RDC9 R&D plans

Introductory remarks
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The big questions

- We seek technologies with transformative power on:
  - the energy resolution of calorimeters,
  - ultra-fast light collection
  - high spatial and time resolution in harsh environments.
  - Efficient light collection with fast photon detectors
  - Front-end electronics to optimize energy/time resolution
  - Efficient use of waveform sampling for time stamp/pile-up suppression
  - Overall system optimization [lightweight support structures, cooling, power distribution, data concentration and transmission]
Areas of interest

1. New materials for calorimetry, and how they can be tailored to a specific application (including prospects from nanotechnology)
2. Front-end electronics needs for high energy resolution
3. Front-end electronics needs for picosecond timing calorimetry
4. System aspects (mechanical): low mass support & cooling
5. System aspects (electronics): powering scheme & interconnections
6. System aspects (data processing): “intelligent calorimeter”
7. Concepts from the above lines of investigation that can be adapted to hadron identification (time-of-flight, RICH….)
Emerging technologies – PID

- Synergies with MCPs now developed for medical applications [see presentations by Kepler Domurat-Sousa and Cameron Poe]: construction of MCPs that are less expensive and more suitable to “industrial-scale” production.

fermilab FBTF PID

Time-of-flight particle ID measurement principle

\[
\text{Single particle TOF} \\
\Delta t = \frac{d}{\beta} \\
\Delta t = \frac{d}{\sqrt{1 + \frac{m^2}{p^2}}} \\
\Delta t = \frac{dE}{p}
\]

TOF difference of two particles

\[
\Delta t_2 = \Delta t_1 - \Delta t_2 \\
\Delta t_2 = \frac{d}{\sqrt{1 + \frac{m_1^2}{p_1^2}} - \sqrt{1 + \frac{m_2^2}{p_2^2}}} \\
\Delta t_2 \approx \frac{d}{p_1} (m_1^2 - m_2^2) \\
\text{(when relativistic and p1>p2)}
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Jinseo Park
On PSEC5 chip