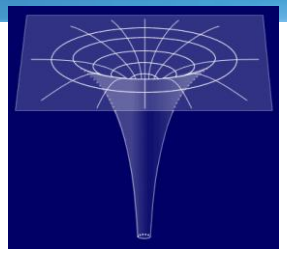
Extra Dimensions

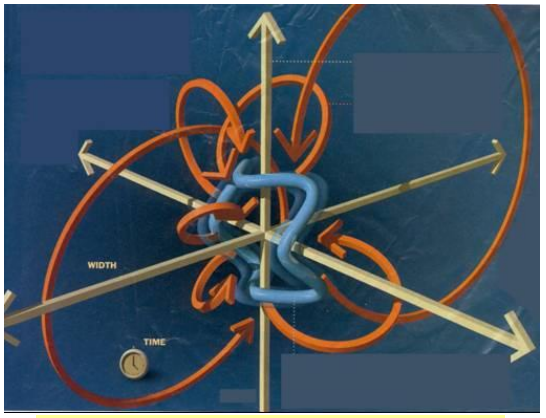




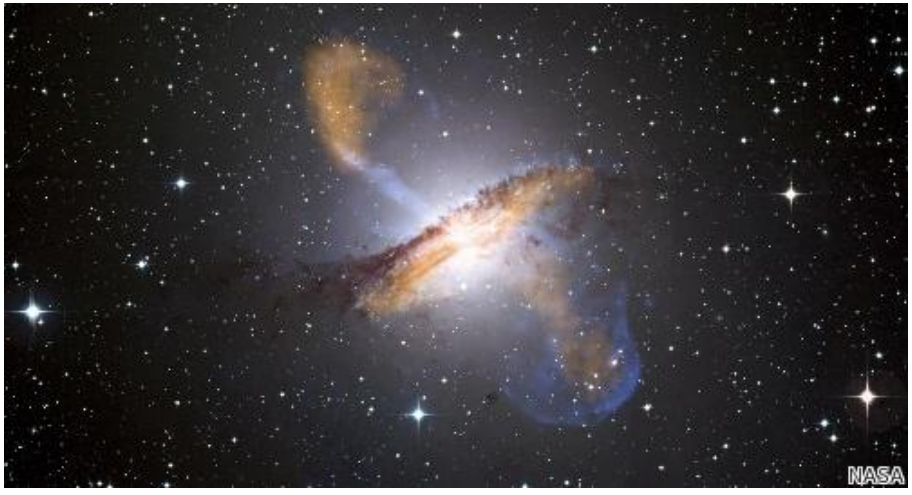
"Gravity
~ space-time
deformations"

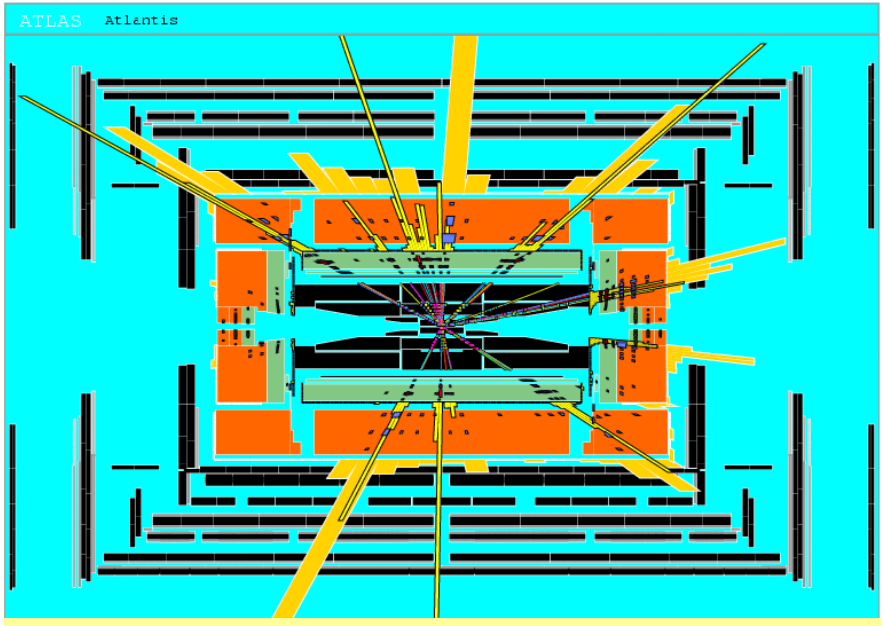
"Black holes evaporate"



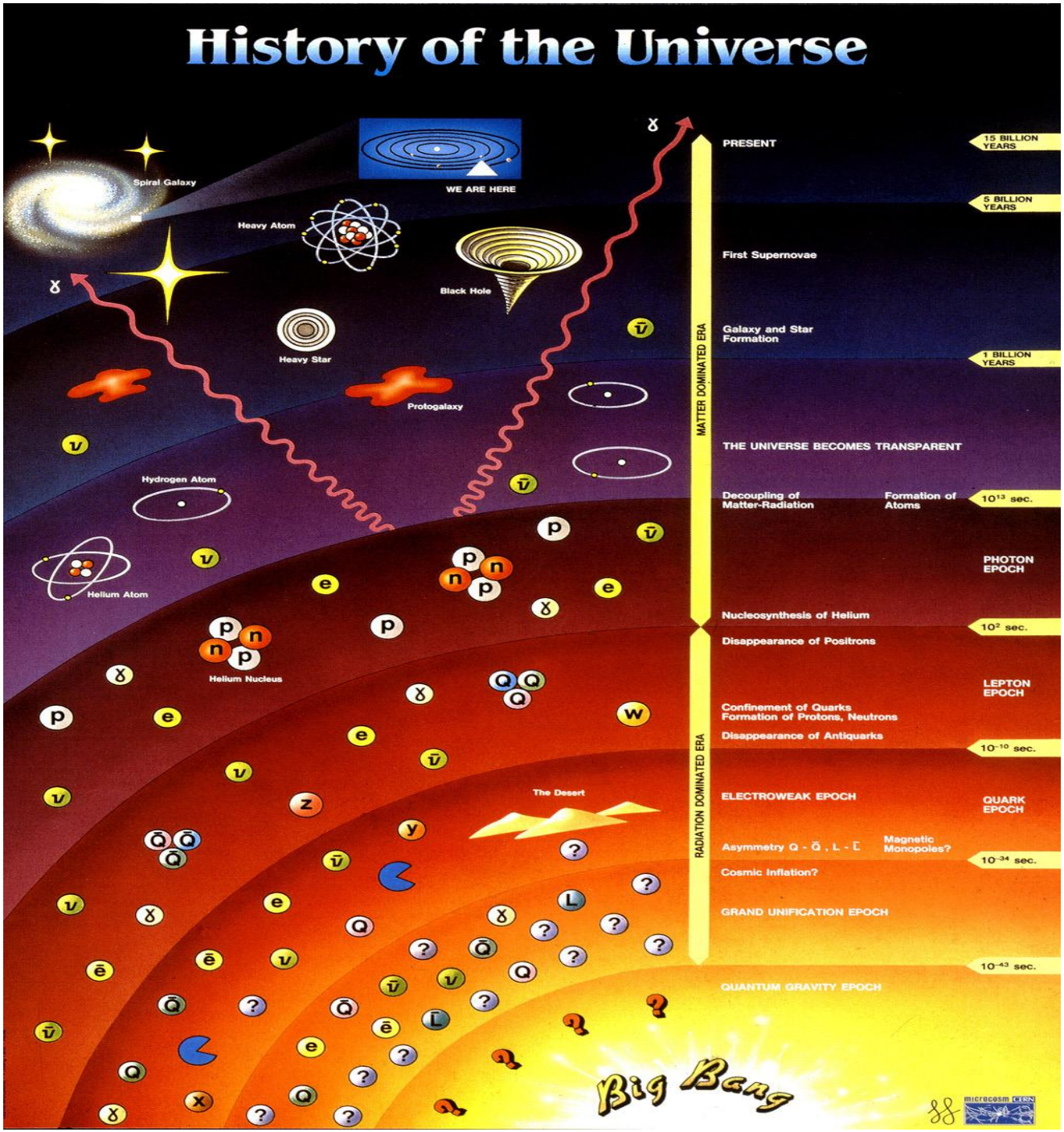


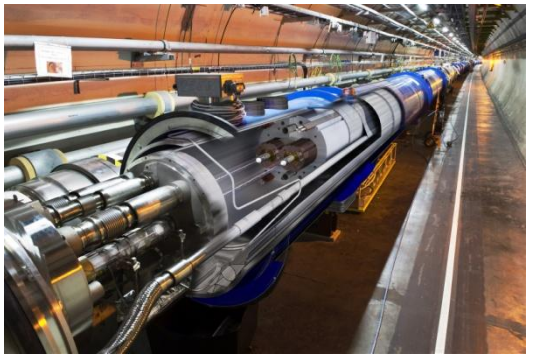
Superstrings live
in 10-dimensions

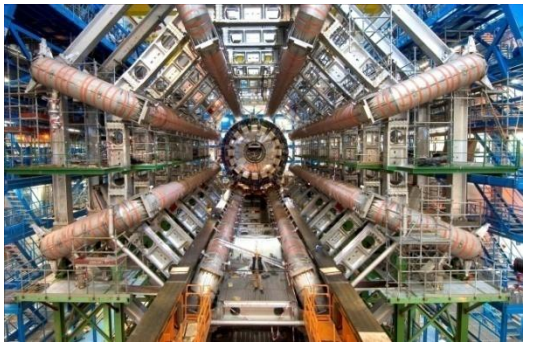




If LHC sees extra dimensions,
mini black holes may be produced(?)







We will soon find out new things at LHC beyond the Standard Model.

Origin of the Universe