Fast Cerenkov calorimetry with longitudinal segmentation and angular alignment

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H2/H4 users meeting
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Fast, compact Cerenkov calorimetry

R&D for future experiments to develop new concepts for crystal calorimerty

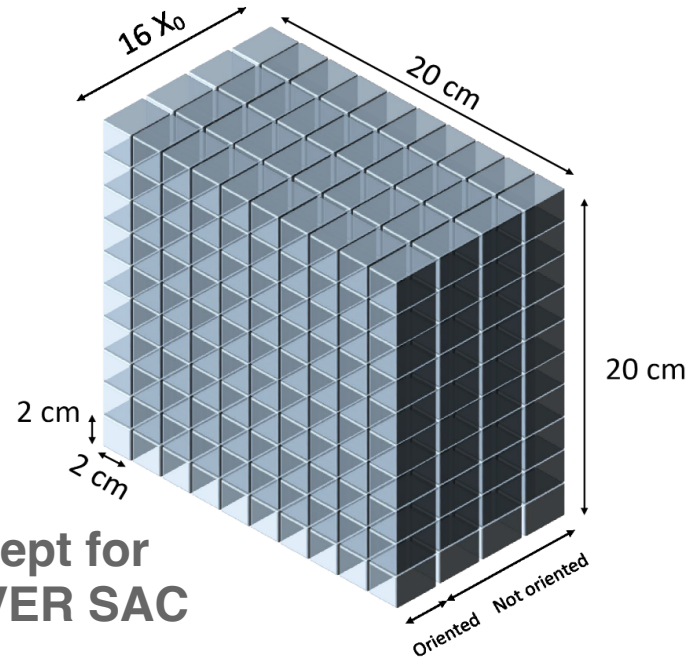
KLEVER small-angle calorimeter (SAC)

- Operates inside neutral beam, rejects γs from $K_L \to \pi^0\pi^0$ escaping through beam hole
- Low-sensitivity for > 400 MHz of beam neutrons
- Possibilities for γ/n discrimination: multilayer structure/longitudinal segmentation

ECAL for Muon Collider (CRILIN design)

- Resolves jet substructure: fine segmentation, both transverse and longitudinal
- Rejects of beam-induced background from low-energy shower particles
- Good sensitivity for low-energy-release topologies (e.g. signal muons)
- Excellent time resolution to allow rejection of background hits at cell level

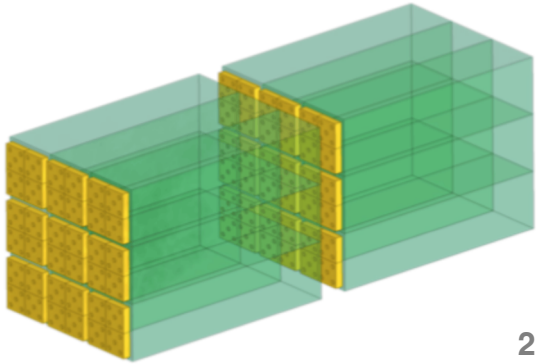
Similar designs for fast PbF_2 calorimeters



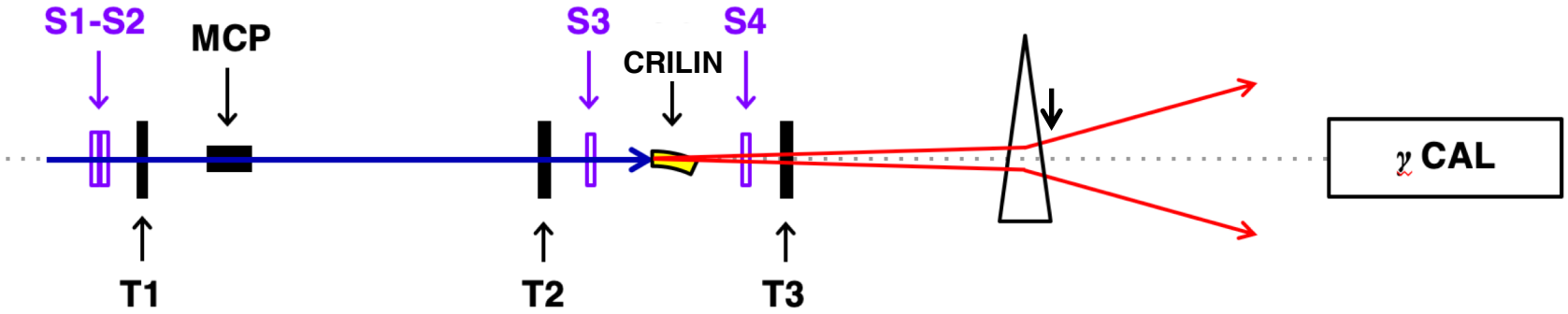
Concept for KLEVER SAC

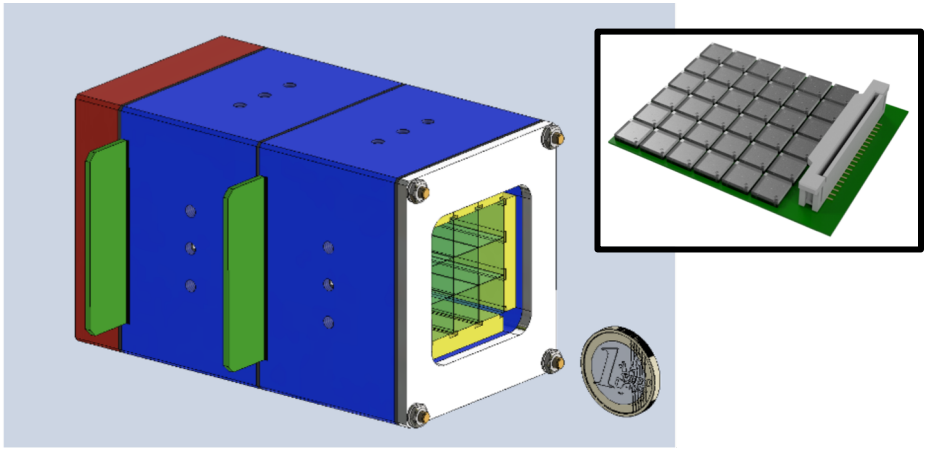
- σ_t < 100 ps
- 2-pulse separation at ~ 1 ns
- 10^{13}-10^{14} n/cm^2 and 10^5-10^6 Gy

Concept for CRILIN prototype



Plans for 2022 KLEVER/CRILIN test in H2





Prototype setup:

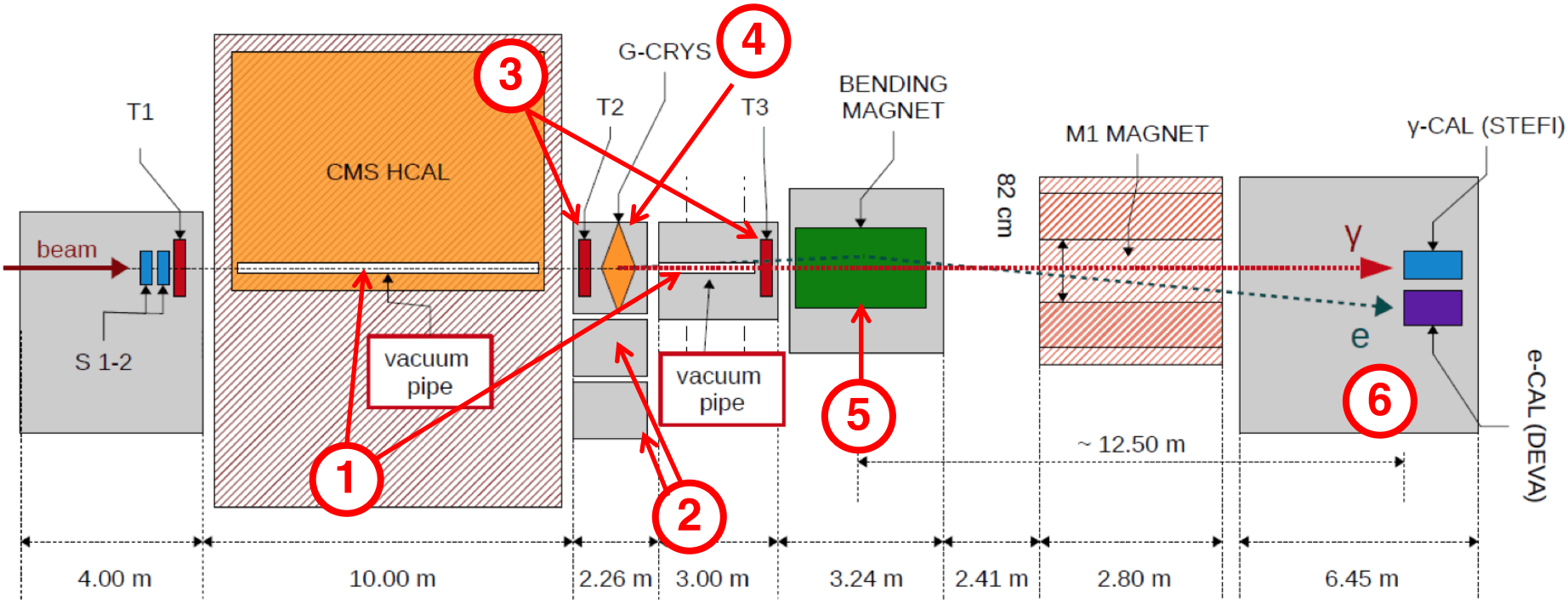
1. Two 3x3 CRILIN test layers
2. Explore possibility to load one layer (9 crystals, 10x10x40 mm^3) with PWO-III instead of PbF_2
3. Faster electronics, better signal shape

Simpler test setup than for 2021:
20-120 GeV e^- (no tagged γ)

Test objectives:

1. Perform complete operational test, possibly including cooling
2. Test cluster reconstruction capability, especially for time resolution
3. Conceptual test of longitudinal segmentation
4. Possible to study angular effects by aligning beam with axis of central crystal

Hardware needs for 2022



Essentially same setup as for STORM

1. Vacuum pipes
2. Extra concrete blocks
3. Yellow plinths (maybe already installed?)
4. XSCA table
5. MBPL magnet
6. DESY table

Beam requested for 2022

Particle type	Electron/positron
Momentum	20-120 GeV (20 GeV intervals)
Intensity/spill	Up to 10^5 particles/spill (or highest available)
Purity	As high as possible (given NA62 running)
Spot dimension	few mm in both x and y (as in 2018, 2021)
Beam divergence	< 90 μrad in both x and y (as in 2018, 2021)

Note:

- Beam parameters are fundamentally same as for STORM
- No tagged photon foreseen running this year

  Briefly discussed as possibility if electron beam very poor,
  but we will find a workaround solution (downstream calorimeter cuts)
- Possible brief request for parallel muon beam file (mips)