ECAL Granularity

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Energy distribution of π^0

https://indico.ihep.ac.cn/event/24259 by Shensen Sun

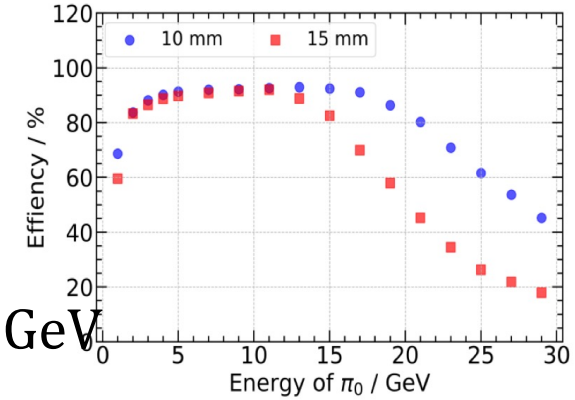
Study the physics performance @10 mm OR 15 mm ECAL granularity

Efficiency/resolution changes @ 10 or 15 mm

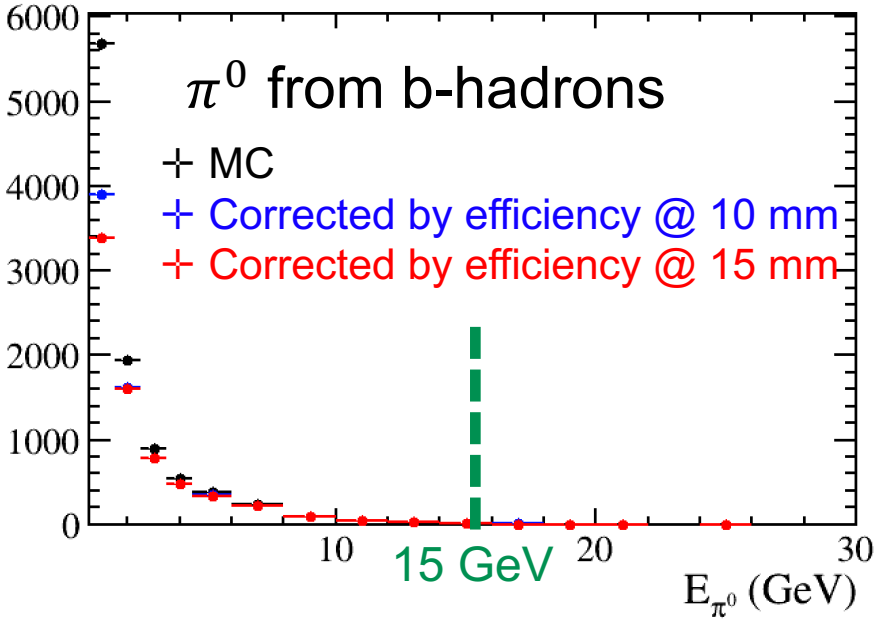
- Take efficiency as first look

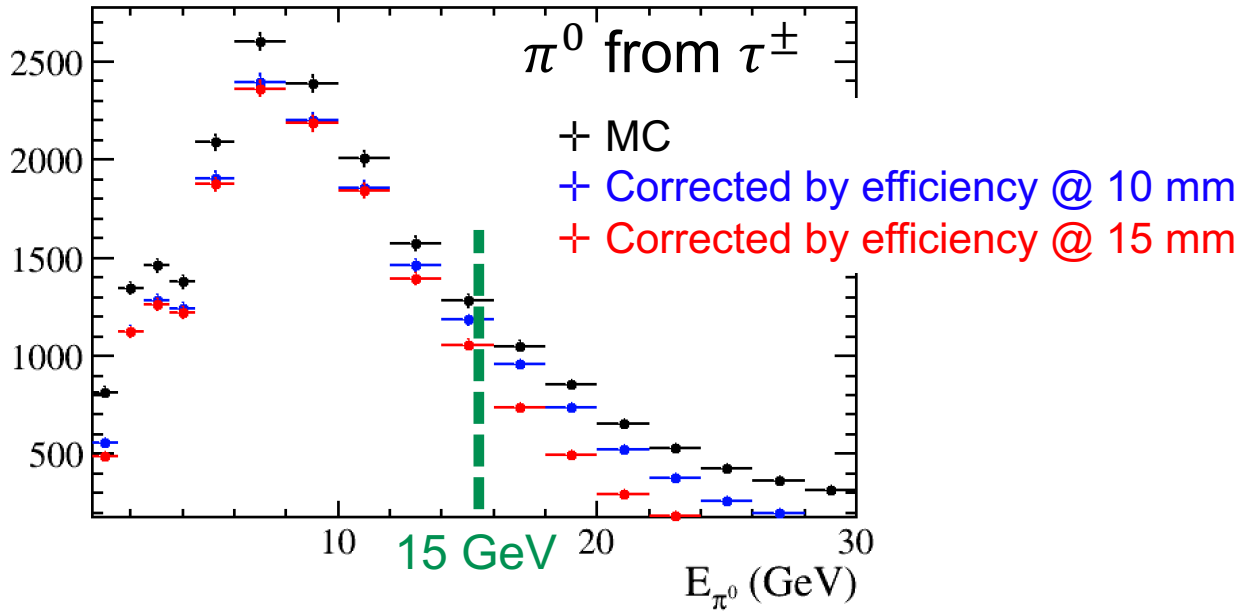
The π^0 from b-hadrons mostly in low range, no difference when $E(\pi^0) > 2$ GeV

The π^0 from $\tau^{\pm}$: More studies for high range



Crystal efficiency





To-do list

No.	Process	$\sqrt{s}$ (GeV)	Observable/physics parameter of interest	Current precision	CEPC precision	Key performance	Relevant section
12	$B^0 \to \pi^0\pi^0$	91.2	BR, A_{CP} (α)	$\sigma(\mathrm{BR})/\mathrm{BR}^{00} = 16\%$ $\sigma(C^{00}_{CP}) = \pm 0.22$ [151]	$\sigma(\mathrm{BR})/\mathrm{BR}^{00} = 0.25\%$* $\sigma(a^{00}_{CP}) = \pm 0.01$* [32]	Fast simulation	ECAL Jet origin ID	5
13	$B^0 \to \pi^+\pi^-$	91.2	BR (α)	$\sigma(\mathrm{BR})/\mathrm{BR}^{+0} = 7\%$ [151]	$\sigma(\mathrm{BR})/\mathrm{BR}^{+0} = 0.1\%$* [32]	Fast simulation	ECAL Jet origin ID	5
14	$B^+ \to \pi^+\pi^0$	91.2	BR, A_{CP} (α)	$\sigma(\mathrm{BR})/\mathrm{BR}^{+-} = 4\%$ $\sigma(C^{+-}_{CP}) = \pm 0.030$ $\sigma(S^{+-}_{CP}) = \pm 0.030$ [151]	$\sigma(\mathrm{BR})/\mathrm{BR}^{+-} = 0.1\%$* $\sigma(C^{+-}_{CP}) = \pm 0.003$* $\sigma(S^{+-}_{CP}) = \pm 0.003$* [32]	Fast simulation	ECAL Jet origin ID	5
24	$Z \to \pi^+\pi^-$	91.2	BR	-	$\lesssim \mathcal{O}(10^{-10})$ [161]	Conjecture	Tracker PID	8
25	$Z \to \pi^+\pi^-\pi^0$	91.2	BR	-	$\lesssim \mathcal{O}(10^{-9})$ [161]	Conjecture	Tracker PID ECAL	8
26	$Z \to \rho\gamma$	91.2	BR	$< 2.5 \times 10^{-5}$ [151]	$\lesssim \mathcal{O}(10^{-9})$ [161]	Conjecture	Tracker PID ECAL	8
27	$Z \to J/\psi\gamma$	91.2	BR	$< 1.4 \times 10^{-6}$ [151]	$\lesssim 10^{-9}$–10^{-10} [161]	Conjecture	Tracker PID ECAL	8
28	$Z \to \tau\mu$	91.2	BR	$< 6.5 \times 10^{-6}$ [207, 335, 336]	$\lesssim \mathcal{O}(10^{-9})$ [157, 161]	Conjecture	Tracker PID E_{beam}	8
29	$Z \to \tau e$	91.2	BR	$< 5.0 \times 10^{-6}$ [207, 335, 336]	$\lesssim \mathcal{O}(10^{-9})$ [157, 161]	Conjecture	Tracker PID E_{beam}	8
30	$Z \to \mu e$	91.2	BR	$< 7.5 \times 10^{-7}$ [207, 335, 336]	$\lesssim 1 \times 10^{-9}$ [204]	Conjecture	Tracker PID	8
31	$Z \to bs$	91.2	BR	-	$< 10^{-7}$*	Fast simulation	Jet origin ID	8
32	$Z \to bd$	91.2	BR	-	$< 10^{-7}$*	Fast simulation	Jet origin ID	8
33	$Z \to cu$	91.2	BR	-	$< 3 \times 10^{-7}$*	Fast simulation	Jet origin ID	8
34	$Z \to sd$	91.2	BR	-	$< 7 \times 10^{-7}$*	Fast simulation	Jet origin ID	8
35	$H \to e\mu$	240	BR	$< 4.4 \times 10^{-5}$ [151]	$< 6 \times 10^{-6}$ [232]	Fast simulation	Lepton ID	9.2
36	$H \to \mu\tau$	240	BR	$< 1.5 \times 10^{-3}$ [151]	$< 6 \times 10^{-5}$ [232]	Fast simulation	Lepton ID	9.2
37	$H \to e\tau$	240	BR	$< 2.0 \times 10^{-3}$ [151]	$< 8 \times 10^{-5}$ [232]	Fast simulation	Lepton ID	9.2
38	$H \to sb$	240	BR	$\lesssim 10^{-2}$ [337]	$< 2.2 \times 10^{-4}$ [33]	Full simulation	Jet origin ID	9
39	$H \to sd$	240	BR	-	$< 8.6 \times 10^{-4}$ [33]	Full simulation	Jet origin ID	9
40	$H \to db$	240	BR	$\lesssim 10^{-2}$ [337]	$< 2.3 \times 10^{-4}$ [33]	Full simulation	Jet origin ID	9
41	$H \to uc$	240	BR	-	$< 3.9 \times 10^{-4}$ [33]	Full simulation	Jet origin ID	9
42	$e^+e^- \to tq$	240	cross section	two-fermion, LHC [237–241] four-fermion, LEP2 [242–245]	1–2 orders of magnitude improvement compared to LEP2 [235]	Fast simulation	Tracker Missing energy Jet origin ID	9
43	$WW \to \ell\nu qq$	240	$\lvert V_{cb}\rvert$	$\pm 0.5 \times 10^{-3}$ (inclusive) $\pm 0.6 \times 10^{-3}$ (exclusive) [151] $\pm 1.2 \times 10^{-3}$ (average)	$\lesssim 0.2 \times 10^{-3}$ [222] $L = 20$ ab^{-1}	Full simulation	Jet origin ID	9
44	$Z \to \mu\mu X_{\mathrm{inv}}$	91.2	BR	-	$\lesssim 3 \times 10^{-11}$ [311]	Fast simulation	Tracker Missing energy	11
45	$\tau \to \mu X_{\mathrm{inv}}$	91.2	BR	$\lesssim 7 \times 10^{-4}$ [319]	$\lesssim$ 3–5 $\times 10^{-6}$	Fast simulation	Tracker Missing energy	11

- π^0 from b-hadron all similar with 10 OR 15 mm
  - ➢ No need for b-hadron benchmark studies

OR

  - ➢ B-hadron decays with π^0, but not easy to find the “golden channel”

- π^0 from $\tau^\pm$
  - ➢ Decays with $\tau^\pm$ from Z/H in the next step