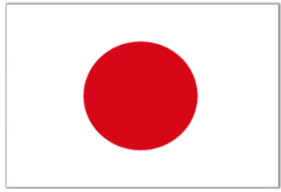
JENNIFER

EU grant n.644294

The project



Japan and Europe Network for Neutrino and Intensity Frontier Experimental Research

EUROPEAN COMMISSION

Horizon 2020 - Research and Innovation Framework Programme

Evaluation Summary Report

Call: H2020-MSCA-RISE-2014
Funding scheme: Marie Skłodowska-Curie Research and Innovation Staff Exchange (RISE)
Proposal number: 644294
Proposal acronym: JENNIFER
Duration (months): 48
Proposal title: Japan and Europe Network for Neutrino and Intensity Frontier Experimental Research
Activity: PHY

N.	Proposer name	Country	Total Cost	%	Grant Requested	%
1	ISTITUTO NAZIONALE DI FISICA NUCLEARE	IT	774,000	33.53%	774,000	33.53%
2	STIFTUNG DEUTSCHES ELEKTRONEN-SYNCHROTRON DESY	DE	418,500	18.13%	418,500	18.13%
3	OESTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN	AT	99,000	4.29%	99,000	4.29%
4	THE HENRYK NIEWODNICZANSKI INSTITUTE OF NUCLEAR PHYSICS, POLISH ACADEMY OF SCIENCES	PL	40,500	1.75%	40,500	1.75%
5	UNIVERZITA KARLOVA V PRAZE	CZ	45,000	1.95%	45,000	1.95%
6	INSTITUT JOZEF STEFAN	SI	121,500	5.26%	121,500	5.26%
7	MIDDLE EAST TECHNICAL UNIVERSITY	TR	63,000	2.73%	63,000	2.73%
8	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	FR	76,500	3.31%	76,500	3.31%
9	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR	126,000	5.46%	126,000	5.46%
10	INSTITUTO DE FISICA DE ALTAS ENERGIAS	ES	103,500	4.48%	103,500	4.48%
11	NARODOWE CENTRUM BADAN JADROWYCH	PL	126,000	5.46%	126,000	5.46%
12	QUEEN MARY UNIVERSITY OF LONDON	UK	126,000	5.46%	126,000	5.46%
13	SCIENCE AND TECHNOLOGY FACILITIES COUNCIL	UK	171,000	7.41%	171,000	7.41%
14	COSTRUZIONI APPARECCHIATURE ELETTRONICHE NUCLEARI C.A.E.N. SPA	IT	18,000	0.78%	18,000	0.78%
15	INTER-UNIVERSITY RESEARCH INSTITUTE CORPORATION, HIGH ENERGY ACCELERATOR RESEARCH ORGANISATION	JP	0	0.00%	0	0.00%
	Total:		2,308,500		2,308,500	

\+ **Tokyo University - ICRR** new partner added during Grant agreement preparation.

Moving people (and ideas) between Europe and Japan

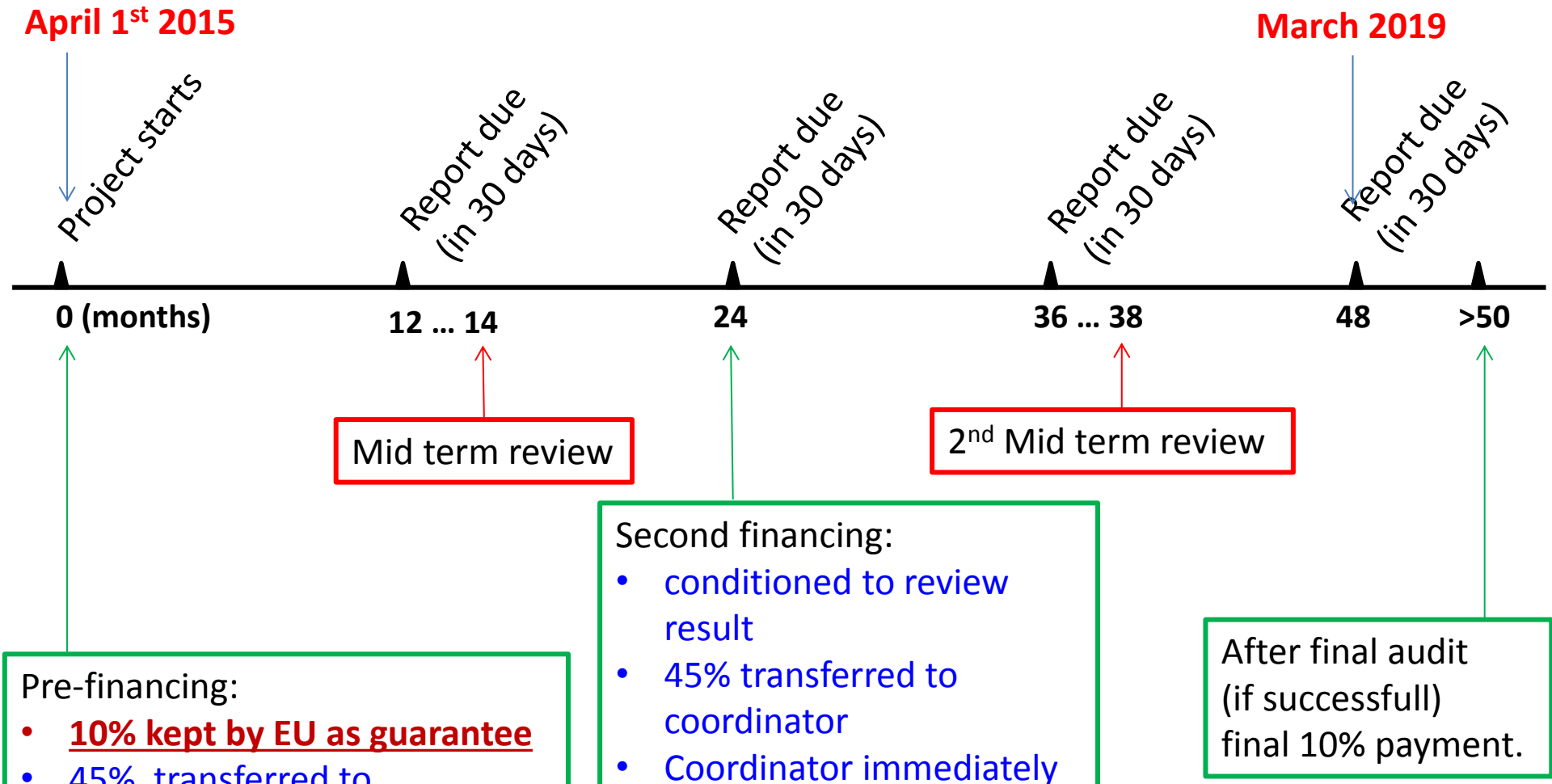
Belle II

T2K

HyperK R&D

4 years
5 Work Packages
513 person months
More than 200 persons (researchers + technicians)
Almost 400 secondments
26 deliverables
8 milestones

Timeline of the project



5 Work Packages:

1-2 BELLE-II
3-4 T2K
5 Management

Table B3: Work Package List

Work Package No	Work Package Title	Activity Type	Number of person-months involved	Start Month	End month
1	Flavour physics at an e+e- collider	Research, training, dissemination, communication	~~70~~ 65	1	48
2	Belle-II detector construction and test	Research, training	~~222~~ 227	1	48
3	Neutrino oscillation physics	Research, training, dissemination, communication	115	1	48
4	Towards HyperK	Research, training	96	1	48
5	Management	Management, Networking, Dissemination, Communication	10	1	48

WP 1

65 person months

Flavour physics at an e^+e^- collider

Task 1.1: Detector related software

Deliverables: annual workshops (first by april 2016)

Task 1.2 : Physics analysis tools

Deliverables: tutorials to Belle-II members (first by april 2016)
written and updated user guide (april 2018)

Task 1.3: Belle-II physics-theory interface platform

Deliverables: Belle-II yellow report (april 2017)

WP 2

227 person months

BELLE-II detector construction and test

Task 2.1: Forward Electromagnetic Calorimeter

Deliverables: final TDR (Feb 2016)
final Commissioning Report (april 2019)

Task 2.2 : Tracking detectors

Deliverables: full CDC commissioning (june 2016)
PXD whitebook (december 2016)
full SVD+PXD integration and commissioning inside BELLE-II (october 2017)

Task 2.3: Particle identification

Deliverables: Barrel PID calibration and commissioning (april 2018)
Forward PID calibration and commissioning (april 2018)

Task 2.4: Luminosity monitor

Deliverables: diamond sensors optimization for accelerator feedback (april 2018)

WP 3

115 person months

Neutrino Oscillation Physics

Task 3.1: Neutrino interactions and cross sections

Task 3.2 : External background studies

Task 3.3: Exotic physics

Common Deliverables: report on anti-neutrino analysis (april 2017)
report on MEC searches methods (april 2019)
report on combined electron and muon neutrino oscillation analysis (april 2019)

WP 4

96 person months

Towards HyperKamiokande

Task 4.1: Water Cherenkov detector

Deliverables: HyperK sensitivity study with a 2 Kton WC detector (april 2017)
Photosensor performance study (april 2018)
1 Kton detector test

Task 4.2 : High Pressure TPC

Deliverables: detailed simulation (april 2017)

Task 4.3: Beam

Deliverables: Beam target design (april 2019)
Beam target proposal (april 2019)

WP 5

10 person months

Task 5.1: Management of secondments

Deliverables: appointing porject Executive Commettee (may 2015)

Secondments DB creation and maintenance (july 2015)

Task 5.2 : Organization of common events

Deliverables: yearly general meeting (with proceedings) (first by april 2016)

Task 5.3: Outreach activities

Deliverables: yearly outreach event (first by april 2016)

yearly school for gratuate students (first by april 2016)

BELLE-II inclusion in masterclasses program (april 2017)

Communication and outreach are an essential part of the project !

The specific JENNIFER «mission»

All our research activities had started since long and would have been done anyway!

EC is supporting them but is requiring us to work in a different way:

Bridging and cross-fertilizing different communities and approaches !

Europe ⟷ **Japan**

Academia ⟷ **Industry**

Quark flavour ⟷ **Neutrino flavour**

research ⟷ **society**

Many common topics to develop together

Physics !

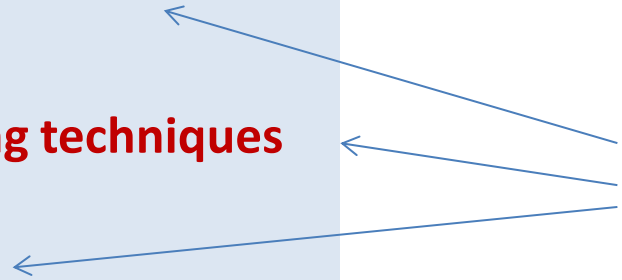
Analysis and computing techniques

Photodetectors

Data acquisition and control systems

Beam-detector interface

Outreach and Communication



See this afternoon sessions

But also many technologies to be shared:

Silicon detectors, Water Cerenkov, Diamond detectors, Scintillating Crystals, Gas electron multipliers, Radiation hardness...

www.jennifer-project.eu

JENNIFER

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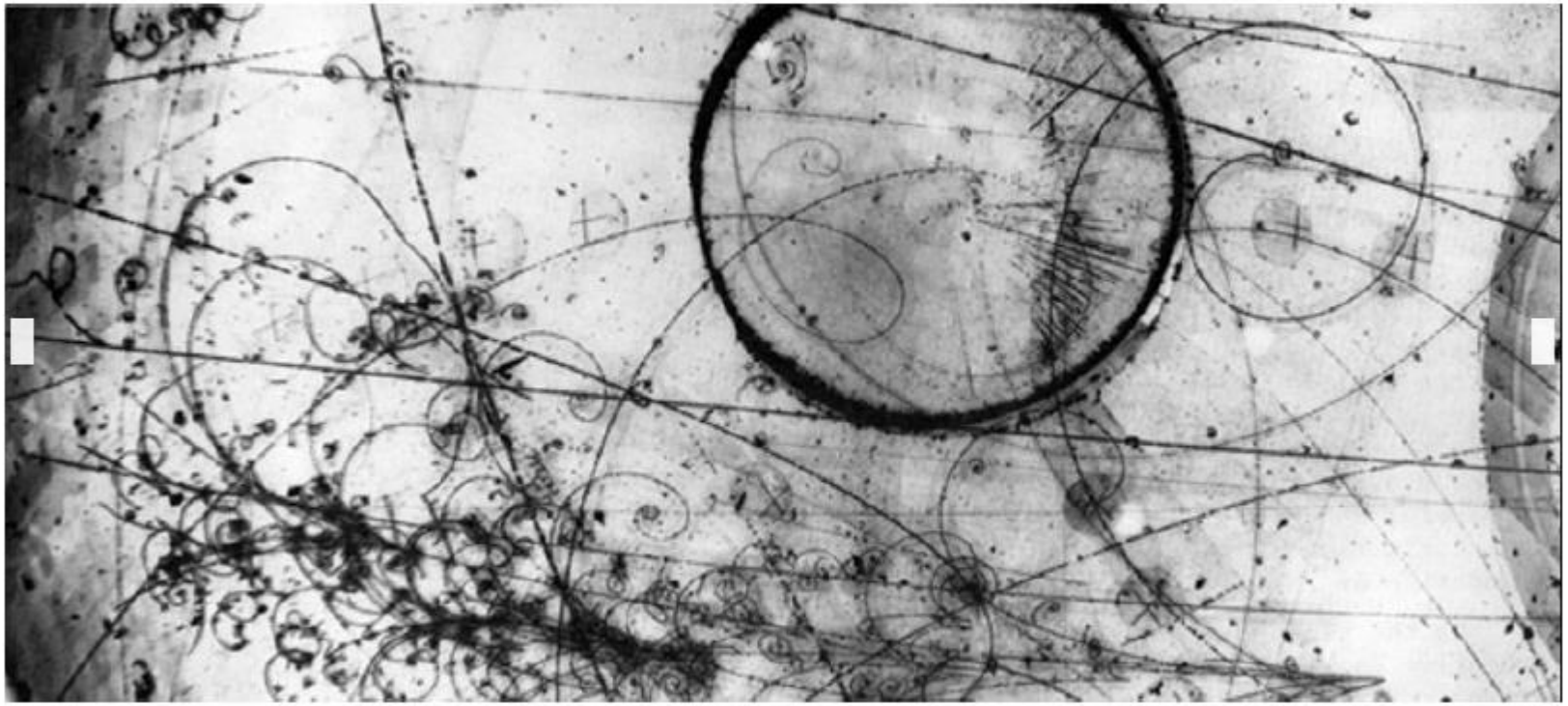


The JENNIFER consortium is formed by 13 academic and 1 industrial european organizations, and by 2 japanese institutions: the KEK laboratory and the Institute for

JENNIFER: impatto su Roma Tre

BELLE-II

Permane l'impegno sul progetto e (forse) la costruzione di un nuovo calorimetro forward a cristalli: task 2.1 del progetto

Resta anche l'impegno sulla fisica del flavour a Belle-II, cui già partecipiamo con parte del gruppo teorico, più un impegno sulle analisi future che sta iniziando: Task 1.1 e 1.3 del progetto.

Outreach

Nuovo e rilevante impegno nella divulgazione, sia verso il pubblico generale che verso le scuole (estensione masterclasses al caso di Belle-II e T2K).
Ovviamente in collaborazione con altri gruppi JENNIFER.
Avviato anche un contatto con industrie di tecnologia italiane: da inserire nelle attività generali di TT dell'INFN.
Partnership con Frascatiscienza.

BelleII ECL detector

- 1/3 of B decay products = π^0 or other neutrals producing γ in [0.02,4] GeV energy range!
- Reuse Belle Calorimeter
  - CsI(Tl) crystals red by PIN diodes
  - Performances (E in GeV):

$$\frac{\sigma_E}{E} = \sqrt{\left(\frac{0.066\%}{E}\right)^2 + \left(\frac{0.81\%}{\sqrt[4]{E}}\right)^2 + (1.34\%)^2}$$

- Higher luminosity means
  - higher event pile-up

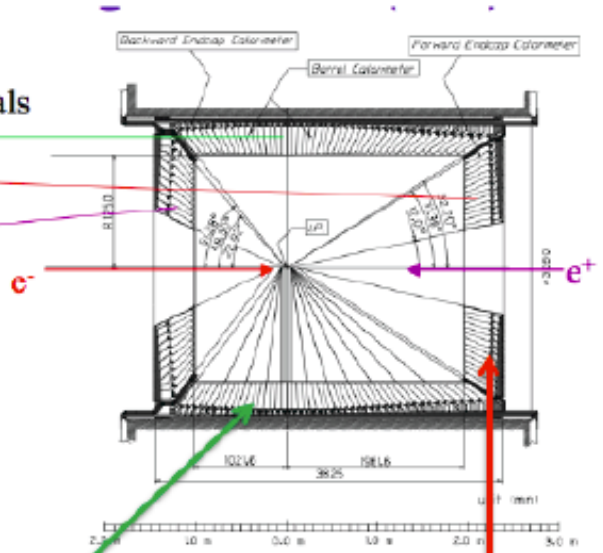
  → faster electronics
  - higher radiation dose absorbed by detectors

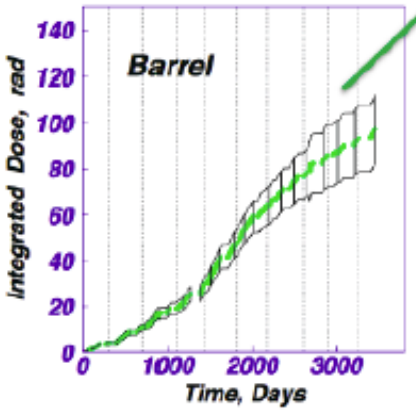
  → need to replace crystals more exposed to radiation damage (forward region)

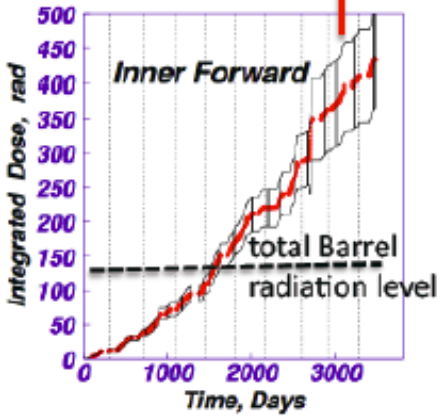
In total, 8736 CsI(T*l*) crystals (6624 in Barrel, 1152 in Fwd. Endcap and 960 in Bwd. Endcap)

Covering 12<θ<155° in Lab. frame.

Inner radius = 1250mm.

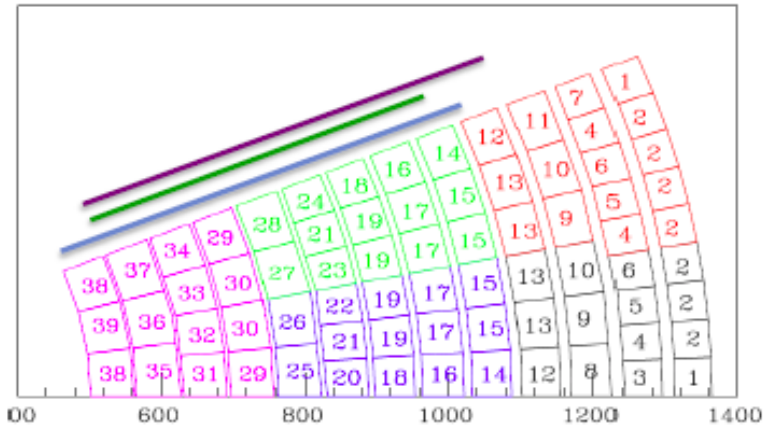




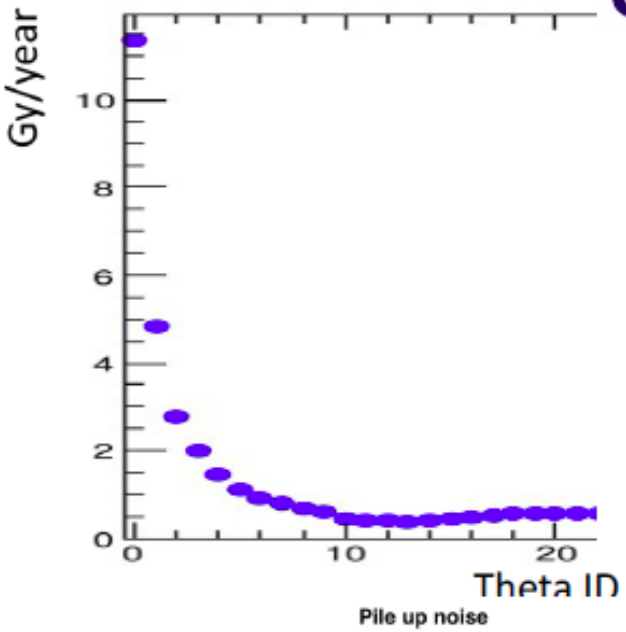


Full Belle experiment data taking period

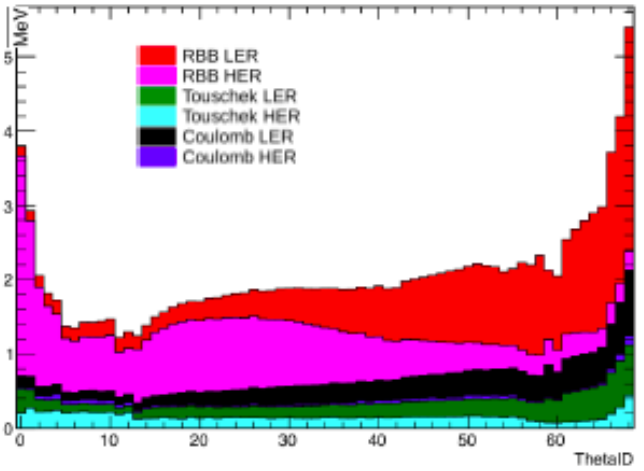
Upgrade of the FWD ECL



a) From 0 to 8
b) From 1 to 8
c) From 1 to 9



Pile up noise



Replace CsI(Tl) with pure CsI crystals

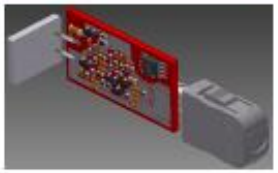
- Same Molière radius → no change in mechanics
- Fast crystals → good for pile-up
- Low light yield (near UV emission 315 nm) → requires a careful study of the photosensor

11/06/2015

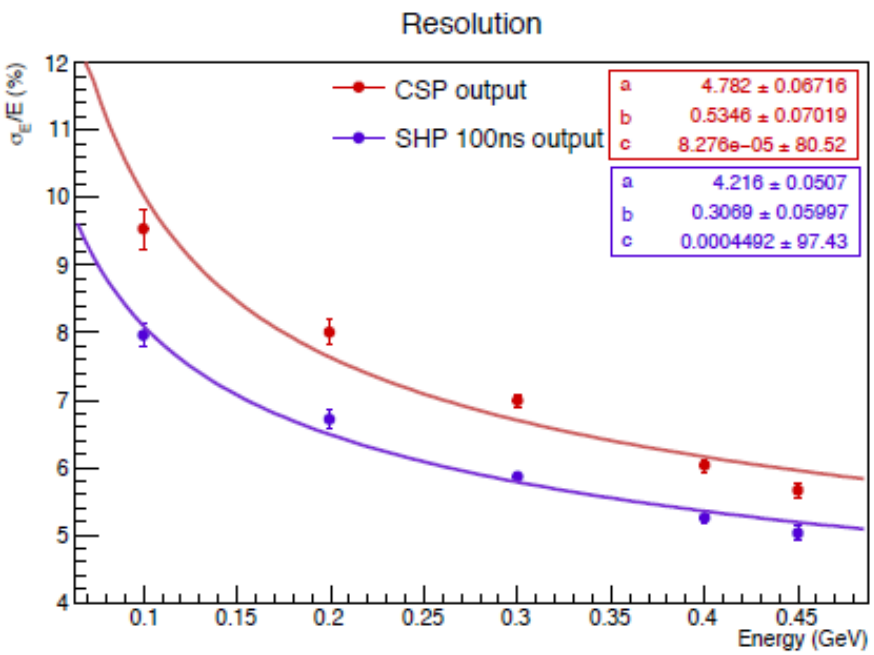
Matrix CsI pure prototype

- 4x4 CsI Pure crystals (all produced by Amcrys)
  - Qualification of an Italian producer (Optomaterials) is ongoing
  - First preliminary results shows a very good quality
- Each crystal equipped with 2 Hamamatsu LA-APD
- Each APD is readout with 1 Charge preamplifier
- Single channel HV regulation on frontend board
- 1 temperature sensor (Maxim 1-wire) for each channel

Charge – Preamplifier
Custom discrete amplifier at BJT transistor.
Gain = 1.4V/pC
Power dissipation = 16mW
Single power = 6V to GND
Dynamic Range 2.2V
Tau IN = 40ns



Beam Test results (II)

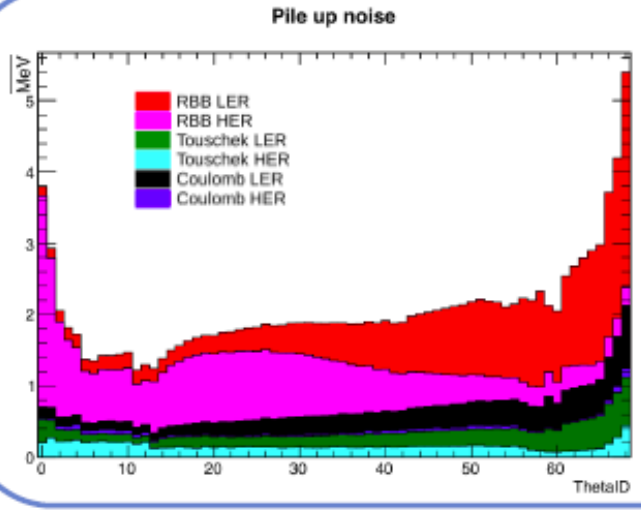


Fit function: $\sigma(E)/E = \frac{a}{\sqrt[4]{E}} \oplus \frac{b}{E} \oplus c$

- Resolution compromised by the pickup noise
- Another effect is the beam degradation due to multiple scattering
  - Matrix - Beam pipe distance ~1.7m
  - 8 silicon layer 400μm each
- constant parameter *c* not extracted correctly
  - Probably due to the few energy points

New Test Beam at Mainz end of July

Background study



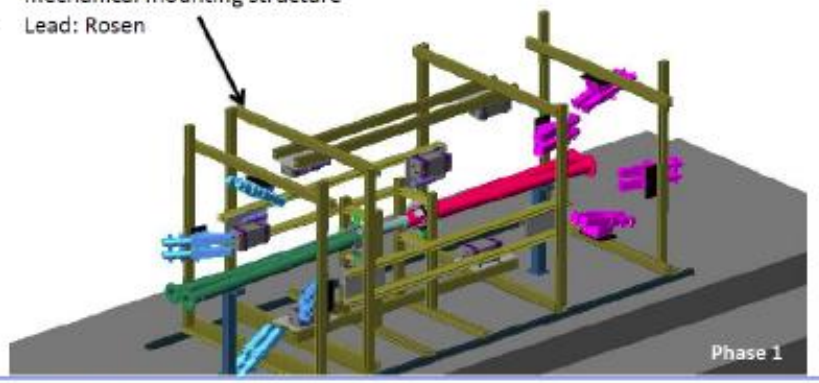
Last results from BelleII MC simulations

Samuel de Jong (UVic)
20th BelleII General Meeting

- Pile up greater than 2MeV on fwd and bwd region
  - High background rate expected
  - Study of background is crucial

BEAST: Beam Exorcism for A Stable Belle Experiment

- Hawaii delivering phase 1 mechanical mounting structure
- Lead: Rosen



- Variety of detector systems on fiberglass support structure
- Some detectors (TPCs, He-3 tubes, PIN diodes) can be easily moved manually
- Full 3D CAD exists (Rosen). Also has been incorporated in the Belle II simulation (Jaegle).
- All parts procured, most assembly, to be used for "MiniBEAST" system test January 2015.
- Disassemble and ship to KEK August 2015.

Goals:

1. Protect Belle II: Ensure radiation levels safe before Belle roll-in
2. Measure individual beam background components
3. System tests (beam abort, VXD occupancy, cooling, mask control system)
4. Provide real-time feedback to SuperKEKB

Phase 1 Jan 2016

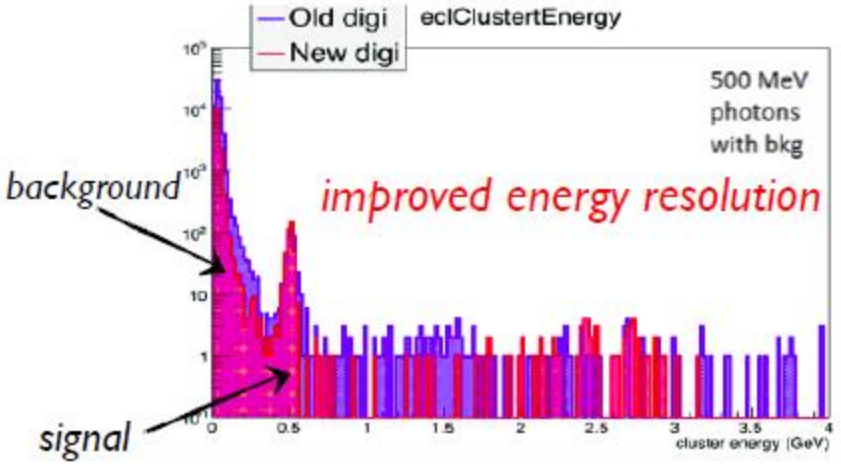
Scrubbing of beam pipe
No collisions, Belle will not roll in
Variety of subsystems on fiberglass support structure

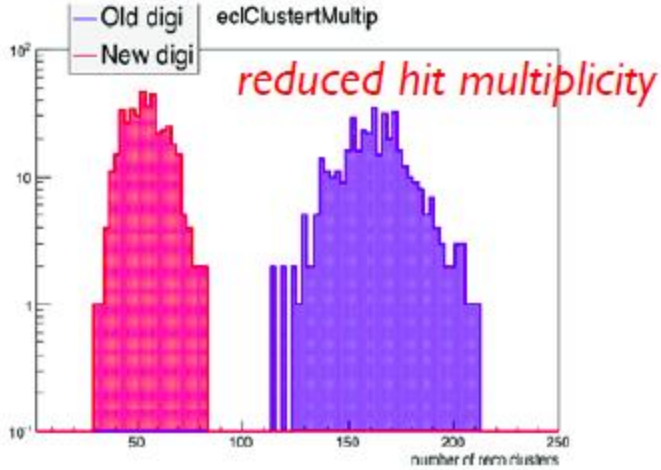
Phase 2 Feb 2017

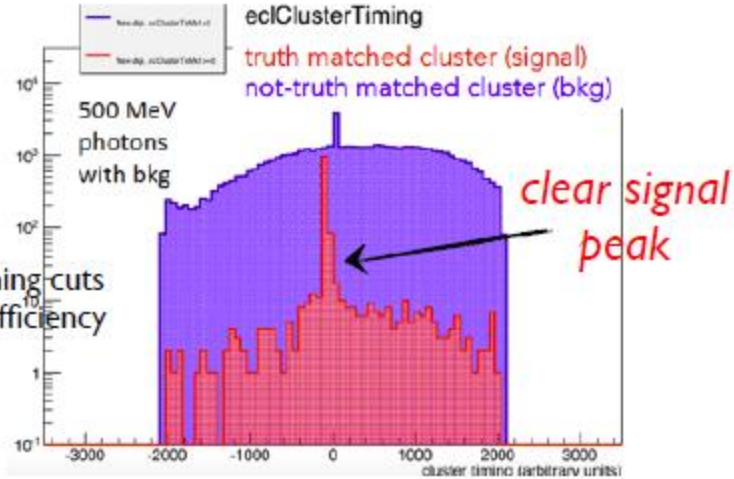
Belle rolled in
VXD BEAST
He-3 and TPC neutron detectors in VXD dock space

E. De Lucia
E. Manoni

New ECL Digitizer







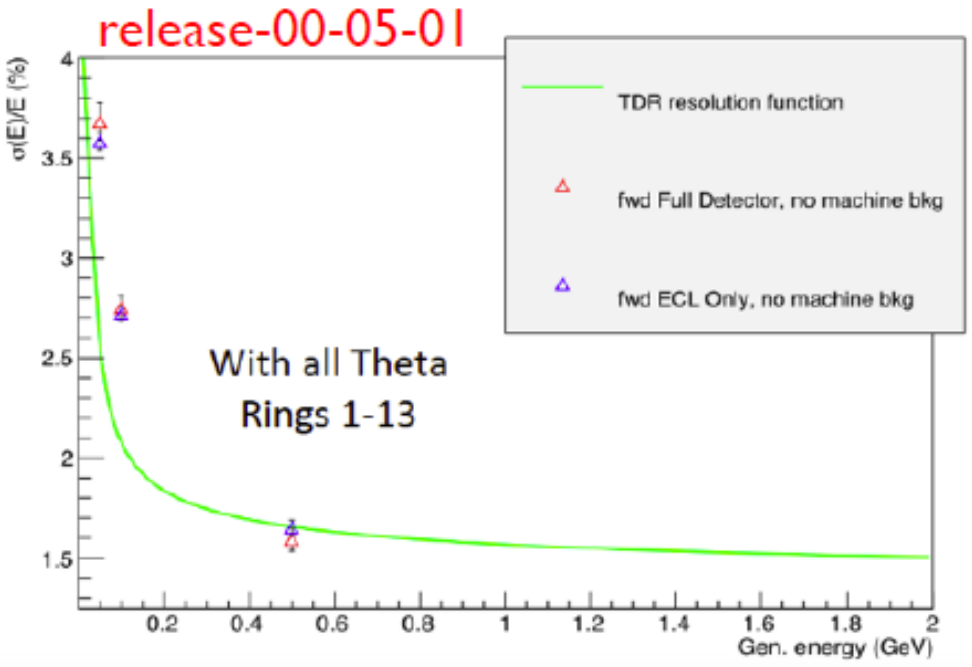
Open issue

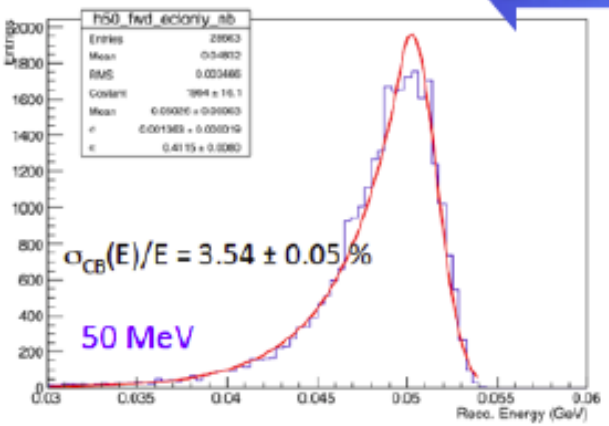
Timing for signal & background:

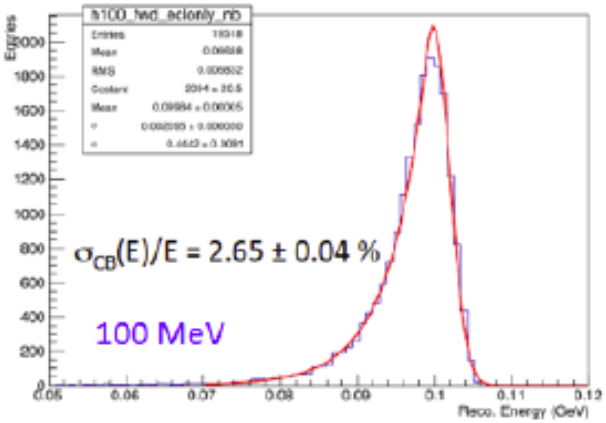
- Signal peaked around -80 a.u.
  => off-set to be understood and fixed
- Background peak at zero due to DigitAmp<AmpThreshold: no TimeFit output => should be properly initializated

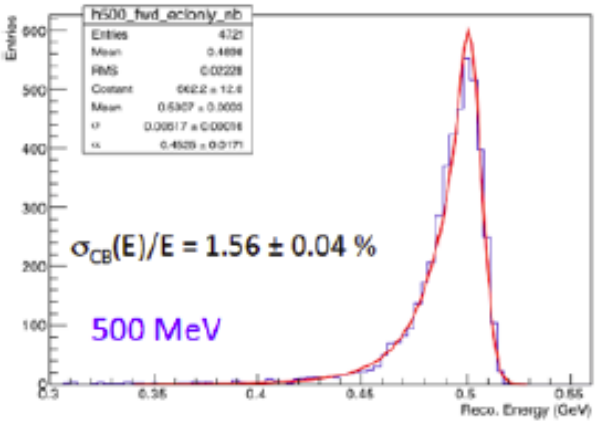
E. De Lucia
E. Manoni

Energy Resolution vs Energy



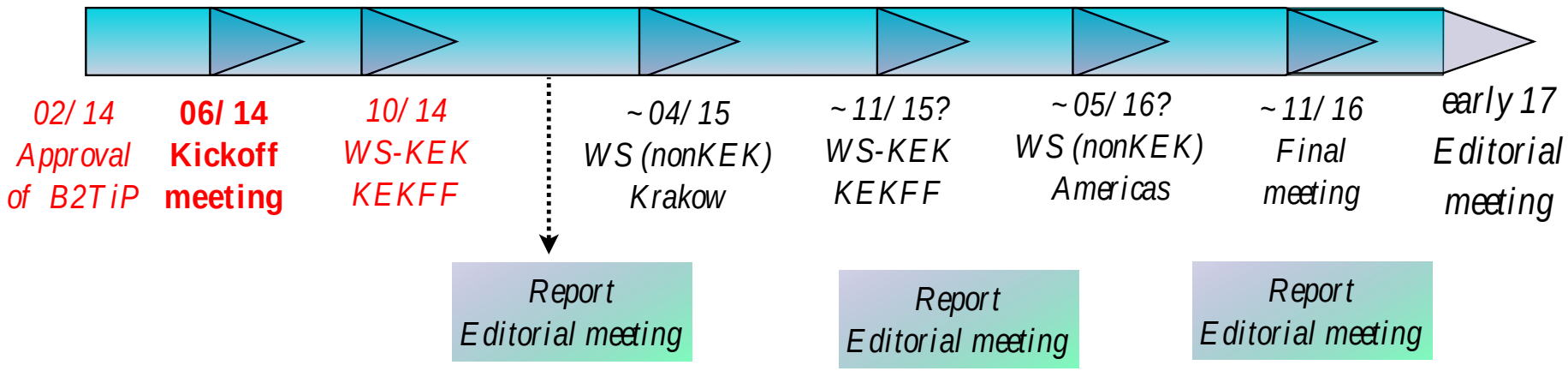






- Resolution at 500 MeV matches TDR expectations
  - true also for the barrel
- Resolution at low energy is far from TDR expectations
  - is TDR expectation the correct benchmark at low E? have different electronics contribution w.r.t. TDR

B2TIP timeline



B2TiP Kickoff: 16-17 June 2014 @ KEK, 17 theorists, >20 Belle II experimentalists
http://kds.kek.jp/conferenceTimeTable.py?confId=15226

B2TiP 1st Workshop (combined with KEKFF W/S): 28-31 October 2014 @ KEK
110 participants, 95 B2TiP presentations, → Each group asked to write a short proceeding.
http://kds.kek.jp/conferenceTimeTable.py?confId=15873

B2TiP New Physics WG Workshop: 23-25 February 2015 @ Karlsruhe, >32 participants
https://indico.cern.ch/event/357770/

B2TiP Workshop: 27-29 April 2015 @ Krakow
http://kds.kek.jp/conferenceDisplay.py?confId=17654

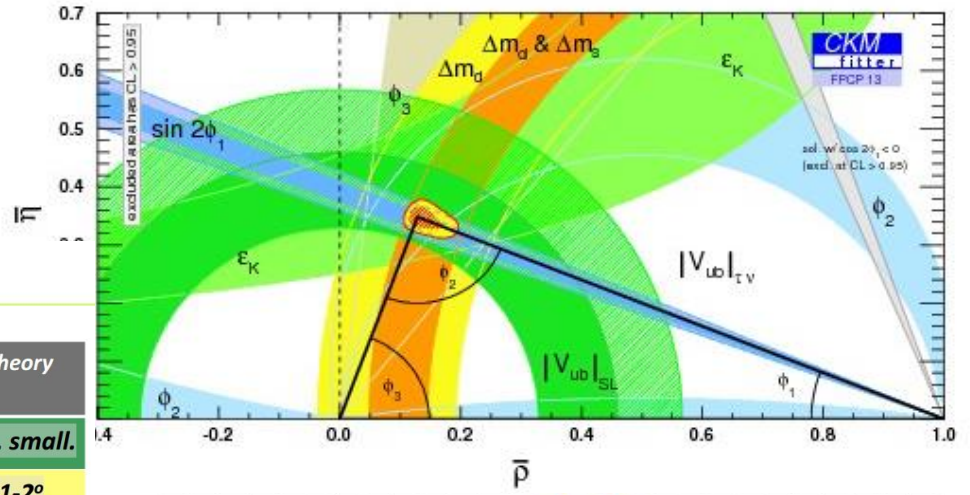
What Can We Expect?

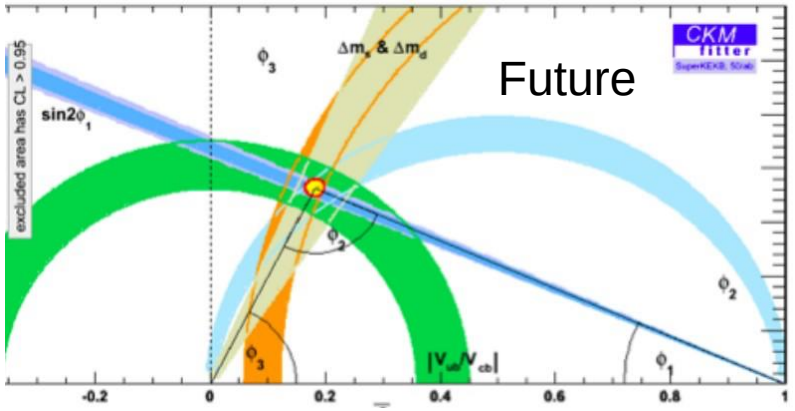
Summary of CKM Metrology

	Belle	BaBar	Global Fit CKMfitter	LHCb Run-2	Belle II 50 ab^{-1}	LHCb Upgrade 50 fb^{-1}	Theory
φ_1: ccs	0.9°		0.9°	0.6°	0.3°	0.3°	v. small.
φ_2: uud	4° (WA)		2.1°		1°		~1-2°
φ_3: DK	14°		3.8°	4°	1.5°	1°	negl.
$\|V_{cb}\|$ inclusive	1.7%		2.4%		1.2%		
$\|V_{cb}\|$ exclusive	2.2%				1.4%		
$\|V_{ub}\|$ inclusive	7%		4.5%		3.0%		
$\|V_{ub}\|$ exclusive	5.5%			7.2%	2.4%		
$\|V_{ub}\|$ leptonic	14%				3.0%		

Experiment: No result; Moderate precision; Precise; Very Precise

Theory: Moderate precision; Clean / LQCD; Clean





Competition

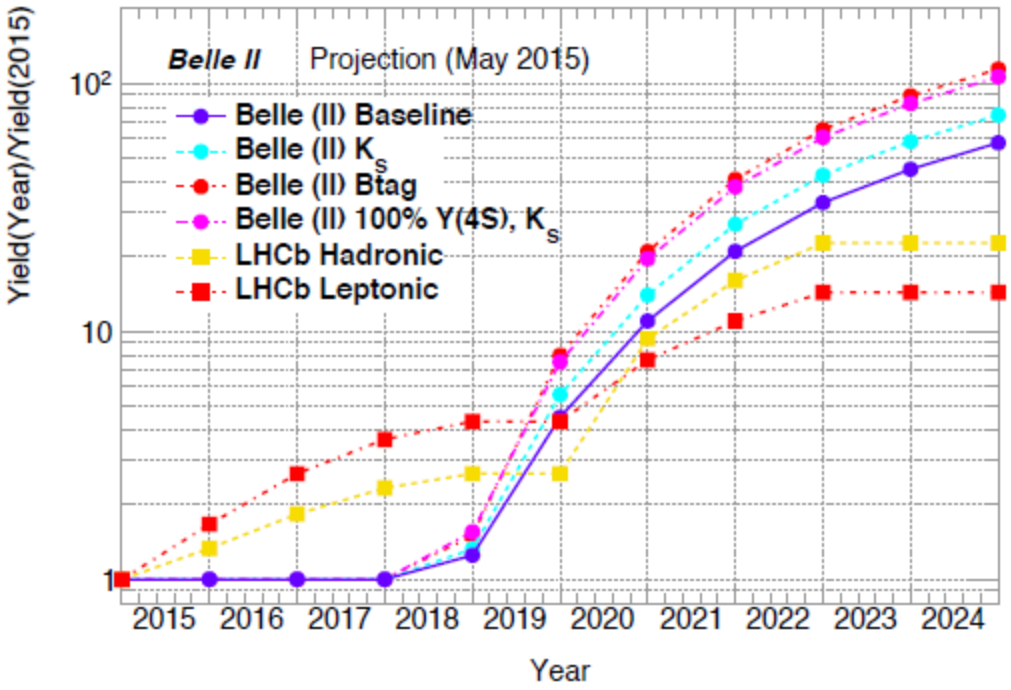
https://d2comp.kek.jp/record/234
BELLE2-NOTE-PH-2015-004

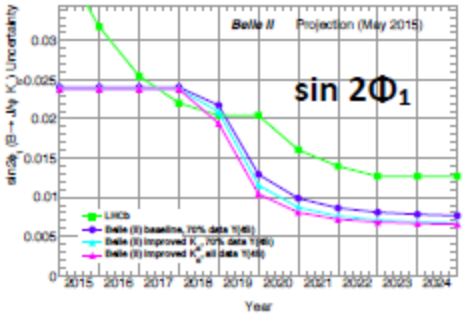
LHC era			HL-LHC era	
Run 1 (2010-12)	Run 2 (2015-18)	Run 3 (2020-22)	Run 4 (2025-28)	Run 5+ (2030+)
3 fb^{-1}	8 fb^{-1}	23 fb^{-1}	46 fb^{-1}	100 fb^{-1}

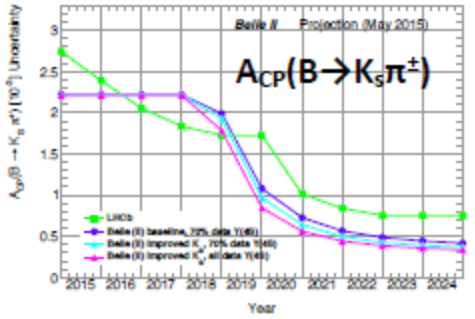
b-, c- quark σ scale linear with √s

Run-2 50% less efficient for hadronic triggered modes

Run-3 will have a new trigger: recovering efficiency loss in hadron trigger, no change for muon triggers.

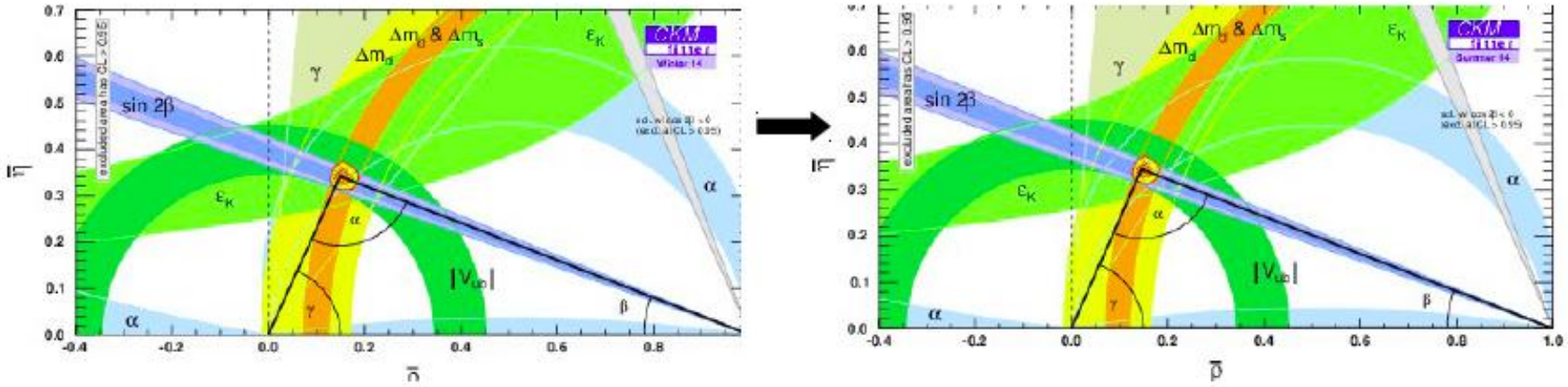






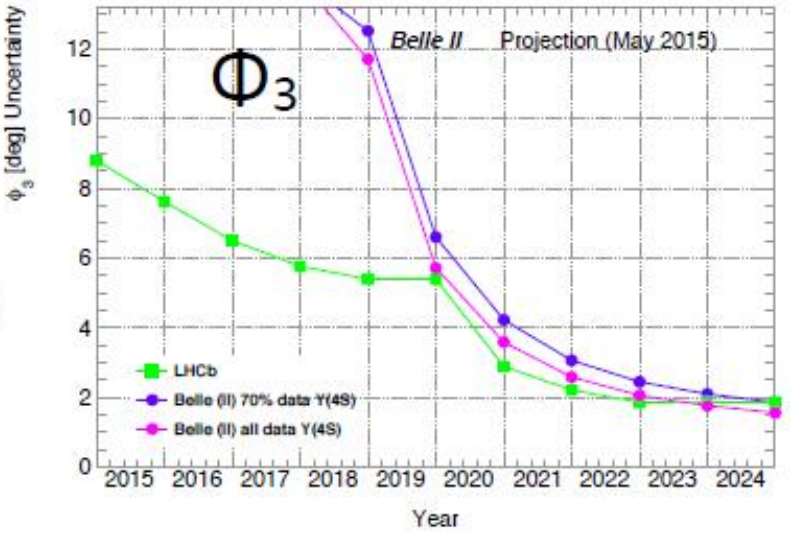
Φ_3

FPCP

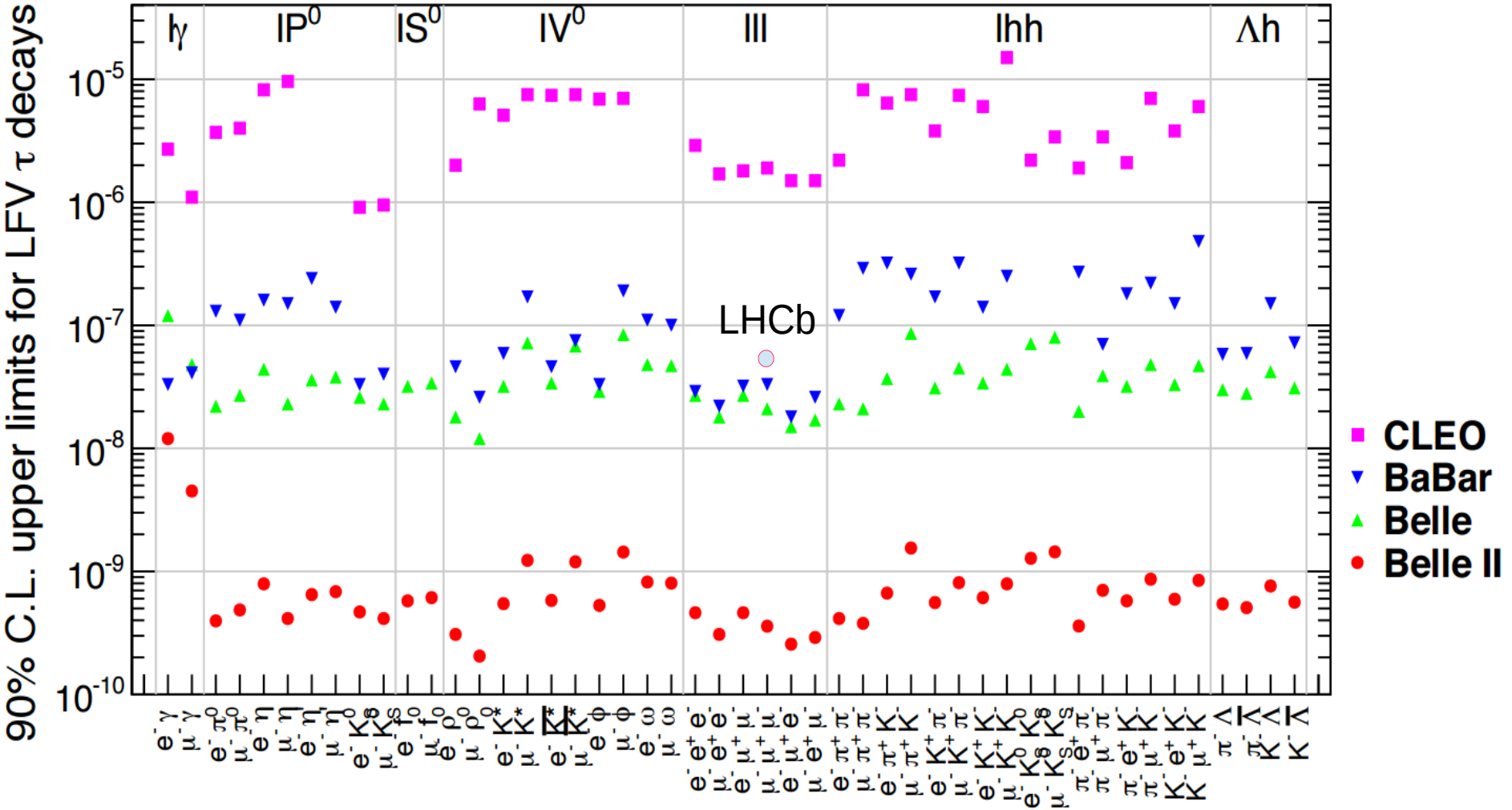


$$\left.\begin{aligned}\gamma_{\text{BaBar}} &= (70 \pm 18)^\circ \\ \gamma_{\text{Belle}} &= (73\ ^{+13}_{-15})^\circ \\ \gamma_{\text{LHCb}} &= (75 \pm 9)^\circ\end{aligned}\right\} \gamma = (73.2\ ^{+6.3}_{-7.0})^\circ$$

$$r_B = 0.0970 \pm 0.0063$$



THE UNIVERSITY OF MELBOURNE



We will have lots of tau-leptons!

B2TIP Working Groups

I. Inclusive semi-leptonic (Vub, Vcb, mb) & Exclusive semi-leptonic and pure leptonic (Vub, Vcb, new physics)

II. Electroweak penguins (inclusive, exclusive, semi-inclusive b->s l+l-, angular analysis, very rare) & Radiative penguins (inclusive, exclusive b-> s/d gamma, CP violation, polarisation, very rare)

III. Hadronic decays (charmless decays, direct CP violation)

IV. Phi$_1$ (tree, penguins, new physics) & Phi$_2$ (penguin/tree interference)

V. Phi$_3$ (time dependent/independent)

VI. Charm (CPV, hadronic, leptonic, semi-leptonic decays, spectroscopy)

VII. Tau (LFV, CPV, alphas) & Low multiplicity & EW

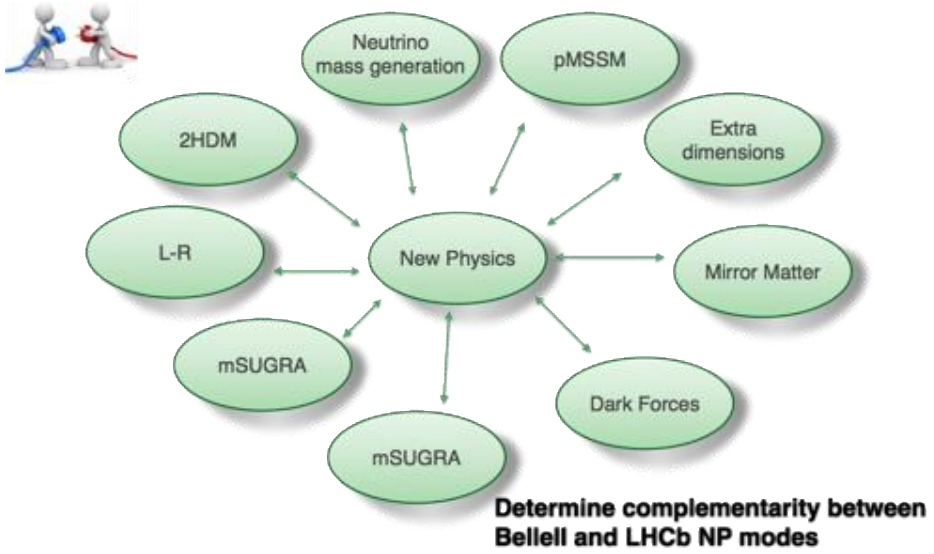
VIII. Upsilon (nS) (dark matter, mb measurements etc, energy scan)&Charmonium (conventional, exotics XYZ)

➡ **Belle II & New Physics**

Coordinators: Theory, Lattice, Belle I,

+ Esteemed advisory committee

+ LHCb invitees



Determine complementarity between BelleII and LHCb NP modes

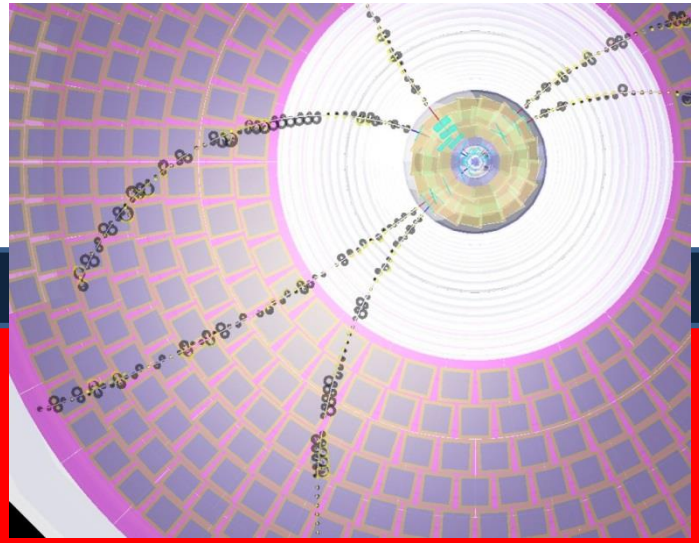
TABLE XXIII: "DNA" of flavour physics effects for the most interesting observables in a selection of SUSY models from Ref. [416]. FFF signals large effects, FF visible but small effects and F implies that the given model does not predict sizable effects in that observable.

	AC	RVV2	AKM	δLL	FBMSSM
$D^0 - \bar{D}^0$	FFF	F	F	F	F
S_{φ}	FFF	FFF	FFF	F	F
$S_{\varphi K_S}$	FFF	FF	F	FFF	FFF
$A_{CP}(B \to X_s\gamma)$	F	F	F	FFF	FFF
$A_{7,8}(B \to K^{*}\mu^+\mu^-)$	F	F	F	FFF	FFF
$A_9(B \to K^{*}\mu^+\mu^-)$	F	F	F	F	F
$B \to K^{(*)}\nu\bar{\nu}$	F	F	F	F	F
$B_s \to \mu^+\mu^-$	FFF	FFF	FFF	FFF	FFF
$\to \mu\gamma$	FFF	FFF	F	FFF	FFF

ROMA TRE
UNIVERSITÀ DEGLI STUDI

LA FISICA incontra la città

Serata Straordinaria
promossa dal Progetto **JENNIFER***
(Japan and Europe Network for Neutrino and Intensity Frontier Experimental Research)



Asimmetrie e Oscillazioni

10 Giugno 2015 – ore 20:30

Dr. Marco Ciuchini
INFN Roma Tre

* Progetto finanziato dal programma di ricerca e innovazione Horizon 2020 dell'Unione Europea, con grant agreement Marie Skłodowska Curie n.644294.

ROMA TRE
UNIVERSITÀ DEGLI STUDI

La Fisica incontra la città

Ciclo di conferenze divulgative 2015
dei corsi di laurea in Fisica e del
dipartimento di Matematica e Fisica

Comitato organizzatore
Prof. Filippo Ceradini
Prof. Paola Gallo
Prof. Giorgio Matt
Prof. Maria Antonietta Ricci

Le conferenze si terranno
alle ore 20.30 presso
l'Università degli Studi Roma Tre
Aula Magna del Rettorato
Via Ostiense 159 Roma
L'ingresso è libero.
Gli abstract sono consultabili sul sito:
www.fis.uniroma3.it/fisincitta/
contatto e-mail: fisincitta@fis.uniroma3.it

INTERNATIONAL MASTERCLASSES HANDS ON PARTICLE PHYSICS

International Masterclasses 2015

Central Coordination

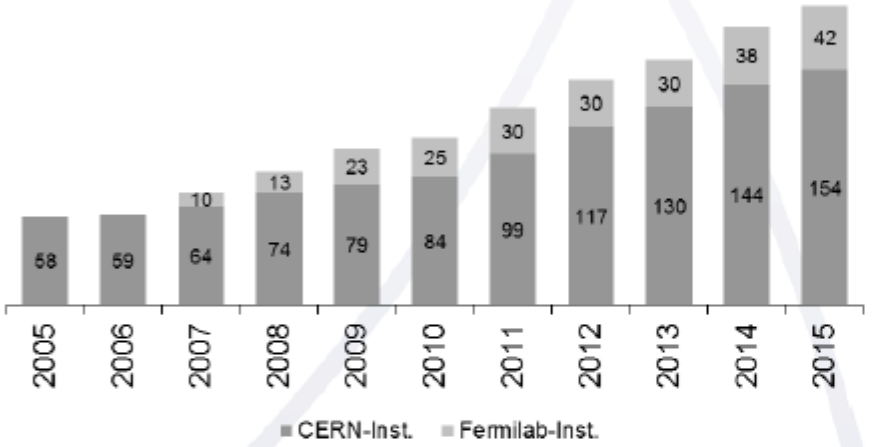
IPPOG meeting – 17.04.2015 - Paris

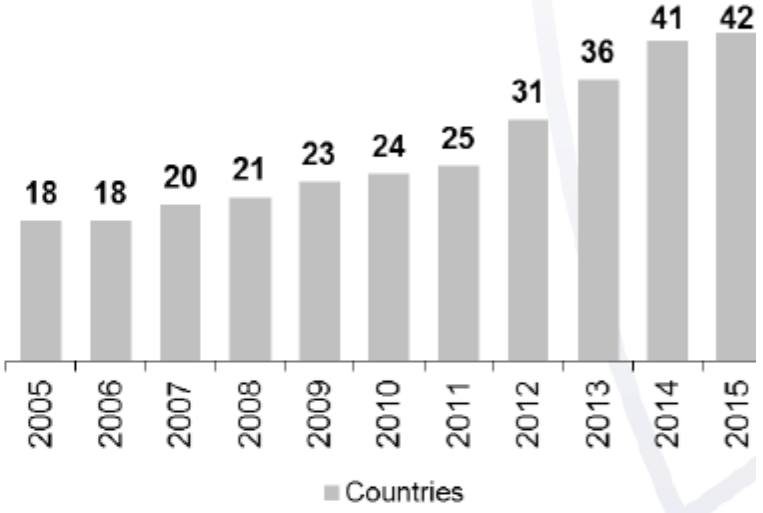
INTERNATIONAL MASTERCLASSES

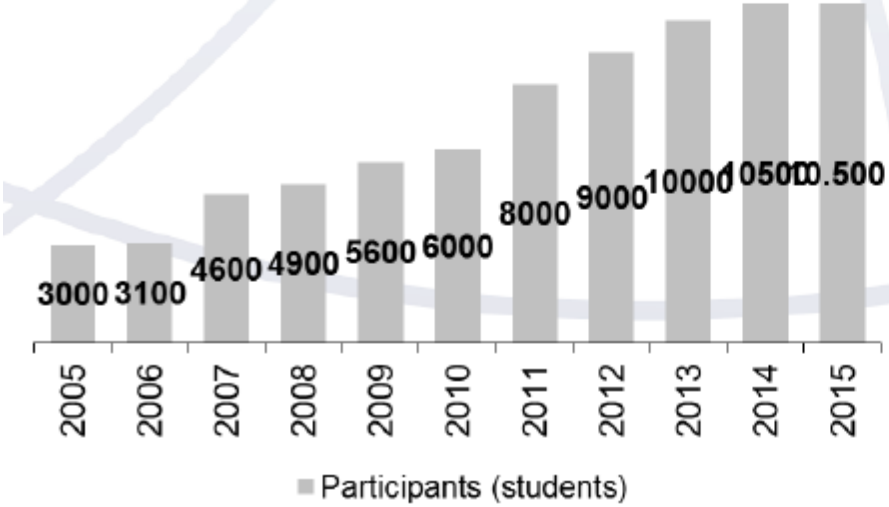
hands on particle physics

Masterclasses are very popular !

Participation Statistics







- 193 Institutes (154 + 42)
- 255 Masterclasses (213 + 45)
- 10.500 High-school students (estimated) incl. 1040 in Fermilab

INTERNATIONAL MASTERCLASSES
hands on particle physics

IMC in 2015

Also in Japan some event is organized by LHC groups

42 Countries – New: Morocco

International Masterclass Day* in October or November

Virtual Masterclasses

INTERNATIONAL MASTERCLASSES
hands on particle physics

JENNIFER: impatto su Roma Tre/2

Amministrazione:

Roma Tre ha tutto il carico della gestione del progetto:
Necessario il supporto di Filomena e del Servizo Fondi esterni RM1-RM3.

Chiesto un borsista diplomato di cui JENNIFER pagherebbe il 50%

Budget:

Missioni: **30 k€ contributo minimale ai viaggi a KEK**
Fondo comune progetto: finora 24 k€ per organizzazione meeting e comuncazione

Overhead: JENNIFER porta a INFN 116 k€. Una frazione (30%?) dovrebbe andare alla sezione

Contratti: preventivato un anno AdR per Belle-II nel 2017 da confinanziare e rendere biennale.