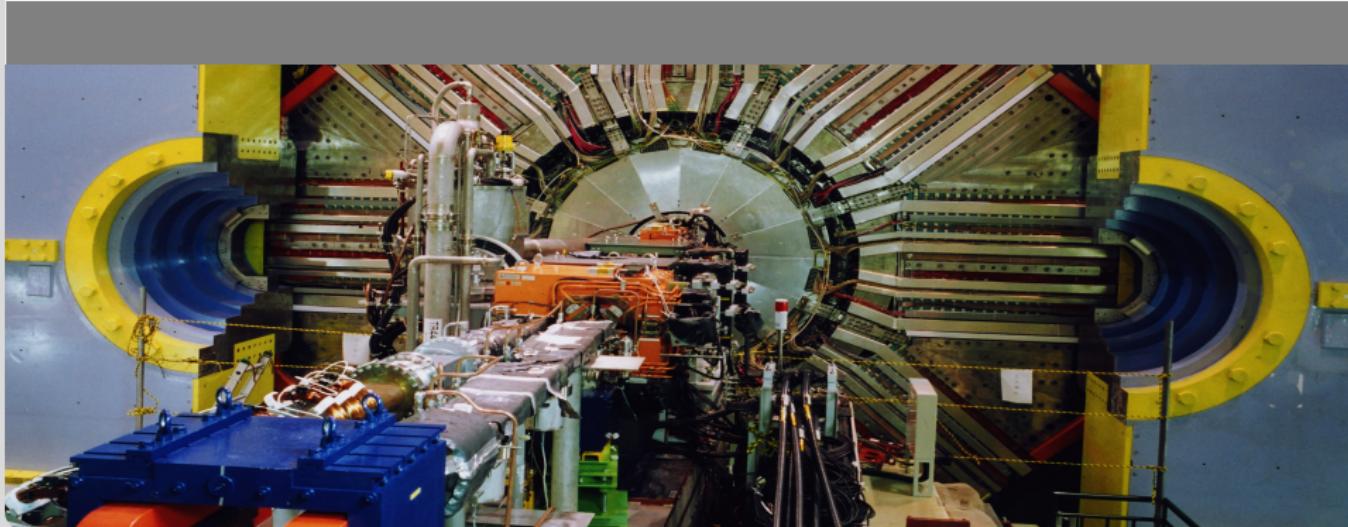
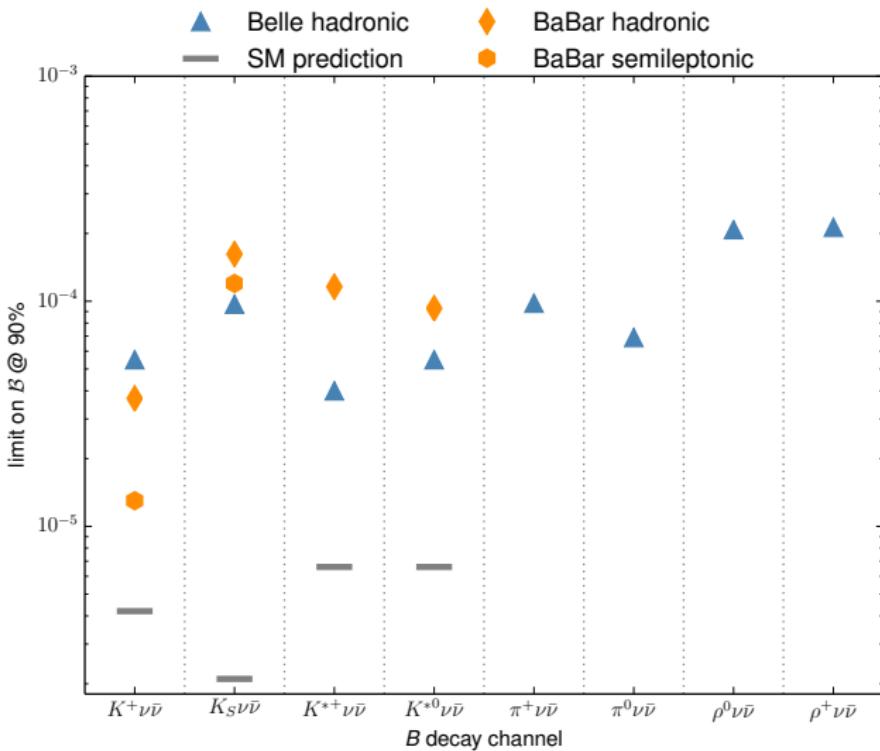


# Analysis of the rare decay $B \rightarrow h\nu\bar{\nu}$ with semileptonic tag

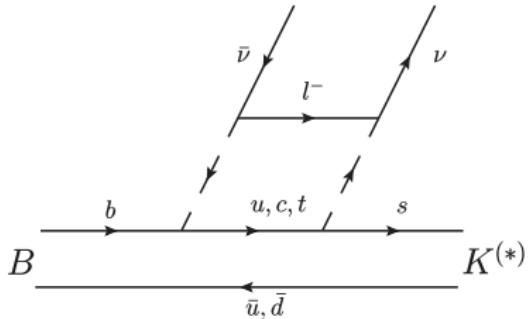
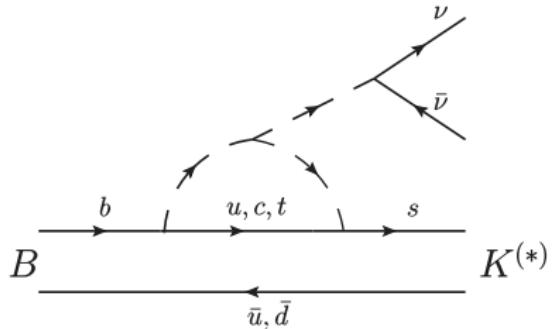
Johannes Grygier | 24-02-16



# history



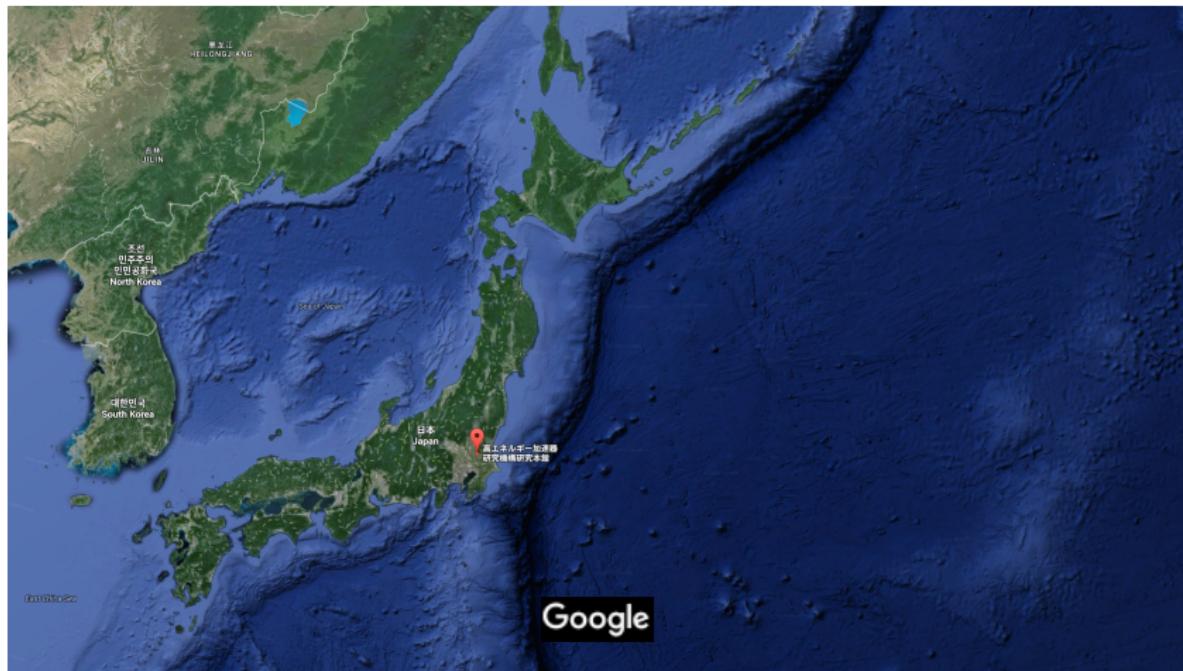
# introduction



final state

visible:	invisible:
one hadron	2 neutrinos

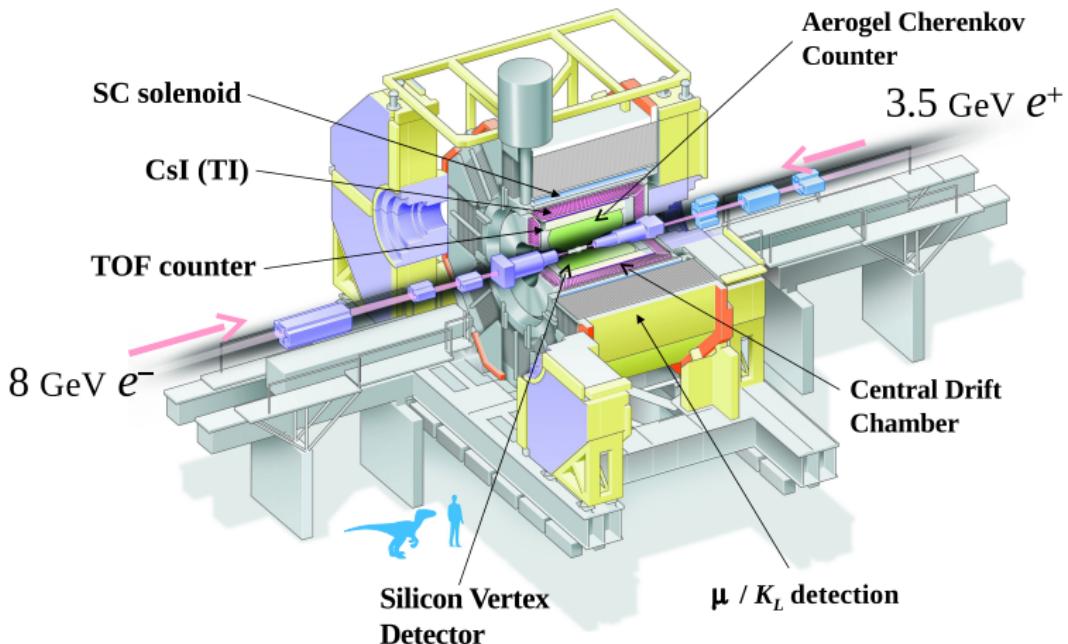
# location, location, location



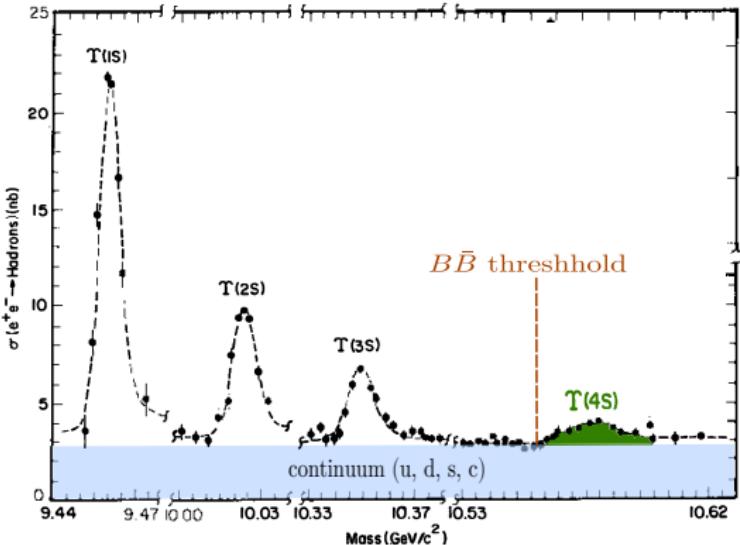
# zooming in



## Belle Detector



# the principle

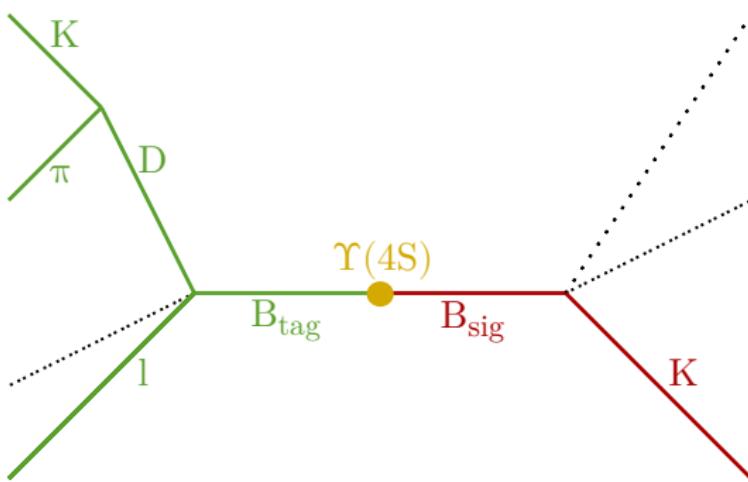


integrated luminosity @  $\Upsilon(4S)$

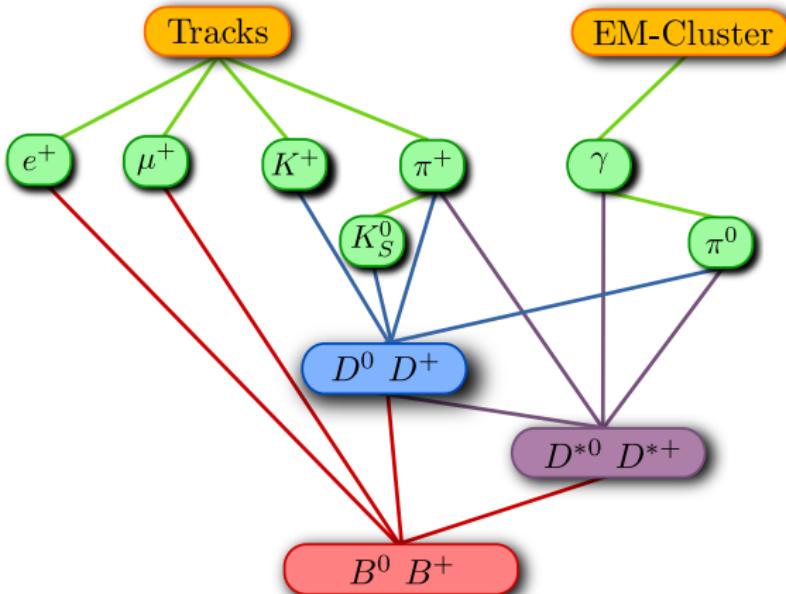
$$\mathcal{L} = 711 \text{ fb}^{-1}$$

$$N_{\Upsilon(4S)} = 770 \times 10^6$$

# principle of reconstruction



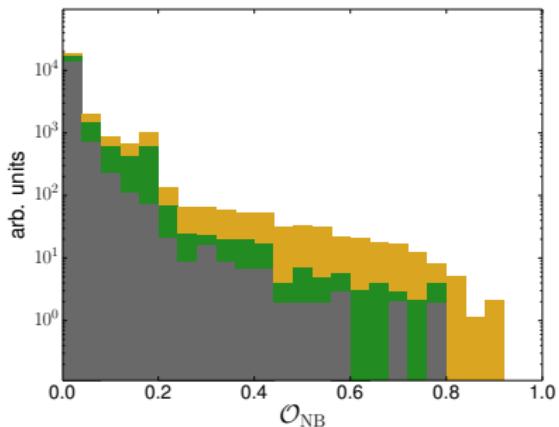
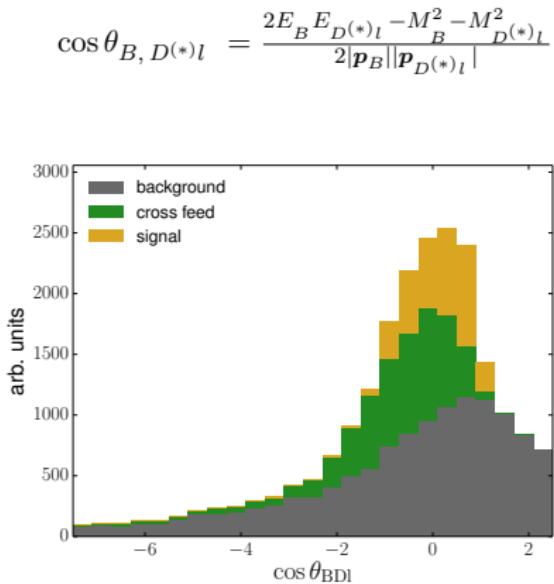
# semileptonic reconstruction



# tag related variables

$$M_\nu^2 = 0 :$$

$\mathcal{O}_{\text{NB}}^{\text{tag, final}}$  :



## select

- get the tag  $B$  candidate
- get the signal meson candidate

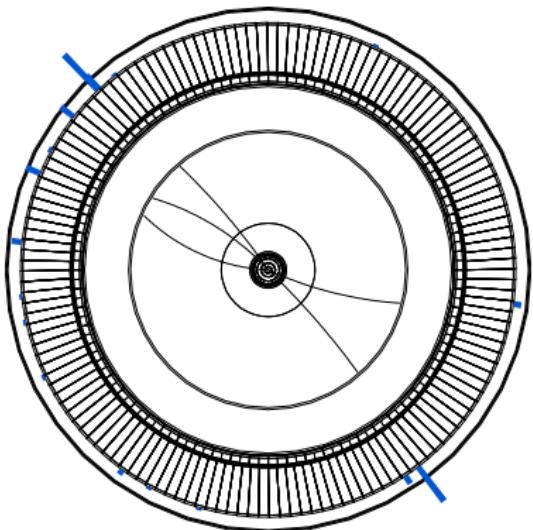
## VETO

- additional particles
  - additional good tracks
  - additional  $K_S^0$
  - additional  $\pi^0$
  - additional  $K_L$

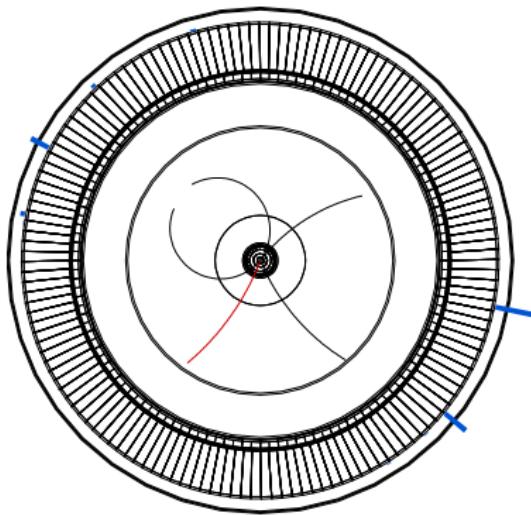
## rough procedure

- rough offline cuts
- select best amongst multiple  $\Upsilon(4S)$ candidates
- continuum suppression
- train multivariate classifier
- final selection
- apply corrections
- extract limit

# continuum suppression



$\approx 80\%$ !



# final selection

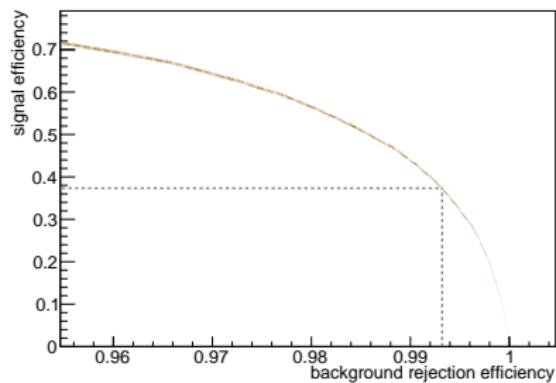
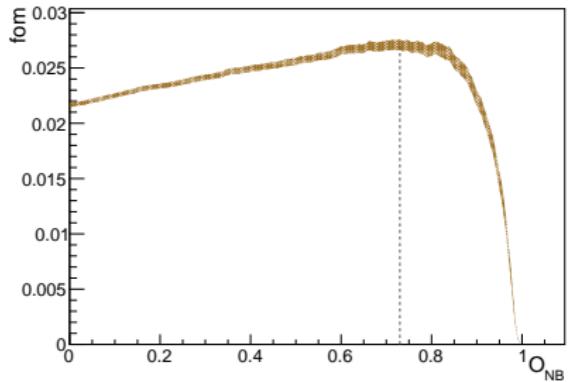
## net input

- continuum suppression, tag output
- momenta
- angles
- masses, PIDs...
- some other

## quantity to optimize

$$\text{fom} = \frac{\varepsilon}{\frac{\sigma}{2} + \sqrt{B}}$$

# how does it look?



$E_{\text{ECL}}$

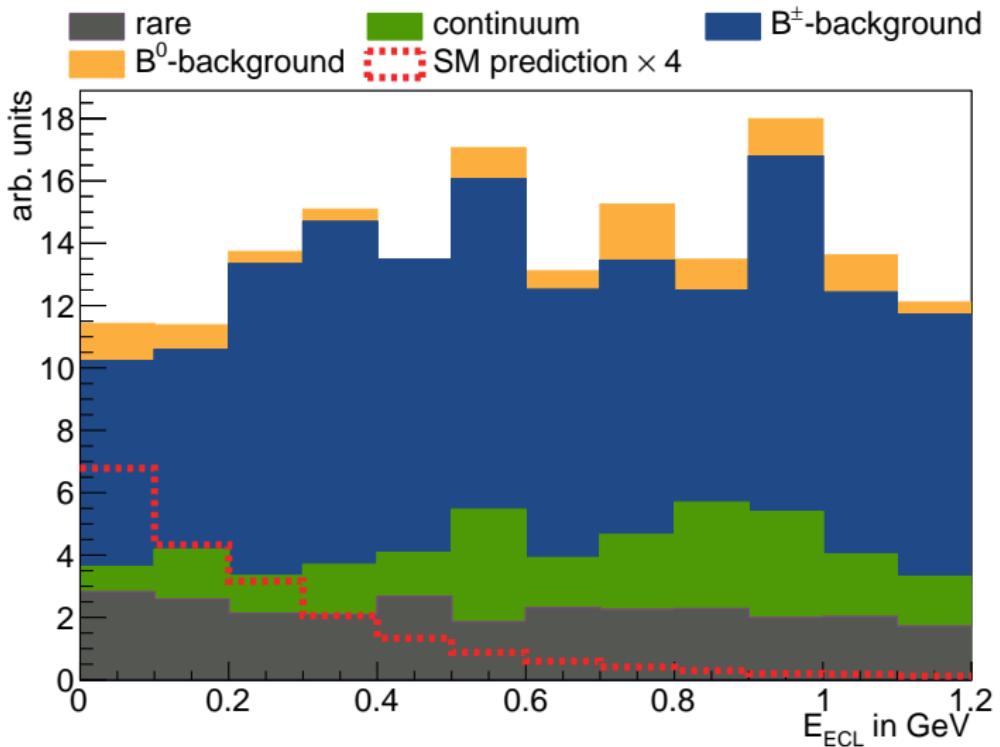
- detector should be empty
- anything remaining hints to misreconstruction

$$E_{\text{ECL}} = \sum_{\text{unused cluster}} \Theta(z, E) E$$

imperfect

- backscattering
- decay in flight
- hadronic reactions
- beam background

# $E_{\text{ECL}}$ appearance



# remaining background

strongly channel dependent

- charged particles out of acceptance
- $K_L$  channels
- charm events
- $B \rightarrow \tau\nu$  ( $B^+ \rightarrow \pi^+\nu\bar{\nu}$ ,  $B^+ \rightarrow \rho^+\nu\bar{\nu}$ )
- random combinations with beam background

# finally observables

## limit extraction

- take shapes from MC
- profile likelihood scan
- integrate until chosen C.L.

## expected limits

- produce a lot of toys
- get a limit for each
- average
- check for biases

# preliminary expected results

