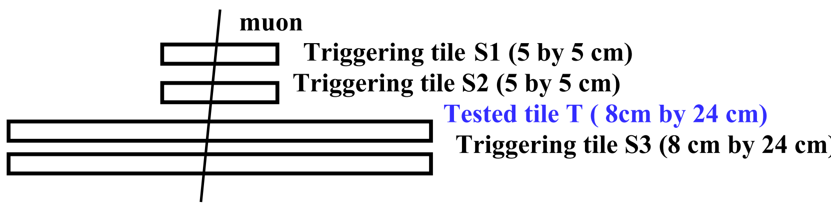
A. Moiseev, 09/28/01

Effect of broken fibers on the tile efficiency

<u>1. Task:</u> study how missing fibers effect the efficiency of the tile

<u>2. Experimental approach:</u> measure the efficiency of the tile with all fibers on the place, and after that start cutting fibers and measure the efficiency. The traditional experimental setup is used:

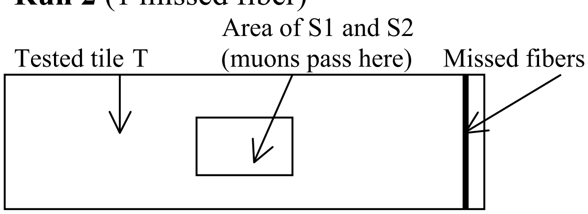


Events with energy depositions (pulse heights) in S1, S2, and S3 corresponding to mean MIP loss (plus-minus approximately 2 sigmas) were selected to determine the efficiency of **tested tile T.** Tiles **T** and **S3** were the tiles made in 1997 for the beam test. These tiles have single-cladding fibers, TYVEK wrapping and are **not the best** made in our lab. I used this tile for the tested tile T because I had to cut fibers, so the tile is lost after the test.

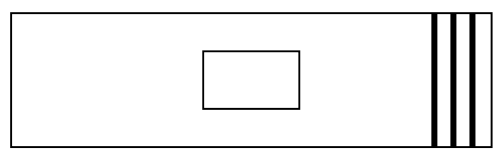
<u>3. Runs description:</u>

Run 1 – all fibers are in place

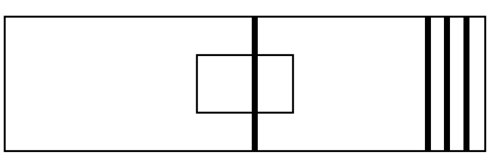
Run 2 (1 missed fiber)



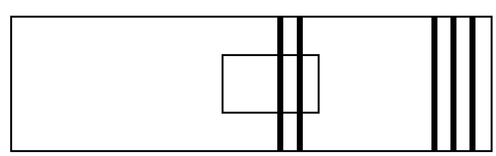
Run 3 (3 missed fibers)



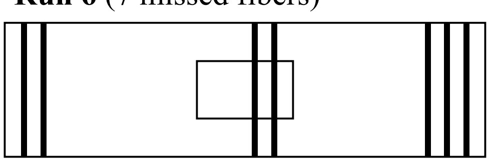
Run 4 (4 missed fibers)



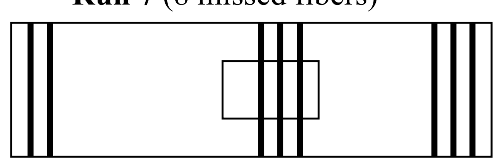
Run 5 (5 missed fibers)



Run 6 (7 missed fibers)



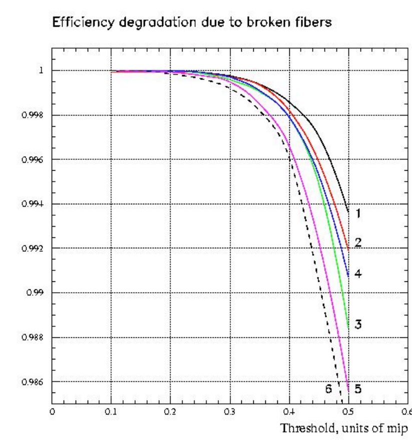
Run 7 (8 missed fibers)

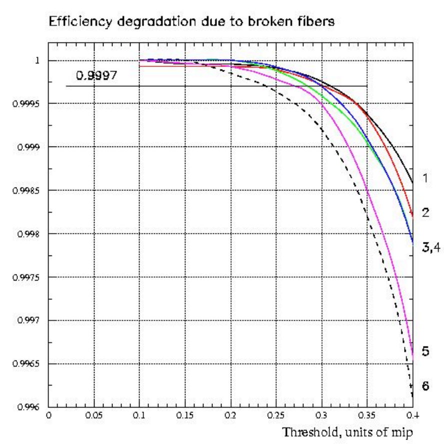


4. MIP mean pulse height.

Run	MIP mean pulse height, channels	MIP mean pulse height, relative
1	369	1
2	374	1
3	367	0.98
4	316	0.85
5	275	0.74
6	274	0.73
7	244	0.65

5. Efficiency measurements

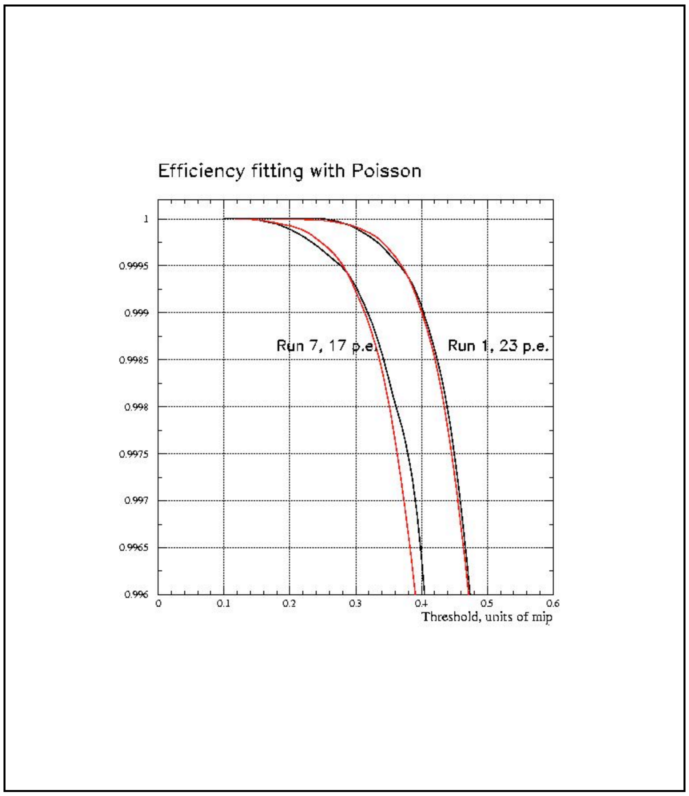




For both figures: Line 1 (black) – run 1; line 2 (red) – run 3; line 3 (green) – run 4; line 4 (bleu) – run 5; line 5 (pink) – run 6; and line 6 (black dashed) – run 7. Run 2 demonstrated the same, even slightly better (within the uncertainty), efficiency as that for run 1, that's why run 2 is not sown.

5. Efficiency fitting by Poisson.

I fitted the best curve (for run 1) and the worst curve (run 7) by Poisson distributions with mean numbers (here number of photoelectrons) respectively 23 and 17. The fitting results are shown below, where the black lines are the experimental, and the red ones are Poisson predictions for given number of p.e.



6. Conclusions.

The ratio between the light yield of run 7 (8 broken fibers, 3 of which are in the vicinity of the trajectory, 17 p.e.) and the tile with no broken fibers (run 1, 23 p.e.) is 0.65 from the MIP mean pulse height and 0.74 from the fitted number of p.e. I believe these numbers are consistent.

Assuming that there are 34 p.e. in total for the current tile design (see fitting in "Light budget assuming light loss in the fibers", fig.2) there will be at least 22 remaining photoelectrons in the case of 8 broken fibers. This number of photoelectrons provides the required efficiency at a threshold ≥0.3 MIP. In the case of running one PMT, we cannot afford to have more than 1 missed fiber, because the light yield from 1 PMT already does not have margins (see the same document, fig.1)

I think that the **minimal design requirements** can be set as follows:

1. To be qualified for the ACD assembly, the tile should have NO missing fibers
2. For assembly into LAT, ACD can have tiles with maximum 2 missing fibers, with minimum of 2 good fibers between the broken ones. There should be not more than 3 tiles in total with broken fibers.
3. ACD launch requirement – not more than 4 missing fibers in any tile, with minimum of 2 good fibers between any 2 broken ones. There should be not more than 3 tiles in total with broken fibers.