

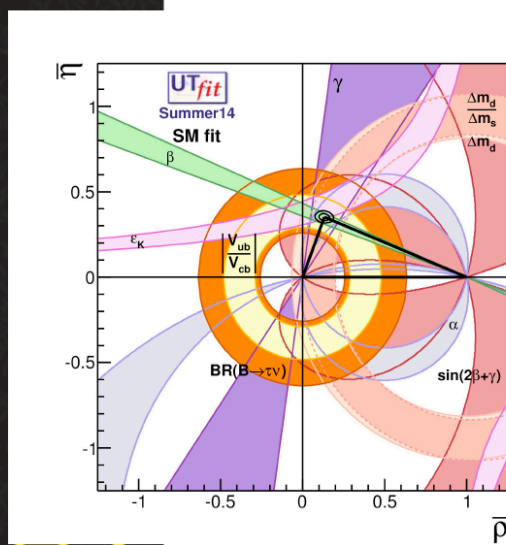
# **ESPERIMENTO BELLE II E OFFERTA TESI LAUREA**

**CLAUDIA CECCHI  
INCONTRO CON GLI STUDENTI  
6 MAGGIO 2020**

# THE STANDARD MODEL: A STORY OF BIG SUCCESS



2008 Nobel Prize



a nobel from  
flavour  
experiments

Sector of the Standard Model  
which distinguishes between  
quark and lepton flavour

a nobel from hadronic  
machines (LHC experiments)

In 2012 ATLAS/CMS  
observed a new boson with  
mass  
 $125.09 \pm 0.24 \text{ GeV}/c^2$



# BUT THIS IS NOT THE ENDO OF THE STORY....

- Why 3 generations ?
- Why mass/mixing hierarchy?
- What is the origin of CP violation ? (can the SM explain the matter-antimatter asymmetry in the Universe ? )
- Which particle(s) are responsible for dark matter ?
- What about gravity ?
- .....

- Theorists at work

„so, what's beyond??



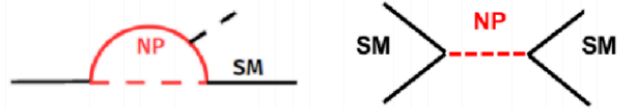
- Experimentalist at work

N.B.: Physics effects/particles/interactions not comprised in the SM framework are referred to as New Physics (NP)

# THE HUNT FOR NEW PHYSICS?

## Intensity / precision frontier

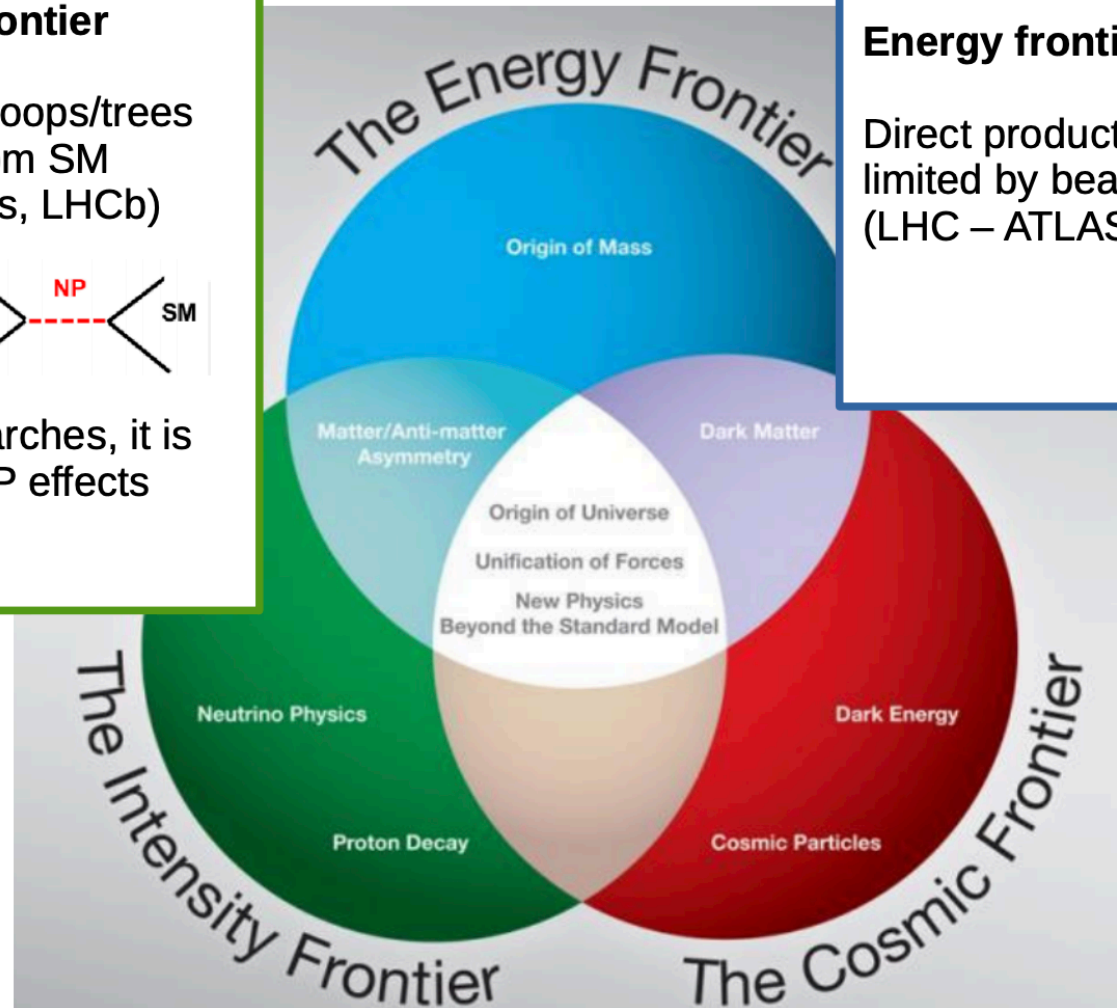
New virtual particles in loops/trees transitions, deviation from SM expectations (B factories, LHCb)



If NP found in direct searches, it is reasonable to expect NP effects in *B*, *D*, *tau* decays

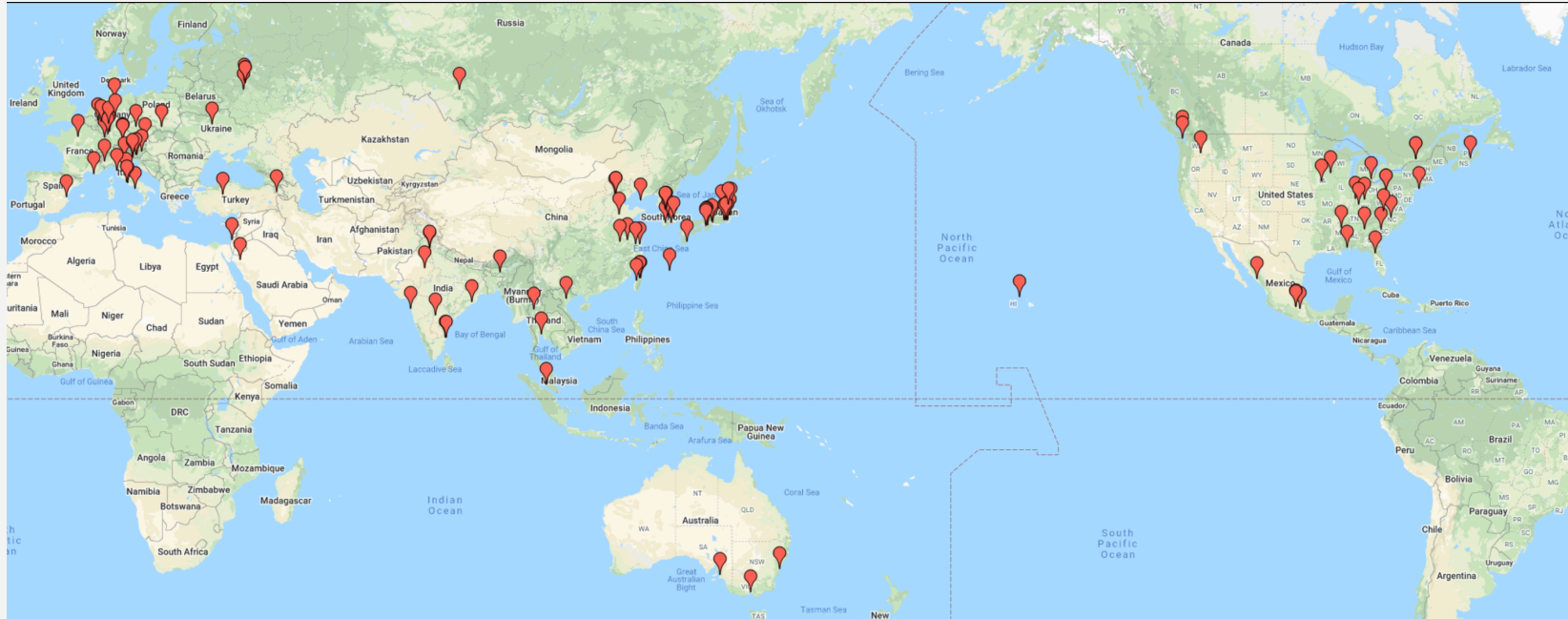
## Energy frontier

Direct production of new particles - limited by beam energy (LHC – ATLAS, CMS)

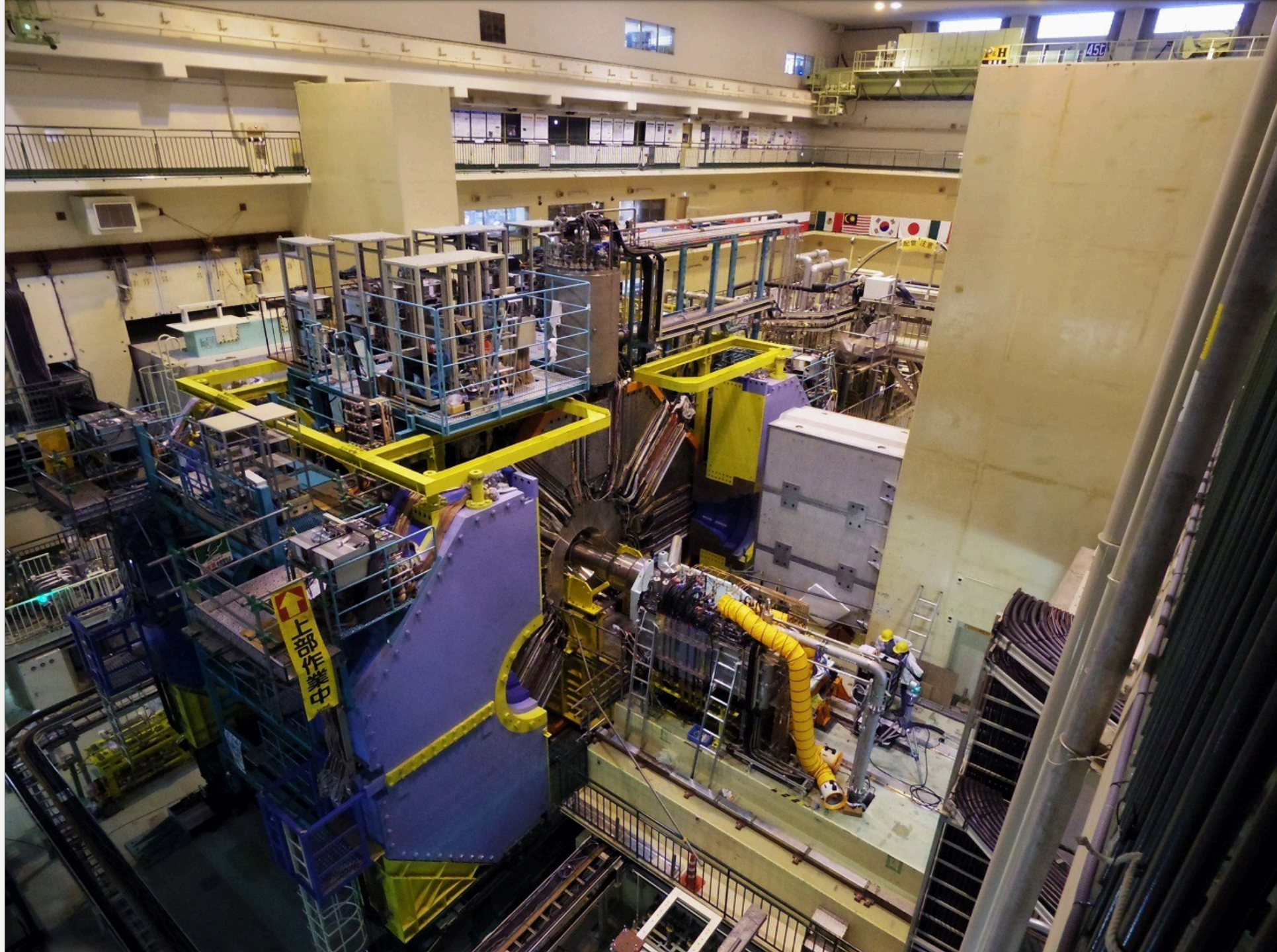


# THE BELLE II EXPERIMENT IN JAPAN

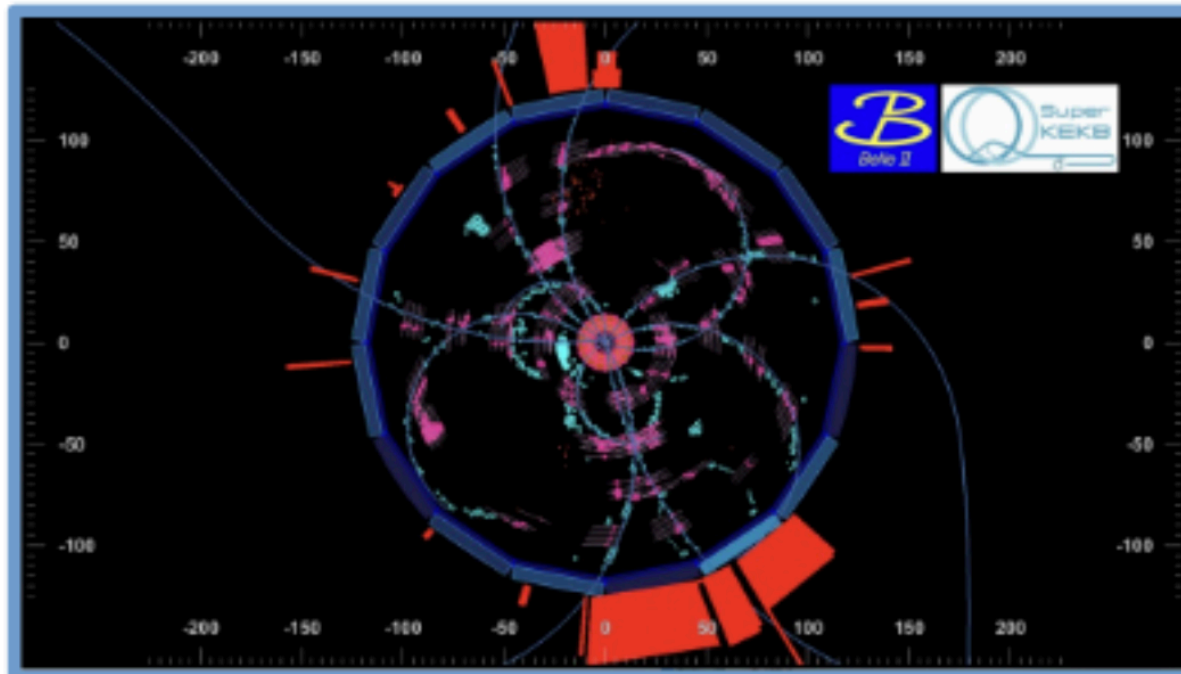
- Flavour physics experiment at the intensity frontier
- Taking data at  $e^+e^-$  SuperKEKB collider (Tsukuba, Japan)
- International collaboration, 26 Countries,  $\sim 1000$  collaborators



- Physics goal: precision test of the Standard model and indirect new physics searches in B, D and  $\tau$  sectors (particle properties, study of rare, forbidden and abundant decays, CP violation parameters)



# THE FIRST COLLISION!



Le "nuove"  
prime collisioni

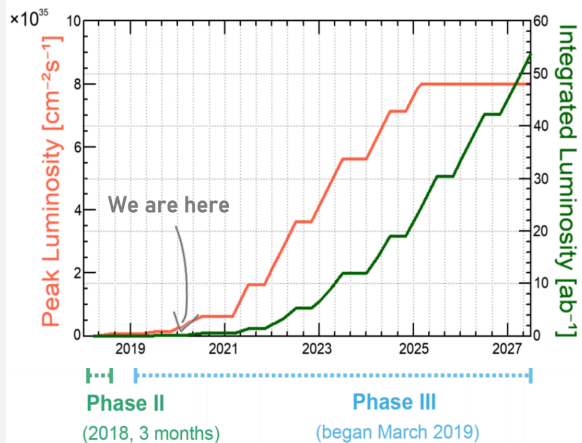
25 Marzo  
2019



# STATUS OF THE EXPERIMENT

## The Belle II Experiment

Time schedule



2018

2019

~2027

### Phase 2

First physics data ( $500 \text{ pb}^{-1}$ ).  
Incomplete detector (1/8 VXD)  
Commissioning data.

### Phase 3

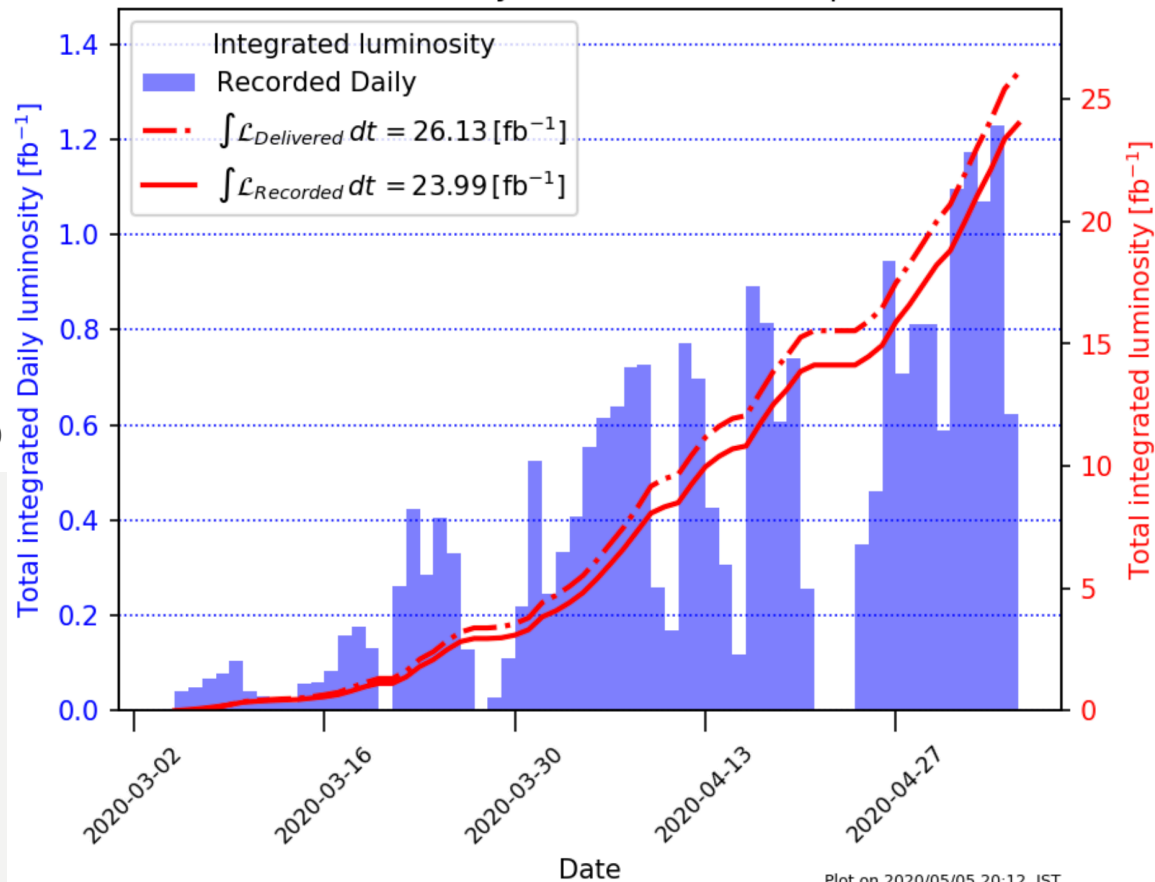
Up to now  $\sim 10 \text{ fb}^{-1}$  collected  
Will continue 7-9 month/years

### Goal

Integrate up to  $50 \text{ ab}^{-1}$   
X50 dataset of its predecessor (Belle)

## Belle II Online luminosity

Exp: 12 - All runs





# IL GRUPPO DI PERUGIA



**Claudia Cecchi**  
**(capogruppo)**  
**Professore Associato**  
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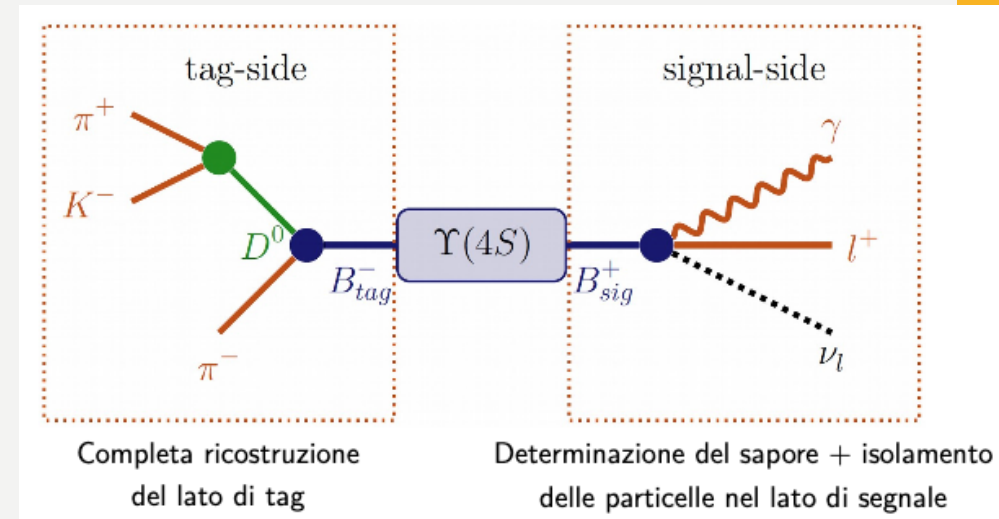
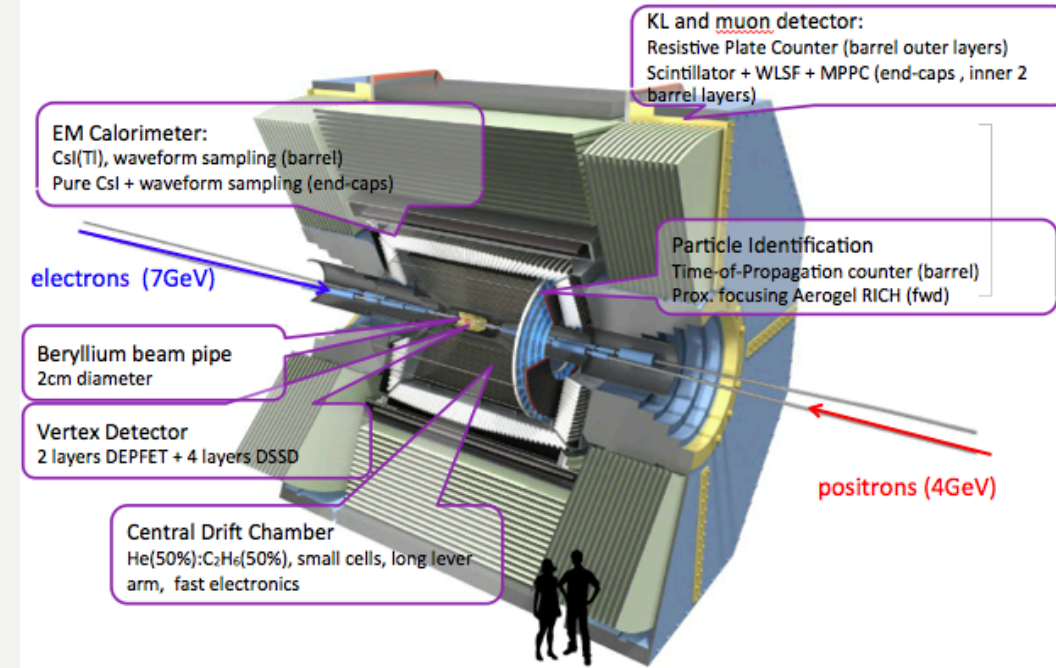
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# ATTIVITA' A PERUGIA

- Software and hardware activities on Electromagnetic calorimeter
  - development of software for neutral particle reconstruction
  - development of calibration algorithm for ECL
  - study of pure CsI crystals for calorimeter upgrade (test bench measurements in Perugia, test beams at beam facilities)
- Data analysis activities
  - Precise measurement of semileptonic B decays, e.g.  $B \rightarrow \tau \nu$
  - Search for rare B decays, e.g.  $B \rightarrow K(^*) \nu \nu$
  - B counting analysis ongoing for near future publication



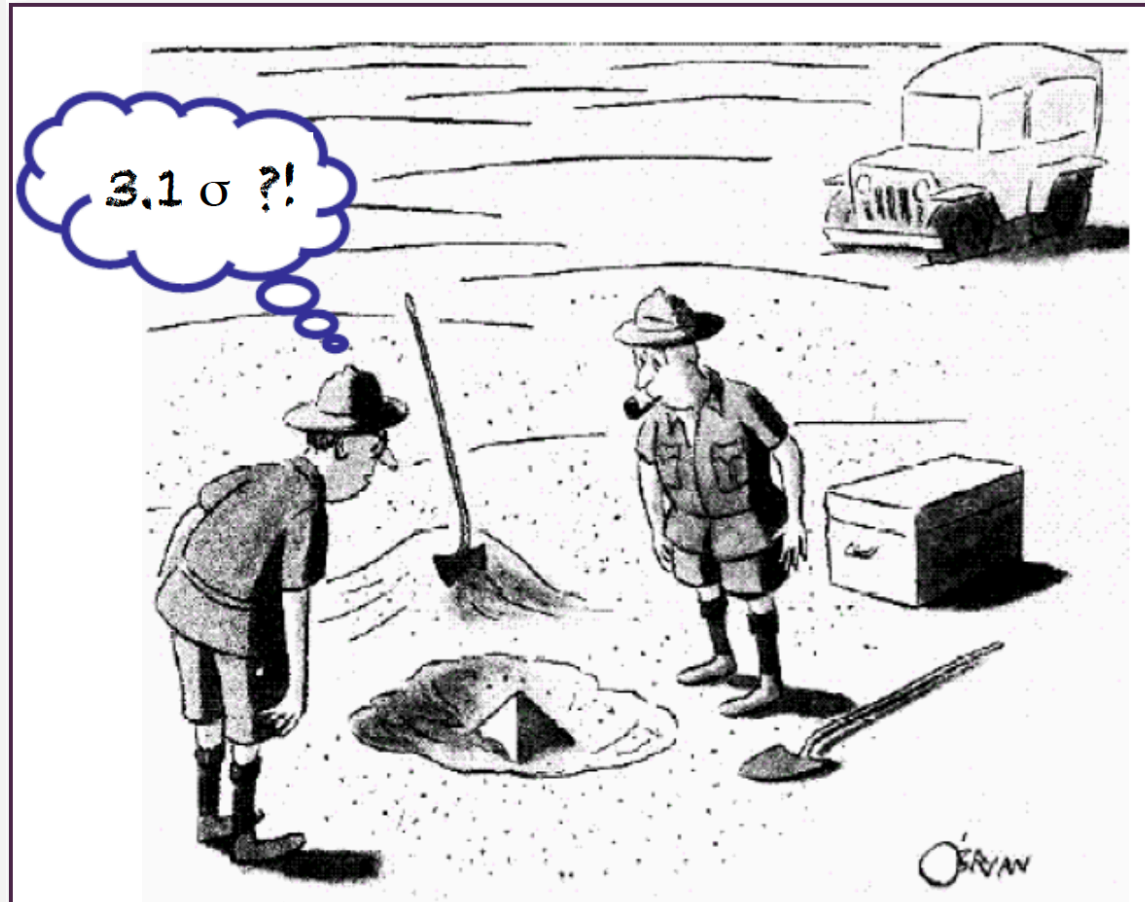
# ARGOMENTI DI TESI

- Adatti sia per tesi triennali che magistrali (cambia il livello di approfondimento), con possibilità di soggiorni ai laboratori di KEK (**POST\_COVID**)
  - Misure in laboratorio su cristalli di CsI puro con diversi fotorivelatori \*
  - Studio delle performance del calorimetro di Belle-II con i dati \*\*
  - Studio della ricostruzione di decadimenti adronici utilizzati in analisi di rinculi con i dati \*\*
  - Studi di canali di fisica in cui sono rilevanti le performance del calorimetro (e.g.  $B \rightarrow K(^*)\nu\nu$ ,  $B \rightarrow \tau\nu$ ) \*\*
  - Studio del B counting, implementazione di due nuovi metodi per confronto con l'analisi in corso di cui uno con applicazioni di analisi multivariate (MVA method) \*\*

\* attività principalmente di laboratorio

\*\* attività principalmente software

# NEW PHYSICS???



*"This could be the greatest discovery of the century. Depending, of course, on how far down it goes..."*