Update on MC studies for the final SuperB FDIRC prototype

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(in collaboration with Jerry Va'vra)

Overview

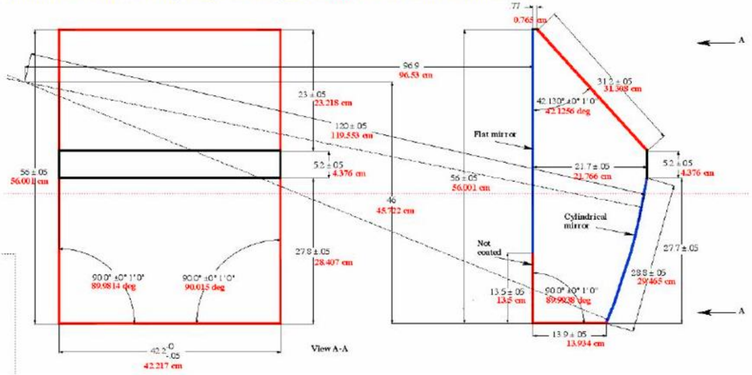
- Studies on the earlier FDIRC prototype (SLAC-PUB-15202, submitted to NIM) have provided useful experience
- Bar geometry and 3-D tracks (not $\perp$ to the bar) produces non-trivial structures in the Cherenkov ring
- Multiple reflections at various surfaces (final FDIRC camera has more of them!) introduce discrete ambiguities in the determination of θ_{Ch}
- Goal: produce a set of reliable $\{k_x, k_y\}$ "constants" for the 12-slot PMT detector-surface configuration and final FDIRC geometry for cosmic data-taking ($\sim$ October)

Updated Camera Geometry

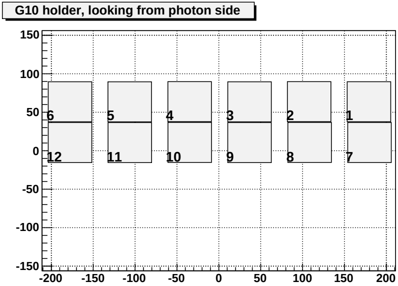
- Updated numbers (in red) from Jerry have been fed into GEANT (some changes are remaining)

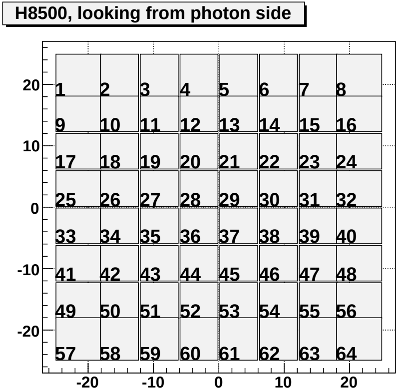
Graphical summary of numbers "as-built":

Numbers relative to my original design (in red are measured numbers):



- 12-slot G10 holder geometry with “as measured” dimensions
- H8500 geometry (from Hamamatsu) with the outer rim wider by 0.06 mm





(All dimensions in mm)

Calculating θ_{Ch}

- To start with, we have a 4-fold ambiguity for the Ch photon, $sgn(k_x^\gamma) = \pm$ (Left-Right ambiguity), $sgn(k_z^\gamma) = \pm$ (direct/indirect photons).
- We loop over all potential solutions (for the hit pixel) for $\cos(\theta_{Ch}) = \vec{k}^\gamma \cdot \vec{k}_{track}$. Cuts possible here as to which solutions we allow.
- In the end, we choose the θ_{Ch} corresponding to the least $\Delta T = (T_{meas} - T_{exp})$, where T_{exp} is calculated, assuming a $\vec{k}^\gamma$.
- This timing cut cleans up the $sgn(k_z^\gamma)$ ambiguity because direct and indirect photons are well-separated in T_{meas}.

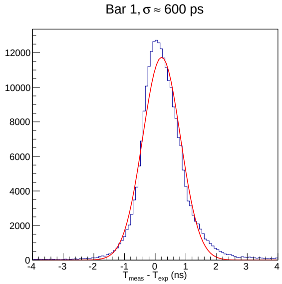
Bar 1

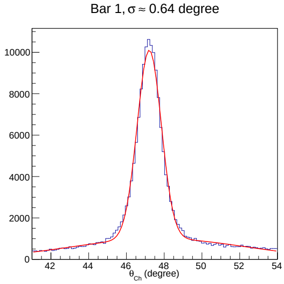
- Bar 1 is the first bar from the left

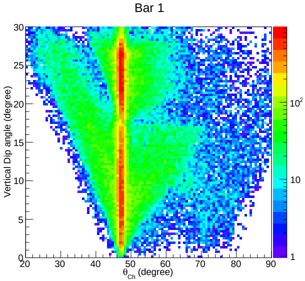
$\Delta T = (T_{meas} - T_{expected})$

Double Gaussian fit to θ_{Ch}

θ_{Ch} vs "Dip" angle w/ the vertical, for 3-D tracks







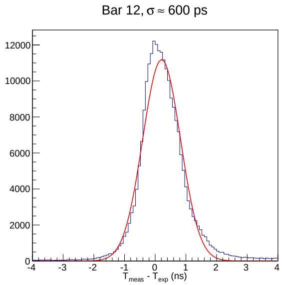
Bar 12

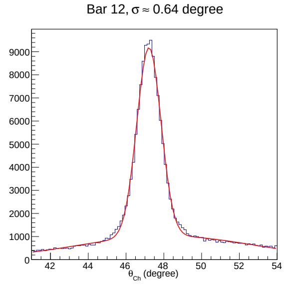
- Bar 12 is the last bar on the right

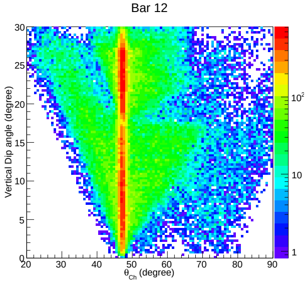
$\Delta T = (T_{meas} - T_{expected})$

Double Gaussian fit to θ_{Ch}

θ_{Ch} vs "Dip" angle w/ the vertical, for 3-D tracks



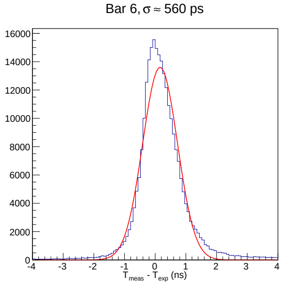




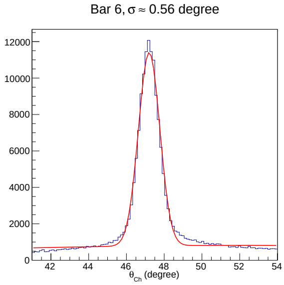
Bar 6

- Bar 6 will be our initial "working" bar for the CRT, in the middle.

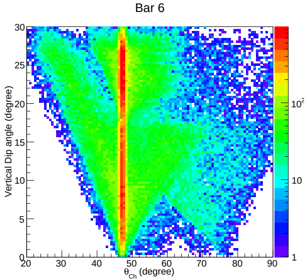
$\Delta T = (T_{meas} - T_{expected})$



Double Gaussian fit to θ_{Ch}



θ_{Ch} vs "Dip" angle w/ the vertical, for 3-D tracks



Summary and ongoing work

- Updated geometry gives reasonable results from GEANT. Preliminary "constants" available, but final test will come from the data.

- More studies on resolution will be required and "jitters" might be needed to reproduce real-data-like distributions. Incorporating the tracking resolution is one of these.

- We are still studying the issue of reducing ambiguities. Cut-based technique posible to throw away bad, or statistically poor solutions. Other ideas welcome.

Data w/ earlier prototype

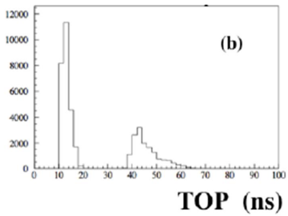
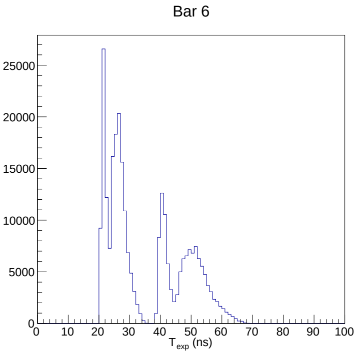


Fig.6. (a) Measured distributions of the photon path length in the bar L_{path} and (b) time-of-propagation, TOP, for the nominal CRT setup (TOP < 30 ns defines direct photons, and TOP > 30 ns defines indirect photons).

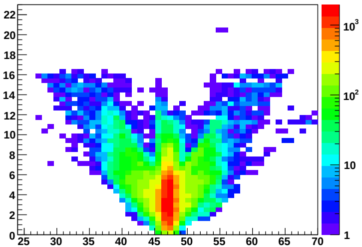
T_{exp} for current setup



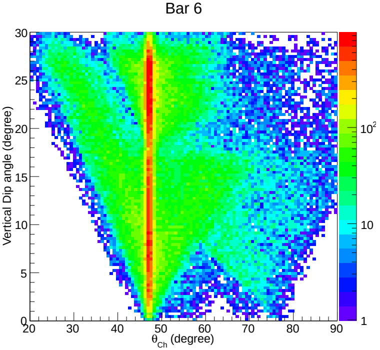
- The present direct and indirect photon distributions seem to have an extra double-structure

Backup

Previous prototype Dip angle vs θ_{Ch}



T_{exp} for current setup



- Some differences exist.