# **Belle II Computing Update**

- 1. Experiment status
- 2. Belle II Computing
  - 2.1 Current operation
  - 2.2 Highlights in 2020 JFY KEKCC replacement Rucio integration Multi-RAW data centers

# Belle II Computing Update 1. Experiment status

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## **Motivation from Physics**



## **Belle II Collaboration**



### Run operation status



#### Even under the COVID-19 pandemic, Belle II kept operation as scheduled



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March 26, 2021 @ ISGC2021 Takanori HARA (KEK IPNS)

## Belle II Computing Model until the end of March 2021



## **Belle II Distributed Computing Structure**



## **Belle II computing sites**



20 countries/region have provided computing resources for Belle II

## Network environment for Belle II

30% of sites on LHCONE covering more that 80% of Computing and Storage Resources 70% of sites General IP

5 Sites on LHCOPN

100G Global Ring runned by SINET

Amsterdam Los Angeles Tokyo After Upgrades

SINET5 will be upgraded to SINET6 from 2020 April LHCOPN optical infrastructure that can be used without jeopardizing resources



LHCONE L3 VPN Connecting all the major Data Centers



S.Pardi (INFN-Napoli) @ LHCONE/OPN meeting (March 2021)

## Automatic RAW data copy from Online→Grid



## RAW data (re)process



## One page summary of activities in 2020 JFY









Max: 8.11. Min: 0.21. Average: 7.83. Current: 8.06

Eree 21.2% Elised 78.8%

- \* ~20k jobs running w/o large gap
  - Many opportunistic CPU from DESY, BNL in early 2020
- \* More than 7PB data transfer
- \* Disk usage of 6PB out of 8PB

rated on 2021-02-29 04:37:54 UTC

## User jobs



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March 26, 2021 @ ISGC2021 Takanori HARA (KEK IPNS)

# to the end of September KEKCC replacement in 2020

as of June 2020

16

(except for people related to the hardware construction directly,

Because of COVID19,

offsite work from Apr. 2020



## Impact on Belle II Distributed computing



Although there were many issues, we managed to keep Belle II Grid activities finally...

## Successful Rucio integration in Belle II comp.

a big step forward in preparing for the future needs of Belle II distributed computing

**Rucio** can tolerate the coming increase in data volumes that we expect with higher luminosity. brings us highly anticipated new features, e.g. automatic file deletion.

#### Before the transition

#### After the transition



Replica policy Distributed Data Management LFC (replica file catalog)

were replaced with

Rucio Data Management Rucio File Catalog (replica file catalog)

also Rucio monitoring

## Successful Rucio integration in Belle II comp.

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#### Rucio operation has started !!



Transfer backlog before Rucio transition quickly finished with 100k files / hour throughput

## **Benefits from Rucio**



SE share defined for previous DDM taken over

Data are properly distributed to each site



Volume per Campaign can be checked

difference in various campaigns (Raw data, MC prod. etc.)

- \* Many benefits expected
  - Automatic deletion of old files
    - -- testing with manual deletion now
  - Popularity (how many times specific files is accessed)
  - Quota per user

## **RAW data centers**

Silvio PARDI (Napoli)+network providers, site members

MAXIMUM Performance reached during Network Data Challenge KEKCC  $\rightarrow$  RAW-DC (up to 16 streams per file in FTS Jobs). To be confirmed/improve during the test vs TAPE systems

	LINK	Peak (Gbps)	Average (Gbps)	Data per Day (TB)	Site Connection (Gbps)	Peak/Site Connect.	Average/Site Connect.	Security Factor TBperDay /42TB
America i a Center i	KEK-BNL	35.0	15.5	167	200	18%	8%	x 4
	KEK -CNAF	20.0	15.0	162	200	10%	8%	x 3.8
	KEK -DESY	16.0	10.0	108	100	16%	10%	x 2.5
	KEK-IN2P3	15.7	14.7	158	100	16%	15%	x 3.7
	KEK-KIT	20.0	13.0	140	100	20%	13%	x 3.3
	KEK -UVIC	14.0	10.0	108	100	14%	10%	x 2.5
ta Center		•	•				25.01	F May 2020



Raw Data Centers

as of May 2020

## **RAW data centers**

#### Silvio PARDI (Napoli)+network providers, site members



we will distribute RAW data to other sites

## Luminosity prospects



To accumulate as much data as possible, we will put priority on the luminosity rather than the beam background reduction in terms of the accelerator tuning / operation

## **Coming events**



## Summary

Belle II has started "phase 3" physics run with the full detector successfully

SuperKEKB accelerator aims integrated luminosity : 480 fb<sup>-1</sup> by the end of 2021 March

Belle II detector is well under controll for data-taking even under COVID-19 crisis

RAW data flow from Online storage to Offline storage, then to GRID was establised each process is automatized and all processes work as a system RAW data has been distributed to outside KEK (currently to BNL) → start distributing to Italy, Germany, Canada, and France, too (from 2021)

RAW data was (re)processed successfully at remote site (BNL)

Different type of jobs (MC production, Skim production, RAW data process, User analysis) are running on GRID KEK Central Computing system was replaced in 2020 summer

Rucio was successfully integrated !

then, we will keep the momentum to improve / develop necessary features for coming events