Belle II Status
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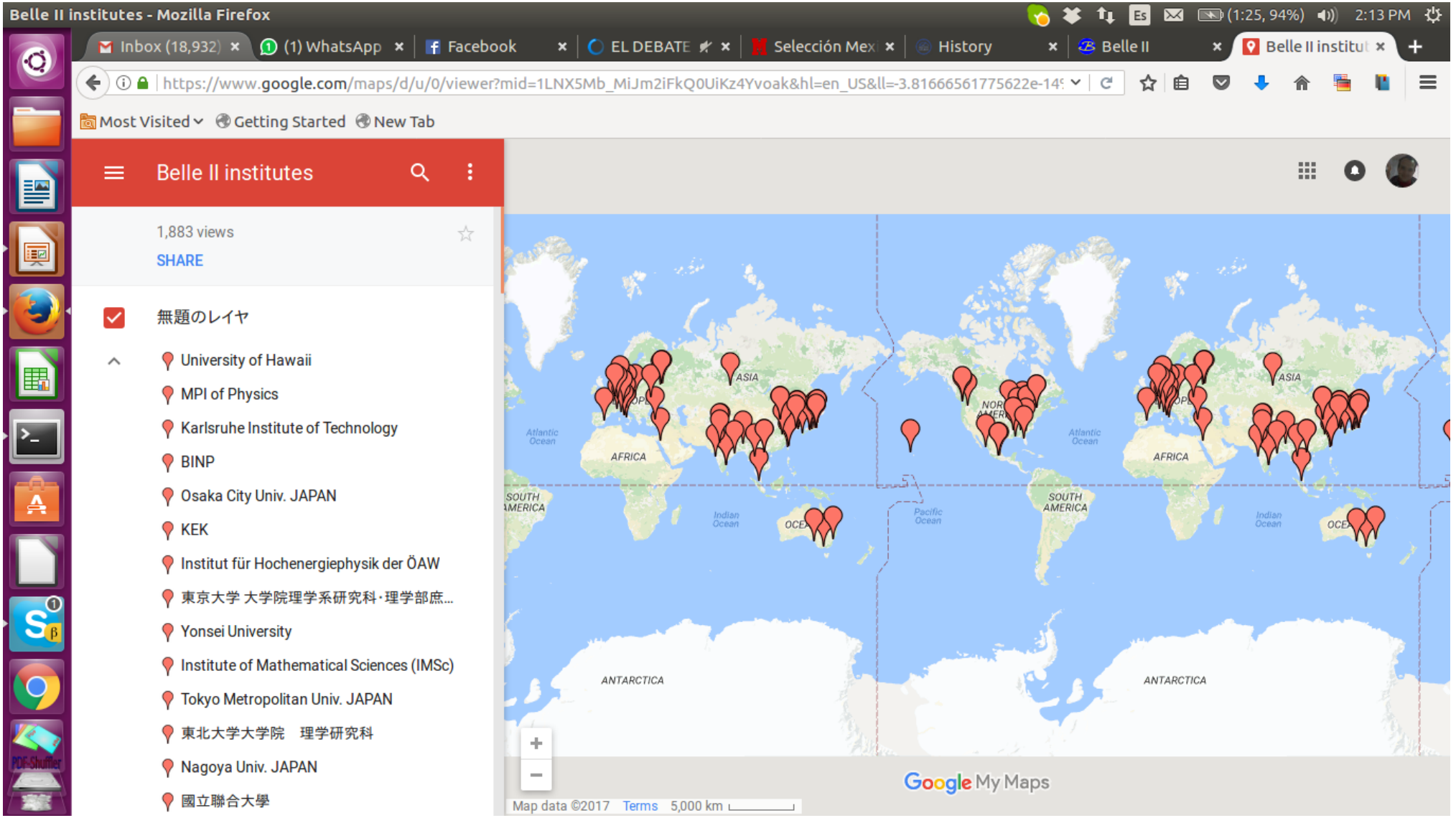
Outline

- *Belle II and superKEK*
- *Large Angle Beamstrahlung Monitor (LABM)*
- *Computing resources, Two Grid Nodes (GRID)*
- *Software for Grid, Analysis (ANALYSIS)*
- *Physics phenomenology (PHYSICS)*

Belle II



105 instituciones, 23 países, 500 físicos e ingenieros

SuperKEKB and Belle II x40 Higher luminosity!!

Belle II

New superconducting /permanent final focusing quads near the IP

New IP

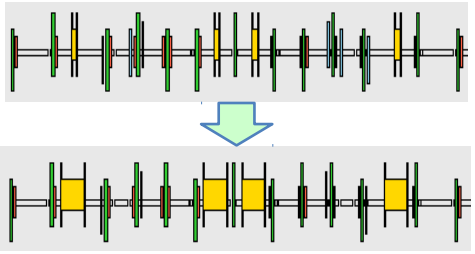
Colliding bunches

e+ 4GeV 3.6 A

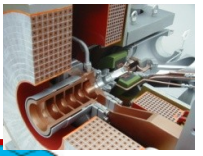
e- 7GeV 2.6 A

Target: L = 8×10^{35}/cm2/s

Replace short dipoles with longer ones (LER)



Add / modify RF systems for higher beam current



Positron source

New positron target / capture section

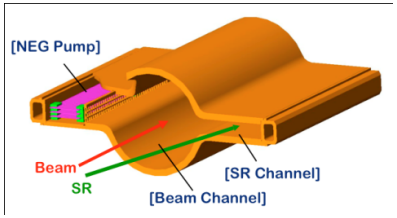
Damping ring

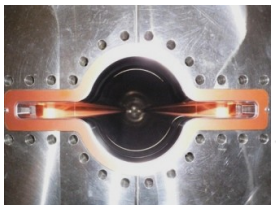
Low emittance positrons to inject

Low emittance gun

Low emittance electrons to inject

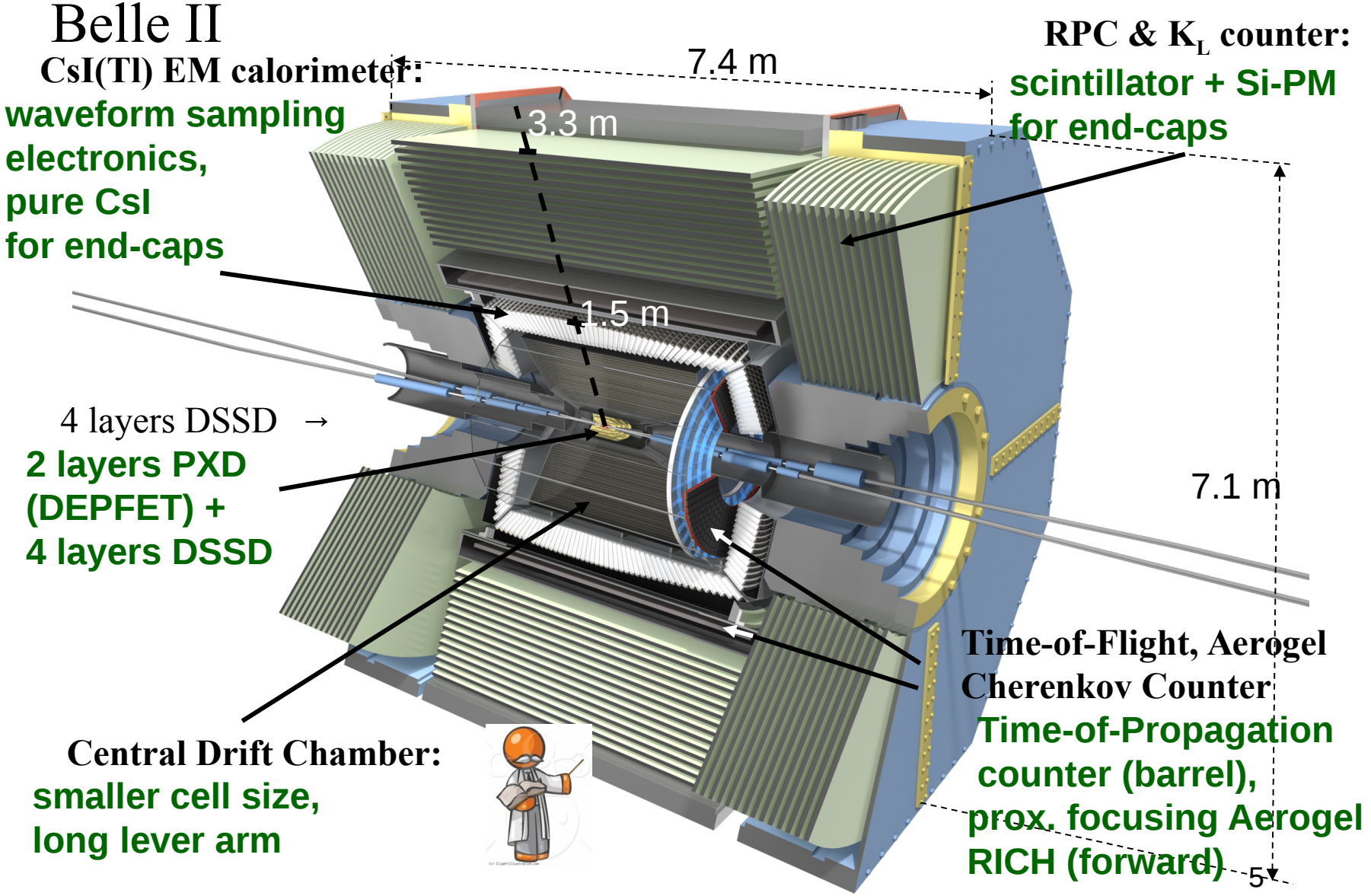
TiN-coated beam pipe with antechambers





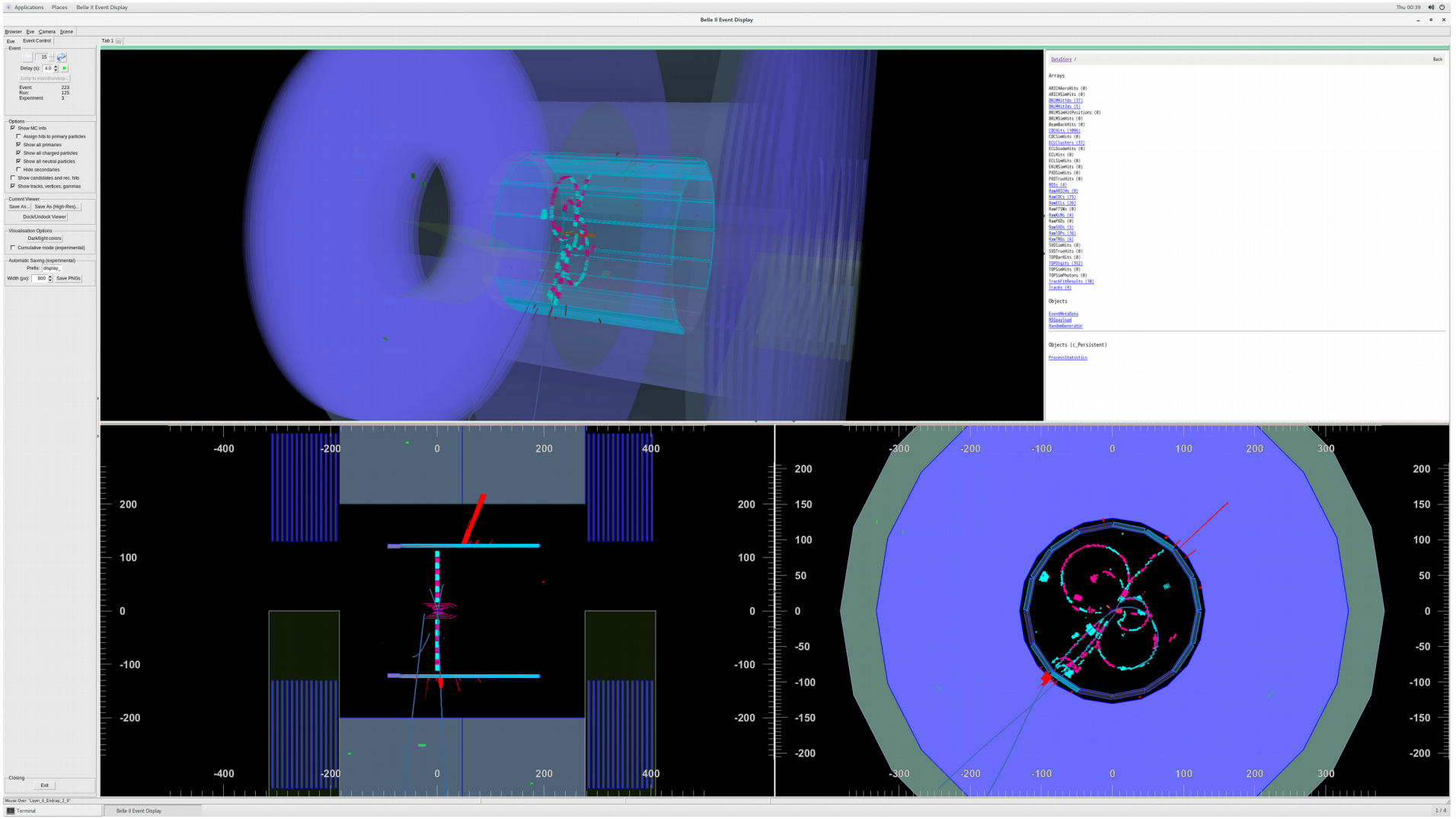
$$L = \frac{\gamma_\pm}{2er_e}\left(1+\frac{\sigma_y^*}{\sigma_x^*}\right)\frac{I_\pm \xi_{\pm y}}{\beta_y^*}\left(\frac{R_L}{R_y}\right)$$

Belle II detector upgrade

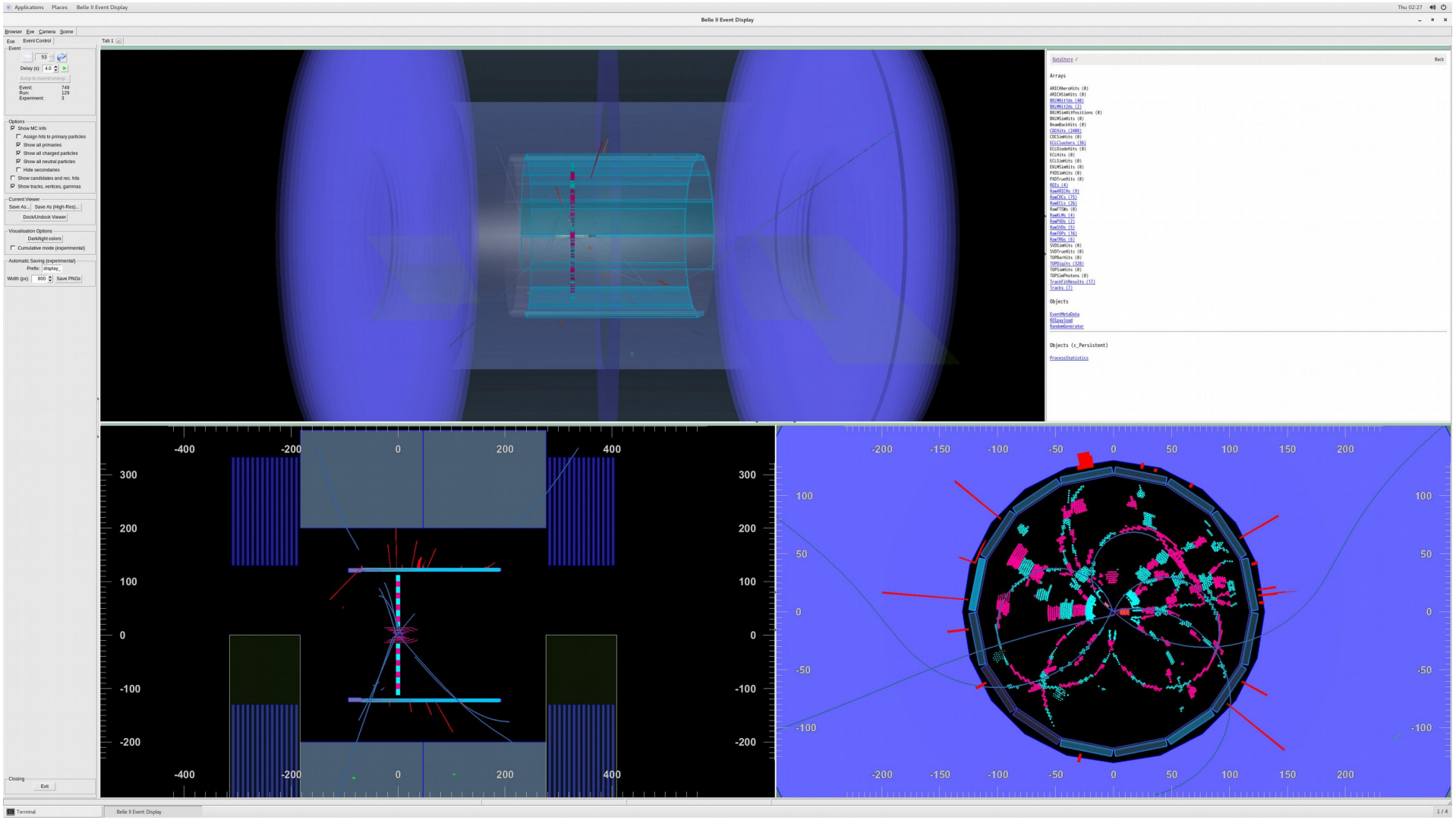


Slide take from kurtis Nishimura talk

First Collision in april 25 2018



First $b\bar{b}$ in april 25 2018



Control Room First Collision

Plans for phase II (Finish in July 2018)

Step 1

- Detuned beta at IP to find closed orbit.
- Test of QCS system(Final Focusing)
- Optics measurements and corrections

Step 2

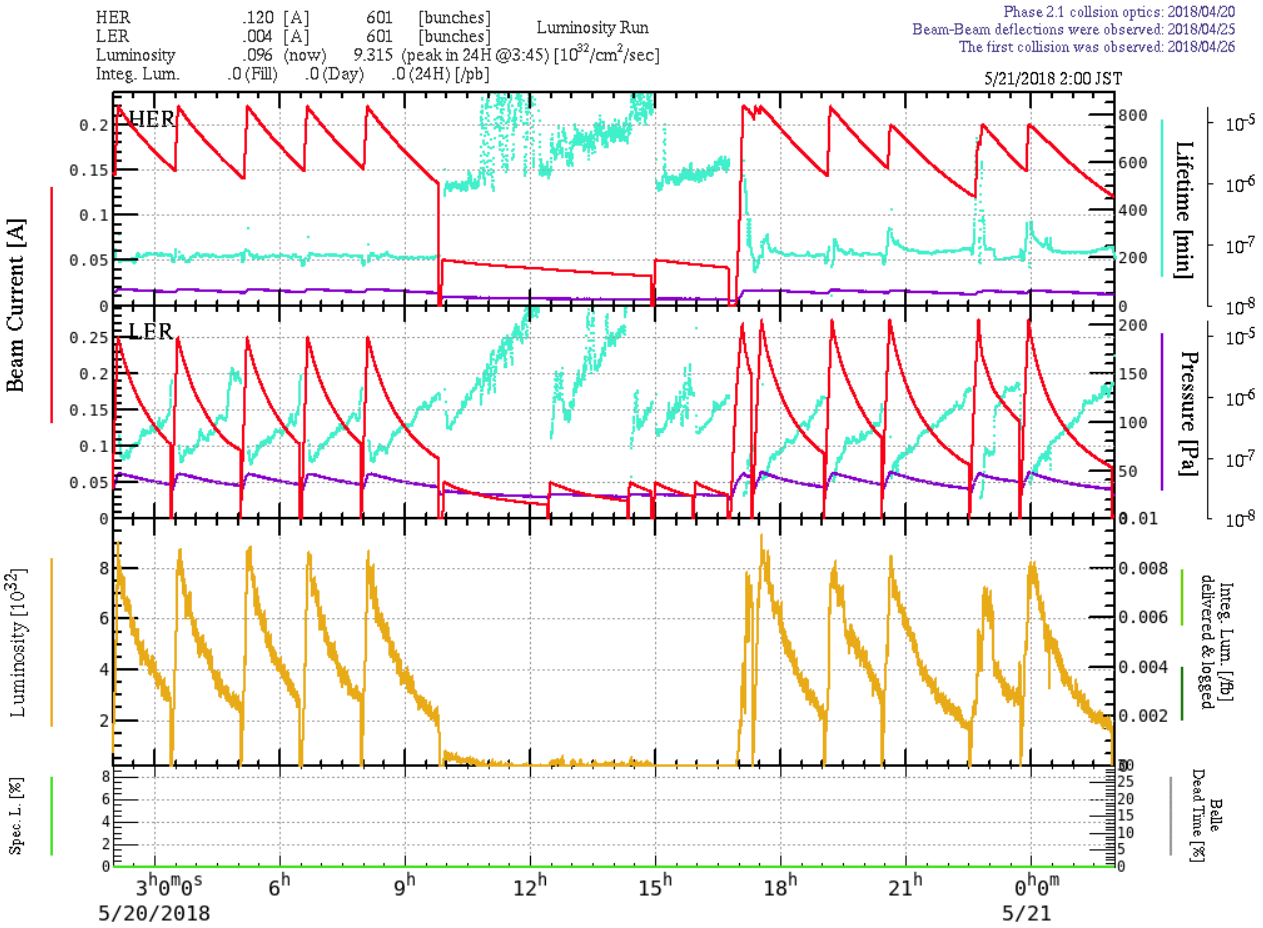
- Collision tuning with squeezing beta at IP and luminosity run
- Tentative target is 10^{34} $cm^{-2}s^{-1}$ (KEKB design)
- Beam current for LER is 1 [A] and 0.8 [A] for HER (design of 30 %)
- Back ground study for Belle II detector

Step 3 (very challenging)

- Further squeezing beta at IP.
- Target luminosity is 2 x 10^{34} cm-2s-1 (recorded peak at KEKB)

Luminosity

(β_y^* = 8mm, 250mA(LER), 220mA(HER)



4.7 x 10^{32}/cm^2/s (May 9th) -> optics correction -> 9.3 x 10^{32}/cm^2/s (May 20th)

(ξ_{yLER}, ξ_{yHER}) = (0.0175, 0.0113)->>>>>>>>>> (0.034,0.022) (assuming $\sigma_{yLER} = \sigma_{yHER}$)

Goals of Phase II

- Luminosity (>~ 1 x 10^{34}/cm^2/s)

- Belle 2 beam background

- Verification of concept of “nano beam scheme”

Understanding and lowering BG sufficiently are a high-priority mission of Phase 2 commissioning.

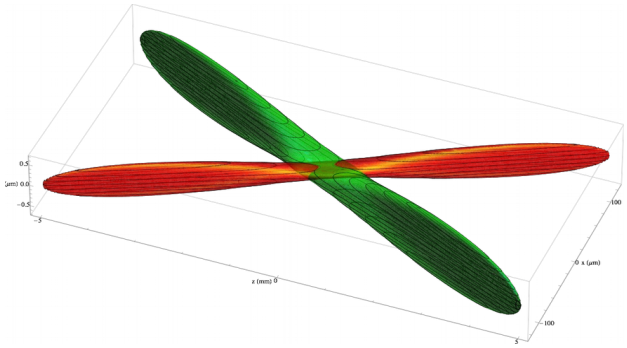
Causes of beam background

- Injection: serious so far
- SR background
- Beam-gas: Coulomb scattering, Bremsstrahlung
- Touscheck
- Radiative Bhabha

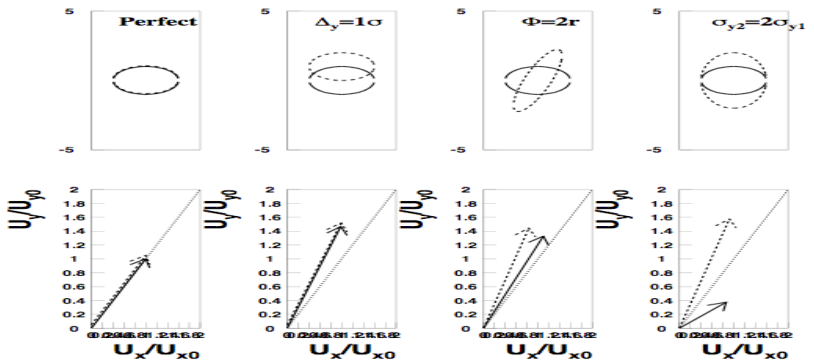
- Injection background
  - We need to investigate correlations of injection background (diamond sensor and CLAWS) with machine parameters related to beam injection (injector beam quality and stability, beam injection efficiency, beam injection orbit parameters, ring parameters etc.)

Hardware

The Large Angle beamstralung Monitor (LABM)

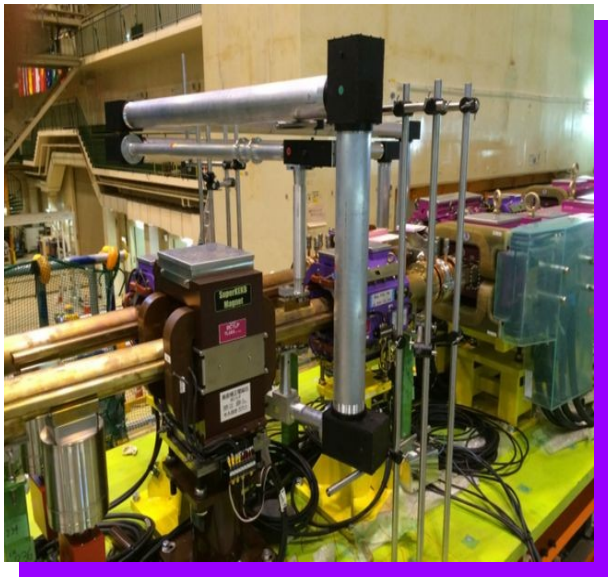


Superkekb nanobeam scheme

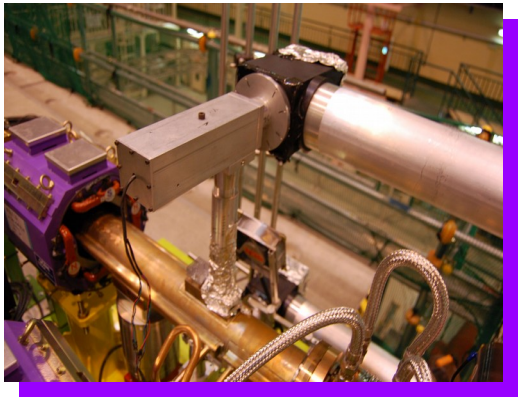


- Beam monitor based in visible light produced by one beam due EM field of the other beam
- We work in electronics, DAQ, control, installations and operations
- Installed in 2015 take data in 2016, upgrade in 2017.
- Key role in accelerator commissioning
- Japan/EUA/Saudi Arabia /Mexico collaboration

LABM light collection

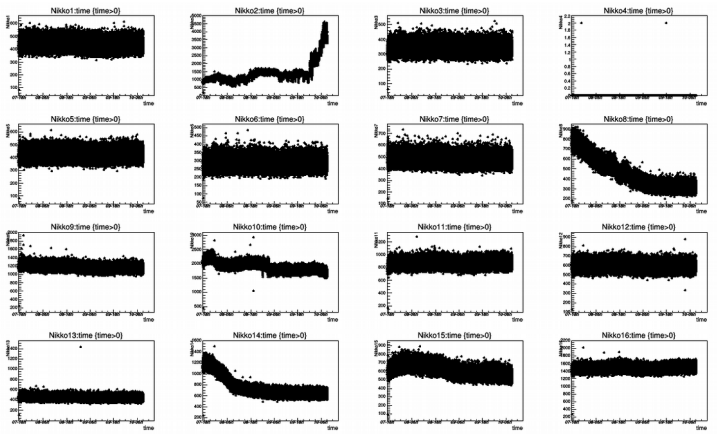


Optical Chanels

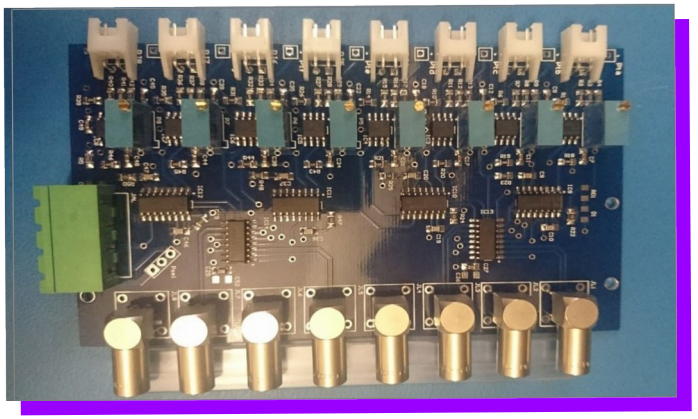


Mirrors remotely controled

HV, LV and counters

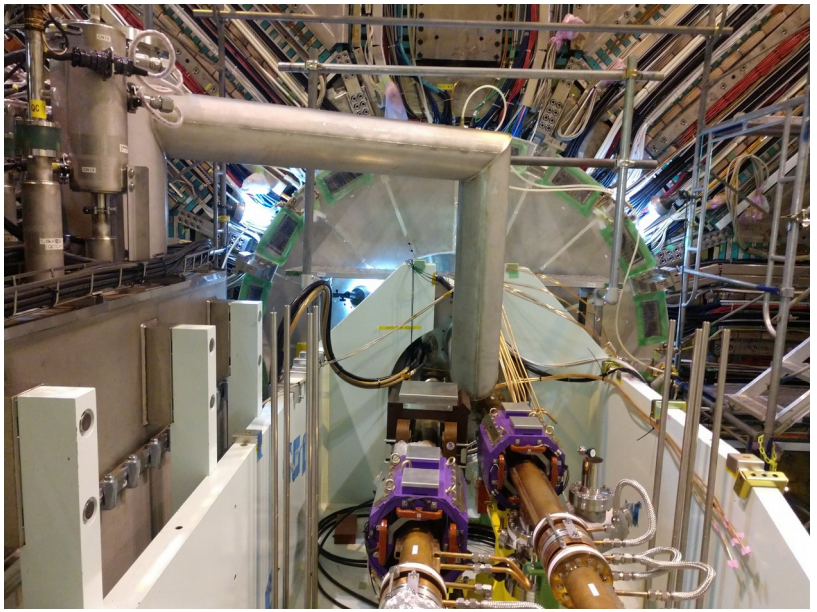


Data

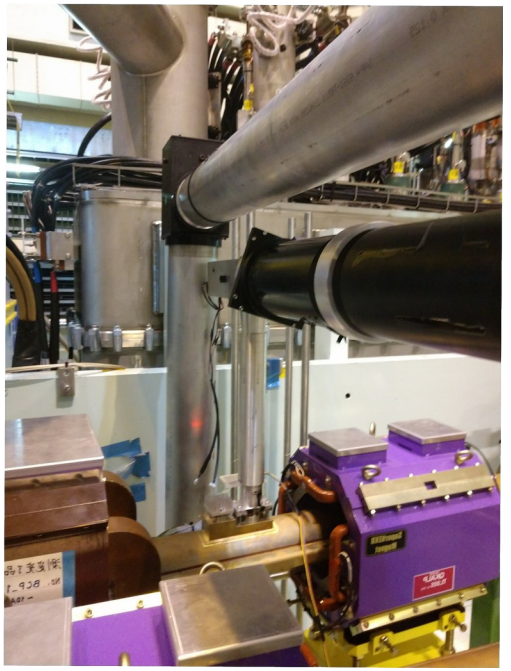


Electronic card

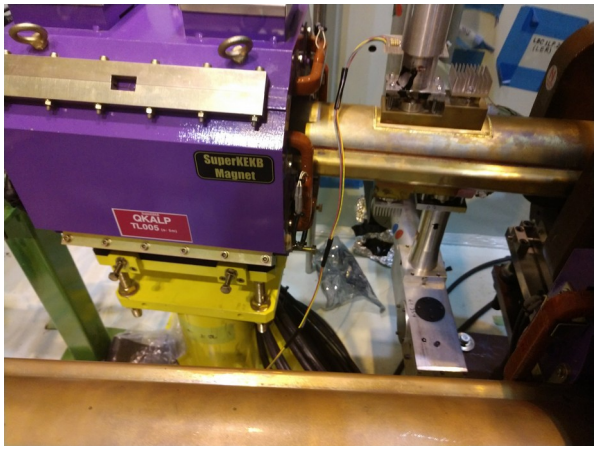
January 2018 Installation



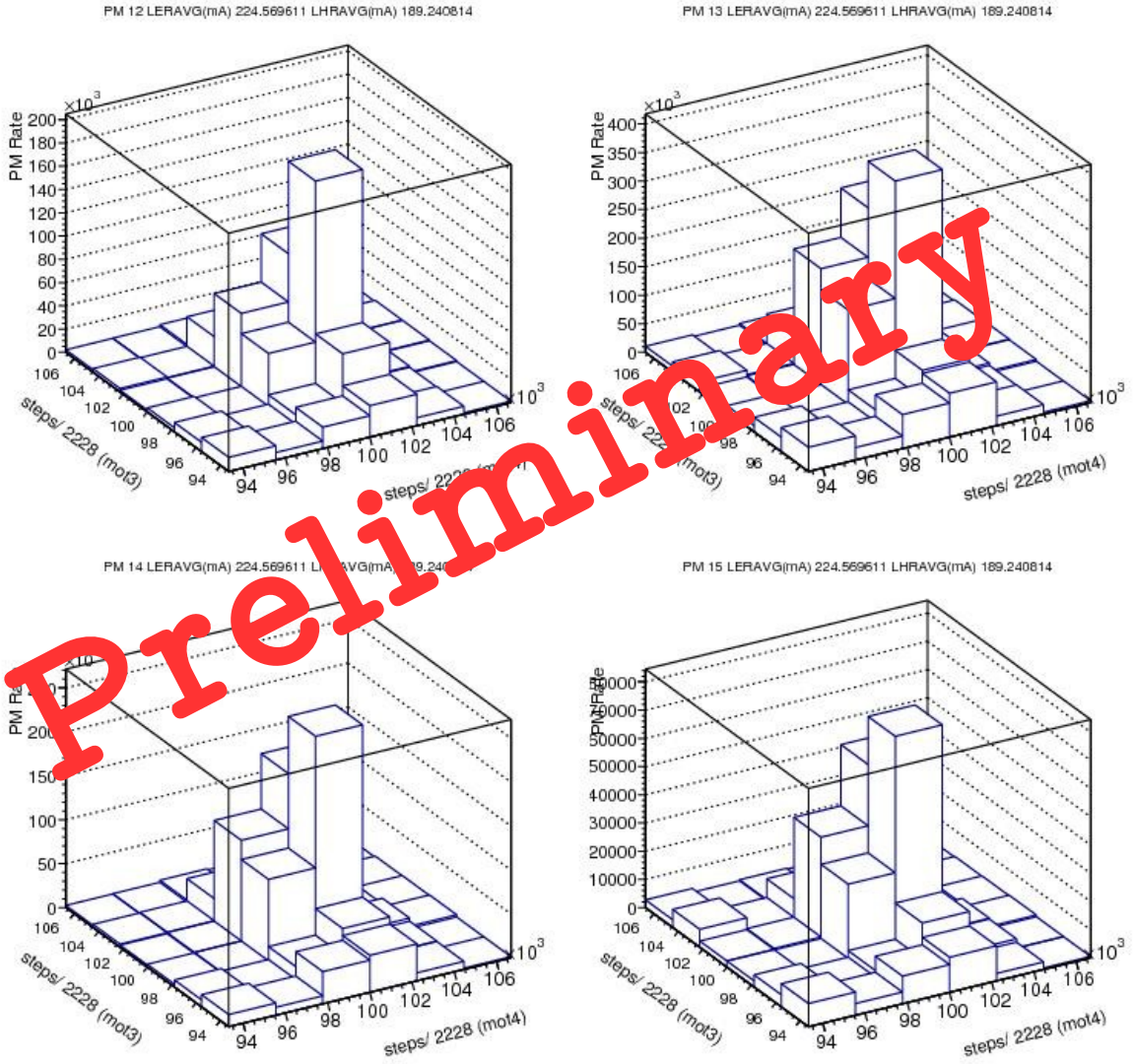
Boat was smaller than expected had to remove secondary motors



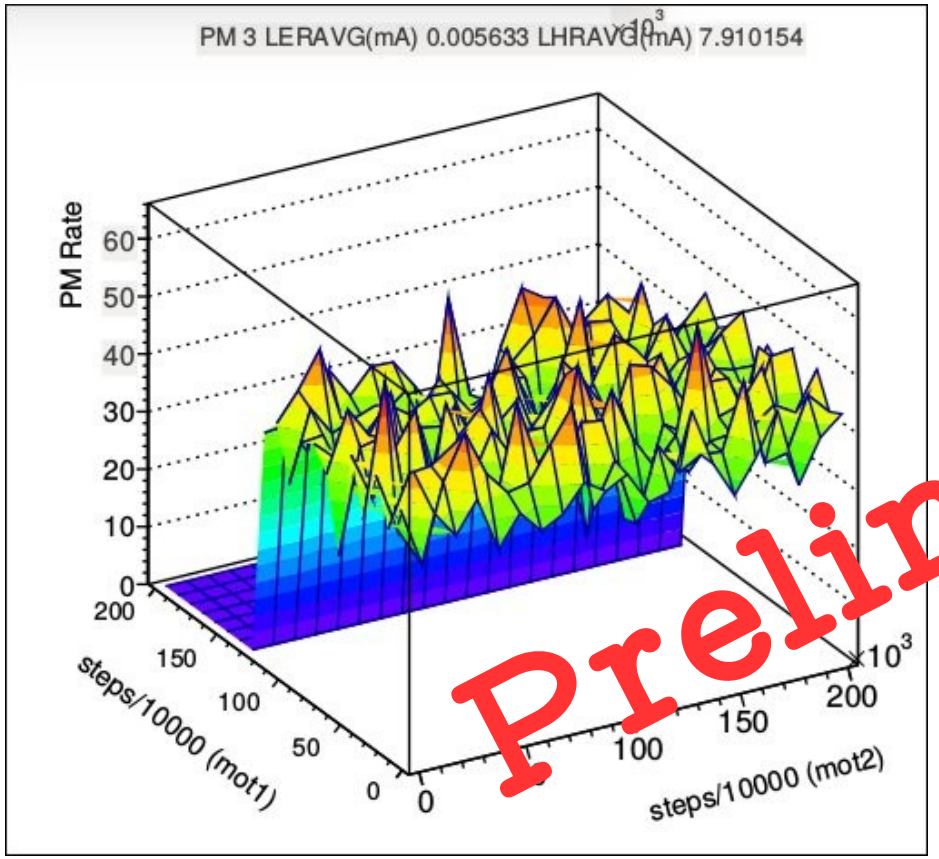
Nikko Side Finished

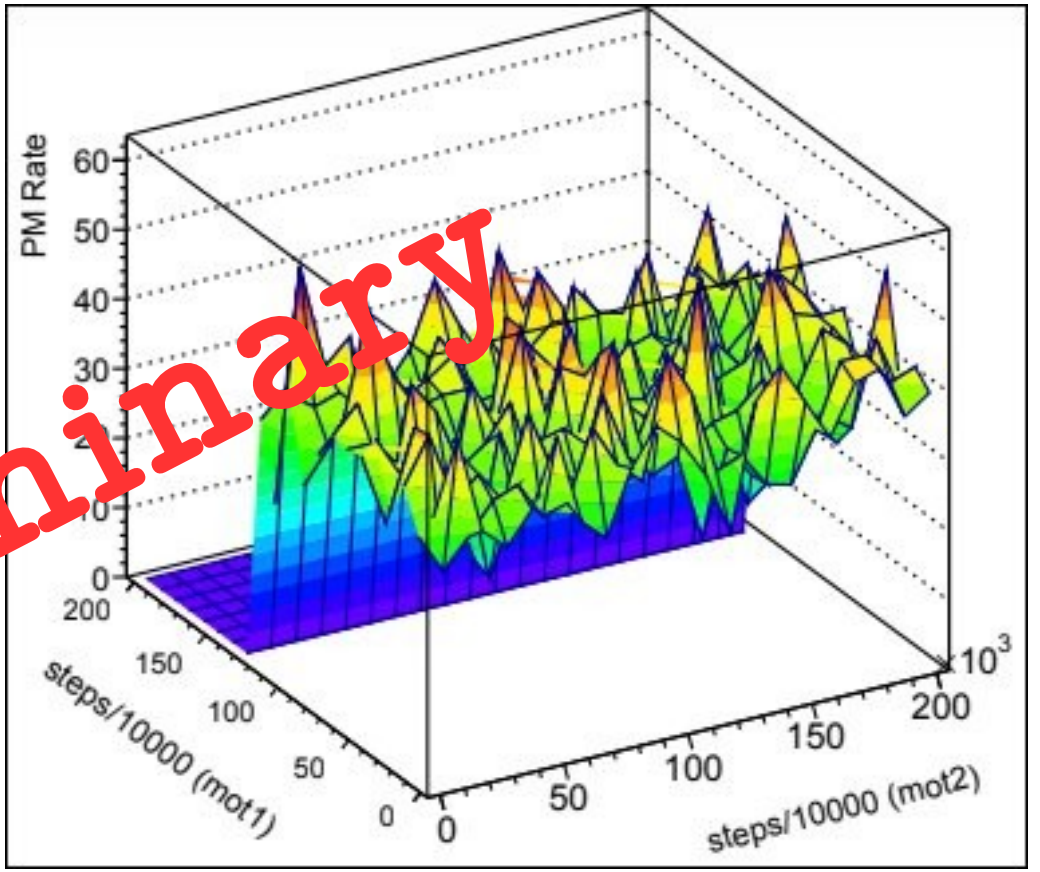


We had a two week window to install LABM, after that vacuum and first injections
We has some issues as for space, this affected our alignment
We finished on time.



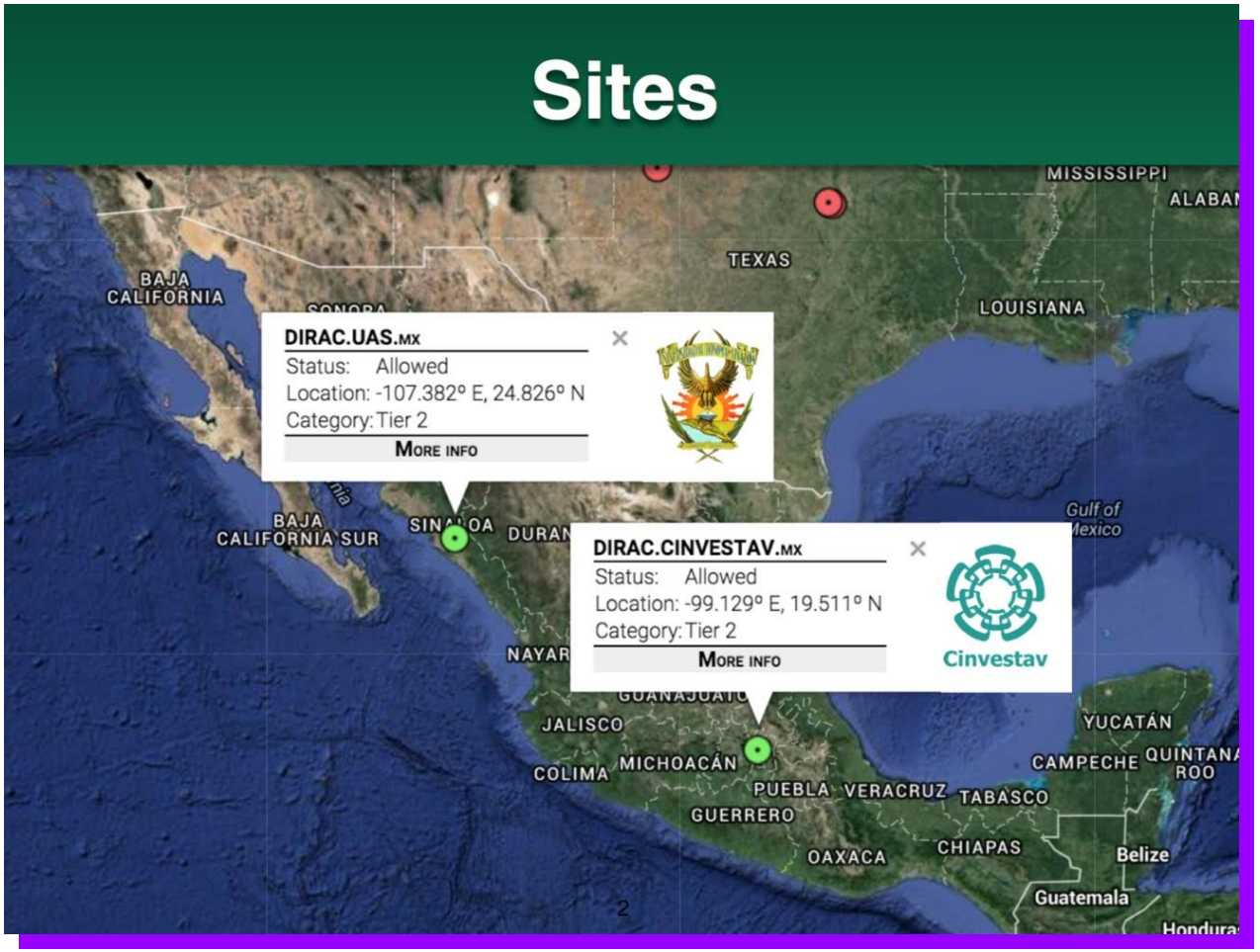
Scan to find the spot where the light is maximum and therefore produced
By beamstrahlung. The rate count of four PMT vs the two degres of freedom
Scan done April 27 2018





No spot the motor got stuck and not possible scan an or bad aligment.

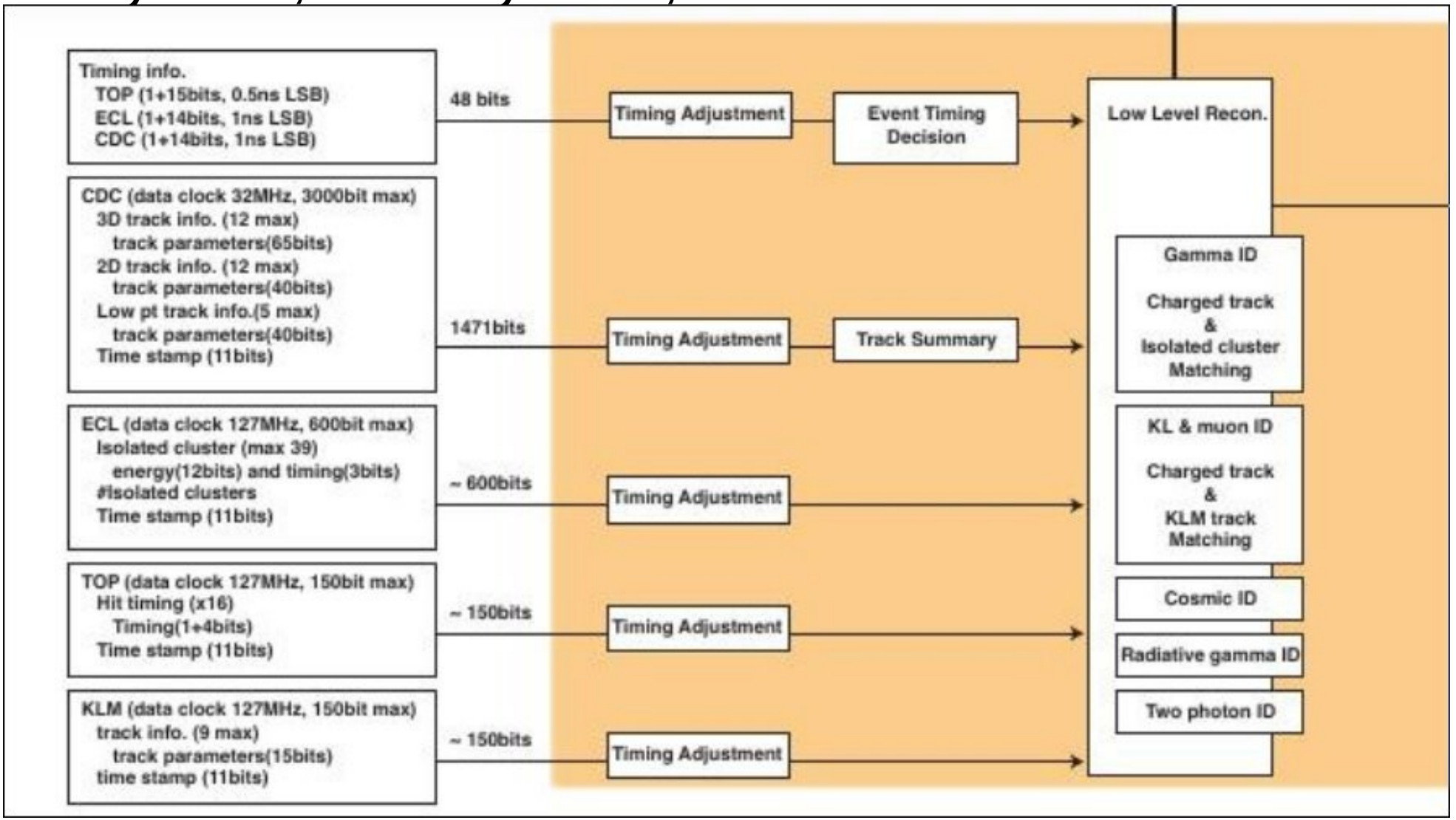
Computing



Two grid nodes one in Sinaloa that is the first Grid Node, and other in Mexico city. Have been operational no problems so far. Need to upgrade in next couple of years

L1 Triggers in Belle II

- We will take data without the inner tracker system, so only TOP,ECL CDC and KLM



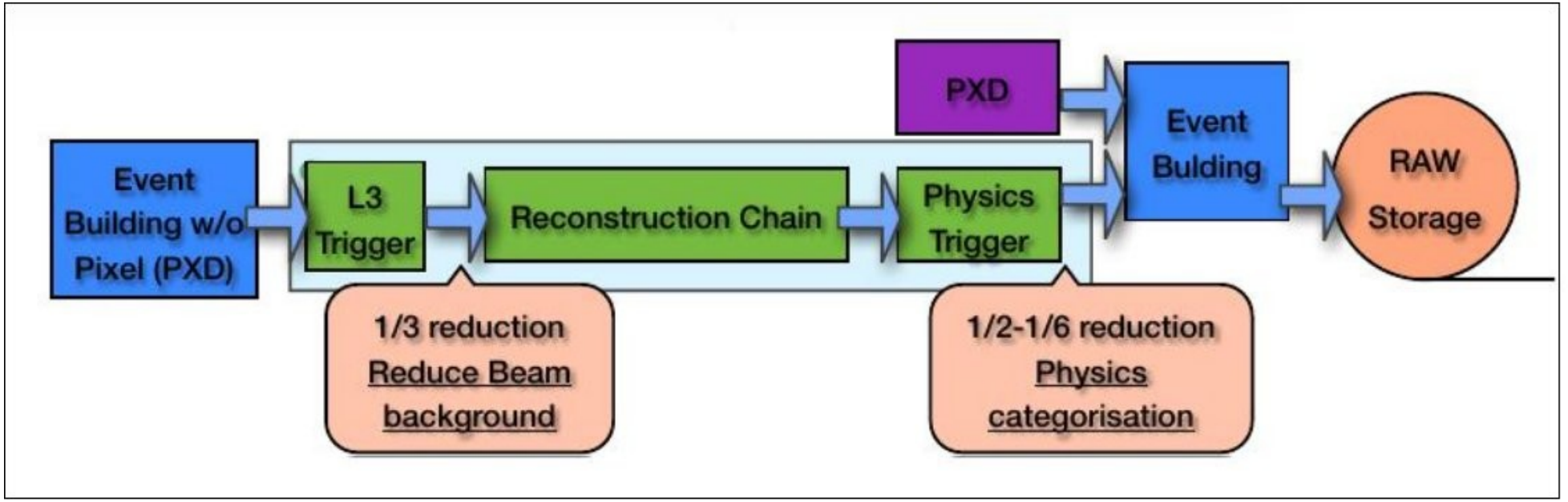
Phase II

- The main purpose is to study background but is still possible to do some physics.
- The Phase II is running without the inner tracker system to measure background and to avoid radiation damge
- The trigger is working at L1 mainly and at L3 is only to be tested.

Efficiency for Taus seem to be around 93 % al L1

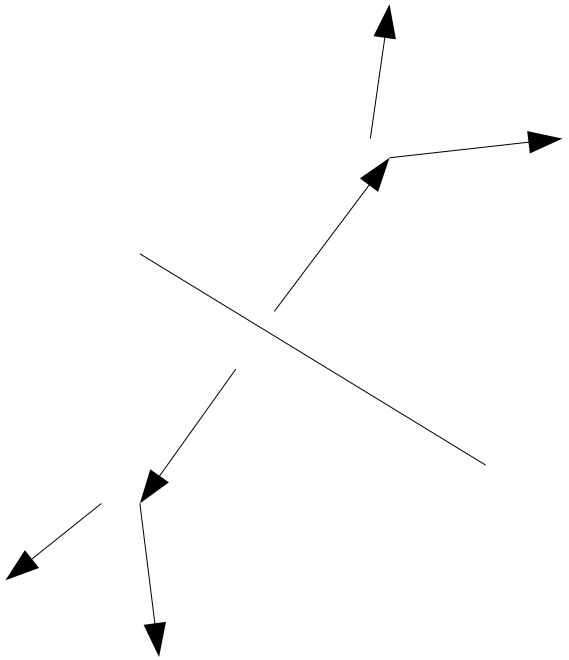
CDCTriggerTrackCombiner	1000	0	0.11	0.11 +- 0.06
TRGECLFAM	1000	42	9.67	9.67 +- 2.52
TRGECL	1000	0	0.25	0.25 +- 0.35
KLMTrigger	1000	0	0.24	0.24 +- 0.25
TRGGRLMatch	1000	0	0.06	0.06 +- 0.03
TRGGRLProjects	1000	0	0.02	0.02 +- 0.01
TRGGDL	1000	0	0.02	0.02 +- 0.02
EffModule	931	0	0.18	0.20 +- 0.74
Sum_TriggerSimulation	931	43	15.48	16.62 +- 6.08
RootOutput	931	127	28.79	30.92 +- 74.33
Total	1001	204	638.28	637.64 +- 335.23

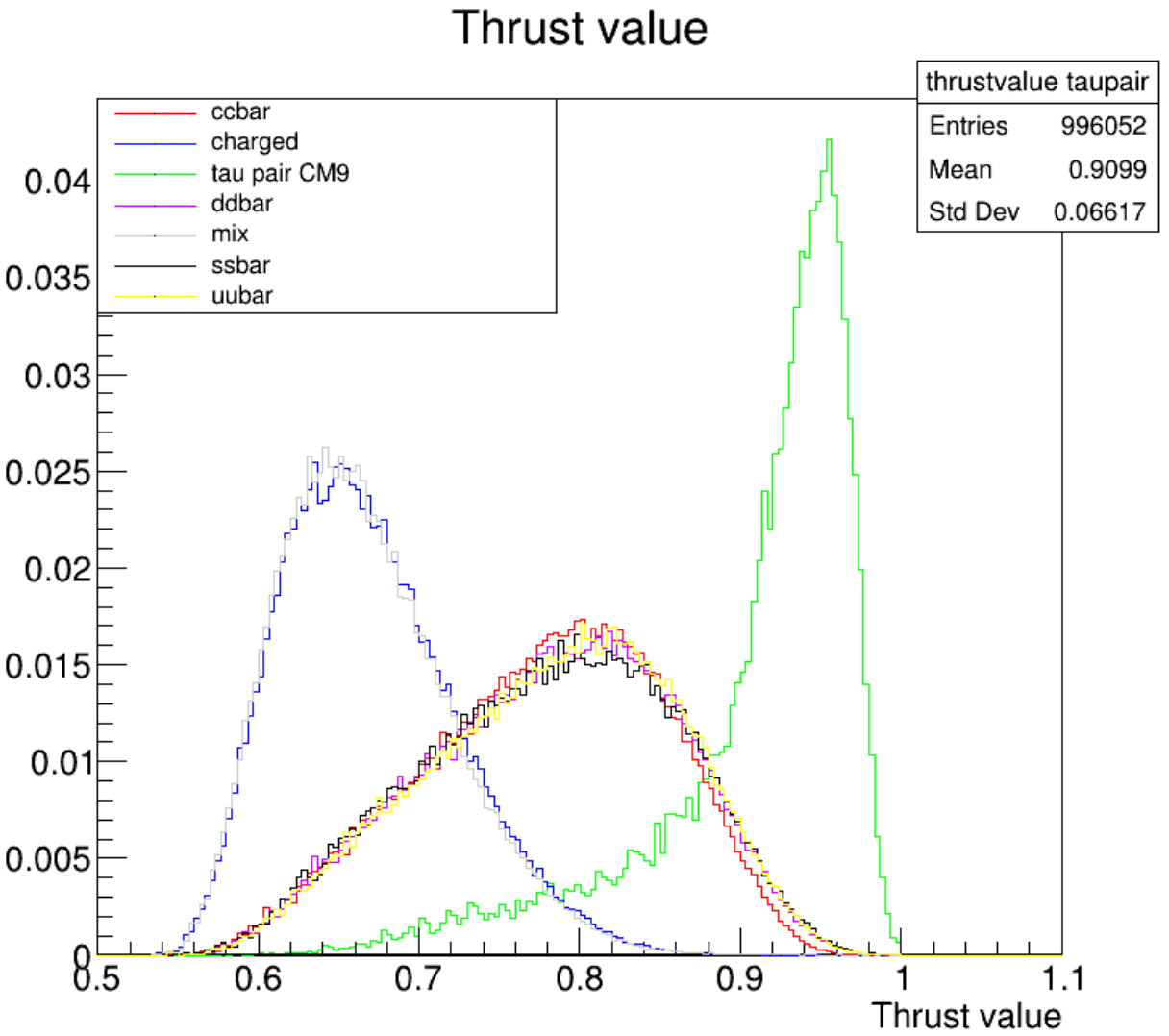
David Rodriguez



Tau Software

- We have been working in Tau specific software.
- Here we show the Trust value to separate tau events from others





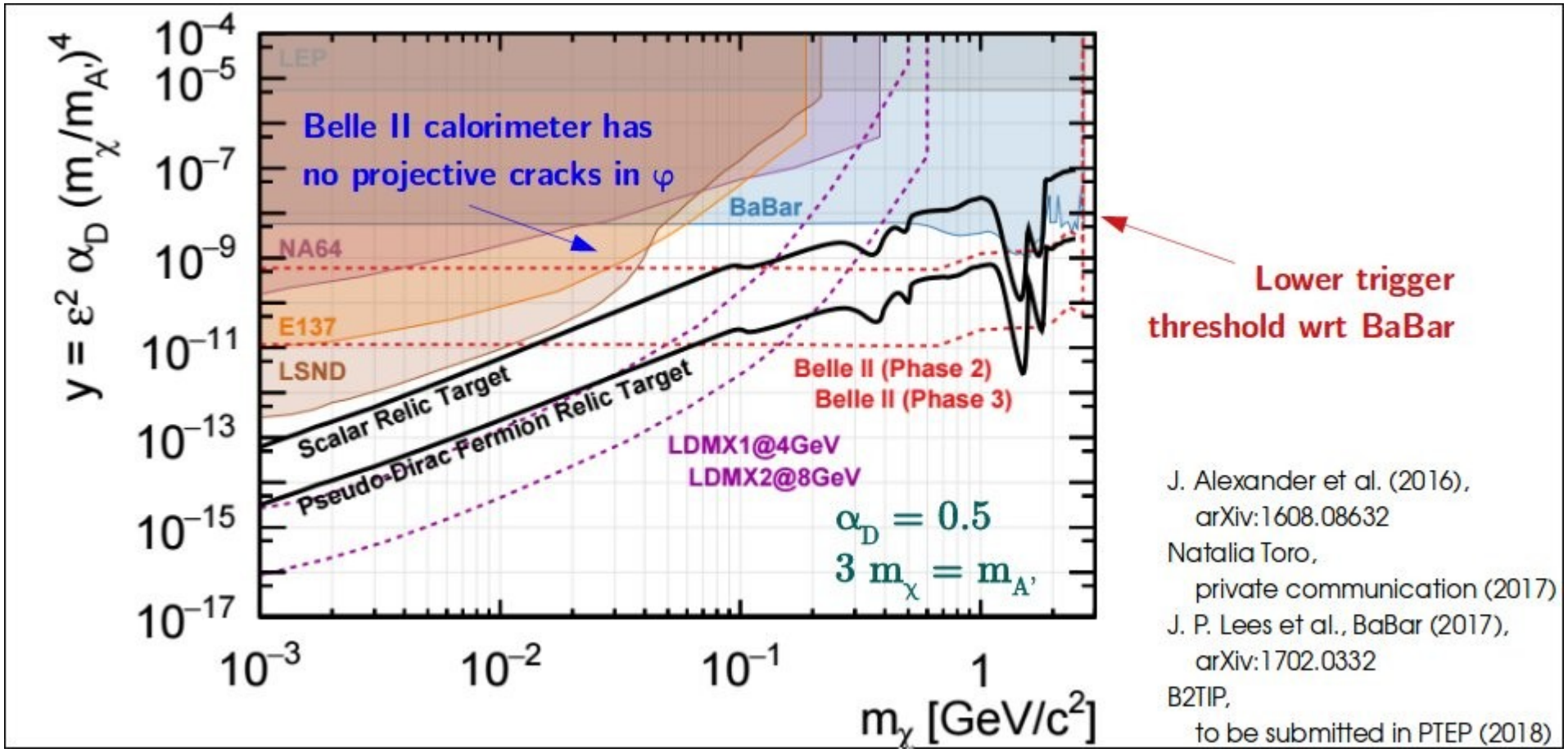
Michel Villanueva

Main problem to identify tau event is the presence of at lest two neutrinos.

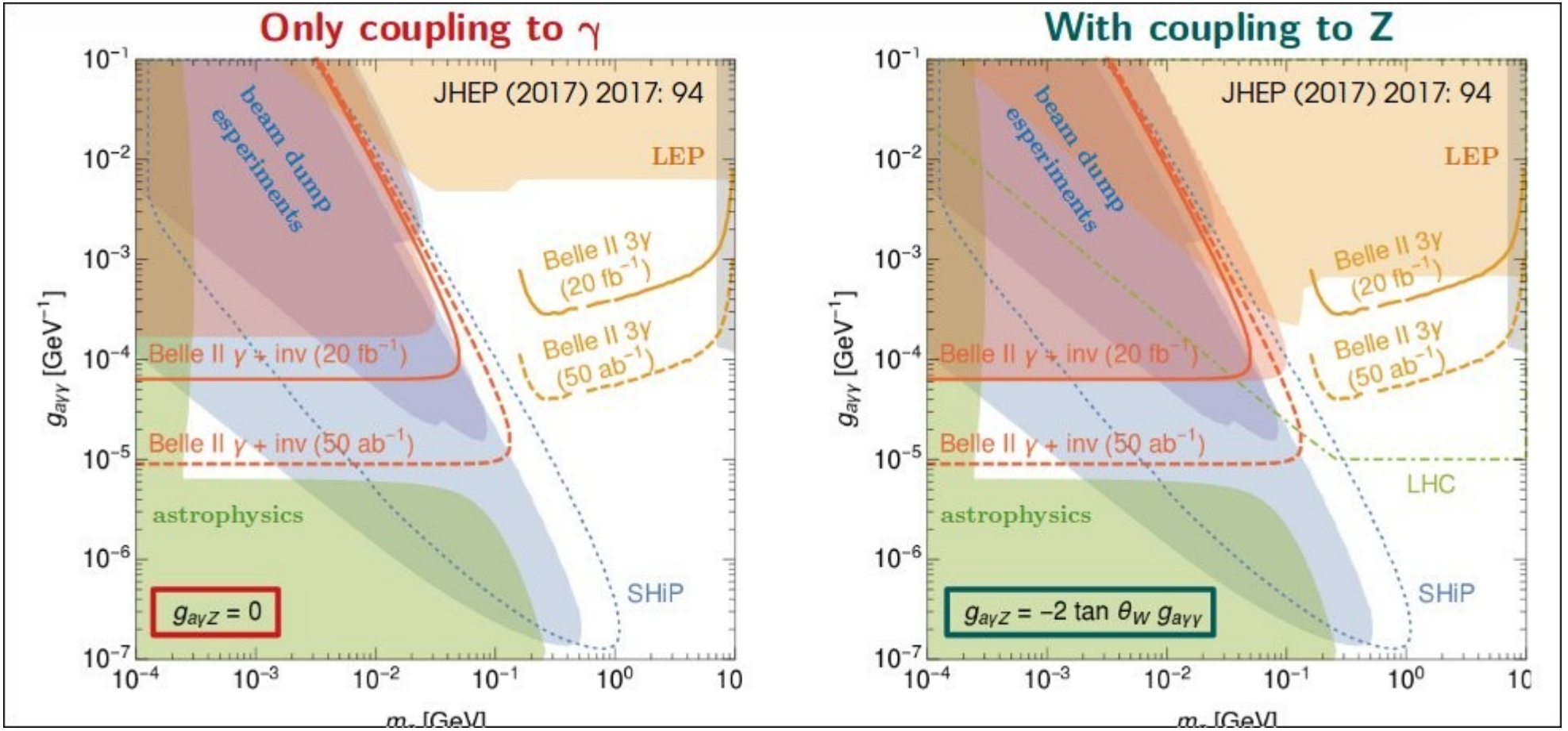
Physics in phase II

Some competitive Physics is possible with Phase II, Dark searches

Dark Photon, Axion Like particles



Axion searches

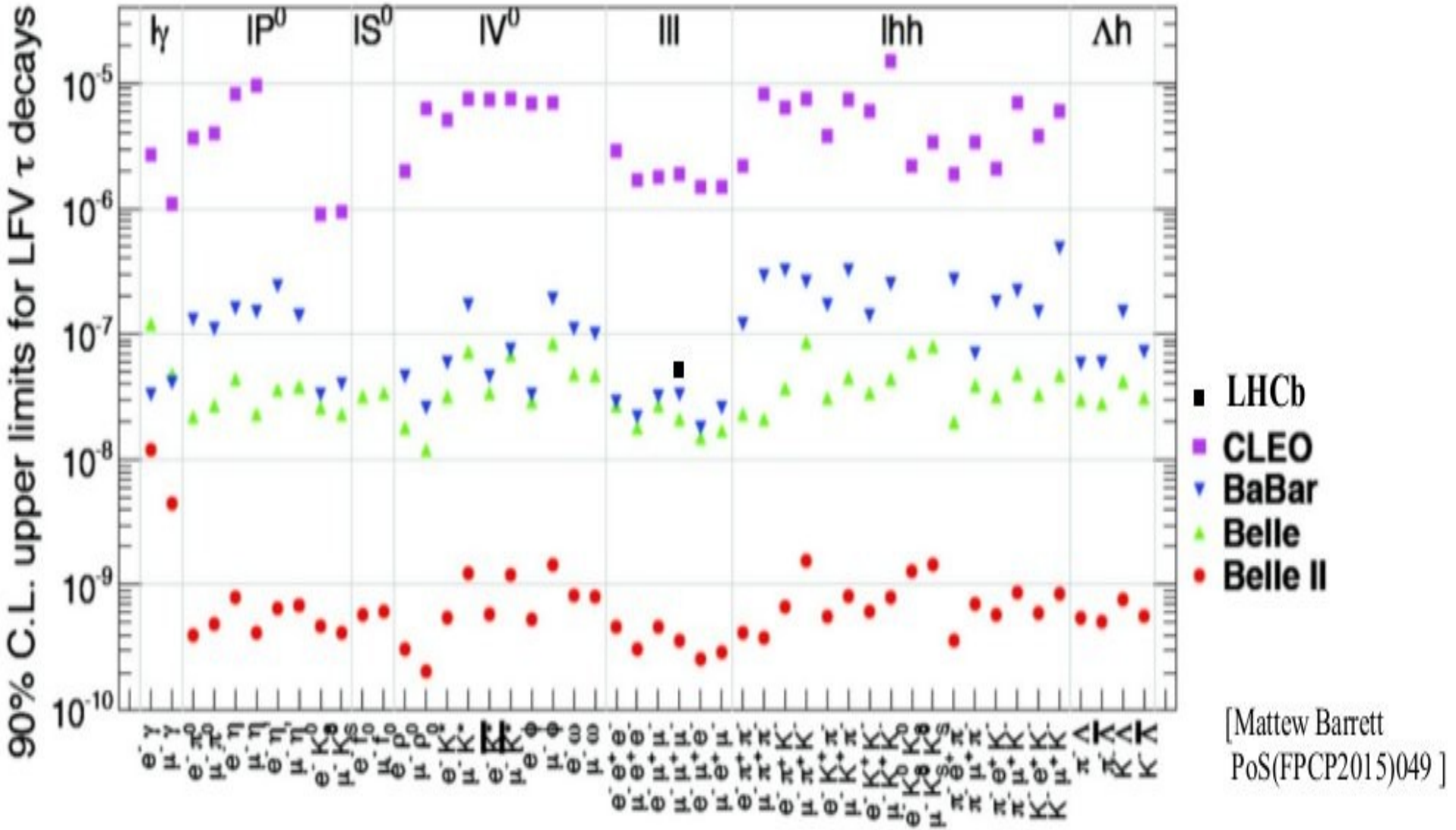


Other Physics in Phase II

- Visible Dark Photon decays
- *Off-shell Dark Photon decays
- Dark Scalar:
  $e^+ e^- \rightarrow \tau^+ \tau^- S ; S \rightarrow l^+ l^-$
- Magnetic Monopoles
- Invisible Y (1S) decays via:
  $Y(3S) \rightarrow Y(1S) \pi^+ \pi^-$
- Long-lived neutral particle decays
- Muonic Dark Force:
  $e^+ e^- \rightarrow \mu^+ \mu^- Z' ; Z' \rightarrow \mu^+ \mu^-$
- LFV:
  $e^+ e^- \rightarrow e^+ \mu^- Z' ; Z' \rightarrow$ invisible
  $e^+ e^- \rightarrow e^+ \mu^- Z' ; Z' \rightarrow e^+ \mu^-$

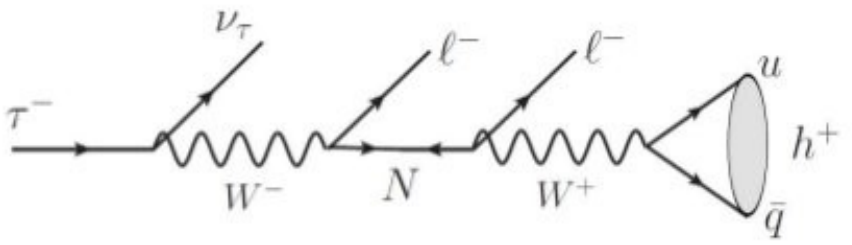
Mexican analysis things more

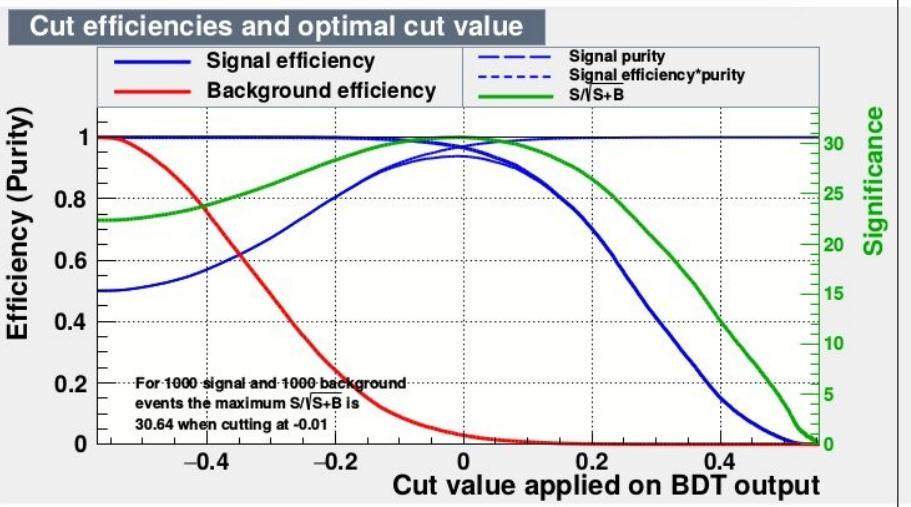
- Search for LNV in Taus



[Mattew Barrett
PoS(FPCP2015)049]

Procesos	Cross-section [nb]	Generador
$e^+e^- \to B^+B^-$ (Charged)	0.525	EvtGen, PYTHIA
$e^+e^- \to B^0\bar{B}^0$ (Mixed)	0.525	EvtGen, PYTHIA
$e^+e^- \to u\bar{u}$ (uubar)	1.61	KKMC
$e^+e^- \to d\bar{d}$ (ddbar)	0.40	KKMC
$e^+e^- \to s\bar{s}$ (ssbar)	0.38	KKMC
$e^+e^- \to c\bar{c}$ (ccbar)	1.30	KKMC
$e^+e^- \to \tau^-\tau^+$ (taupair-generic)	1.30	KKMC





Procesos	$S/\sqrt{S+B}$
$e^+e^- \to B^+B^-$ (Charged)	31.11
$e^+e^- \to B^0\bar{B}^0$ (Mixed)	31.17
$e^+e^- \to u\bar{u}$ (uubar)	30.58
$e^+e^- \to d\bar{d}$ (ddbar)	30.63
$e^+e^- \to s\bar{s}$ (ssbar)	30.32
$e^+e^- \to c\bar{c}$ (ccbar)	30.64
$e^+e^- \to \tau^-\tau^+$ (taupair-generic)	30.02

LNV in Taus

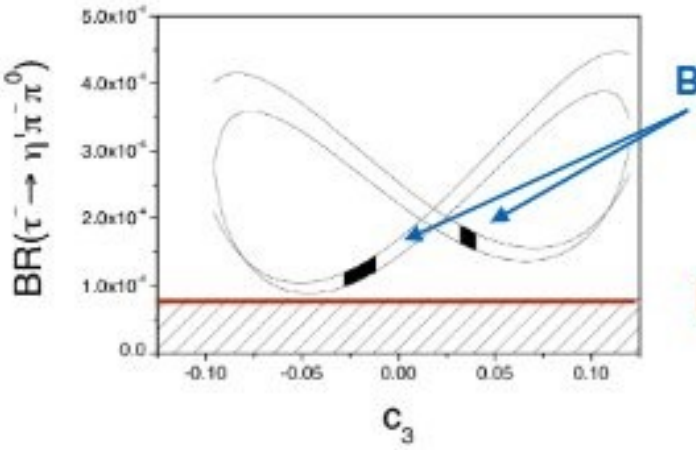
Backgrounds is the Key in Belle II analysis

The $\tau \to \eta\pi\pi^0\nu$ decay

- In the limit of the SU(2) isospin symmetry, is a good cross-check of consistency with $\sigma(e^+e^- \to \eta\pi^+\pi^-)$ in the low energy region [1]

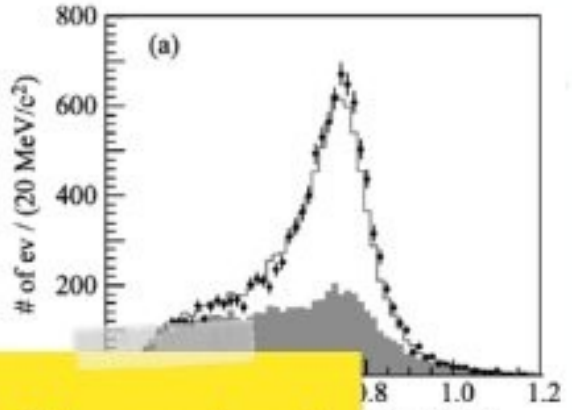
$$\frac{d\Gamma(\tau^- \to \eta\pi^-\pi^0\nu_\tau)}{dQ^2} = 2\, f(Q^2)\sigma(e^+e^- \to \eta\pi^+\pi^-)$$

- Given the η - η' mixing, currently there is an slightly inconsistency between the UL of $\boldsymbol{\tau \to \eta'\pi\pi^0\nu}$, and the BR measured for $\boldsymbol{\tau \to \eta\pi\pi^0\nu}$. [1]

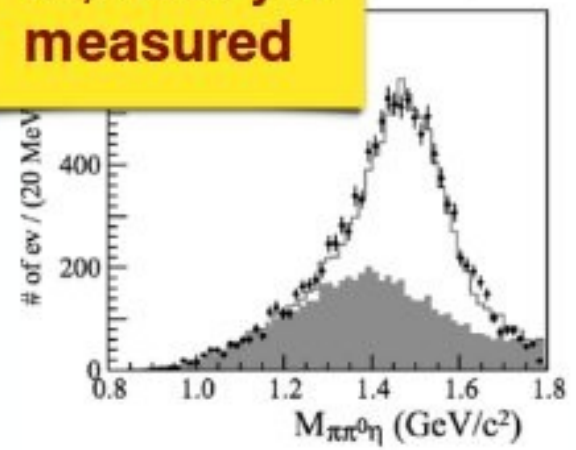


Allowed by BR($\tau \to \eta\pi\pi^0\nu$)

UL (90% CL)



$M_{\eta\pi}$ not yet measured



K. Inami et.al (BELLE)
Phys.Lett. B672 (2009)

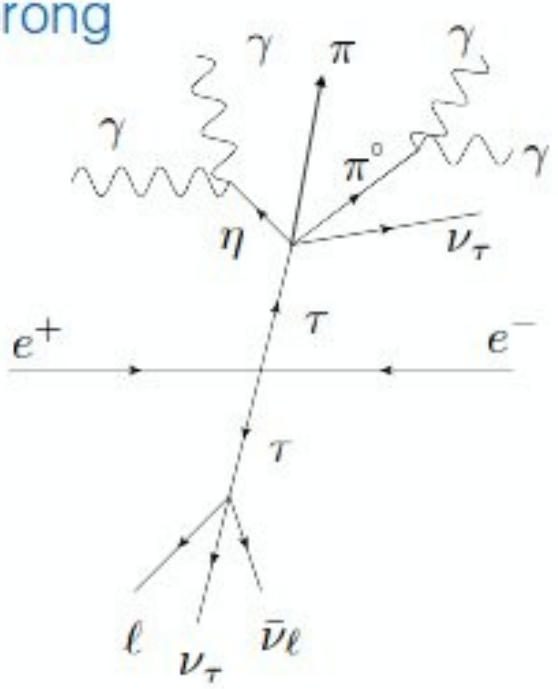
[1] D. Gómez Dumm and P. Roig; Phys. Rev. D 86, 076009 (2012)

Cinvestav

Reconstruction of $(\tau \to \ell\nu\nu)(\tau \to \eta\pi\pi^0\nu)$

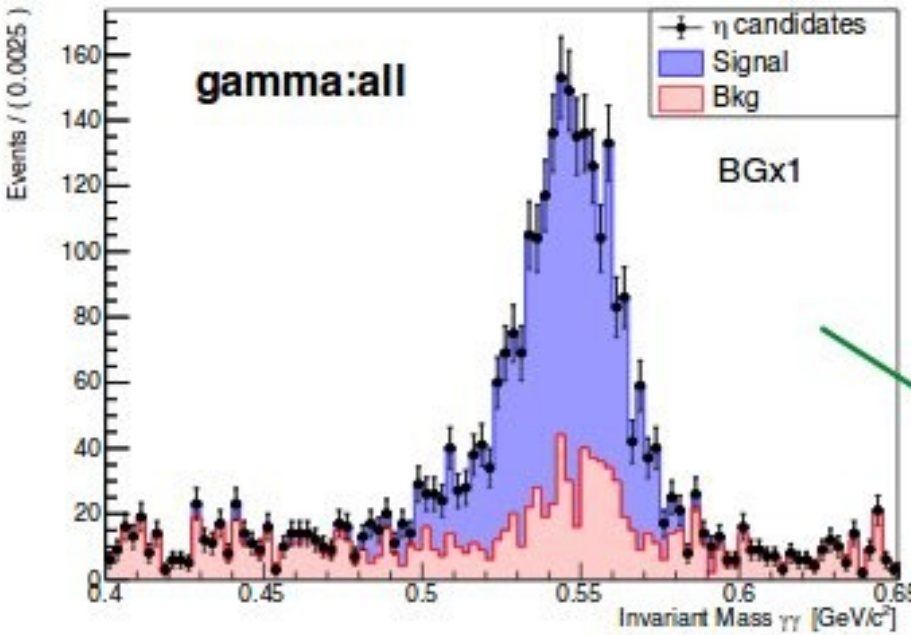
- To set the best selection cuts, reconstruction is performed with minimum cuts (invariant mass, cleaning tracks).
- matchMCTruth performed in both tau candidates.
- If candidate matches a generated particle, is tagged as signal, otherwise we call it bkg.
- EventShape information obtained.
- Flag in γ's for pi0 veto.
- Steering file is located **here**.

1-prong



Cinvestav

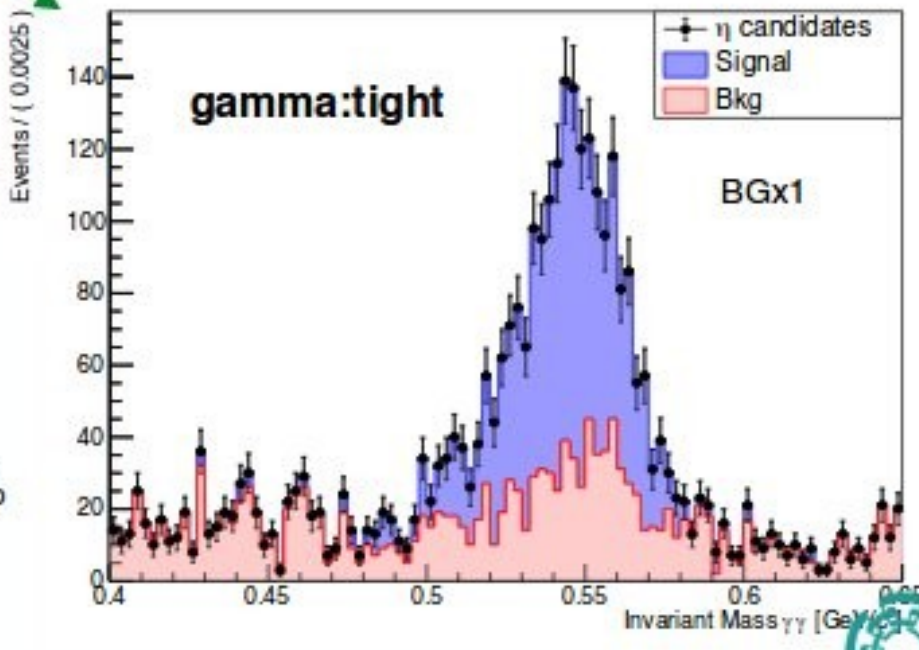
ParticleLists for $\gamma\gamma$ candidates



`gamma:all`

Efficiency (signal): 0.22 %
Percentage signal (S/[S+B]): 60.64 %

Tag: good 62%; wrong 37%



`gamma:tight`

Efficiency (signal): 0.16 %
Percentage signal (S/[S+B]): 50.09 %

Tag: good 63%; wrong 36%

Close collaboration with theorist

1.- "$\tau \to \eta^{(\prime)} \pi \nu \gamma$ decays as background in the search for second class currents",

A. Guevara, G. Lopez Castro and P. Roig, Phys. Rev. D95, 054015 (2017).

2.- "Five-body leptonic decays of muon and tau leptons",

A. Flores-Tlalpa, G. Lopez Castro and P. Roig, JHEP 1604, 185 (2016)

3.- "LFV in hadronic decays of the tau lepton in the simplest little Higgs model",

Lami, J. Portoles and P. Roig, Phys. Rev. D93, 076008 (2016)

4. "Predictions on the second class currents decays $\tau \to \pi \eta^{(\prime)} \nu$", R. Escribano,

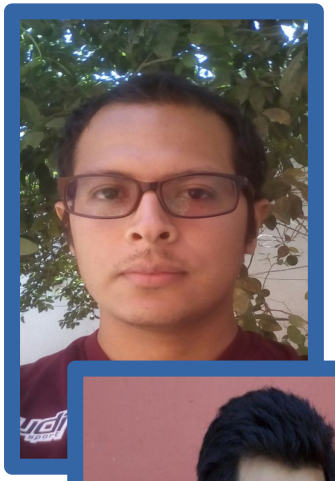
S. González Solís and P. Roig, Phys. Rev. D94, 034008 (2016).

Conclusions

- *No major showstopper for now, problems seem to be workables*
- *Need to develop robust motor or mechanism for LABM, but working beamstralung is there so is working.*
- *Very intensive work on software, shift and data analysis.*
- *We have explored some possibilities of new physics in Tau sector mainly LNV, LFV and SCC.*
- *Expect exciting results for next year.*

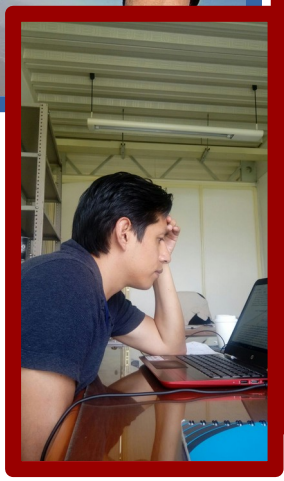
THANKS

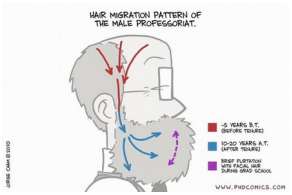








WAR MIGRATION PATTERN OF THE MALE PROFESSORIAT.
<5 YEARS B.T. (BEFORE TENURE)
10-20 YEARS A.T. (AFTER TENURE)
BRIEF FLIRTATION WITH FACIAL HAIR DURING GRAD SCHOOL
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