"Maximum Information" Crystal Calorimeter for future Higgs Factories

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KEY FEATURES & KEY CHALLENGES

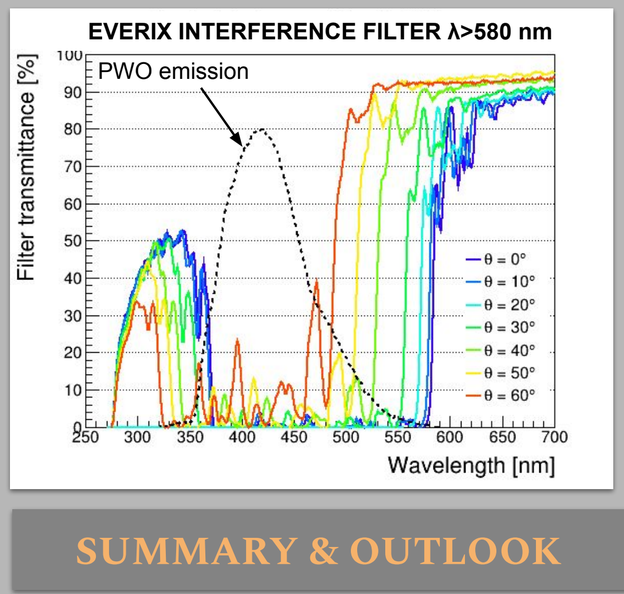
- An e^+e^- **collider** has been identified as the highest priority future accelerator for a thorough characterization of the **Higgs boson** properties and search for hints of new physics
- A homogeneous **crystal** electromagnetic calorimeter with **high granularity and dual-readout** capability **can expand its physics reach** combining an efficient jet reconstruction with excellent timing and energy resolution (3%/√E) to EM particles
- The necessity of a simultaneous readout of **Cherenkov** and scintillation light from the same active element requires the use of **thin optical filters coupled to SiPM** with infrared sensitivity

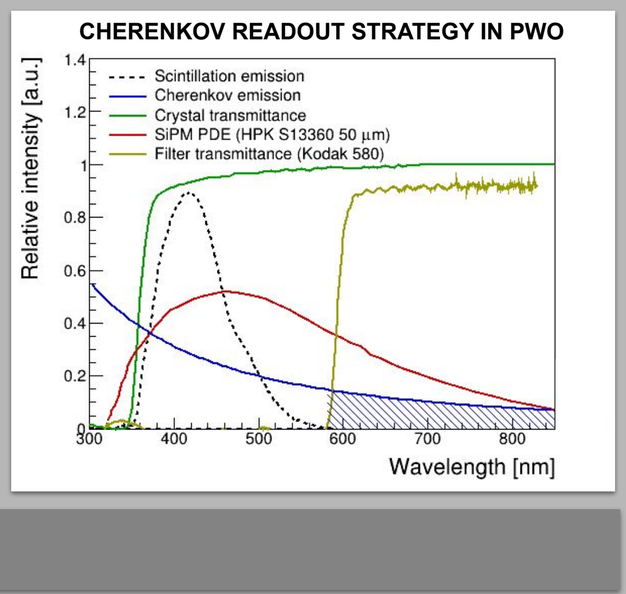
THE CRYSTAL CHOICE

- High granularity compact calorimeters call for high density crystals with small Molière radius and radiation length. The requirement of a high Cherenkov yield (>50 phe/GeV) favors crystals with high refractive index
- A set of **PWO, BGO and BSO** crystal has been characterized in terms of scintillation light output as a function of the crystal and SiPM dimensions with both PMTs and SiPMs readout
- All crystals were proven to provide the required scintillation light output of at least **2500 phe/GeV** when coupled via optical grease with a 15% PDE SiPM of area bigger than 5% of the crystal section

THIN OPTICAL FILTERS

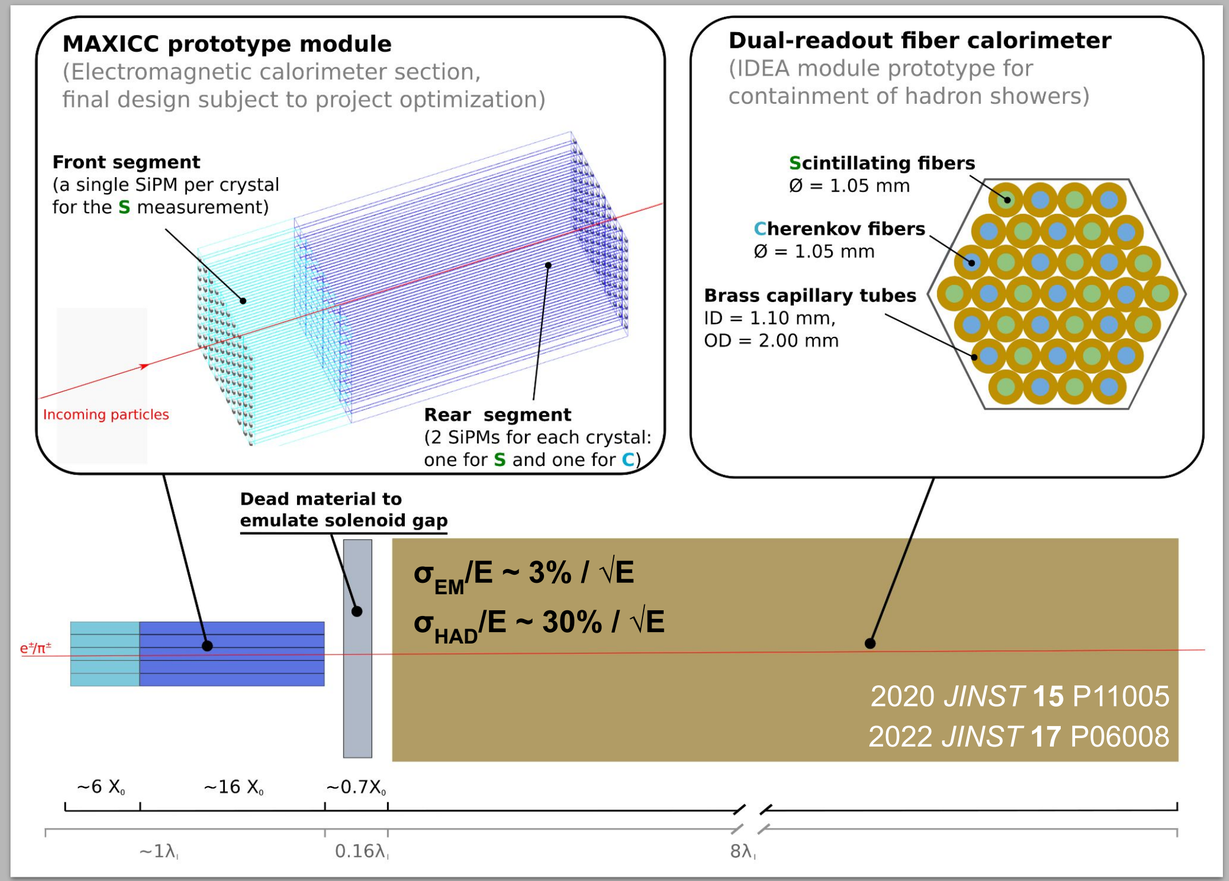
- Targeting the detection of a pure cherenkov signal (free from scintillation contamination) in the 560-1000 nm region
- Exploring O(100 um) thin filters for optimal integration within the SiPM protective window and optimal light collection
- **Customized interference filters** tested and discarded because their transmittance curve has a strong dependence on the photon incident angle ϑ by construction (and scintillation photons exit the crystal also at large angles)
- **Absorptive thin filters** have angular independent response and high optical density

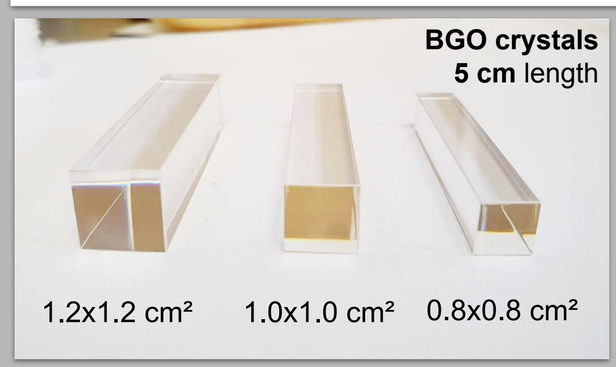


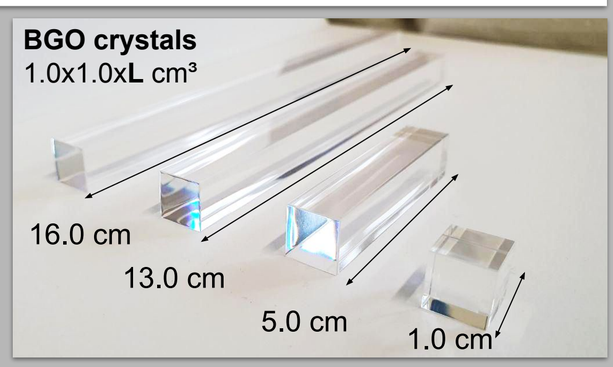


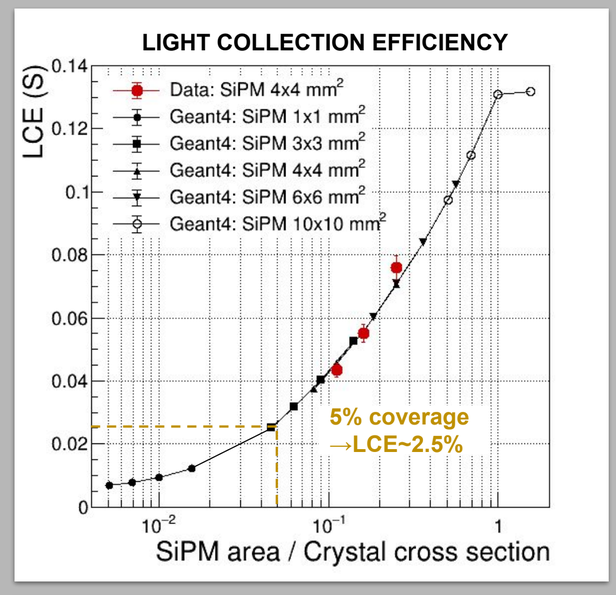
SUMMARY & OUTLOOK

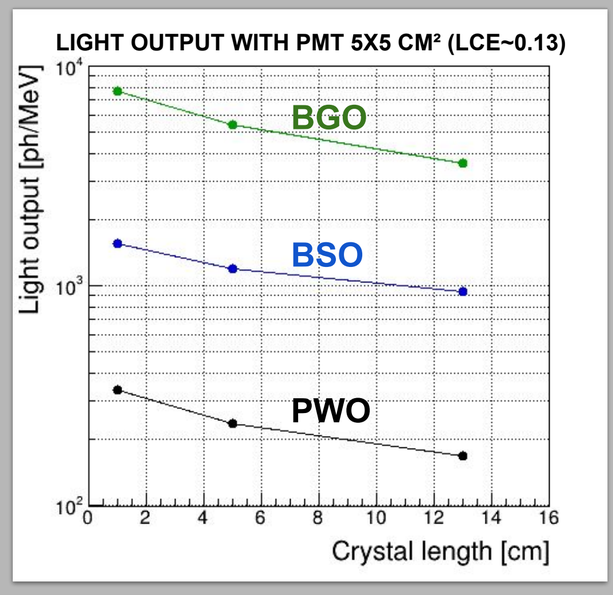
- This study provided a set of optimal parameters (crystal / SiPM dimensions and specifications) and optical filter candidates to be tested on beam with high energy electrons and for future construction of a full containment EM calorimeter prototype





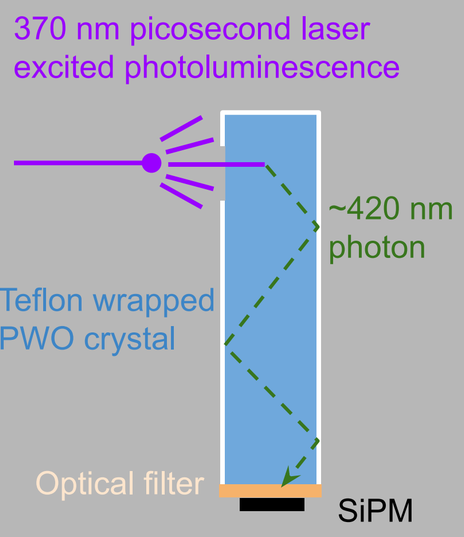


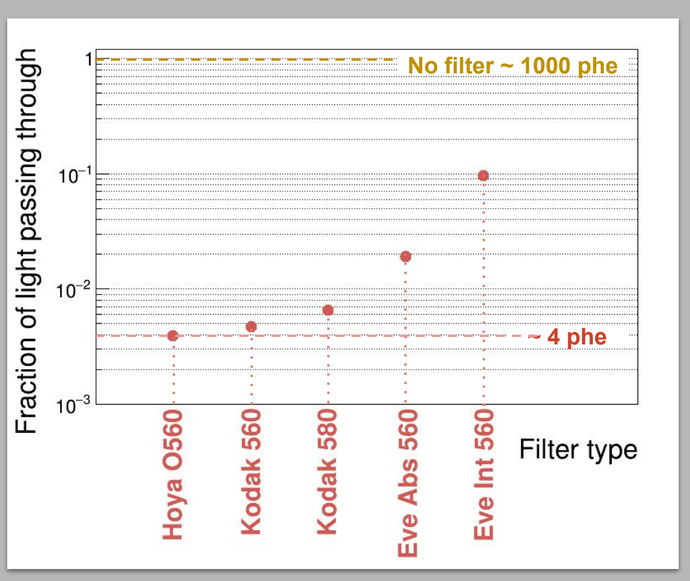




FILTER PERFORMANCE WITH LASER EXCITATION

- The filters performance was estimated by exciting a 1x1x5 cm^3 PWO crystal with a UV picosecond laser (λ=370 nm) and measuring the light output w/ and w/o filter using a 3x3 mm^2 SiPM
- Due to the angular dependence of its response the interference filter (Everix >580 nm) let 10% of the PWO light pass through
- The best absorptive filters tested (Kodak 560, Kodak 580 and Hoya O560) let only ~0.5% of the light pass through





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