CHOD IMPROVEMENT

Reusing most of the
Existing equipment

I. Mannelli

L0 Trigger and CHOD

- An L0 trigger based only on RICH*AntiMUV3 would have an intolerably high rate, mostly because of particles outside of the useful acceptance which MISS the MUV3

A basic function of CHOD, required in coincidence with RICH*AntiMUV3, is the limitation of the geometrical acceptance to an annular region of external radius about 108cm (the inner radius of LAV12) and inner radius of about 13.5cm (The IRC has 14.0 cm outside radius).
At present the outside perimeter is an octagon with radius of inscribed circle 121.5cm.

What follows is meant as a contribution of ideas in order to stimulate discussions on principles to be concretely adopted in such a way as to assure the necessary performance of this overwhelming important part of the NA62 detector and its effective realization

Mail to MauroPiccini et al. 01/06/2011

On possible improvement of CHOD

I was inspired by the presentation by Alexey Khudyakov during the latest MUV group meeting (which unfortunately I could not attend) of the work done in view of providing an adequate new CHOD for NA62, in proposing, as I will briefly attempt to explain in the following, a change in the light collection of the "OLD" CHOD that could result in a meaningful improvement of its performance for triggering in coincidence with the RICH (and with MUV3 in veto) at level 0 while reusing ALL the already existing parts, with relatively minor additions.

The basic point is the following: consider one of the 6.5cm wide (2.0cm thick) and about 100cm long scintillator strip and to carve, on one of the 6.5x100cm2 sides, grooves, at distance from each other of order 4.0cm perpendicular to the long direction in which fibers could be glued in optical contact with the scintillator.
The WLS fibers (with Al Mylar at the far end) should be all of the same length and could be brought to one PMT (or otherwise split into more than one PMT with light corresponding (optically) to different (virtual or real) segments of the scintillator.
Assume the scintillator to be a horizontal one:
in this case the signals from all particles (from a given K decay) within the 6.5cm width in Y would arrive at the same time to the PM.

The knowledge of the Y position, coupled with the slope in y of the track (deduced from the Y coordinate of the center of the Cherenkov ring in the RICH would provide an estimate of the Z position of the decay vertex, useful in view of rejecting triggers originating from (the numerous)decays occurring after the end of the fiducial region.

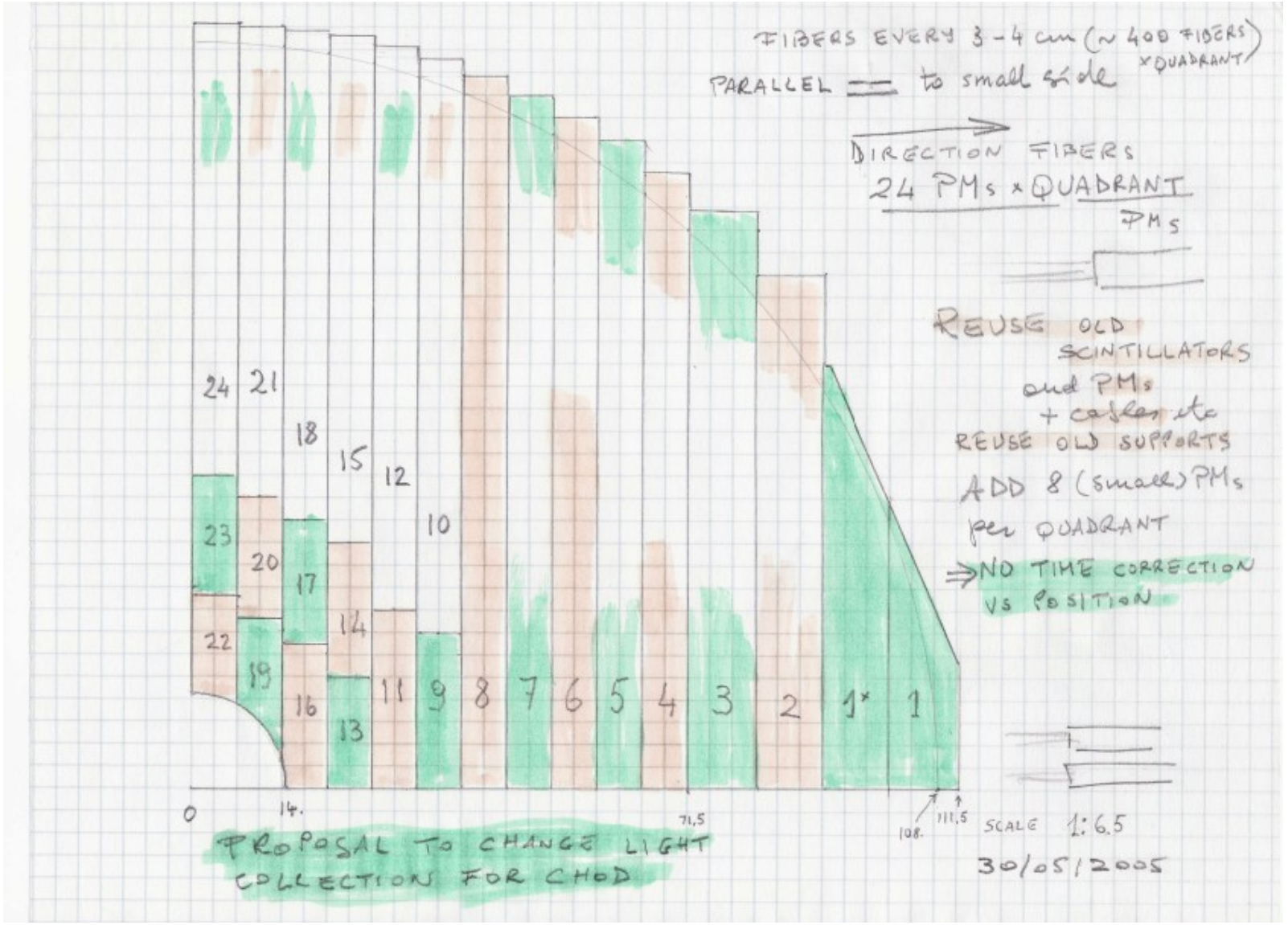
Also, with a similar arrangement for the second plane of scintillators strips, coincidences could be performed with good time resolution

WITHOUT need of correction for the space coordinates of the (any number of) particles.

As far as the practicalities of adopting such a light collection scheme I believe it could be done in such a way (with additional "passive" grooves) as to allow for fibers reaching the PMT while all scintillator are positioned on a a single flat front panel of a BLACK BOX out of which (in suitable flexible corrugated pipes) the bundle of fibers would emerge on their way towards the PMTs.

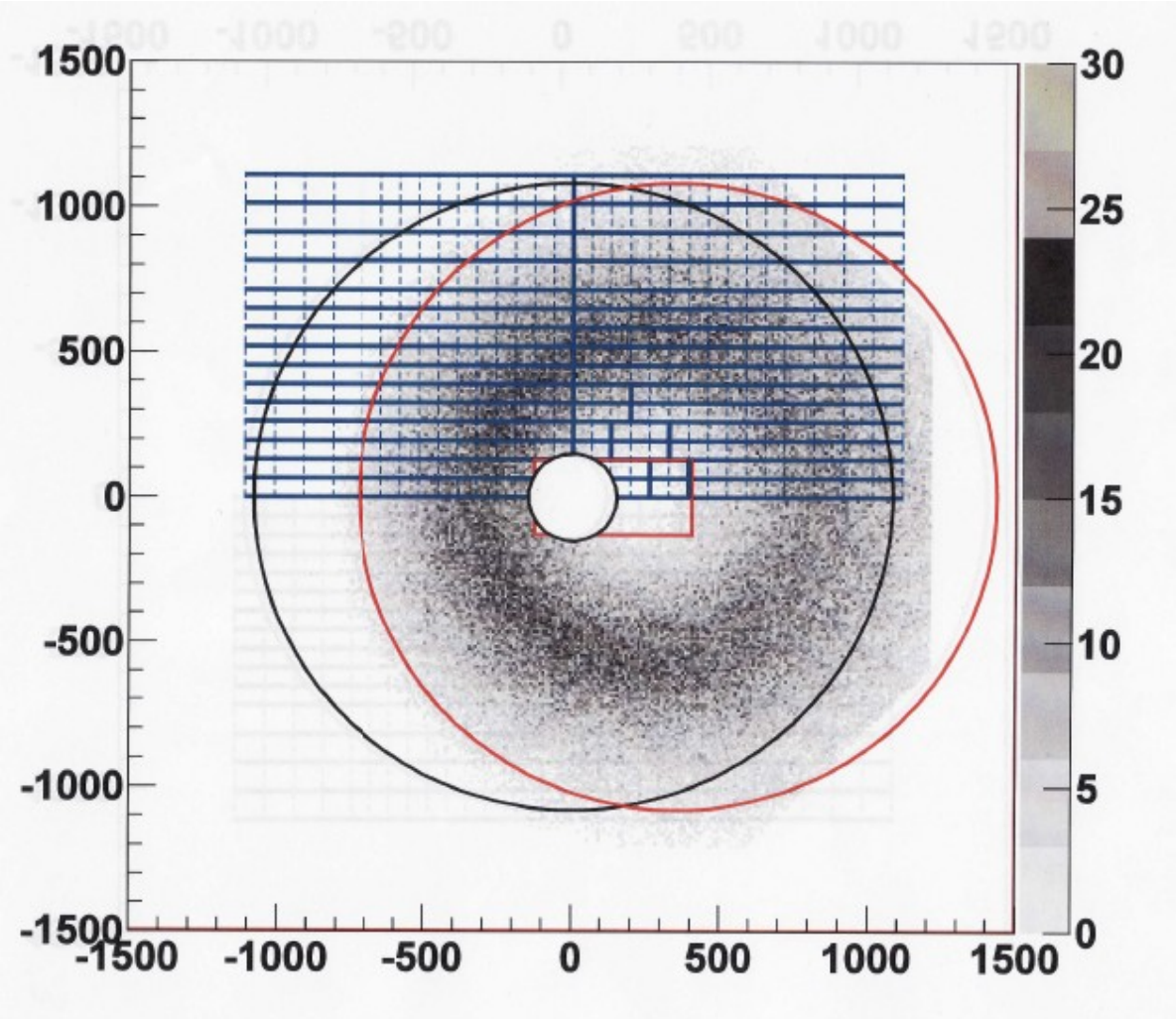
As level 0 of this kind of improvement program (in my opinion OK for first tests) only 15 PMTs of the 16 PMTs per quadrant could be used, each connected to the fibers (perpendicular to the long direction) from the 15 scintillator strips needed to cover up to 111.5 cm radius.

Proposal as in mail 01/06/2011



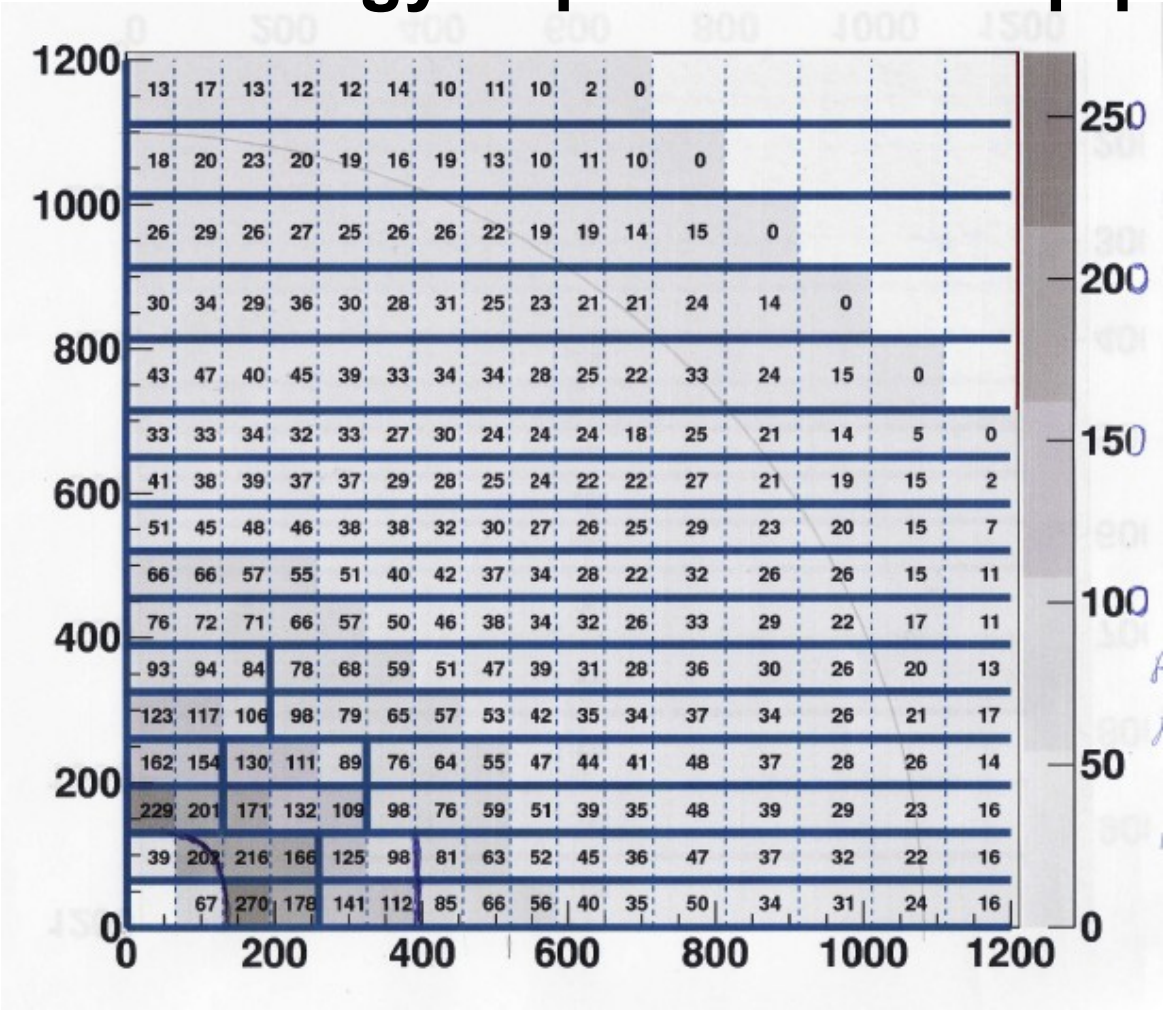
Spasimir has simulated the rate of particles hitting the hodoscope, subdividing its surface in small tiles of dimensions (6.5x6.5cm2) and (10x10cm2) equal to the width of the scintillator strips (see next transparencies).
The result allow to evaluate (the upper limit of)the rate of tiles consisting of several smaller ones.

Hits from K→ pai nu antinu



Circles are 108cm Radius (as LAV12)

Rates of energy deposits >0.5 Mip per cell

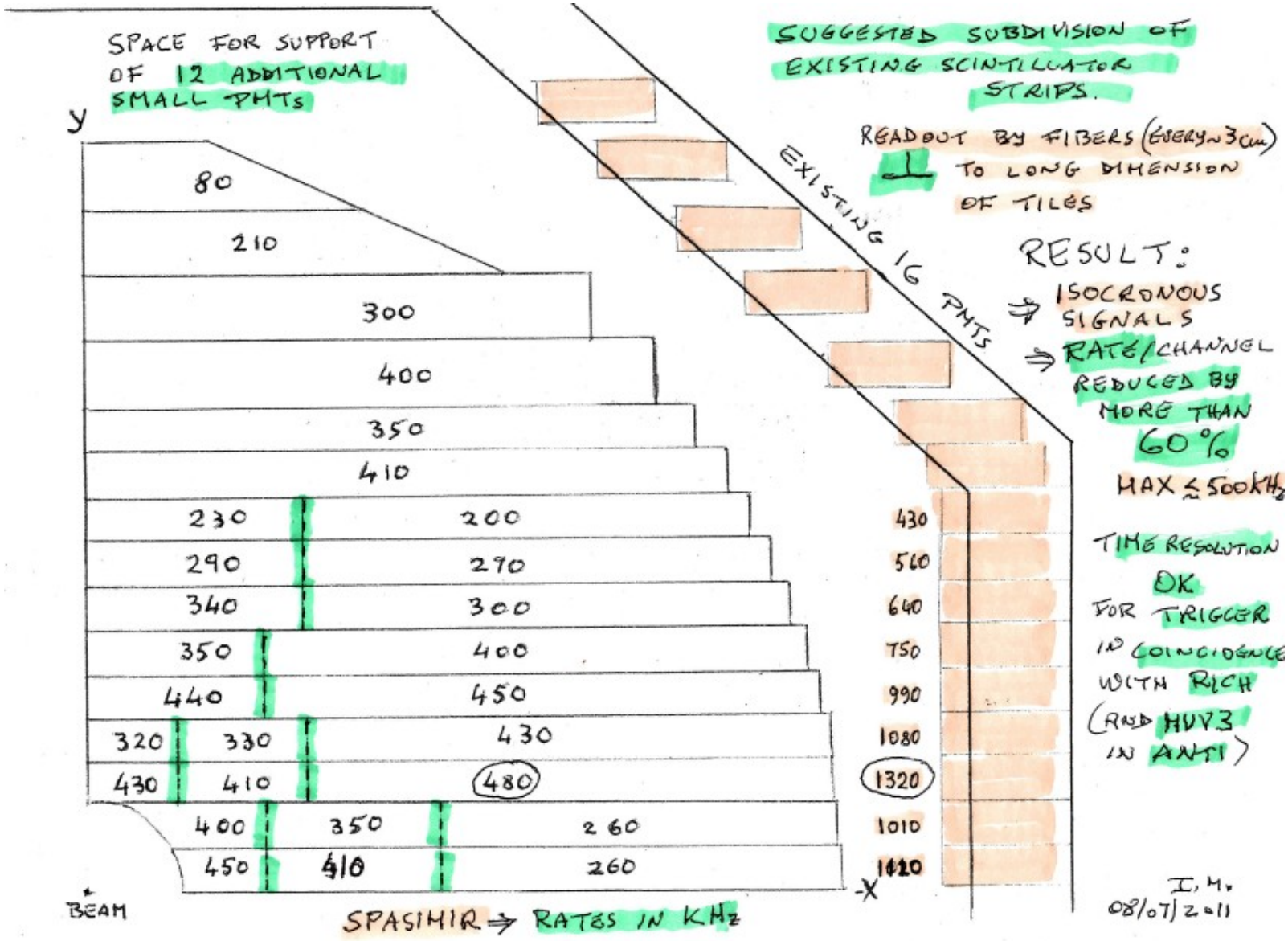


Including al decays and background

Spasimir June 2011

As a possible improvement, adding 12 (smaller) PMTs to the existing 16 PMTs would allow a subdivision of the useful surface area in regions of quite similar counting rate.

Of course the reuse of the existing scintillators, PMTs, support frame, cables (HV and signal) etc would be essential to carry out the improvement in the most economical, and effective manner, which is a factor not to be forgotten given the limited resource globally available to the collaboration.


SPACE FOR SUPPORT OF 12 ADDITIONAL SMALL PMTs
y
80
210
300
400
350
410
230
200
290
290
340
300
350
400
440
450
320
330
430
430
410
480
400
350
260
450
410
260
BEAM
-X
EXISTING 16 PMTs
430
560
640
750
990
1080
1320
1010
1120
SUGGESTED SUBDIVISION OF EXISTING SCINTILLATOR STRIPS.
READOUT BY FIBERS (EVERY ≈ 3 cm) ⊥ TO LONG DIMENSION OF TILES
RESULT:
⇒ ISOCRONOUS SIGNALS
⇒ RATE/CHANNEL REDUCED BY MORE THAN 60%
MAX ≲ 500 kHz
TIME RESOLUTION OK FOR TRIGGER IN COINCIDENCE WITH RICH (AND HV3 IN ANTI)
SPASIMIR ⇒ RATES IN KHz
I. M.
08/07/2011

Taking into account that for practically

ALL

charged particles of interest

ABS(Y2) ≥ ABS(Y1) and X2 ≤ X1

where 1 and 2 refers to the coordinates at the two CHOD planes

(for deflection of positive particles towards the negative X direction)

I believe that BOTH CHOD PLANES should have the scintillator strips ORIENTED HORIZONTALLY and hits in a given tile in Plane 1 could then be put efficiently in COINCIDENCE with the OR of ONLY the corresponding tile in Plane 2 plus the nearest one in Y(towards higher ABS(Y)) plus the nearest one in X (towards negativeX).

Presumably in this way the rate due to ACCIDENTALS and to the effect of BACK SPLASH from interaction in the material beyond the CHOD should be drastically REDUCED

The time resolution would be defined essentially by the properties of the WLS fibers and should not change with gradual loss of transparency of the scintillator due to radiation damage

Alexey has carried out some test which appears to me very positive from this point of view.

The CHANTI group, as documented in a detailed fashion in the TRD, has made measurement which give me confidence that with 2cm thick scintillator and fiber spacing 3 cm a good number of photo-electrons could be produced by a MIP, since they managed to obtain 100 p.e. out of a plane (17mm thick) of overlapping triangularly shaped scintillator bars

In conclusion it is high time for the NA62 collaboration to organize a conclusive round of discussions in order to agree on an ADEQUATE design for CHOD and ASSURE its availability for the experiment