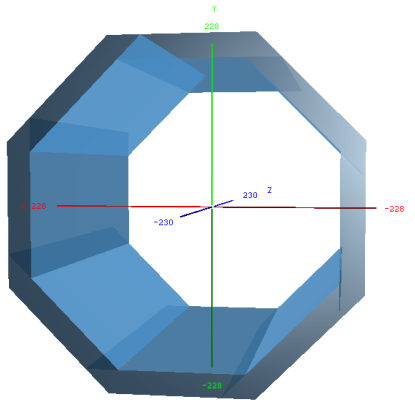
# Crystal bar ECAL data size estimation

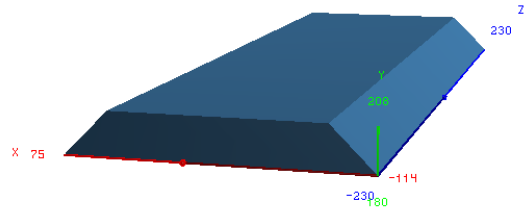
- **Luminosity (CEPC accelerator TDR, 2023)**
  - $\mathcal{L} = 115\times10^{34}\ cm^{-2}s^{-1}$ / IP @ 30 MW
  - $\mathcal{L} = 192\times10^{34}\ cm^{-2}s^{-1}$ / IP @ 50 MW

| Physics Process @ Z mode | $\sigma$ (nb) @ $\sqrt{s} = 91.2GeV$ | Rate (kHz) @ 30 MW | Rate (kHz) @ 50 MW |
|---|---|---|---|
| $e^+e^- \to q\bar{q}$ | 30.20 | 34.7 | 58.0 |
| $e^+e^- \to \mu^+\mu^-$ | 1.51 | 1.73 | 2.90 |

*No $ee \to \tau\tau$ cross section, but should at the same level as $ee \to \mu\mu$.

- **Simulation geometry: Octagonal ECAL**
  - Inner R = 1860 mm, depth 280 mm, Z = 6700 mm.
  - In each module: 4*11 blocks, bar length 400~600 mm, bar size ~60k.
  - Physical process: $\sqrt{s} = 91$ GeV, Bhabha, $ee \to Z/\gamma^* \to \mu\mu/\tau\tau/qq$.
- **Digitization:**
  - Bar energy threshold 0.1 MeV.





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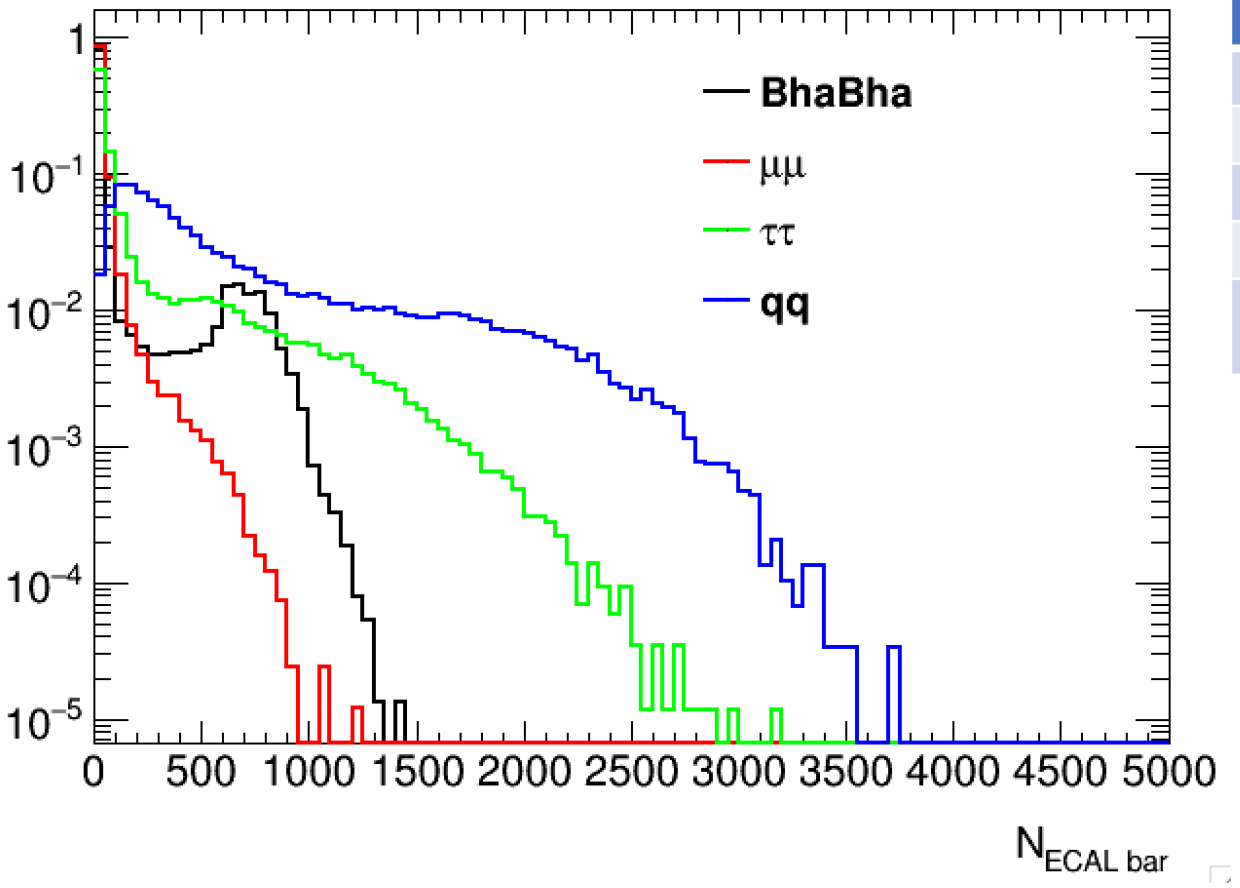
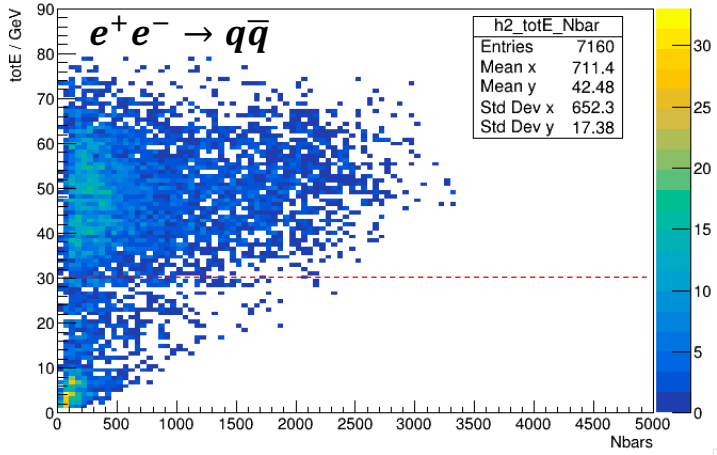
- **Fired bar size in each module**




| Process | Barrel acceptance* | Rate @ 30 MW [kHz] | Rate @ 50 MW [kHz] |
|---|---|---|---|
| $Bhabha$ | 48.7% | | |
| $e^+e^- \to \mu\mu$ | - | | |
| $e^+e^- \to \tau\tau$ ** | 82% | 1.42 | 2.38 |
| $e^+e^- \to q\bar{q}$ | 99.4% | 34.5 | 57.7 |
| $e^+e^- \to q\bar{q}$ $(E_{tot} > 30\ GeV)$ | 79.9% | 27.7 | 46.3 |

*Definition: deposit >1GeV energy in ECAL.
*Use $\sigma(ee \to \mu\mu)$ and it's rate.




Can set a safe case:
5k bars @ E>30 GeV

# Crystal bar ECAL data size estimation

- **Readout:**
  - Double-side readout, so 2 channels / bar.
  - data size = 32bit / channel.
  - Data size for the hottest module (only count $e^+e^- \rightarrow q\bar{q}$ process):
    - 30 MW: 27.7 [kHz] * 5k [bars] * 2 * 32 [bit] = 8.86 Gbits/s = 1.1 GB/s
    - 50 MW: 46.3 [kHz] * 5k [bars] * 2 * 32 [bit] = 14.8 Gbits/s = 1.9 GB/s