

Rates of hits in dRICH from various sources

M.Osipenko
INFN sez. di Genova

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Sources of hits

- Not possible to use RECO data only (**missing link from DRICHRawHits to MCParticle**);
- SIM(FULL) data have link to MCParticle - from branch "_DRICHHits_particle.index" with index of "DRICHHits";
- in MCParticles loop from "MCParticles.parents_begin" to "MCParticles.parents_and" separating photons and non photon (PDG!=22);
- selected by "MCParticles.generatorStatus": $\text{ABS}(\text{stat}-2000) < 100 \Rightarrow \text{source}=2$ etc. for other sources (typically stat=2004 - initial Synch.Rad. photon, or 2001 - gen. final state photon);

Symbol	Process	Description	Sampling Frequency (kHz)	Status Code Shift
	signal	DIS NC 18x275 $Q^2 > 1$ (Deep inelastic scattering neutral current)	500	0
	synrad	Synchrotron Radiation	14000	2000
	ebrems	Electron bremsstrahlung radiation	316.94	3000
	etouschek	Electron Touschek scattering (intrabeam scattering)	1.3	4000
	ecoulomb	Electron Coulomb scattering processes	0.72	5000
	p.b.gas	Proton beam gas interactions	22.5	6000

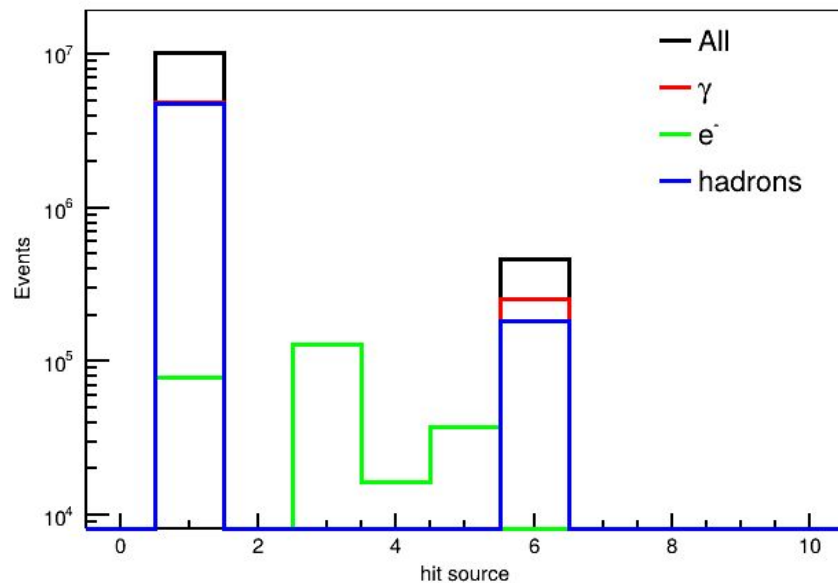
Source:

1
2
3
4
5
6

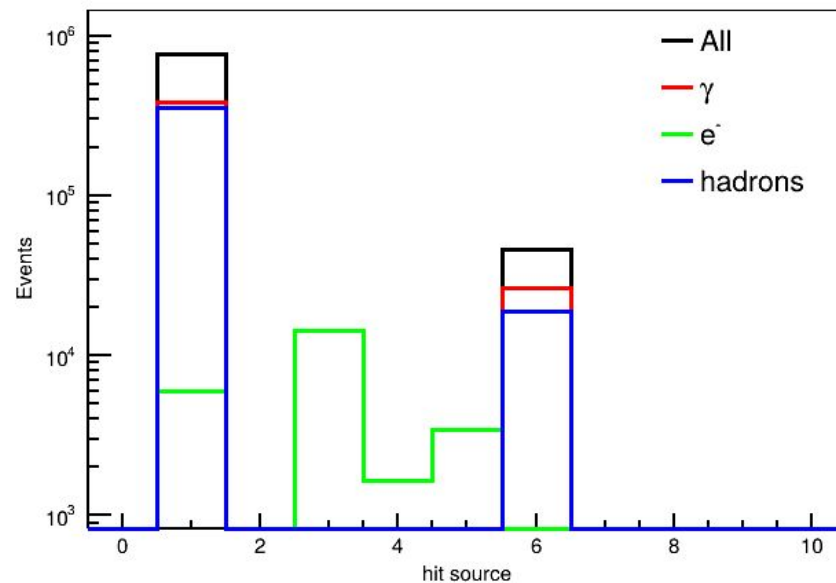
Results for 10x100 GeV in 2 us data frame

- total dRICH hit rate from DIS($Q^2 > 1 \text{ GeV}^2$) = $10^7 \text{ hits} / 10^4 * 2 \text{ us} = 543 \text{ MHz}$; (DIS=94%, Synchrotron Radiation γ =0%, bremsstrahlung e^- =1.2%, p-gas=4.3%);
- total dRICH hit rate from SIDIS($Q^2 < 1 \text{ GeV}^2$) = $8 * 10^5 \text{ hits} / 10^3 \text{ hits} / 2 \text{ us} = 413 \text{ MHz}$; (DIS=92%, Synchrotron Radiation γ =0%, bremsstrahlung e^- =1.7%, p-gas=5.5%)

26.07.1,Bkg_Exact1S_2us/GoldCt/10um/10x100/mi
nQ2=1/pythia8NCDIS (100 file=9999 events)



26.07.1,Bkg_Exact1S_2us/GoldCt/10um/SIDIS/
pythia6/10x100/q2_0to1 (1 file=99 events)



Normalization of signal/background

- name of campaign: “Bkg_1SignalPer2usFrame” suggests that we have 1 DIS signal every 2 us + Background integrated in these 2 us (100 events/file);
- $\text{DIS}(Q^2 > 1 \text{ GeV}^2) = 0.6 \text{ ub}$, thus $L = R/s = 1/(1 \text{ us} * 0.6 \text{ ub}) = 24637 \text{ 1/(fb*y)}$;
- Concluding, there is no normalization of the signal, only Background is added in time frame of 2 us to every event;
- However, there is no Background alone simulation: how do we calculate the total background rate?
- Probably the recipe could be the following:

$$\text{SignalRate} = \frac{N_{sig.hits}}{N_{gen.events}} L \times \sigma_{tot}$$

$$\text{BackgroundRate} = \frac{N_{bkg.hits}}{N_{gen.events}} \frac{1}{2\mu s}$$

In previous slide we had:

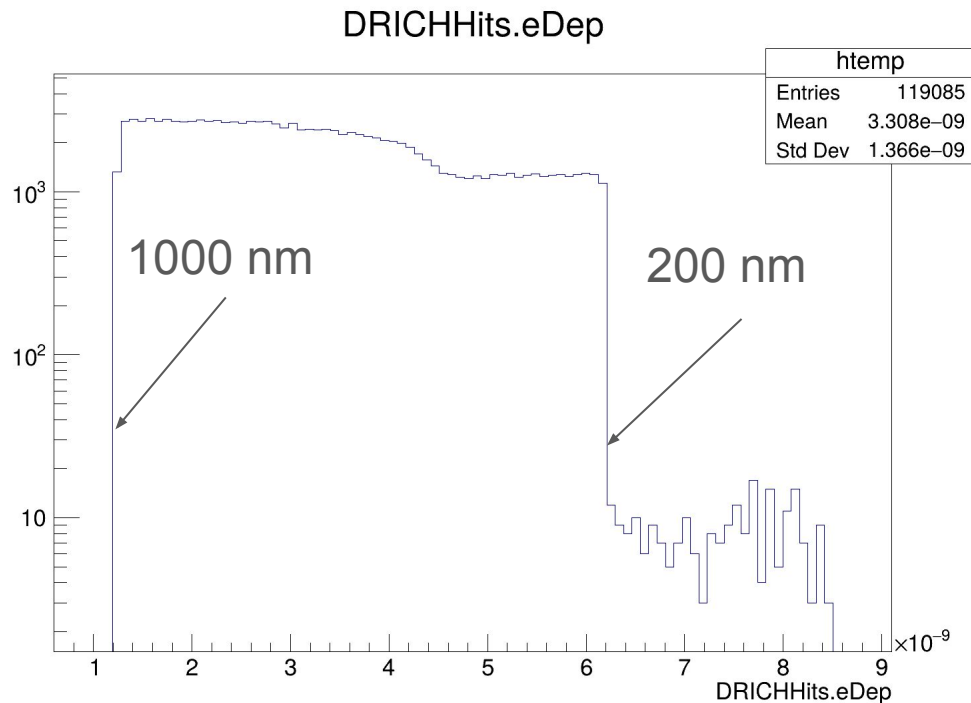
signal = $10^7 \text{ hits}/10^4 \text{ events} * 0.6 \text{ ub}/(\text{fb*y}) = 20 \text{ kHz}$;

background = $0.06 * 10^7 \text{ hits}/10^4 \text{ events}/2 \text{ us} = 30 \text{ MHz}$;

Hits accounted in DRICHHits

- even in the SIMulation file (FULL) “DRICHHits” branch contains only optical photon interactions;
- all direct ionization hits by charged particles (100% efficiency) and neutrals are missing;

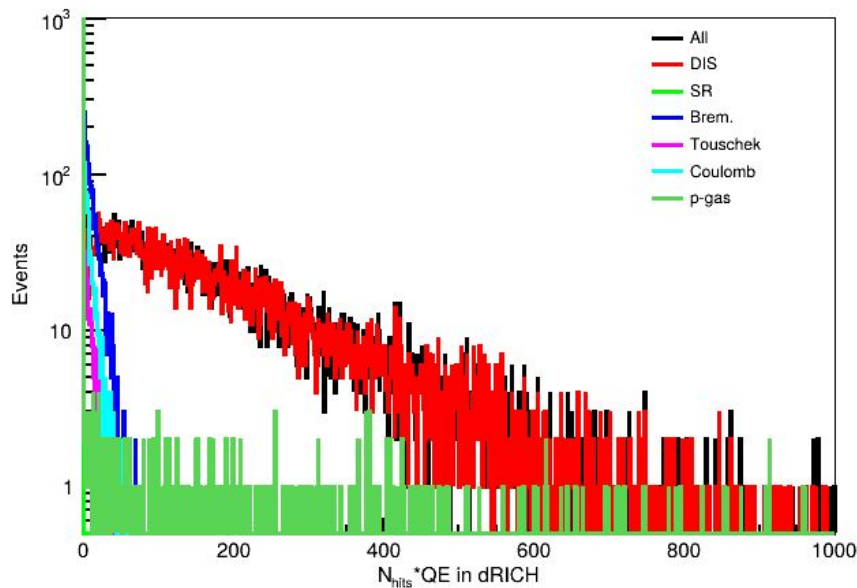
1. ionizing hits must be added into DRICHHits branch;
2. these have to be treated separately from optical photons;
3. for neutrals the special avalanche layer ($\sim 2.4 \mu\text{m}$) must be defined.



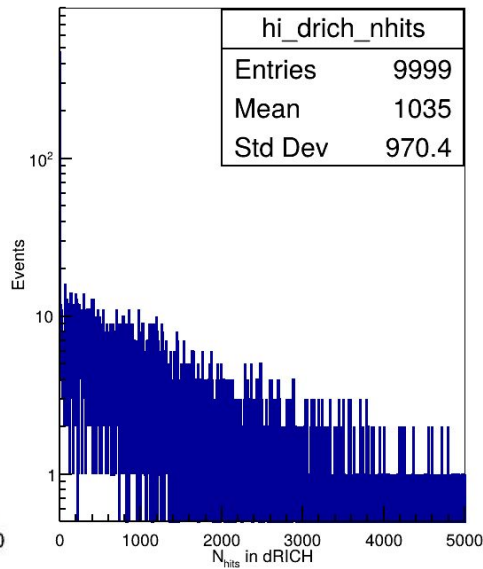
Number of dRICH hits per event

- observed number of hits/event~180 using "DRICHHits" branch and QE from <src/detectors/DRICH/DRICH.cc>;
- DIS and p-gas have similar mean value, while all electron beam backgrounds give small values <3;

QE-applied: sorted in sources



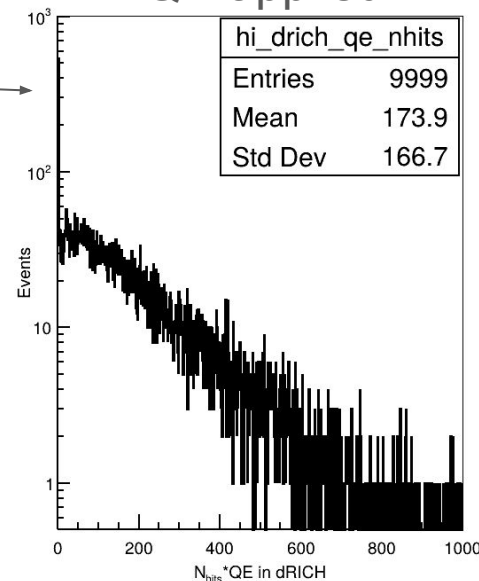
All SIM hits



mean

QE~17%

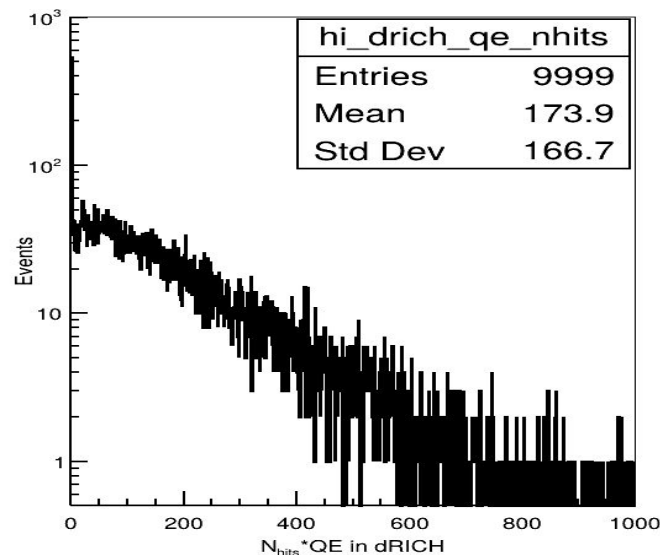
QE-applied



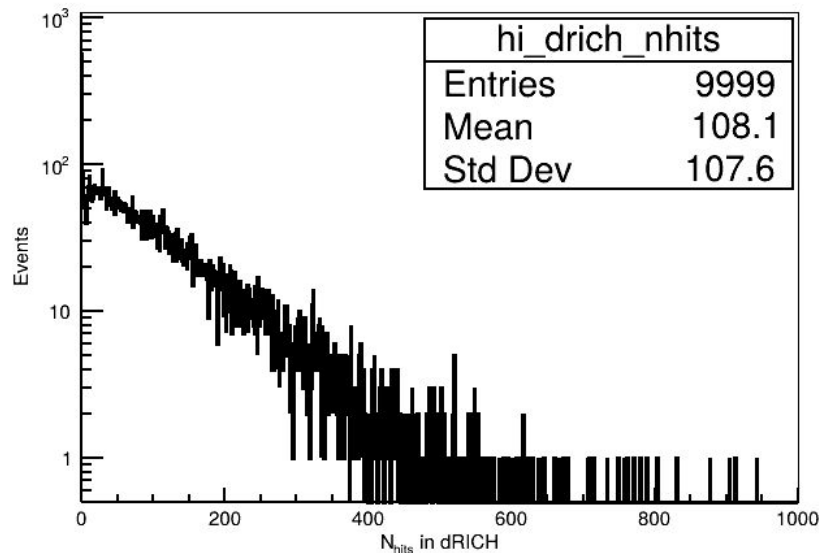
Number of dRICH raw hits per event

- using “DRICHRawHits” however gives 1.6 times less hits/event;
- why digitized hits are reduced? What is the base for hit removal?

DRICHHits: simulated hits * QE

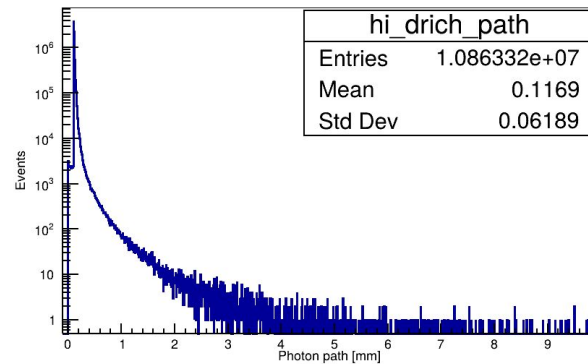
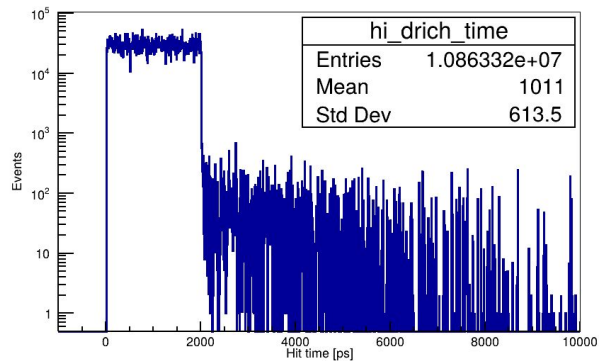
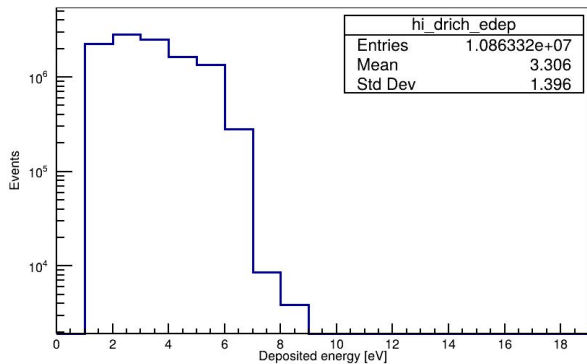
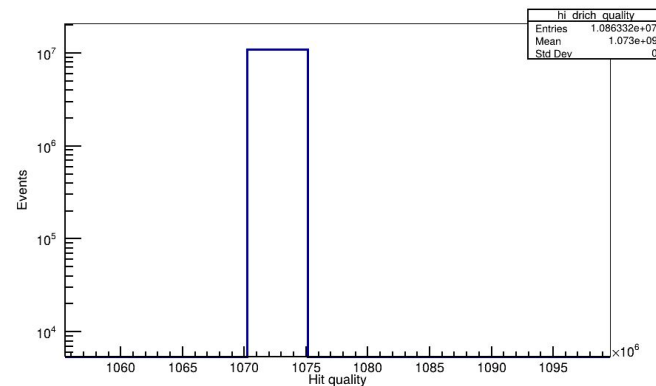
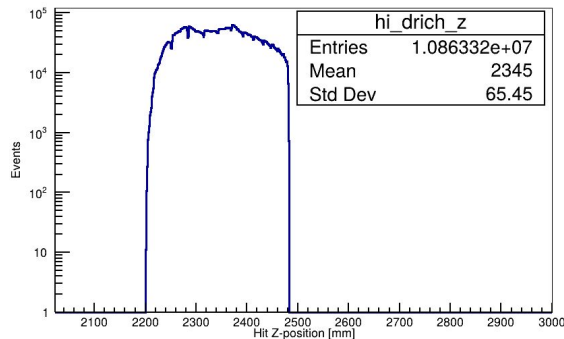
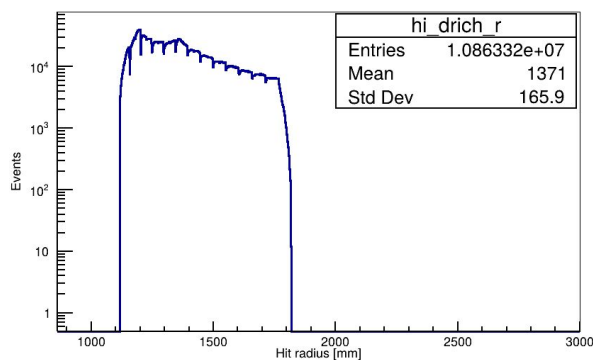


DRICHRawHits: digitized hits



Can a part of hits be invalidated?

- all parameters of simulated hits seem to be reasonable, not clear why 60% of them is removed? Hit the same SPAD?



Distance between hits

- some hits appear in the same point?
- but the fraction of this hits $< 0.04\%$;
- cannot explain 60% loss.

