MicroBooNE PMT Distribution 101

Hans Jostlein July 23, 2010

Summary

We take a simplified, but realistic, look at PMT light gathering versus PMT location.

To do that we calculate the wave shifter disk solid angle as seen from an assumed event location. We sum over the disks. We assume further that the detector is uniform along the tank axis, hence we calculate a longitudinal slice. One can get from these solid angles to the 3-D solid angles by multiplying by roughly a factor 2.5 At the TPC ends one needs to double up PMT's at these Z-location to make up for the "absent" PMT's beyond the end of the detector.

We find (not surprisingly) that the solid angles for events far from the PMT's are quite insensitive to the PMT locations. Events near the PMT's show marked variation with the PMT placement.

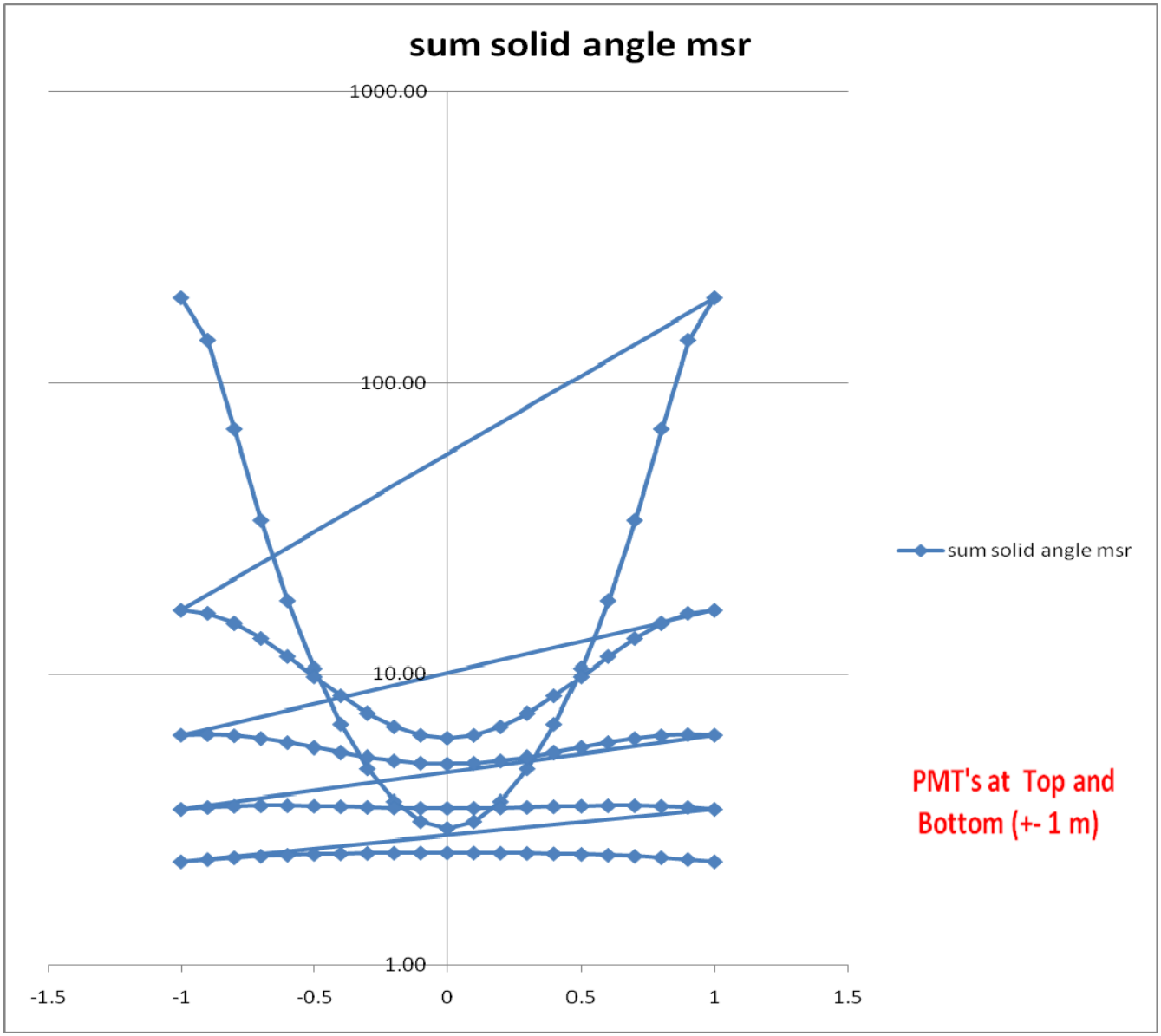
While one can even out the response for the events near the PMT plane (see the graphs) , there is an unavoidable drop by about a factor of 10 for events near the top and bottom because space does not permit placing PMT's much outside the +- 0.5 m vertical zone.

If the goal of light detection is to trigger efficiently on events at all locations, then the most relevant curve is the bottom one in all graphs, representing the solid angle for events near the cathode plane.

PMT's at Top and Bottom (Y= +-1 m)

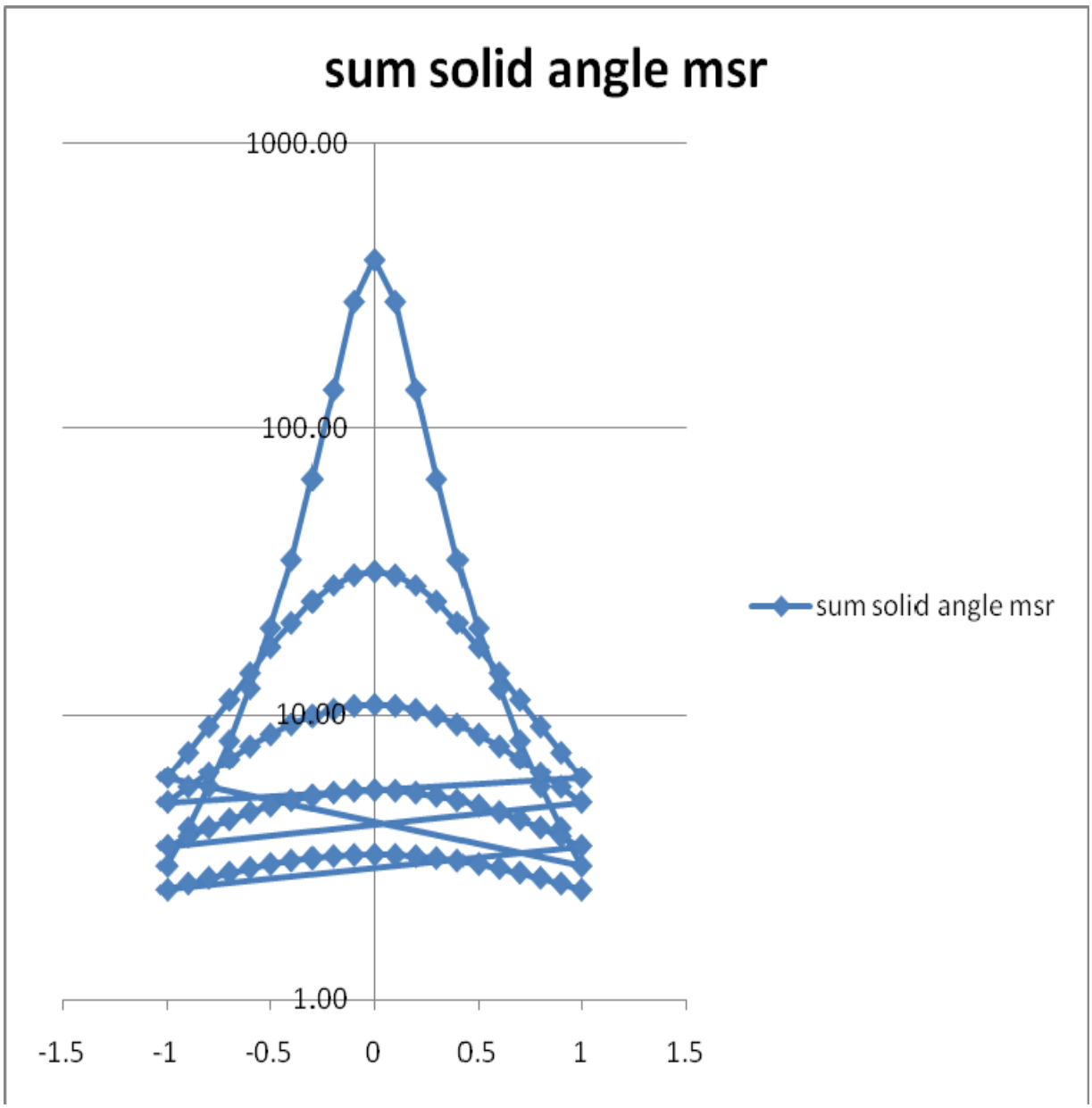
(Note that there is no room to use that location in reality)

Event locations at X = -1m, -0.5 m, center, X=-0.5m, and X= 1m.



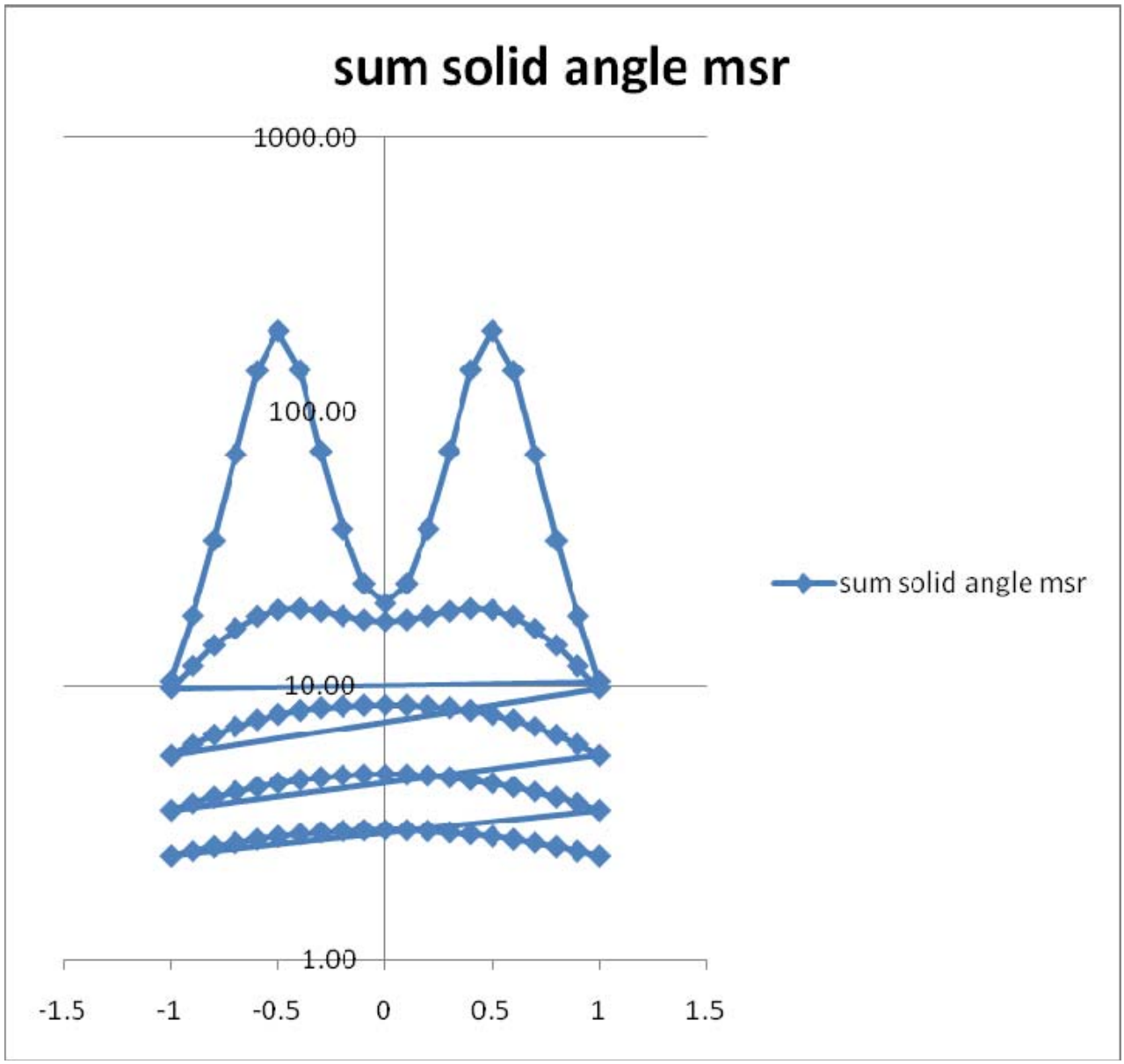
PMT's all at Mid-Height (y=0)

Event locations at X = -1m, -.5 m, center, X=-.5m, and X= 1m.



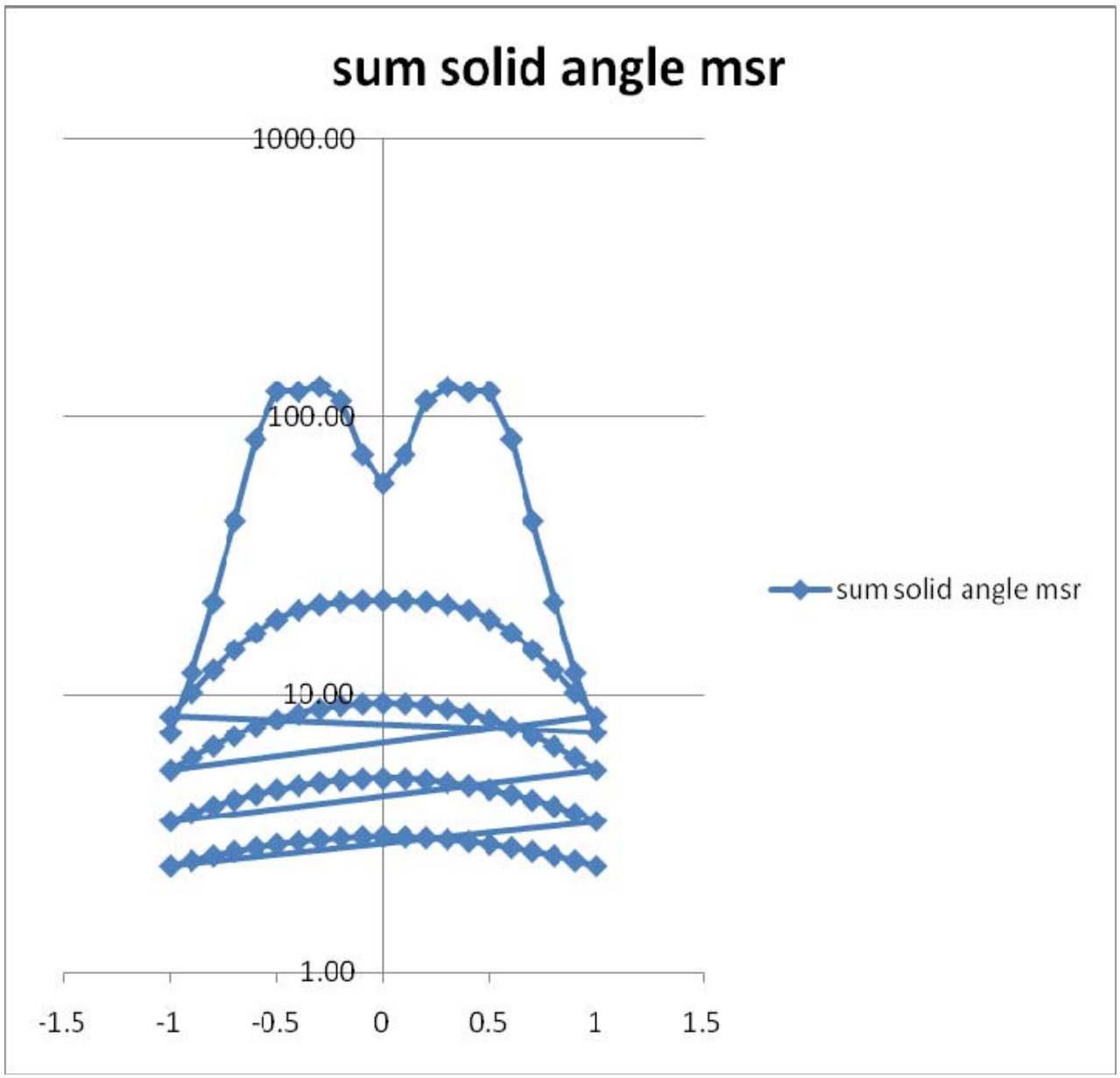
PMT's at half-heights (y= +- 0.5 m)

Event locations at X = -1m, -.5 m, center, X=-.5m, and X= 1m.



PMT's at half-heights (y= +- 0.5 m) and mid-plane (Z=0)

Event locations at X = -1m, -.5 m, center, X=-.5m, and X= 1m.



PMT's evenly distributed between Y=-0.5m and Y=0.5 m

Event locations at X = -1m, -.5 m, center, X=-.5m, and X= 1m.