LED pulser for ESC

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draft by Peter

1 Purpose

The LED system should

1. provide general diagnostics (PM ok, scintillator ok, stability)
2. check flat efficiency after mu stop

Item 2) is the more critical requirement

2 Quantitative Requirements

2.1 What accuracy required

First of all, there should not be a time dependent electron efficiency like (simplest case)

```
eps@t_, a_, b_D := eps0 I1 + a E^-br0tM
```

in MuCap. While this sounds reasonable, how can one proof it? The resulting time distribution

```
g@ax_, bx_, t_D := H1 - axL E^-r0t + ax E^-bxr0t
```

to first order in ax, rele, the relative change of r_eff, is

$$\frac{ax\,H-1+bxL}{bx^2}$$

i.e. ax/4 @ bx=2, 2 ax @ bx=0.5. Of course, a more detailed study is required to determine which values of bx can be separated in the fit and which need independent information. So roughly an accuracy of 1E-5 required.

2.2 Is there a chance

to determine this with a pulser? In general the effect of an threshold variation leads to an efficiency variation as

$\Delta\varepsilon = f(Et)\,\Delta E / \int_{Et}^{\infty} f(E)\,dE = k\,\Delta E$

where Et is the threshold energy and f(E) the differential energy spectrum. For real electrons in ESC k is about . For a narrow pulser centered at the threshold k is . Hopefully we win 2-3 orders of magnitude there.

2.3 Other methods

Other methods are

study auto-correlations

introduce distance to previous electron pulse

mu+ measurement and comparison to PDG and MuLan

electron peak amplitude with WFDs

?

3 Realization

Either as random accidentals or after mu stop. I would prefer the former, if we can get the statistics, because this avoids any correlations to the mu stop a priori.

Nevertheless, one has to worry that the real electrons do not interfere with the tagged pulser signals.

We should subdivide the pulsers on the detector element. In the end we want to measure if a electron trajectories efficiency is time dependent, so global, simultaneous pulsing of the whole detector is an unrealistic simulations for this case. Also the up and downstream end of the gondola should be pulsed independently. A reasonable scheme based on a few led boxes with distributor fibers should be worked out.

Is there a reasonable chance to achieve sufficient statistics, without taking too much pulser data?

Long term stability monitoring with PIN diode could/should be implemented, but probably not very important.

4 Tasks

Several tasks are evident:

Study section 2.1

Fill in numbers for 2.2

Think about 2.3

Make concept for 3

Other uses of pulser?

5 Literature

A lot.

Ask Peter or Cenap.

See also the French fiber system of our G0 collaborators.