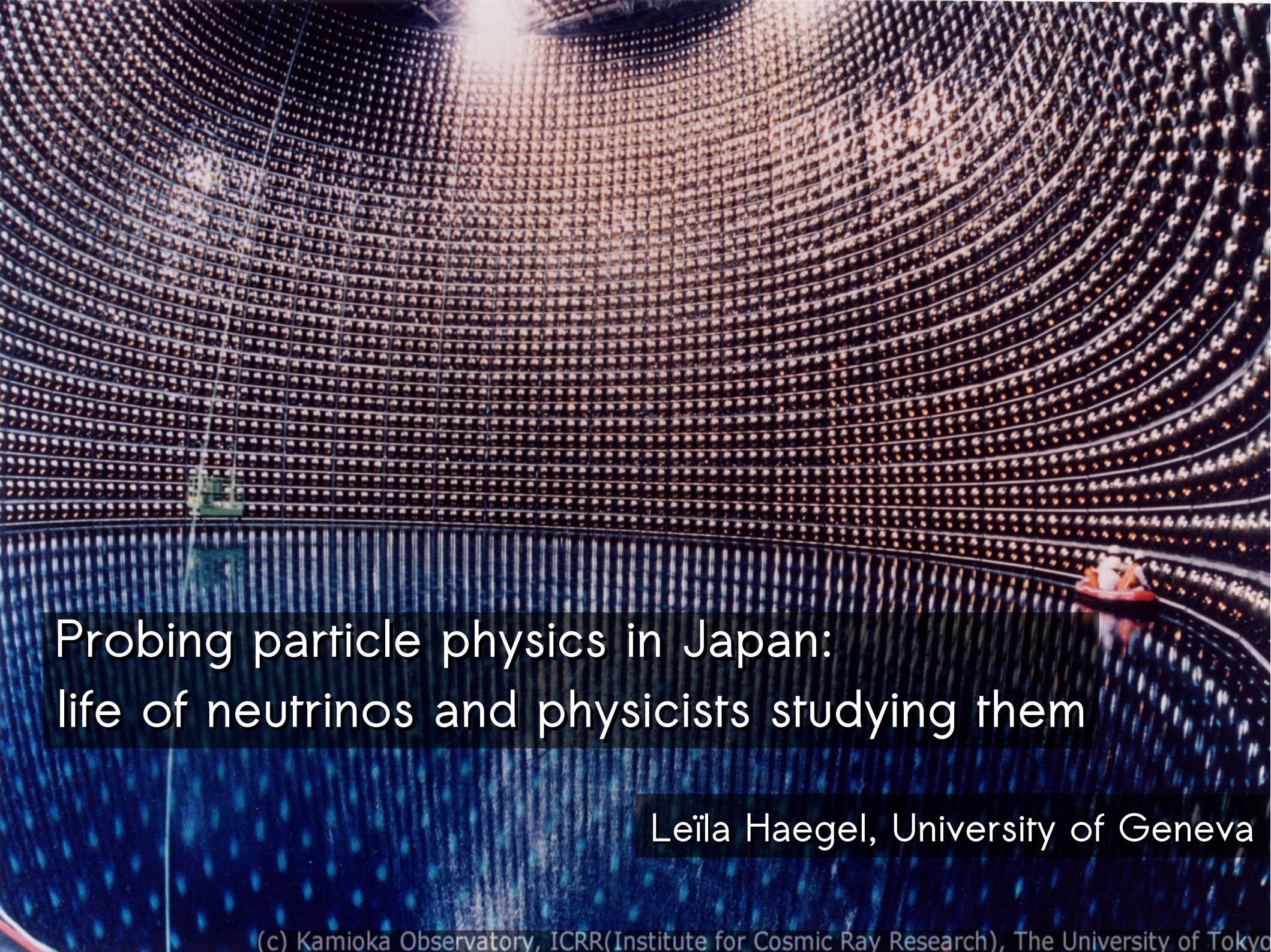
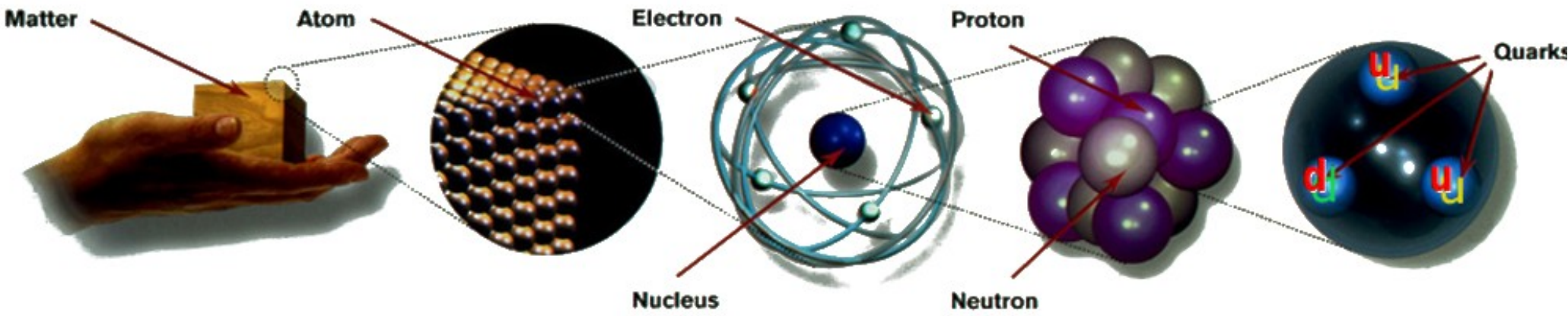


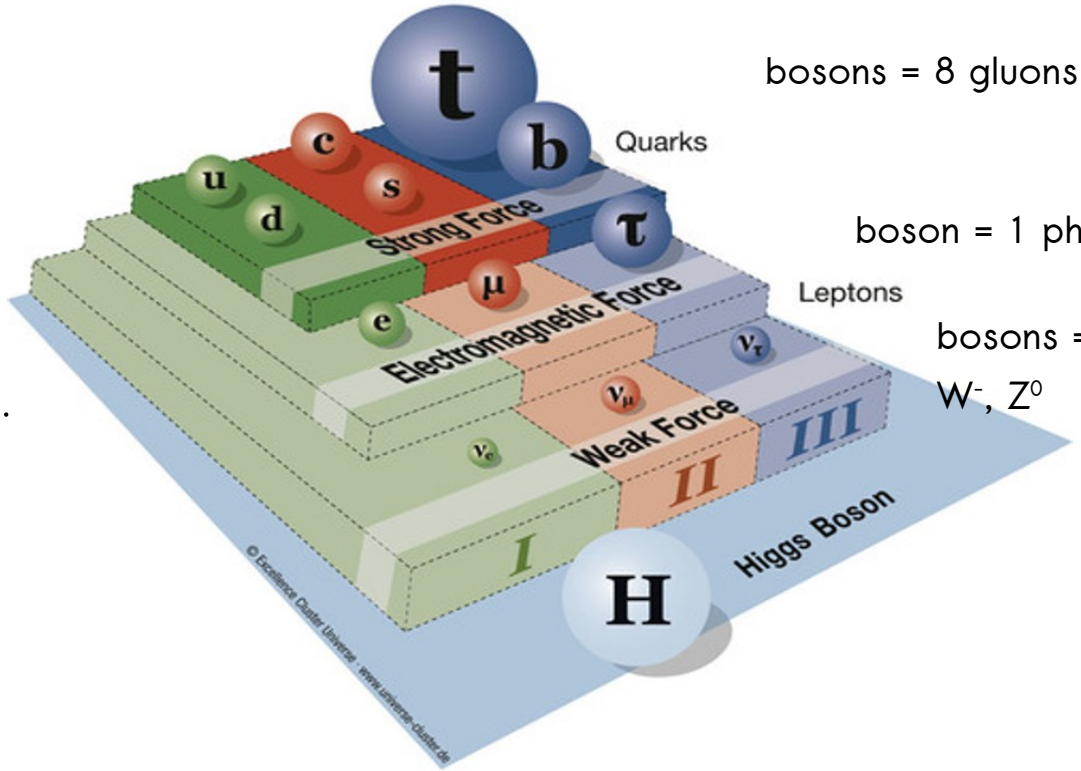
Probing particle physics in Japan: life of neutrinos and physicists studying them

Leïla Haegel, University of Geneva

A short introduction to particle physics



- **All matter is made of particles** : the fermions.
- **Matter sticks together** thanks to particles too : they are the bosons.
- **Matter transforms** thanks to interactions between particles.

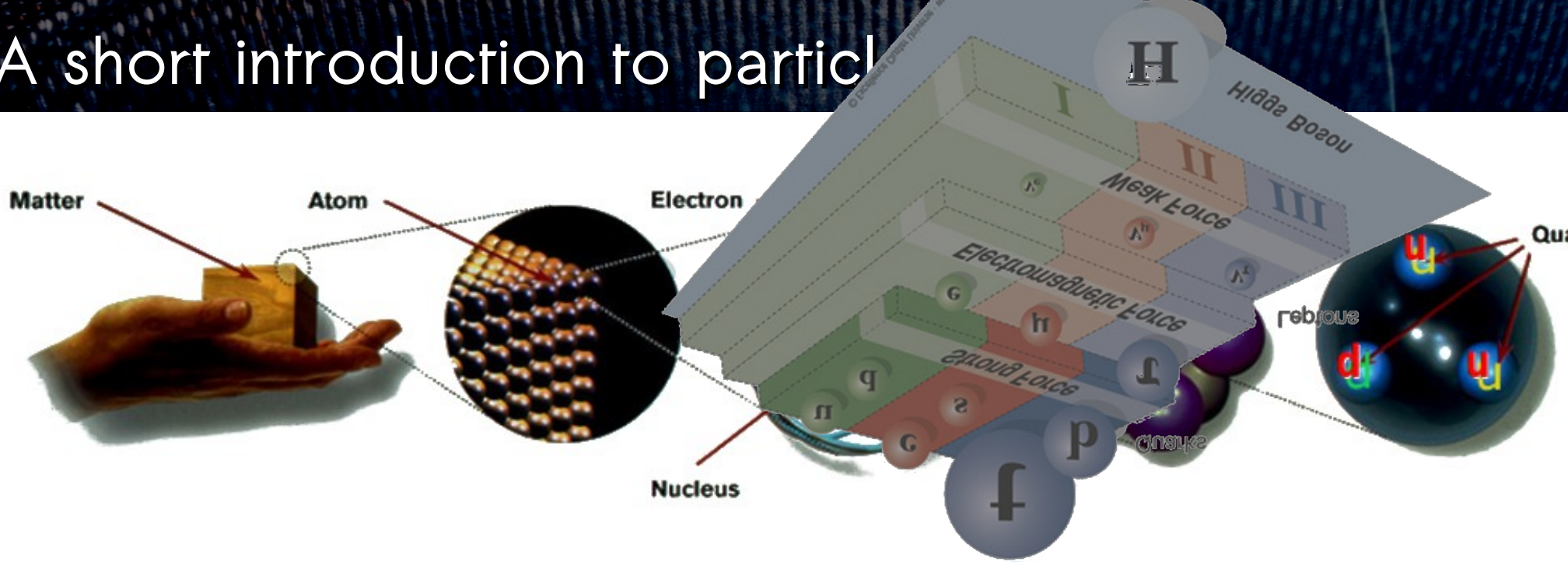


bosons = 8 gluons

boson = 1 photon

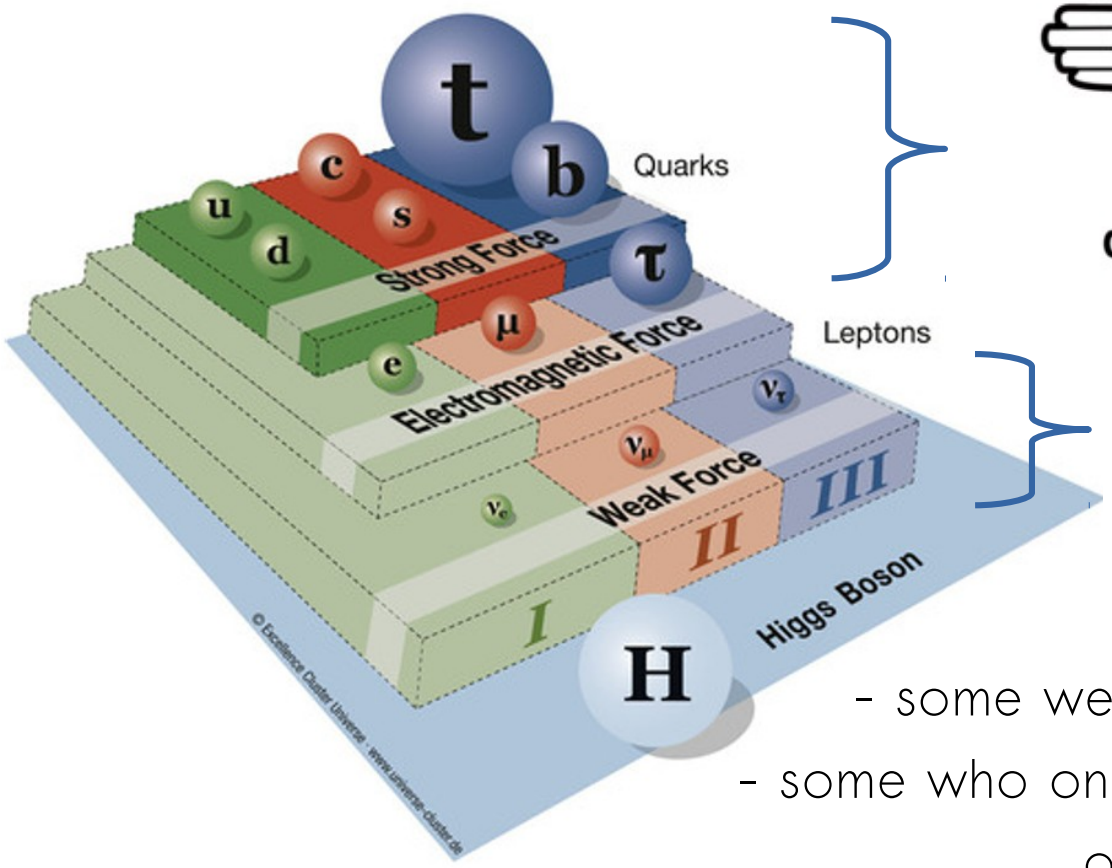
bosons = W^+, W^-, Z^0

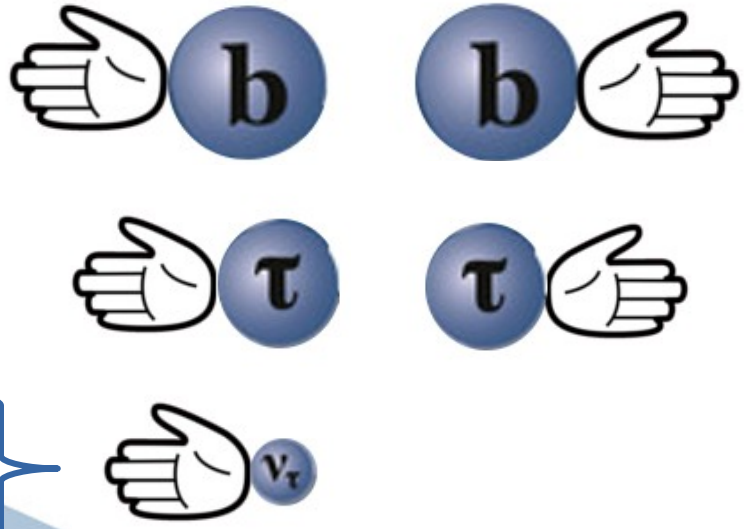
A short introduction to particl



- **All matter is made of particles** : the fermions.
- **Matter sticks together** thanks to particles too : they are the bosor
- **Matter transforms** thanks to interactions between particles.
- All particles have an associated **antiparticle**.

The case of neutrinos

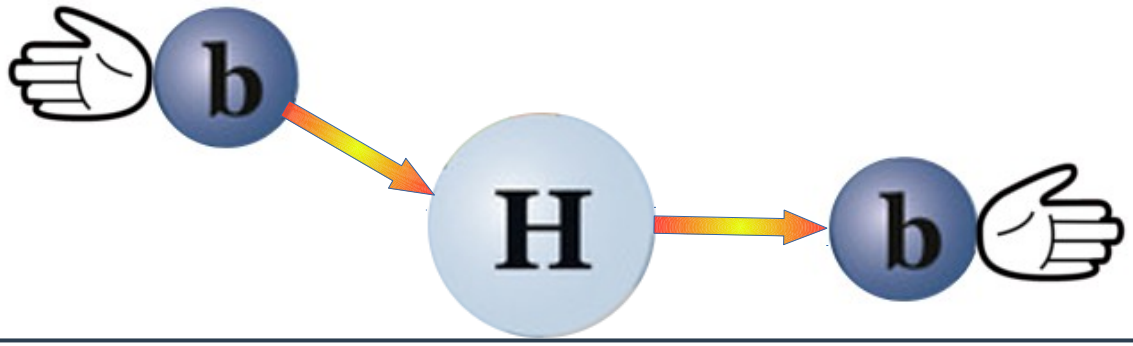


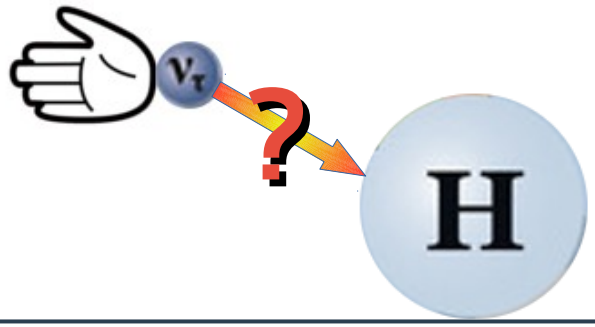


Particles have specific properties :

- some we all heard about : mass, electric charge;
- some who only exist at quantum level : spin, isospin...

...one of them is the <u>helicity = handedness.</u>

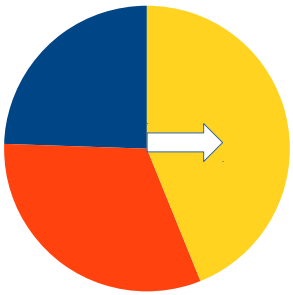




Neutrino oscillates

Flavours: electron
muon
tau

A **neutrino without mass** do not rotate:



Neutrino oscillates

Flavours: electron
muon
tau

A **neutrino without mass** do not rotate:
we will always see a muon neutrino !

Neutrino oscillates

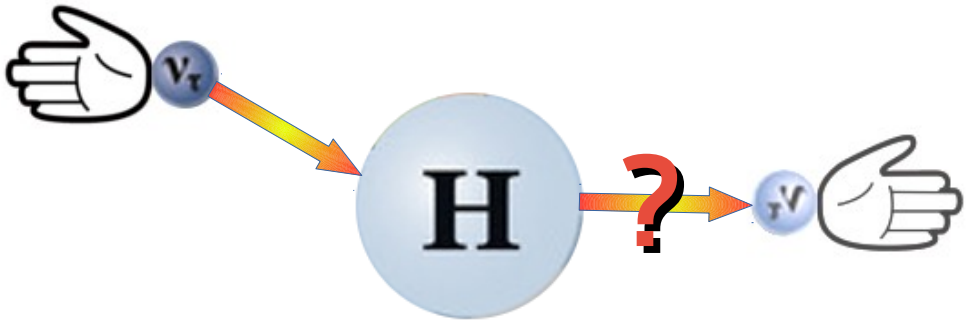
Flavours: electron
muon
tau

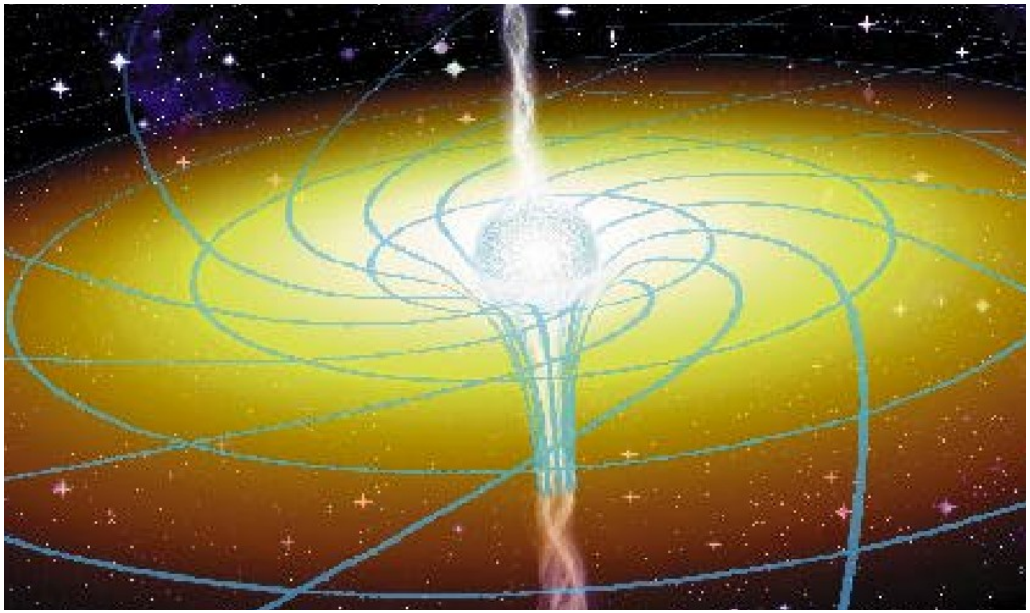
A **neutrino without mass** do not rotate:
we will always see a muon neutrino !

A **neutrino with mass** rotates:
we can see a different flavour !

Why is it important ?

- Is there a **right-handed** hiding neutrino ?
  Or **new mechanisms** to give mass ?

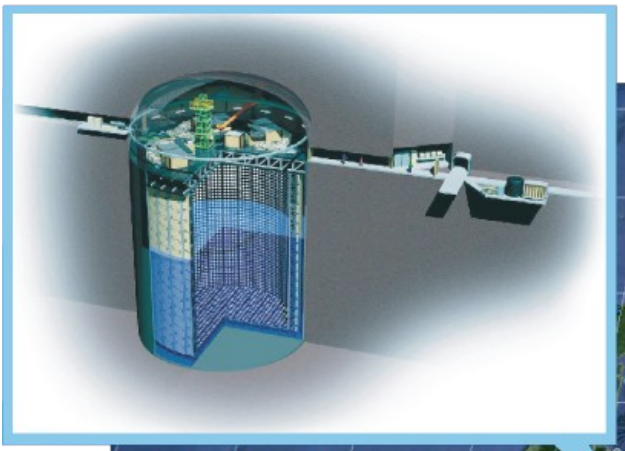




- **We don't understand mass** :
  in particle physics, it is given by the Higgs boson,
  in gravitation, it is matter changing space-time geometry

- It can explains the **absence of antimatter** in the Universe.

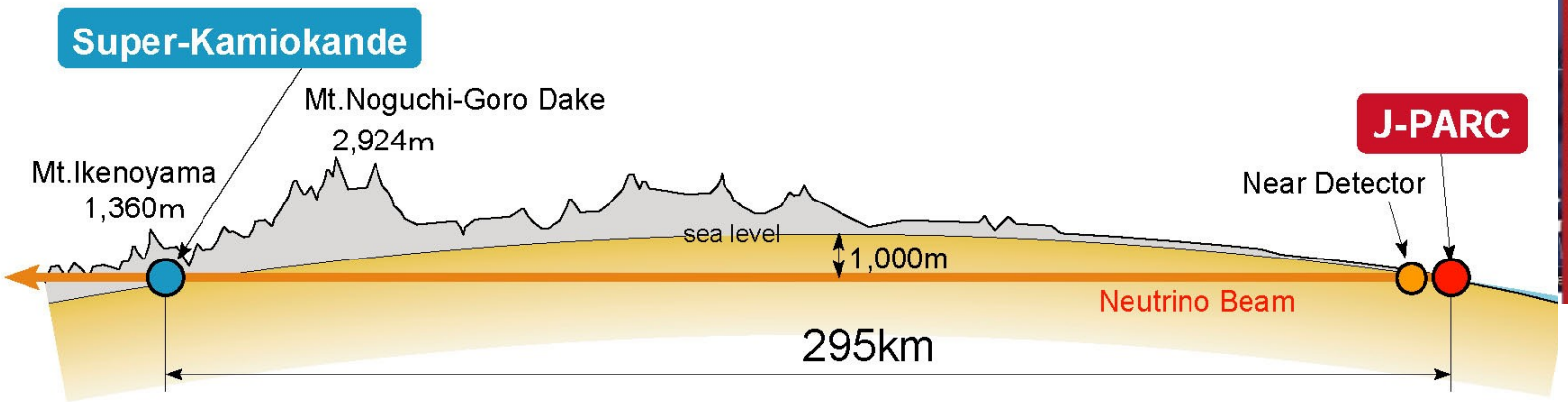
The T2K experiment



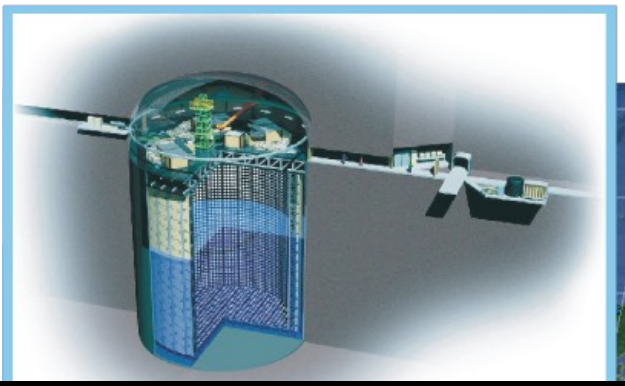
Super-Kamiokande
(ICRR, Univ. Tokyo)

295km

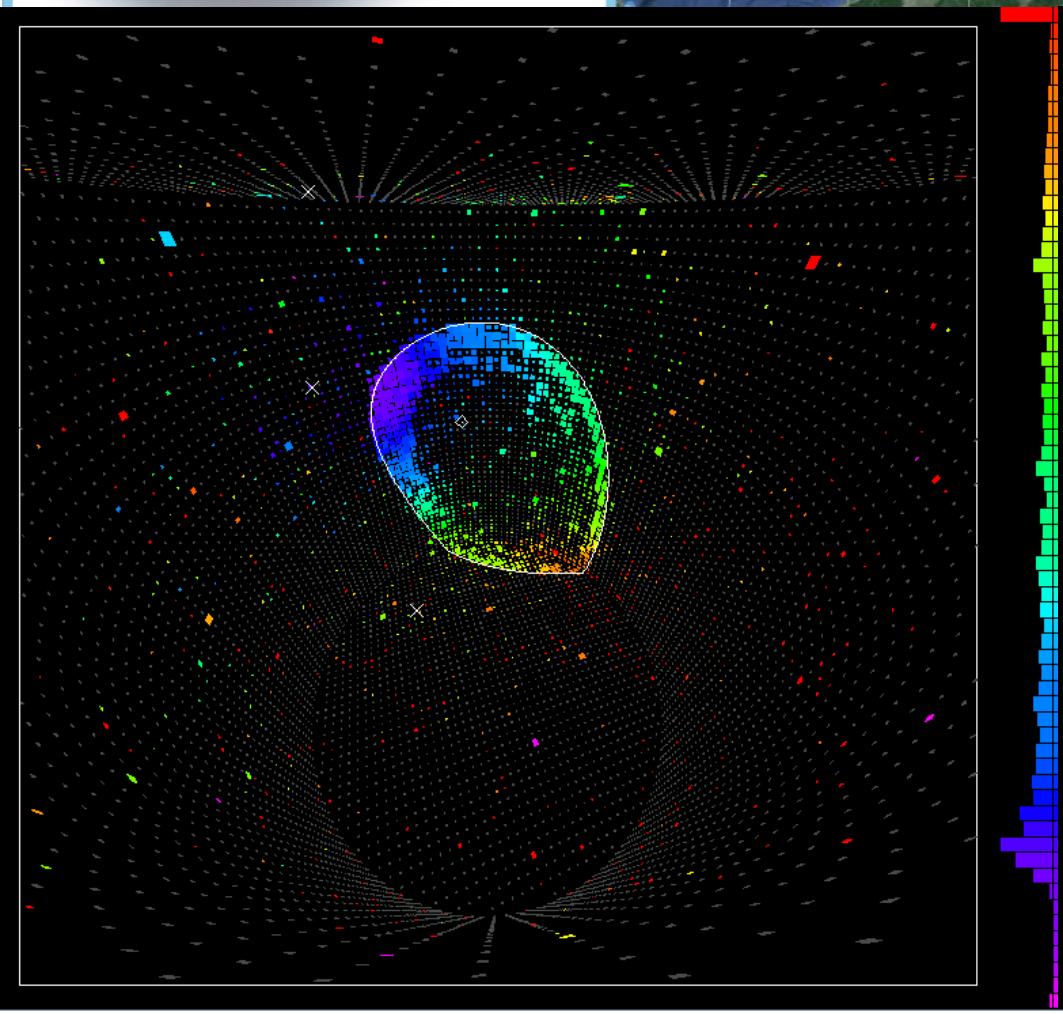
Neutrino Facility
at J-PARC
(KEK-JAEA, Tokai)

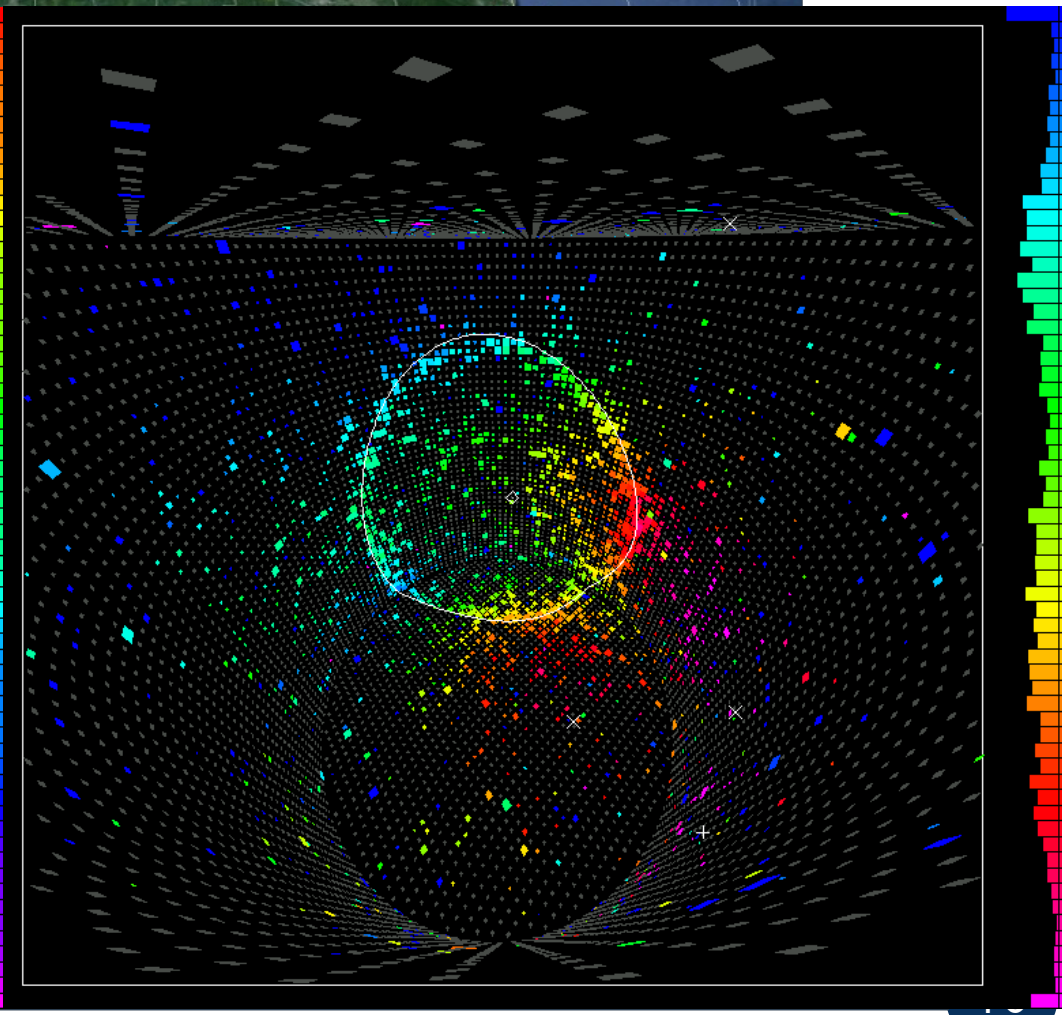


Super-Kamiokande



T2K





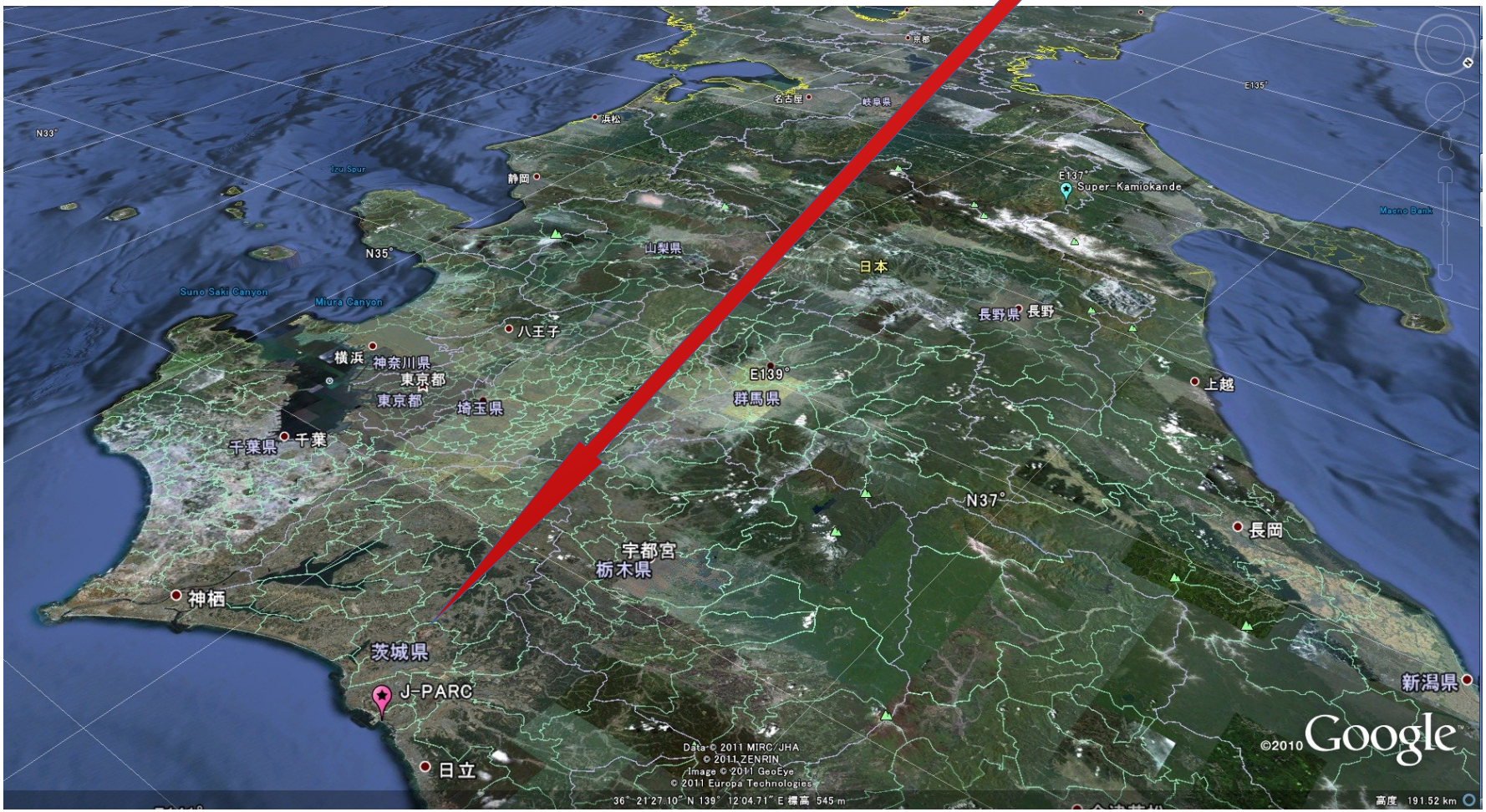
The T2K collaboration

473 collaborators, 58 institutions, 11 countries

Visits to Japan

- 3 collaboration meetings per year
- 2 weeks of shift per year (in theory)
- X conferences...

} in J-PARC, Tokai-mura, Ibaraki



Visiting Japan

- **J-PARC dormitories** are available to rent, some universities bought apartments.

Visiting Japan

- **J-PARC dormitories** are available to rent, some universities bought apartments.
- A T2K member organise **social sport** at each collaboration meeting.
- The Tokai cultural association organises **“typically Japanese” activities**.

Calligraphy trial lesson

Demonstration of procedure for making tea

Visiting Japan

- **J-PARC dormitories** are available to rent, some universities bought apartments.
- A T2K member organise **social sport** at each collaboration meeting.
- The Tokai cultural association organises **“typically Japanese” activities**.
- **Buses and train** schedules are very convenient to reach Narita.
- Some restaurants translated their **menu in English**.
- If you stay long time you can take **Japanese classes and swim or climb**.
- We have a **T2K secretary** who helps us for any kind of issues.

2015 is the neutrino year !

Nobel prize given to neutrino oscillations !

Breakthrough prize given to 6 neutrino oscillations collaborations !

Thank you for your attention !
ありがとうございます