

RADiCAL going forward - 5 June, 2023

Fundamental/Initial Work

1. We have equipment yet to be returned to the US. Status:
 - a. RADiCAL module - gamma spectroscopy
 - b. Pb glass - Ba 186
 - c. Other items: MCP, CAEN DRS4, FE cards,...
2. We have requested per diem for students.
 - a. **No word yet from Euro - Labs fund**
3. We have 30+M triggers over electron energy range from $25 < E < 150$ GeV
 - a. James has created a google site for information and also a google sheets logbook.
 - b. <https://drive.google.com/drive/folders/1ByVSS3MuvjJYxJN3c7EBACDdeU8-Q1SL>
 - c. https://docs.google.com/spreadsheets/d/1Hz8mxsaT30foSM1LqJtExPkWXnySr9WCD_s7oRQQZ1w/edit#gid=0
4. Priority is to get this data analyzed.
 1. Given extensive international collaboration, this will need to be a weekly meeting to match time zones appropriately.
 2. We now have an Indico Page for our work on Global Indico. Randy will set up access permissions and this will be used to post sides, papers, etc.
 3. <https://indico.cern.ch/category/16950/>

Analyses - for DSB1, for LuAG:Ce

1. Energy resolution
2. Timing resolution
3. Position/spatial resolution
4. Simulation studies
5. Novel fiber arrangements including timing and energy measurement

RADiCAL going forward - analysis

Organization - Initial Work

1. Data all moved to convenient and accessible location(s)
2. Discard bad or marginal data files.
3. Event synchronization between CAEN modules
4. Set up a ROOT file structure for events for group to use.
5. Set up a set of ROOT tutorial sessions to train analysis team.
6. Wire chamber (WC) localization at the RADiCAL module: determine (x,y) coordinate system.
7. Review MCP pulse shape as a function of chamber (x,y) and set threshold for appropriate regions to set MCP time stamp.
8. Organization needed and responsibilities taken.
9. Milestones/Timeline need to be established with attention given to meetings and presentation opportunities.

Energy analysis - for DSB1, for LuAG:Ce

1. Calibration of Capillary Energy Signals - up and downstream.
 - a. Use WC info to locate beam within the 14x14 module
 - b. Develop energy shape script
 - c. Sum of energy scaled to beam energy of the data file
 - d. Set up ROOT script for general usage
2. Calibration of PbGlass Energy Signals -
 - a. Use WC info to locate beam outside of 14x14 module, but within the 20x20 trigger counter region.
 - b. Sum of energy scaled to beam energy of the data file
 - c. Set up ROOT script for general usage
3. Compare RADiCAL Energy vs PbGlass Energy
 - a. For various beam energies
 - b. Look at upstream and downstream signals - do we see evidence for Cherenkov signals downstream?

RADiCAL going forward - analysis

Timing Analysis - DSB1 and LuAG:Ce

1. Develop timing pulse shape script
2. Compare timing pulses upstream and downstream in capillaries.
 - a. Scale/compare these with corresponding energy signals
3. Set thresholds appropriate for upstream and downstream time stamps.
4. Divide module into 9 subsquares of $4.67 \times 4.67 \text{ mm}^2$ based on WC beam position
 - a. Find average time (sum of 8) for each region and compare with MCP time stamp
 - b. Find time resolution for each beam energy based on these subsquare locations. At this stage optimal would be the central region.

Timing Analysis - DSB1 and LuAG:Ce

5. Time walk correction - for upstream and downstream time stamps.
 - a. For each high gain signal, compute time difference with respect to the MCP.
 - b. Plot this difference vs the distance of the WC beam position from the capillary center.
 - c. Use resulting correlation fit to correct time walk.

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Position Analysis - DSB1 and LuAG:Ce

1. Develop energy pulse shape script
2. Compare energy pulses upstream and downstream in capillaries.
 - a. Sum these for each capillary
3. Plot energy pulse integral (or amplitude) vs distance from capillary center for each capillary as a function of WC location.
 - a. Identify, if possible, a correlation fit parameter
 - b. May benefit from 9 subsquares of $4.67 \times 4.67 \text{ mm}^2$ based on WC beam position to help form correlations based on subregion

Position Analysis - DSB1 and LuAG:Ce

4. Analytical possibilities (may be more)
 - a. Form Sasha (u,v) coordinate system approach:
 - a. $V = (E_{ne} - E_{sw}) / (E_{ne} + E_{sw})$
 - b. $U = (E_{nw} - E_{se}) / (E_{nw} + E_{se})$
 - c. Plot comparison of RADiCAL (U,V) vs WC (X,Y) to determine position resolution for EM shower.
 - b. If a fit form form E_i vs radial distance r_i to WC location can be found, for example: $E_i = E_{i0} * (1 - a * r_i)$
 - a. Find r_i for each capillary. Note a may not be universal but may depend on subsquare.
 - b. Compare such forms in the 9 subsquares and find intersections of circles of radii r_i from each of the four capillaries to find possible hit location.
 - c. Then compare with WC(X,Y) to determine position resolution for EM shower.

RADiCAL going forward - analysis

Simulations - DSB1 and LuAG:Ce

1. Build on Sasha's existing work if possible.
2. Optical transmissions and effects with GEANT vs Slitrani
3. Confirm current performances
4. Develop future designs based on this test beam experience.

Novel arrangements of WLS

1. To be studied once basic measurements are understood and determined.

During Alignment Procedures: May 26, from Sasha

