

# 50th Anniversary of France-Japan Scientific Cooperation

from LHC Programs, especially,

## ATLAS Experiment

Masaya Ishino

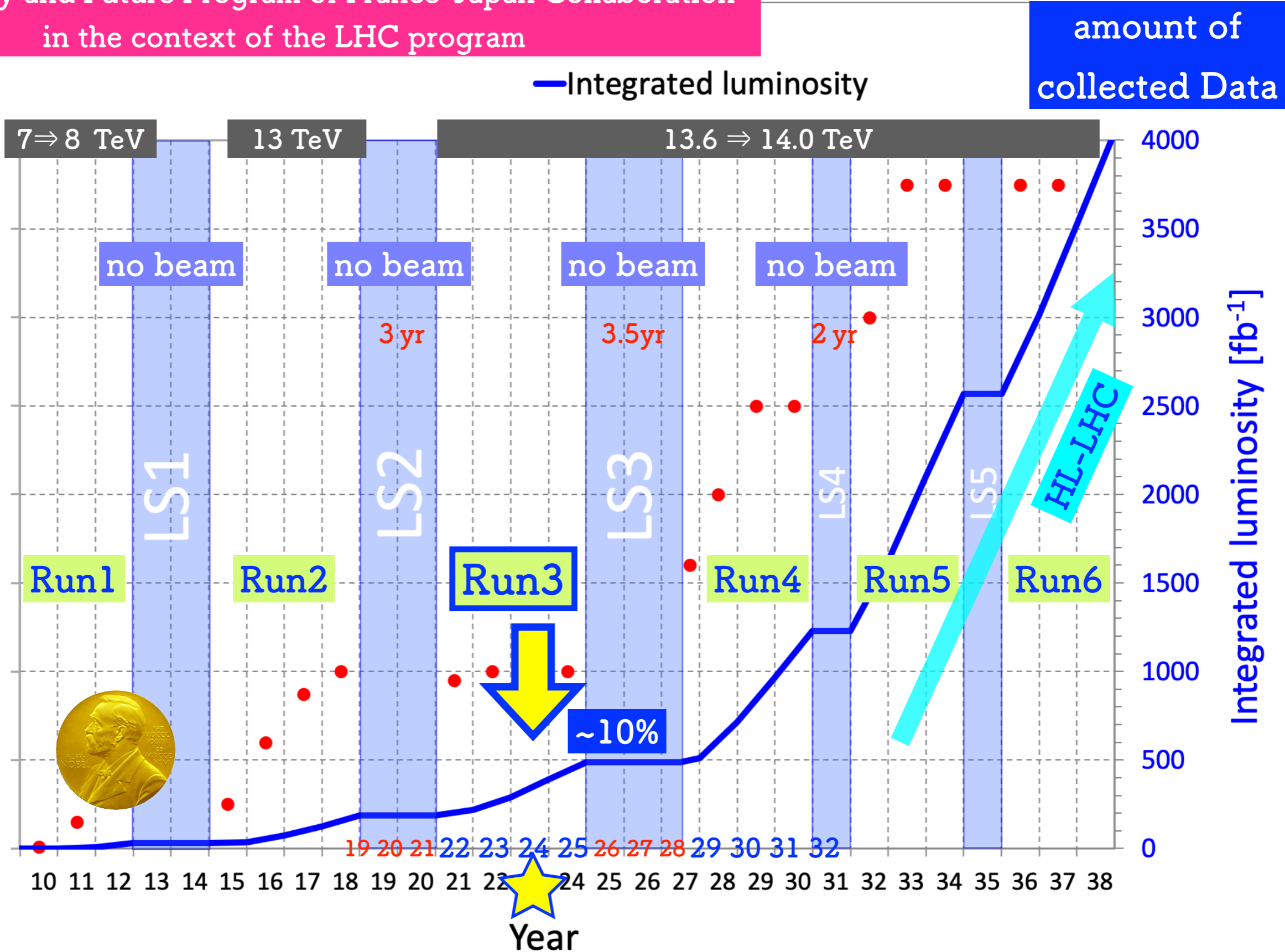
( ICEPP, UTokyo )

2024.10.09



# LHC Program - Past and Future

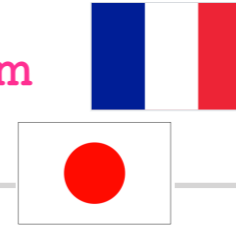
Long History and Future Program of France-Japan Collaboration in the context of the LHC program



# Discovery of Higgs Boson in 2012

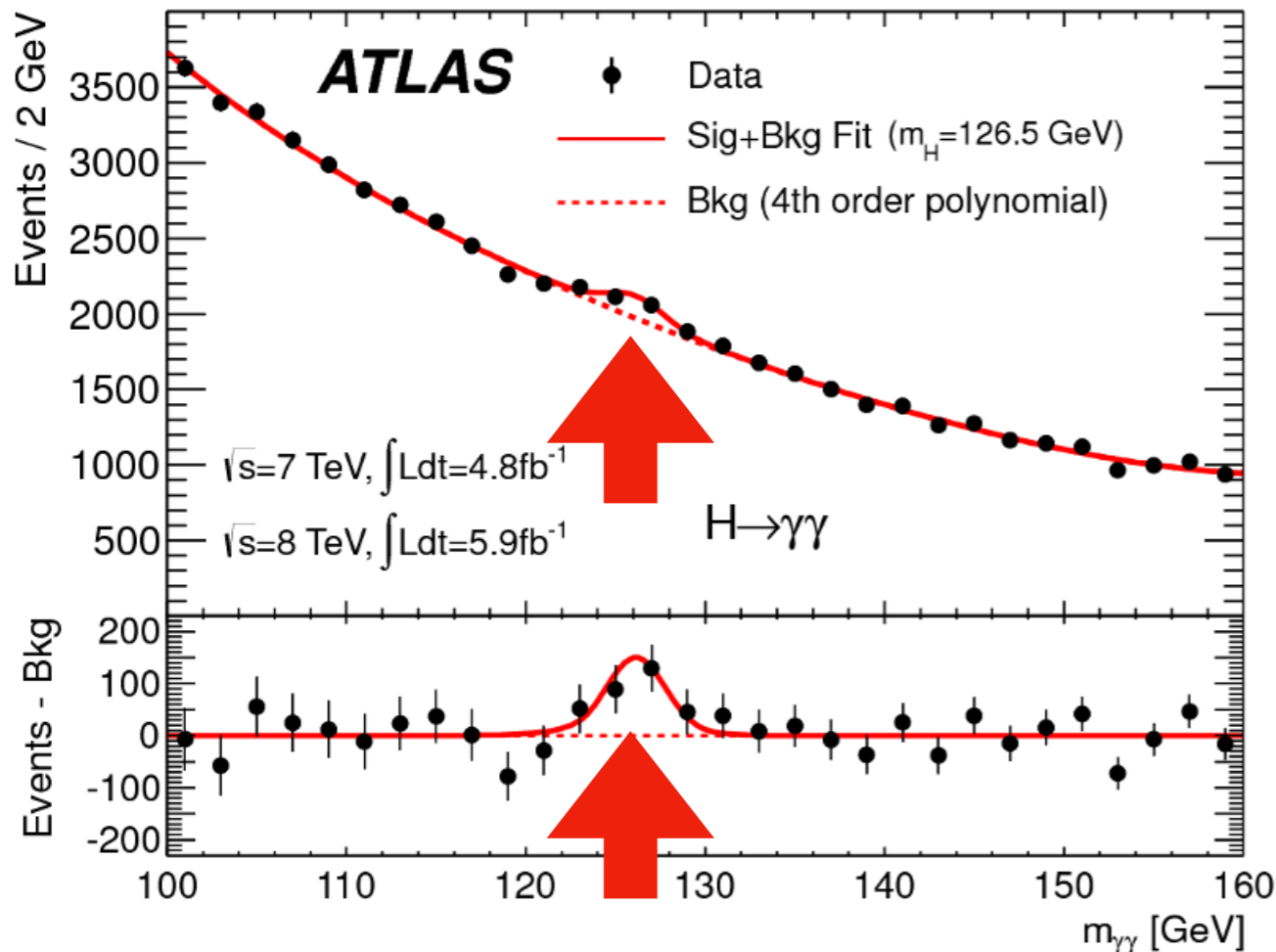
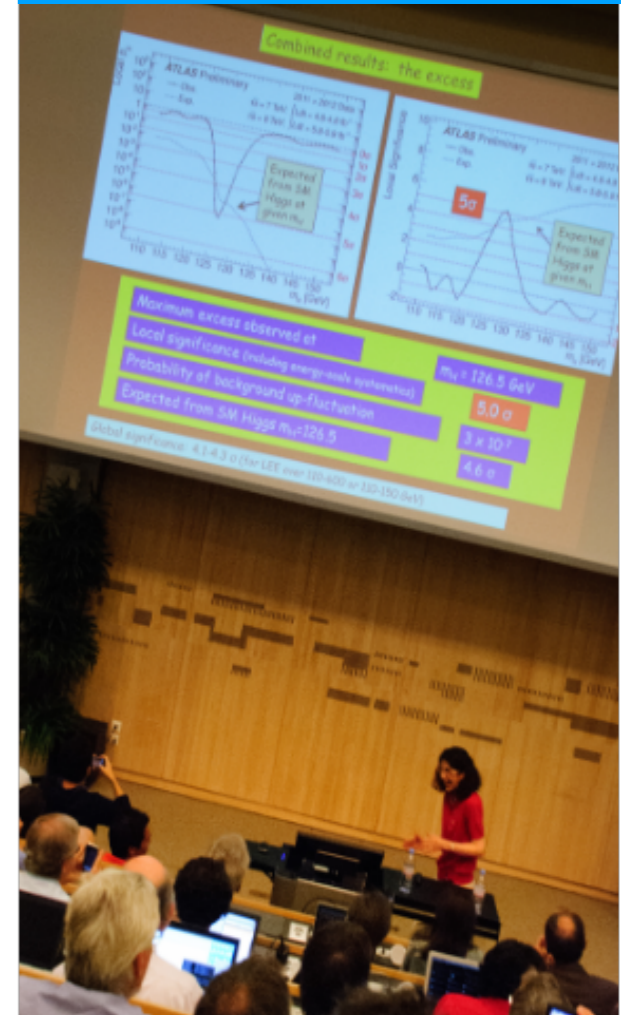


- $H \rightarrow \gamma \gamma$  was one of the Higgs decay modes to discover the presence of Higgs
- Here, the strong collaboration between France and Japan.
  - ▶ Key Detector (Liquid Argon Calorimeter) ,  $\gamma$  Identification Algorithm
  - ▶  $H \rightarrow \gamma \gamma$  Analysis Team



Higgs Seminar at CERN

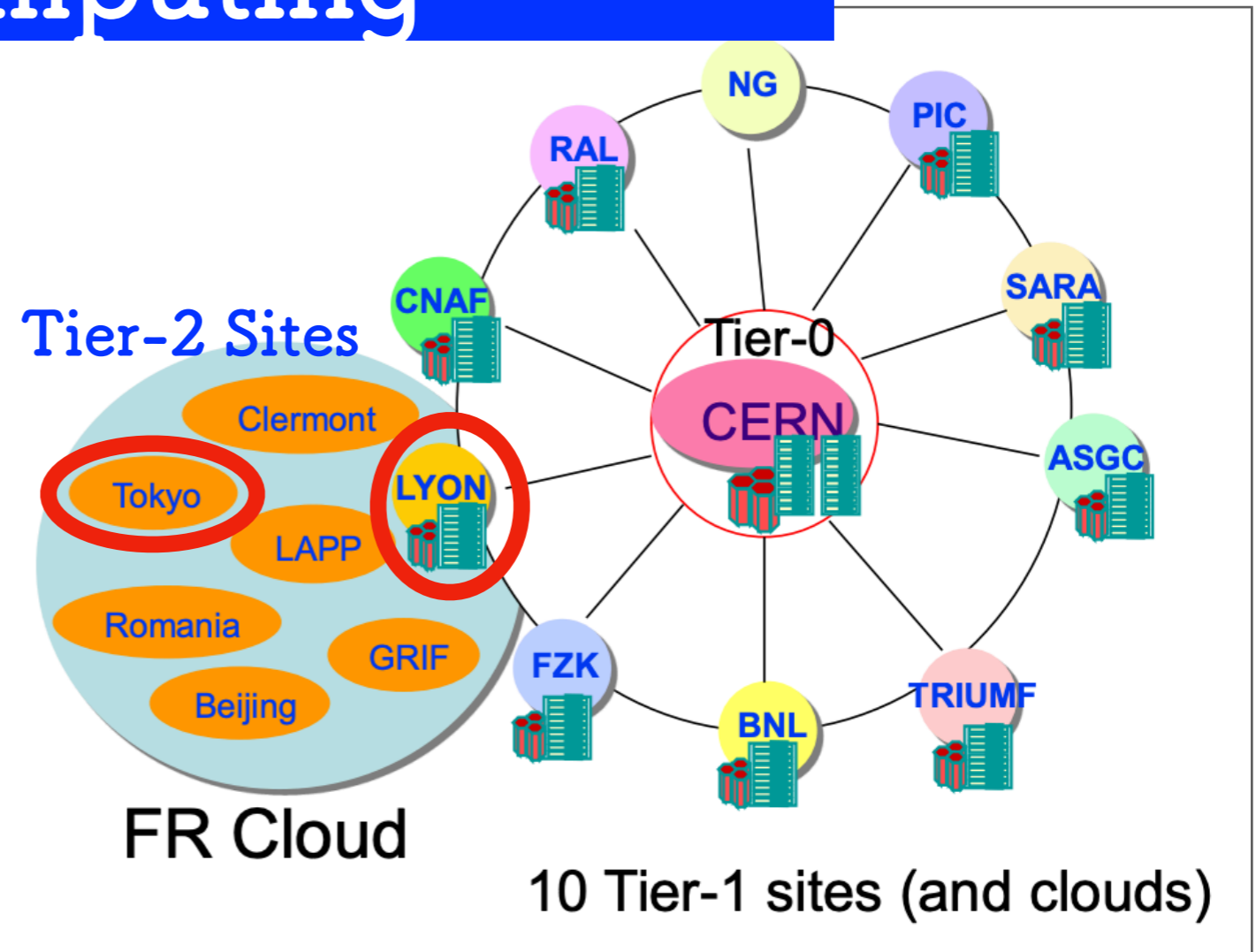
4 July 2012






 東京大学  
 THE UNIVERSITY OF TOKYO


# Computing

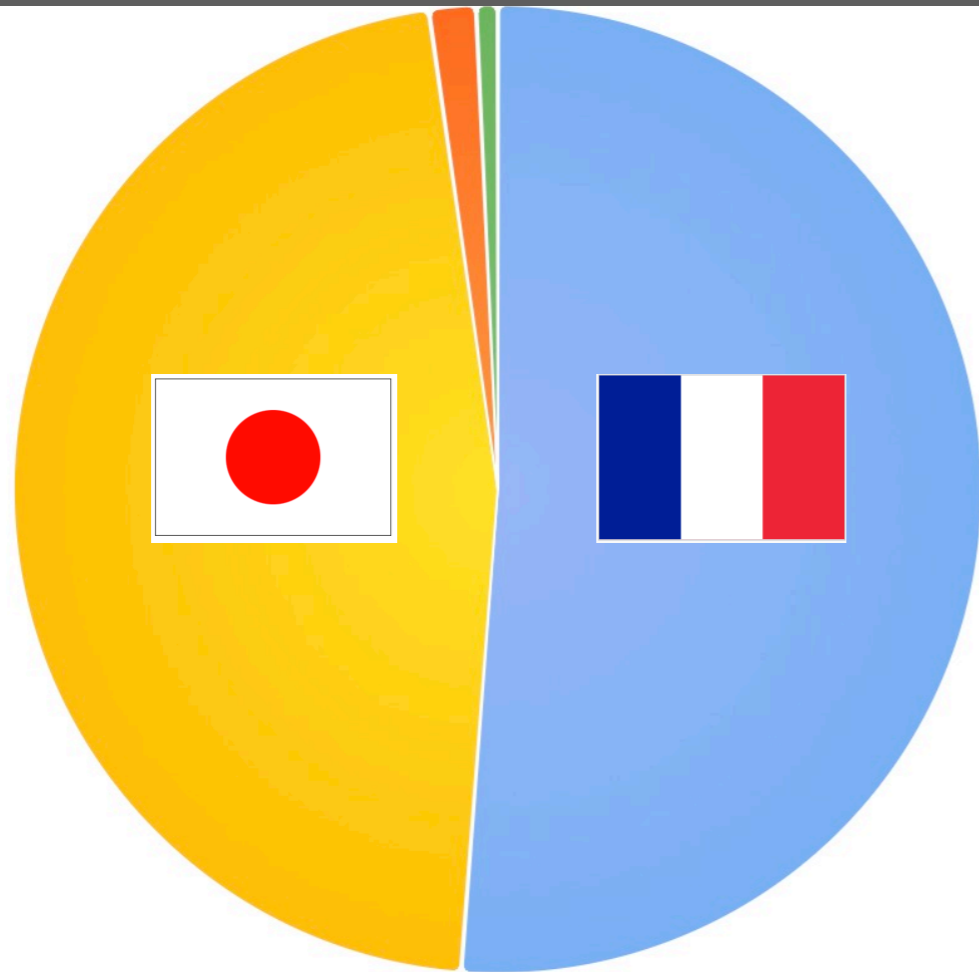


Data: Tier-0 (CERN) → Tier-1 (Lyon) → Tier-2 (Tokyo)

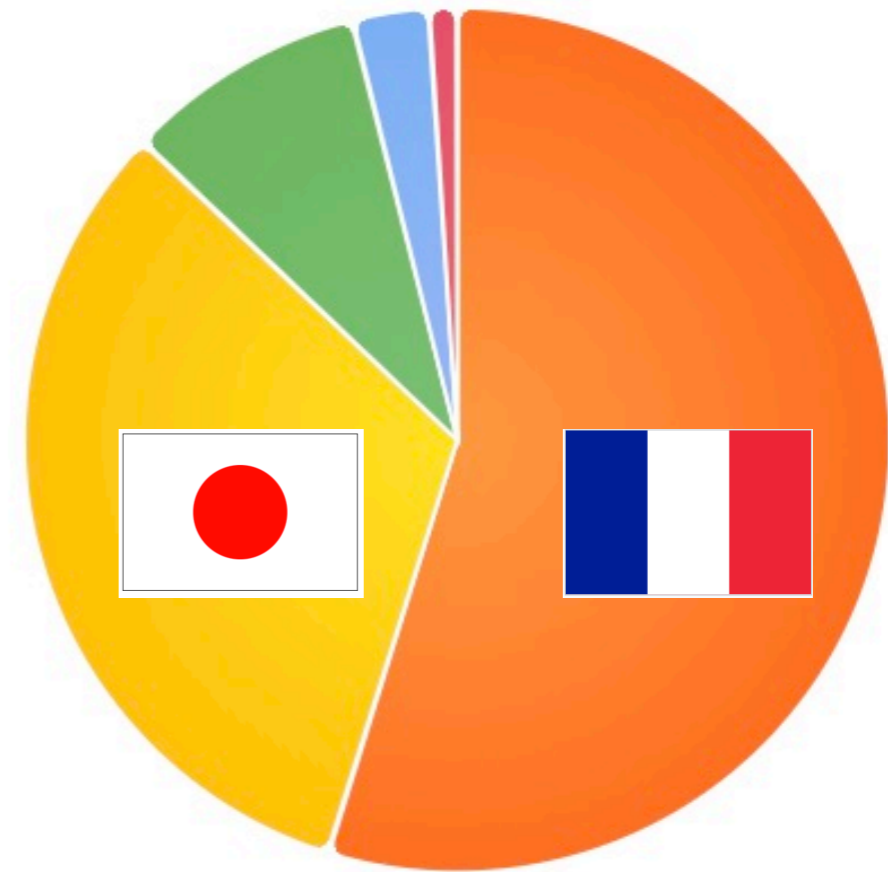
Simulation: Tier-2 (Tokyo) → Tier-1 (Lyon)

4Gbps (2009) >> 100Gbps x 4 (2024)



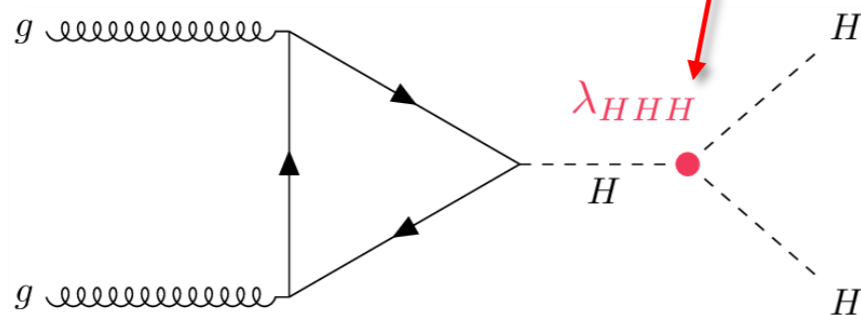
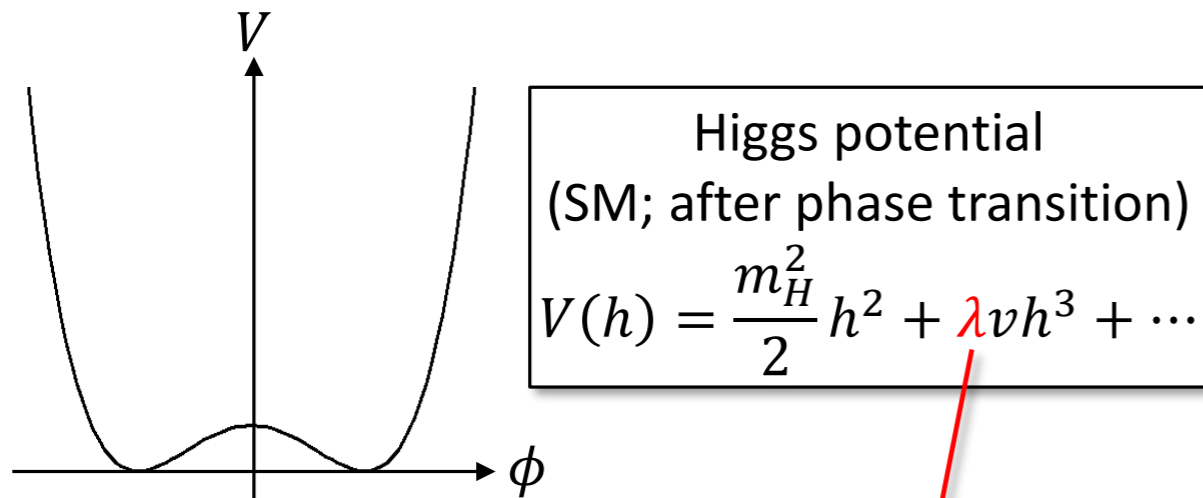
Wall Clock Time ( ~ CPU Time ) of  
 Tier-2 Centers under Fr. Tier-1


	Value	Percent
France	159 Bil	51%
Japan	145 Bil	47%
China	4.61 Bil	1%
Romania	1.99 Bil	1%

 Wall Clock Time ( ~ CPU Time ) of  
 Tier-2 Centers under Fr. Tier-1


	Value	Percent
France	18.1 PB	55%
Japan	10.6 PB	32%
Romania	2.95 PB	9%
Hong Kong SAR	915 TB	3%
China	322 TB	1%

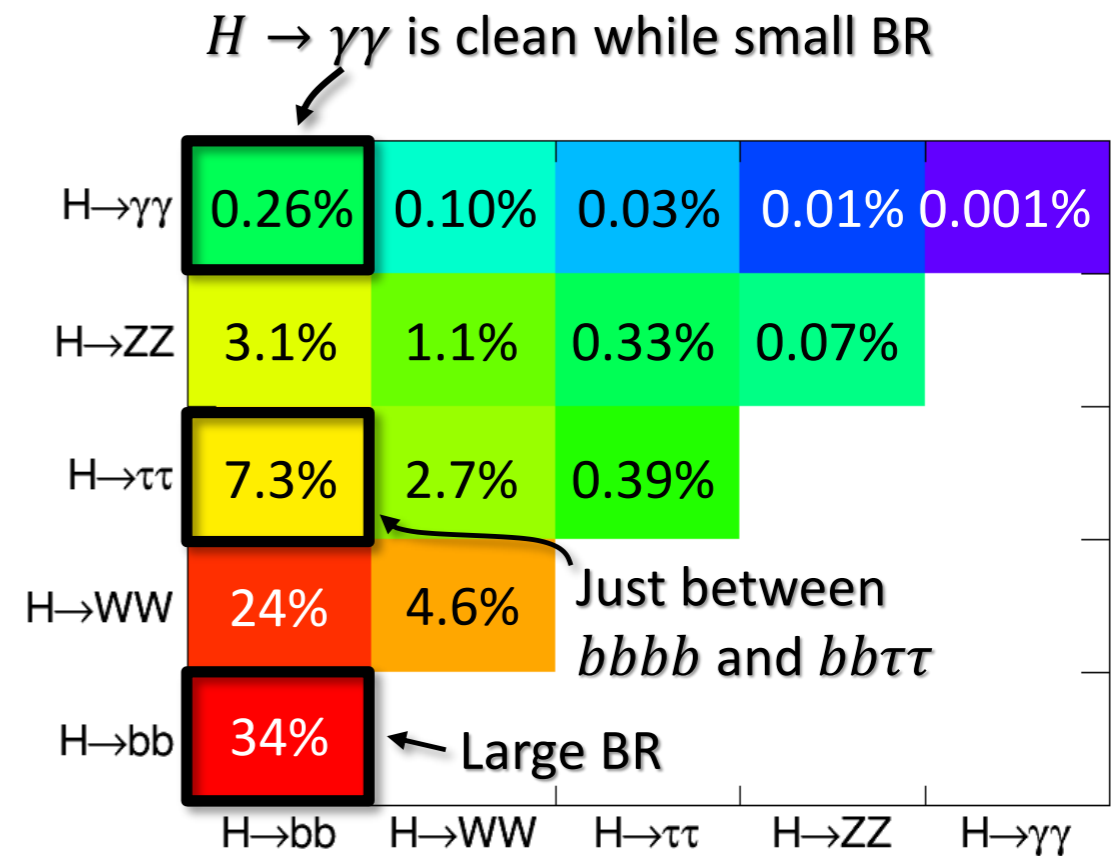
# The Most Important Physics in Coming 10 years



$$\sigma_{HH}^{\text{SM}} = 34.4 \text{ fb}$$

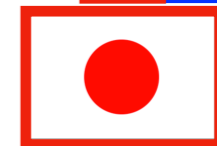
Only ~10,000 events  
in the current dataset

Measuring the  $HH$  process at LHC is still challenging, but important



Three golden channels:

$bbbb$ ,  $bb\tau\tau$ ,  $bb\gamma\gamma$



Maximize the performance by leveraging the strength of  
the Japan & France Group

- The long history of France-Japan Scientific Cooperation in the LHC program
- Major contributions to the Higgs Discovery in 2012
  - $H \rightarrow \gamma \gamma$  Analysis
  - $H \rightarrow 4\mu, 2\mu 2e, 4e$  Analysis
  - Computing [ Tier-1 & Tier-2 ]
- Detector Upgrade: Liquid Argon Calorimeter
- Important Physics Program of the measurement of the di-Higgs Process is coming ( High-Luminosity LHC ): The collaboration of France-Japan will play an important role





# Discovery of Higgs Boson in 2012

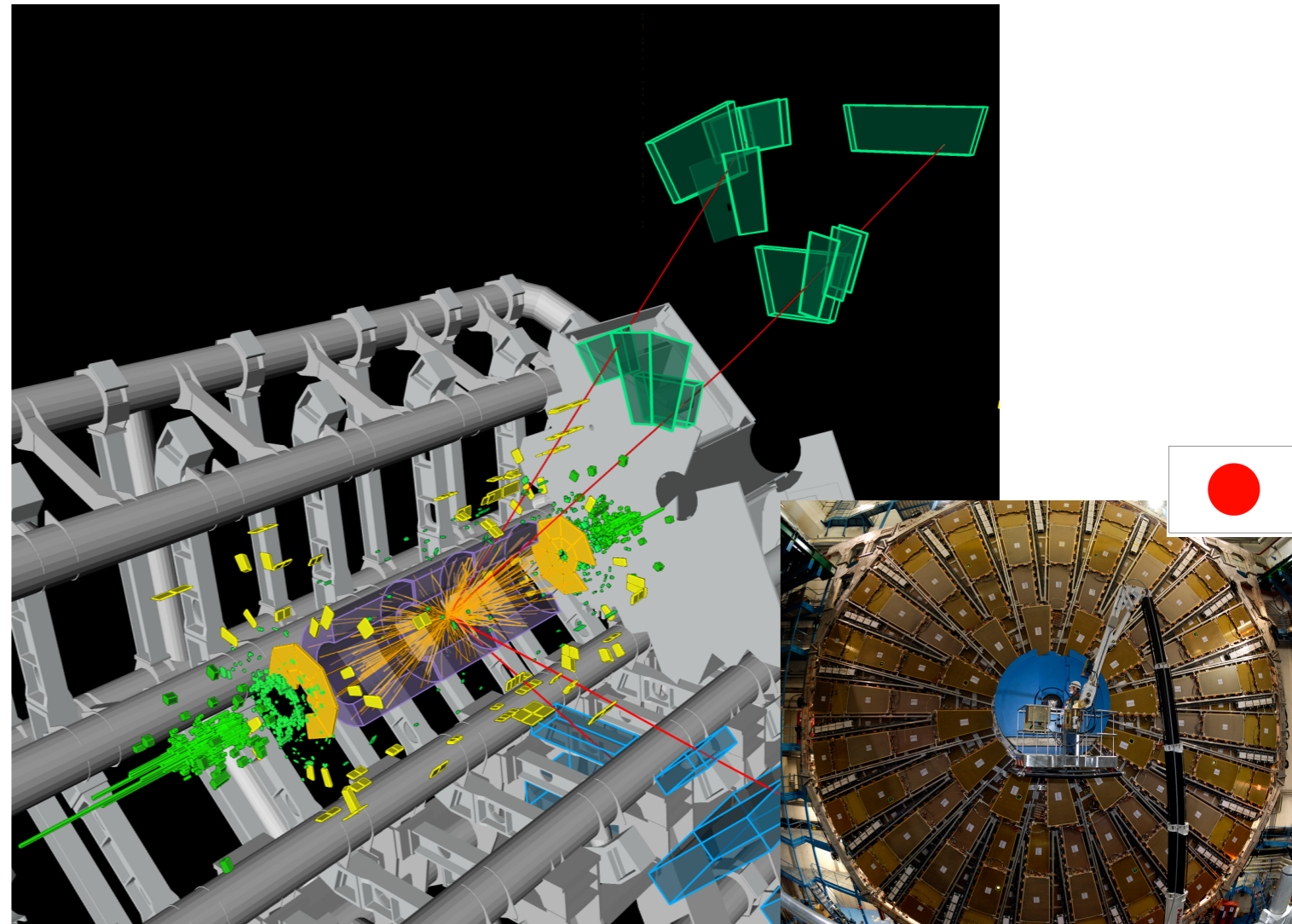
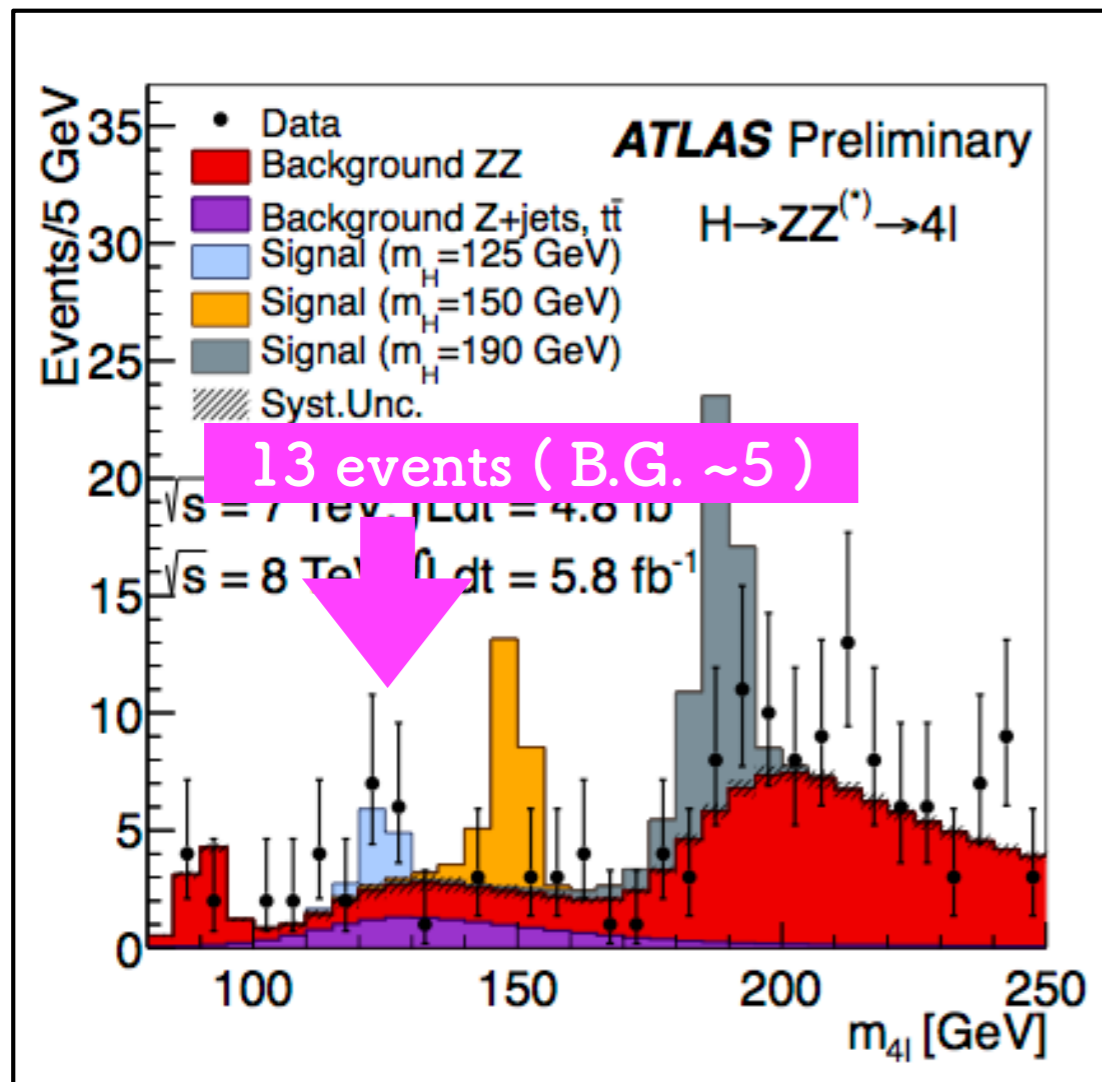
$$H \rightarrow 4\mu, 2\mu 2e, 4e$$

- $H \rightarrow 4\mu, 2\mu 2e, 4e$  : the other Higgs decay mode to discover Higgs

- Here, the strong collaboration between France and Japan.

▶  $\mu$  Detector Design, Drift-Tube Detector, Reconstruction Software, Higgs Analysis 

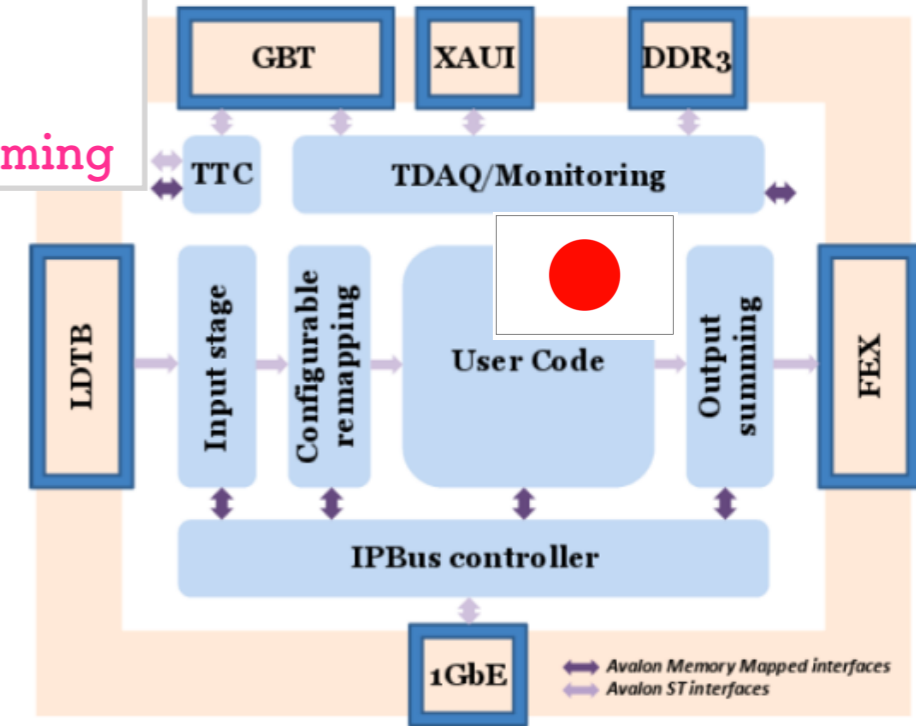
▶  $\mu$  Trigger System 



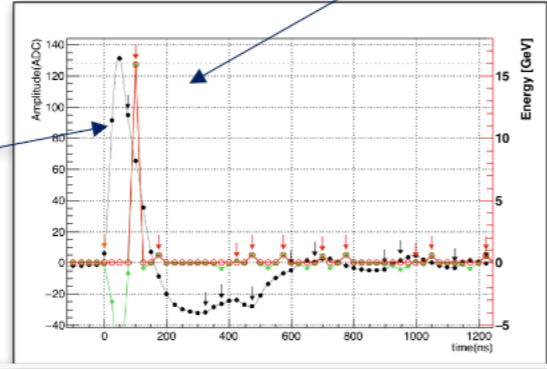
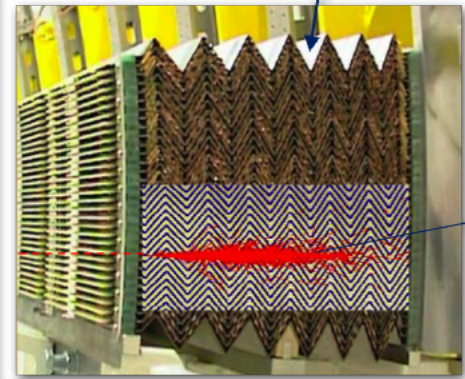
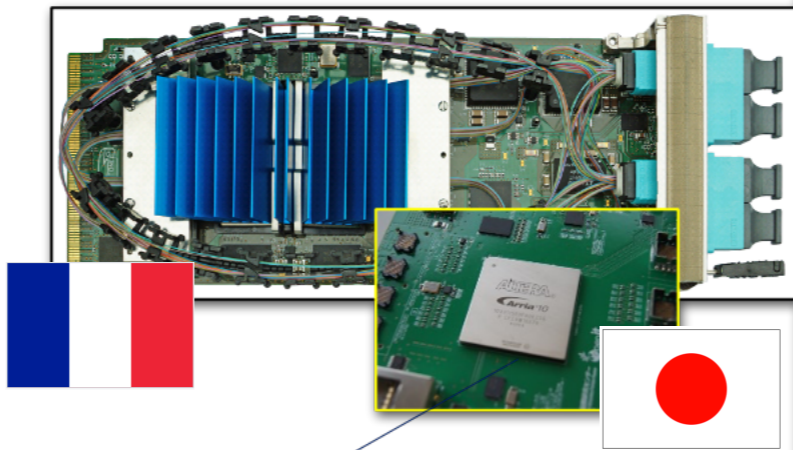
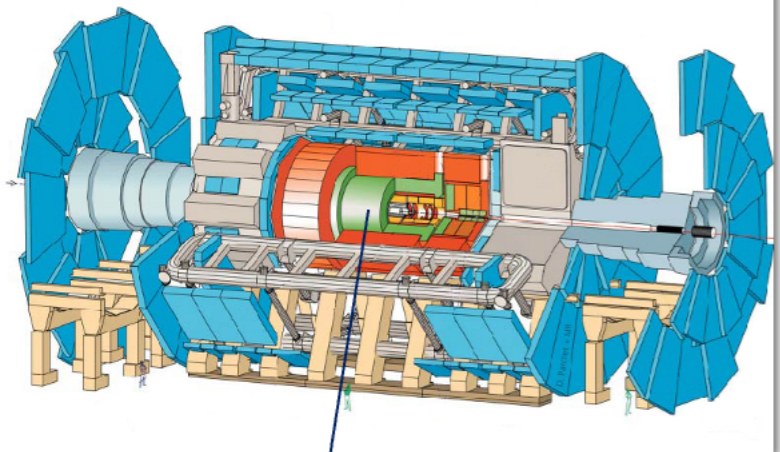


## Liquid Argon Calorimeter

- Here, the strong collaboration between **France and Japan**.
  - ▶ France: The main institute of the Liquid Argon Calorimeter Group
  - ▶ Japan : UTokyo developed the major firmware to estimate Energy & Timing



### Firmware in the main FPGA



Energy  
Timing



Liquid Argon Group Meeting in Tokyo (2018)