Ax-Pet Daq/analysis meeting
21/10/09


Agenda:
Status of measurements Mod2 (bld 304)
1. Pedestal problems
2. Accidentals (too many photoelectric effects observed)
3. Studies of Compton kinematics & Comparison data - simulations
4. Energy calibration Mod 2

CHANGE IN THE TIMETABLE: from next week on, the meetings will be at 9:00 instead of 9:30!!

1. Pedestals (see attached plots)
- all pedestals are intended with bias (MPPC) off and power (Ampl) on
- deformation in the WLS pedestals (tail at low values) observed
- the mean value of the pedestal is unaffected
- the problem appears only for WLS (all normal for LYSO)
- it was good before
- need to be investigated

2. Accidentals (photoelectric effects) (see attached plots)
- Starting point observation: too many photoelectric effects (1! lyso) are observed everywhere in the target, even when the small tagger is used. This is incompatible with the beam spot geometry, resulting in accidentals.

- Tests done: different runs at different thresholds on the tagger PMT:
  a) default THR = 80 mV without Pb bricks around => known behavior
  b) THR = 200 mV (right below the photopeak, cutting all Compton events in the tagger) => still the same behavior (i.e. the contribution to these accidentals events does not come from events that scatter somewhere around the setup -other than lead bricks- and are then detected by the tagger)
  c) THR = 400 mV (right above the photopeak, cutting all good events that should be in coinc. with the tagger) => A coincidence rate of ~ 3 Hz is registered. It is due to the 1.2 MeV photon from the source (photoelectric + Compton spectrum) in coincidence with a 511 keV in the module (not constrained to follow to any geometrical configuration). A uniform occupancy in the target is seen, as expected, with the attenuation at different layers. The number of registered events is compatible with the accidentals registered before. These events (1.2 MeV in the tagger in coincidence with 511 keV in the module) are the source of the observed accidentals in the photopeak events.

- Actions to be taken: suppress the high energy hits in the tagger (either with a coinc. unit >4 inputs, or with a common veto to the coinc. unit)

3. Compton kinematics (see slides)
- First studies of Compton scattered events. See results on the slides.
- Outcome of discussion:
  - a run is needed with only LL thr on module sum, in order to increase the statistics of low energy hits and check the WLS performance vs lyso energy (presently spectra are dominated by photopeak events or 2 hits events photopeak + escape line).
  - more studies are needed, but first hints are that Compton events could be resolved down to ~ 100 keV at max.
- A strange angular distribution (promoting 180° evts) is found. Needed to be crossequicked with simulations. Suggestion: When the small tagger is used, one should constrain the first hit in the only few crystals seen by the beam spot.

**Simulations & comparison with data:**
- A few crystals weighted by Thomas => LYSO density is 7.1 - 7.4 g/cm³ (computed using the nominal size for crystals: 3x3x100mm³).
- Still there is some uncertainty on the percentage of the different components.
- With a reasonable Lu concentration (72%) a big discrepancy data-simulations is observed (too many photoelectric events in the data). The observed accidentals fraction (see above) is not big enough to explain this discrepancy.

4. **Energy calibration Mod2** (see attached plots)
- Energy calibration performed on Mod 2 using several couples of runs (intrinsic radioactivity + external trigger); by default, high thr (70 mV) is used on the Gp5 for the calibration, but a dedicated run with low thr (30 mV) is done and the Lu escape line peak is included in the calibration.

- Summary of the results:
  - For all the runs at 70 mV thr: the calibration procedure applied to every couple of runs and cross checked (with the uniformity of the photopeak positions after calibration) on the same run used to derive the calibrations gives consistent (good) results.
  - However, the calibration derived for one set of data does not apply to the others. The reason is that, despite the fact that the BIAS IS ADJUSTED BY THE RECORDED TEMPERATURE, the ADC values of the peaks (already before calibration) do not match from one run to the other. This is a potential problem that needs to be investigated!
- Calibration performed at 30 mV:
  i. the Lu escape line can be added in the calibration; its effect is almost irrelevant on the final photopeak positions, but helps in having a smaller spread (among the different channels) in the distribution of the offset parameter for the calibration fit (par[0] : En(ADC=0)).
  ii. the photopeak position (after calibration) for the 30 mV thr data is on average ~ 505 keV, significantly lower than 511 keV. Also, comparing the raw spectra, it looks like there is a shift in the data with external trigger and intrinsic radioactivity. Need to be repeated with other runs and understood

**Open points raised by the energy calibration studies:**
1. Dependence of the Vbias vs Temperature
2. Difference in the positions of the peaks for conditions: 30 mV vs 70 mV / internal vs external trig.

3. **The Sample & Hold Time Tuning on Mod 2 has not been done so far!!!** This could be the reason of the generally lower gain recorded for Mod2 wrt Mod1 and maybe (?) also of the observed instabilities. In any case, it must be done asap!