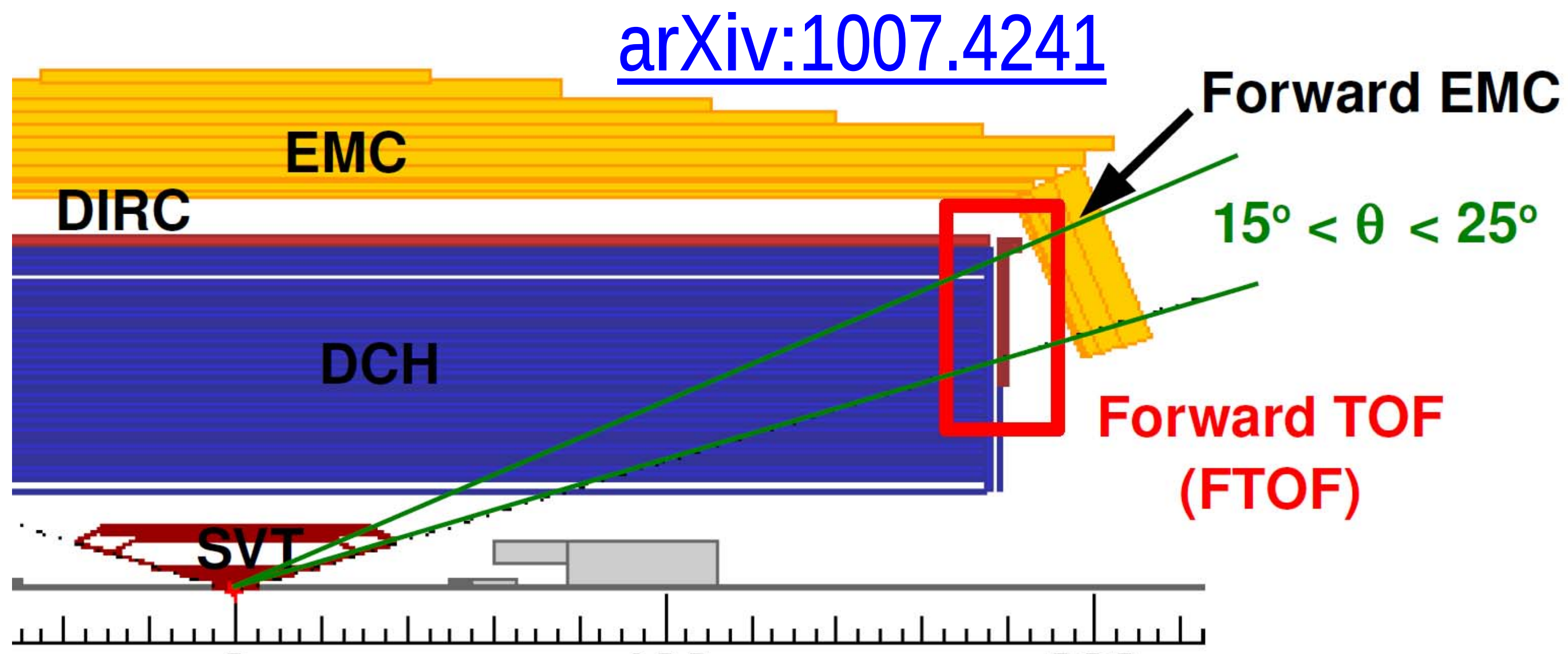
A **Particle ID detector** for the **forward region** of SuperB

arXiv:1007.4241



Side view of the *SuperB* detector

❶ Charged **Particle IDentification (PID)**: key tool for *SuperB*

- **Barrel region**: π/K separation up to a few GeV/c provided by the '**Focusing DIRC**', successor of the BaBar DIRC.
  → **See dedicated talk** by **J. Va'vra** (SLAC)
- **Forward region**: not covered by the FDIRC – dE/dx only
  ⇒ **A dedicated detector would improve the PID coverage**: higher signal efficiency, better background rejection.
  ⇒ **Design selected by *SuperB*: a Forward Time-Of-Flight**

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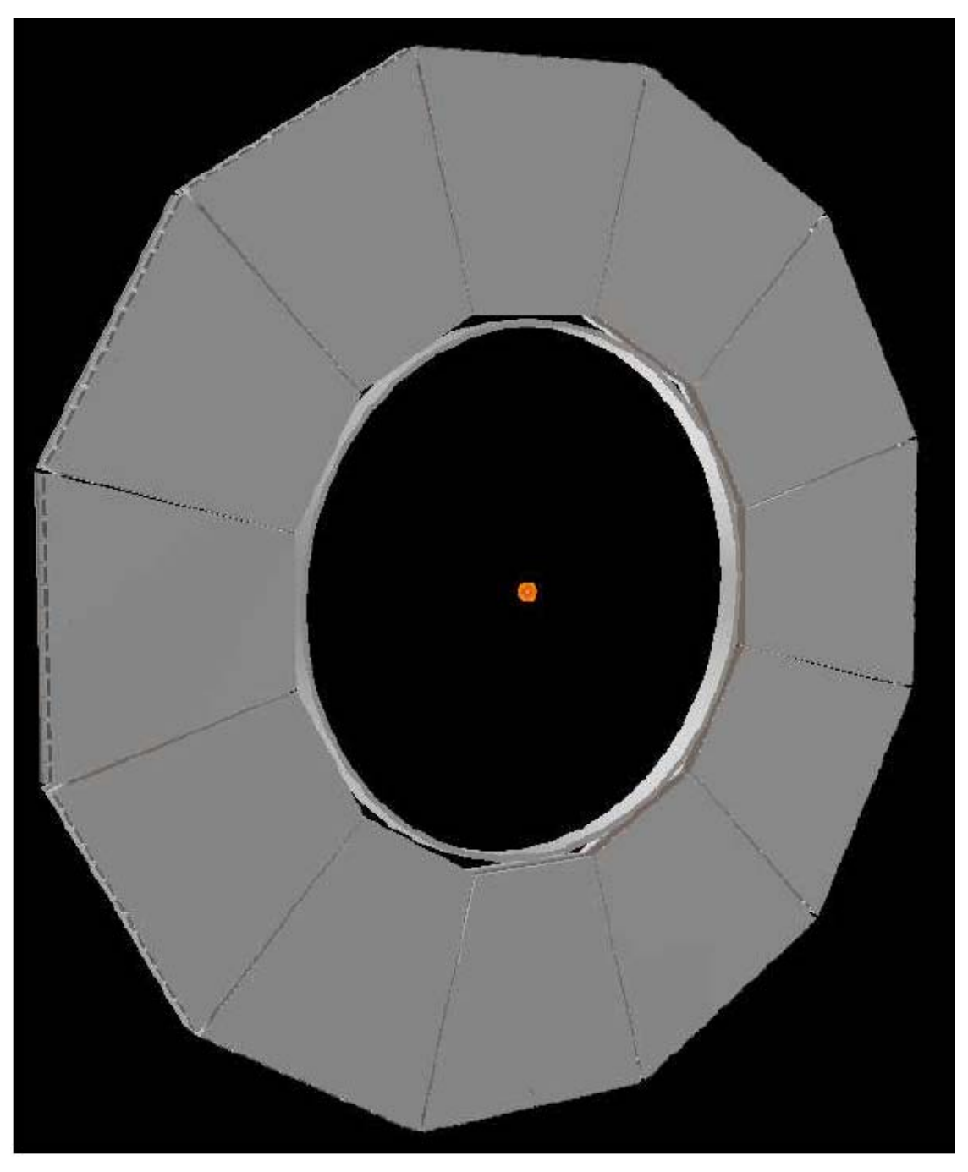
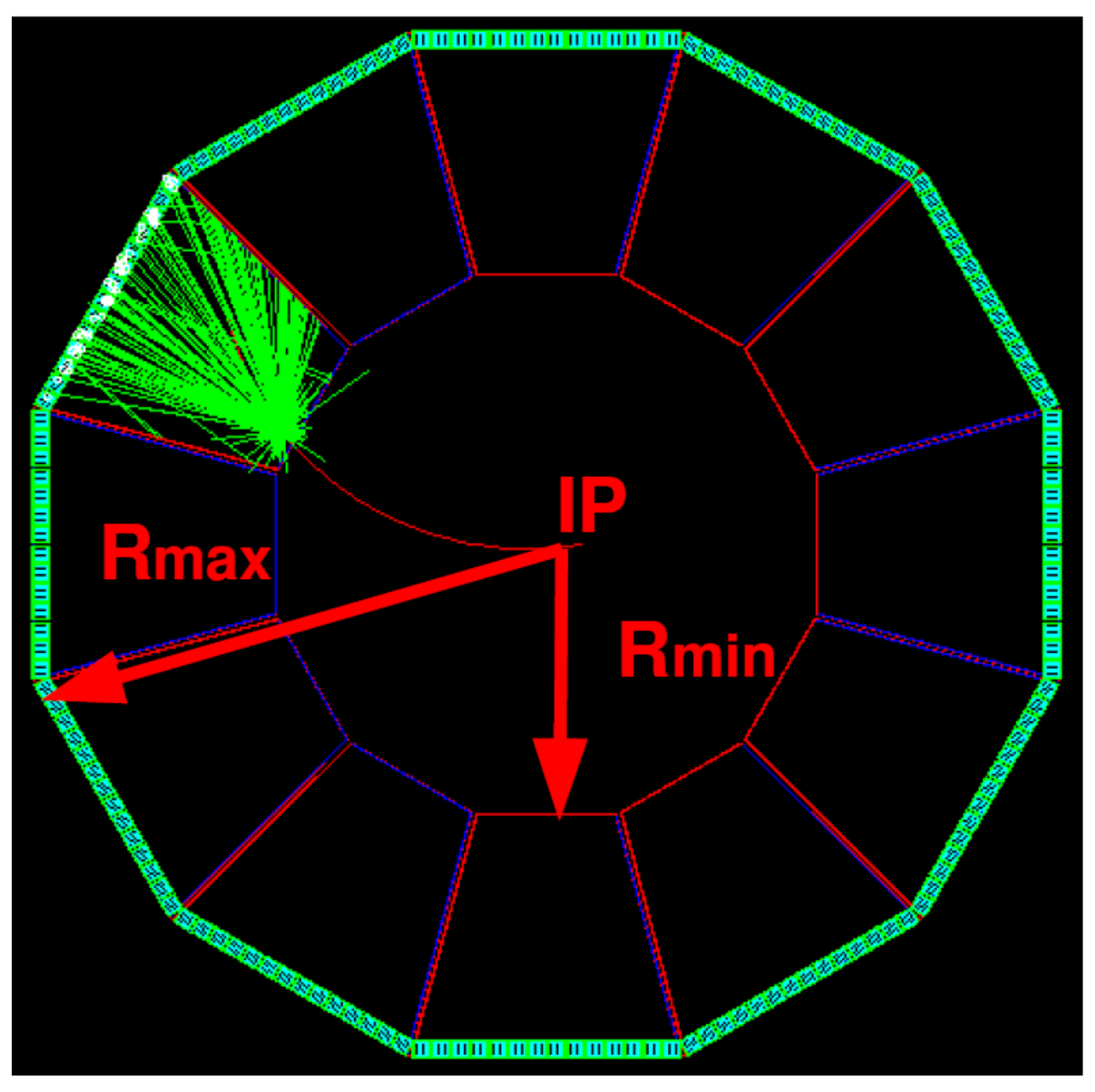
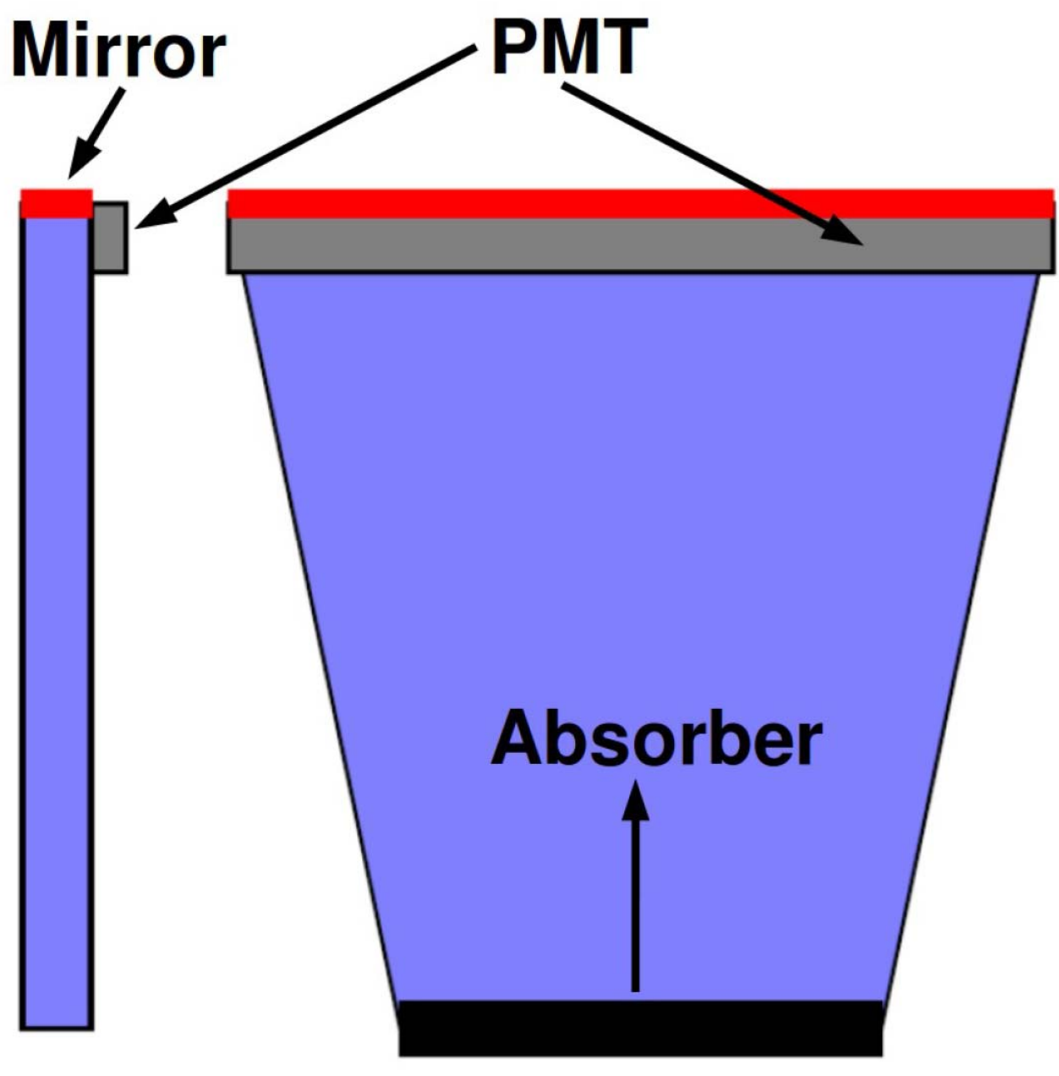
❷ An innovative detector: the DIRC-like Time-Of-Flight for the *SuperB* Forward side – the FTOF

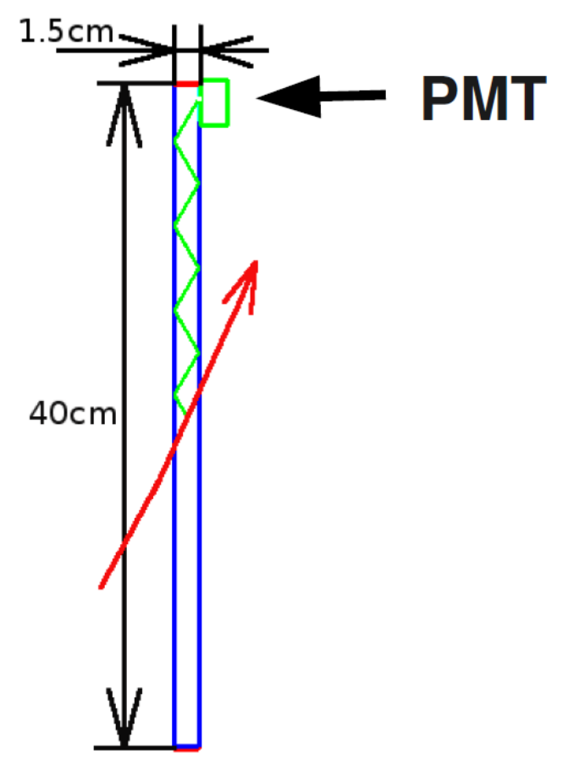




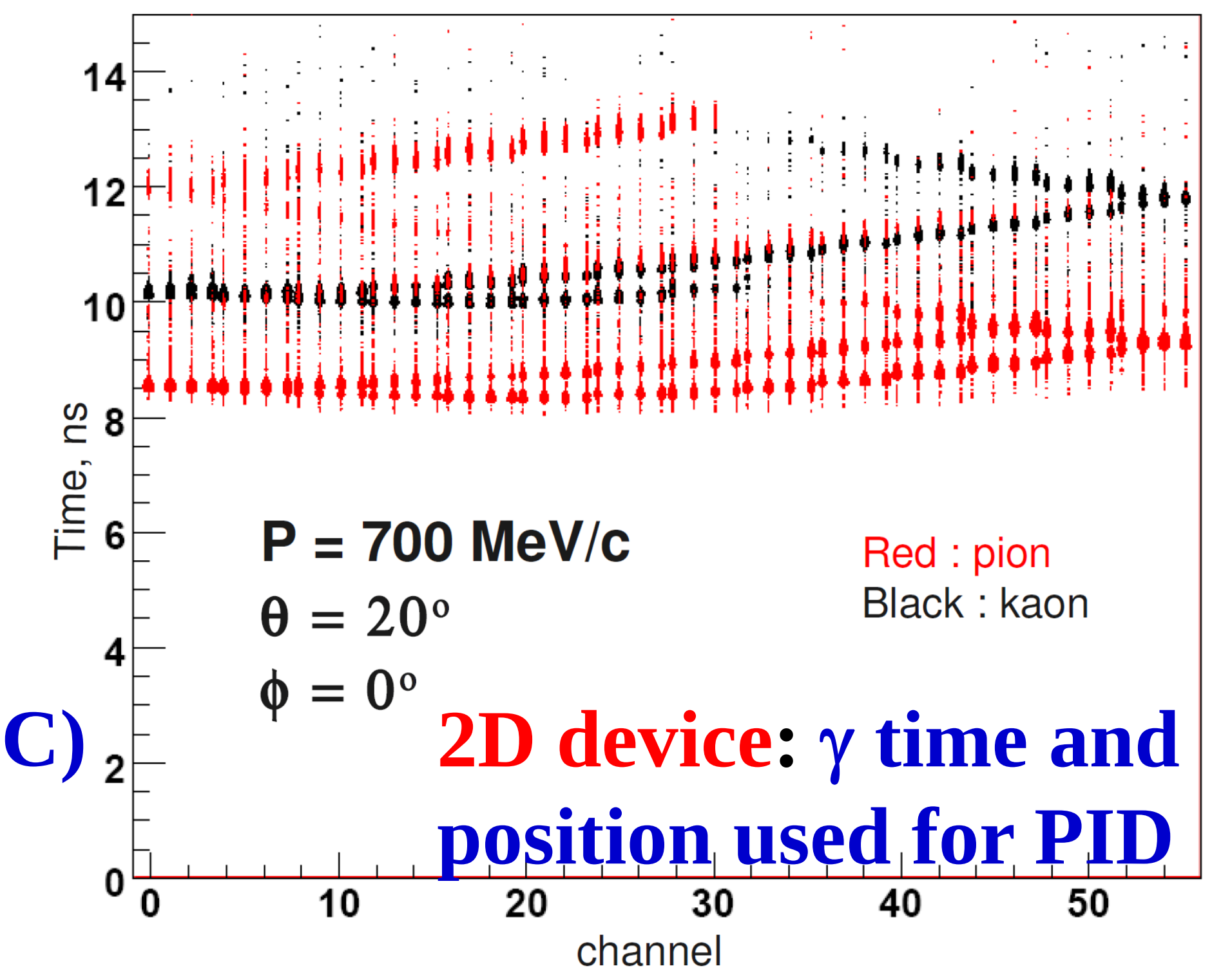
- Original idea by SLAC, then development @ LAL
- Reference: **L. Burmistrov**, PhD thesis (2011)
  http://publication.lal.in2p3.fr/2011/Thesis-Burmistrov

- **12 thin** (1.5 cm width) tiles of **fused silica** covering 2π
- Charged particles produce **Cherenkov light**
- γ trapped by **internal reflection** reach the **MCP-PMTs**
- **Flight path ~ 2 m ⇒ 30 ps total accuracy needed**





- **G4-based optimization** of the geometry
  → Main criteria: ↑ **photon yield**
  ↓ **timing spread**
- **Very fast MCP PMTs** needed
  → **e.g. the Hamamatsu SL-10**
  168 in total for the FTOF; 4 channel / γ detector
- **New ultra-fast electronics**: **USB WaveCatcher (USBWC)** developed jointly by LAL and CEA/Irfu
  → **See dedicated poster**



2D device: γ time and position used for PID

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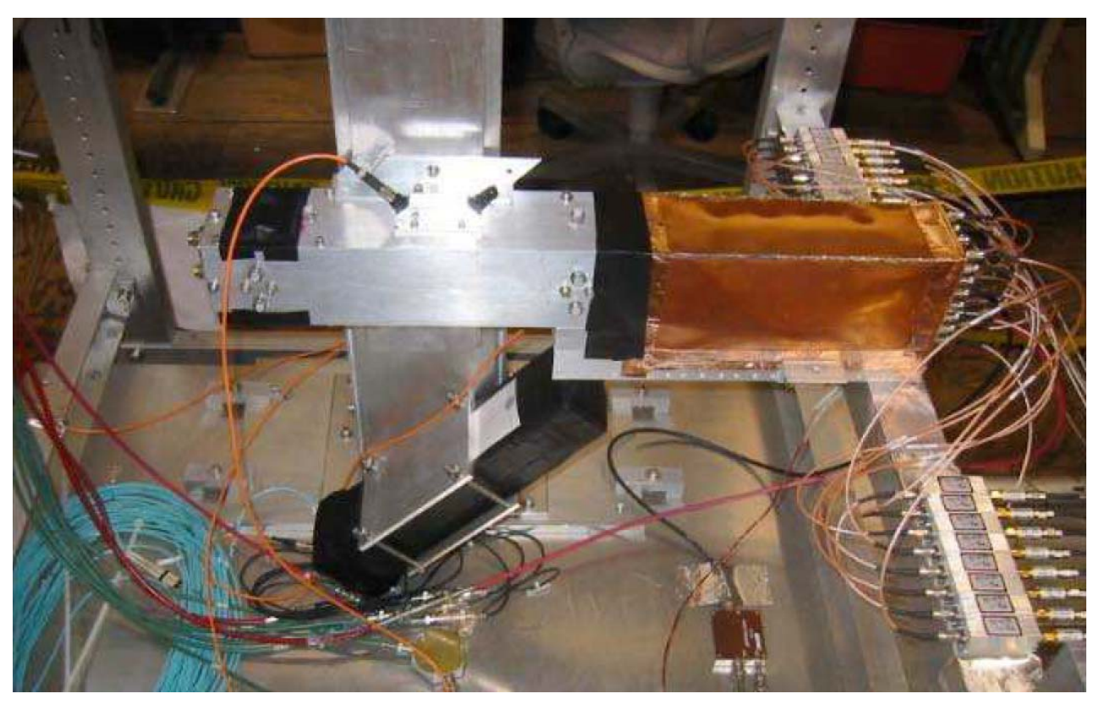
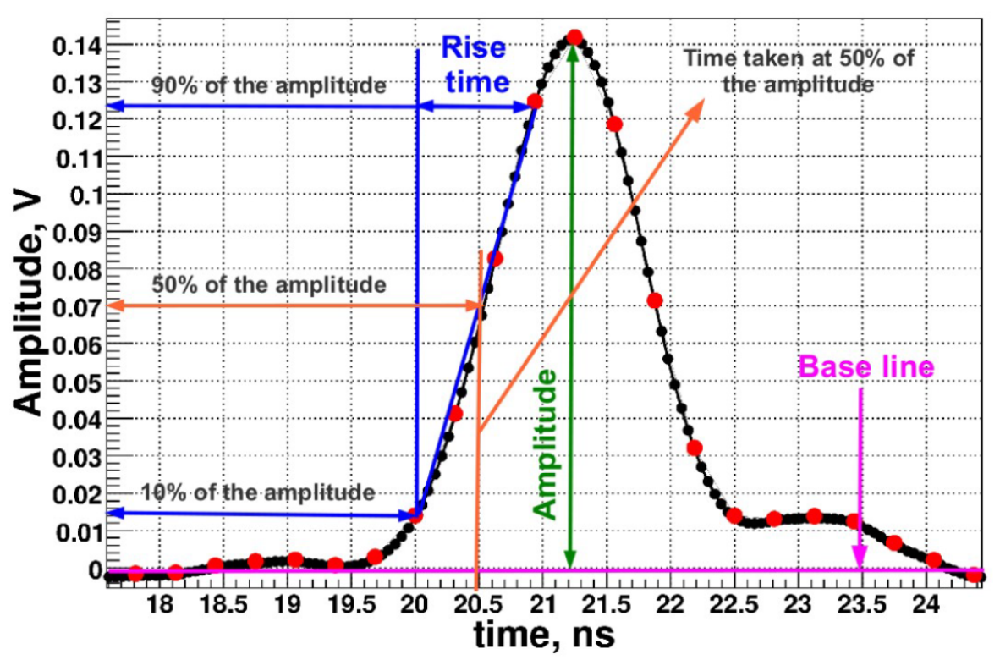
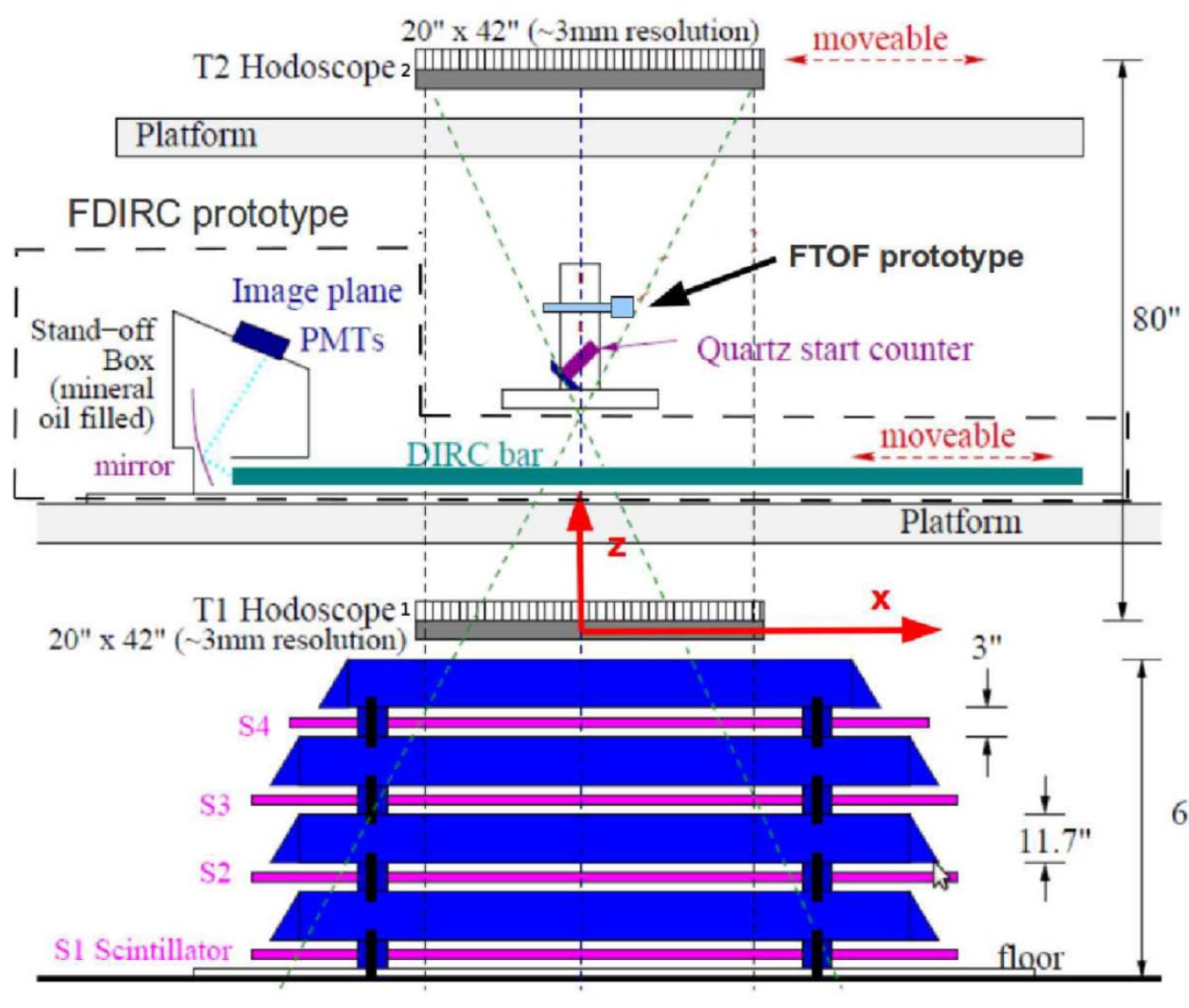
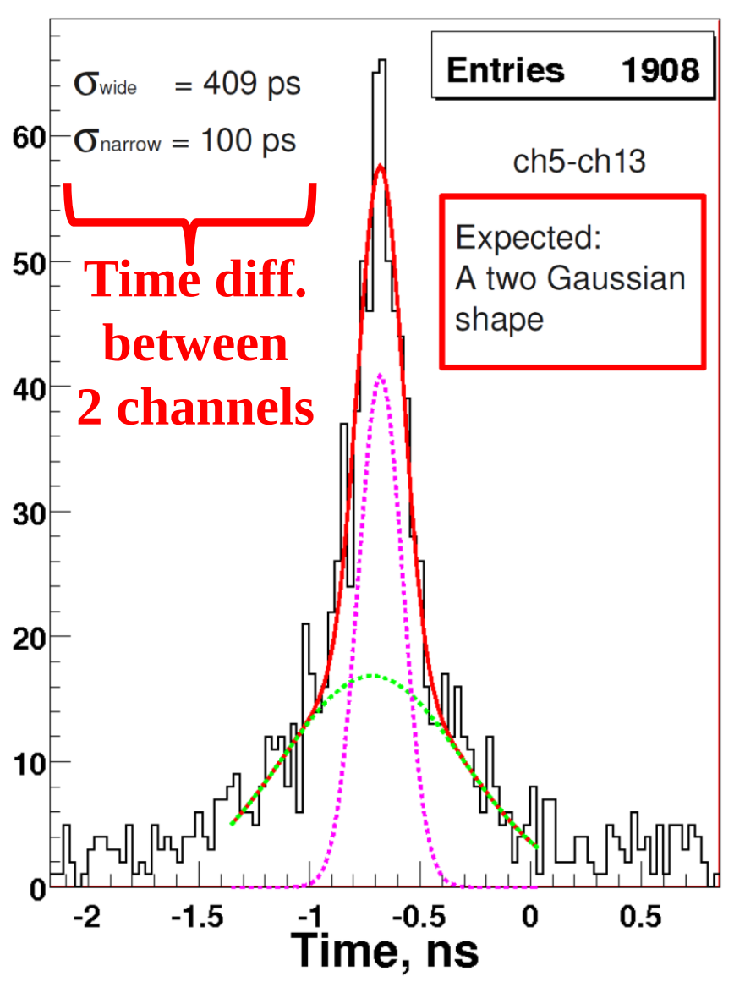
❸ 2010-2011: test of the FTOF concept @ SLAC Cosmic Ray Telescope (CRT)

- ▪ Two quartz bars, readout by a MCP-PMT
- ▪ **Eight 2-channel USBWC** electronics boards
- ▪ **Waveform analyzis** for timing measurements

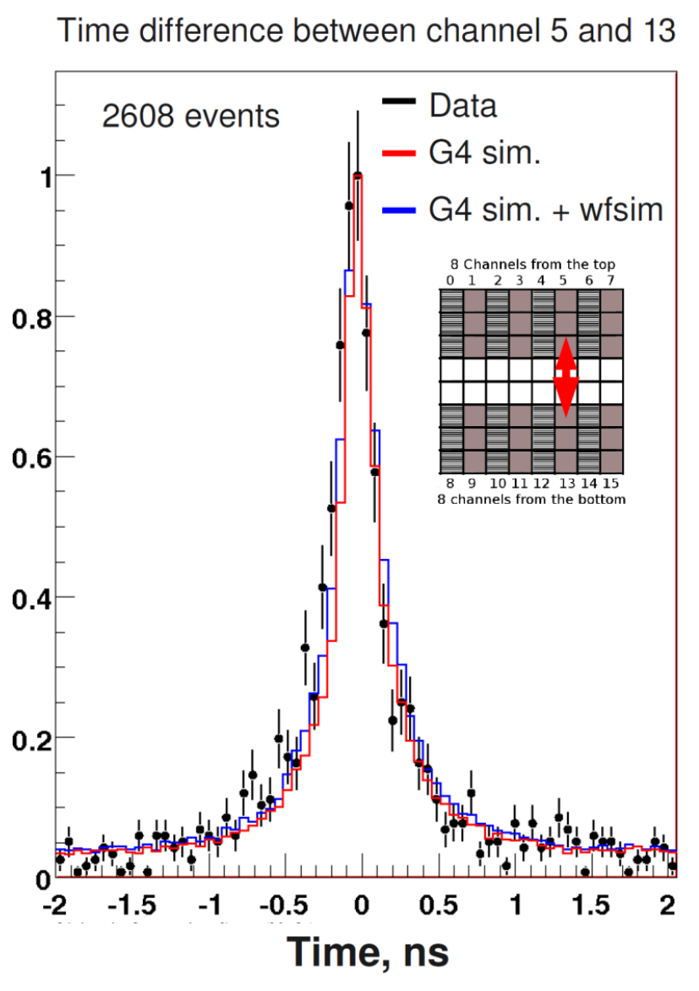








Example of **time diff. between 2 channels** ⇔ Timing accuracy per γ ($\approx \sigma_{narrow}/\sqrt{2}$)



Good agreement data/MC

$$\underset{\text{Reso. per channel}}{80\text{ ps}} = \frac{\sigma_{\text{narrow}}}{\sqrt{2}} = [\sigma_{\text{detector}} \oplus \overset{35\text{ ps}}{\sigma_{\text{TTS}}} \oplus \overset{10\text{ ps}}{\sigma_{\text{electronics}}}] \oplus \sigma_{\text{muon}}$$

$$\sigma_{\text{detector}} \oplus \sigma_{\text{muon}} = 70\text{ ps}$$

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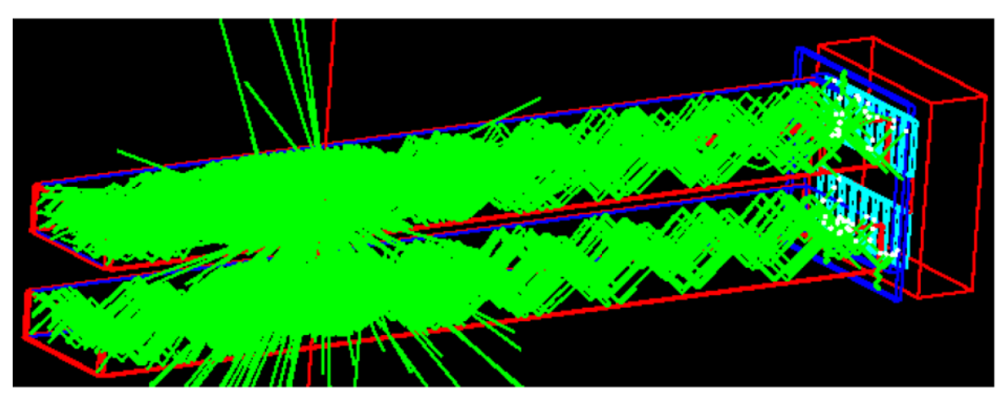
❹ Next on the agenda (LAL + LPSC + …)



- ▪ Reanalyze CRT data using 3D-tracking
- ▪ Purchase quartz tile(s) and MCP-PMTs for tests

→ **Build a full-size FTOF sector for validation in cosmics & beam test**

→ **Goal: final *SuperB* approval**

- ▪ **Reconstruction** algorithm
- ▪ **Background estimation & mitigation** (MCP-PMT **integrated charge**)

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