EU grant n.822070

Status of WP5: common tools

**JENNIFER2 MidTerm Review
(December 2022, Bruxelles)**

S.Bolognesi (CEA Saclay)

WP5: why?

Neutrino physics community and B-physics community comes historically from very different roads:

- different statistics and thus different precision needs

- neutrino oscillations have been established only relatively recently as robust schema which could open another door to flavor physics

The neutrino physics of today (T2K) and of next generation (HyperKamiokande) are getting into a **new era where the needs are getting similar and the physics more directly related** to B-physics: a lot to gain by working together!

Jennifer 2 (and the working package 5 in particular) is establishing/enlarging a very timely and very promising collaboration between these two communities

WP5: common tools

Putting together skills and efforts from neutrino and B-physics communities for new, innovative developments on:

- Computing: data distribution, storage and access (Grid, Cloud) and software and network monitoring [Task 5.1]

- Data acquisition and remote control: challenges of high data bandwidth and high trigger rate with intelligent algorithm for data-reduction (Neural Networks) [Task 5.2]

→ requirements in HEP have always been anticipating societal needs: these developments are addressing the needs of tomorrow !

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Extract the most from the data we collect:

- identify and document sound statistical methods to combine results from different experiments [Task 5.3]

- support from theorists for a joint assessment of CP violation in quark and lepton sector and develop a common analysis tools [Task 5.4]

→ CP violation in the quark sector re-worded by Nobel prize, CP violation in neutrino sector could be the next! Unique flavor theory (Lepton+Quarks) would be a major breakthrough

WP5: Computing and networking

- Work started with a **common workshop** on the subject in 2019

WP5:
Computing and networking

Jennifer2 Computing WorkShop - Task 5.1
📅 Thursday 12 Dec 2019, 11:00 → 18:15 Europe/Rome
📍 4-1-021 (CERN)

Description First workshop for the coordination of the activities within the Task 5.1: Common Computing and data handling.

Please join the meeting by clicking this link: https://vidyoportal.cern.ch/join/AF9WJ09OEN

If you want to join by phone, please use one of the phone numbers listed in the link below:

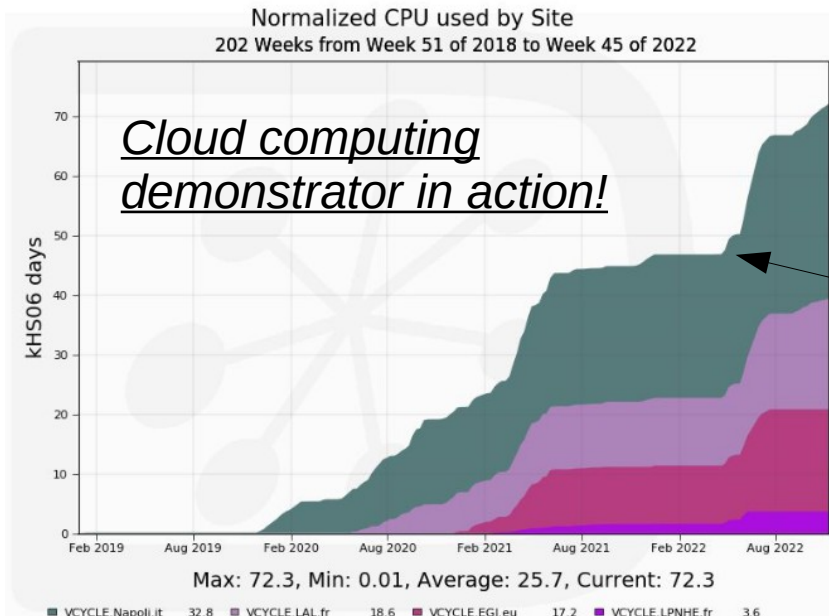http://information-technology.web.cern.ch/services/fe/howto/users-join-vidyo-meeting-phone

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Registration ✎ Registration   ✏ Register

Participants A Alexander Finch D Daniele Spiga D Davide Michelino J Jacek Holeczek M Marco Destefanis M Marko Bracko
M Mathieu Guigue R Roberto Cevenini S Silvio Pardi S Sophie King T Thomas Kuhr

Normalized CPU used by Site
202 Weeks from Week 51 of 2018 to Week 45 of 2022

Cloud computing demonstrator in action!

Max: 72.3, Min: 0.01, Average: 25.7, Current: 72.3
■ VCYCLE.Napoli.it   32.8   ■ VCYCLE.LAL.fr   18.6   ■ VCYCLE.EGI.eu   17.2   ■ VCYCLE.LPNHE.fr   3.6
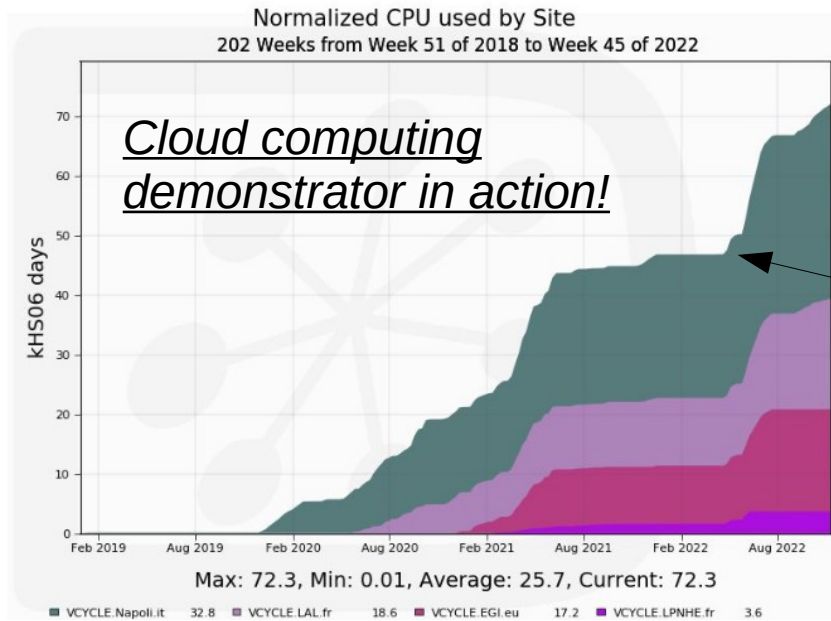
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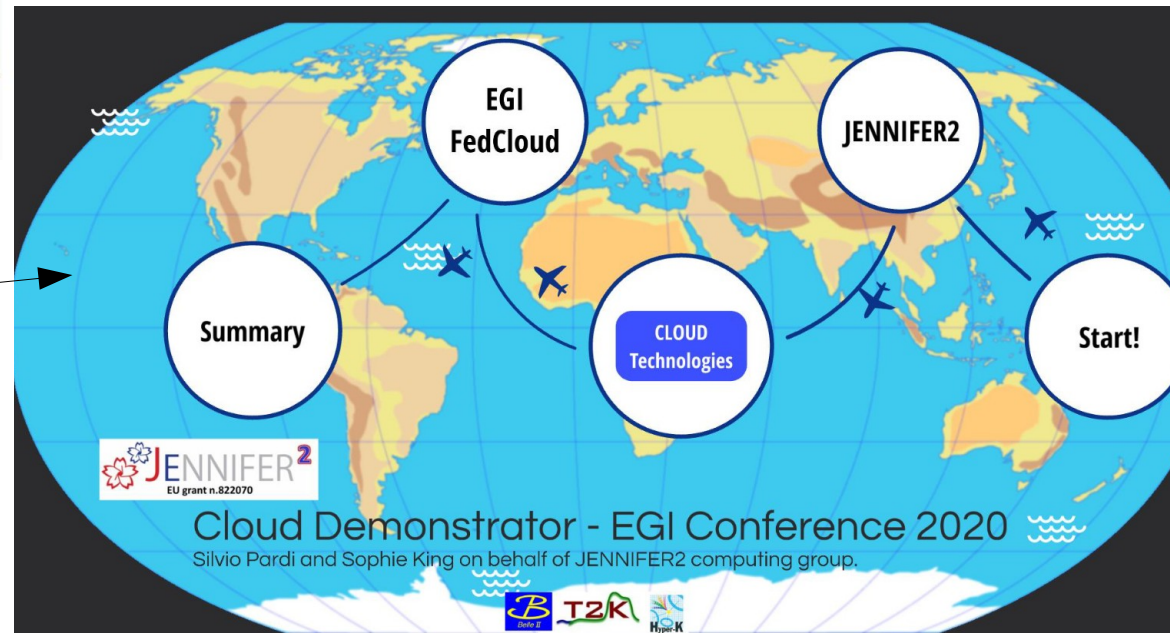and enter the meeting extension 1099994 in order to join.

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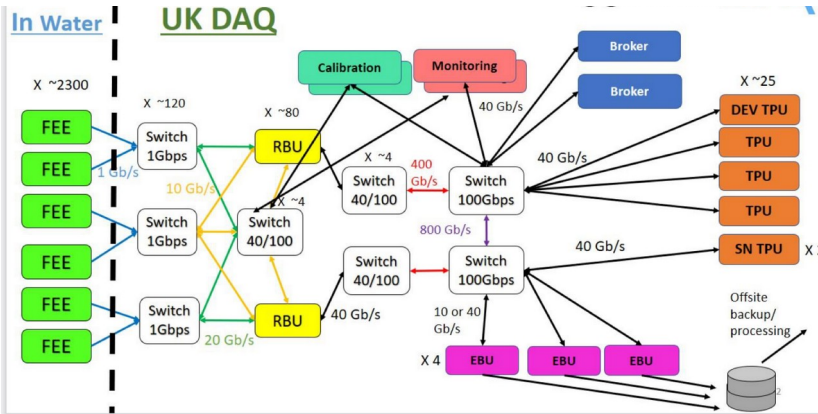
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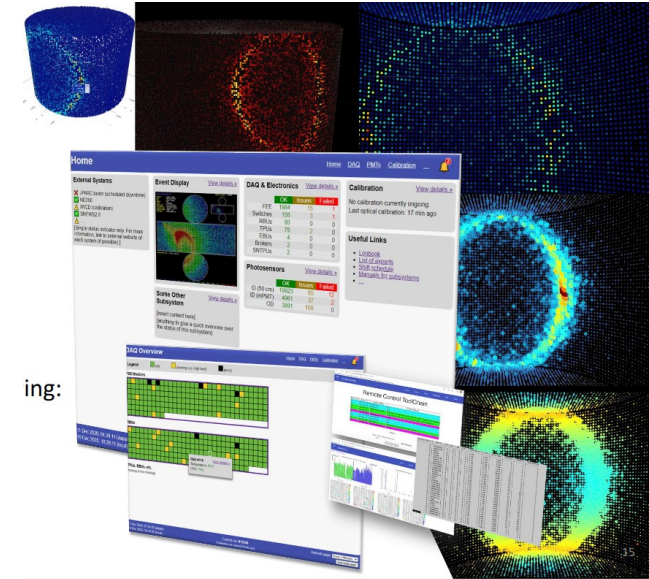
- Presented at EGI2020(*) conference and at ICEMP2022(*): **best presentation award!**

(*)

EGI=European Grid Infrastructure

ICEMP = International Conference on Engineering Mathematics and Physics

EGI FedCloud JENNIFER2 Summary CLOUD Technologies Start!

JENNIFER²
EU grant n.822070

Cloud Demonstrator - EGI Conference 2020
Silvio Pardi and Sophie King on behalf of JENNIFER2 computing group.

WP5: data acquisition, reduction and remote control

Data acquisition:

ToolDAQ
ToolAnalysis
ToolFramework

The software is now being actively used on 9 different experiments as DAQ, front end electronics firmware, monitoring, slow control, database systems, calibration, generation, reconstruction and analysis.
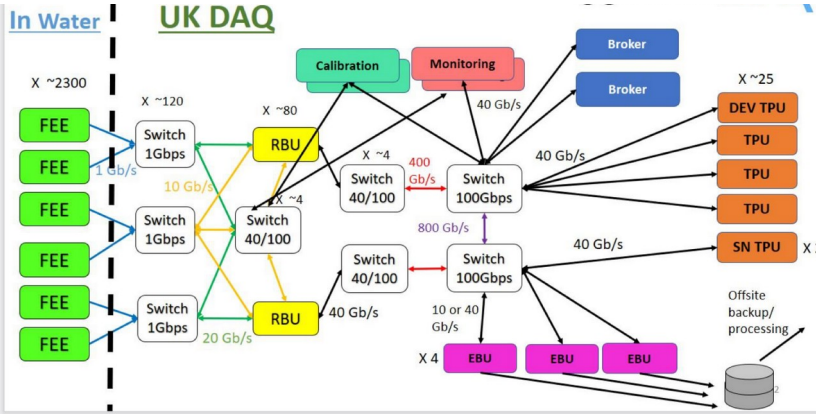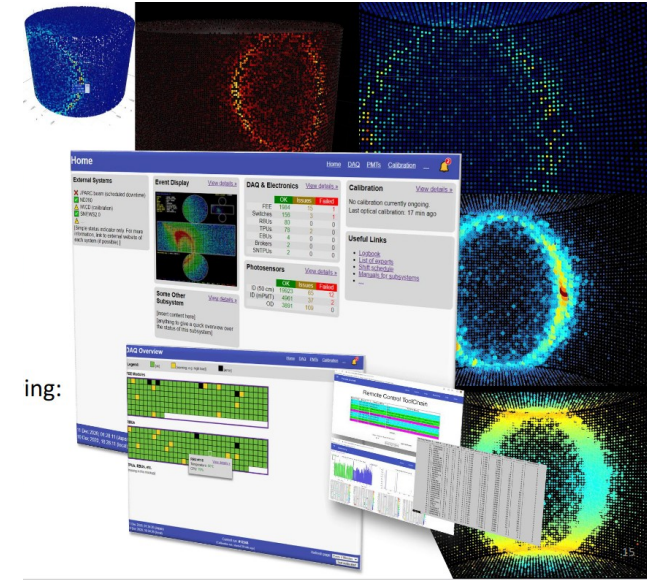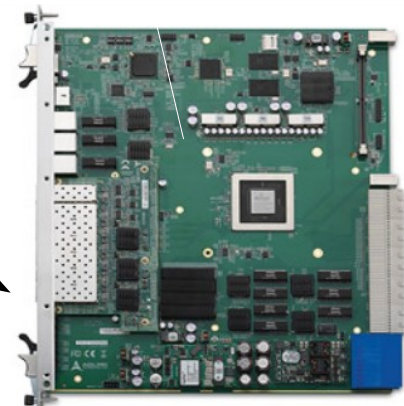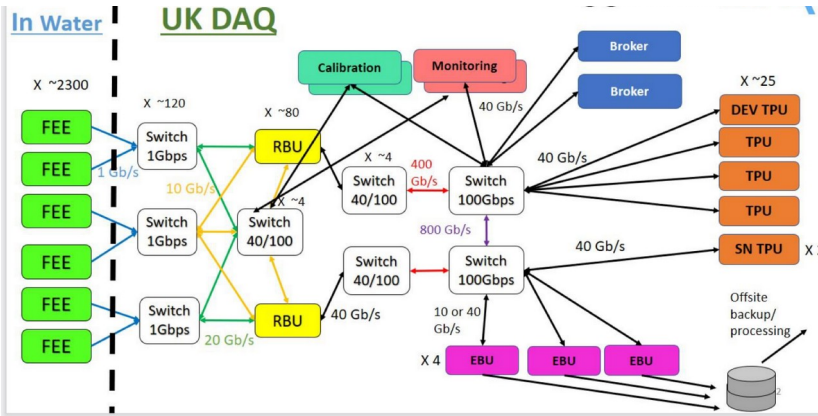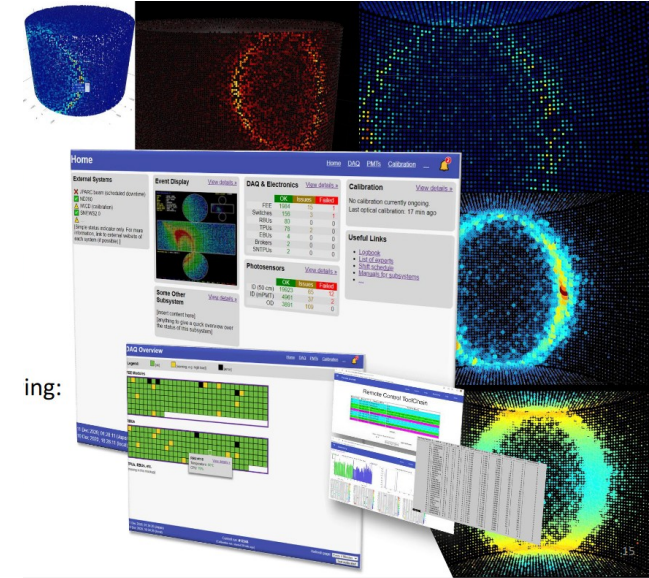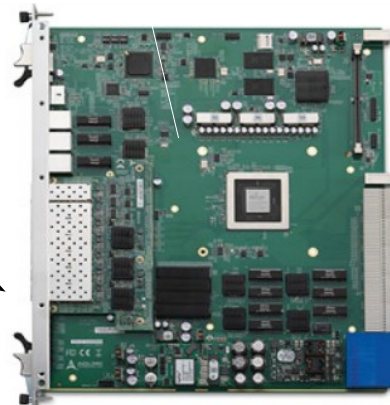
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ONSEN system
(here: system test at Giessen)

High data badwidth:

Wifi (802.11 a/g)	20 Mbps
4G	20 Mbps (download)
5G	100-300 Mbps (download)
Gigabit Ethernet	1 Gbps
ONSEN link	6.125 Gbps
ONSEN link new carrier board	16.3 Gbps
complete PXD	~200 Gbps @ 3% occupancy (5 DVD per 1 second)
ATCA ADLINK aTCA-3150	10 Gbps (uplink)
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Klemens Lautenbach, Ph. D. thesis

ONSEN system
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Neural Network for trigger:

Results published for magnetic monopoles anomaly detection
K. Dort et al., Eur. Phys. J. C 82 (2022) 7, 587,

Hardware implementation of 'neuro-trigger':
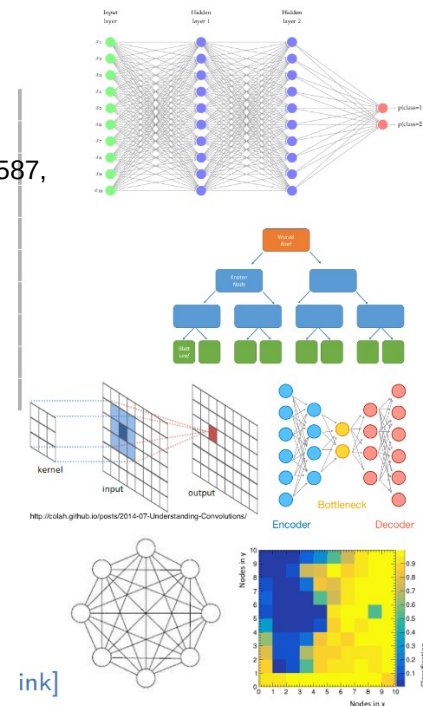
http://colah.github.io/posts/2014-07-Understanding-Convolutions/

ink]

WP5: statistical tool for combinations

First publication of **Belle+BelleII combination**

Combined analysis of Belle and Belle II data to determine the CKM angle ϕ_3 using $B^+ \to D(K_S^0 h^+ h^-)h^+$ decays

The Belle and Belle II collaborations

E-mail: niharikarout@physics.iitm.ac.in, coll-publications@belle2.org

ABSTRACT: We present a measurement of the Cabibbo-Kobayashi-Maskawa unitarity triangle angle ϕ_3 (also known as γ) using a model-independent Dalitz plot analysis of $B^+ \to D\left(K_S^0 h^+ h^-\right)h^+$, where D is either a D^0 or $\bar{D}^0$ meson and h is either a π or K. This is the first measurement that simultaneously uses Belle and Belle II data, combining samples corresponding to integrated luminosities of $711\,\text{fb}^{-1}$ and $128\,\text{fb}^{-1}$, respectively. All data were accumulated from energy-asymmetric e^+e^- collisions at a centre-of-mass energy corresponding to the mass of the $\Upsilon(4S)$ resonance. We measure $\phi_3 = (78.4 \pm 11.4 \pm 0.5 \pm 1.0)^\circ$, where the first uncertainty is statistical, the second is the experimental systematic uncertainty and the third is from the uncertainties on external measurements of the D-decay strong-phase parameters.
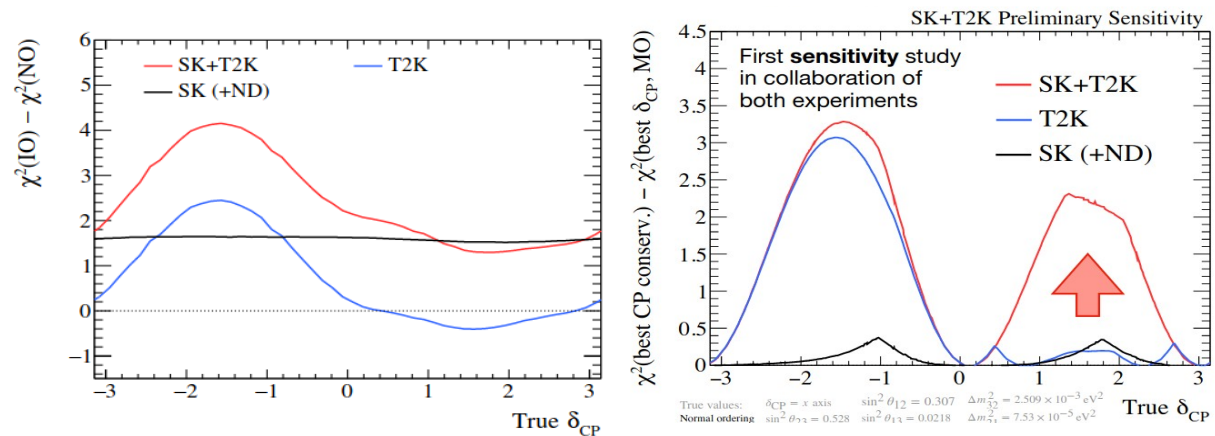
KEYWORDS: B Physics, CKM Angle Gamma, e^+-e^- Experiments

ARXIV EPRINT: 2110.12125

Combination of **neutrinos from cosmic rays (SuperKamiokande) and from accelerator (T2K):** big boost in sensitivity!

Sensitivity presented at Neutrino 2022 conference: DOI 10.5281/zenodo.6683820

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WP5: statistical tool for combinations

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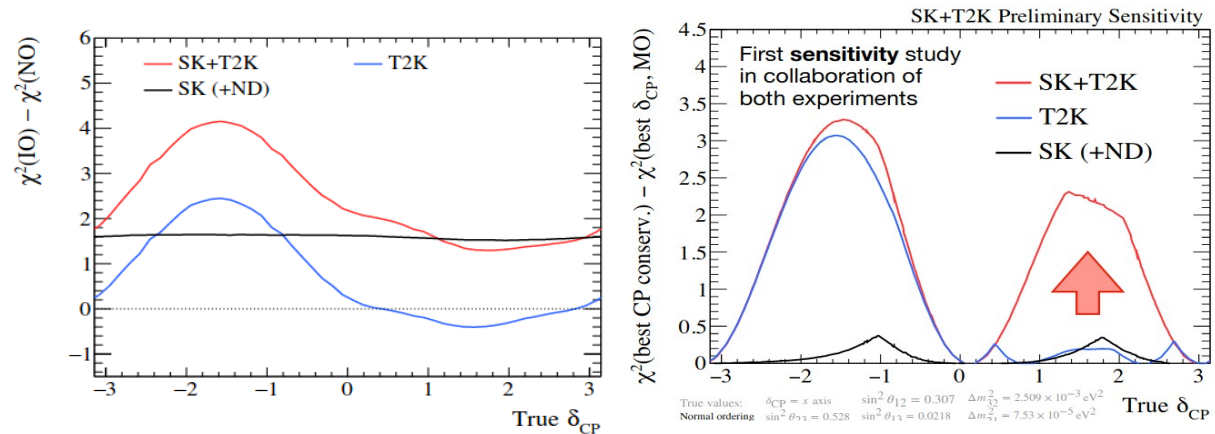
Public data sharing

Which format of the data to be useful? Issue at the core of our J2 task: 'likelihood preservation'

WP5: generator and phenomenology

- Develop a coherent **theoretical framework for CP violation** analyses in both quark (Belle II) and lepton sector (T2[H]K)

Book: I.Bigi, *G. Ricciardi*, M. Pallavicini,
New Era for CP Asymmetries
IWorld Scientific 2022
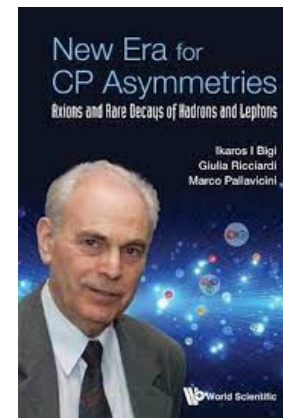
- **Theoretical support** to flavour and lepton analyses.
(Eg, publication on the most important theory uncertainty for neutrinos)

G. Ricciardi, F. Vissani, N. Vignaroli,
An accurate evaluation of electron (anti-)neutrino scattering on nucleons, JHEP 08 (2022) 212
A. Addazi, *G. Ricciardi*, S. Scarlatella, R. Srivastava, J. Valle,
Interpreting B anomalies within an extended 331 gauge theory, Phys.Rev.D 106 (2022)

Workshops directly organized/funded by J2
- Belle II Physics Week,
- Workshop "Anomalies and Precision in the Belle II" at Vien
- KEK-FF : Feb. 9-10, 2023, first flavour workshop at KEK

WP5: deliverables

J2 people are having a crucial role in the effort at the core of the WP5 challenges: important and innovative developments in computing, software, electronics, analysis, statistics and theory!

Task 5.1 : **A common Belle II – HyperK Cloud Computing demonstrator** (month 36)
~DONE~

Task 5.3: **Reference report on statistical treatment** of rare signal searches for future combination (month 36)
A lot of material already: real-life implementation with on-going combined analyses

Task 5.2: **Joint real time and remote control workshop** (month 36)

A lot of work separately in T2(H)K and Belle2 → looking forward to commonalities, complementarities

This part was slowed done by COVID: difficult to get together to discuss practical issues (eg, working together at the lab around a new electronics setup). Looking forward to rump-up since November Prague meeting!

Task 5.4 **Organization of a common physics workshop** (month 48)
A lot of work on phenomenology side to build robust theory uncertainties and a common interpretation framework.
Looking forward to what it promises to be a very interesting workshop!

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WP5: secondments

Institution	WP5 done (months)	WP5 planned	WP5 % done
INFN	2,0	14,0	14,5%
DESY	1,9	11,0	17,0%
JSI	0,2	5,0	4,7%
LAL-CNRS	0,4	4,0	9,2%
CEA	1,1	4,0	26,7%
UNIGE	0,0	2,0	0,0%
KCL (Qmul)	0,0	12,0	0,0%
UKRI	0,0	4,0	0,0%
Total	5,6	56,0	9,9%

All groups have also large participation to **other WP:** often parallel activities in the same secondment, not always accounted on WP5 in the past

Same groups (e.g., INFN, CNRS) recently **increased their activities on WP5** (eg, computing for HK) → expected to increase WP5 secondments

Same institutions (e.g., CEA) recently **increased the group size** → expected to increase the overall secondments (also in WP5)

A bureaucratic problem with KCL (was QML): no possibility for accounting secondments during first phase (despite large involvment in DAQ and computing activities of WP5)

In general the secondments are planned to restart quite intensively after COVID break