Dual readout and CCC

Dual readout calorimetry is the thrust for one of the proto-collaborations for future circular colliders: IDEA
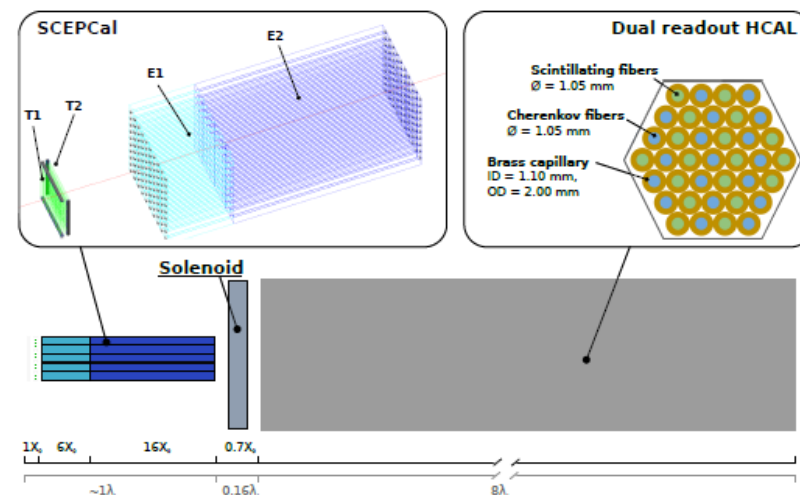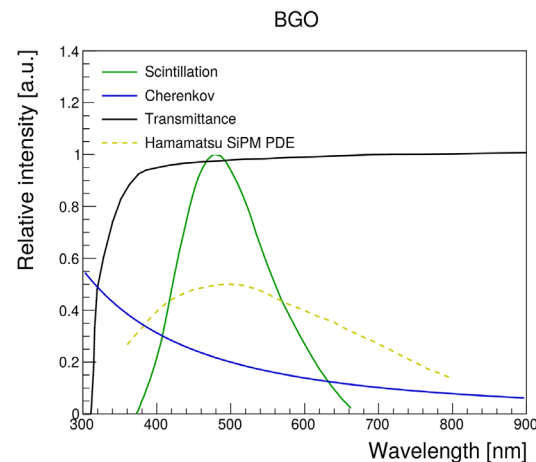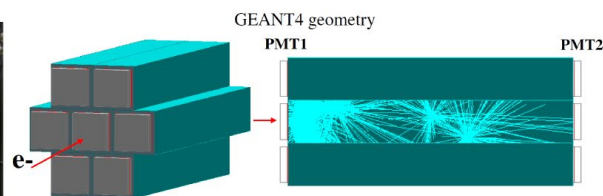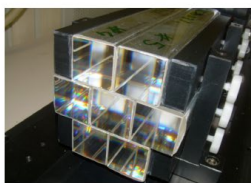
The IDEA collaboration is a detector proposal for FCC-ee and/or CEPC and/or muon collider using a dual-readout calorimeter. Calorimeters with or without precision EM ECAL are considered

Copper + scintillating and Cherenkov fibers

Precision EM possible
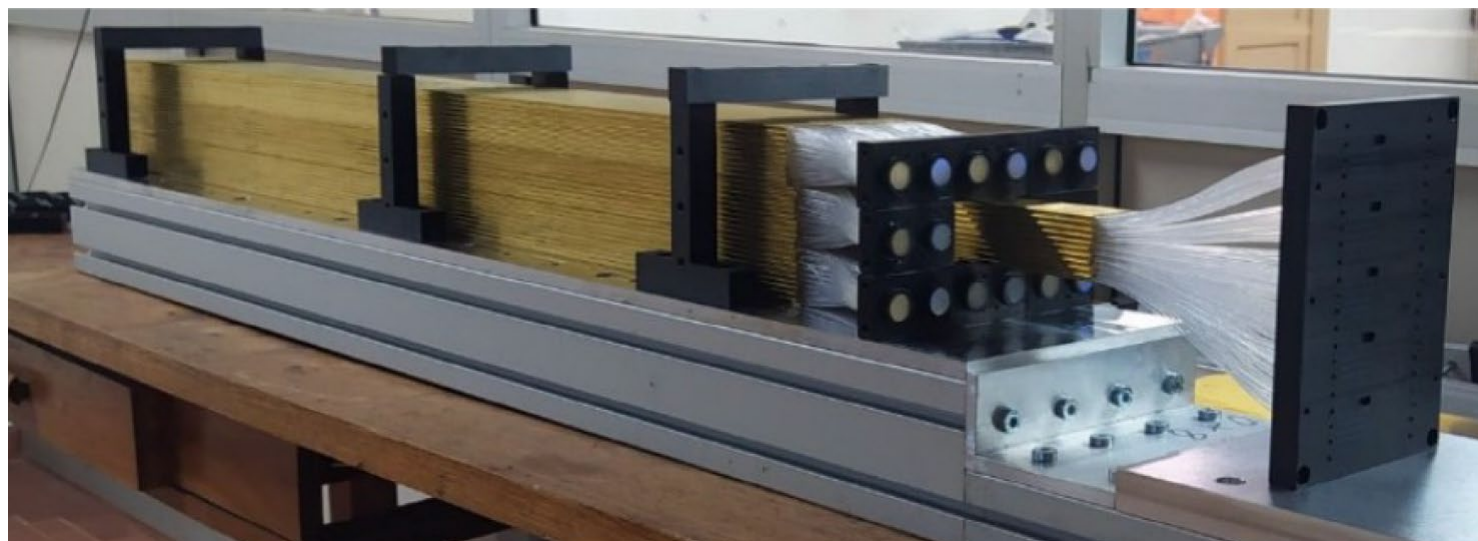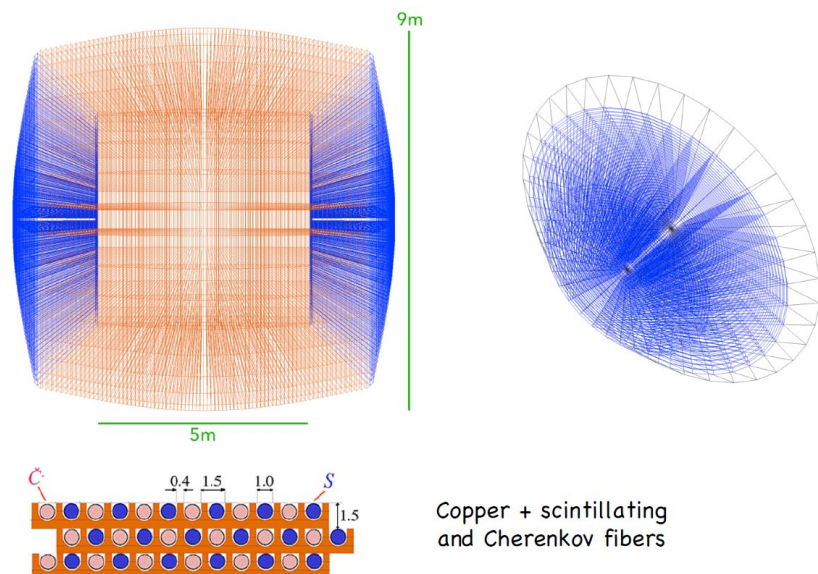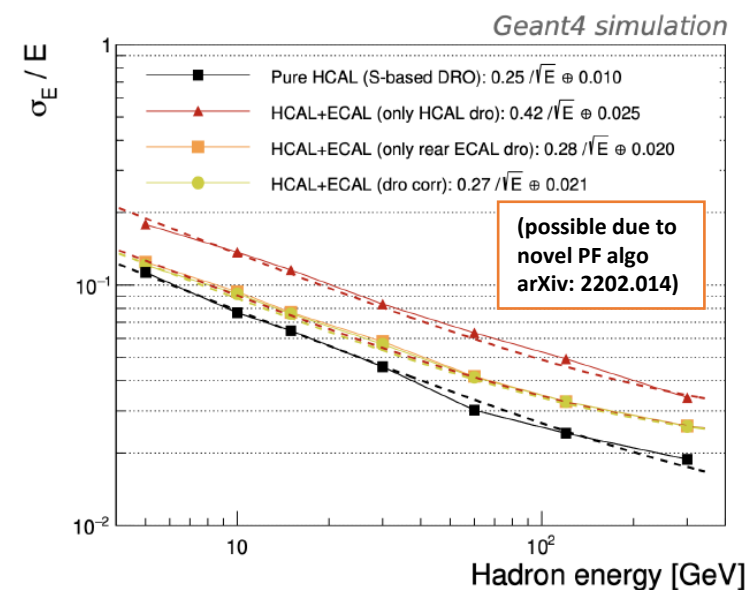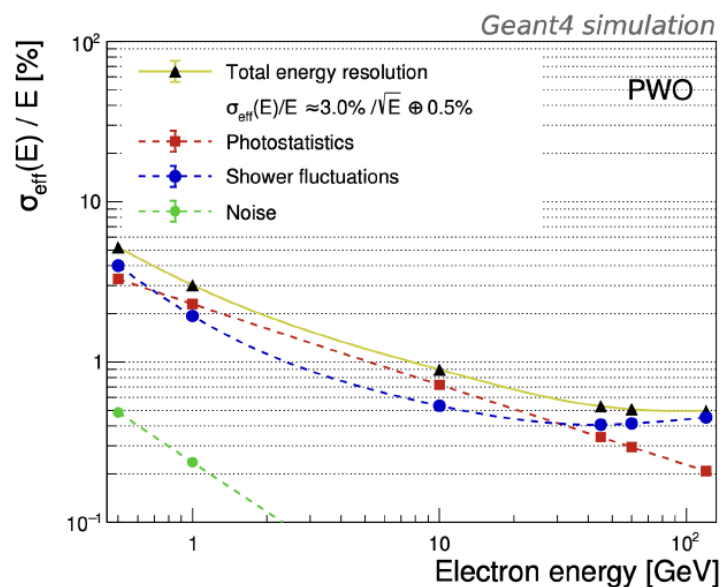
While past attempts by RD52/DREAM to use crystals for dual readout failed due to the photodetector technology at that time, modern wavelength extended SiPMs may change this.

A plethora of flavour physics could be enabled by this precision EM calorimetry (e.g. https://arxiv.org/abs/2107.12832)

BGO

https://arxiv.org/abs/2008.00338

(possible due to novel PF algo arXiv: 2202.014)

Dual readout calorimetry and CCC

Physicists in the US (Argonne, Caltech, FNAL, Maryland, Michigan, MIT, Oak Ridge, Princeton, Purdue, Texas Tech, Virginia) received in 2022 funding for an initial 3-year program in dual-readout homogeneous calorimetry. Our goals are:

- Advanced simulations of crystal-based measurements with maximum flexibility of materials etc. Support for Simulation like Geant4 is especially critical and requires support further development of models and continuous physics validation. There is also the need to identify small experiments that can help to further constrain and tune current model and the parameters thereof.
- Understanding how to make maximal use of possible measurements for improvement of calorimeter performance (e.g. see arXiv:2107.10207), including early and/or late timing, light polarization, light angle
- Further development of novel particle flow algorithms for this type of calorimetry, including interplay with other detector elements
- Verify the Cherenkov/scintillation yields and separation from https://arxiv.org/abs/2008.00338 on bench and via test beams
- Measure z coordinate of energy deposit in fiber via precision timing
- Find new materials with lower cost (current emphasis is glasses) (see next talk in this session)
- Follow new photodetector developments that allow further improvements (SPADs, dSiPMs)
- Design new electronics to allow on-detector measurements via new generations SoC ASICs and FPAAs with data processing (analog or digital) in the front end of timing, time over threshold, C/S ratios with 2-layer NNs (with CAEN and NALU)
- Low-mass mechanic support for the precision EM calorimeter

We are also interested in developing a more extensive set of physics benchmark processes to be sure that we design the future detectors we need to do the full physics programs of future machines.

Dual readout and CCC

Some interesting questions specific to ccc

- The jet resolution with a crystal ecal is great for jets at a center-of-mass energy around ZH, but is it good enough for TeV energies?
- The segmentation is good enough for ZH and for b-physics at Z running. But is it good enough for high energy?

Our web site and indigo are https://detectors.fnal.gov/projects/calvision/ and https://indico.fnal.gov/category/1426/
We have monthly meetings. We also have a mattermost channel.
New collaborators are welcome to join! (e.g. many opportunities for short-term student simulation work)