Stato dell'esperimento Belle II

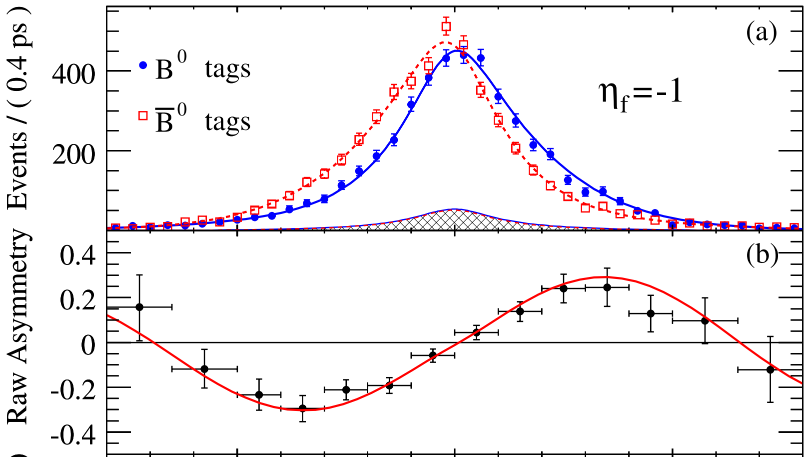
Guglielmo De Nardo
University of Napoli *Federico II* and INFN

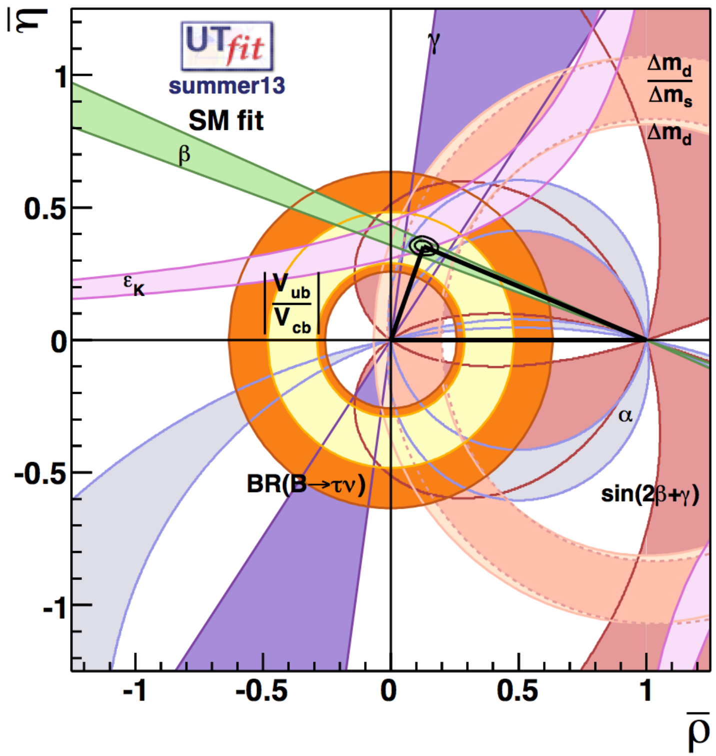
Riunione di fine anno 2014 del Gr I Sezione di Napoli
7 Gennaio 2015, Napoli, Italy

Outline

- Physics motivations
- Status of the project
- Physics program highlights
- Napoli activities
  (calorimeter, software, computing)

Belle and BaBar achievements





Successful experimental program

Established CP violation in B system and remarkable consitency of the CKM mechanism of the SM

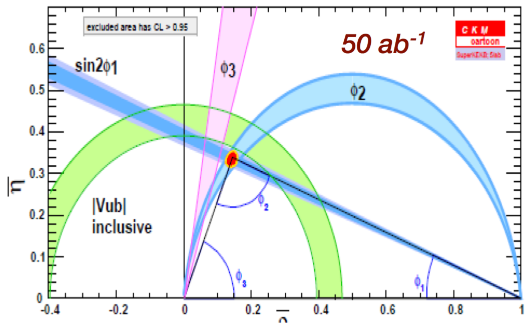
Nobel Prize in Physics In 2008 awarded to Kobayashi and Maskawa

2008

The role of flavour in the search for NP

Despite the BaBar and Belle experimental efforts SM did not break down.

The triumph of the SM continued with the Higgs boson found where it was expected …and nothing else …yet



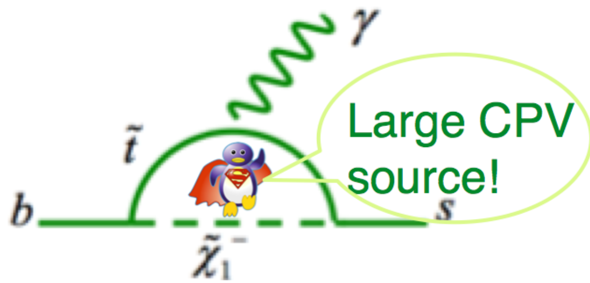
Mission of Belle II and LHCb

Scenario A: new particles or interactions ARE found with direct search at LHC

→ Reveal the flavour structure of NP

Scenario B: NP keeps hiding

→ Extend the search to even higher mass scales looking at many possible effects at low energy



KEKB upgrade to SuperKEKB

Channel	Belle	BaBar	Belle II (per year)
$B\bar{B}$	7.7×10^8	4.8×10^8	1.1×10^{10}
$B_s^{(*)}\bar{B}_s^{(*)}$	7.0×10^6	–	6.0×10^8
$\Upsilon(1S)$	1.0×10^8		1.8×10^{11}
$\Upsilon(2S)$	1.7×10^8	0.9×10^7	7.0×10^{10}
$\Upsilon(3S)$	1.0×10^7	1.0×10^8	3.7×10^{10}
$\Upsilon(5S)$	3.6×10^7	–	3.0×10^9
$\tau\tau$	1.0×10^9	0.6×10^9	1.0×10^{10}

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

Lorentz factor

Beam current

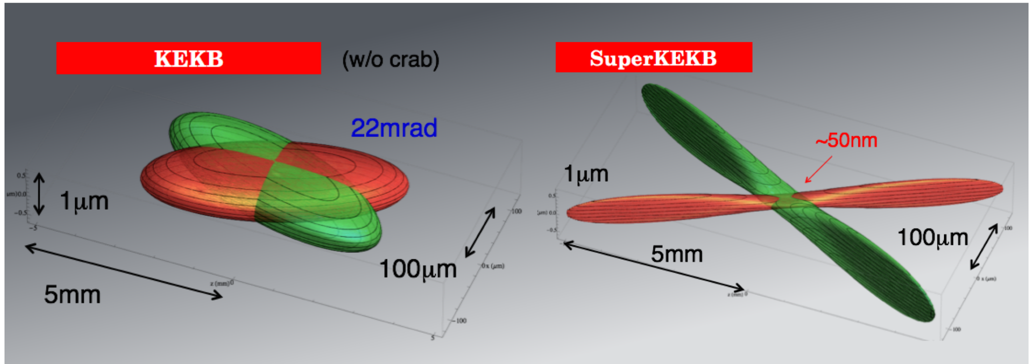
Beam-Beam parameter

Geometrical reduction factors (crossing angle, hourglass effect)

Beam aspect ratio at IP

Vertical beta function at IP

Minimum value is limited by hourglass effect



	E (GeV) LER/HER	β*y (mm) LER/HER	β*x (cm) LER/HER	φ (mrad)	I (A) LER/HER	L (cm⁻²s⁻¹)
KEKB	3.5/8.0	5.9/5.9	120/120	11	1.6/1.2	2.1×10^{34}
SuperKEKB	4.0/7.0	0.27/0.30	3.2/2.5	41.5	3.6/2.6	80×10^{34}

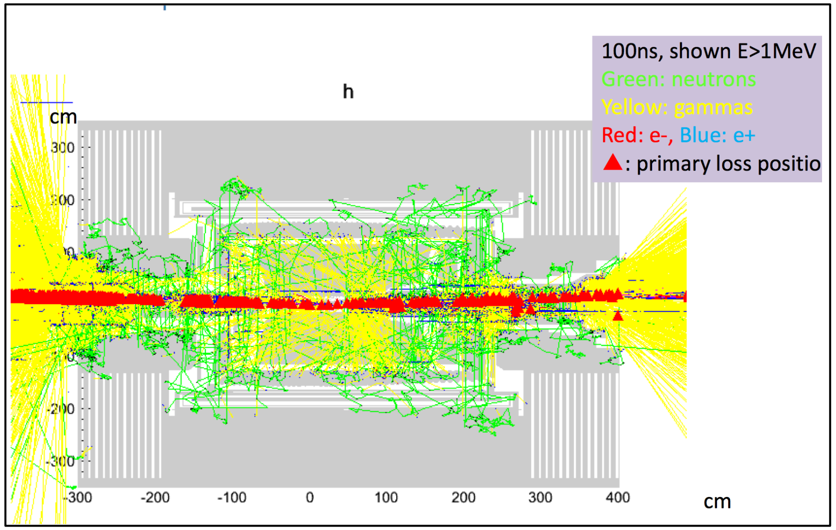
Instantaneous luminosity 40x KEKB luminosity

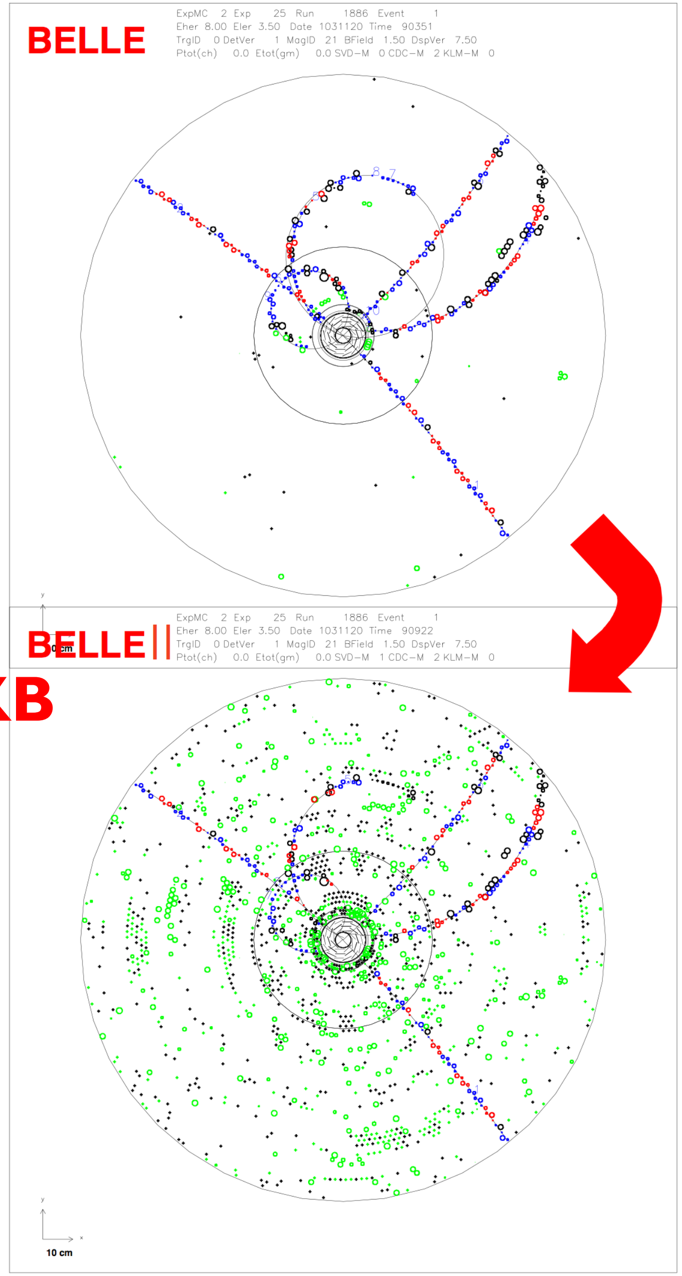
- nano-beams scheme
- (first proposed by P. Raimondi for SuperB)
- Upgrades on many accelerator components
- 2x higher currents

Costruction mostly done. Commisioning starting in 2015

Belle II detector upgrade

Toucheck
Rad. Bhabha
2-photon

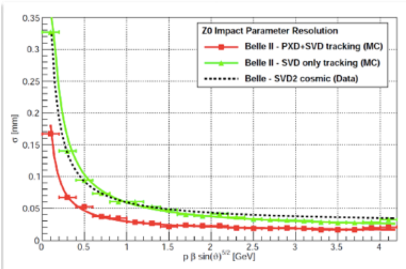


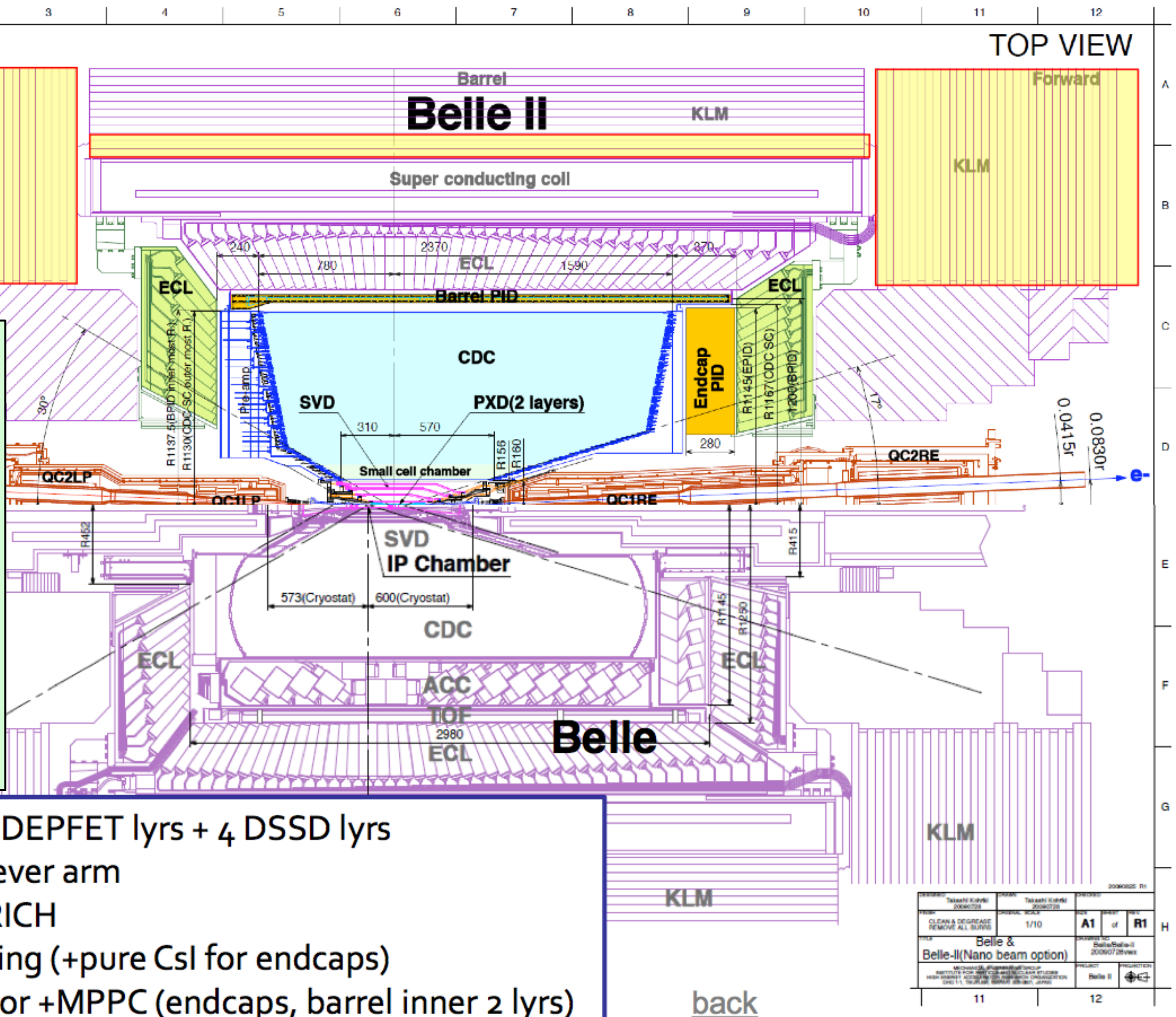


Beam related backgrounds 10-20x KEKB

Occupancy in detector
pile-up in calorimeter
fake hits
radiation damage
Higher event rates (L1 trigger: 20 kHz)

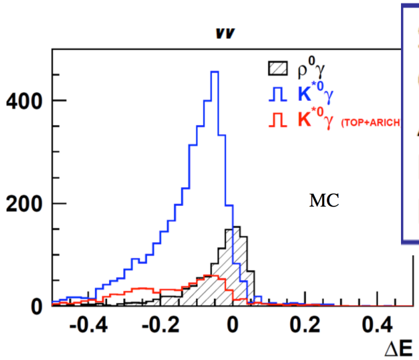
Belle II upgraded detector





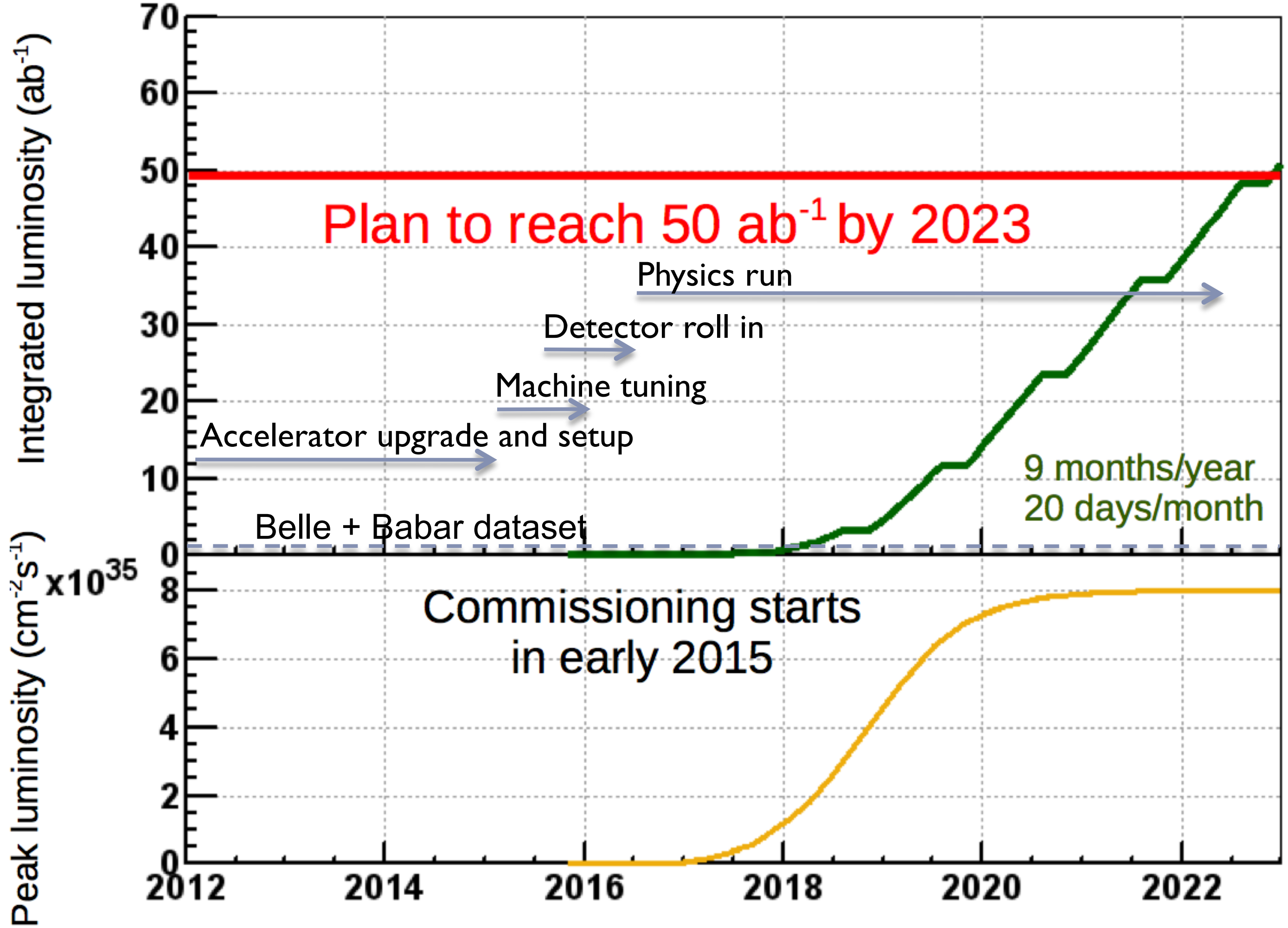
Improvements w.r.t. Belle

- IP and secondary vtx resolution
- Ks reconstruction eff.
- Muon ID and KL detection
- K identification in Fwd.



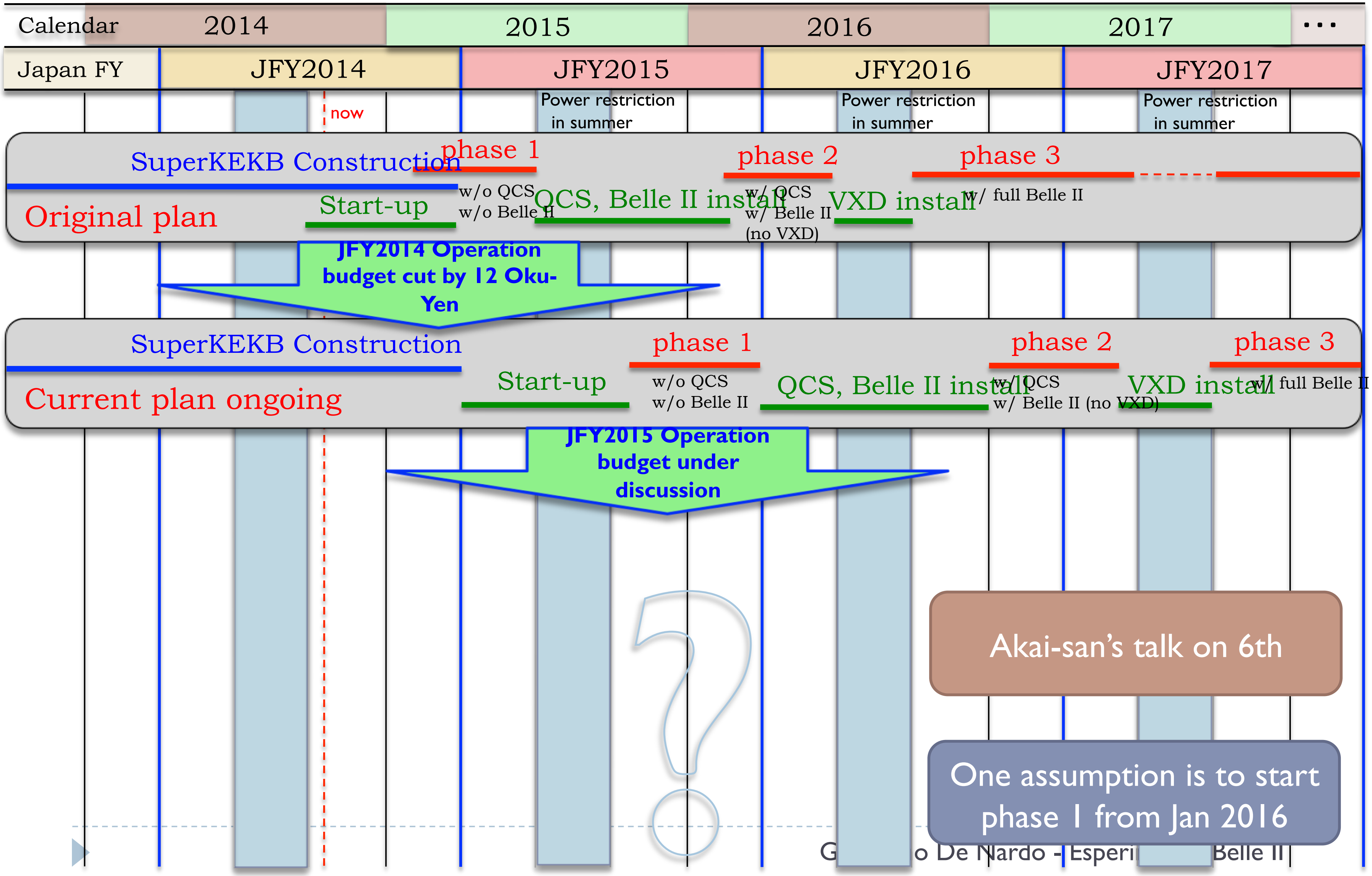
- SVD: 4 DSSD lyrs → 2 DEPFET lyrs + 4 DSSD lyrs
- CDC: small cell, long lever arm
- ACC+TOF → TOP+A-RICH
- ECL: waveform sampling (+pure CsI for endcaps)
- KLM: RPC → Scintillator +MPPC (endcaps, barrel inner 2 lyrs)

Profilo della luminosità (Riunione fine anno 2013)



Oct. 14, 2014

SuperKEKB/Belle II Schedule



Belle II unique capabilities

Exactly 2 quantum correlated B mesons at $\Upsilon(4S)$

No trigger bias – almost 100% for B pairs

Excellent efficiency and resolution in tracking as well as in detecting photons, K_L, π^0

→reconstruction of intermediate resonances

→Dalitz plot studies

Clean environment (compared to hadron machines) allows "full interpretation" of the event

→ powerful tool for physics with missing energy (many neutrinos) or fully inclusive analyses

Large sample of D and τ with low background

Physics deliverables

Improved precision on CKM elements and UT angles

Earch for CP violation phases:

tree level decays

penguins, including neutral modes

Inclusive measurements $b \to s/d\ \gamma$ $b \to s\ l\ l$

ACP in radiative decays

Missing energy modes

$B \to l\ \nu$ $B \to K\ \nu\ \nu$, $B \to X_{u,c}\ l\ \nu$

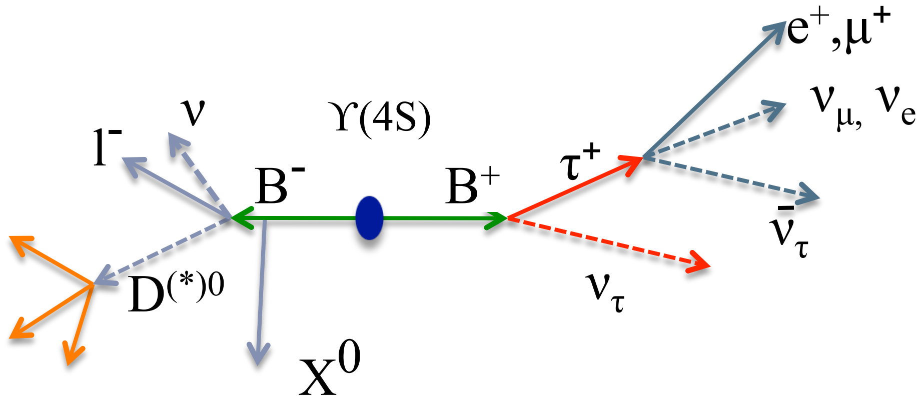
LFV in $\tau \to l\ \gamma$, $l\ l\ l$

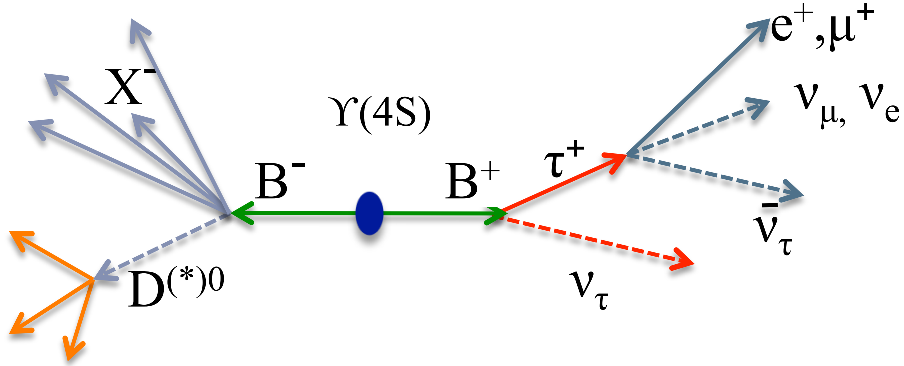
Dark matter, spectroscopy, Hidden sector

Full event interpretation (tagged analyses)

- For signal with weak exp. signature like
  - Decay with missing momentum (many neutrinos in the final state)
  - Inclusive analyses
- background rejection improved fully reconstructing the companion B (tag)
- Tag with semileptonic decays
  - PRO: Higher efficiency ε_{tag} ~ 1.5%
    CON: more backgrounds, B momentum unmeasured
- Tag with hadronic decays
  - PRO: much cleaner events,
    B momentum reconstructed
    CON: smaller efficiency ε_{tag} ~ 0.2%

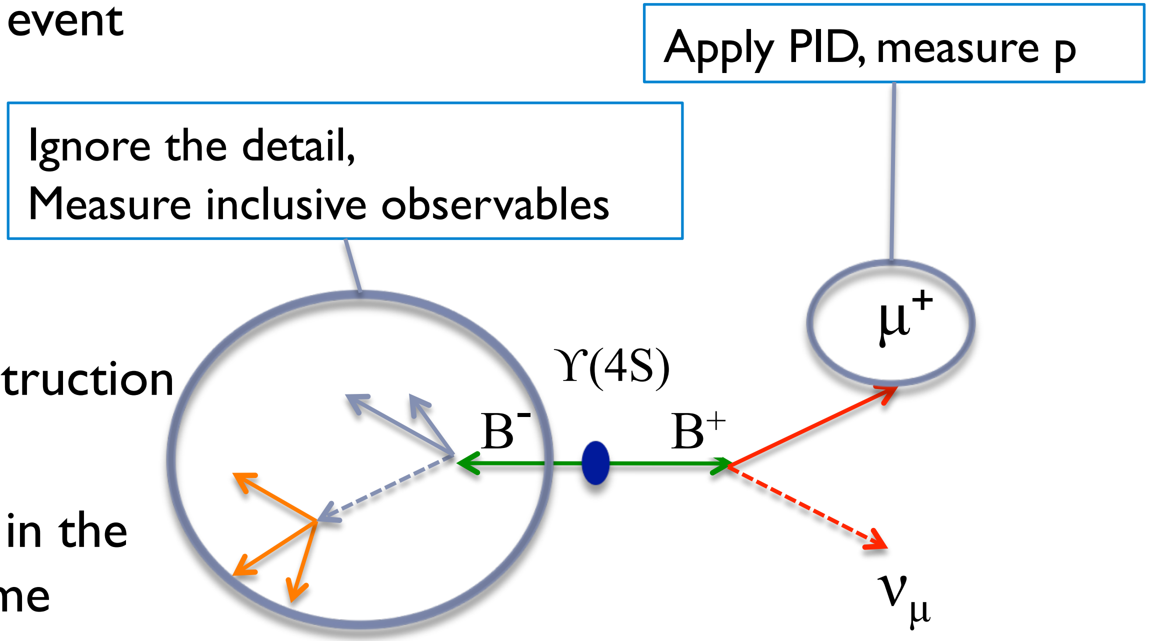
Fully reco **Look for signal**





Untagged analyses still possible

- Inclusive on the rest of the event when the signal signature strong enough
- B → π l ν
  - Loose neutrino reconstruction
- B → μ ν
  - Monochromatic muon in the final state in B rest frame
    - Smeared in the CM frame



High efficiency but large backgrounds, too

Belle II Collaboration

Belle II already a large collaboration with Institutes from Asia Europe and North America

Physics Highlights

(selected topics of a vast program)

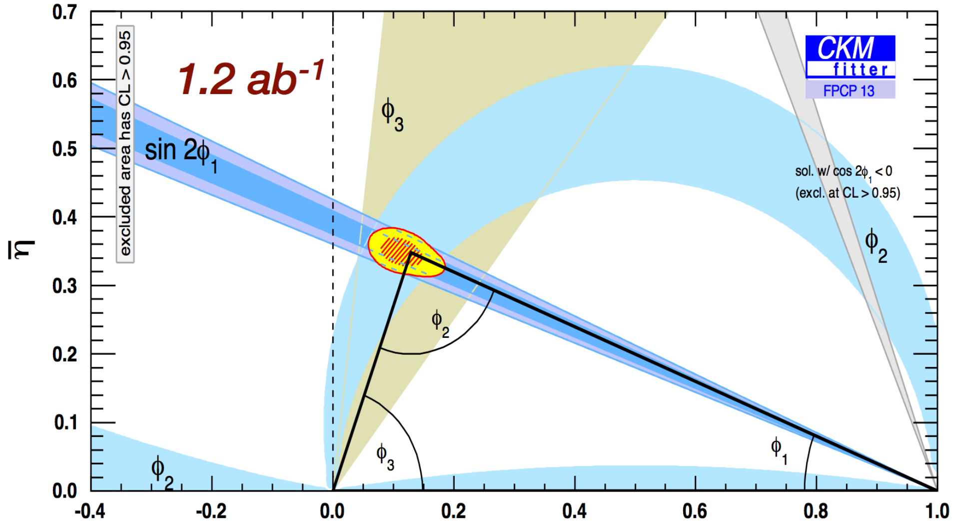
CKM UT angles

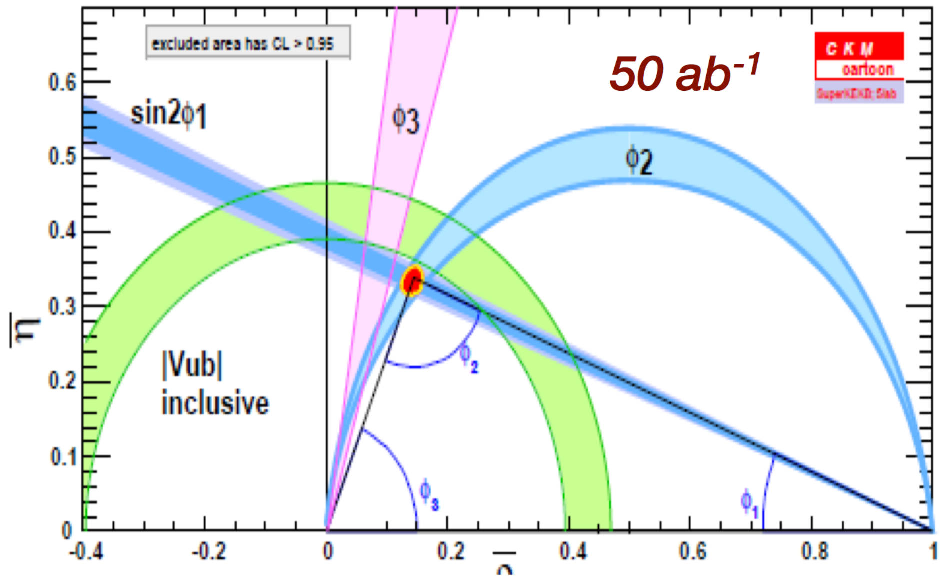
Uncertainties on UT angles will be substantially reduced

Competitive with LHC-b
In addition accurate measurements on many final states (with neutrals):
ex: B→ππ, ρπ, ρρ etc…

UT 2014		Belle II
α	4° (WA)	**1°**
β	0.8° (WA)	**0.2°**
γ	8.5° (WA) 14°(Belle)	**1-1.5°**

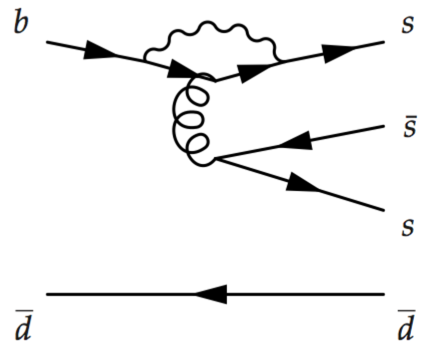
Measurement of γ and |Vub| can have the role of setting the SM baseline for interprenting deviations as NP signals



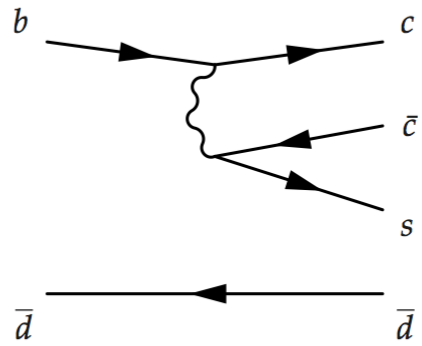


Additional sources of CPV

$B^0 \to \phi K^0$
$B^0 \to \eta' K^0$
$B^0 \to K^0 K^0 K^0$

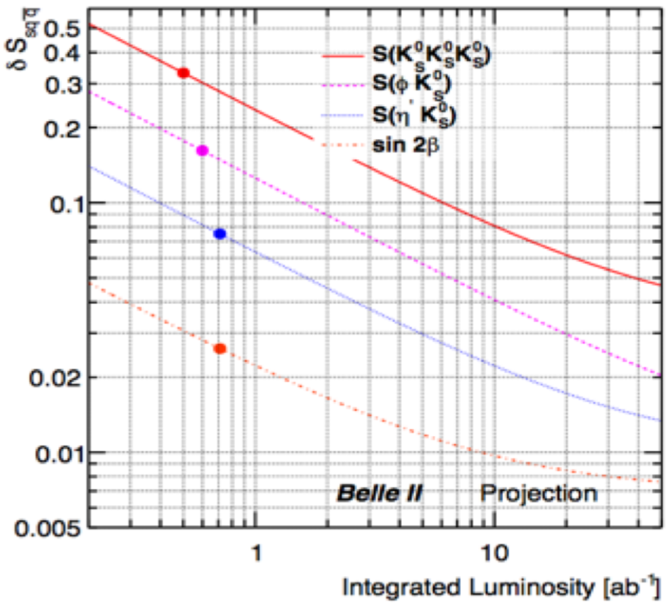


VS



$B^0 \to J/\psi K^0$

Belle II projections

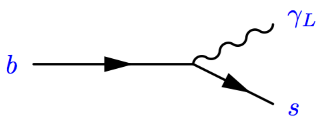


0.033 $S(K^0K^0K^0)$
0.018 $S(\phi K^0)$
0.011 $S(\eta' K^0)$
0.008 $S(J/\psi K^0)$

Prospects for δS(b→s) = 0.01 @ 50ab-1

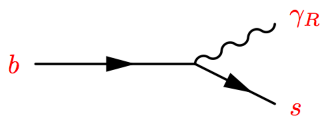
Need theory uncertainty on SM be competitive

Mixing induced CPV with radiative peng.

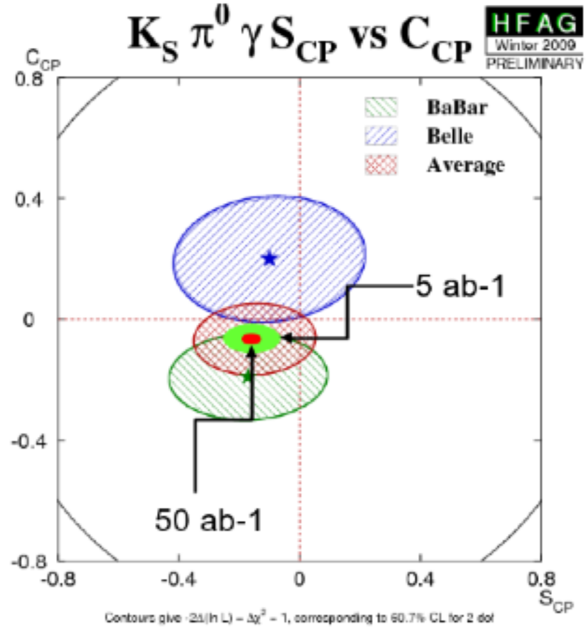


dominant

and



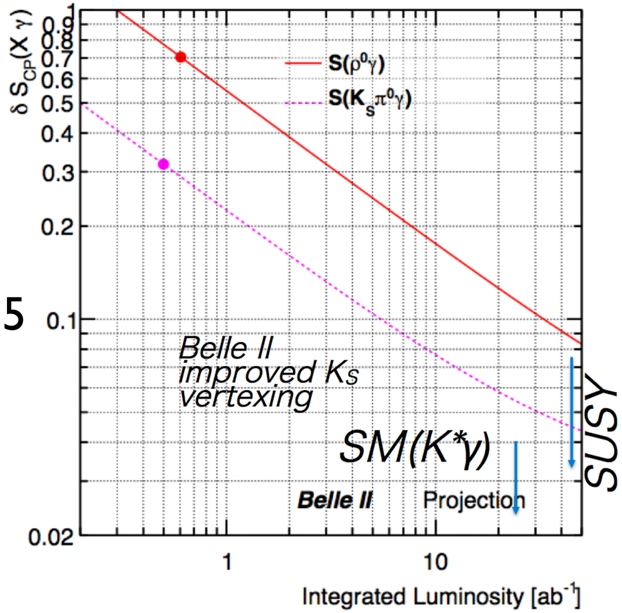
helicity suppressed (m_s/m_b)



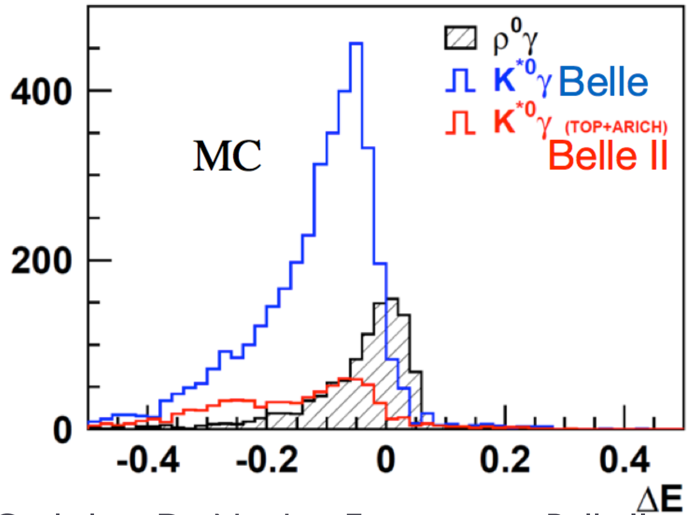
In SM helicity suppresion.
BSM RH current may enhance interference
→ TD CP asymmetry

SM exp: S ~ - 0.03

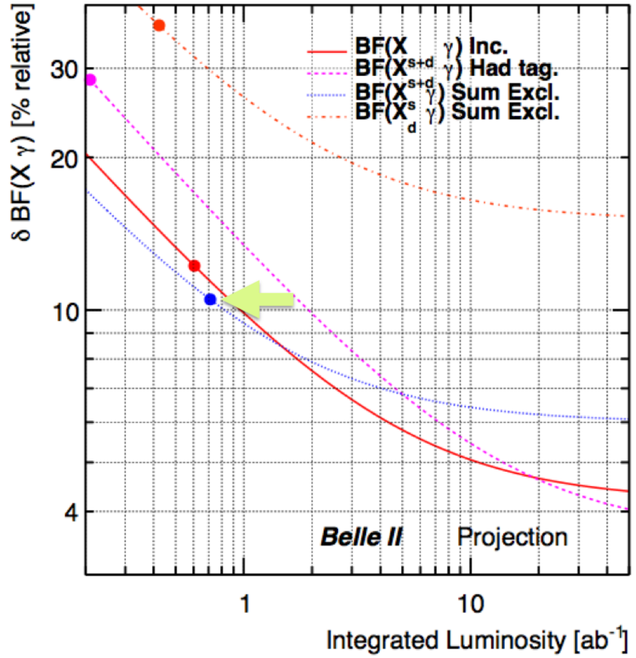
Left-right models up to 0.5



TOP + ARICH PID



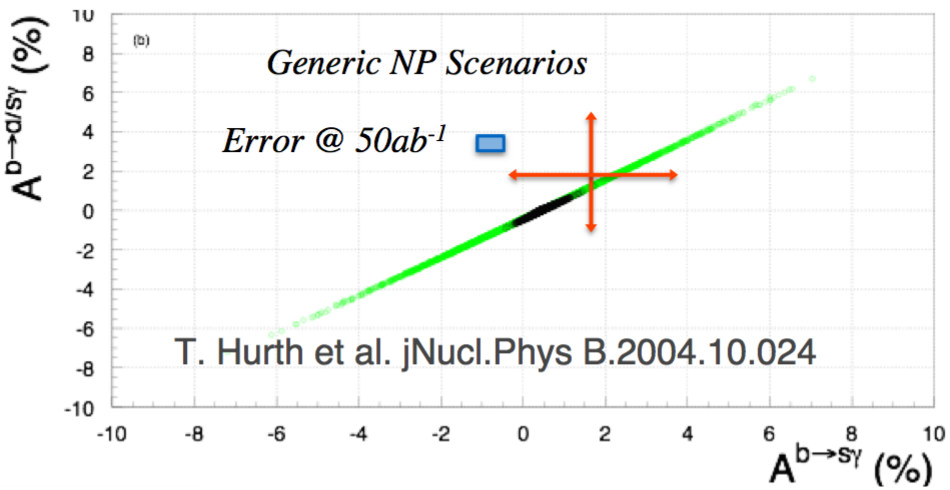
Inclusive radiative b→ s/d γ

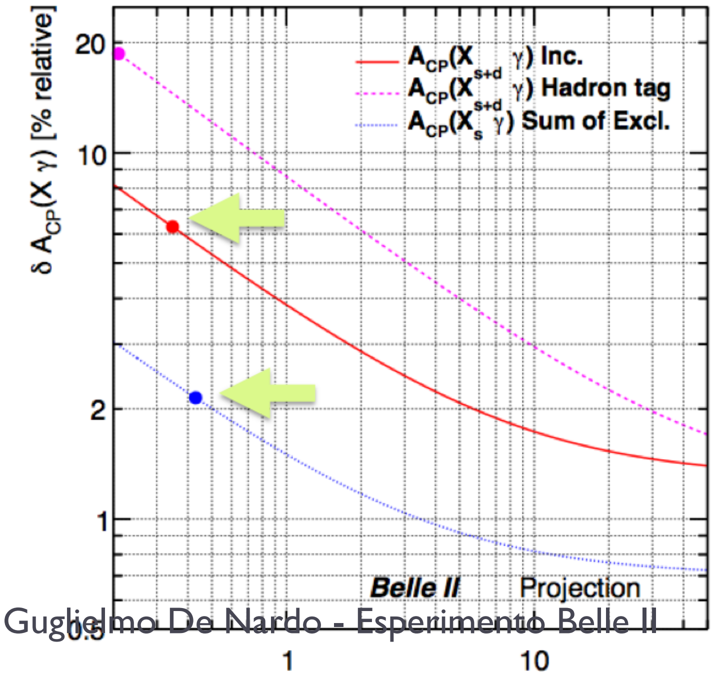


Two exp. techniques: sum of exclusive modes or inclusive
Sum of exclusive shows disagreements with simulated fragmentation models

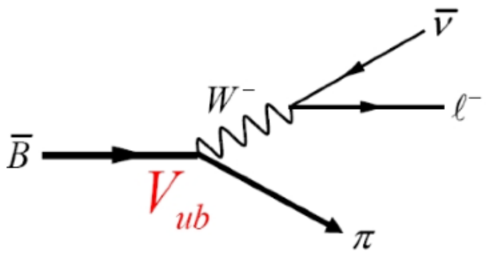
Rate
Experimental uncertainty at 5% level

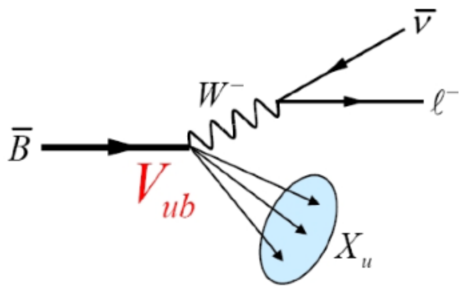
A_{CP} may be a test of NP: expected experimental error: 0.5%





|Vub| extraction from b → u





$$\frac{d\Gamma(B \to \pi l \nu)}{dq^2} = \frac{G_F^2}{24\pi^3} p_\pi^3 |V_{ub}|^2 \times |f(q^2)|^2$$

$$\Gamma_{SL} = |V_{ub}|^2 \frac{G_F^2 m_b^5}{192\pi^3} \times A_{pert} \times A_{non-pert}(1/m_b)$$

Theory input: form factors from Lattice and sum rules

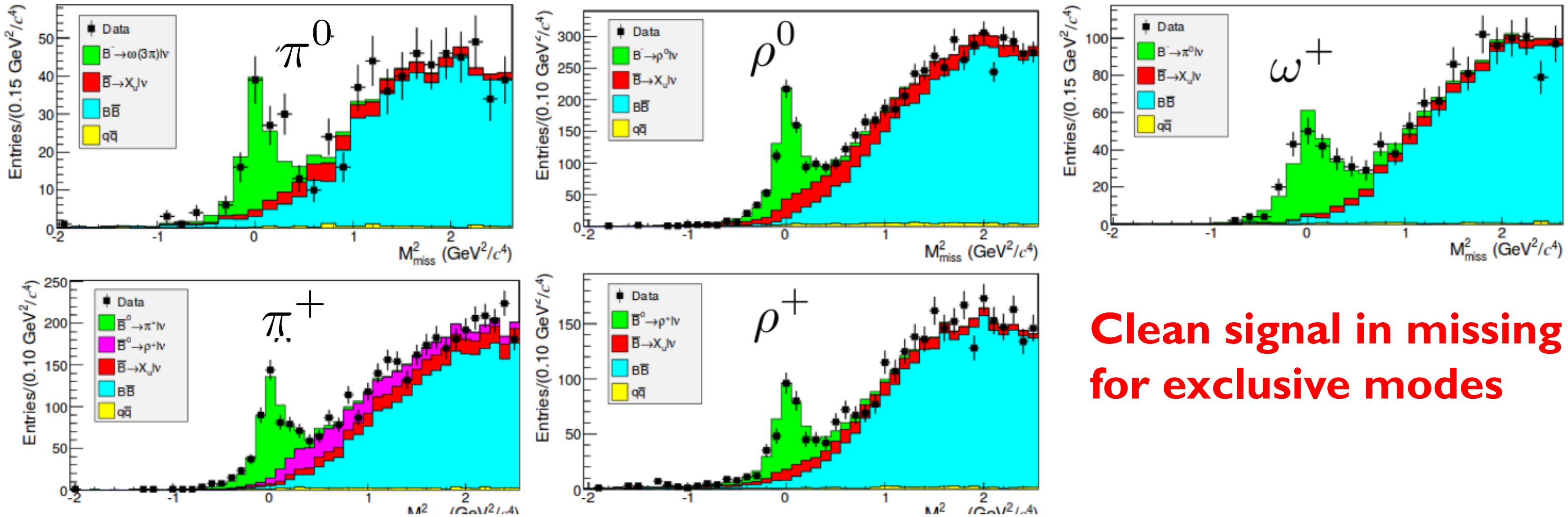
Experimentally more constrained

Both untagged & tagged analyses

Theory input: OPE
Huge b→c l ν background
Must select phase space region (M_x, q^2, p_l) to enhance B→ u signal
Need theory to extrapolate to full rate
Tight selections jeopardize theory extrapolation

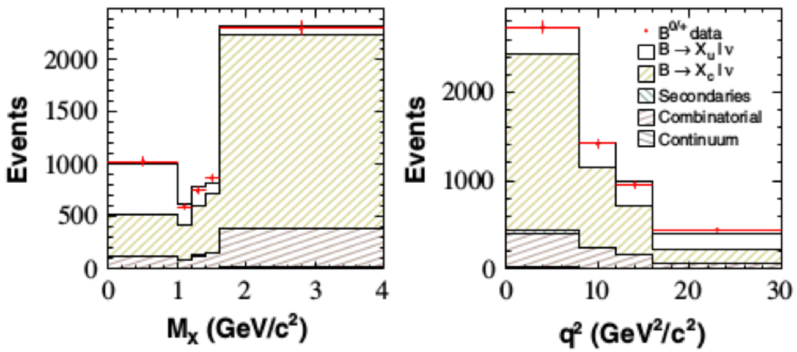
Current Measurements with hadronic tag

Belle exclusive



Clean signal in missing mass for exclusive modes

Belle inclusive



$b \to u\, l\, \nu$ signal enhanced w.r.t. $b \to c$ backgrounds in low M_X and high q^2 but

important: control on systematics effects from charm background composition and u quark fragmentation → can be improved with Belle II

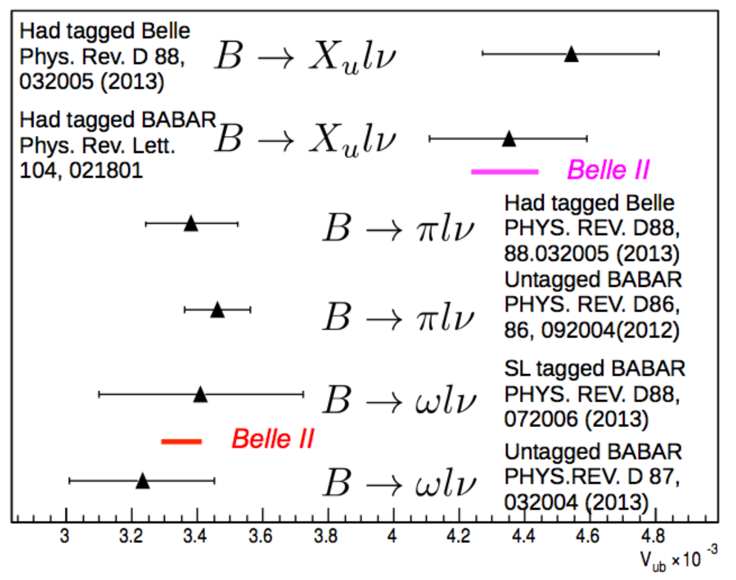
Extrapolation to Belle II (1)

|Vub|$_{exc}$ vs |Vub|$_{inc}$ "tension" is still here after years of experimental and theoretical efforts
Just statistics?

A systematic effect in experiment. or theory or both?

Belle II expected to settle this.

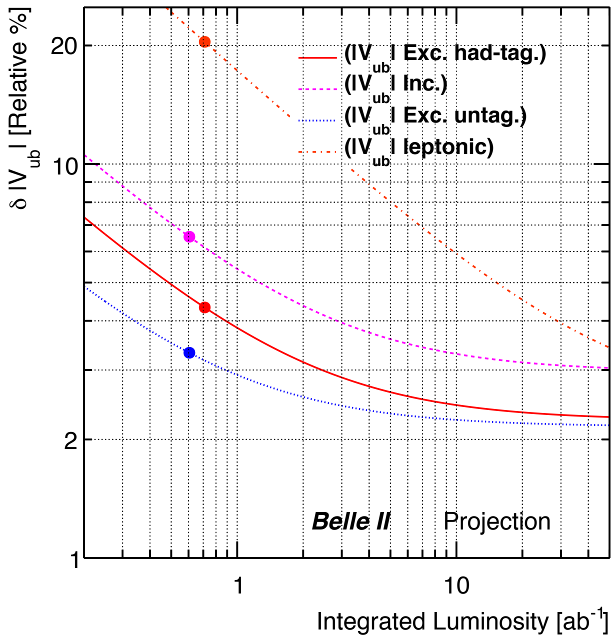
Alexander Ermakov (FPCP14):



Belle II will reduce the uncertainties on |Vub|

Provide much more consistency checks for theory and experimental effects

|Vub| extrapolation for Belle II (2)



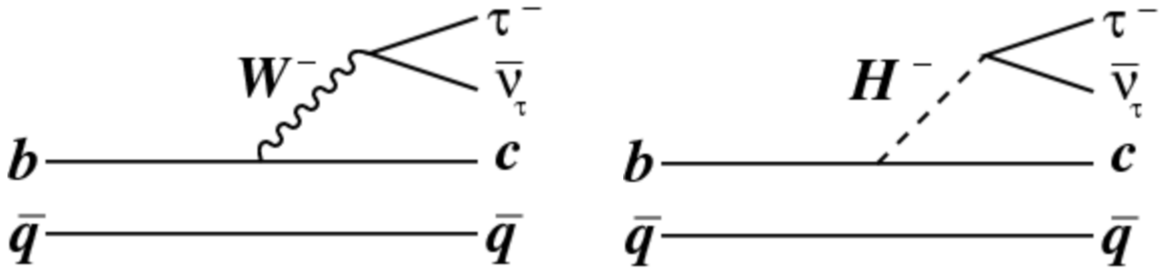
	Statistical	Systematic (reducible, irreducible)	Total Exp	Theory	Total
$\|V_{ub}\|$ exclusive (had. tagged)					
711 fb^{-1}	3.0	(2.3, 1.0)	3.8	8.7 (2.0)	9.5 (4.3)
5 ab^{-1}	1.1	(0.9, 1.0)	1.7	4.0 (2.0)	4.4 (2.6)
50 ab^{-1}	0.4	(0.3, 1.0)	1.1	2.0	2.3
$\|V_{ub}\|$ exclusive (untagged)					
605 fb^{-1}	1.4	(2.1, 0.8)	2.9	8.7 (2.0)	9.1 (4.0)
5 ab^{-1}	0.5	(0.8, 0.8)	1.2	4.0 (2.0)	4.2 (2.4)
50 ab^{-1}	0.2	(0.3, 0.8)	0.9	2.0	2.2
$\|V_{ub}\|$ inclusive					
605 fb^{-1} (old B tag)	4.5	(3.7, 1.6)	6.0	2.5−4.5	6.5−7.5
5 ab^{-1}	1.1	(1.3, 1.6)	2.3	2.5−4.5	3.4−5.1
50 ab^{-1}	0.4	(0.4, 1.6)	1.7	2.5−4.5	3.0−4.8

Assumption is theory error down to 2% for exclusive and 2-4 % for inclusive modes

Most promising are exclusive analysis with hadronic tags: to perform clean and detailed exploration of exclusive b→ u modes spectra.
Improvements on theory predictions need as well (B → ρ l ν lattice)

Untagged analyses still competitive for |Vub| measurement

B → D* τ ν



Input for SM prediction:

exp: |Vcb| measurement

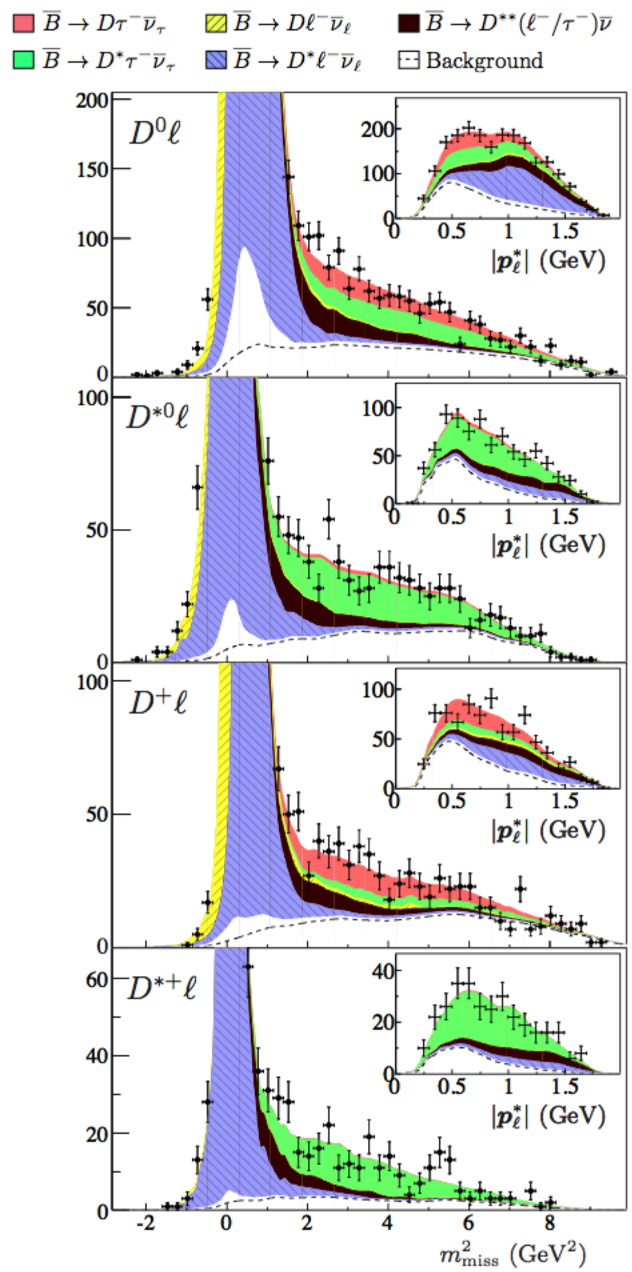
theory: form factor

New Physics from Charged Higgs

Measure a ratio R = B(B→ D$^{(*)}$ τ ν)/B(B→D$^{(*)}$lν)

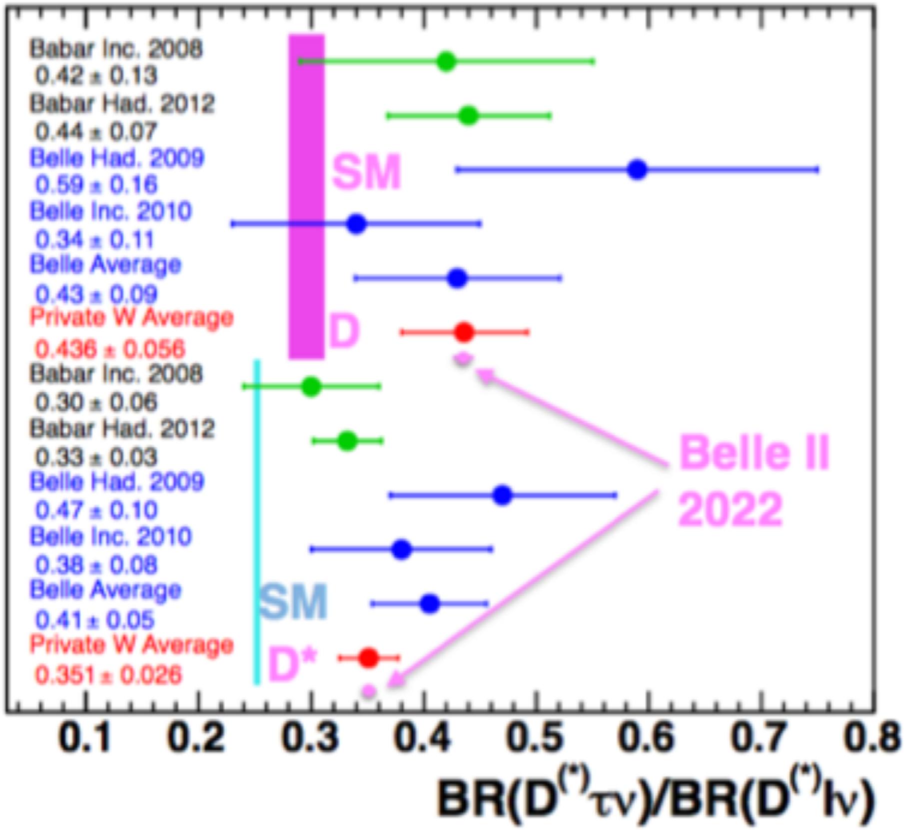
Experimentally hard: signature is not a peak on a smooth background!

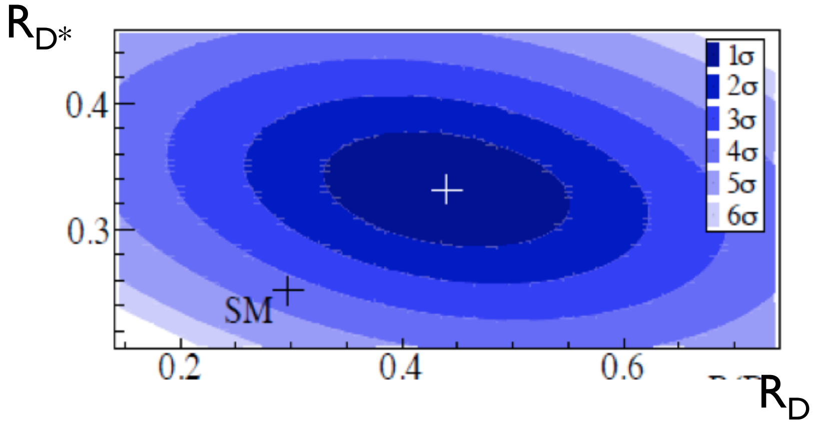
Data driven methods to control the backgrounds (combinatorial and D** backgrounds)



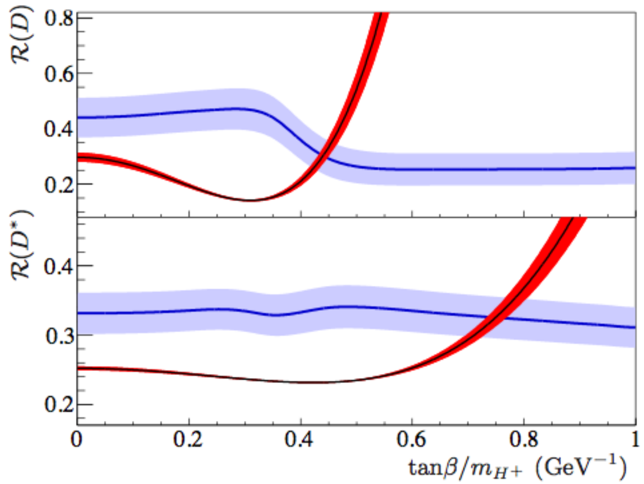
B → D* τ ν

Surprise: 3σ excess over SM prediction!





Surprise: kills the 2HDM Type II



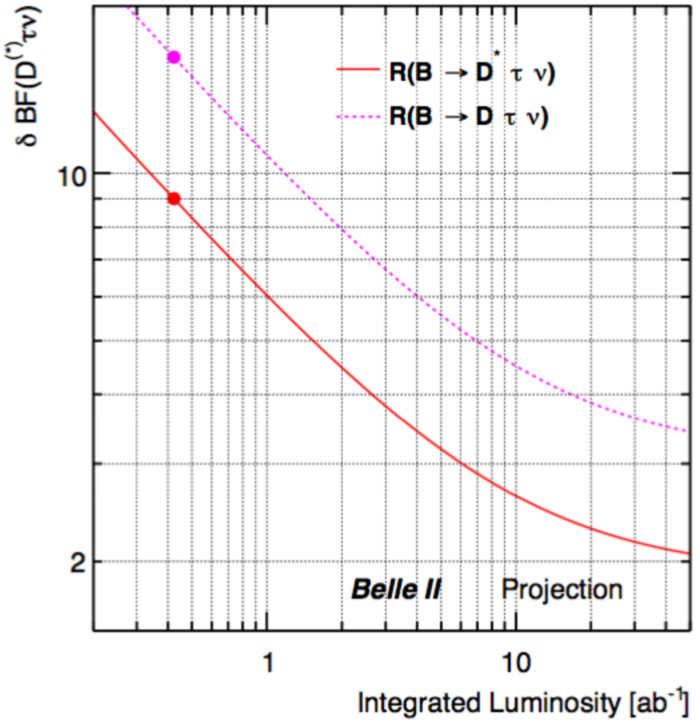
Belle II improvements in B→D*τν

Confirm the excess with few ab^{-1}

With more data, better understanding of backgrounds tails under the signal.

We also expect a better understanding of B → D** l ν (most delicate BG)

Measure differential distribution



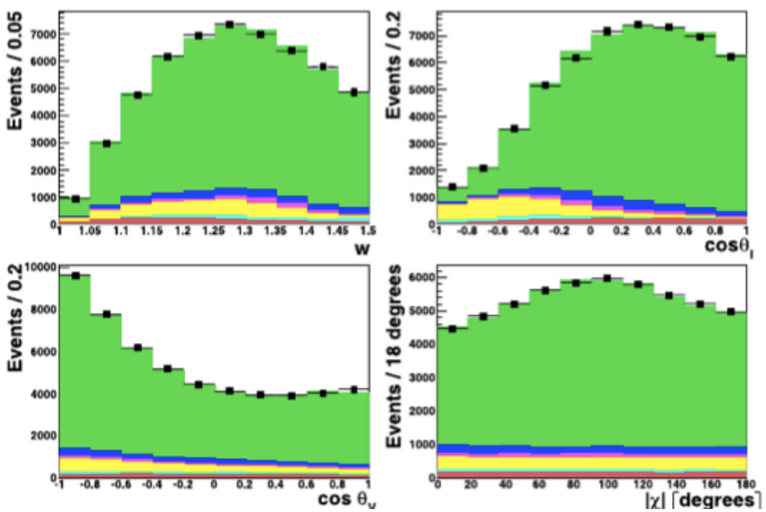
Expected Uncertainties

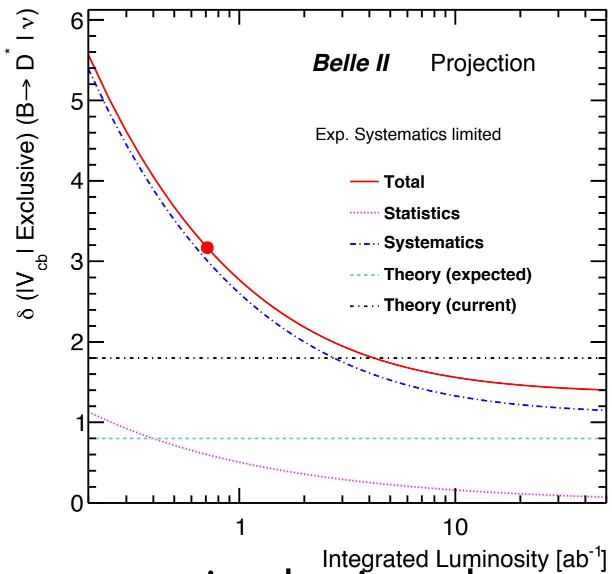
Ratio	5 ab^{-1}	50 ab^{-1}
R_{D*}	3%	2%
R_D	6%	3%

Uncertainty dominated by systematics

|Vcb| exclusive B → D* l ν

•Currently most accurate measurement of |Vcb| from B → D* l ν exclusive decay





Belle measurement has 5% total uncertainty, already systematics dominated
Expect theo uncertainty from 2% → below 1% with Belle II taking data
Most of the systematics are detector related and can improve with Belle II apparatus and scale with luminosity.
Experimental irreducible component estimated at 1% level

B→ D* l ν and B→D l ν

	Statistical	Systematic (reducible, irreducible)	Total Exp	Theory	Total
$\lvert V_{cb}\rvert$ exclusive : F(1)					
711 fb^{-1}	0.6	(2.8, 1.1)	3.1	1.8	3.6
5 ab^{-1}	0.2	(1.1, 1.1)	1.5	1.0	1.8
50 ab^{-1}	0.1	(0.3, 1.1)	1.2	0.8*	1.4
$\lvert V_{cb}\rvert$ exclusive : G(1)					
423 fb^{-1}	4.5	(3.1, 1.2)	5.6	2.2	3.6
5 ab^{-1}	1.3	(0.9, 1.2)	2.0	1.5*	2.7
50 ab^{-1}	0.6	(0.4, 1.2)	1.4	1.0*	1.7

Similar level of accuracy from B→ D l ν and B→ D l ν*

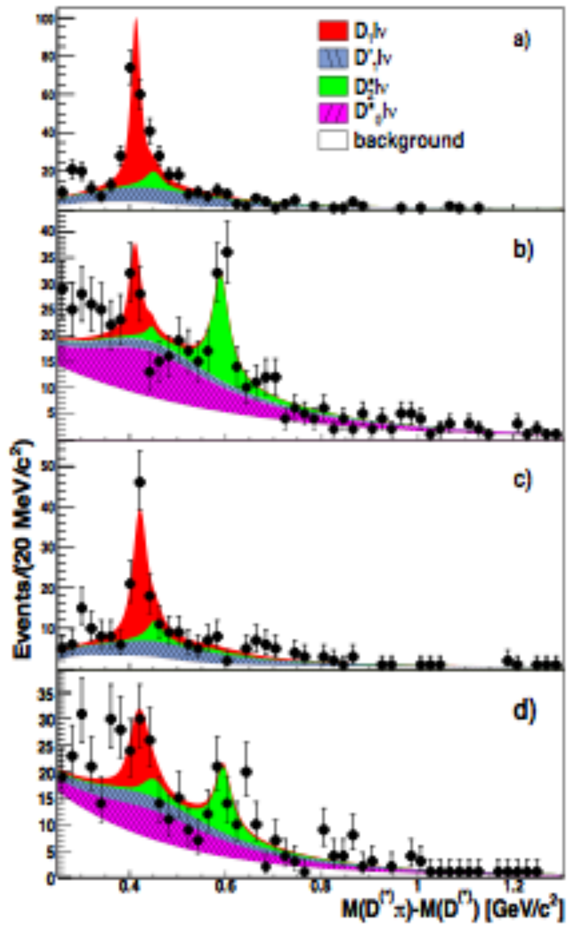
$B \rightarrow X_c\, l\, \nu$ inclusive at Belle II

(Modest) improvement of experimental uncertainties expected.

•Better determination of $B \rightarrow D^{**}\, l\, \nu$ component
•Improved control on the tag B normalization
•Largest experimental systematics from PID and tracking

We expect a 0.5% ultimate systematic uncertainty

We assume theory uncertainty at 1% that will saturate the error budget

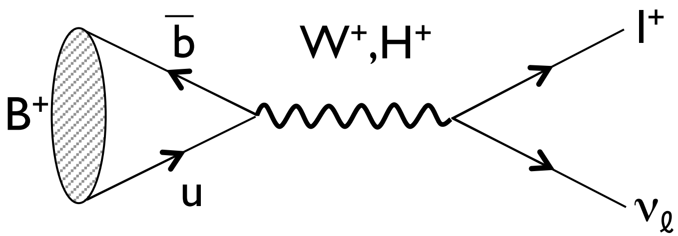


Fitted $D^{(*)}\pi$ mass spectrum of Phys.Rev.Lett. 101 (2008) 261802

Belle II deliverables:
Detailed exploration of $B \rightarrow D\, n\pi\, l\, \nu$

Solve"puzzles" like the gap between inclusive and exclusive Vcb
Check if exclusive modes saturate inclusive rate

B → l ν



Very clean theoretically, hard experimentally

SM contribution helicity suppressed

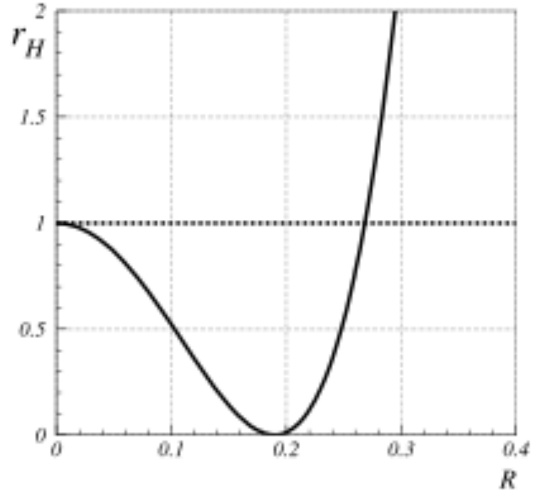
Sensitive to NP contribution (charged Higgs)

$$\mathcal{B}(B \to l\nu) = \frac{G_F^2 m_B}{8\pi} m_l^2 (1 - \frac{m_l^2}{m_B^2})^2 f_B^2 |V_{ub}|^2 \tau_B$$

$$\mathcal{B}(B \to l\nu) = \mathcal{B}(B \to l\nu)_{SM} \times r_H$$

$$r_H = (1 - \tan^2\beta \frac{m_B^2}{m_H^2})^2$$

in 2HDM type II



Standard Model Predictions

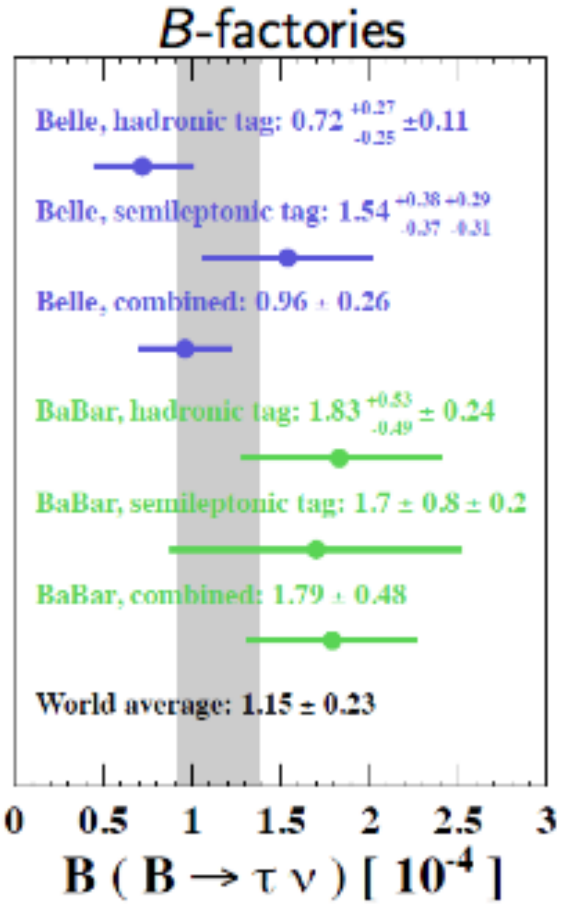
Mode	$\mathcal{B}(B^+ \to \ell^+\nu_\ell)$	
$\tau\nu_\tau$	$(1.01 \pm 0.29) \times 10^{-4}$	*Accessible with current data sets*
$\mu\nu_\mu$	$\sim 0.45 \times 10^{-6}$	*Need Belle II statistics*
$e\nu_e$	$\sim 0.8 \times 10^{-11}$	*Beyond the reach of experiments*

Belle II can also test lepton flavour universality →

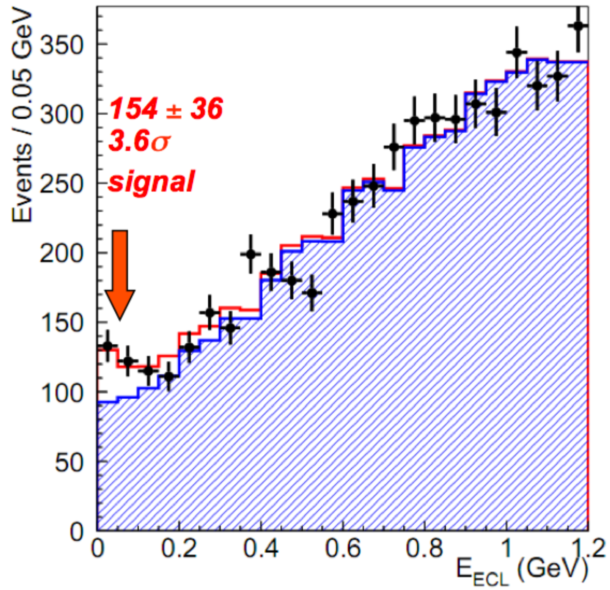
$$R^{\tau e} = \frac{\Gamma(B \to e\nu)}{\Gamma(B \to \tau\nu)}$$

$$R^{\tau\mu} = \frac{\Gamma(B \to \mu\nu)}{\Gamma(B \to \tau\nu)}$$

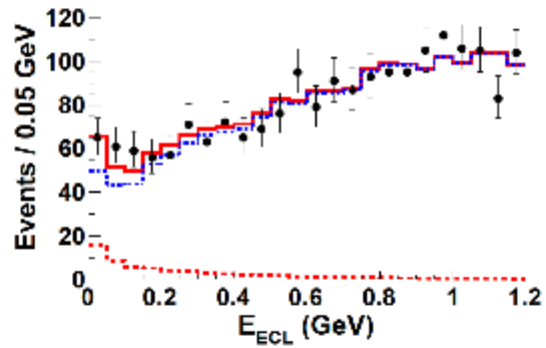
Belle and BaBar measurements



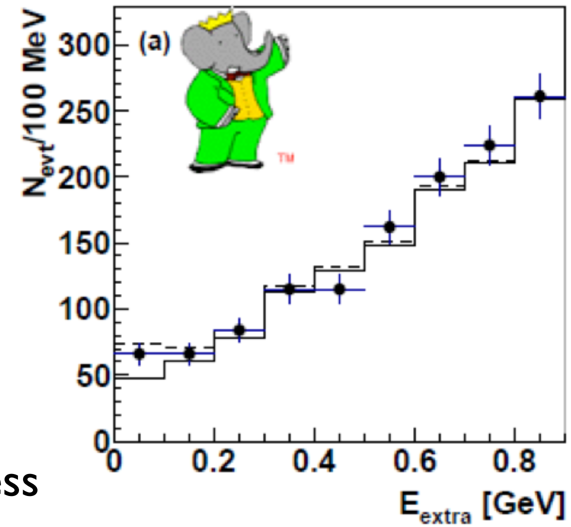
Belle semileptonic tag



Belle Hadronic tag



BaBar Hadronic tag



New Belle semileptonic tag results further reduce the excess

$$\mathcal{B}(B \to \tau\nu) = (1.14 \pm 0.22) \times 10^{-4} (\text{HFAG2013})$$

B → μ ν and B → e ν

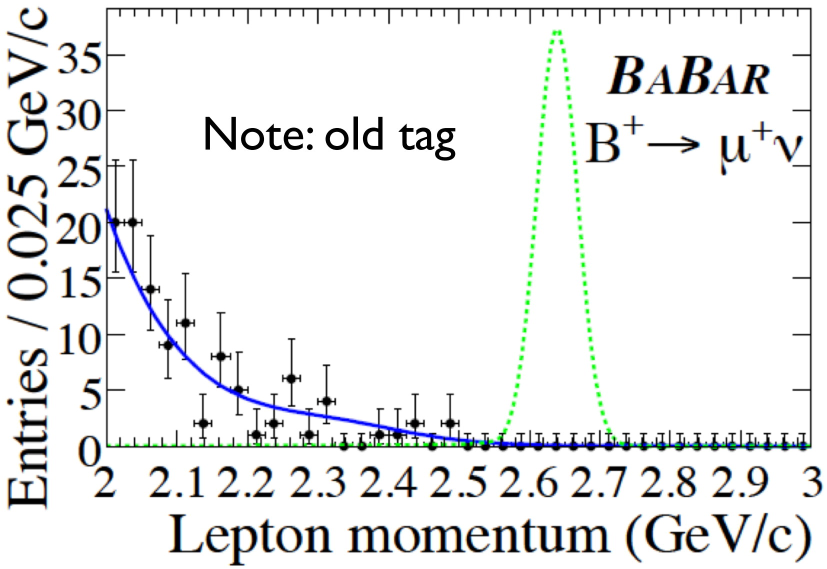
Monochromatic lepton in the B rest frame

Almost background free with tagged analyses

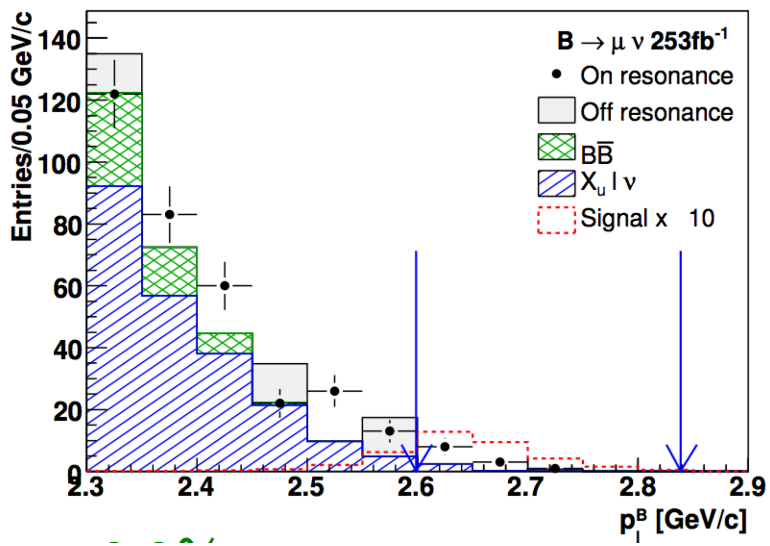
$\mathcal{B}(B \to \mu\nu) < 5.6 \times 10^{-6}$

$\mathcal{B}(B \to \mu\nu) < 1.7 \times 10^{-6}$

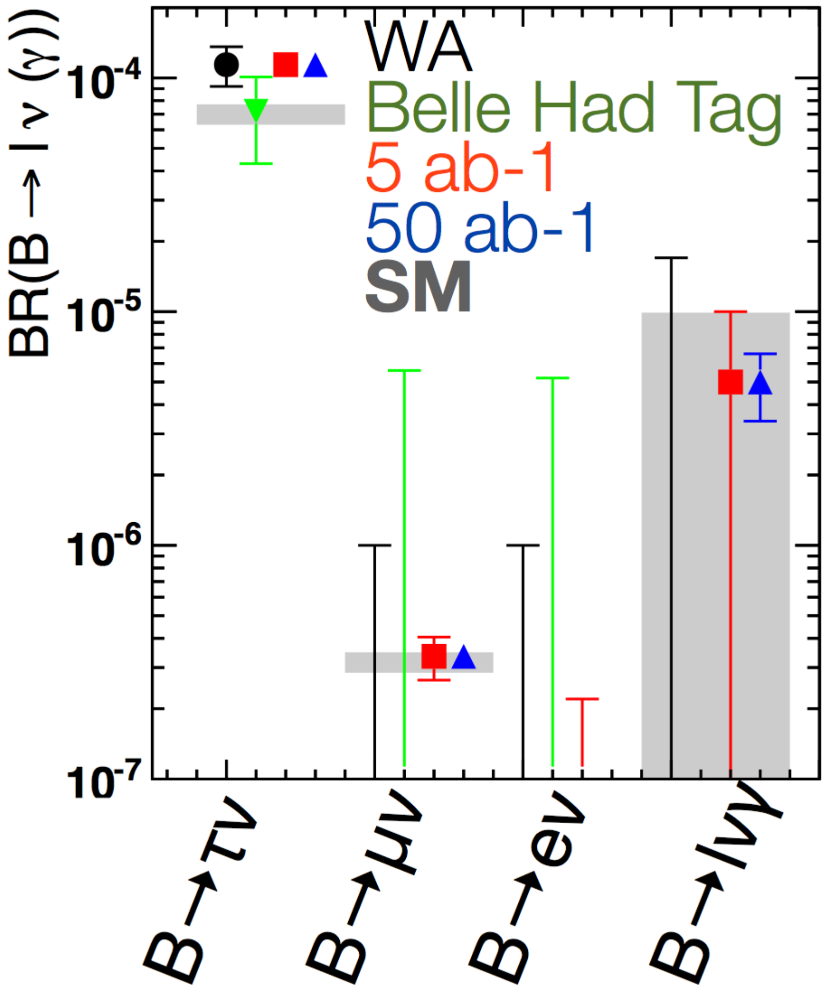
Hadronic tag BaBar



Semileptonic tag Belle



Belle II outlook for leptonic B decays



Extrapolated B → τ ν uncertainty
10% after 5 ab^{-1} and 3%-5% after 50 ab^{-1}
Dominated by systematics

Extrapolated B → μ ν uncertainty
20% after 5 ab^{-1} and 7% after 50 ab^{-1}

B → e ν SM prediction out of reach,
Sensitivity to B.R. of 7 10^{-8} with 50 ab^{-1}

Q:What is the ultimate the ultimate experimental systematic uncertainty?
Naïve guess : 3%

Electroweak penguins with charged leptons

B→ K* μ μ decays FB asymmetry

the q^2 distribution zero crossing precisely known in SM

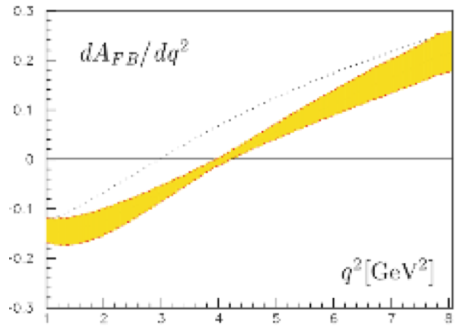
LHC-b will reach a 2% accuracy

Belle II: smaller statistics but adds

- Clean electron mode B → $K^{(*)}$ e e
- inclusive analysis of B → X_s $l^+ l^-$
- third generation B →K τ τ

$K^* \ell^+ \ell^-$

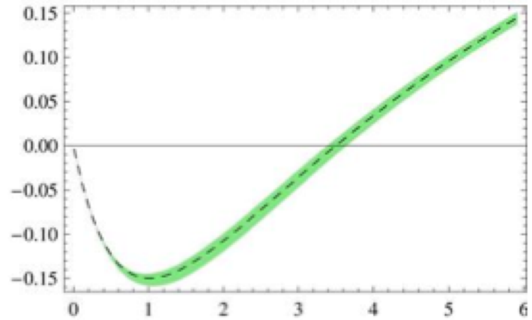
[Ali et al.,EPJ,C47(2006) 625]



$$q_0^2 = \left(4.07^{+0.16}_{-0.13}\right)\ \mathrm{GeV}^2$$

$X_s \ell^+ \ell^-$

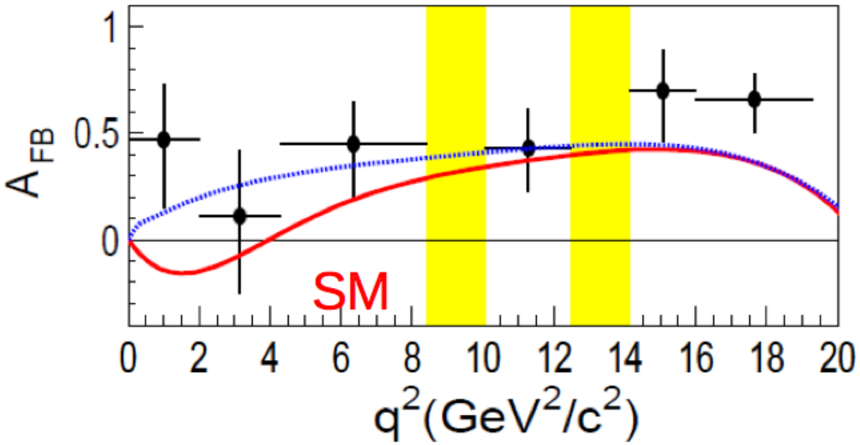
[Huber et al., NPB 802 (2008) 40]



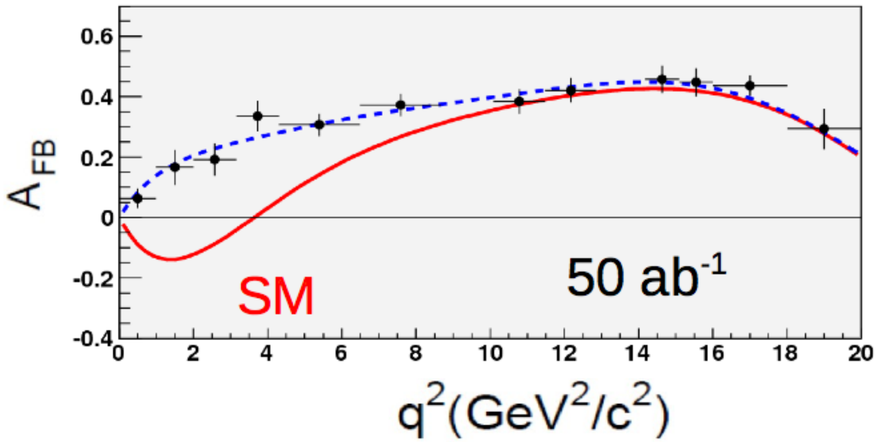
$$(q_0^2)_{\mu\mu} = (3.50 \pm 0.12)\ \mathrm{GeV}^2$$

$$(q_0^2)_{ee} = (3.38 \pm 0.11)\ \mathrm{GeV}^2$$

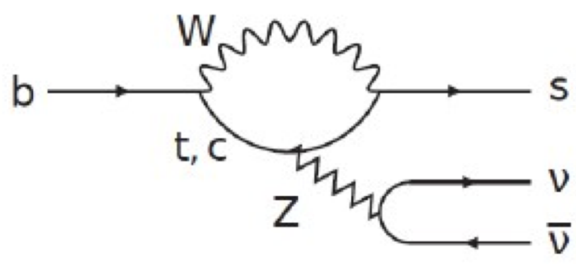
Belle : Phys Rev Lett 103 171801 (2009)



Extrapolation to Belle II with 50 ab^{-1}

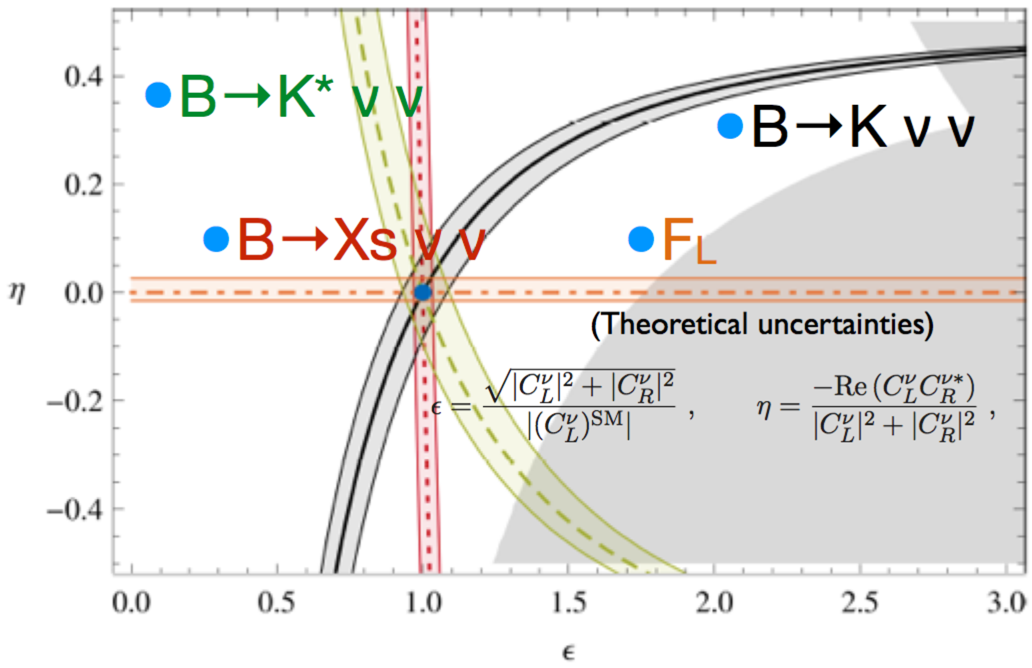


Electroweak penguins with neutrinos

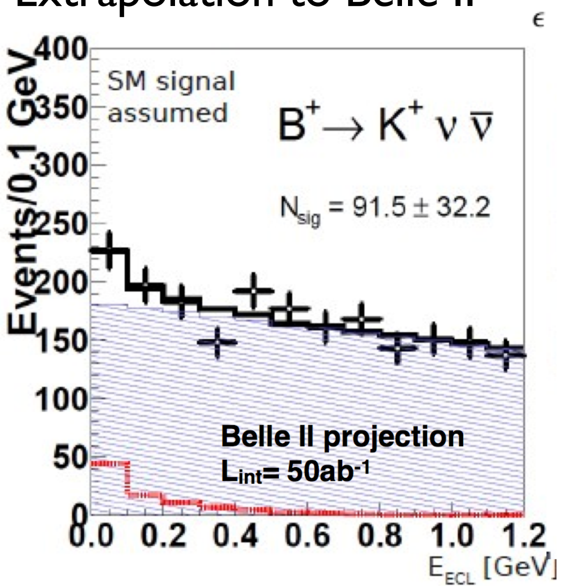


B → K$^{(*)}$ ν ν possible only at Belle II

Altmannshofer et al., JHEP 0904:022,2009



Extrapolation to Belle II



Extrapolation to Belle II 30% accuracy assuming SM
With with one tag method only (hadronic)

To be considered: improvements in PID, tagging efficiency, better K_L rejection, background rejection with ECL timing…

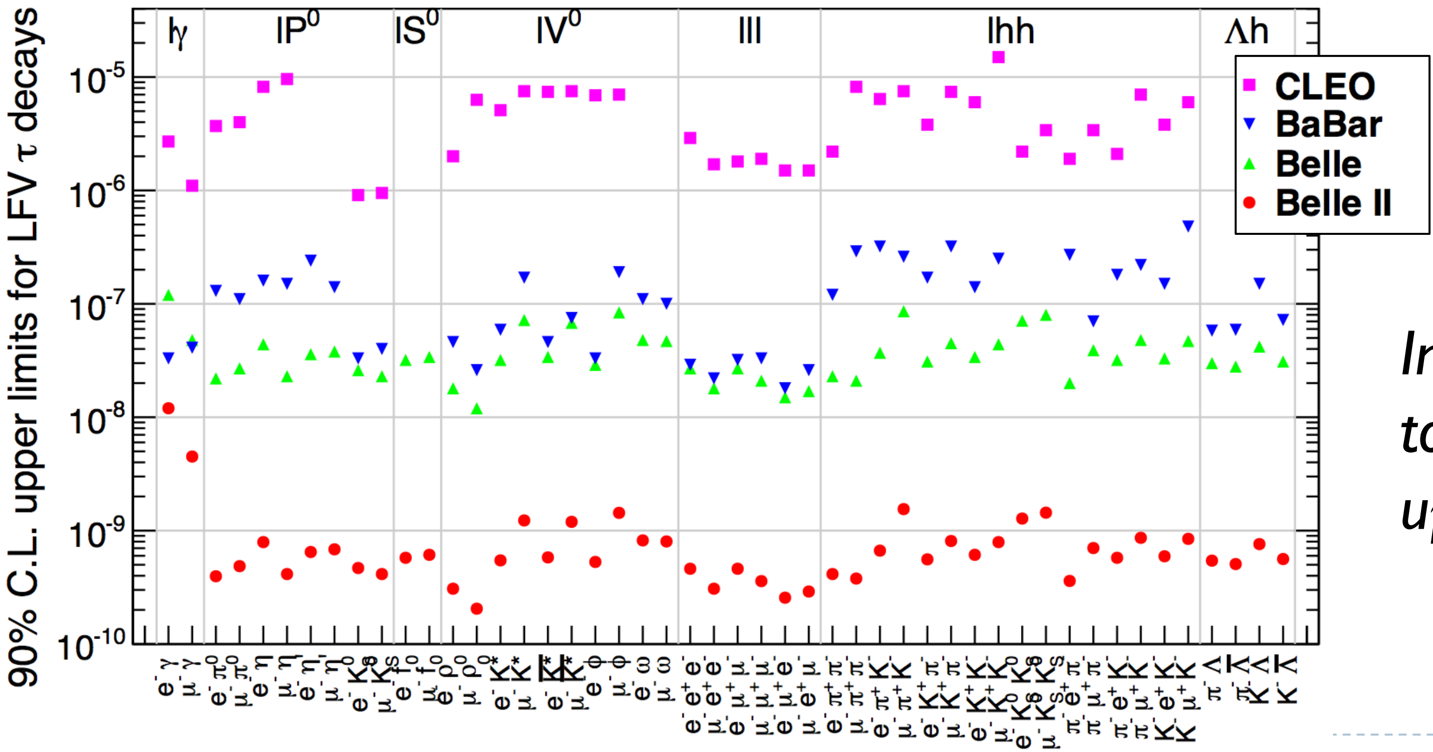
Lepton Flavour Violation in Tau decays

LFV in τ decays clean null test of SM

τ → μμμ and eee background free searches

LHCb not competitive (?)

	reference	τ→μγ	τ→μμμ
SM + heavy Maj ν_R	PRD 66(2002)034008	10^{-9}	10^{-10}
Non-universal Z'	PLB 547(2002)252	10^{-9}	10^{-8}
SUSY SO(10)	PRD 68(2003)033012	10^{-8}	10^{-10}
mSUGRA+seesaw	PRD 66(2002)115013	10^{-7}	10^{-9}
SUSY Higgs	PLB 566(2003)217	10^{-10}	10^{-7}



Improvements up to 50x on all upper limits

Charm

Charm recoil technique

Based on hadronic B full reconstruction

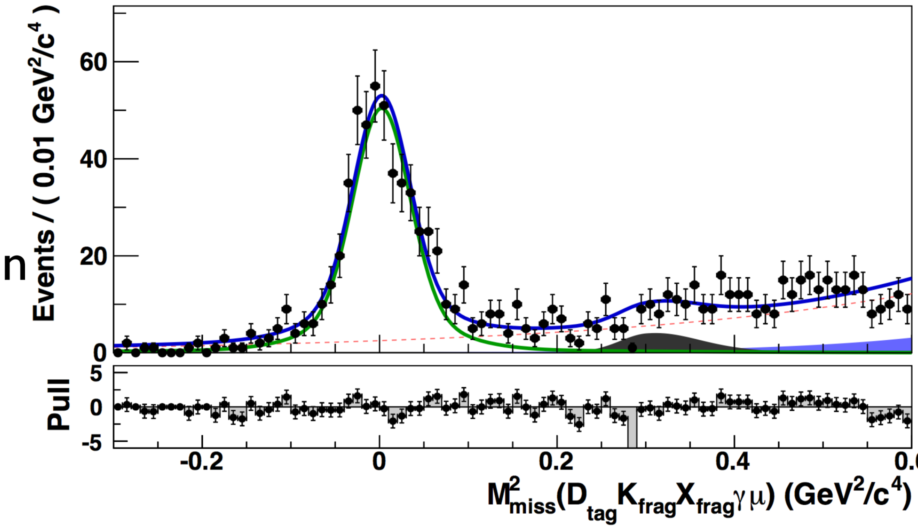
D→ μ ν at 1% and D →τ ν at 3%

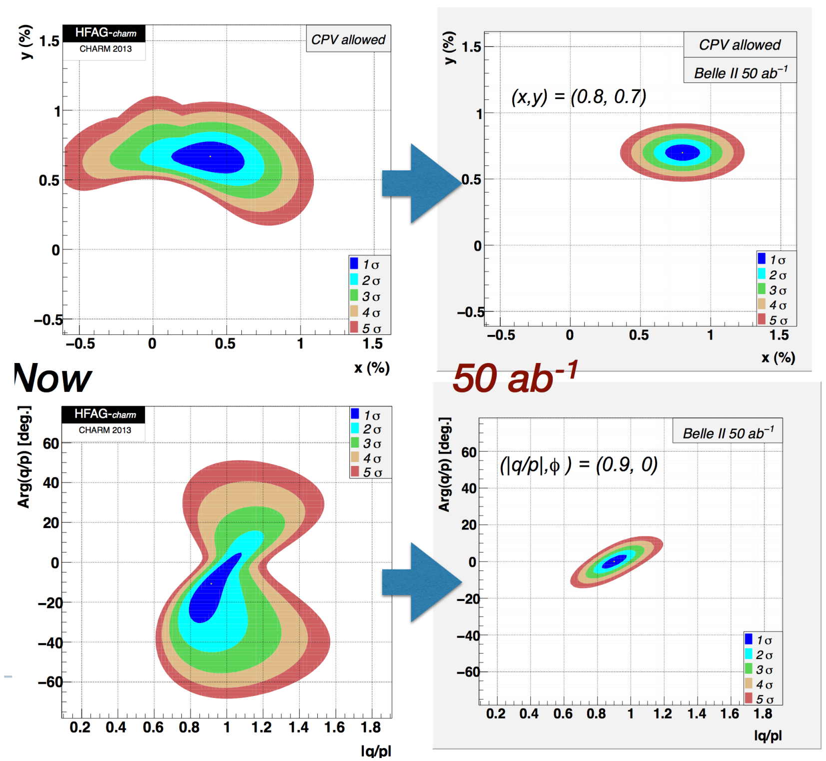
D →γ γ sensitivity at 10^{-7}
(help constrain LD in D→μμ)

D→ νν (dark scalar)

Complement and cross check measurements where LHCb will dominate

$$e^+e^- \to c\bar{c} \to \overline{D}_{\rm tag} X_{\rm frag} D^{(*)}_{\rm recoil}$$





Conclusions on Physics perspectives

- Belle II Physics program very rich and complementary to LHC-b
  - Unique capabilities of the machine/detector greatly improve the discovery potential
- SuperKEKB construction on schedule and will start commissioning at beginning of 2015.
- Physics run anticipated to start end of 2017
- Belle II unique place to solve current puzzles and shed light on new Physics
  - More accurate theory predictions and new ideas to be exploited
  - Refinements of experimental techniques to let systematic uncertainties shrink with statistics
  - We are still building the detail of the physics Program
    - An experiment-theory effort on-going:
      Belle II experiment Theory Interface Platform (B2TIP)
      https://belle2.cc.kek.jp/~twiki/bin/view/Public/B2TIP

Gruppo di Napoli

Nome	Qualifica	FTE
Aloisio	Prof. Ord.	30%
De Nardo (Responsabile)	Prof. Ass.	80%
Giordano	Assegnista	70%
Laccetti	Prof. Ord.	20%
Lapegna	Prof. Ass.	10%
Merola M.	Assegnista	40%
Ordine	Pr. Tecnologo	30%
Pardi	Tecnologo	20%
Russo	Prof. Ord.	30%
Sciacca	Prof. Emerito	0%
TOTALE:		3.6 FTE

Principali Attività:

Calorimetro elettromagnetico

Software e Fisica

Computing

Responsabilità ufficiali:

Identificazione degli elettroni
Convener Analisi Leptonici, Semileptonici e con Missing energy

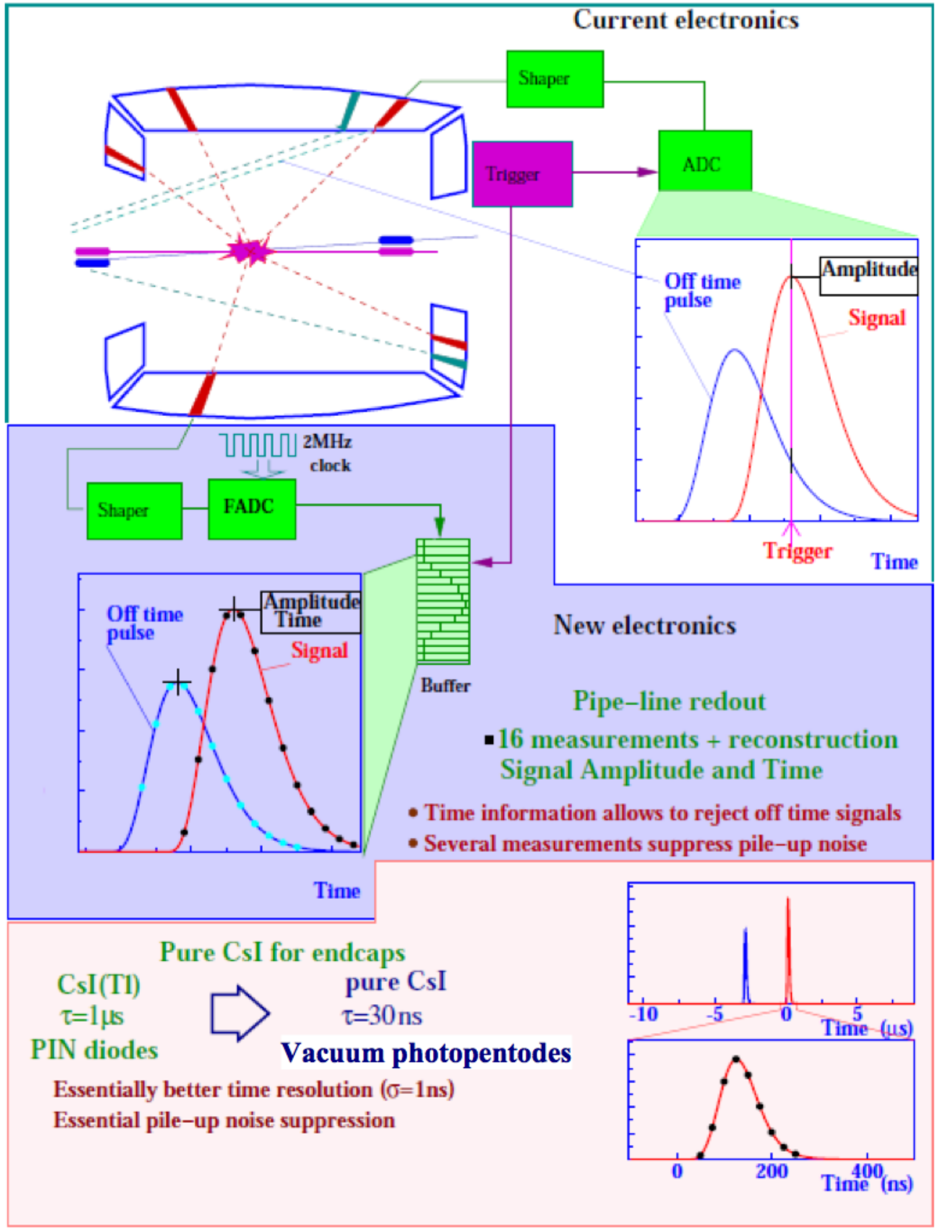
Studio del Network per data distribution
Responsabile Fisica italiano

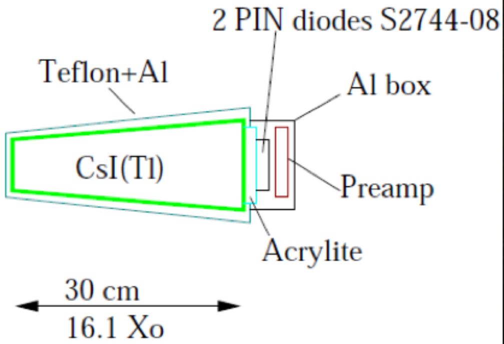
Attività a Napoli: Calorimetro EM (2014)

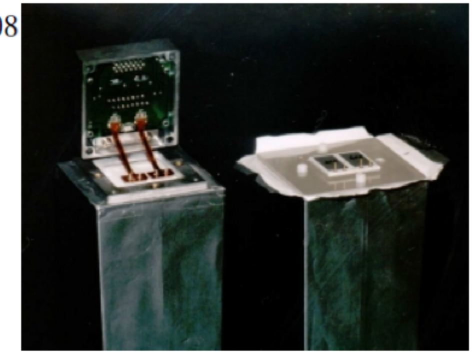
(Aloisio, Cavaliere, De Nardo, Giordano, Ordine, Sciacca)

	Day 1	Day 2
Programma Belle II	Riutilizzo del calorimetro di Belle CsI(Tl) + completo rifacimento dell'elettronica di lettura Sviluppo del software di ricostruzione e PID	Early upgrade degli endcaps per le alte dosi di radiazione. Nuovi cristalli di CsI puro , sensori ed elettronica di lettura. CsI puro già scelto. Opzione sensori ancora aperta
Commitments Napoli	Software di identificazione elettroni e studi di fisica associati (con LNF, RM3) Aiuto nella sostituzione elettronica Barrel: primavera 2014 Endacap: fine 2014	- R&D su lettura CsI puro con Large Area APDs (con PG,LNF,RM3) - Sviluppo sistema di controllo e slow daq (con RM3)

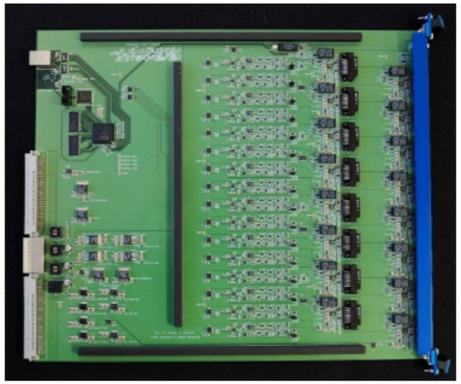
Electromagnetic calorimeter (ECL), barrel

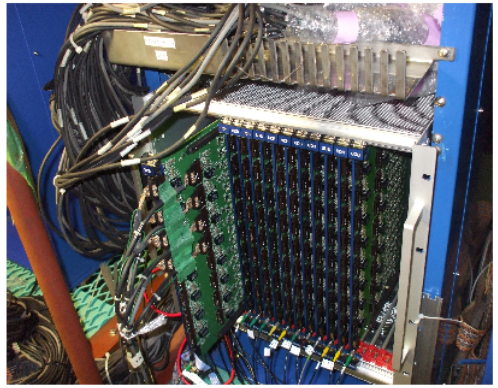




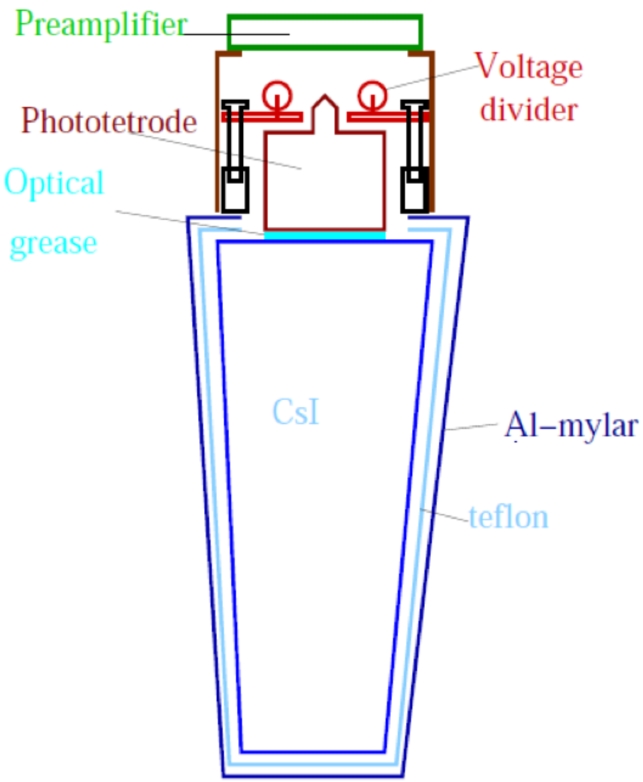


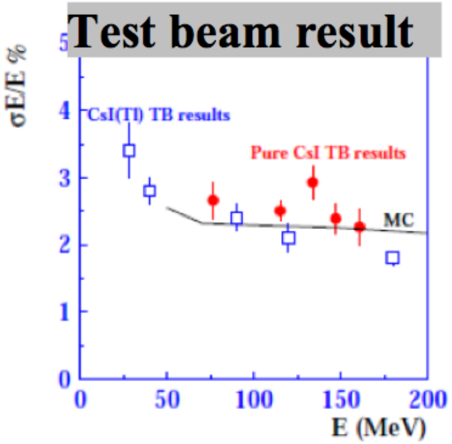
- **Barrel ECL** will be reused, new electronics with pipe-line readout and waveform analysis (16 ch Shaper-DSP board) has been developed and tested. 112 from 432 Shaper-DSP boards were produced, tested and delivered to KEK lab.
- All 6624 ECL barrel channels have been tested with new electronics (all are alive).
- Belle II DAQ electronics has been tested in the ECL data transfer runs with the frequency up to 30 kHz.
- In 2014 ECL electronics will be installed in detector.





ECL end-cap upgrade





- At the first stage of the Belle II experiment we will reuse Belle end-cap ECL (1152 + 960 channels) (with new preamplifiers and readout electronics).
- **The main end-cap ECL upgrade option is to use CsI(pure) crystals and Hamamatsu photopentodes** (dedicated R&D showed good results):
  - ✓ Low pile-up noise and good energy and spatial resolution
  - ✓ Similar physical characteristics (as for CsI(Tl)), better radiation hardness
  - ✓ There are several crystal producers, acceptable price
- However there are some difficulties: no redundancy, notable dependency on magnetic field, completely new mechanical support is needed. To solve these difficulties **second R&D option was formulated: CsI(pure) + Si APD**
- In the CsI(pure) + Si APD option we are investigating APD from two producers: *Advanced Photonix*, *Hamamatsu Photonics*. The main problem is to reach admissible level of electronic noise.

Hamamatsu APD S8664-1010

Advanced Photonix APD

Attività ECL

- Nel corso del 2014 l' attivita è focalizzata su R&D CsI puro
  - Test e ottimizzazione lettura con diversi tipi di APD.

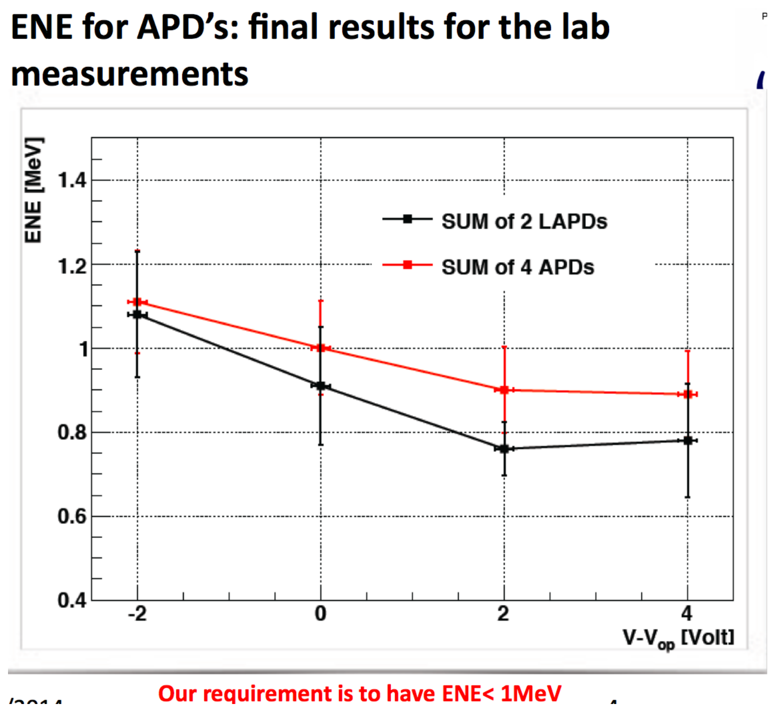
  - → scelta di Large Area APD della
  - Hamamatsu

Sistematica caratterizzazione dei cristalli
Di CsI puro e CsI(Tl) all'ENEA:

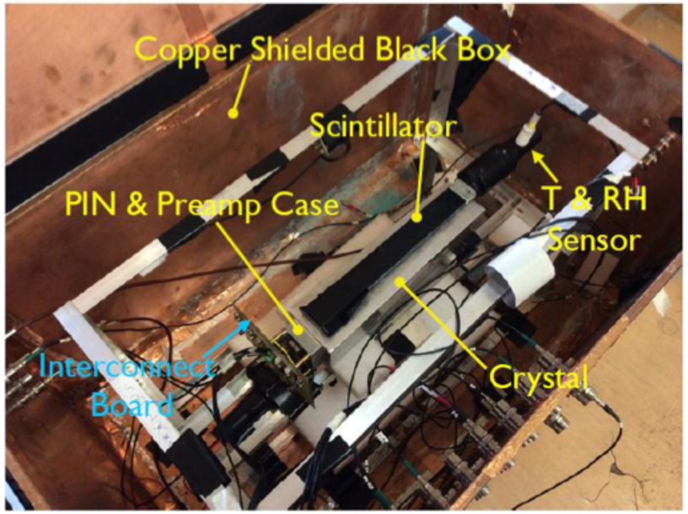
Test di radiation hardness sui sensori

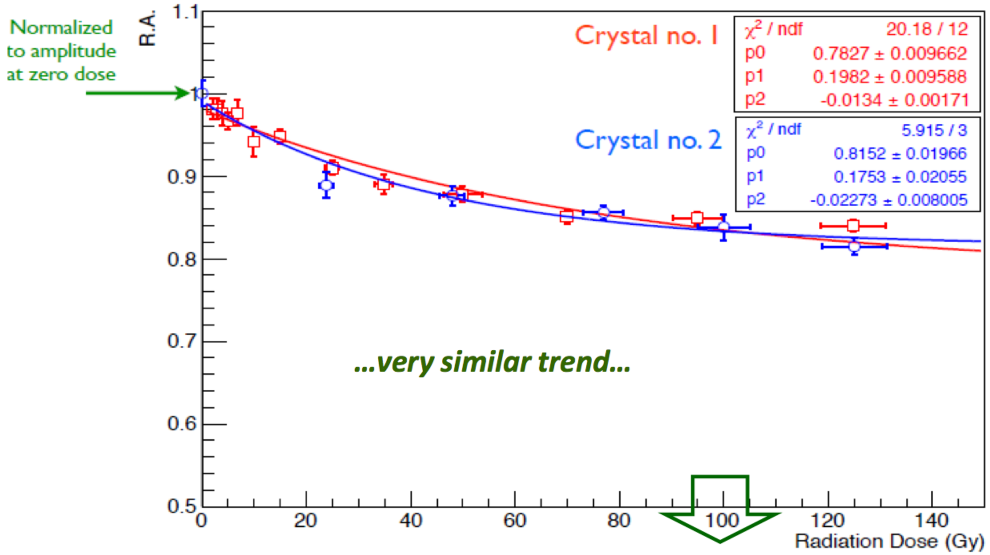
Caratterizzazione delle colle

Studi su wavelength shifters

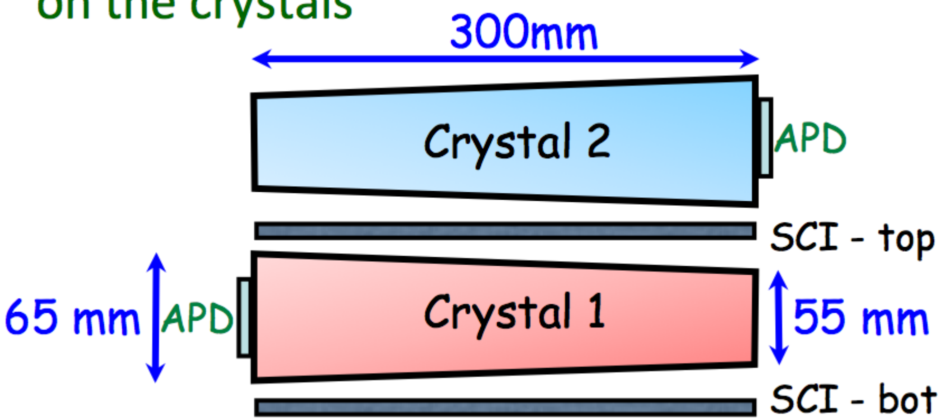


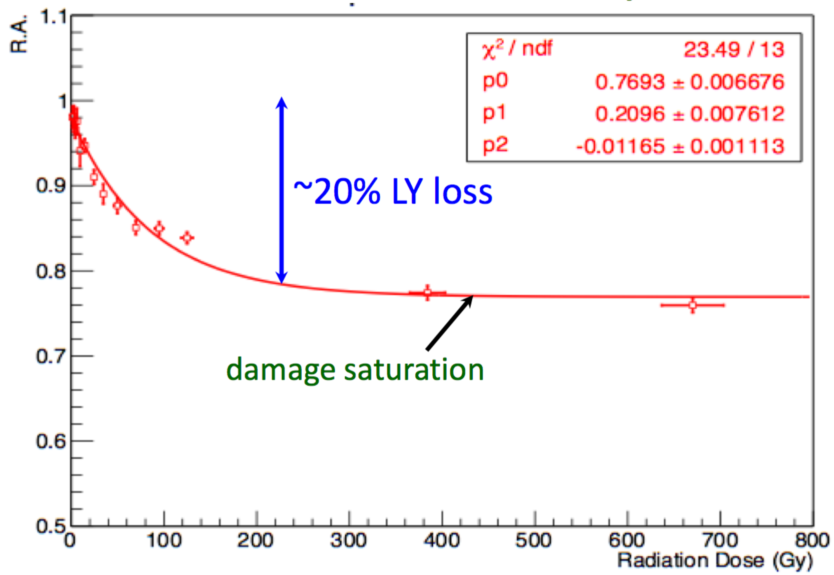
Attività ECL



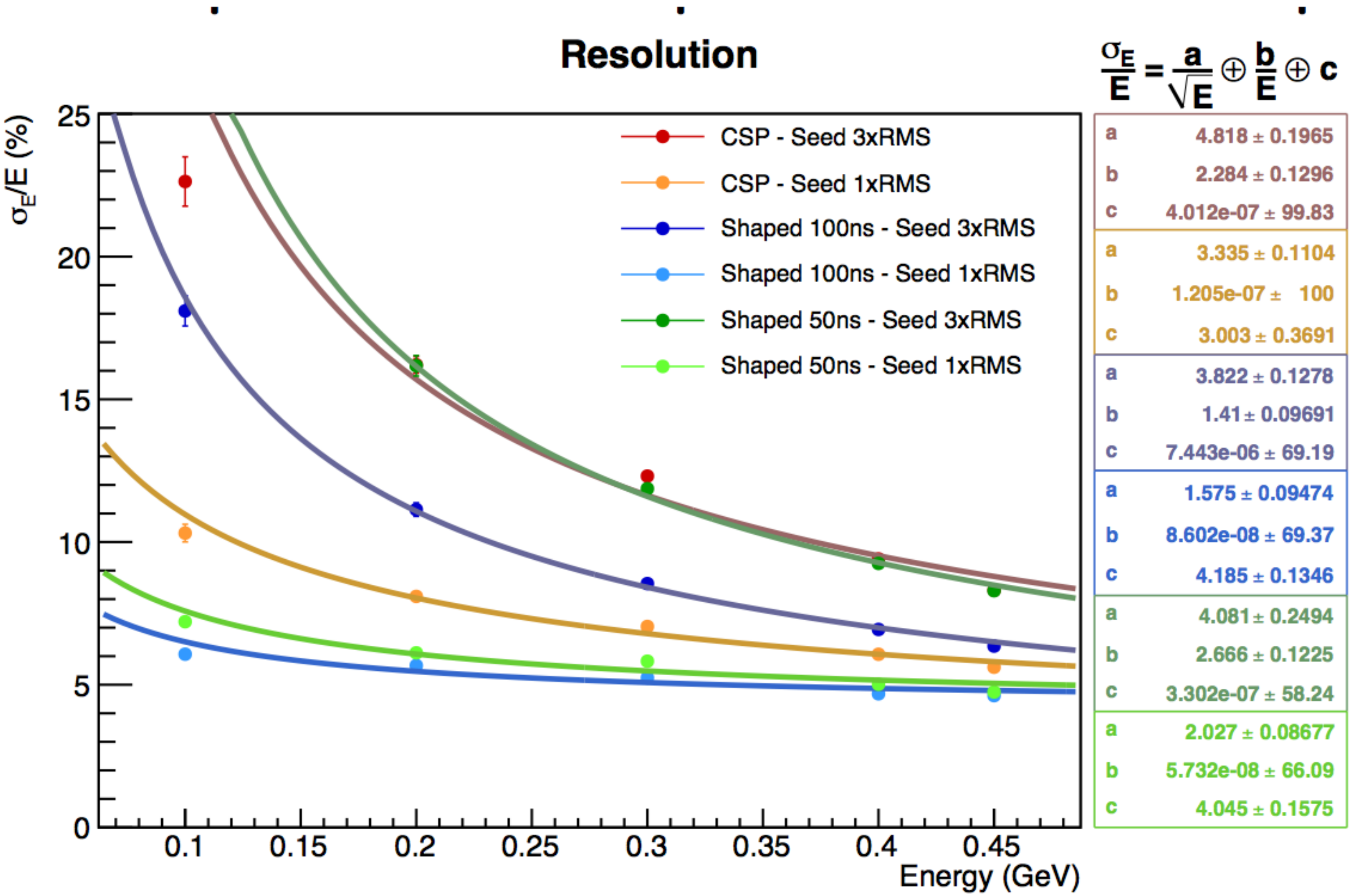


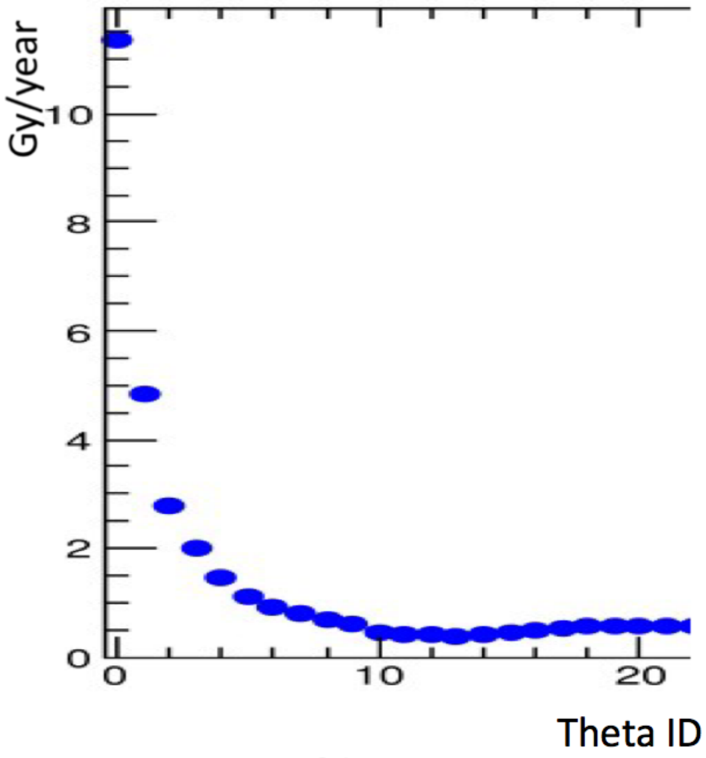
CR data by a pair of 3x30 cm², 10 mm thick, trigger scintillators placed longitudinally on the crystals

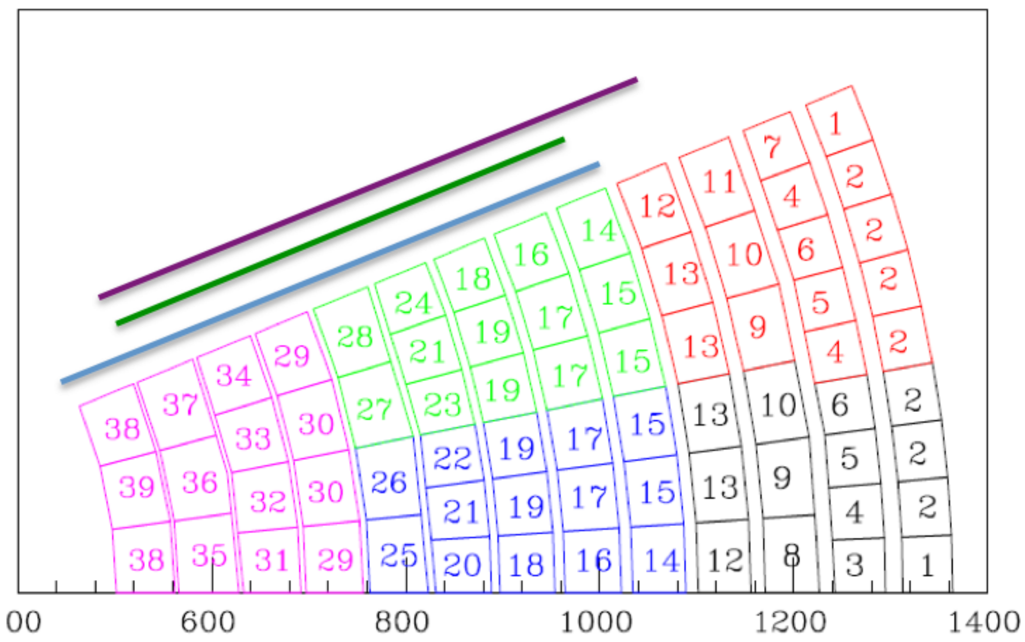




Test beam at BTF





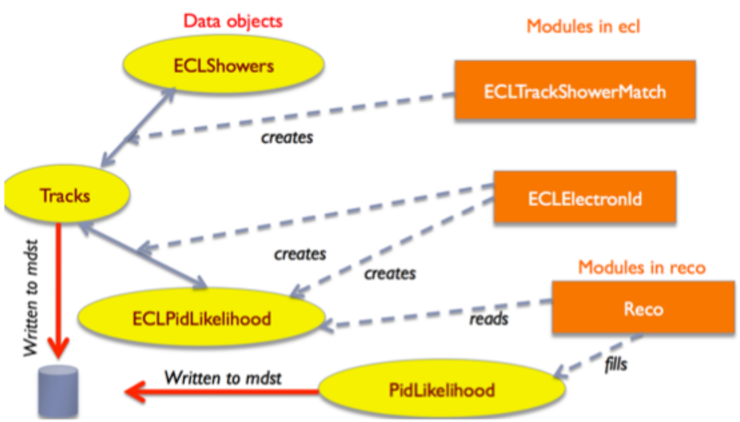


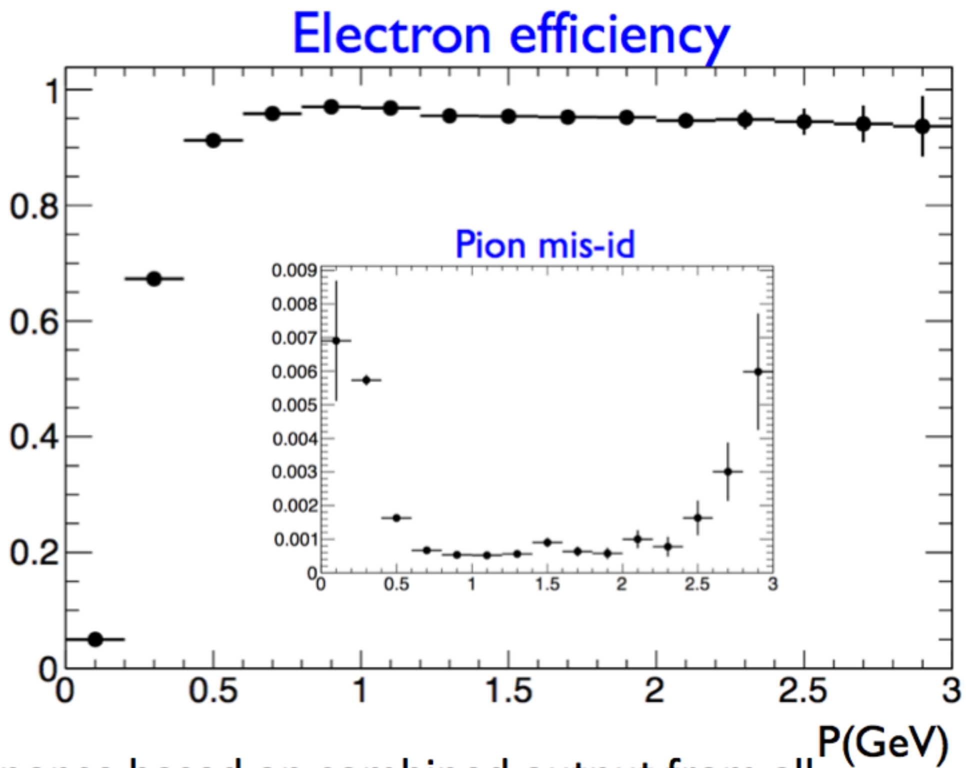
Next steps nel corso del 2015:

Verificare l'impatto sulla Fisica di varie configurazioni di upgrade (inclusa l'assenza)
N.B. gli strumenti di simulazione dei background e di simulazione/ricostruzione del detector sono ancora in sviluppo (i.e. necessario contribuire anche a questo livello)

Software e identificazione elettroni

Responsabilità: Guglielmo De Nardo (NA)



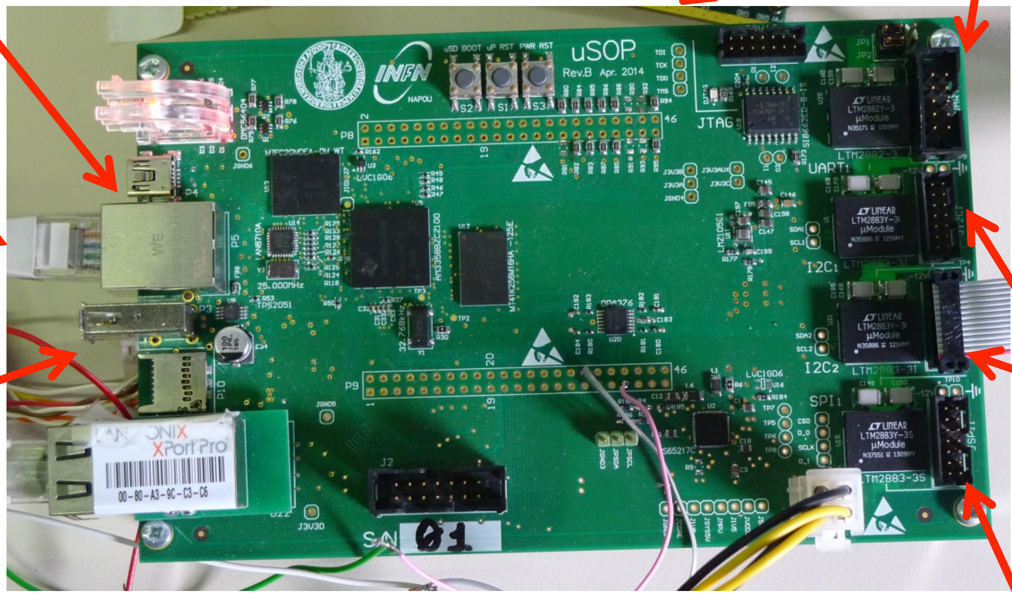


PID selection base on a likelihood response based on combined output from all Subdetectors capable of PID

e-ID currently uses E/p from ECL and dE/dx from SVD+CDC

R. Giordano

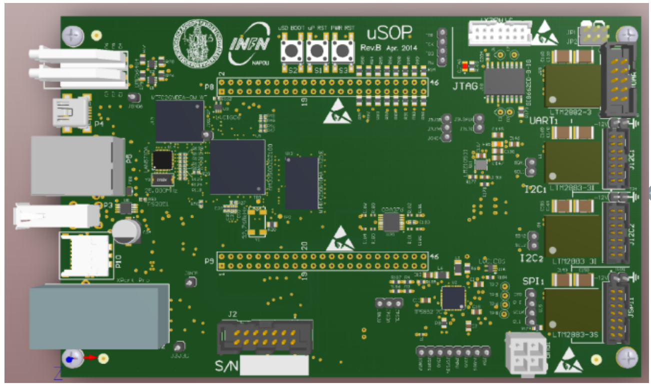
Micro Service Oriented Platform



- A single-board computer
- Runs Linux
- Flexible: Ethernet, I2C, SPI, RS232, USB
- Low power: 2W
- Inexpensive: 100EUR
- Derived-from and compatible-with BeagleBoneBlack open source system
- All HW/SW for BBB con be reused with uSOP

- Specs:
  - Cortex A8 uP @ 1GHz (Sitara)
  - 2 GB Flash
  - 512 MB RAM

R. Giordano



I2C , SPI, JTAG, UART, USB

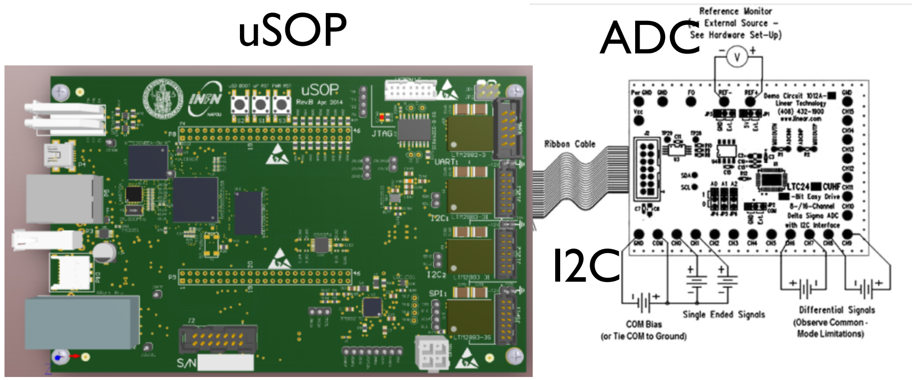
Your sensor/device here

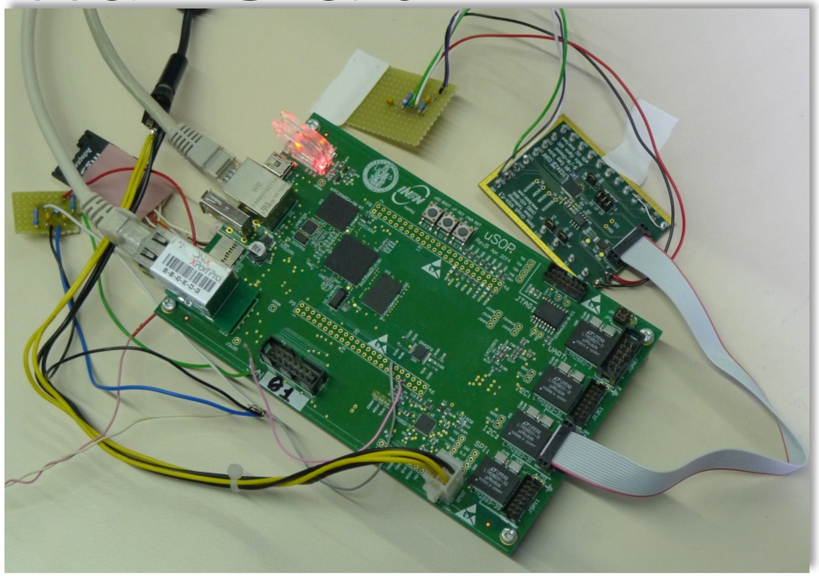
e.g. HV/Sensor/FPGA/ADC/DAC

- Extreme flexibility
- Large interface portfolio: can be connected to virtually any sensor/device
- Can even program external devices via JTAG
- Endless possibilities, will see just a few examples

R. Giordano

Sensor Read-Out

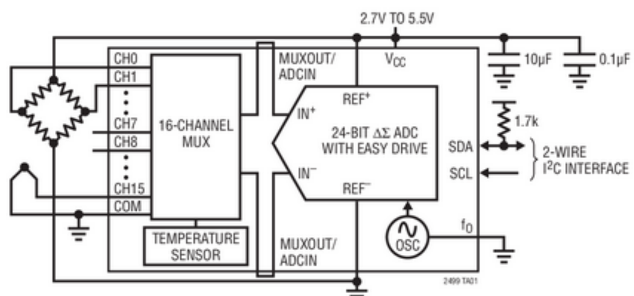




- uSOP supports protocols for remote data acquisition via field busses (I2C, SPI, JTAG, …)
- Example for temperature readout in Belle2 ECL: LTC2499 ADC
  - 8 ch. diff or 16 ch. single ended
  - 24-bit, ΣΔ architecture
  - 50/60 Hz line noise filter
  - 7.5 Hz sampling Rate
  - On-chip Temperature sensor
  - I2C interface

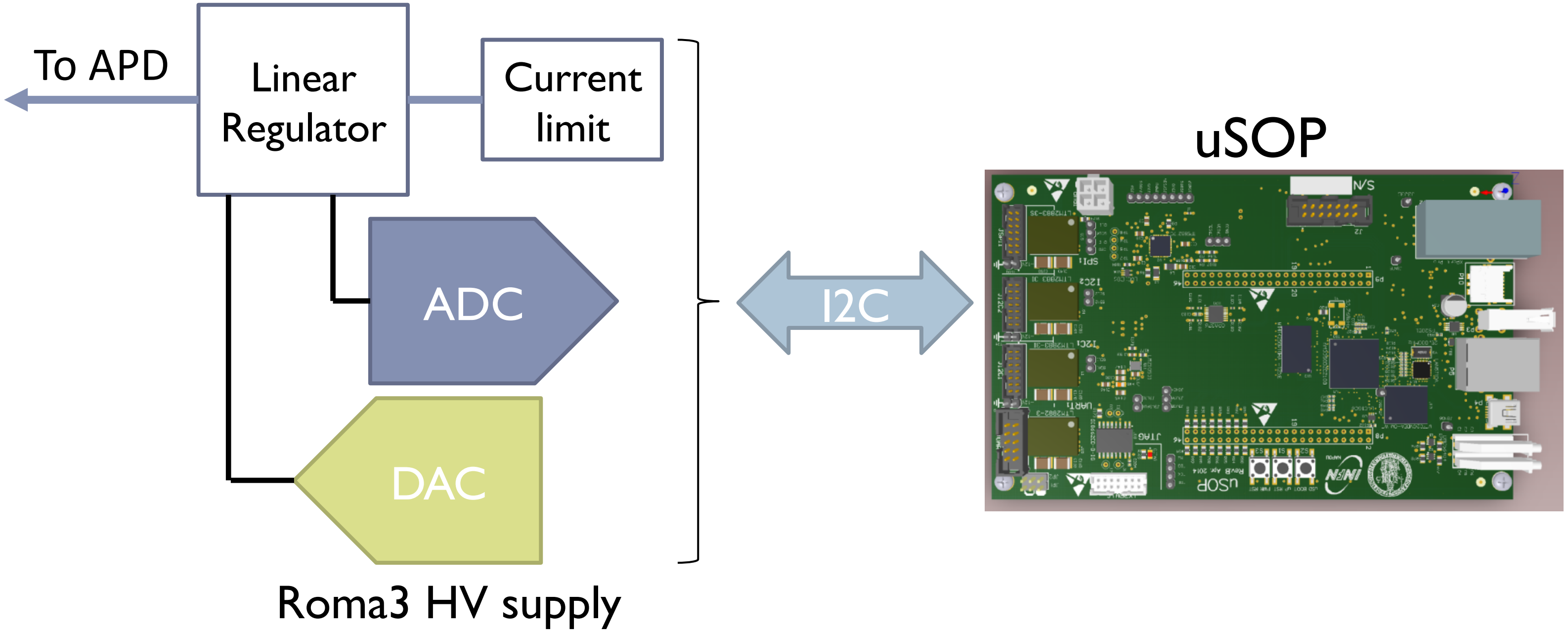
Typical Application

Data Acquisition System with Temperature Compensation



R. Giordano

High-Voltage Control



- uSOP will be interfaced with custom Roma3 HV supply, such to provide a complete slow control path for APDs power supply
- HV control could be adjusted in real-time according to temperature measurement

S. Pardi

Networking – Belle II & LHCONE

E' stato accettato il traffico Belle-2 nella rete LHCONE.

Discussione in atto su come connettere ad LHCONE i siti di Belle II.

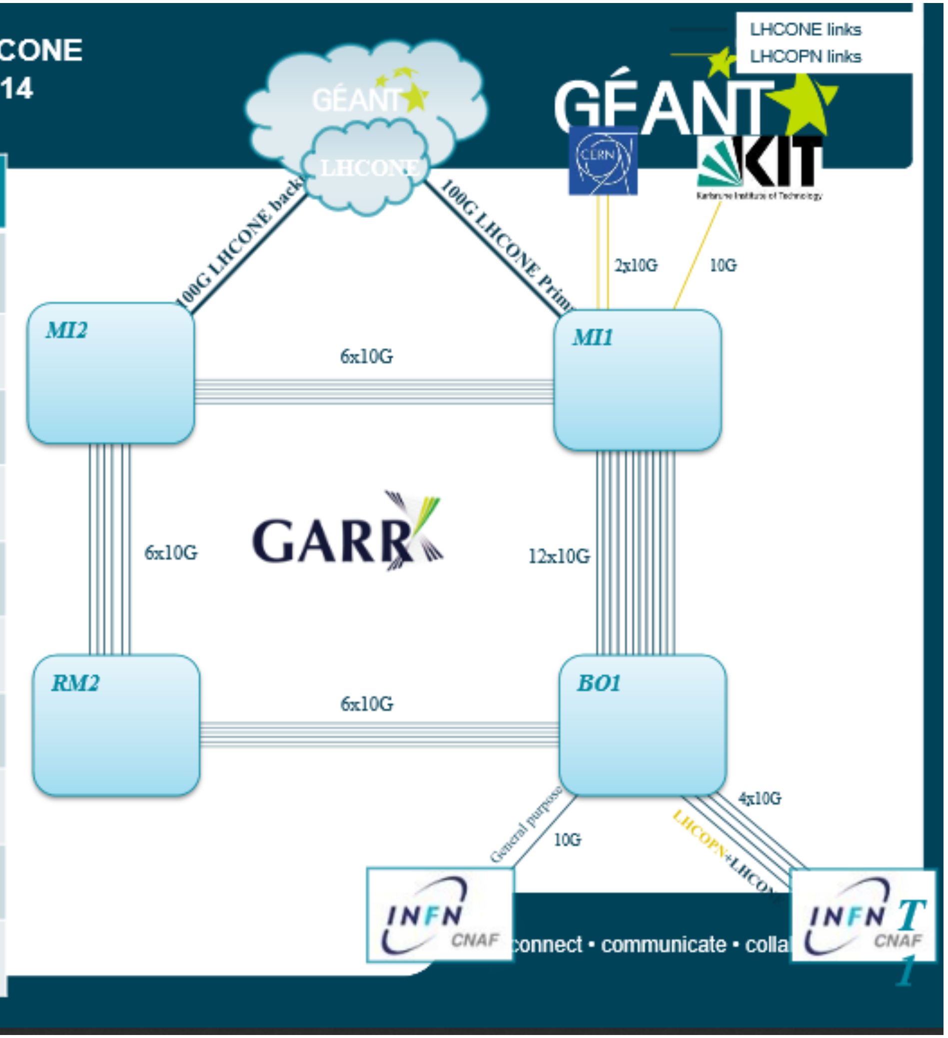
Praticamente tutti i siti Italiani coinvolti in BELLE II sono in LHCONE o stanno per entrare

Consortium GARR

HCOPN/LHCONE

ARR Q1 2014

Site	Connection
INFN-CNAF Bologna (T1)	4x10G (LHCONE+LHCOPN)
INFN-Bari (T2)	10G (LHCONE)
INFN-Catania (T2)	10G (LHCONE)
INFN-Frascati (T2)	10G (LHCONE)
INFN-Legnaro (T2)	2x10G (LHCONE+GP)
INFN-Napoli (T2)	10G (LHCONE)
INFN-Milano (T2)	10G (LHCONE)
INFN-Pisa (T2)	2x10G (LHCONE+GP)
INFN-Roma1 (T2)	10G (LHCONE)
INFN-Torino (T2)	10G



SCENARIO I

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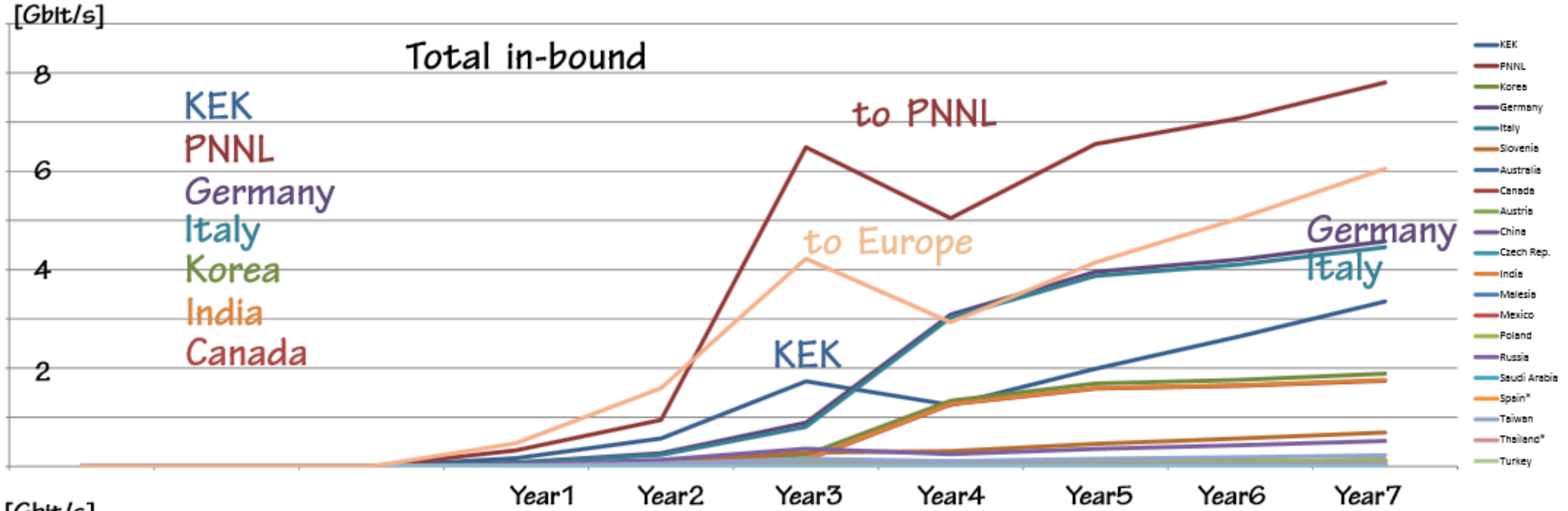
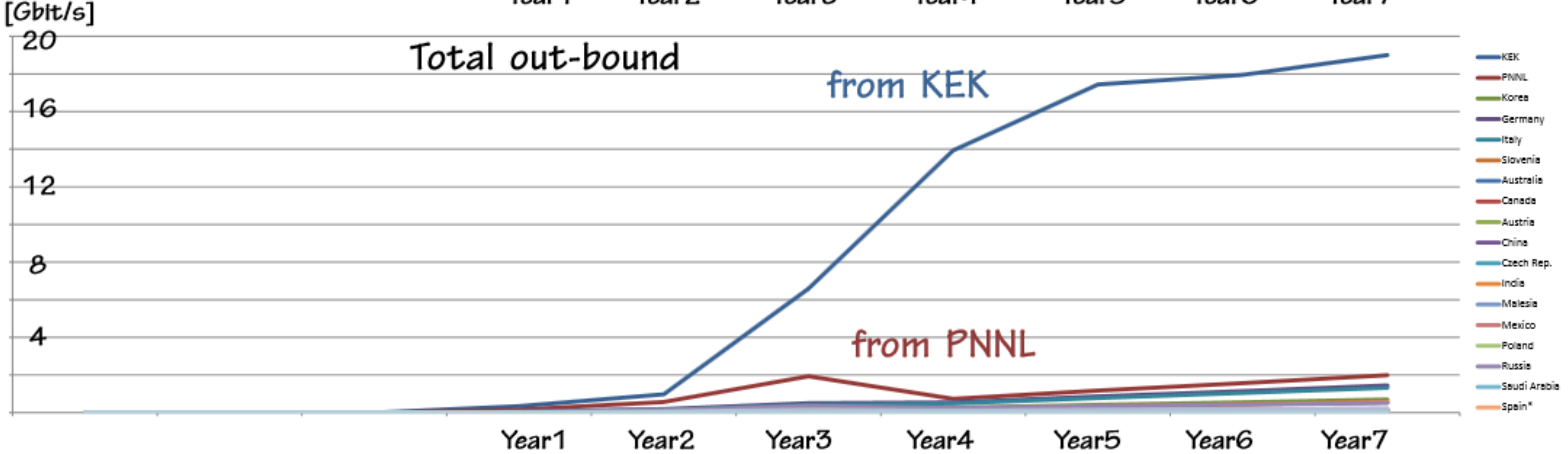




S. Pardi

Risorse Dedicate per Belle II

- **1024 Core Dedicati con protocollo Grid e Cloud**
- **578 TB Disco Dedicati con protocollo DPM**
- **Altri 960 Core Dedicati in prossima acquisizione**

Data Center SCoPE

ReCaS: Belle II

	tipo	core	ram	TB	HepSpec
1	CMC RITTAL				
2	**rear:** pannello 36 LC duplex mm OM4				
3	**rear:** pannello passa permute				
4	**rear:** Pannello 24 porte RJ45 (MNG)				
5	**rear:** pannello passa permute				
6	**rear:** Pannello 24 porte RJ45 (MNG)				
7	**front: juniper EX4200 48-port (MNG)**				
8	**rear: juniper EX4200 48-port (Backup)**				
9					
10					
11					
12					
13	**DELL PE R620**	16	64	1	268
14	**DELL PE R620**	16	64	1	268
15	**DELL MD 3600f**			48	
16					
17	**DELL MD 1200**			48	
18					
19	**DELL MD 1200**			48	
20					
21	**DELL MD 1200**			48	
22					
23	**DELL MD 1200**			48	
24					
25	**DELL MD 1200**			48	
26					
27	**DELL PE R720xd**	16	64	44	268
28					
29	**DELL PE R720xd**	16	64	44	268
30					
31	**DELL PE R720xd**	16	64	44	268
32					
33	**DELL PE R720xd**	16	64	44	268
34					
35	**DELL PE R720xd**	16	64	44	268
36					
37	**DELL PE R720xd**	16	64	44	268
38					
39	**DELL PE R720xd**	16	64	44	268
40					
41	**DELL PE R720xd**	16	64	44	268
42					
totale:		**160**	**640**	**642**	**2680**

ReCaS: Belle II *rack 23*

	tipo	core	ram	TB	HepSpec
1	CMC RITTAL				
2	**rear:** pannello 36 LC duplex mm OM4				
3	**rear:** pannello passa permute				
4	**rear:** Pannello 24 porte RJ45 (MNG)				
5	**rear:** pannello passa permute				
6	**rear:** Pannello 24 porte RJ45 (MNG)				
7	**front: CISCO SG200 48-port (MNG)**				
8	**rear: juniper EX4200 48-port (Backup)**				
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21	**DELL PE R515**	16	64	44	180
22					
23	**Supermicro As-2042g**	64	256	24	561
24					
25	**Supermicro As-2042g**	64	256	24	561
26					
27	**Supermicro As-2042g**	64	256	24	561
28					
29	**Supermicro As-2042g**	64	256	24	561
30					
31	**Supermicro As-2042g**	64	256	24	561
32					
33	**Supermicro As-2042g**	64	256	24	561
34					
35	**DELL PE R210 II**	4	16	4	87
36	**DELL PE R210 II**	4	16	4	87
37	**DELL PE R210 II**	4	16	4	87
38	**DELL PE R210 II**	4	16	4	87
39	**DELL PE R210 II**	4	16	4	87
40	**DELL PE R210 II**	4	16	4	87
41	**DELL PE R210 II**	4	16	4	87
42	**DELL PE R210 II**	4	16	4	87
totale:		**432**	**1728**	**220**	**4242**

Data Center Fisica 1g01

ReCaS

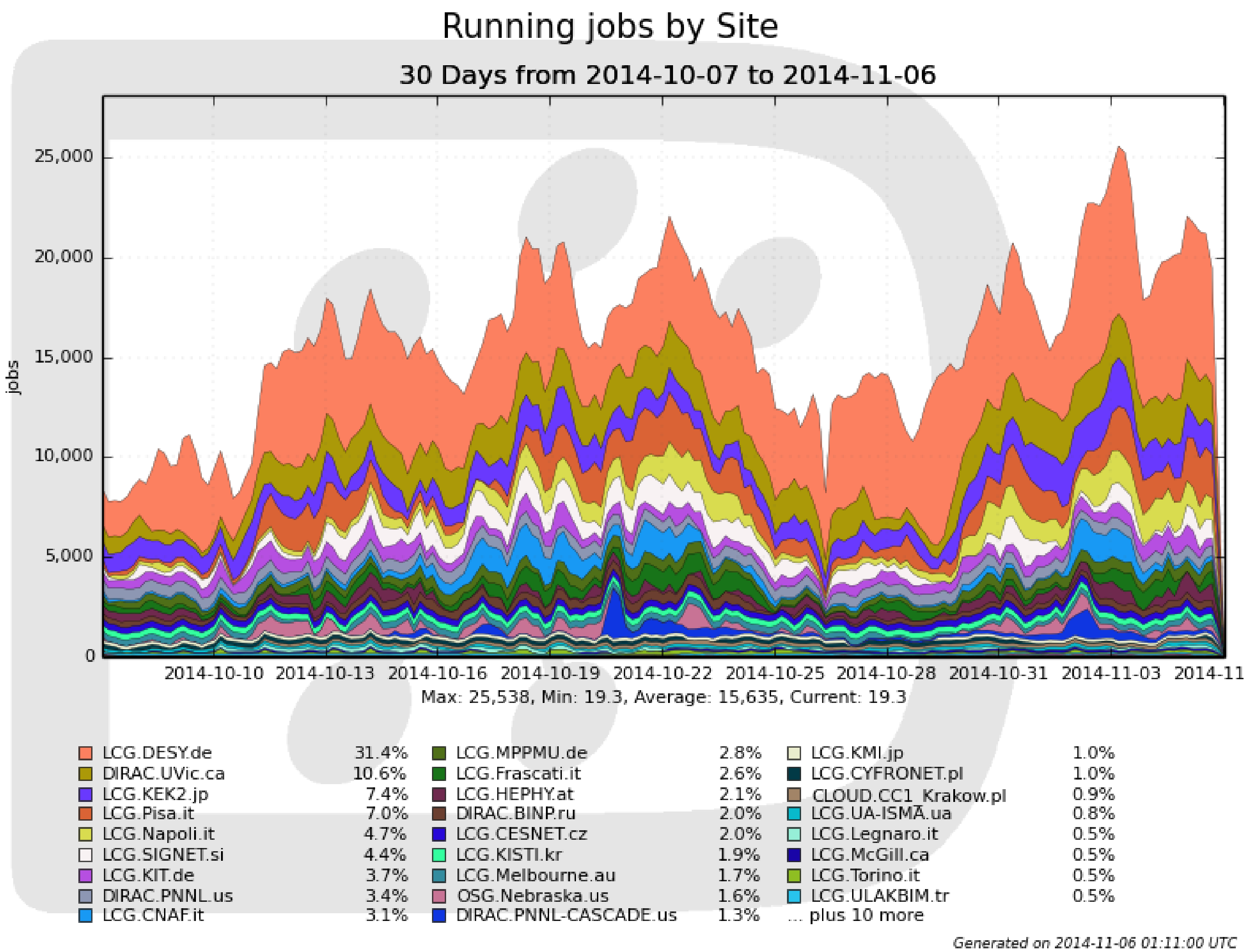
1	CMC RITTAL				
2	**rear:** patch panel ottico (24 bussole LC quad MULT)				
3	**rear:** passacavi				
4	**rear:** patch panel rame 24 porte				
5	**rear:** patch panel rame 24 porte				
6	**front: CISCO SG200-50 (48p) man. Rack**				
7					
8					
9					
10					
11	in gara Regione Campania		256		
12					
13	in gara Regione Campania		256		
14					
15	in gara Regione Campania		256		
16					
17	in gara Regione Campania		256		
18					
19	in gara Regione Campania		256		
20					
21	in gara Regione Campania		256		
22					
23	in gara Regione Campania		256		
24					
25	in gara Regione Campania		256		
26					
27	in gara Regione Campania		256		
28					
29	in gara Regione Campania		256		
30					
31	in gara Regione Campania		256		
32					
33	in gara Regione Campania		256		
34					
35	in gara Regione Campania		256		
36					
37	in gara Regione Campania		256		
38					
39	in gara Regione Campania		256		
40					
41					
42					
totale:		**0**	**3840**	**0**	**0**

ReCaS

				TB	HepSpec
1	CMC RITTAL				
2	**rear:** patch panel ottico (24 bussole LC quad MULT)				
3	**rear:** passacavi				
4	**rear:** patch panel rame 24 porte				
5	**rear:** patch panel rame 24 porte				
6	**front: CISCO SG200-50 (48p) man. Rack**				
7					
8					
9					
10	DELL R620 (DB DPM)	16	64	1	268
11	Supermicro As-2042g	64	256	24	561
12					
13	Supermicro As-2042g	64	256	24	561
14					
15	Supermicro As-2042g	64	256	24	561
16					
17	Supermicro As-2042g	64	256	24	561
18					
19	Supermicro As-2042g	64	256	24	561
20					
21	Supermicro As-2042g	64	256	24	561
22					
23	DELL PE R620 (esist.)	16	64	1	268
24	DELL PE R620 (esist.)	16	64	1	268
25	DELL MD 3600f			48	
26					
27	DELL MD 1200			48	
28					
29	DELL MD 1200			48	
30					
31	DELL MD 1200			48	
32					
33	DELL MD 1200			48	
34					
35	DELL MD 1200			48	
36					
37	DELL MD 1200			48	
38					
39	DELL MD 1200			48	
40					
41	DELL MD 1200			48	
42	(predisposte 2U)				
totale:		**432**	**1728**	**579**	**4170**

Autumn 2014 MC Campaign

S. Pardi



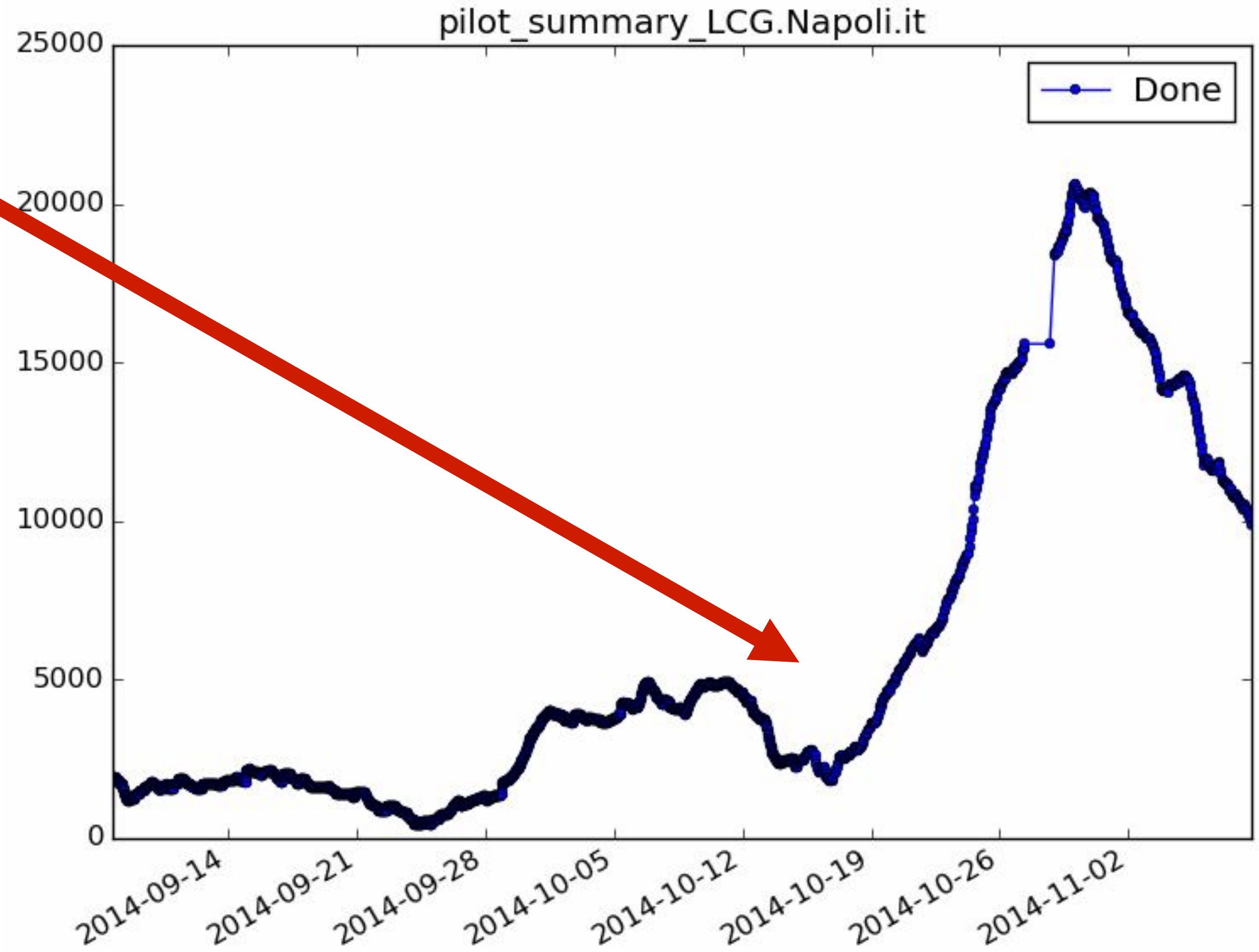
Pisa 7.0%
Napoli 4.7%
CNAF 3.1%
Frascati 2.6%
Legnaro 0.5%
Torino 0.5 %

S. Pardi

4th MC Campaign

Contributo dell'infrastruttura di Napoli nell'ultima campagna di produzione MC.

Impatto della messa in esercizio delle risorse di ReCaS



S. Pardi

In corso:

- Calcolo delle esigenze di rete per il prossimi anni
- Setup delle farm
- Monitoring con PerfSonar dei siti

Cosa si potrebbe fare:

- Partecipare alla definizione dei tools di sviluppo
- Framework DIRAC
- Testing dei File Catalog