

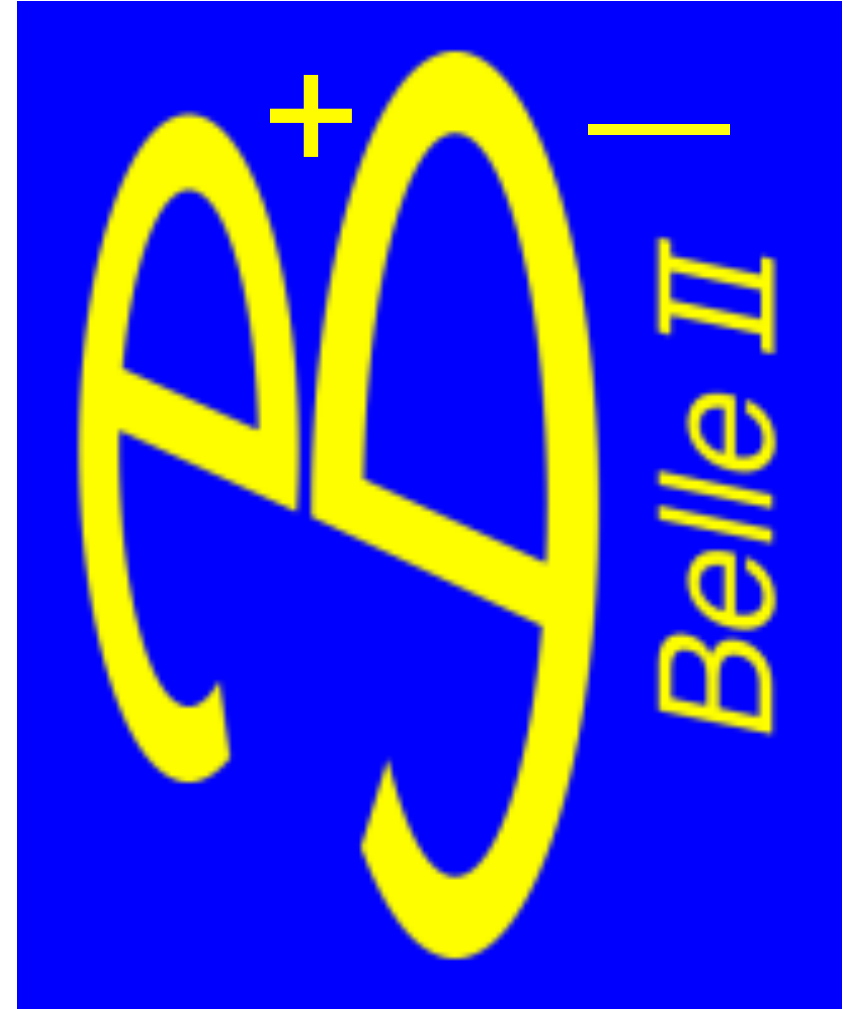
First data from Belle II

Lepton Identification Tau Rediscovery

Yurii Kvasiuk, Miho Wakai

DESY, September 6th 2018





Belle II

Located in Tsukuba,
Japan

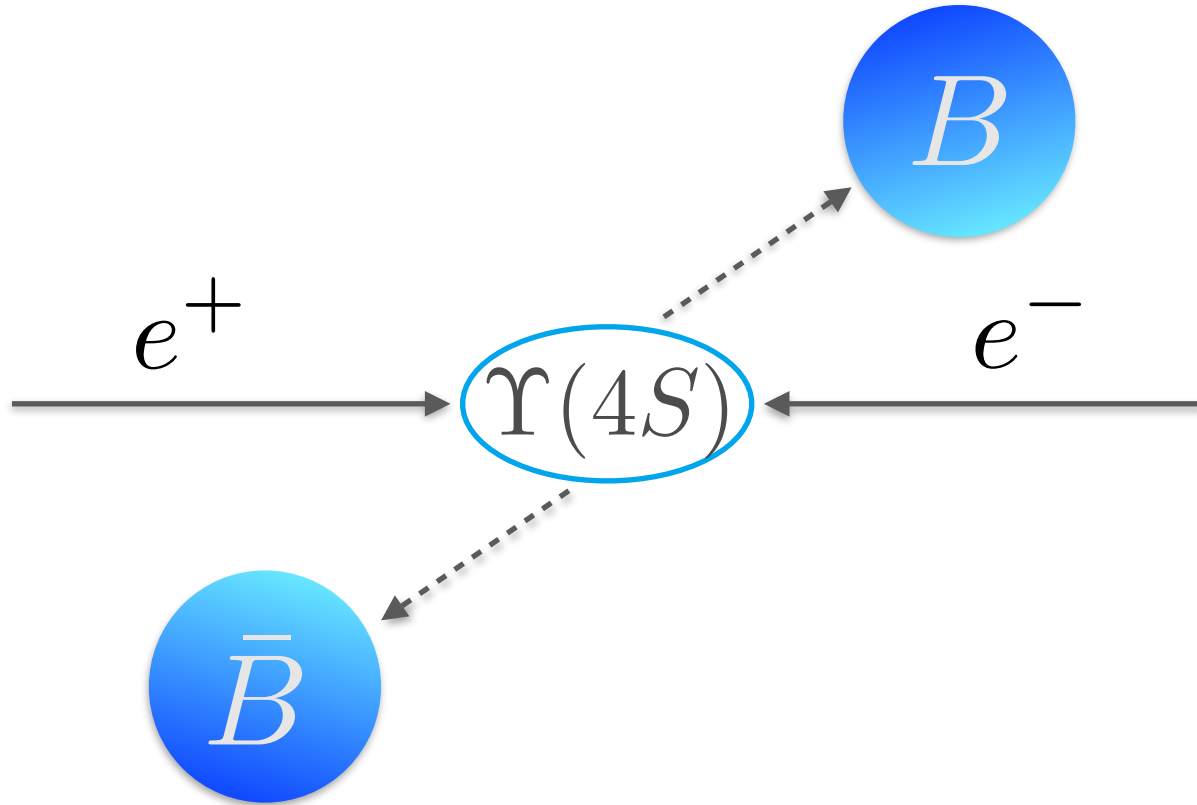
2 hours from Tokyo

Studying mainly :

- Heavy flavour
 - B meson
 - D meson
- τ physics
- Dark sector and other
Beyond the Standard
Model



B factory 101



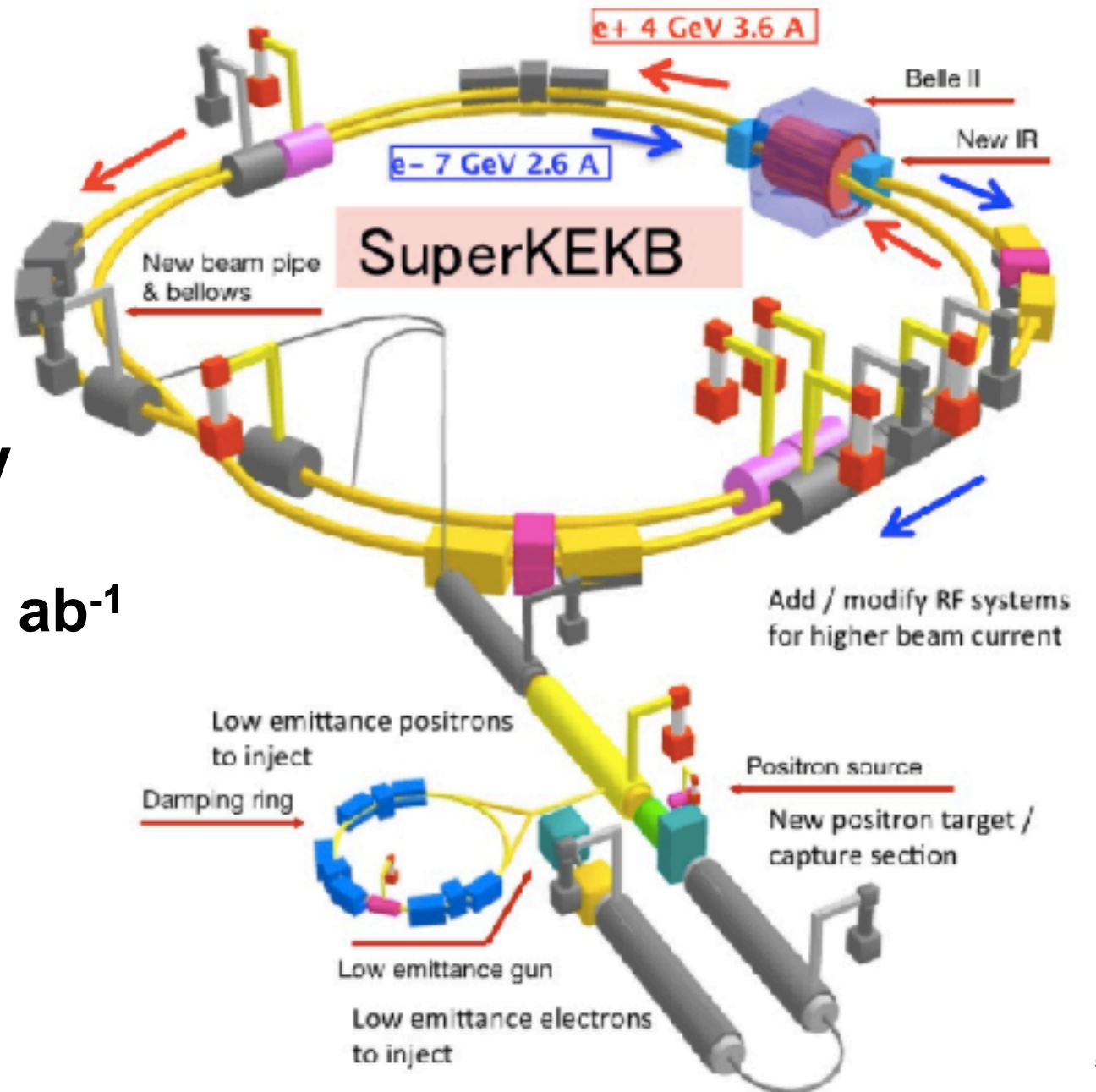
Events	cross section
$\Upsilon(4S)$	1.05
$u\bar{u}$	1.61
e^+e^-	300
$\mu^+\mu^-$	1.148
$c\bar{c}$	1.30

Super KEKB

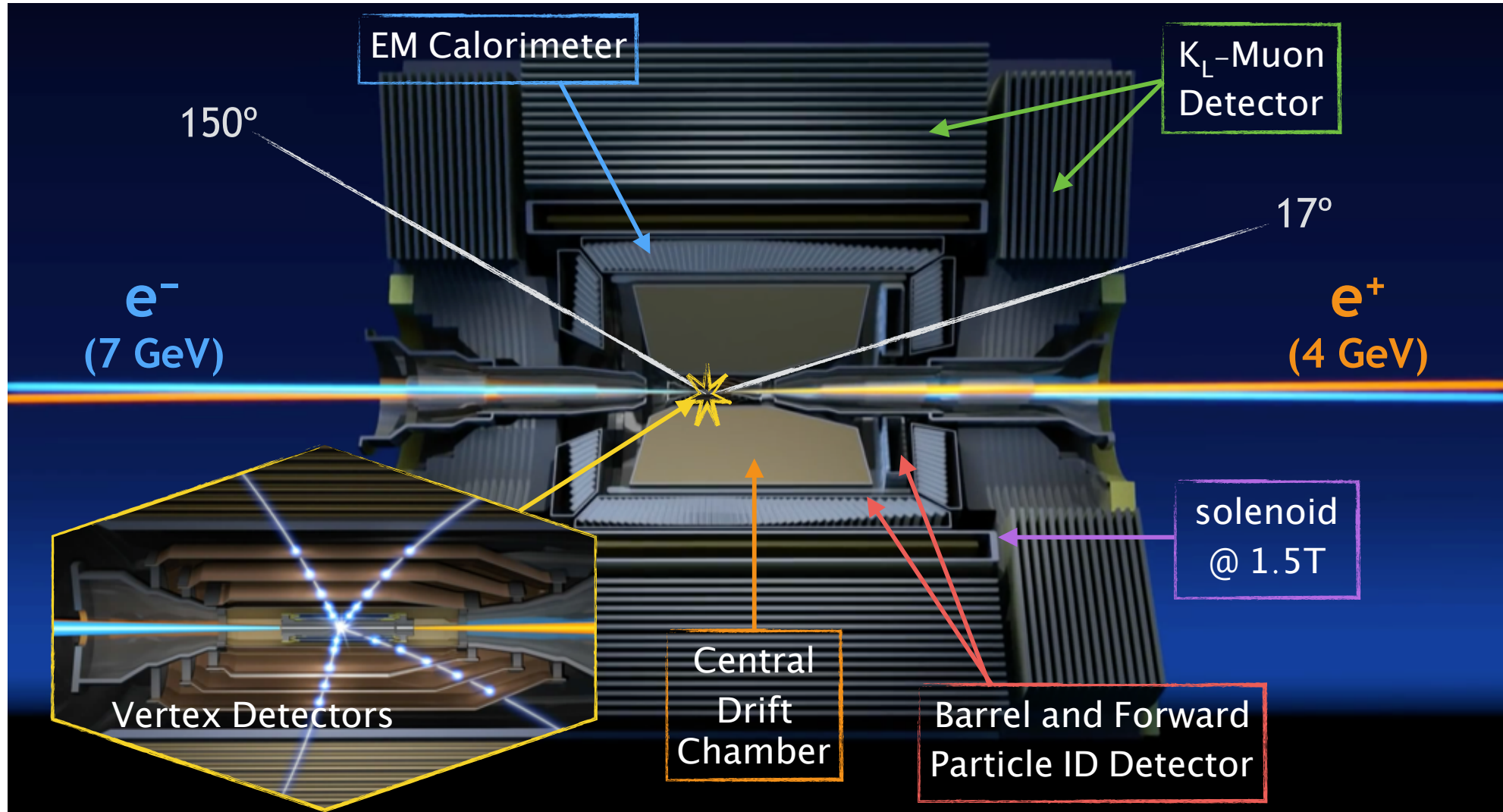
Centre of mass energy: **10.58 GeV**

Expected integrated luminosity: **50 ab⁻¹**

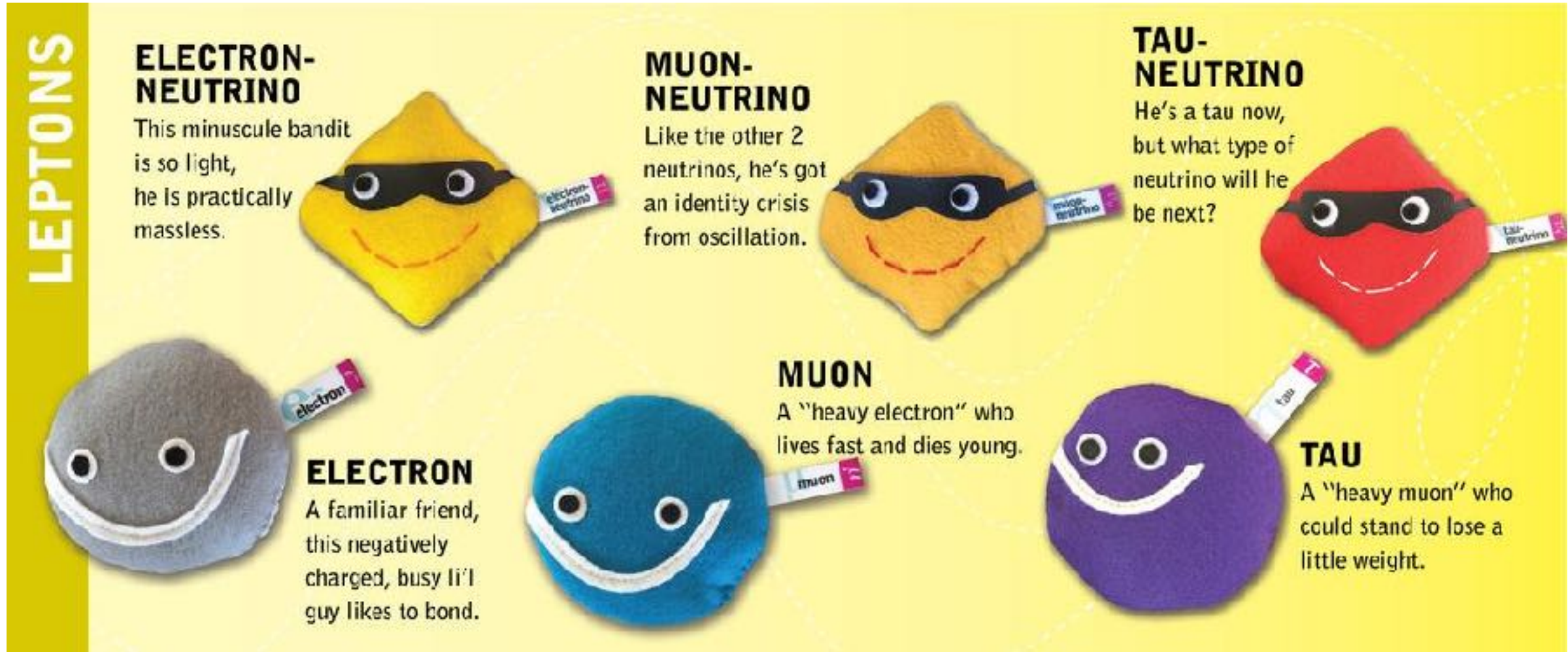
Asymmetric e⁻e⁺ collider



Belle II Detector

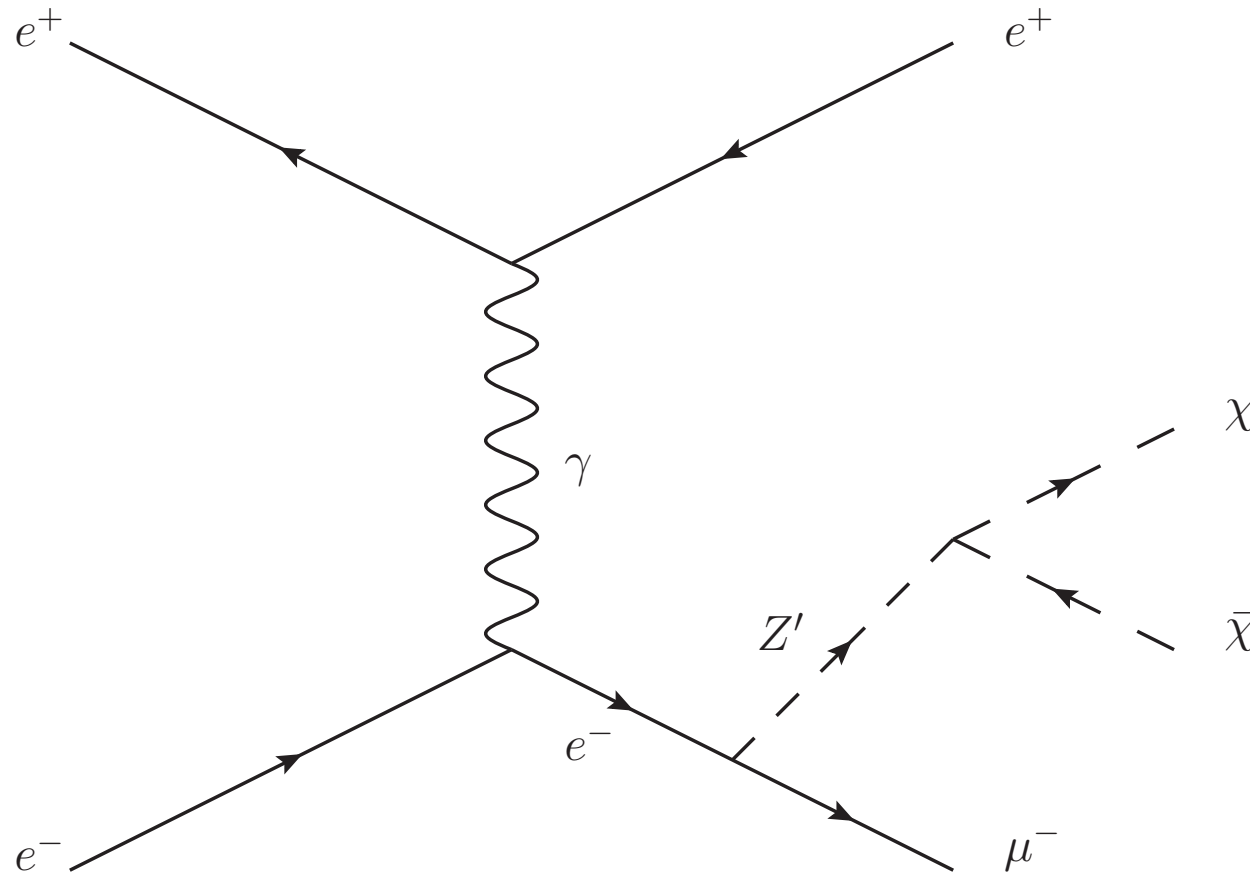


Particles

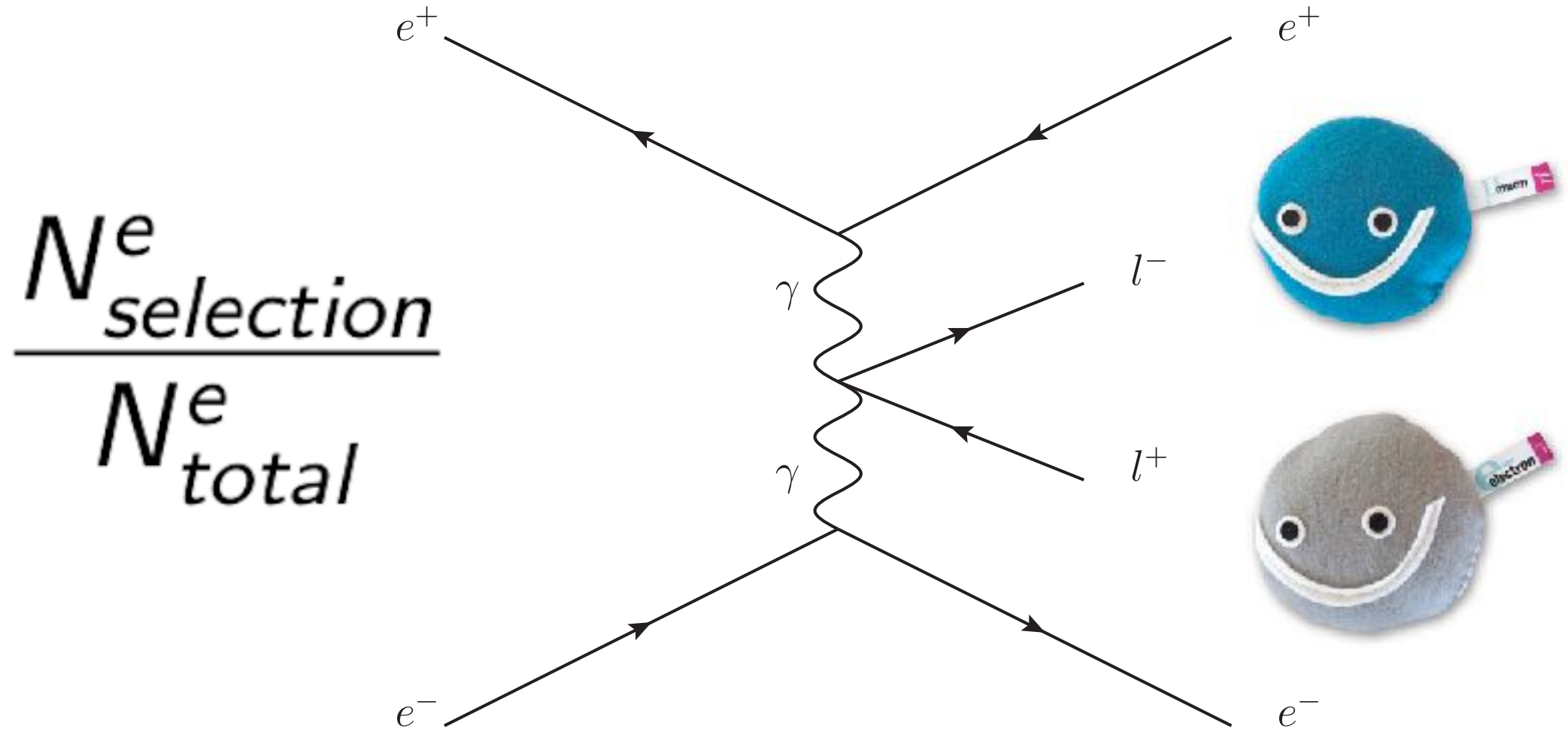


Why lepton identification?

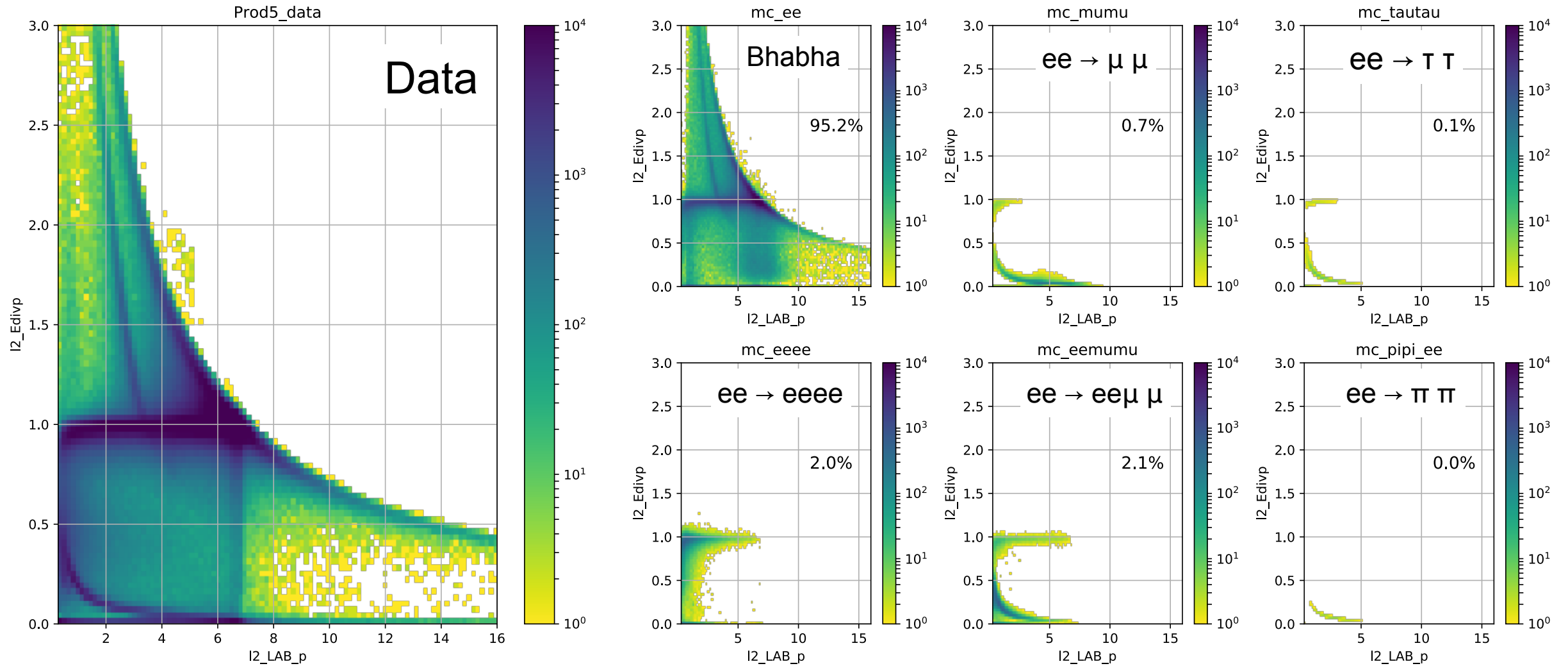
Lepton Flavour Violating Dark Matter



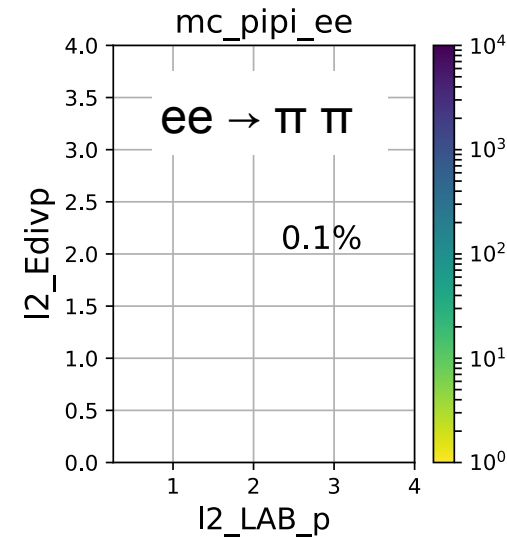
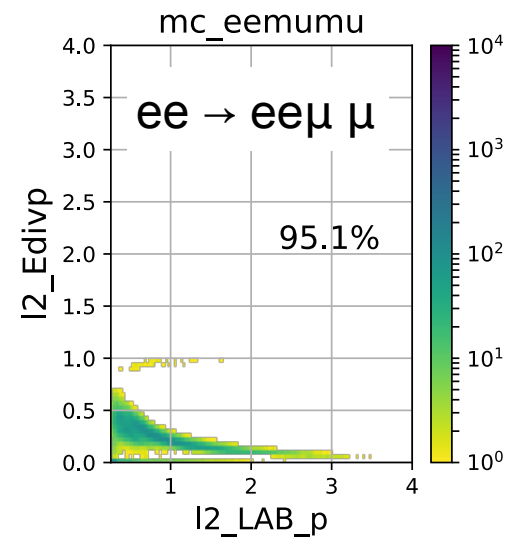
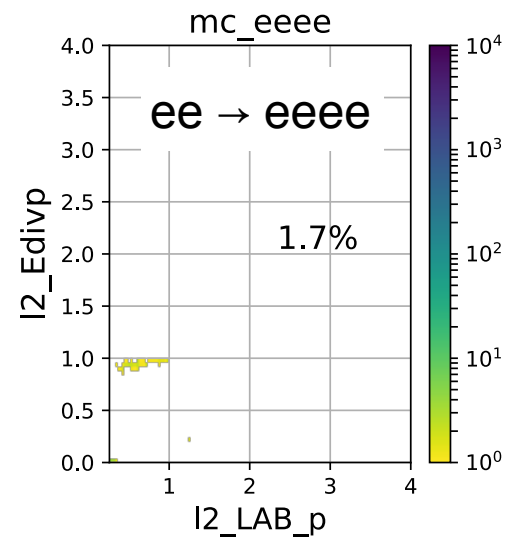
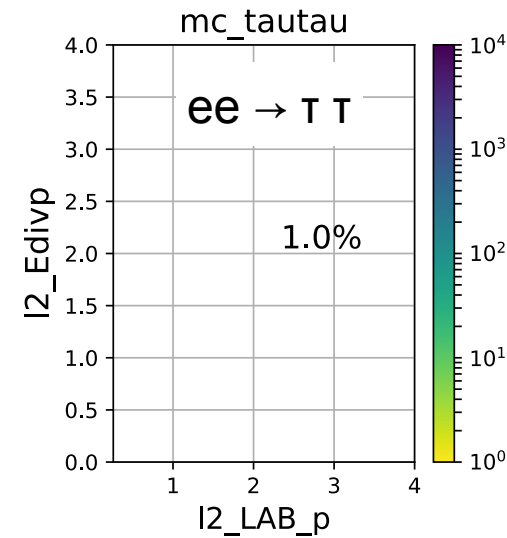
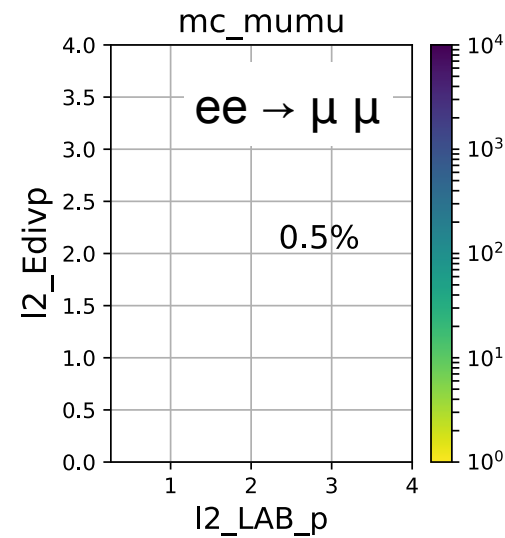
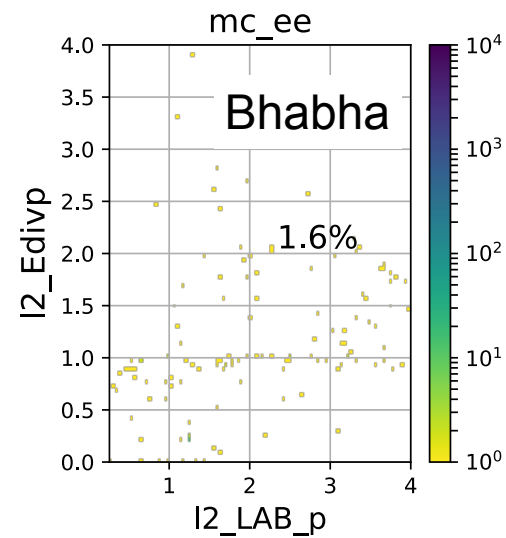
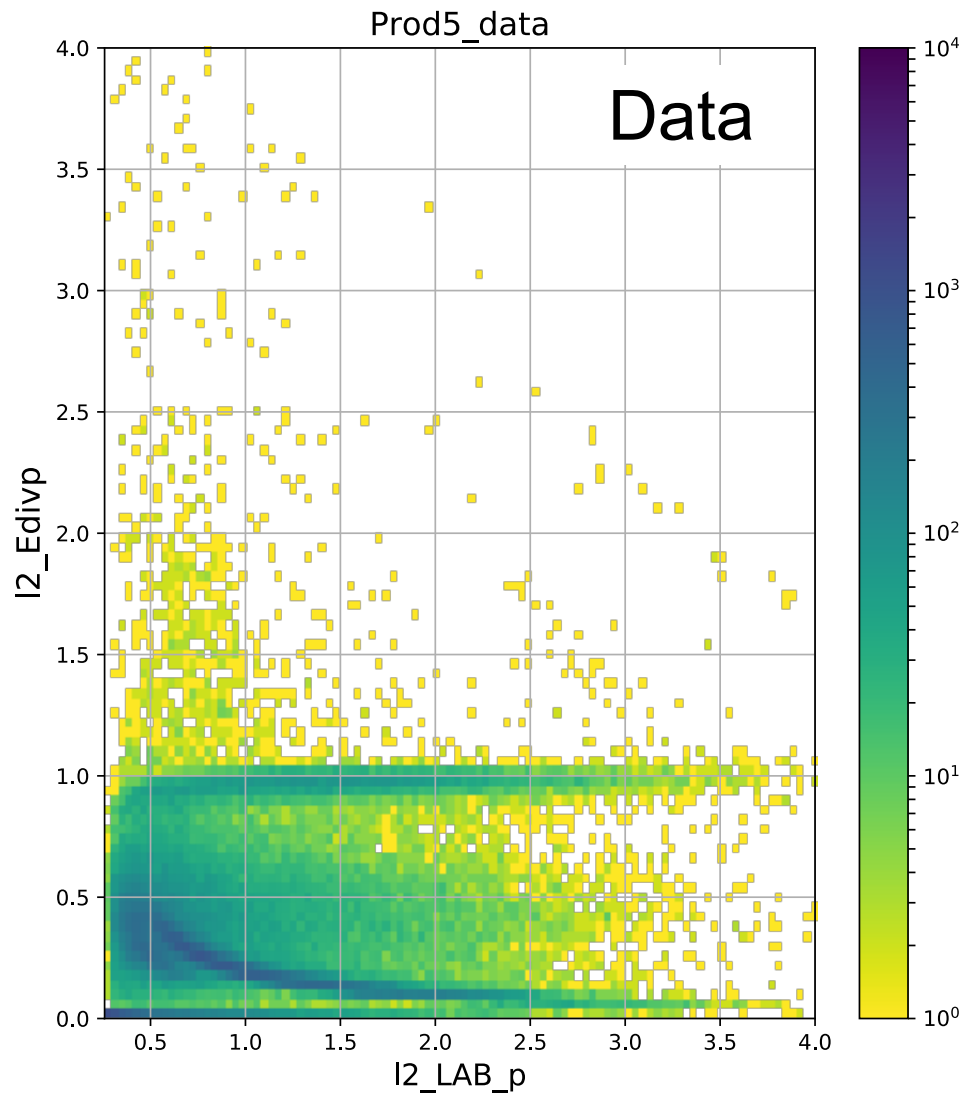
What is the efficiency of μ / e selection?



Data composition before selection



Data composition after tagging



LID Calibration

Calibration procedure:

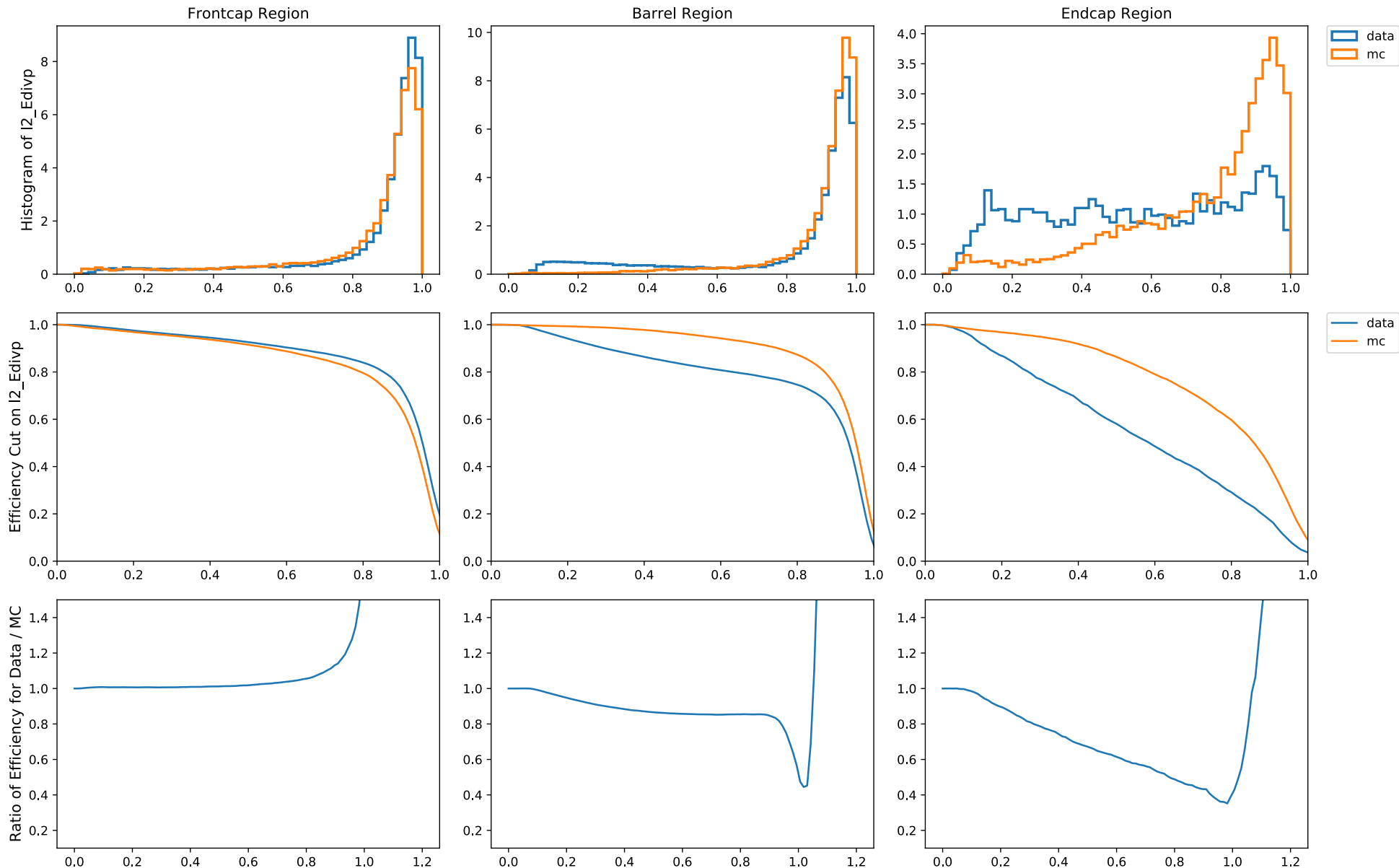
Choose probe particle
in detector region

Plot distribution of LID

Plotting efficiency as a
function of variable

Take ratio of the
efficiencies for data and
MC

Repeat for all regions of
interest



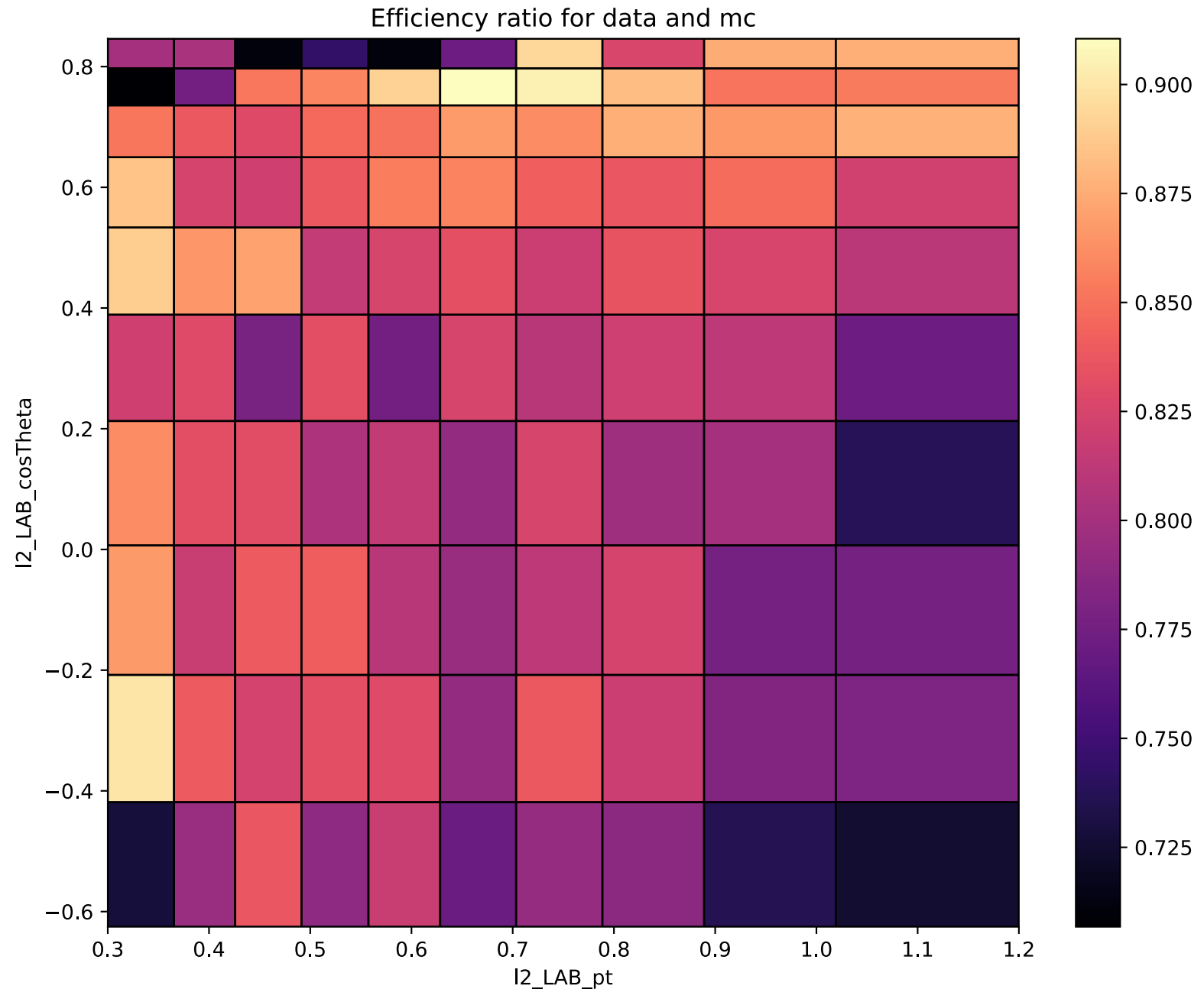
2D Mapping

Mapping the efficiency ratio

LID depends on phase space

We calibrated LID performance in bins of phase space

Overall efficiency of data is 20% less than MC



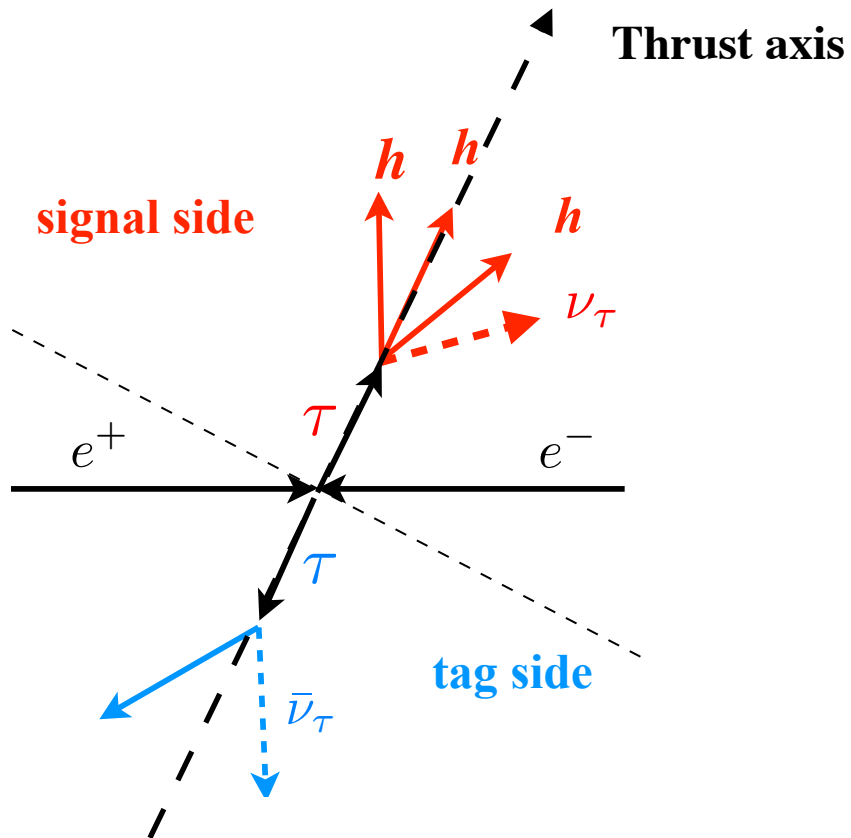
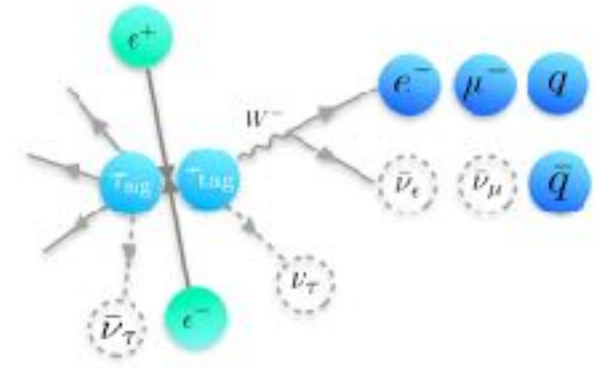


Rediscovery of tau leptons



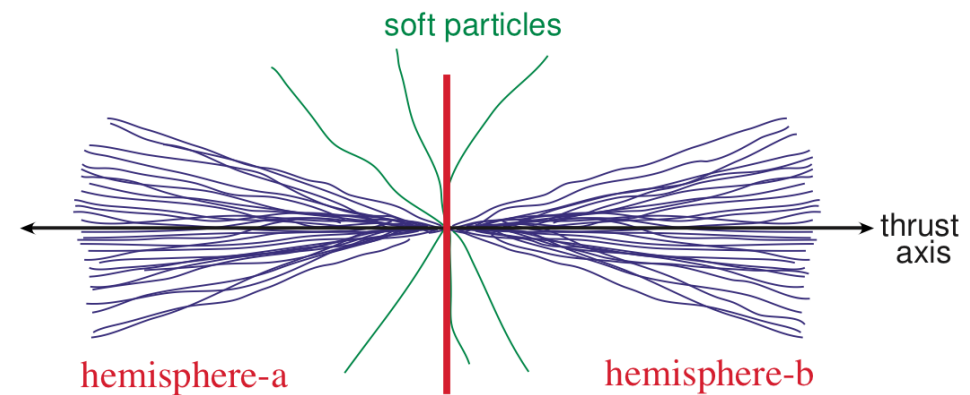
Tau Studies

- Tau cross section is comparable with one of B-mesons.
- Can be a tool for searching for NP
- Difficult to reconstruct because of neutrinos

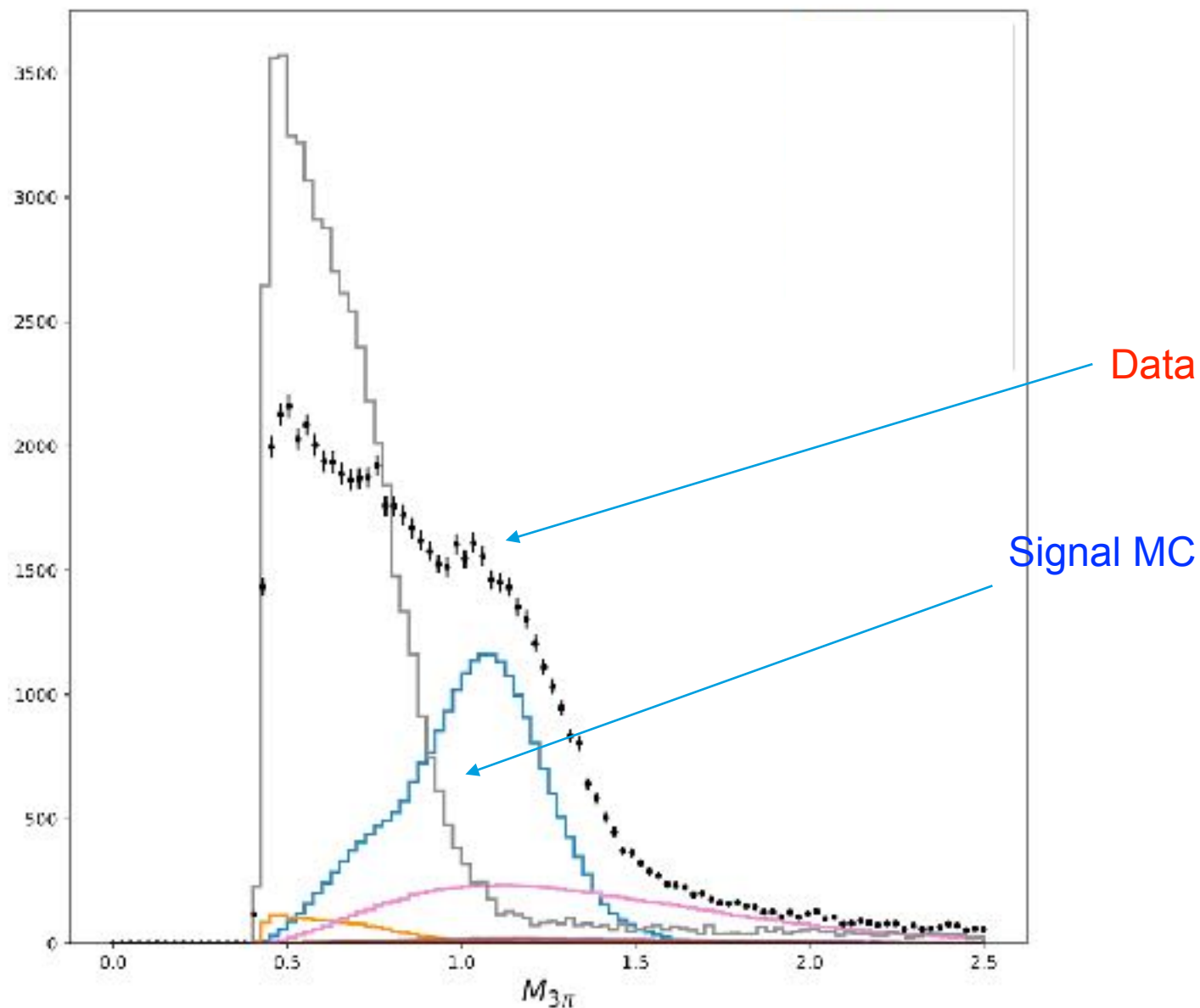


Thrust axis is maximising the jet event shape variable:

$$\mathbf{T} = \sum_h \frac{\vec{P}_h \cdot \hat{n}}{|P_h|}$$



... if only 4 tracks in event...



Background

- $e^+e^-\gamma$
- $\mu^+\mu^-\gamma$
- $e^+e^-e^+e^-$
- $e^+e^-\mu^+\mu^-$
- $q_i\bar{q}_i$ (u,d,s,c)
- $B\bar{B}$

E/p

Cut the electrons/positrons

- plot from Petar -

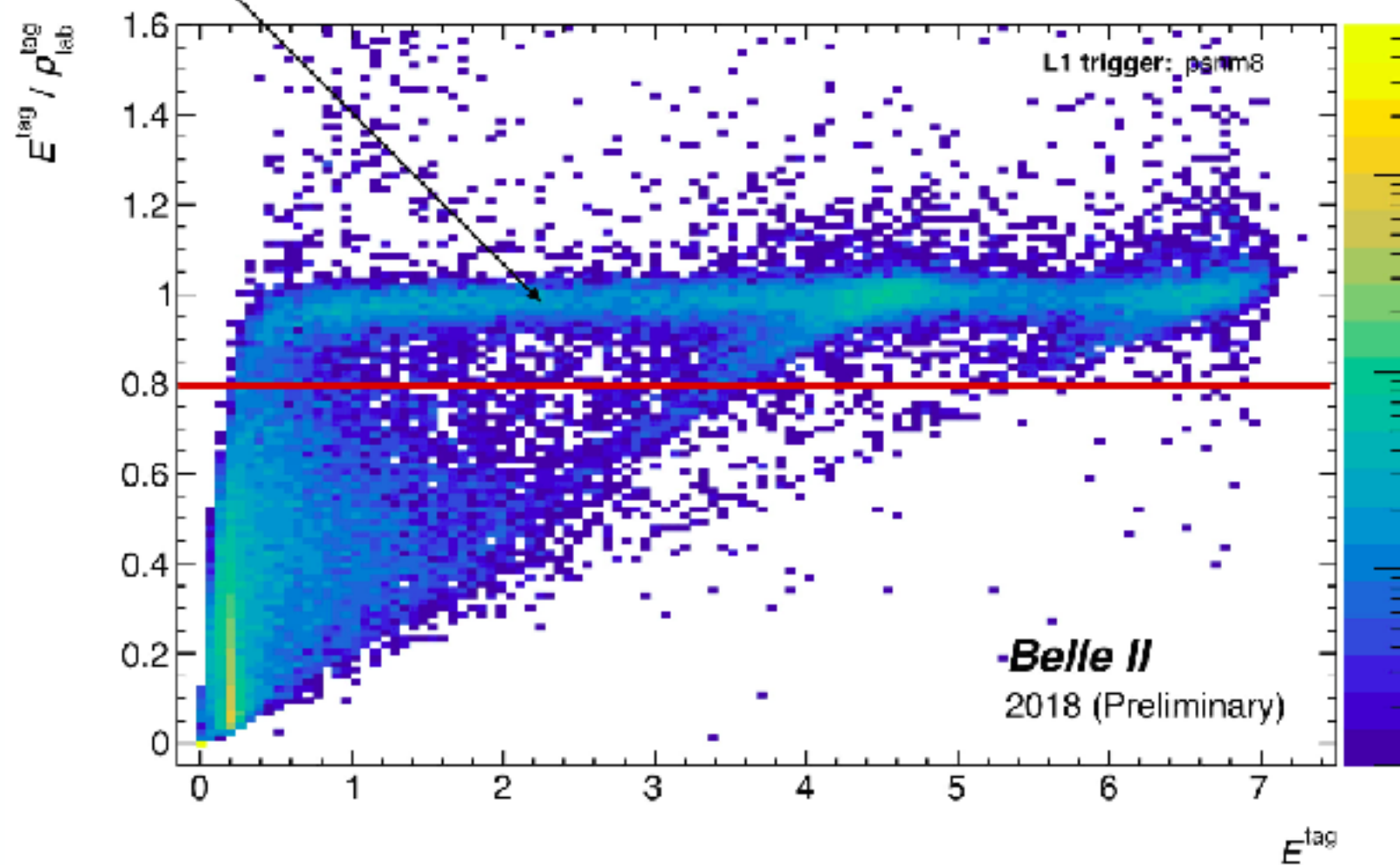
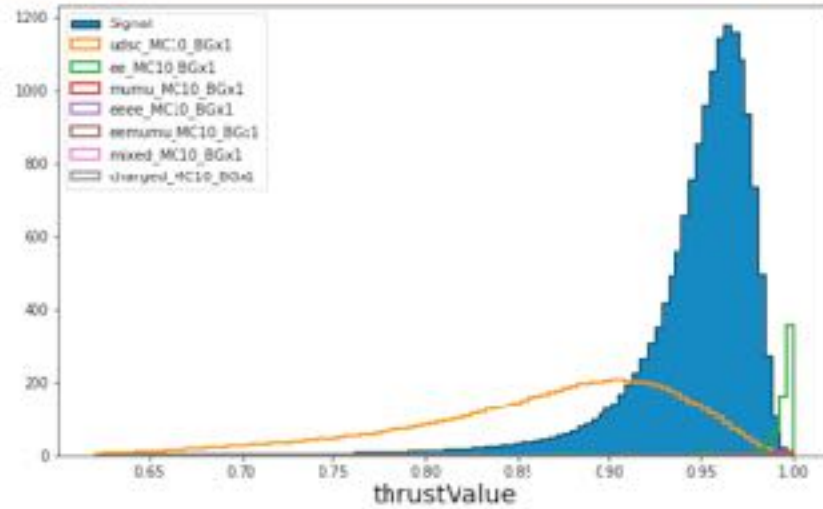


Figure of Merit

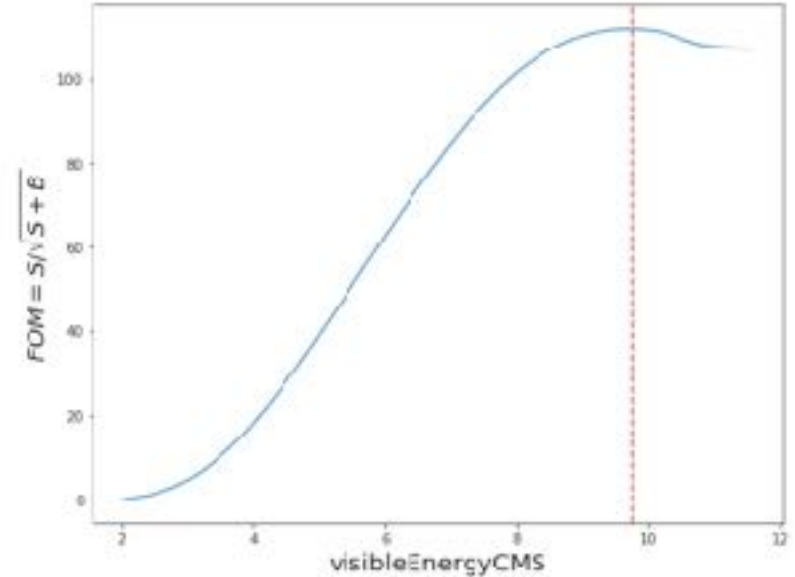
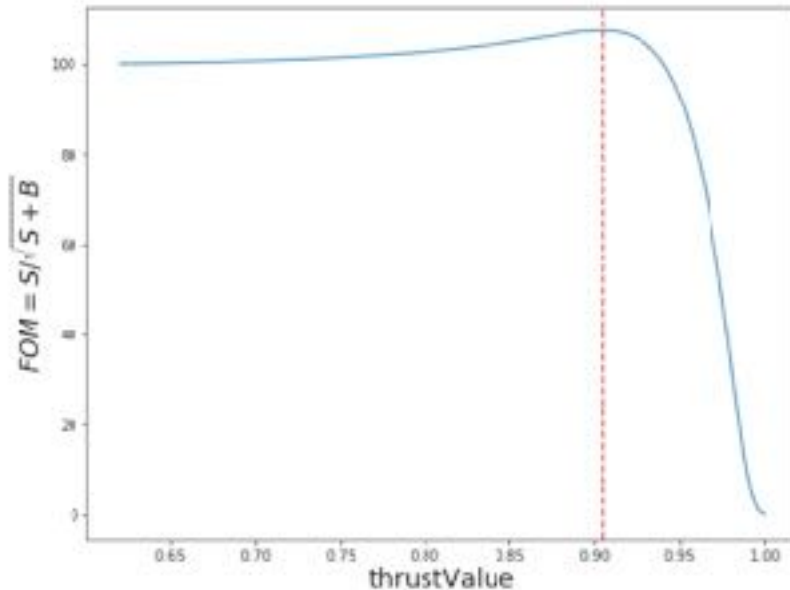
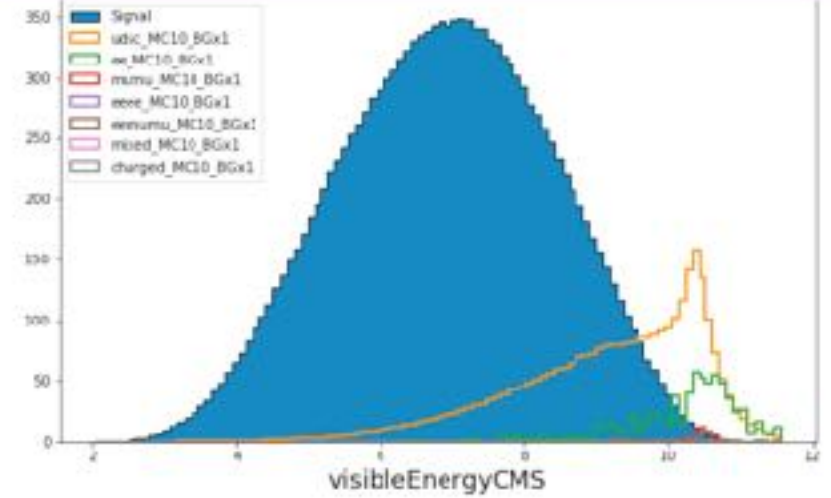
Thrust

$$FOM = \frac{S}{\sqrt{S+B}}$$

Visible Energy

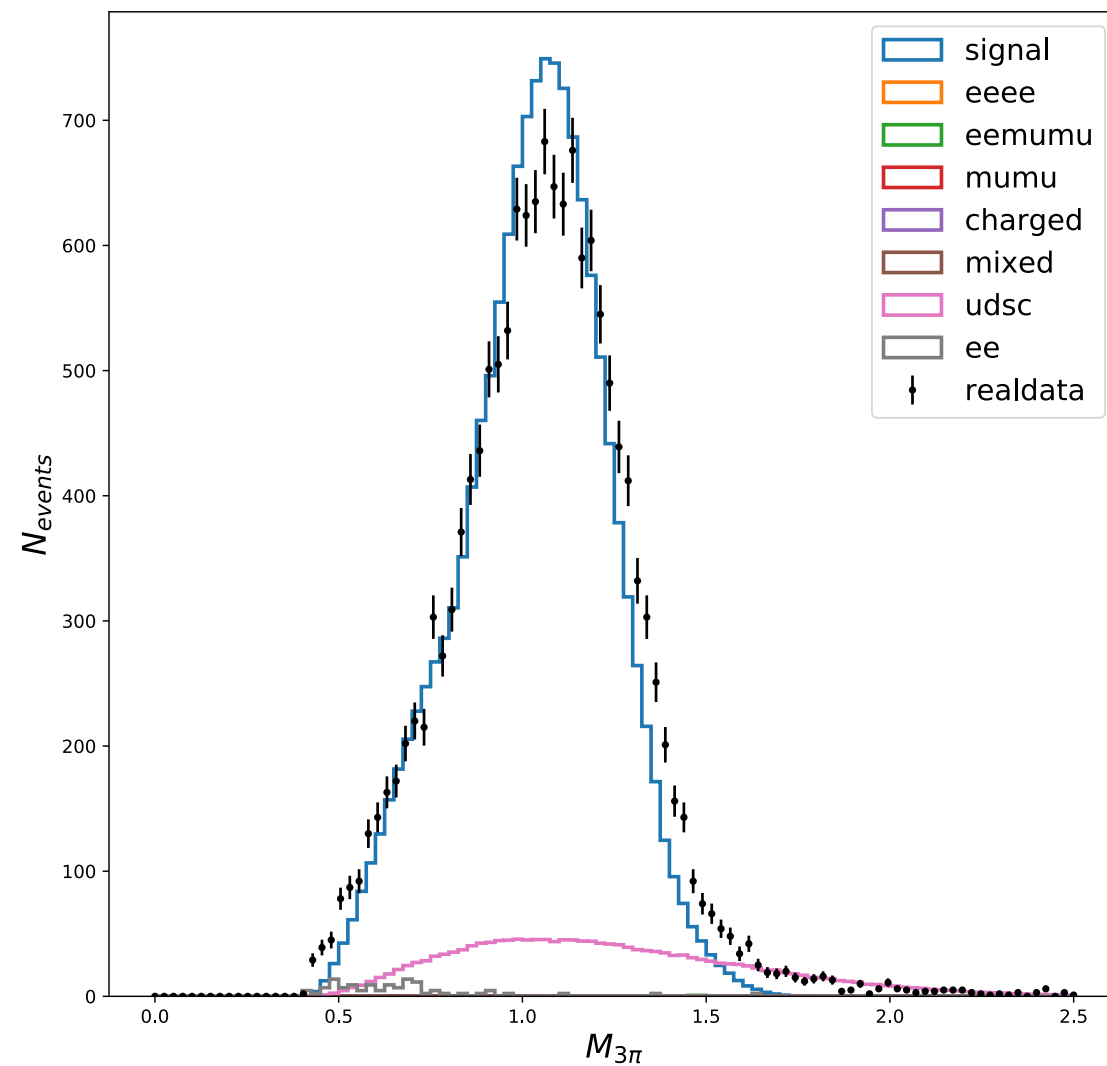
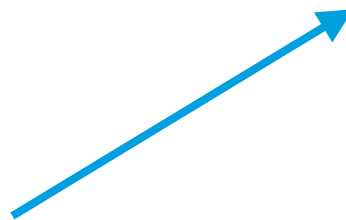
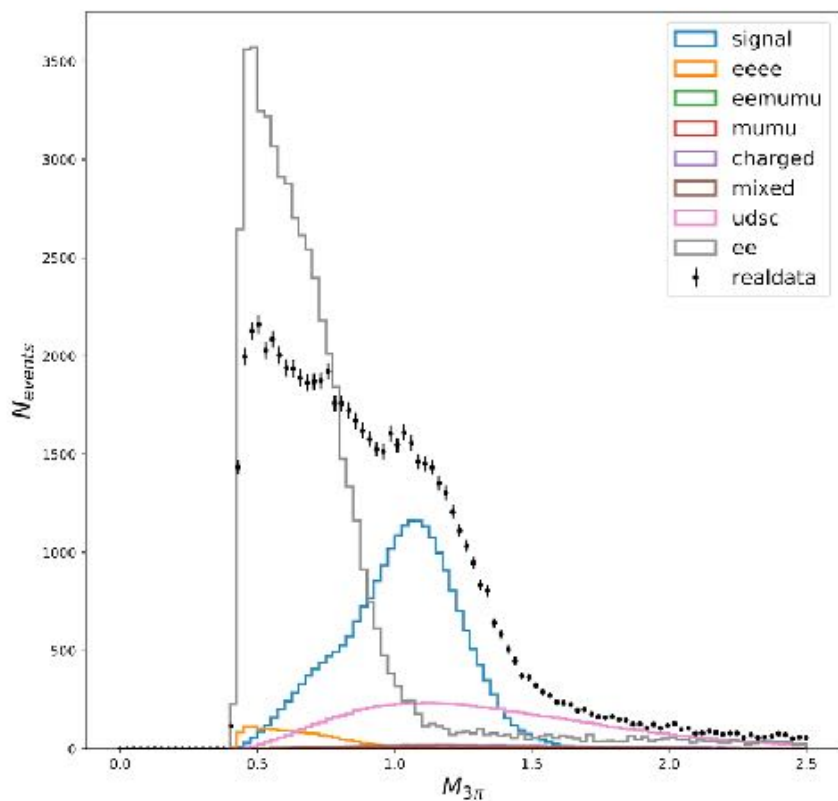


S - number of signal events
B - number of background events



BG suppressed!

Finalised of tau candidates selection



Final Remarks

