Dual-readout calorimetry for future e^+e^- colliders

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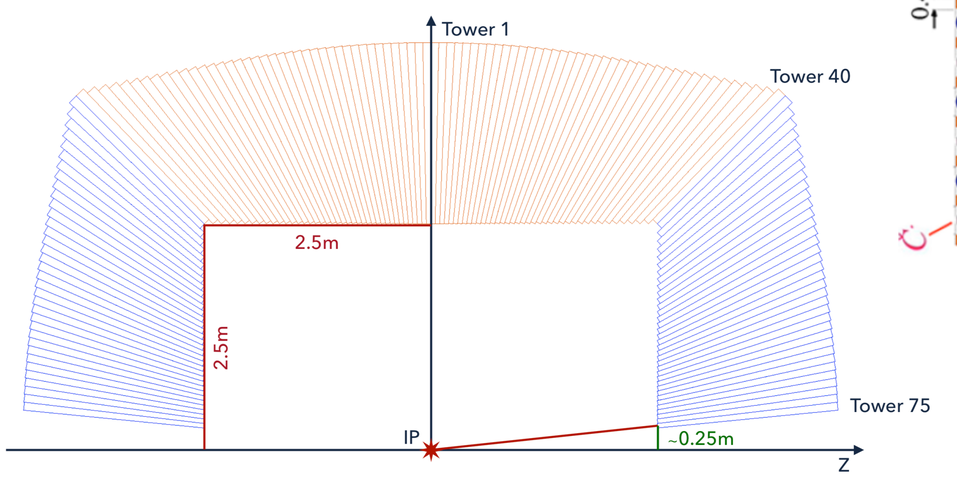
On behalf of the IDEA Dual-Readout Collaboration

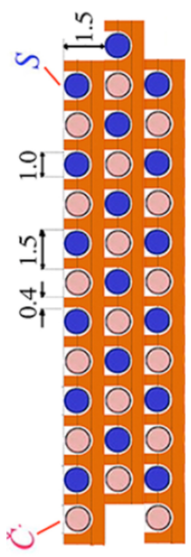
1- Introduction

A calorimeter with **two readouts with different e/h factors** can measure the **electromagnetic fraction** of the hadronic shower **event-by-event**, therefore dramatically **improving the energy measurement resolution** [1].

2 - Geometry

- Alternating **doped** (scintillating) and **undoped** (Cherenkov) plastic fibers.
- **Projective towers** around the collision point as for the IDEA detector concept [2].

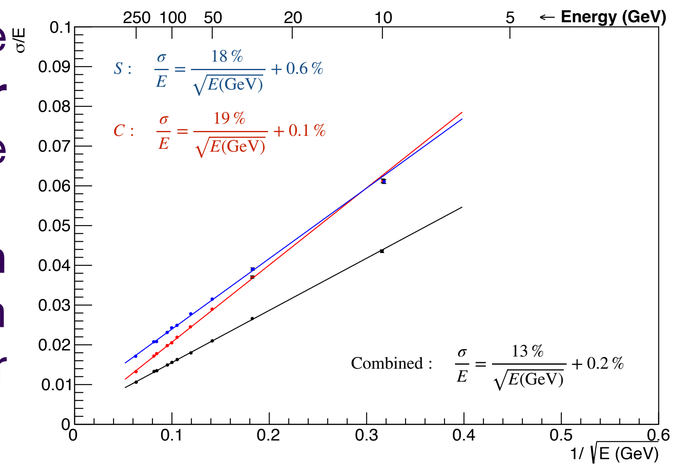




3 - Resolution

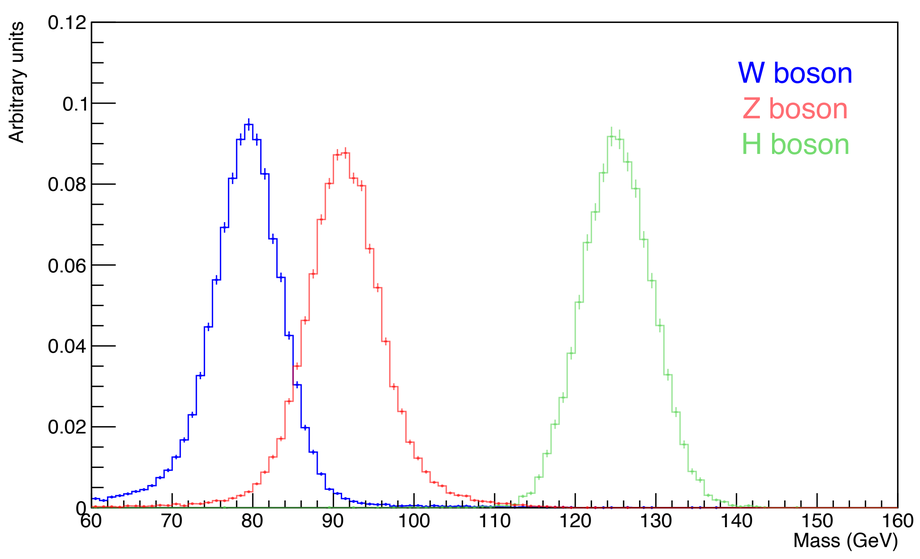
-Calorimeter response **calibrated at tower level** with single electrons.

-Single **electron/photon** response good enough for use at FCC-ee or CEPC [3].



-**Jet response** evaluated in $e^+e^- \to jj$ (at various $\sqrt{s}$) and in WW, ZH events.

- **Competitive hadronic resolution**. Boson peaks nicely separated [3].



4 - Particle ID

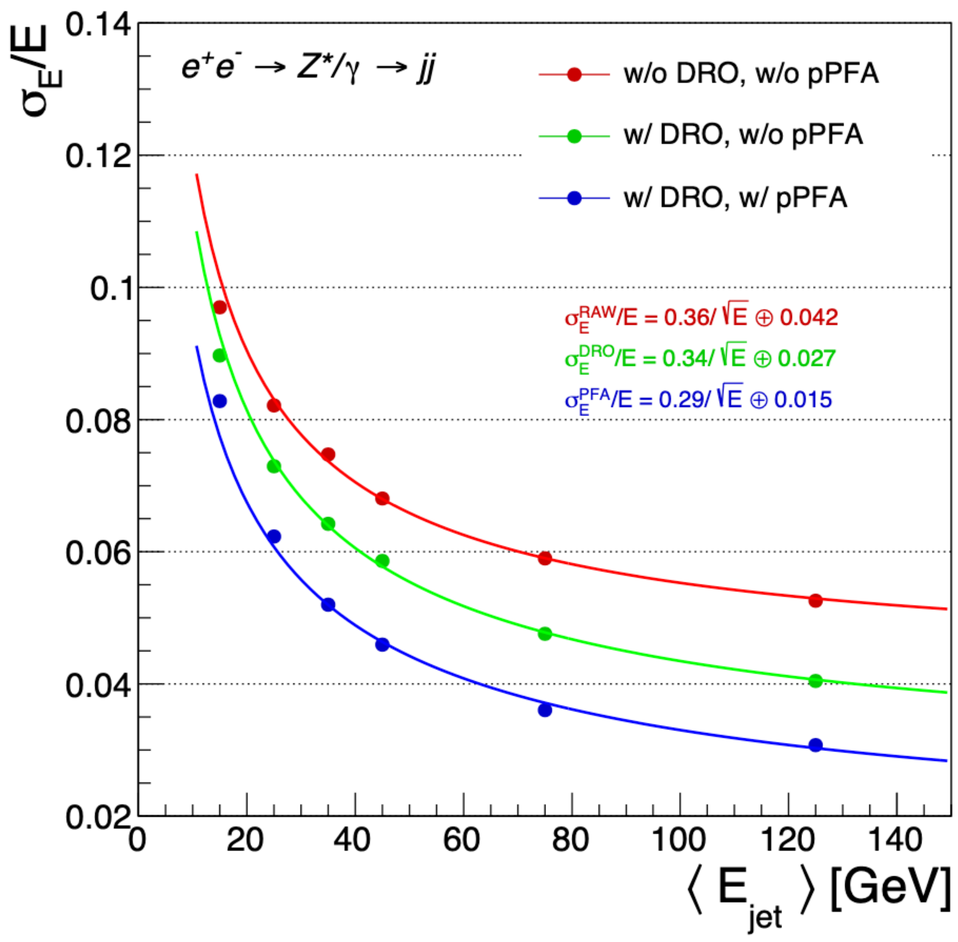
Superior **lateral granularity**, good **time resolution** and **dual-readout features** provide **excellent PID capabilities**. When using neural networks, one achieves:

- 99% e efficiency for < 1% π fake on wide energy range.
- 99% γ efficiency for ~1% π^0 fake at 40 GeV
- Excellent ability in identifying different hadronic τ decays.

5 - Crystal-based EM section

The fibre-based calorimeter can be complemented by a **dual-readout crystal-based electromagnetic (EM) section** [4]:

- Boost of EM performance.
- Longitudinal segmentation improves **particle-flow application** perspective.



6 - Summary

Dual-readout fibre calorimeter performance **exceeds** the requirements for future e^+e^- colliders.

A **crystal-based EM section** delivers improved **particle-flow** performance, further **boosting jet energy resolution**.

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[1] Lee, S., Livan, M., & Wigmans, R. (2018). Dual-readout calorimetry. Reviews of Modern Physics, 90(2), 025002.
[2] Antonello, M. "IDEA: A detector concept for future leptonic colliders." *Il nuovo cimento C* 43.2-3 (2020): 1-6.
[3] L. Pezzotti et al., "Dual-Readout Calorimetry for Future Experiments Probing Fundamental Physics", arXiv:2203.04312.
[4] M. T. Lucchini et al., 2022 JINST 17 P06008.