

pfRICH Background Update

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TIC Meeting

September 28, 2026

Background Evaluation Status

- ❑ Background simulation unchanged since first presentation in May
- ❑ Cross check waiting for full integration of IRT-2
- ❑ Since May have updated data rates based on official FCFD data format information from Artur

Simulation Setup

- ❑ Results presented based on 10x275 simulation (conclusions not substantially different for 10x100)
- ❑ Use geometry/code in branch irt-2.1c of irt, ElCrecon, epic, and edm4eic to ensure proper pfRICH geometry and optics
 - Run in eic-shell version 25.12.0-stable
- ❑ Background sources

(https://github.com/eic/simulation_campaign_datasets/blob/main/config_data/synrad_egasbrems_egascoulomb_egastouschek_hgas_10GeVx275GeV_GoldCoating_10um_10000Ahr_machineruntime_50s.json)

 - **Synchrotron:** root://dtn-eic.jlab.org/volatile/eic/EPIC/EVGEN/BACKGROUNDS/SYNRAD/dataproduct_rel_1.0.0/10x275/GoldCoating/10um/dataproduct_rel_1.0.0_synrad_10x275_run001.preproc_10000repeats.hepmc3.tree.root
 - **Electron Brems:** root://dtn-eic.jlab.org/volatile/eic/EPIC/EVGEN/BACKGROUNDS/BEAMGAS/electron/GETaLM1.0.0-1.0/10GeV/GETaLM1.0.0-1.0_ElectronBeamGas_10GeV_foam_emin10keV_run001.hepmc3.tree.root
 - **Electron Coulomb:** root://dtn-eic.jlab.org/volatile/eic/EPIC/EVGEN/BACKGROUNDS/BEAMGAS/electron/coulomb/EIC_ESR_Xsuite/dataproduct_rel_1.0.1/10x275/10000Ahr/MachineRuntime50s/dataproduct_rel_1.0.1_electron_coulomb_10x275_10000Ahr.hepmc3.tree.root
 - **Electron Touschek:** root://dtn-eic.jlab.org/volatile/eic/EPIC/EVGEN/BACKGROUNDS/BEAMGAS/electron/touschek/EIC_ESR_Xsuite/dataproduct_rel_1.0.1/10x275/10000Ahr/MachineRuntime50s/dataproduct_rel_1.0.1_electron_touschek_10x275_10000Ahr.hepmc3.tree.root
 - **Proton Beam Gas:** root://dtn-eic.jlab.org/volatile/eic/EPIC/EVGEN/BACKGROUNDS/BEAMGAS/proton/pythia8.306-1.0/275GeV/combined/pythia8.306-1.0_ProtonBeamGas_275GeV_combined.hepmc3.tree.root

Simulation Setup

☐ Background Rates

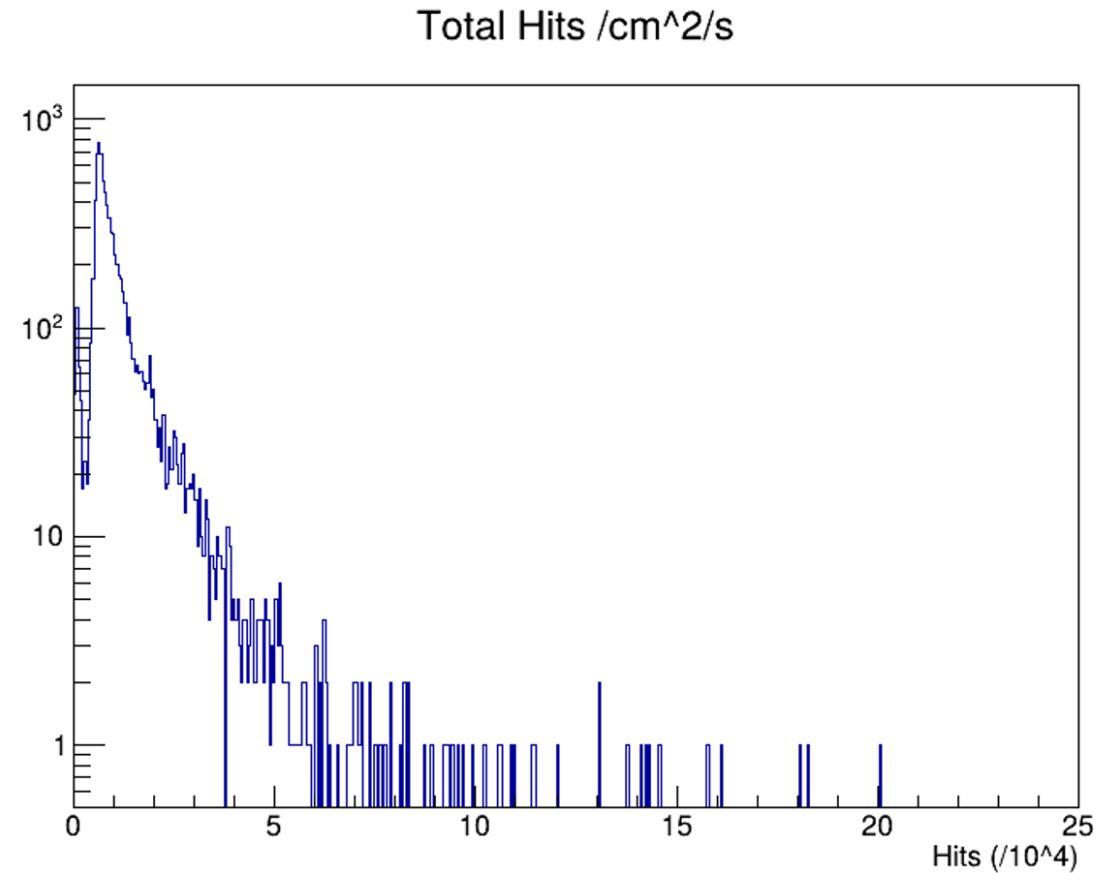
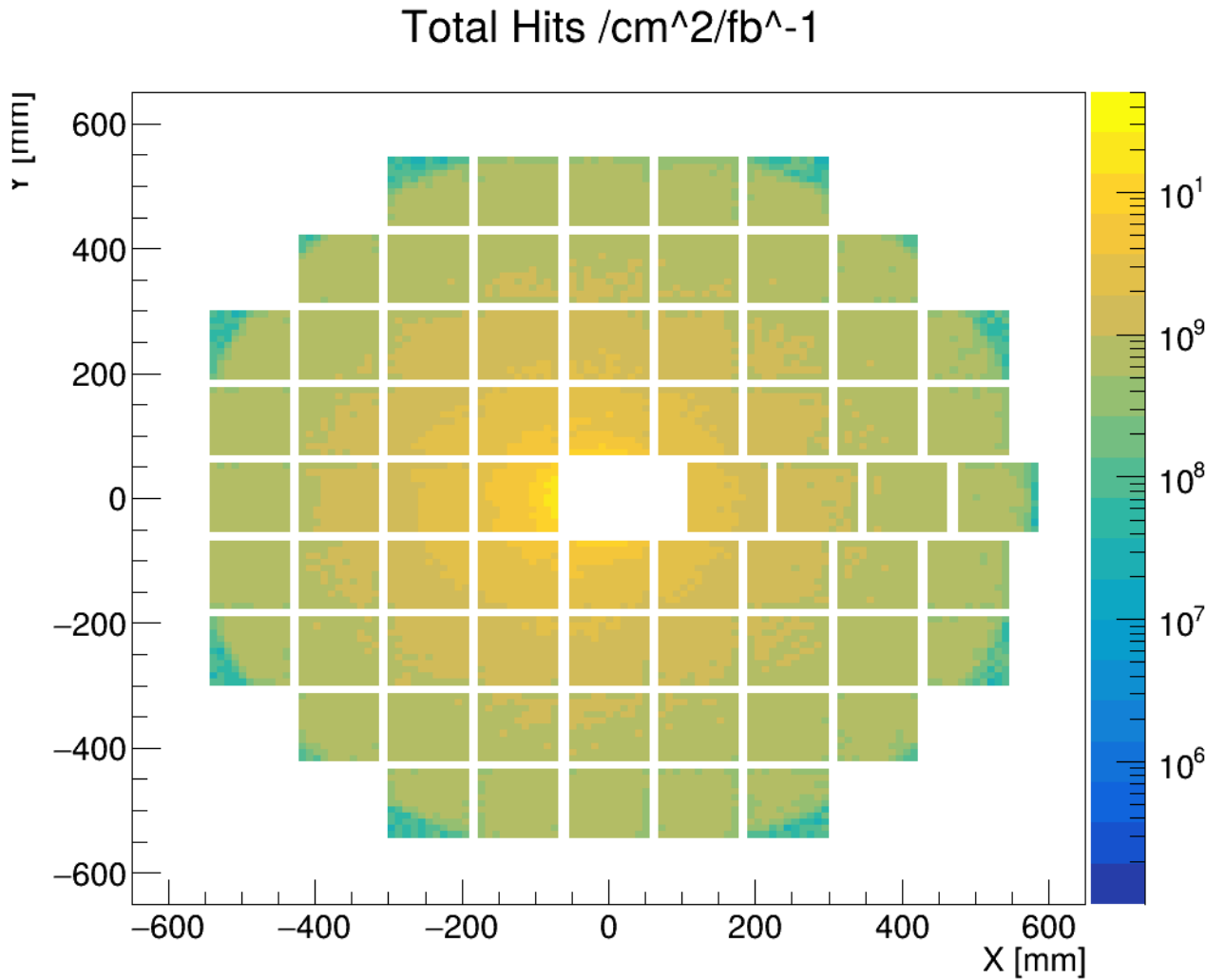
- Synchrotron: 13277000 KHz
- Electron Brems: 3177.25 KHz
- Electron Coulomb: 29.56 KHz
- Electron Touschek: 233.5 KHz
- Proton Beam Gas: 32.6 KHz

☐ Signal generated using Pythia6 minbias samples – 50 microbarn total cross section

☐ Total signal rate at $10 \times 250 = 500$ KHz (1 fb^{-1} in 10^5 s)

- $Q_2 < 1$: 491.87 KHz
- $1 < Q_2 < 10$: 0.74 KHz
- $10 < Q_2 < 100$: 0.59 KHz
- $100 < Q_2 < 1000$: 0.02 KHz

Background + Signal Hit Map and Frequency



Data Rates

* Data rate estimates provided by Takao Sakaguchi

❑ Hit rate [/cm²/s]

- Hottest region: 200000
- MPV: 6000
- Peak region (75% of total): 5000 – 15000

❑ Convert Hit rate from /cm² to /pad: 9 pads occupy $(0.325 \times 3)^2 = 0.95 \text{ cm}^2 \rightarrow \text{Rate/pad} = \text{Rate/cm}^2 \times 0.95/9$

❑ FCFD data size from Artur: 160 bits / hit

❑ Data rate [Mbps/pad]

- Hottest region: 3.2 (assume this for 32 pads = 102 Mbps/chip < 320 Mbps/chip limit)
- MPV: 0.96
- Peak region: 0.8 – 2.4

❑ For the hottest HRPPD: hit rate = 7.7M hits/s $\rightarrow$ data rate = 1.2 Gbps

❑ Total pfRICH sees ~90M hits/s or ~14 Gbps

- 80M Backgrounds hits/s
- 10M Signal hits/s

❑ lpGBT+VTRX+ bandwidth of 7.7 Gbps $\rightarrow$ lots of room

