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Studies of GRINCH (and RICH) background

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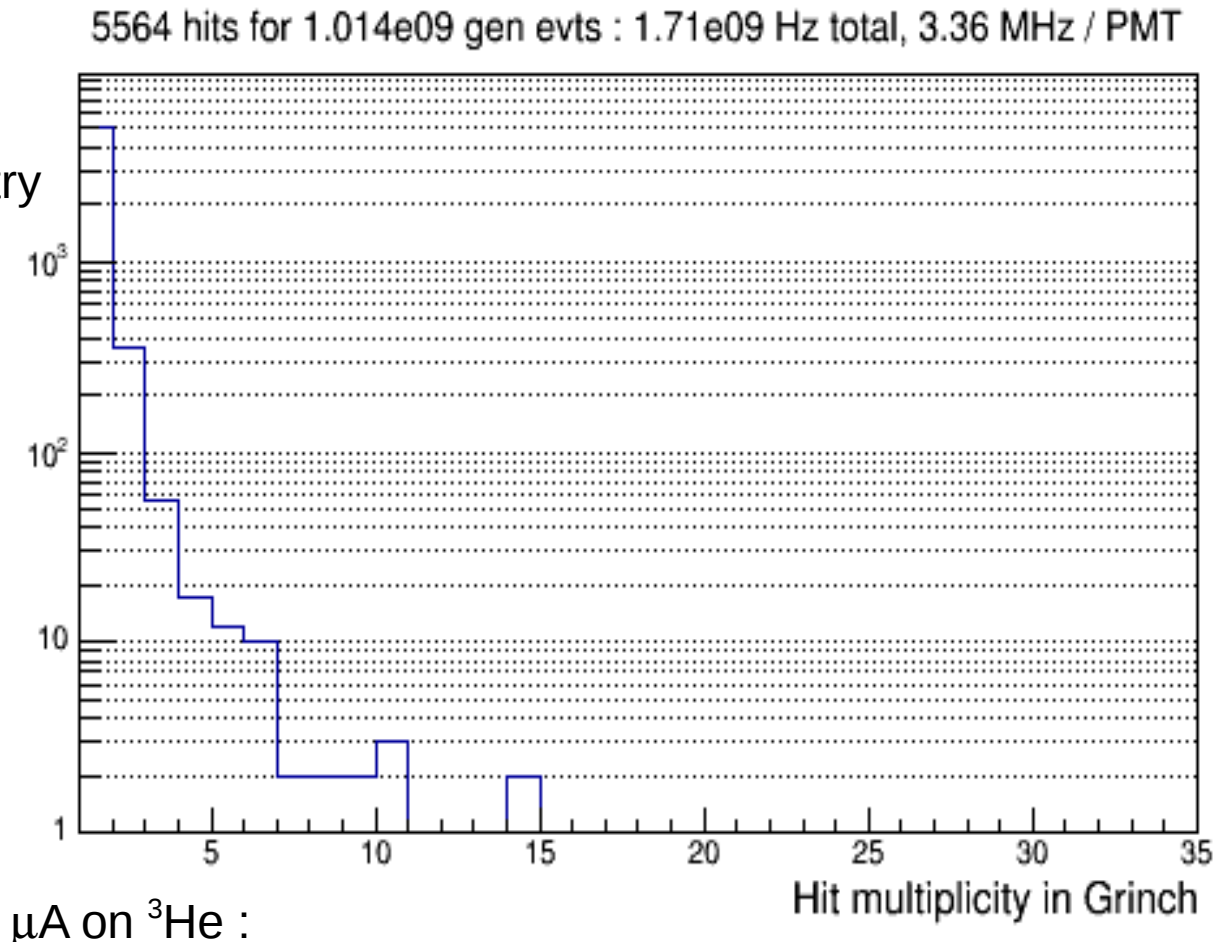
Background: number of hits and multiplicites for the GRINCH detector

~ 10^9 beam events generated with :

BB angle = 30 deg;
BB dist = 1.55 m;
(SIDIS setting)
with old Grinch geometry



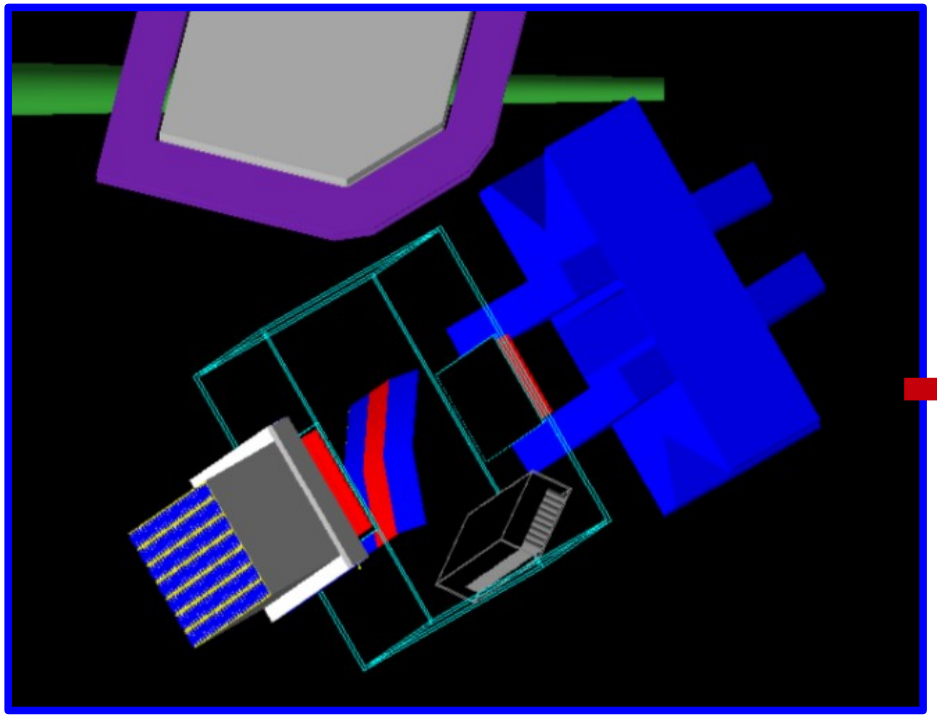
@ 50 μA on ^{3}He :
=> ~ **1.7 GHz** over the detector
~ **3.3 MHz** / PMT

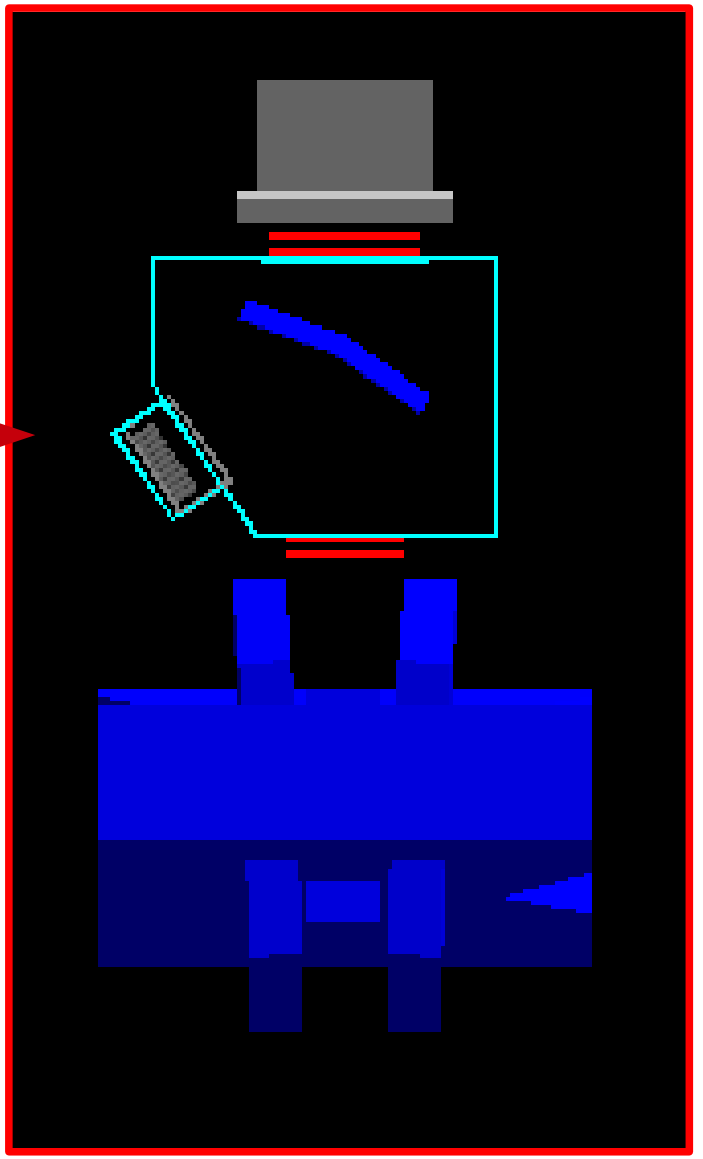
Possible sources : - *tank geometry*;
- *beamline*;

Tank geometry improvement

old tank geometry : Simple box,
~150 cm wide, 200 cm tall, 92 cm deep.
1/2 inch stainless still.

Now : geometry closer to actual design
114 cm wide, 247 cm tall,
1/4 inch Al





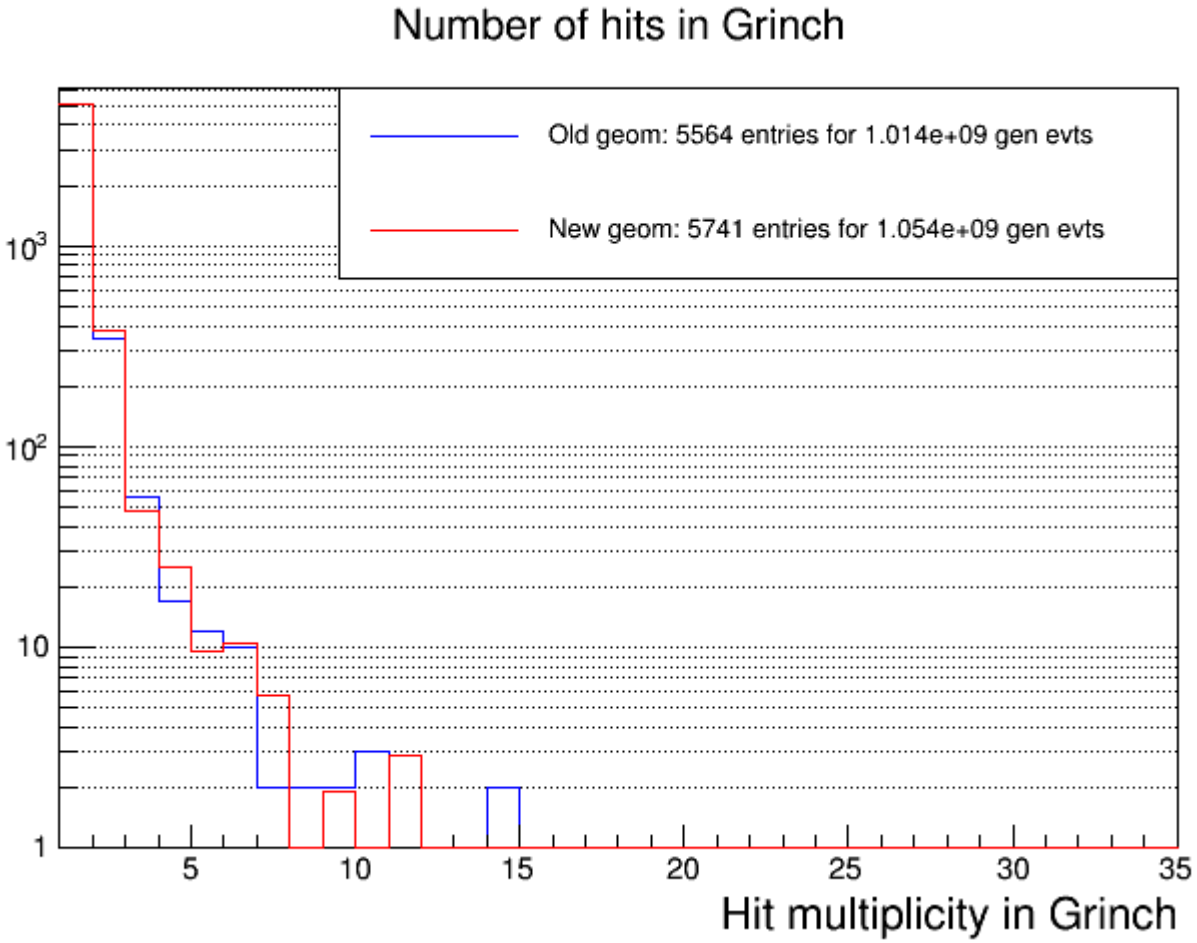
Such extended tank was thought to pick up more background than expected "in real life".
=> change tank geometry

See also SBS software meeting presentation from 2016/09/07

Compare number of hits and multiplicites for old and new geometry for ***background***:

~ 10^9 beam events generated with :

BB angle = 30 deg;
BB dist = 1.55 m;
(SIDIS setting)
=> with Old *and* new Grinch geometry

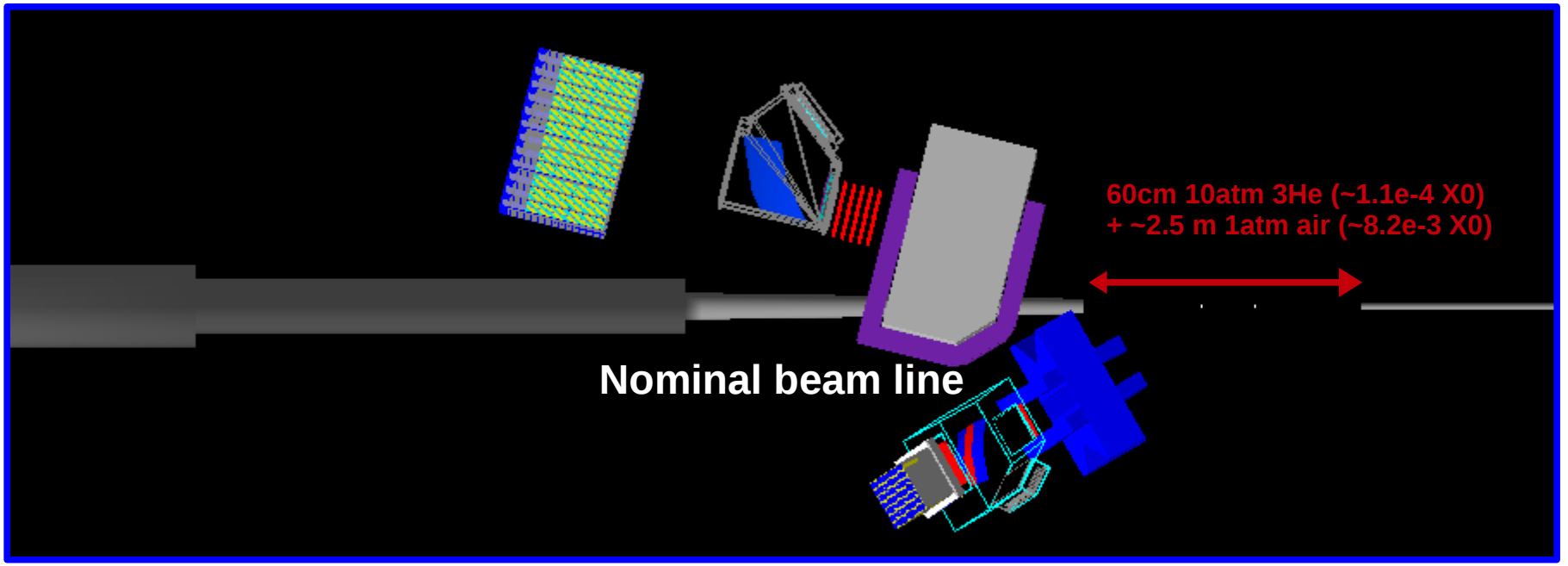


New geometry does not seem to improve background…

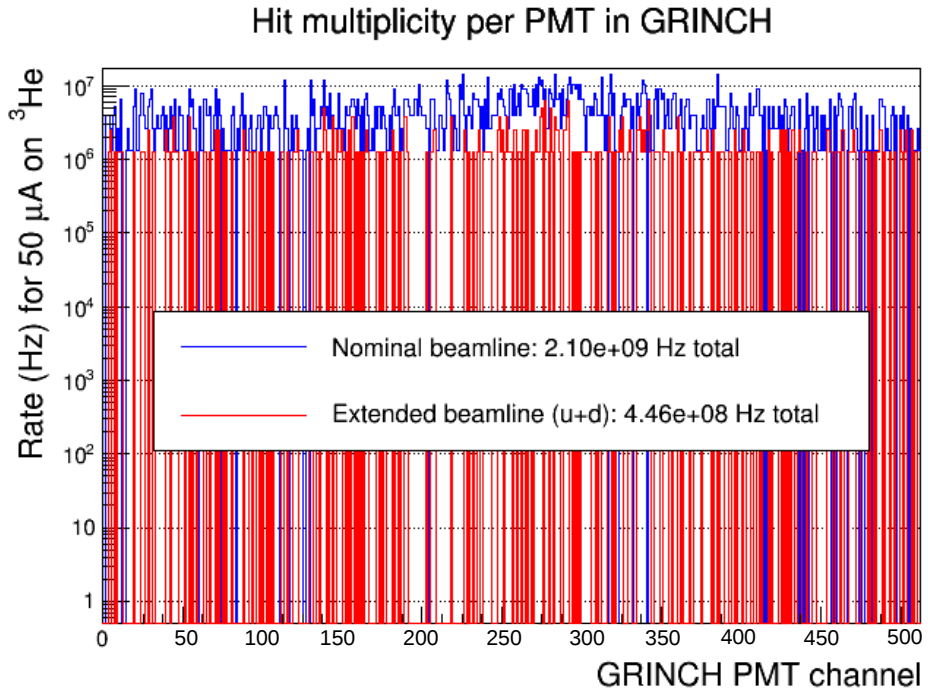
@ 50 μA on ^{3}He :
=> ~ **1.7 GHz** over the detector
~ **3.3 MHz** / PMT
~ 10 % occupancy (for a online 30ns timing window for coincidence)

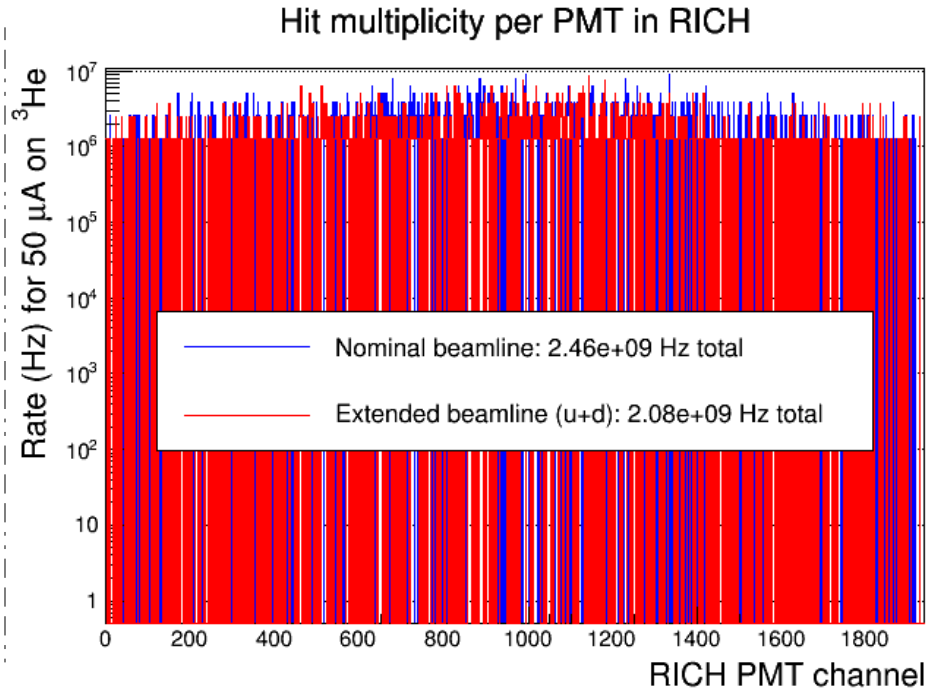
See also SBS software meeting presentation from 2016/09/07

Beamline optimization studies



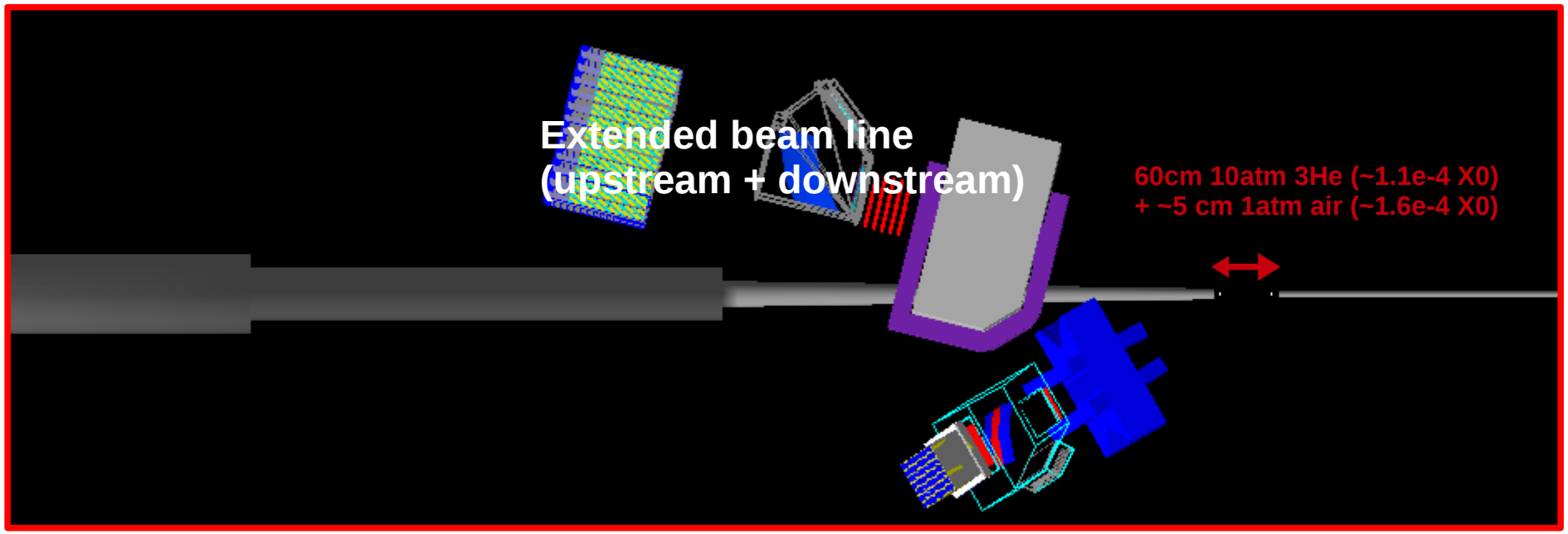
Comparison between background measured with layout on this page (blue) vs layout on next page (red). (observations on next slide, top)





Background in GRINCH divided by ~4: 3/4 of the background measured in the GRINCH comes from the air thickness around the target

Background in RICH drops by ~15 % when both beam pipes are extended...



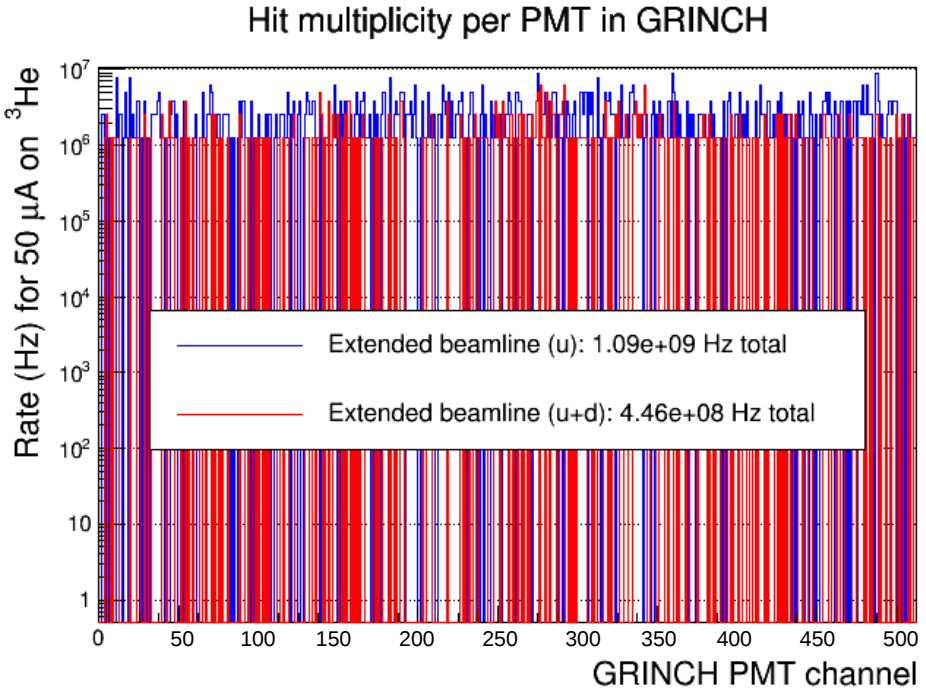
Background ~2x lower with both extended beam pipes w.r.t. to upstream extended beampipe only.

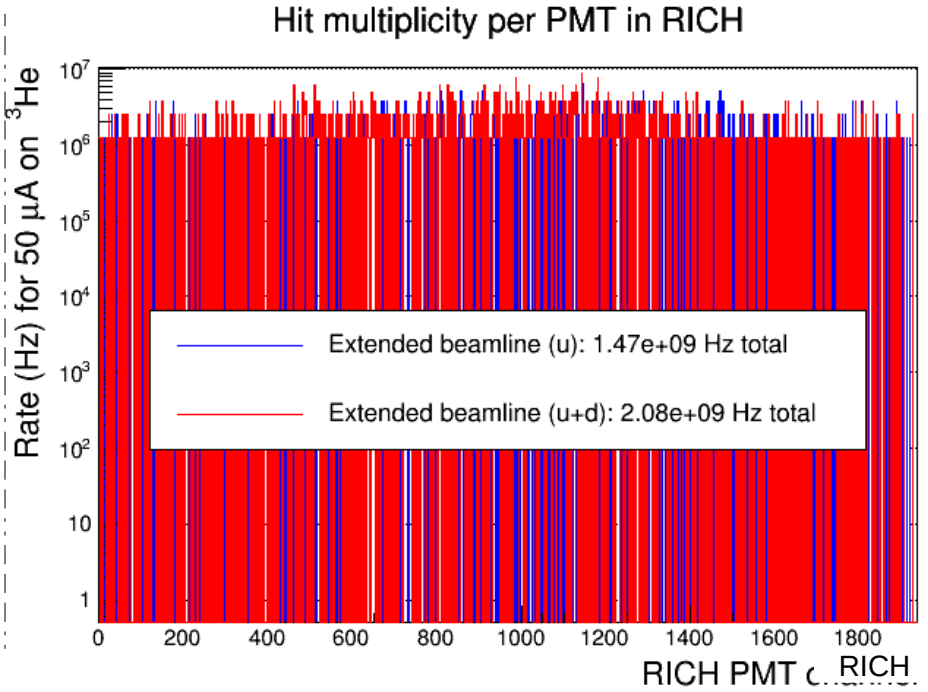
=> **1/2 of background in original setup comes from air upstream target** (lower angle seen from GRINCH)

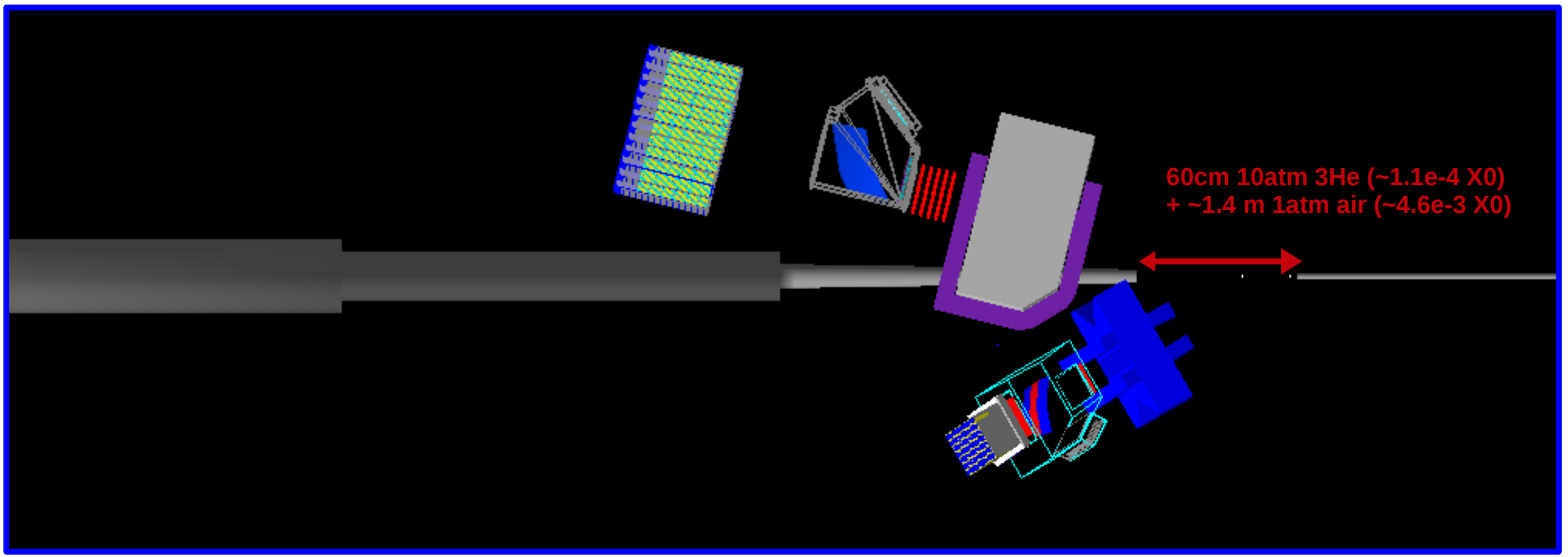
… but it is ~25 % lower when only the upstream beam pipe is extended (wrt the setup on this slide).

A large part of the background in RICH comes from the downstream pipe material. (replacing it by vacuum in g4sbs reduces bkgd rates by *50 % wrt original setup*)

Comparison between background measured with layout on this page (blue) vs layout on previous page (red) (observations on previous slide, bottom)







Side notes :

The fact that the background in the RICH PMTs and in the GRINCH PMTs behave differently with setup change is due to their different configuration.
The RICH PMTs are better shielded from the target area by the SBS magnet yoke. On the other hand they are indeed more sensitive to the background coming from the beam pipe.

The background in the RICH might be more critical (because we want to reconstruct p.e. circles), even though we do *not* mean to use the information from the RICH online (on constrast with the GRINCH we may want to include in the trigger).
Assuming a 10ns timing window for offline coincidence, average PMT occupancy is ~1.6 % (average rate ~ 1.6 MHz); max occupancy being <10%...

In the original setup, the Be window for the upstream beampipe was not even in place (plots slide 2, 4), and was put back for the other studies (slides 5 and further). Replacing it in the original setup added ~10 % (~25 %) more background in GRINCH (RICH).
This also explains the apparent discrepency between GRINCH background presented in slide 4 (~1.7GHz) and in slide 5 (2.10 GHz).

Conclusions :

A majority (~3/4) of the GRINCH background estimated previously by the simulations were due to the air thickness around the 3He target, mostly coming from the air thickness upstream the target (~1/2 of total background);

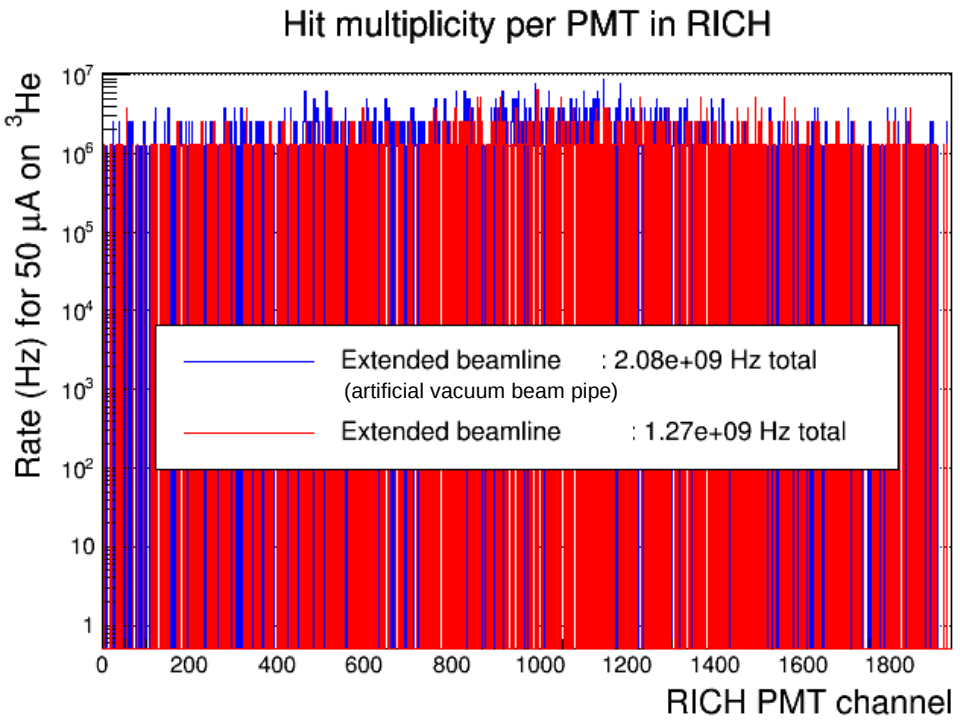
Extending the beampipe, however, would not decrease by much the background in the RICH. RICH is indeed more sensitive to the background emanating from downstream beam pipe (~1/2 of total background).

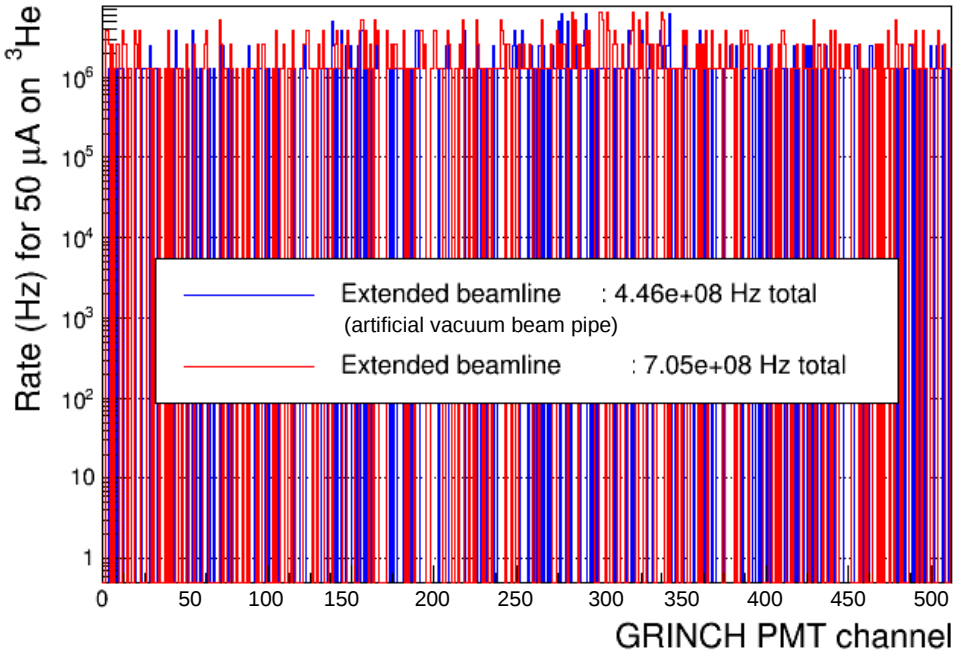
TODO :

* Design some shielding for RICH ?
* Study the possibility to include GRINCH in online trigger
  (see next set of slides) ;

Thank you for your attention !

Layout s6 : Vacuum Vs Al downstream beam pipe





Layout s5 : No Be Vs Be downstream beam pipe