Collection of EMCal Readout Requirements (vFeb2024- siPM/Adapter Focused)

Energy Resolution (Cluster) A = 2.5% + B = 1% **Earlier 2023** 1%+2.5%/sqrtE [**+ 1%/E ?]**

Spatial resolution: 1+3%/sqrtE

Linearity : non-linearities correctable to <= 0.5 %

Threshold (single tower) : ~5 MeV

Dynamic Range : Tower level 2-5 MeV to ~15 GeV (x 7500-3000) (Cluster level -20-100 MeV – 20 GeV)

(assume >= 1-3 ADCU per 5 MeV – which is threshold target.)

In pC : ~10pC to 30-75nC [?]– per channel : (min pC from summer epic calo questionnaire document answer of "10-10000pC")

ADC : 14bit [?]

Rate Capability : 20-100 kHz (highest channels): Dominated by beam backgrounds, to be confirmed by further studies

Waveform/timing: All three of the below TBD
Timing resolution : identify bunch crossing ~10 ns -- [can assume >=2 tower measurements if needed -? 14 ns?]
Peak Time, **N_samples :** >= 3-5 in Peak + 2 pre-pedestal?
Sampling rate : determined by above 40-80 MSPS

Noise Requirements TBD by timing/resolution requirements: Pre-raddamage : DCR <= 3-10 MHz Dark Current: <=1.4 microAmps [Gerard's fEcal siPM presentation] Post-rad-damage

Temperature/ Heating

Temperature Sensitivity of siPM's - (Confirmation) tests of this would be good w/ w/o rad damage etc… look for opportunity

Temperature Stability - tied to previous

Power consumption / Heating

Pre-amp location [on adapter or preferably on IU adc board w/ 60 cm cable] - will be tested by Gerard IU.

Less Likely to be a concern in decisions:

Operating voltage vs gain variation [Hamamatsu testing/batching] -- mfgr characterizations so far enough – not a concern [GV: Gain compensation will be adjustable by slow controls anyway… So really the slope does not need to be known in advance, better than +/-50% maybe.]

Operating voltage uniformity per siPM : ~~same~~ [GV: Well… This does matter. Probably need to match Vbr for SiPM's on one board or channel, so we don't need too many channels of bias voltage control.]

References:

Other requirement/specifications from ~1 year ago (2023) [assuming fADC 250Mhz's]:

https://wiki.jlab.org/cuawiki/index.php/OVERVIEW_OF_SPECIFICATIONS

Copy of summer epic calo electronics questionnaire (from Carlos?) :

https://drive.google.com/file/d/1erBCQ4AmwQL-fZnVqWb6ZGZlcVh9z9XC/view?usp=drive_link

Min Threshold Study : Sasha Bazilevsky Aug 2024:

https://indico.bnl.gov/event/20245/contributions/79460/attachments/49044/83535/epic_MinE.pdf