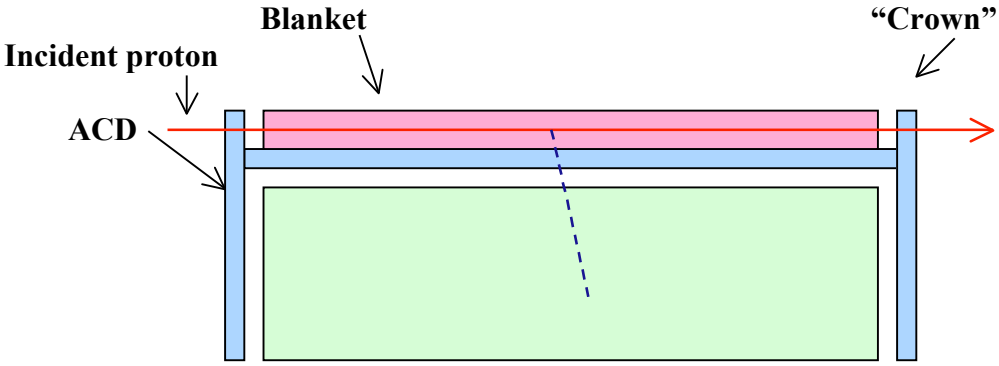
Alex Moiseev, 09/19/01

Does ACD need a crown ?

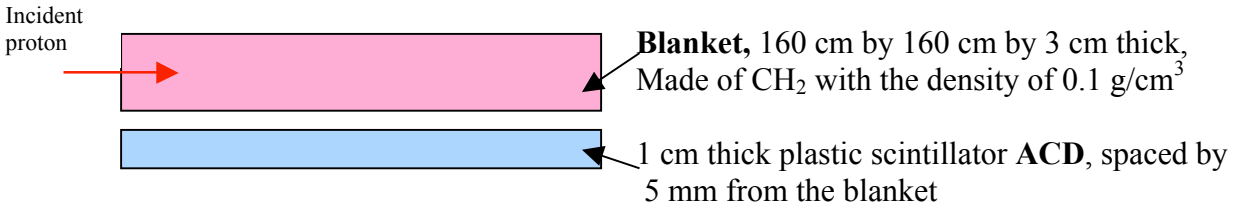
The first alert was brought by EGRET data analysis that there could be background photons which are produced by protons interacting in the micrometeoroid shield (blanket); these protons went undetected by the ACD. These background gammas are undistinguishable from the celestial ones. The way to protect the experiment against them is to extend the ACD to the top to cover the blanket **("crown")**. In this case the protons, which can cause background gammas, would be detected by these extended ACD parts and the events would be vetoed.



It is obvious that the "crown" complicates the design. To understand how critical could be this background for GLAST, this effect was simulated.

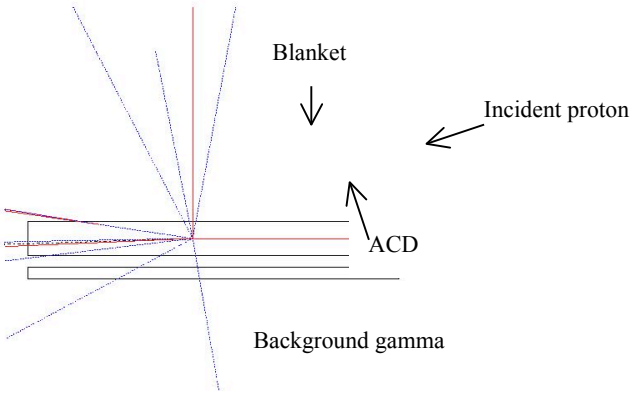
Simulation approach.

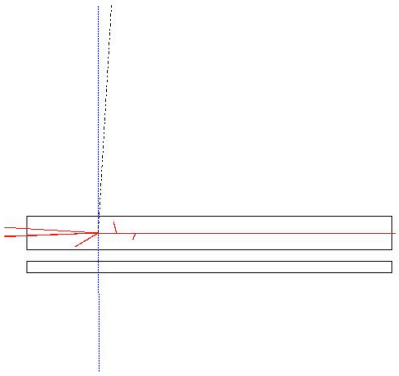
Package Geant 3.21/Fluka was used.

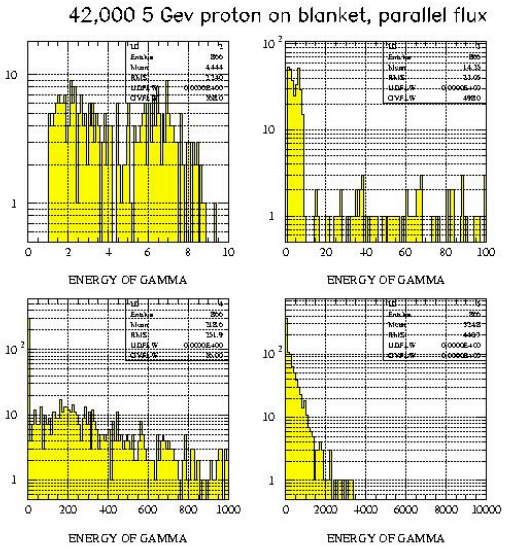


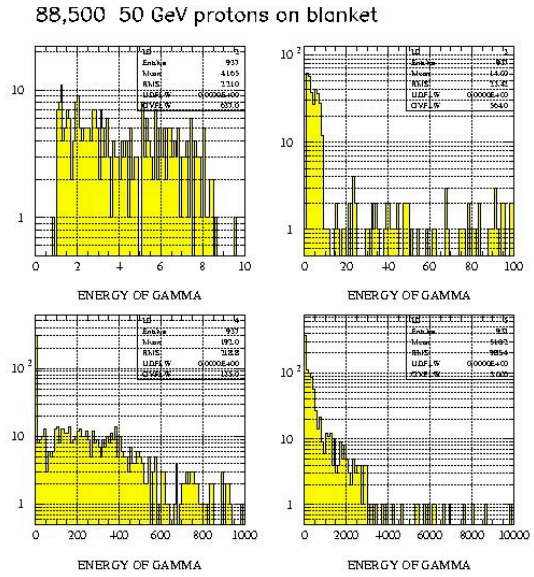
Incident protons were shooting along the axis of the blanket not to directly intersect the ACD. At all other directions they would touch the ACD and consequently create the veto signal.

The events with the presence of gamma in the ACD and with the signal in ACD less than 0.2 MIP (400 KeV) were selected as potential background events. Examples of these events are shown below where the red lines correspond to the charged particles, blue dashed lines – to the gammas, and black dashed – to the neutrons. The energy histogram for such gammas with incident 5 GeV and 50 GeV protons are also shown below.









Results.

Geometrical factor for the side entry in the blanket is 7.5 cm^2sr (calculated by the J.D.Sullivan's formula) for one side, or 30 cm^2sr for all 4 sides.

The integral flux of cosmic ray protons with the energy above 5 GeV is approximately 0.04 $cm^{-2}s^{-1}sr^{-1}$, which yields the rate of protons which enter the blanket in the described above conditions, is ~1.2 Hz

For the simulation run with 5 GeV protons there are 455 events of 42,000 with the gamma above 40 MeV in the instrument accompanied by either no signal in ACD or less than 0.2 MIP (1.08%). This yields the **rate of background gammas above 40 MeV of ~0.013 Hz.** The rate of background gamma with energy **above 1 GeV is ~ 0.0016 Hz.** (fraction of events 0.13%)

The fraction of 50 GeV incident protons which produce background gammas (with nothing in ACD) are 0.6% and 0.15% for respectively gammas above 40 MeV and 1 GeV. Increase of incident proton energy increases the fraction of high energy gammas (seen in the histograms). For more precise background estimate we need to run real cosmic ray proton spectrum and look at the resulting spectrum of background gammas.

Rough estimate for the rate of diffuse gammas with energy more than 40 MeV: their integral flux is ~ 5 □10^{-7} cm^{-2} s^{-1} sr^{-1}, and GLAST geometric factor would be ~ 16,000 cm^2 sr, so the **rate of diffuse gammas will be ~ 0.01 Hz**. Compare with the estimated background rate.

ACD does need a crown.