Computing system at Belle II experiment

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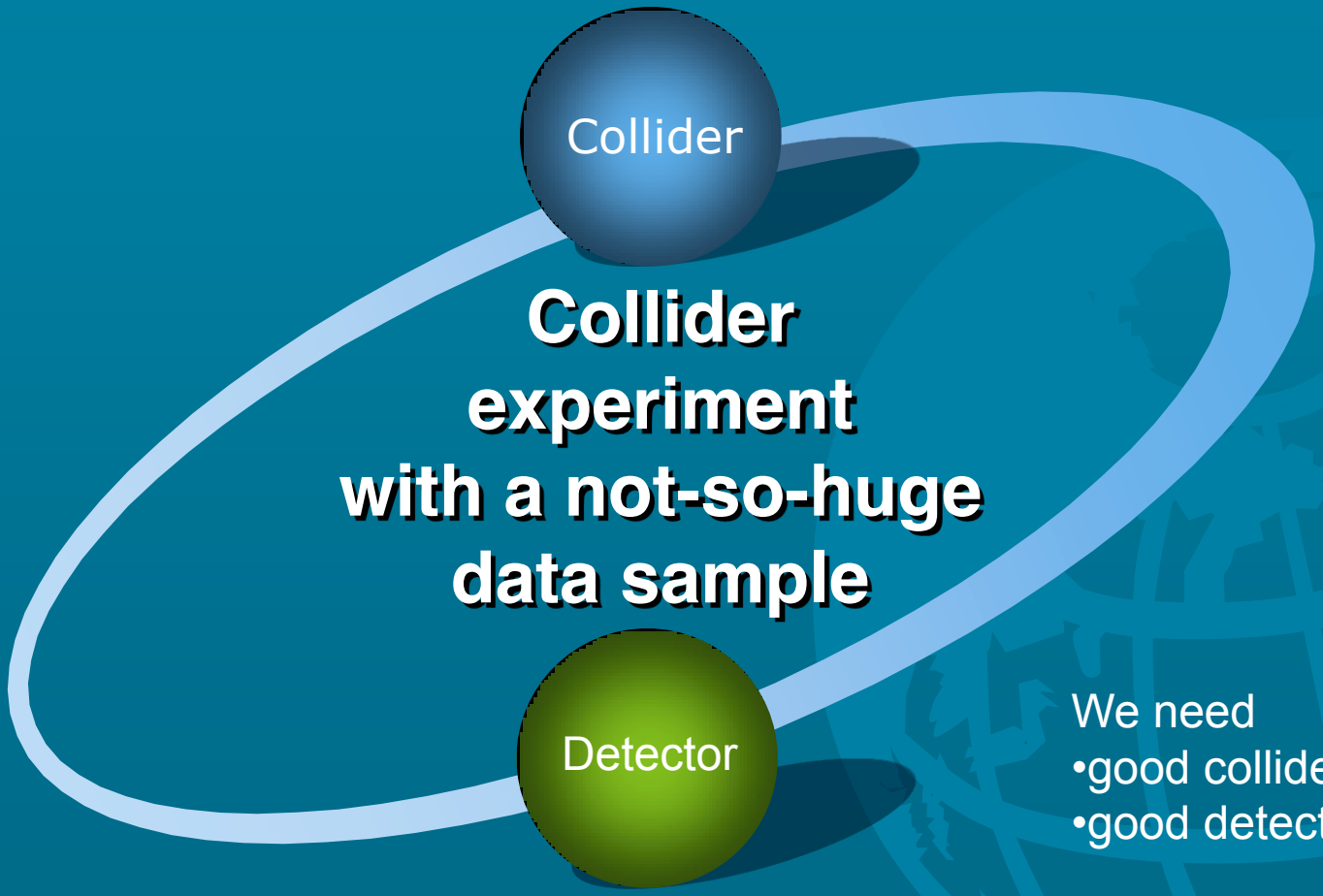
Experiments before LHC era

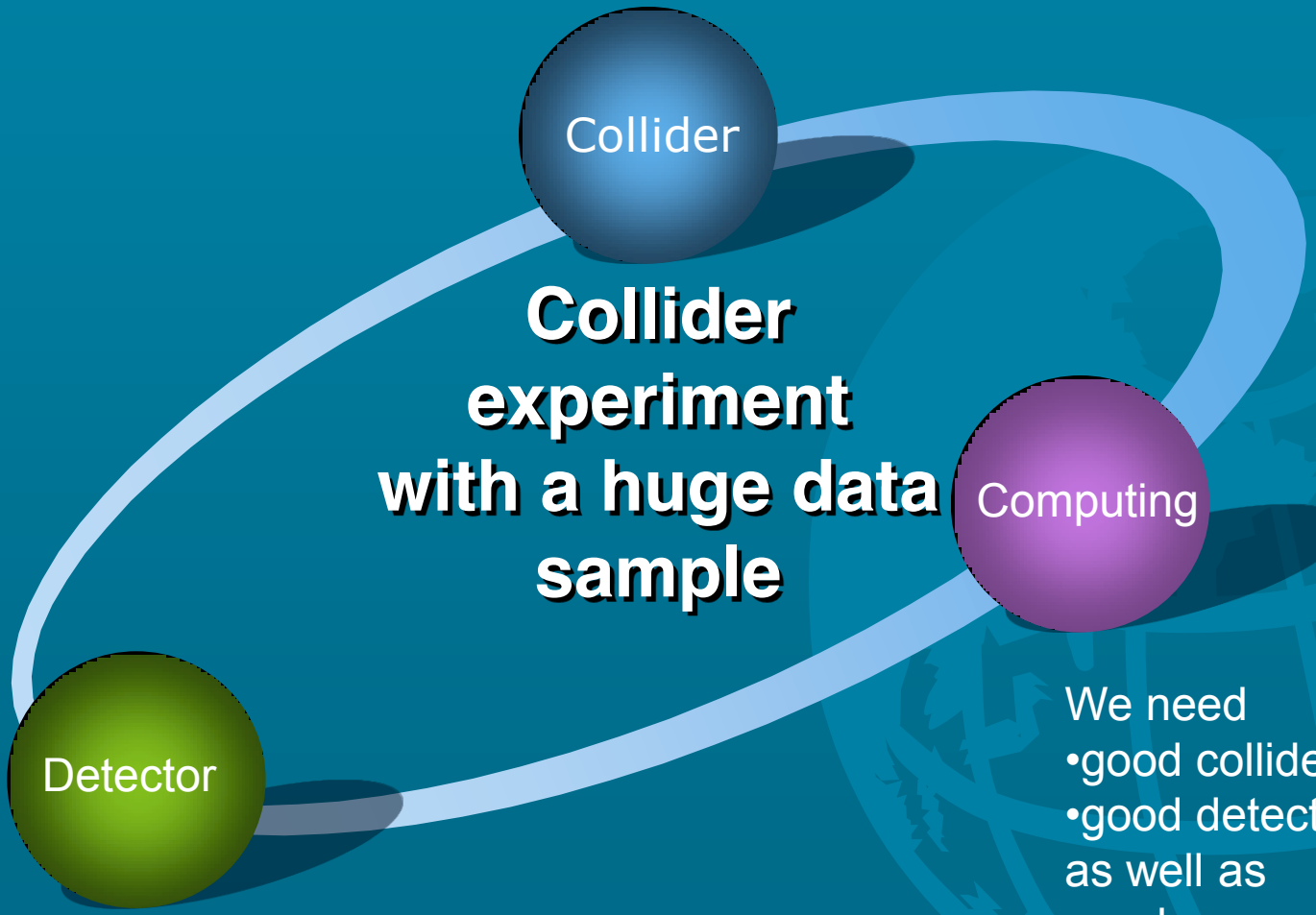
Keys for the success of the experiment



We need
- good collider
- good detector

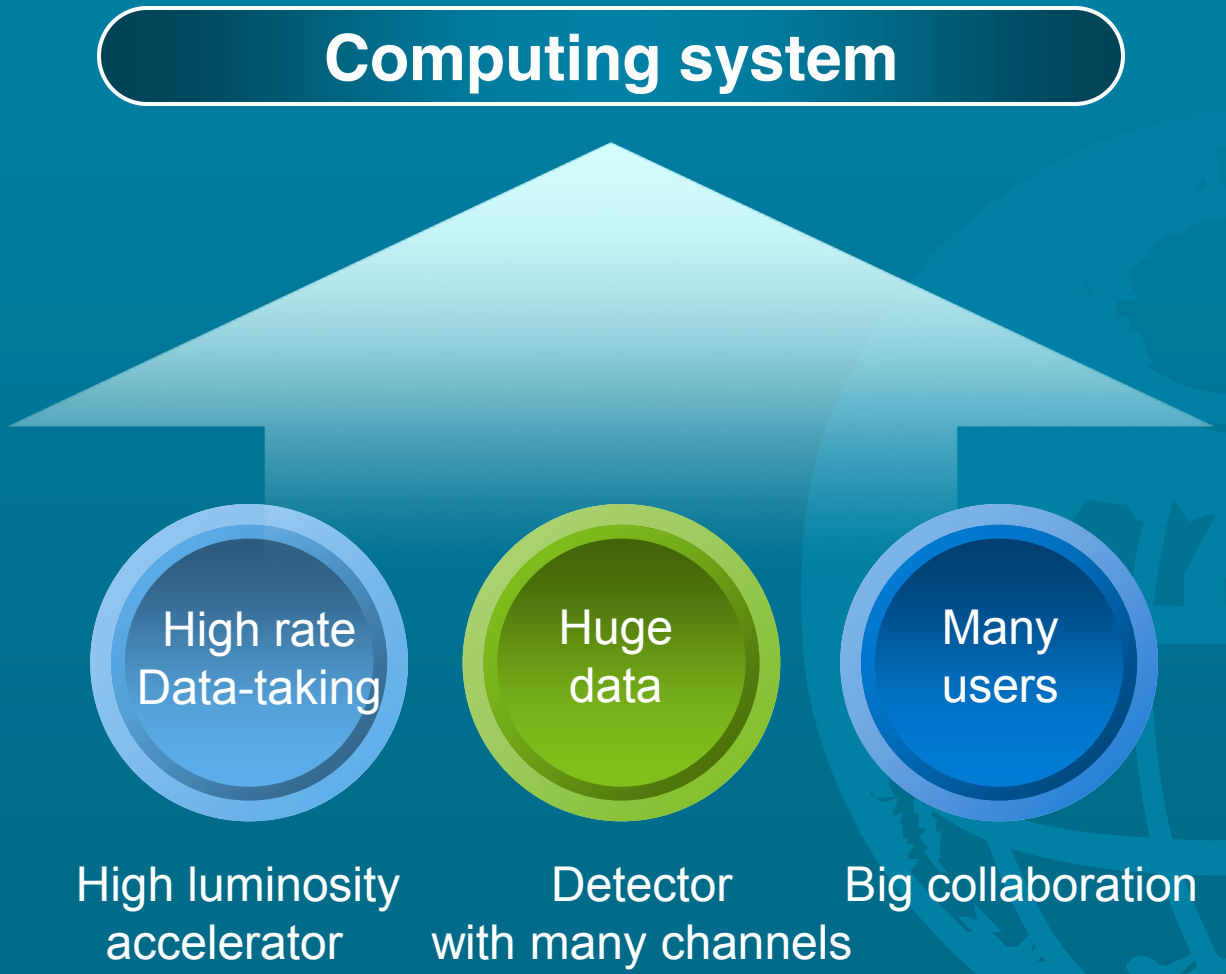
Modern experiments

Keys for the success of the experiment



We need
•good collider
•good detector
as well as
good computing system

Good computing system?



Good computing system?

Computing system

Many high performance CPUs
Huge size storage

High luminosity accelerator

Detector with many channels

Big collaboration

Good computing system?

Computing system

Many high performance CPUs
Huge size storage

Impossible to be supplied by only one site!

High luminosity accelerator

Detector with many channels

Big collaboration

Good computing system?

Computing system

Many high performance CPUs
Huge size storage

Only one solution is a grid (distributed) computing!

High luminosity accelerator

Detector with many channels

Big collaboration

Grid (distributed) computing system

Roughly say, by gathering computing resources over the world, unify them and make them look like only one computer!

→ ***We can have high-performance CPU and huge storage.***

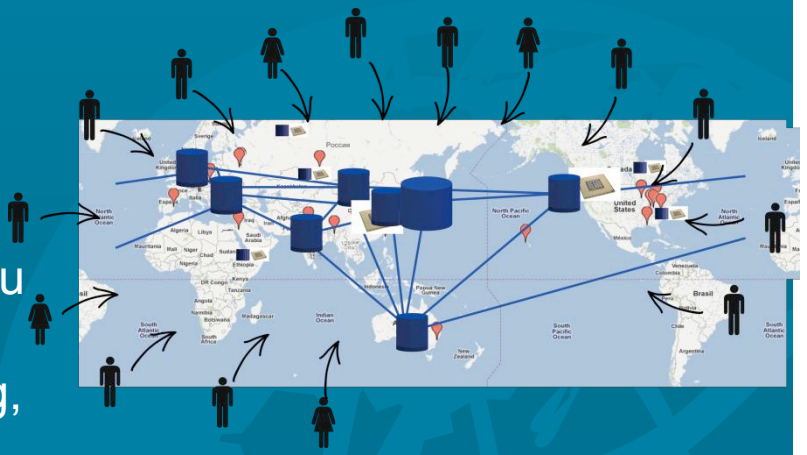
Why it is called GRID?

→Analogy to Power Grid

- •Don't care which power plant generates electricity
- •Once you plug your equipment, you can get the electricity
- •Follow the standard. Shape of plug, voltage, frequency.

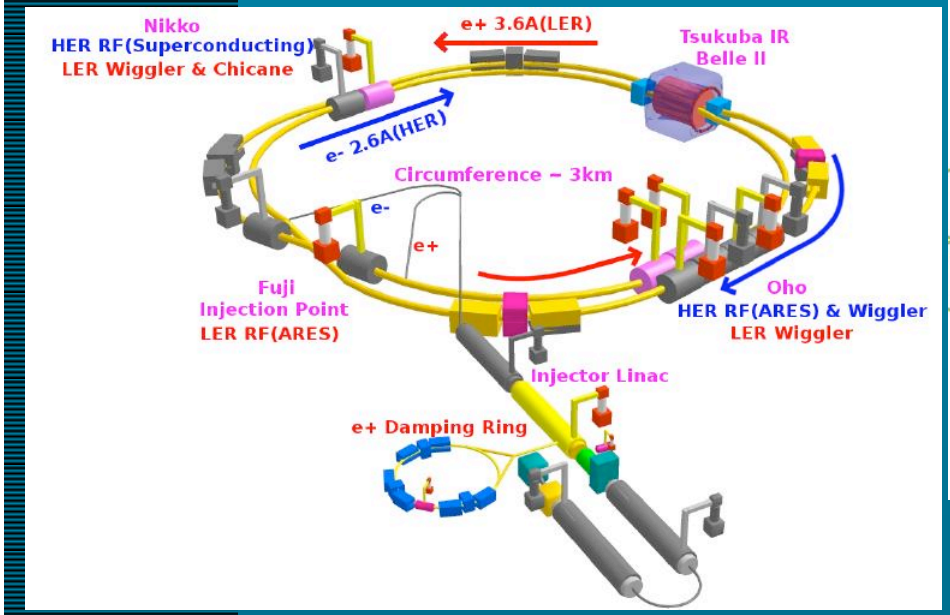
→Computing Grid

- •Don't care which resource center processes your data
- •Once you plug your computer, you can get the processing power
- •Follow the standard. Communication protocols.



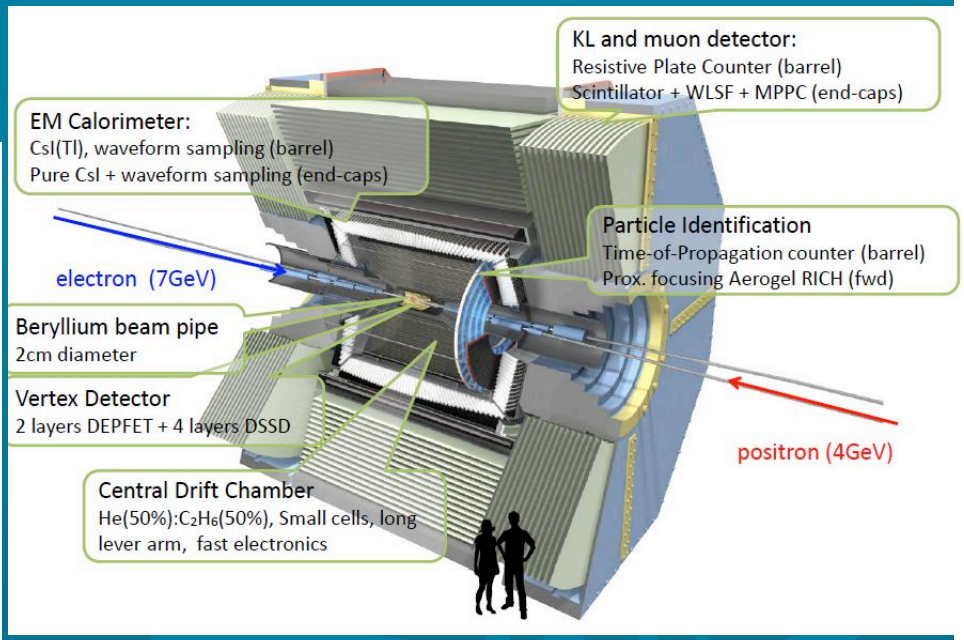
SuperKEKB and BelleII

Finally, 50ab^{-1} will be collected.



Vertical β function: 5.9 mm → 0.27/0.30 mm (x20)
Beam current: 1.7/1.4 A → 3.6/2.6 A (x2)

→ L = 2x10^{34} cm^{-2}s^{-1} → 8x10^{35} cm^{-2}s^{-1} (x40)

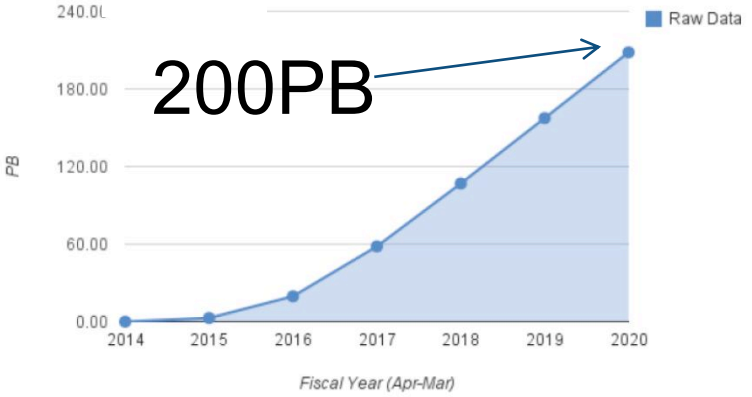


SVD: 4 DSSD lyrs → 2 DEPFET lyrs + 4 DSSD lyrs
CDC: small cell, long lever arm
ACC+TOF → TOP+A-RICH
ECL: waveform sampling, pure CsI for end-caps
KLM: RPC → Scintillator +SiPM (end-caps)

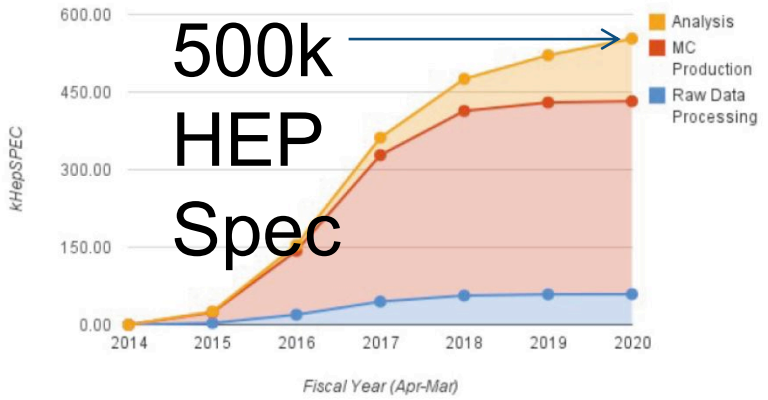
Requirements from Belle II

Estimation depends on the accelerator performance. Resources will be assigned to each country to satisfy this demand with the weight which is proportional to No. of the students to get PhD.

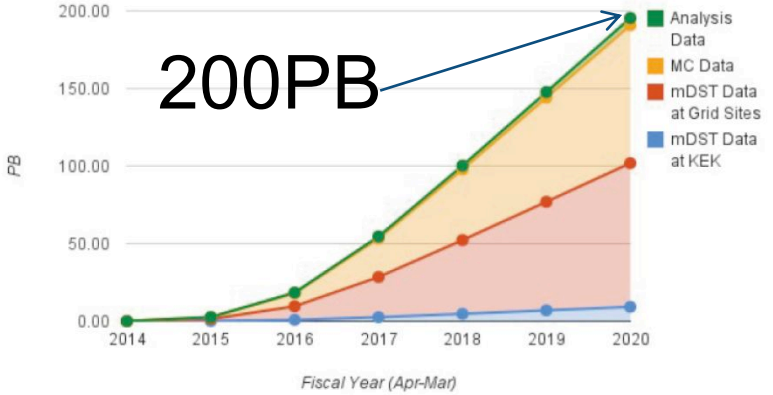
TAPE



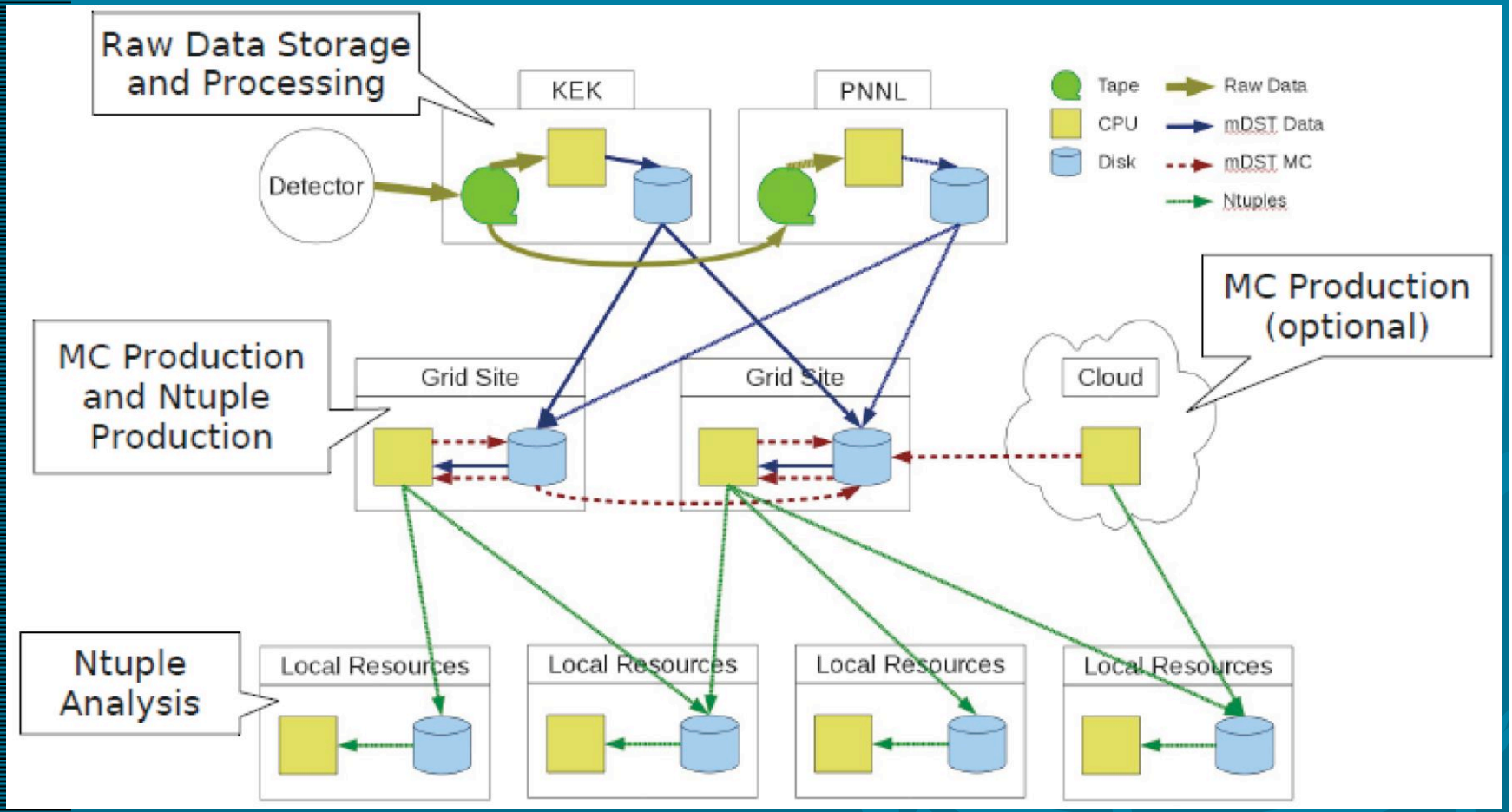
CPU



DISK



Belle II computing model



Just a 2-layered structure (Main & local sites)

PNNL= Pacific Northwest National Laboratory

Software framework for Belle II GRID

DIRAC
THE INTERWARE

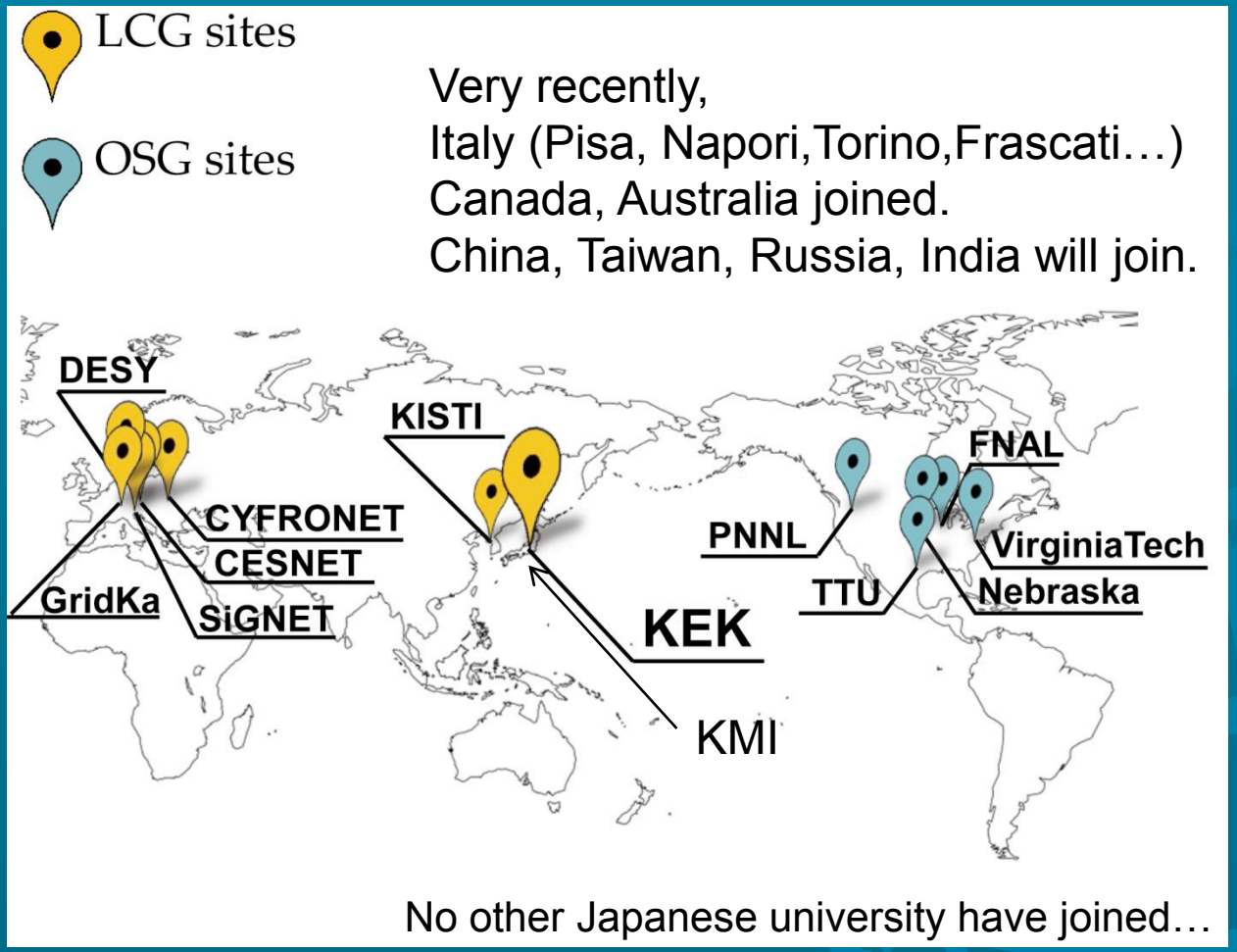
ARDA METADATA CATALOGUE PROJECT
overview downloads installation browse source more docs

Distributed Infrastructure with Remote Agent Control
•Software framework to provide the common interface for the different-type computing resources (LCG, OSG)
ARDA Metadata Grid Application
•Metadata server

gbasf2: Belle II analysis framework for GRID
This is an interface for Belle II GRID like basf2.
Seamlessly, we can use Belle II GRID as usual analysis on the local computer.

ARDA=A Roadmap to Distributed Analysis

GRID sites for Belle II



However, FNAL and so on are not Belle II members, they allow us to use their resources.

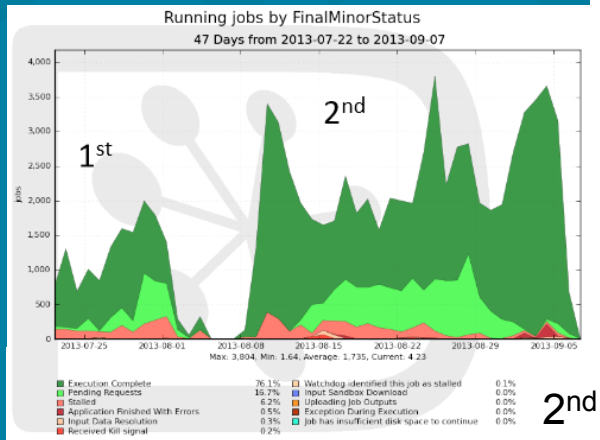
Belle II MC campaign

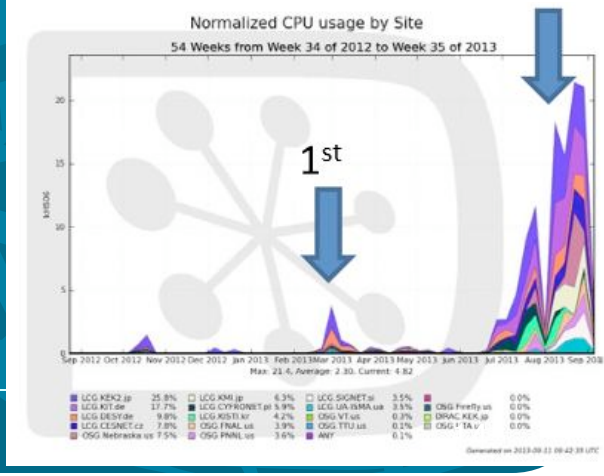
By generating huge number of MC events, check the performance of our GRID system and train the expert for the operation.

1st MC campaign (2013 Feb.28-Mar.20)
- Joined 11 GRID sites (~40kHepSpec x day)
- Generated 60M BB events(3M events/day)

2nd MC campaign (2013 Jul.22-Sep.8)
- Joined 13 GRID sites (~700kHepSpec x day)
- Generated 560M BB events (11M events/day)

3rd MC campaign (2014 Feb)
- Just planned





KMI GRID computing system

EMI3 middleware has been installed:
WN: Intel Xeon E5-2690 (6cores) x2 x10
(= 30HepSPEC x10)
SE: 250TB lustre storage with StoRM

Other grid components:
CREAM (CE), StoRM(SE), top/site BDII, ARGUS, WMS, L&B, PROX.
They are working on the ***virtual machine*** to realize strong tolerance using Red Hat High Availability:
Checking heart beat and change the host server if it has a problem.

Host server for VM (KVM):
Intel Xeon E5-2630L (6cores)x2 x 6

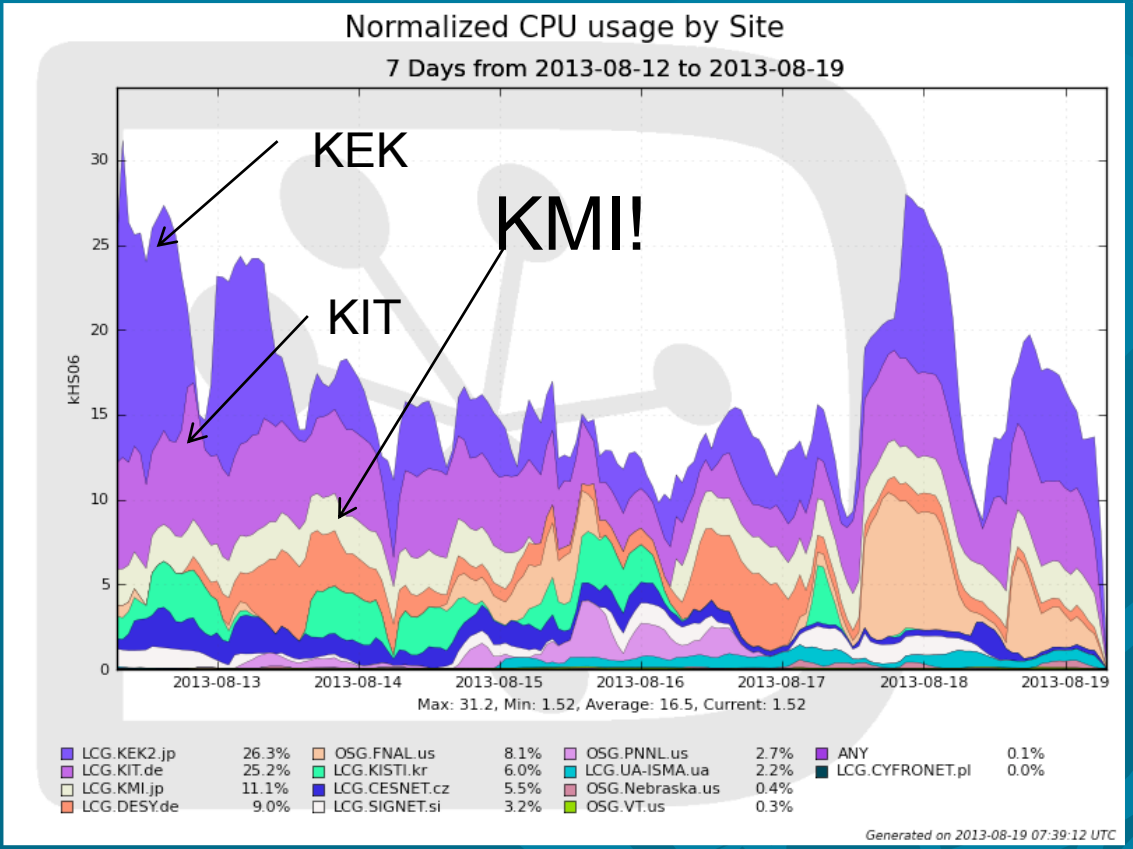
Hayasaka:
Belle II grid steering team
Representative of the universities in Japan

Contribution to Belle II MC campaign

•We have joined 2nd Belle II MC campaign from 12th Aug. After 1 week operation, we have achieved the 3rd biggest contribution! (10% of the total amounts of CPU resources)

•Stable operation
•Belle II dedicated

During it, totally, 45,000 jobs have been processed.



Reveal the problems for Belle II GRID

KMI gird site is the only site operated by the Physicist while the other sites are operated by the IT professionals.
→We can directly observe the behavior of the GRID software and understand what happens:

•Proxy problem → Sometimes job fails without any clear reason. Due to the long wait, proxy is expired. By making proxy's lifetime long, it is solved.

•DIRAC problem → Sometimes DIRAC misrecognize the number of waiting jobs. Due to it, even when no jobs is fulfilled to computing node, no more jobs is submitted. By increasing the number of waiting jobs, "no-job-running-time" cannot appear.

Summary

•Belle II experiment = high luminosity experiment with a huge data sample → Need good accelerator and detector as well as high-performance computing system
•Grid computing can satisfy the requirements.

•KMI Tau-Lepton Data Analysis Laboratory joins Belle II grid.

Having not so big resources, but by stable operation, *we have achieved the big contribution to Belle II.*

•KMI Belle II grid site is the only site the physicists operate while the IT professional operates other sites.

We have solved several problems for the operation.

•KMI will lead Japanese computing team as a representative of the universities in Japan.