Touschek background estimation for FTOF detector

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Outlook

- Analyzed files
- Incoming particles
- Secondary electrons
- Background Cherenkov photon rate and timing
- Absorbed dose
- Conclusions

General information about analyzed files

The root files are in: /storage/gpfs_superb/prod/Touschek_perez/Touschek_SuperB/

HER:

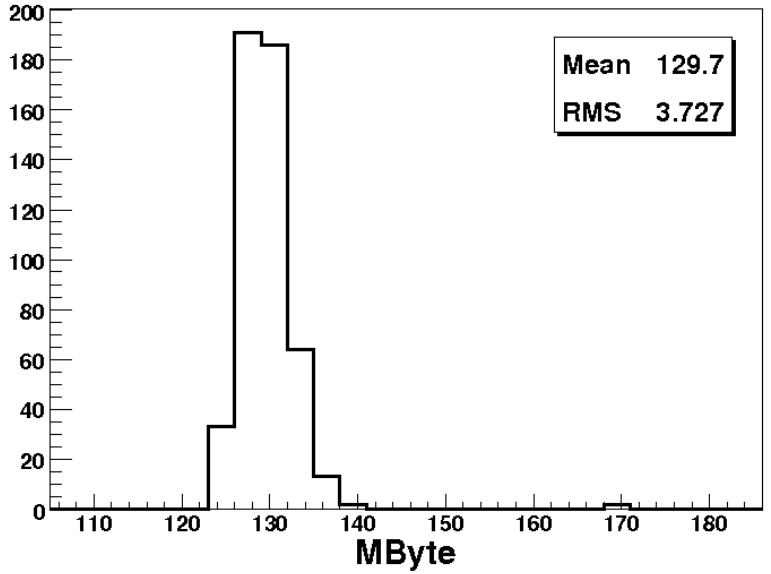
111277 simulated Touschek particles

Total number of root files : 501

Number of root files with error* : 11 (2.2%)

Number of analyzed root files : 490

Size of the files



LER:

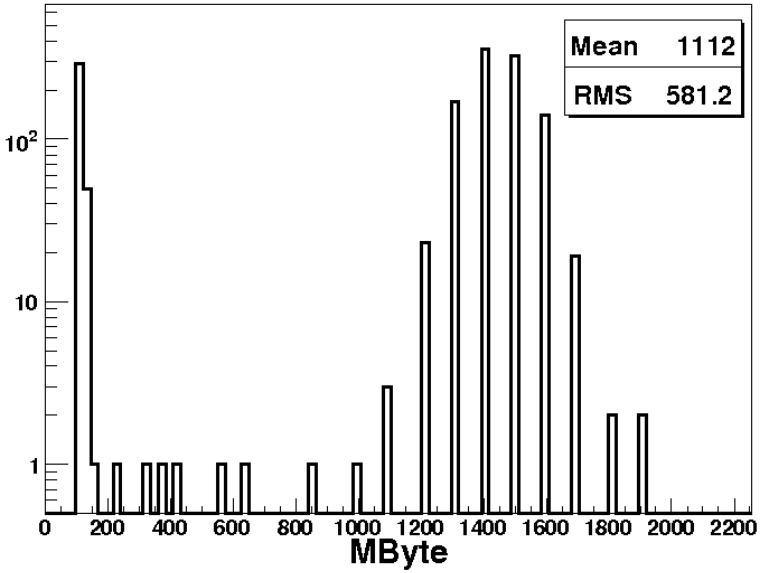
334739 simulated Touschek particles

Total number of root files : 1387

Number of root files with error : 0

Number of analyzed root files : 1387

Size of the files



*probably not closed, trying to recover Warning in <TFile::Init>: no keys recovered, file has been made a Zombie:

.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-129.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-244.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-269.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-279.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-313.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-347.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-386.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-459.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-487.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-492.root
.../Bruno_output_Touschek_losses_primaries_SuperB_sf10_v12_HER_Nobacktrack_guinea_222_Evts-6.root

Constants

In this presentation we estimate particles fluxes and doses in the FTOF quartz tiles only*

Total surface of the FTOF detector (quartz tiles) is = 1.71 x 10^4 cm^2

Its mass is = 56.4 kg

Total sensitive surface of the MCP-PMTs is = 813.12 cm^2

Incoming particles

HER:

Gammas ~ 58%
Neutrons ~ 42%
Other << 1%

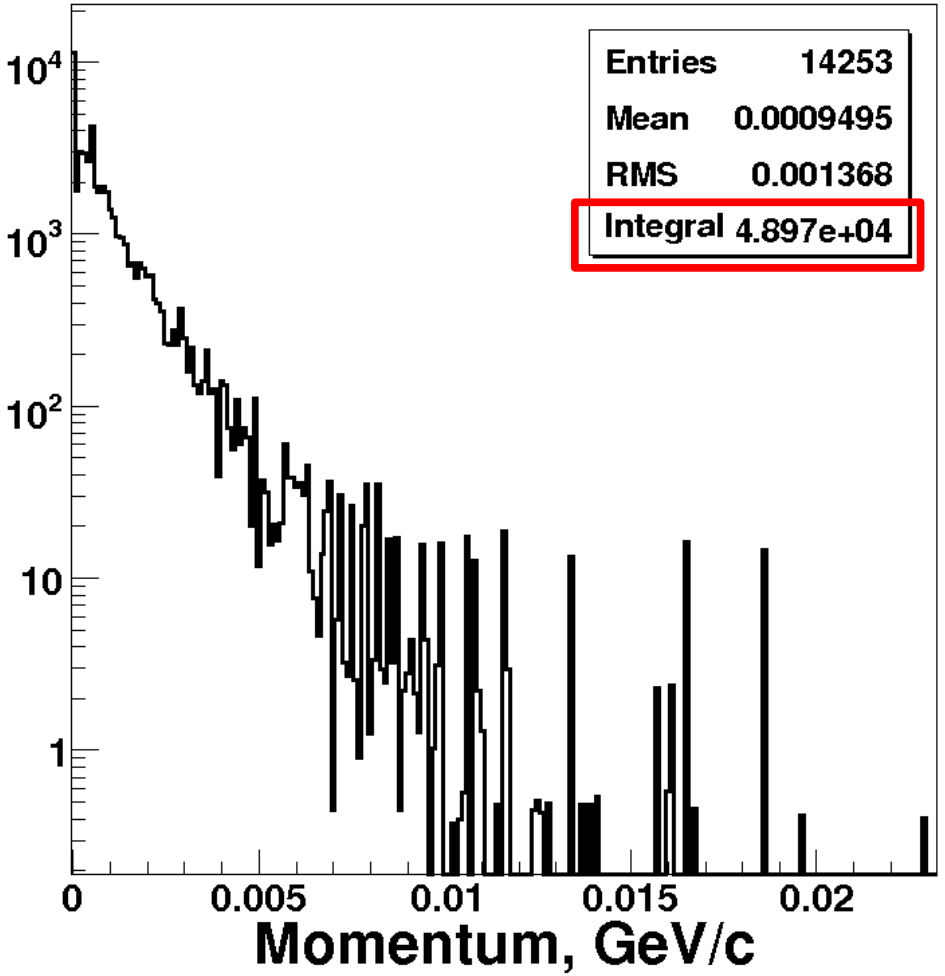
LER:

Gammas ~ 94%
Neutrons ~ 6%
Other <<1%

* geometry of the FTOF detector implemented in Bruno shown in backup slides

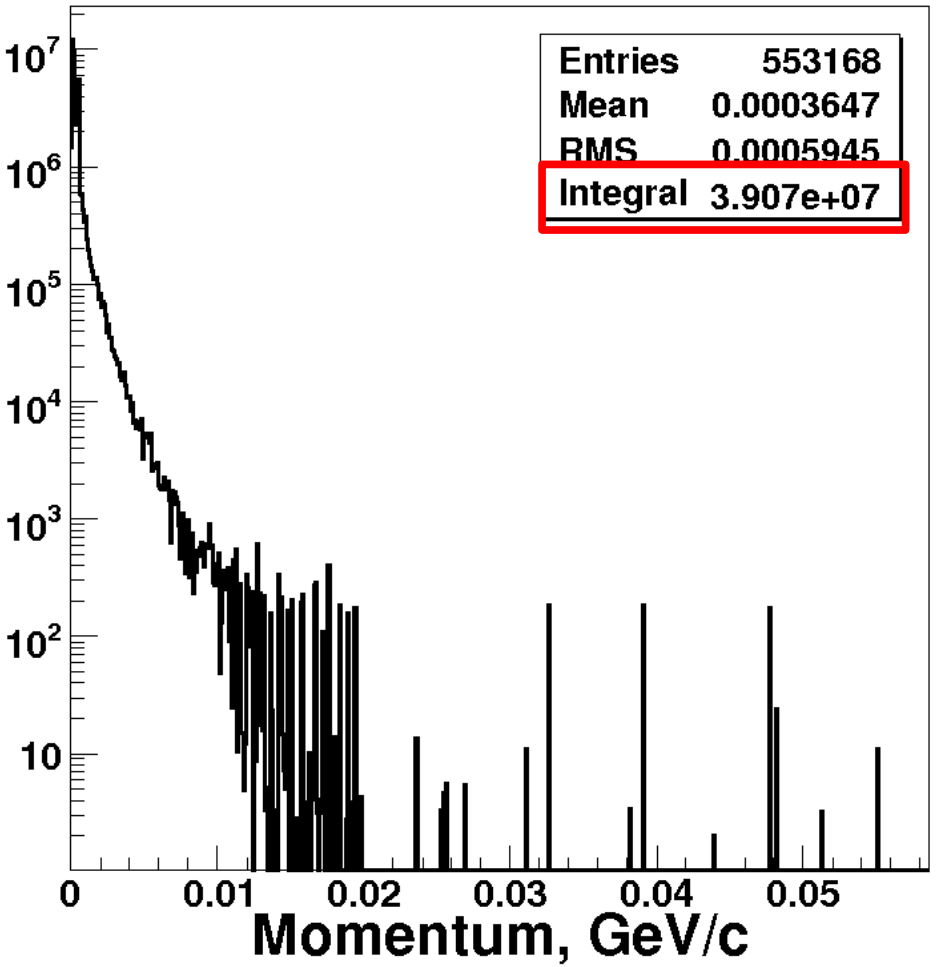
Incoming particles (Gamma)

HER:



~3.0 Hz/cm^2

LER:



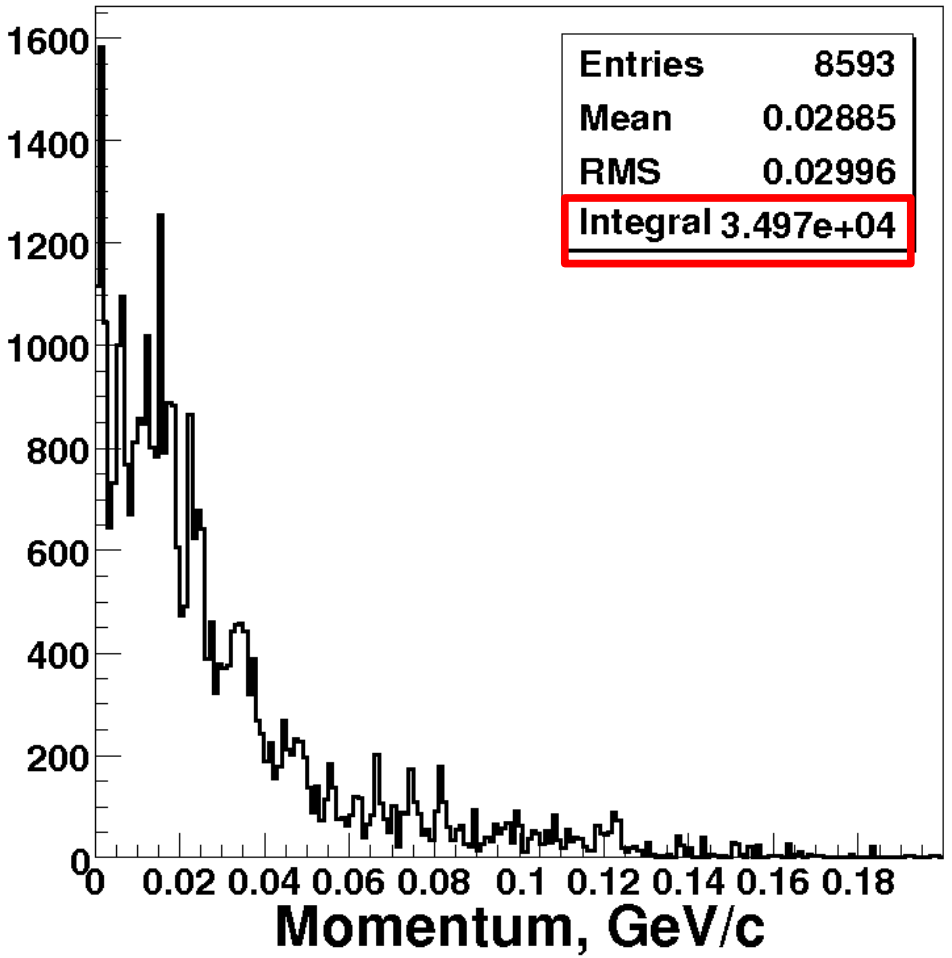
~2.3 kHz/cm^2

The integrals on the histograms corresponds to a total number of gammas entering the FTOF detector in a second. Knowing the FTOF surface one can calculate the flux:

Flux = (Integral)/(surface)

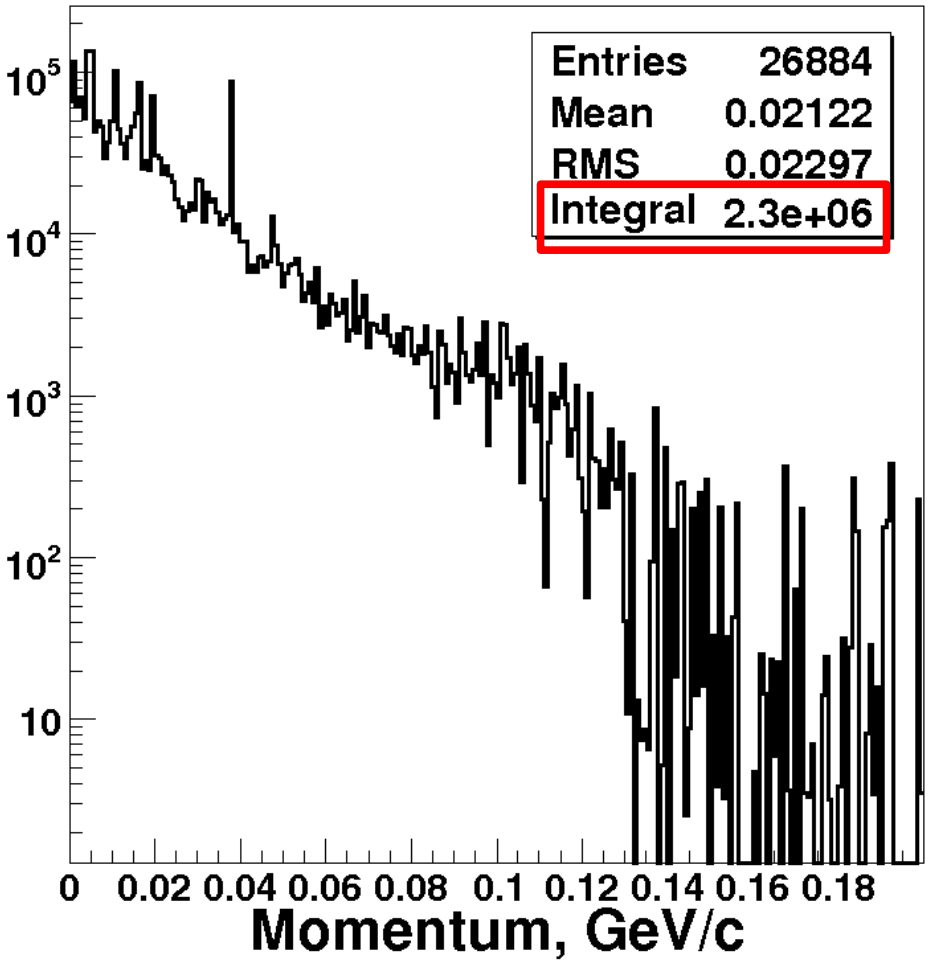
Incoming particles (Neutrons)

HER:



~2.1 Hz/cm^2

LER:

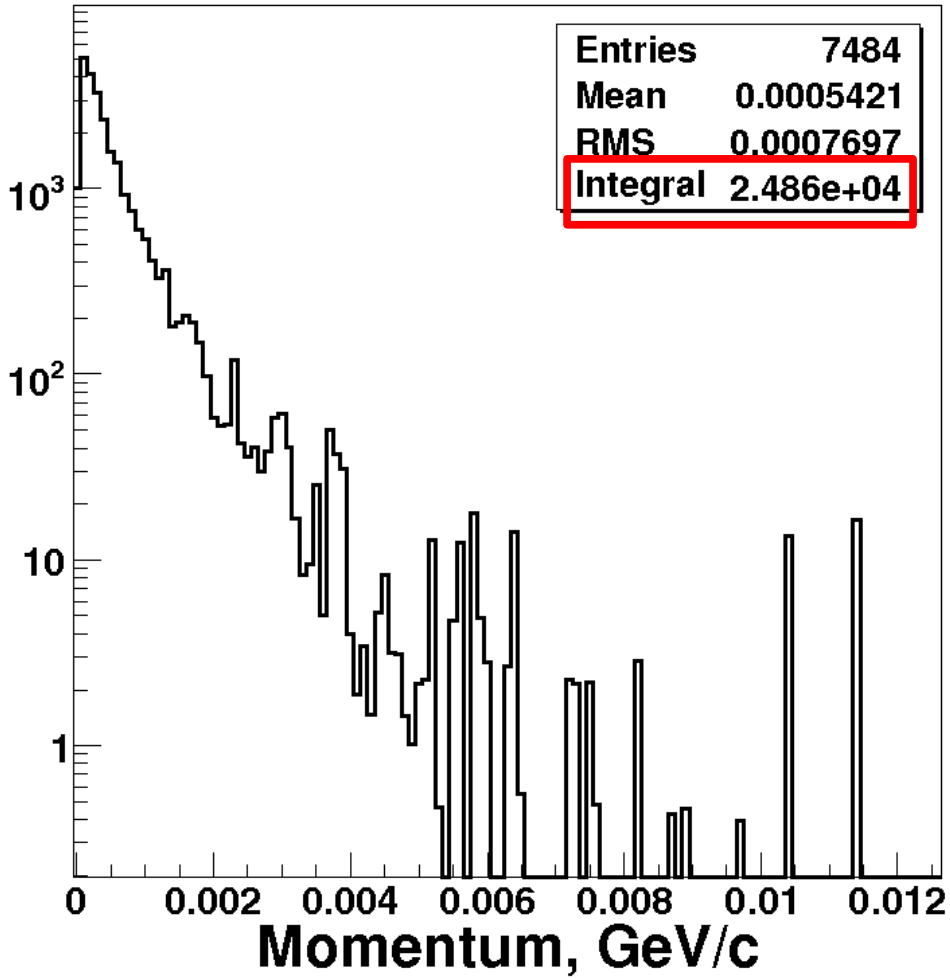


~135 Hz/cm^2

Secondary electrons produced in the FTOF detector

HER:

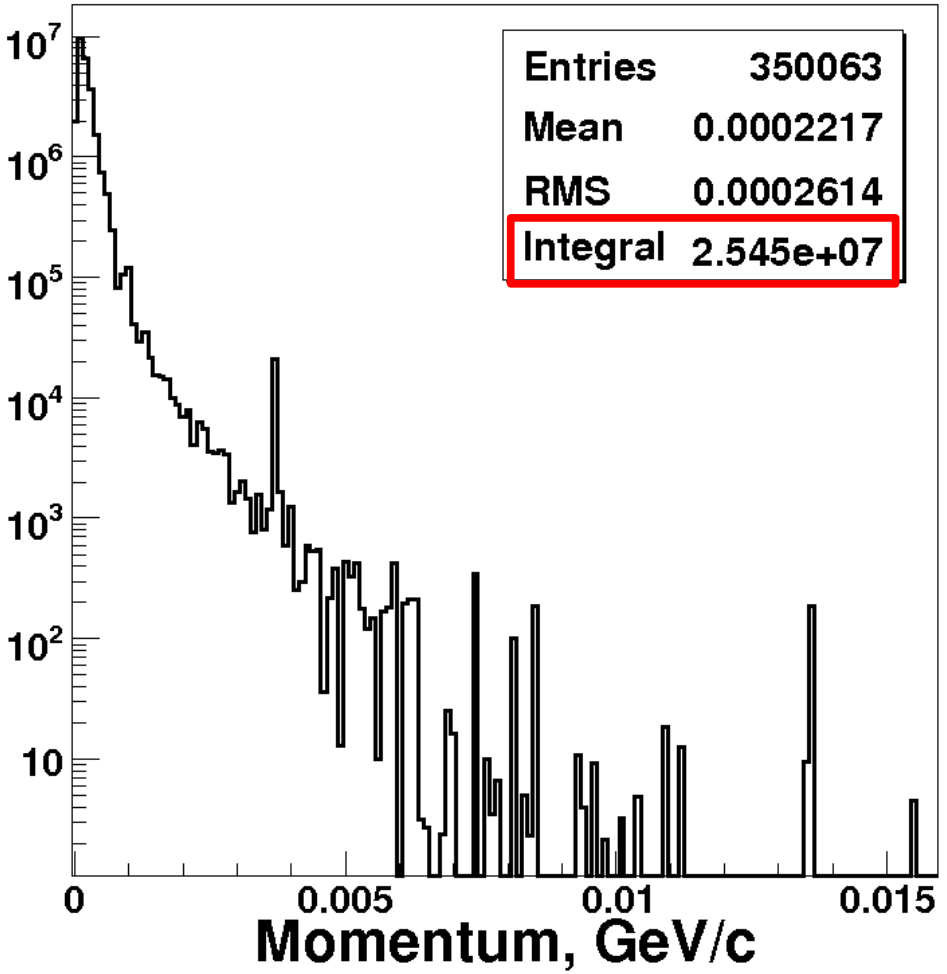
Electron



~1.5 Hz/cm^2

LER:

Electron

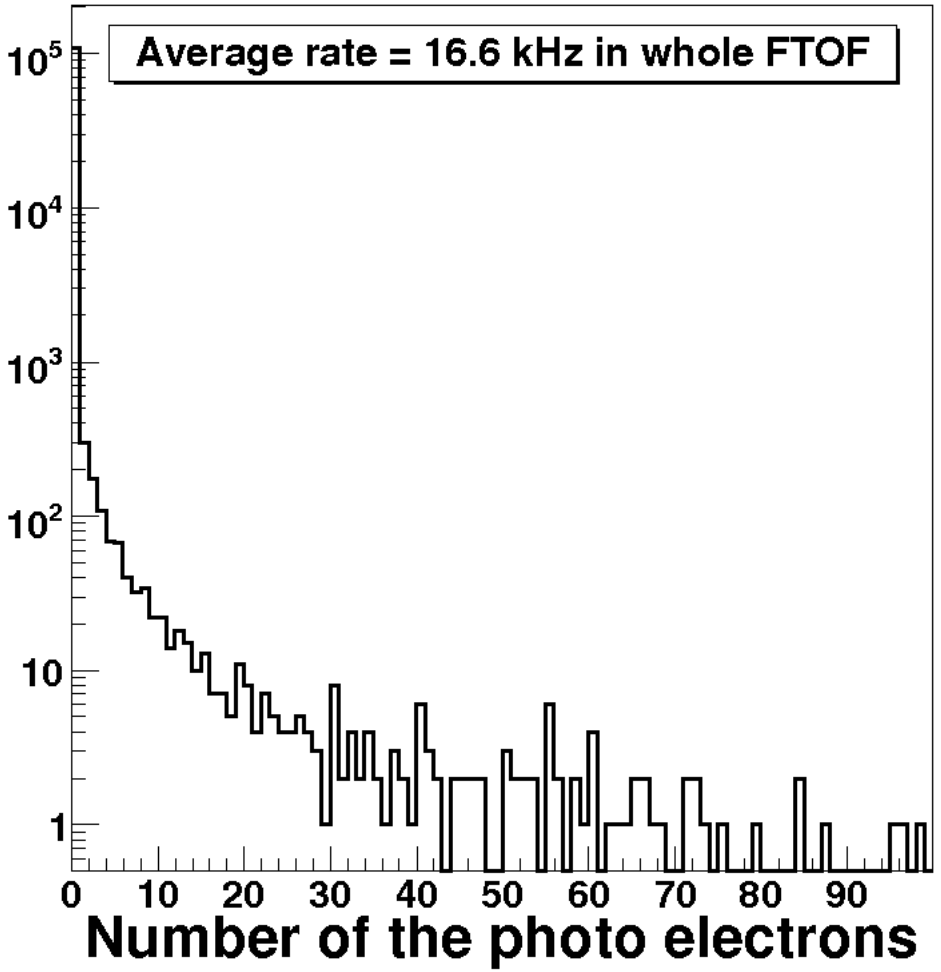


~1.5 kHz/cm^2

Rate of the background photons

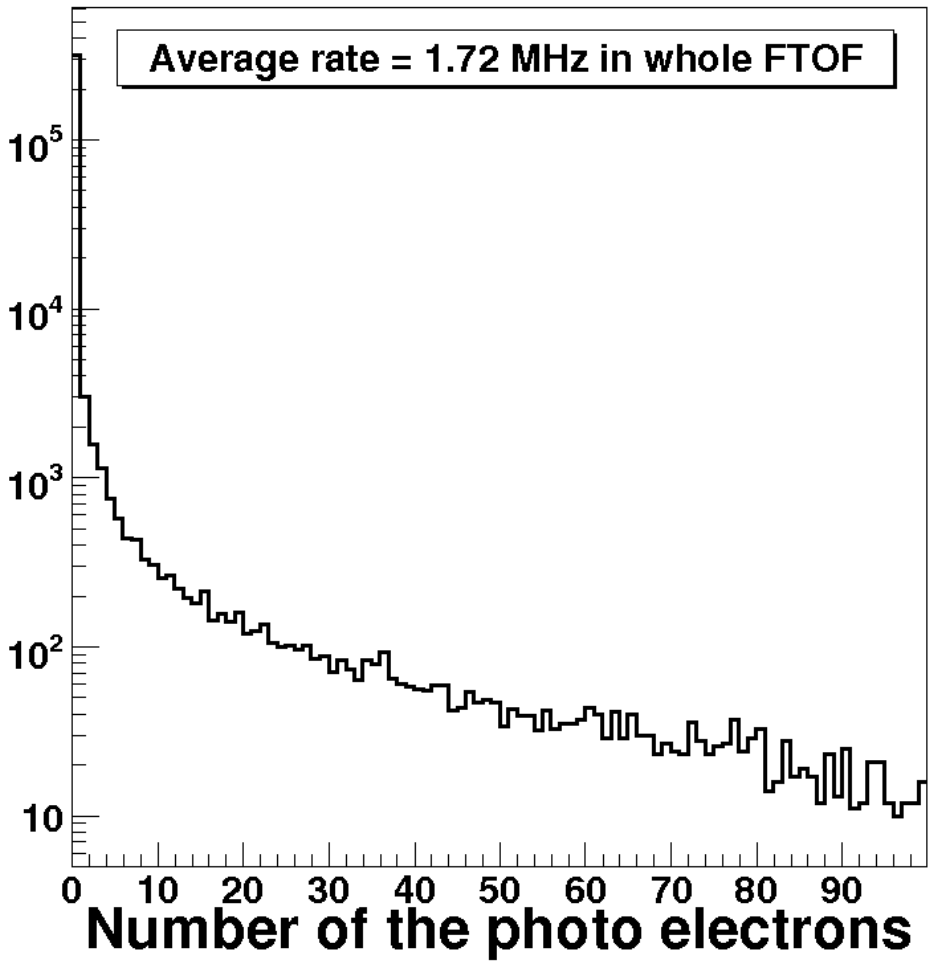
To calculate the background photon rate we use Jerry's method*

HER:



Rate: ~20.4 Hz/cm²

LER:



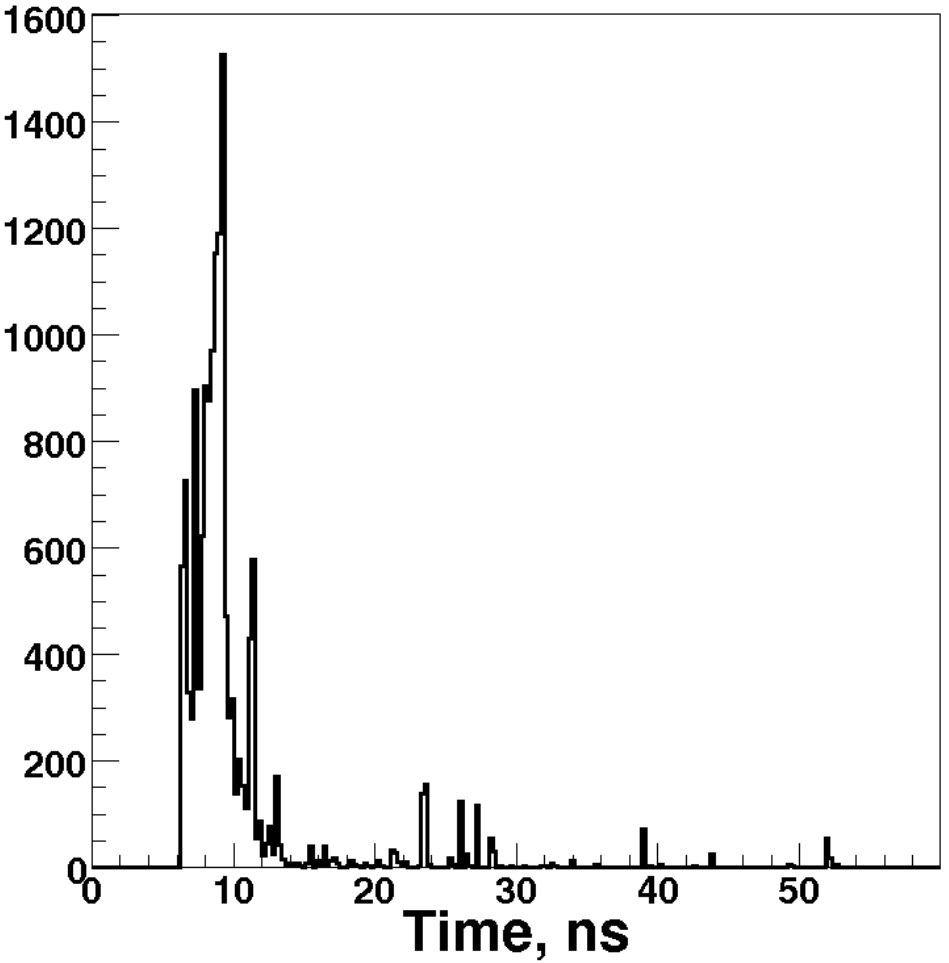
Rate: ~2.2 kHz/cm²

NOTE: this rate shows how many photo electrons are produced per one cm² of the MCP-PMT sensitive area in one second.

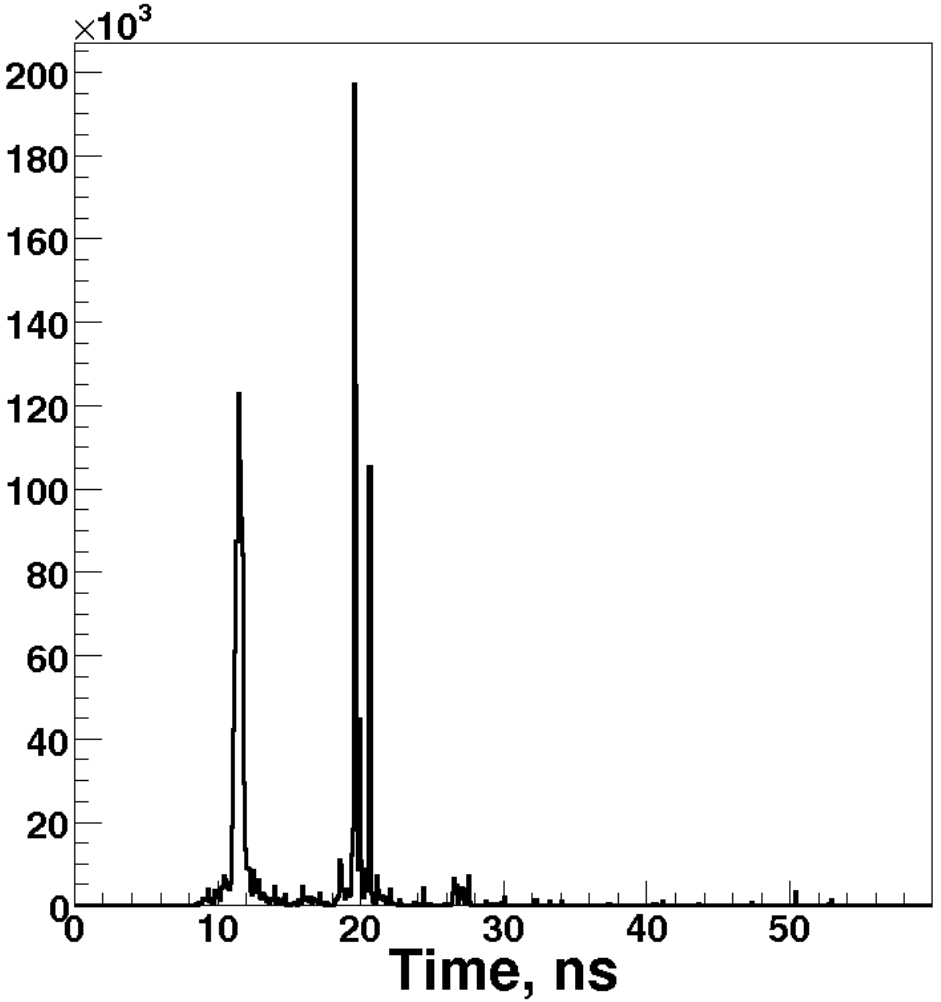
*See backup slides

Time distribution of the first secondary electron produced in the FTOF detector

HER:



LER:

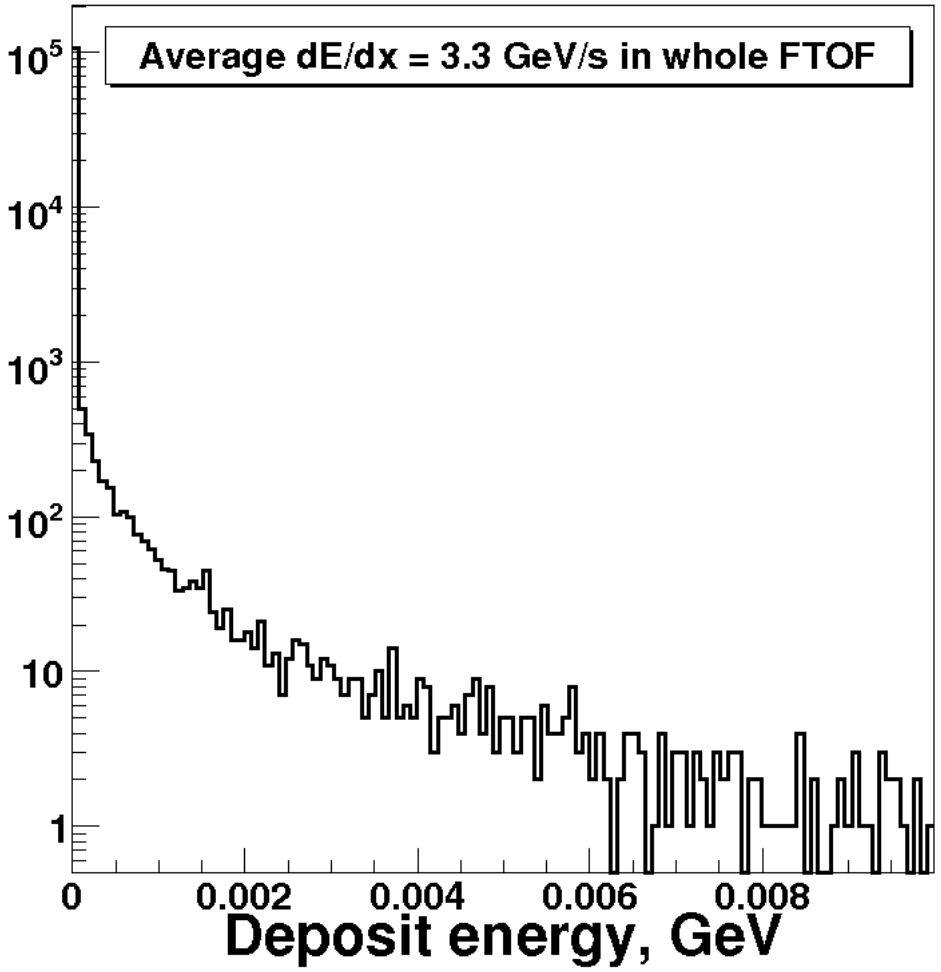


NOTE: the touschek particles are produced within a bunch hence they does not come from the interaction point.

Time zero is arbitrary defined

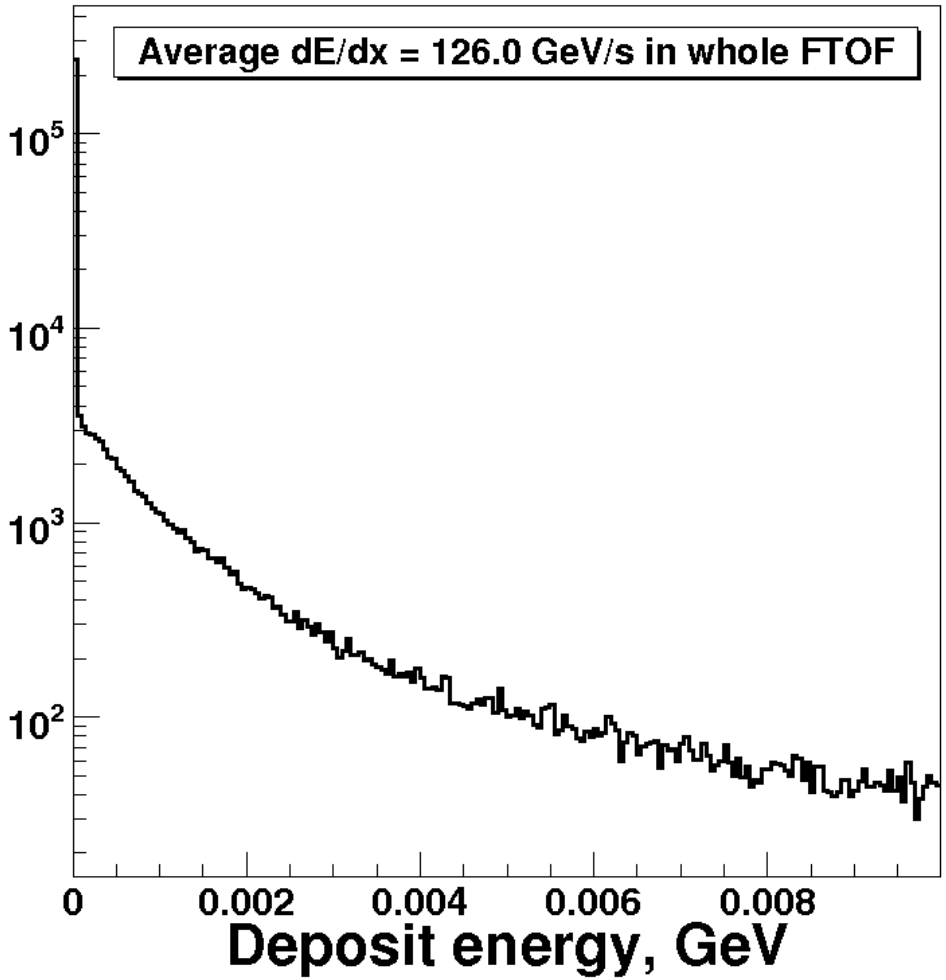
Absorbed dose by FTOF

HER:



~0.02 Rad/year

LER:



~0.7 Rad/year

Conclusions

→ The HER touschek particles cause 2-3 orders of magnitude less background then LER particles.

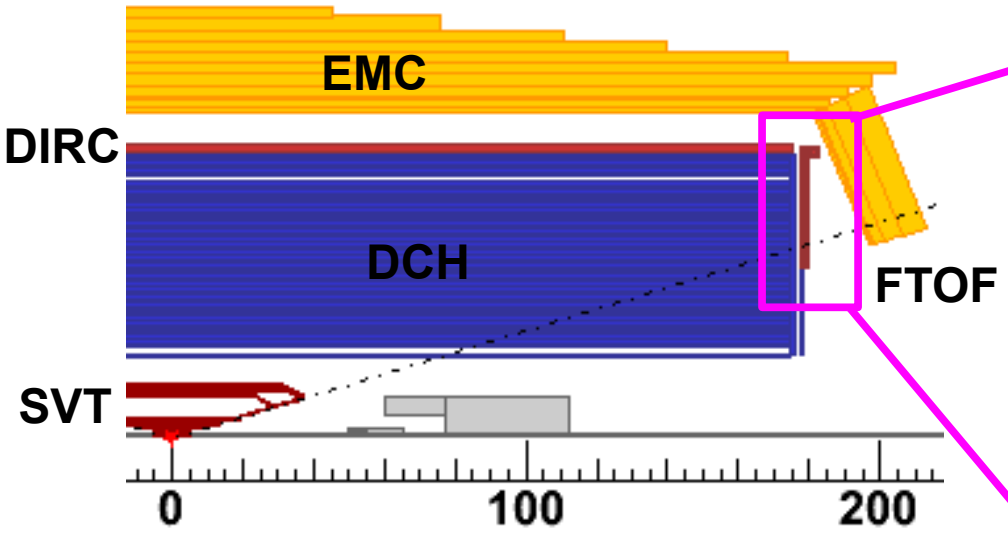
	HER:	LER:
Gammas	~3.0 Hz/cm^2	~2.3 kHz/cm^2
Neutrons	~2.1 Hz/cm^2	~135 Hz/cm^2
Photo electrons	~20.4 Hz/cm^2	~2.2 kHz/cm^2
Doses	~0.02 Rad/year	~0.7 Rad/year

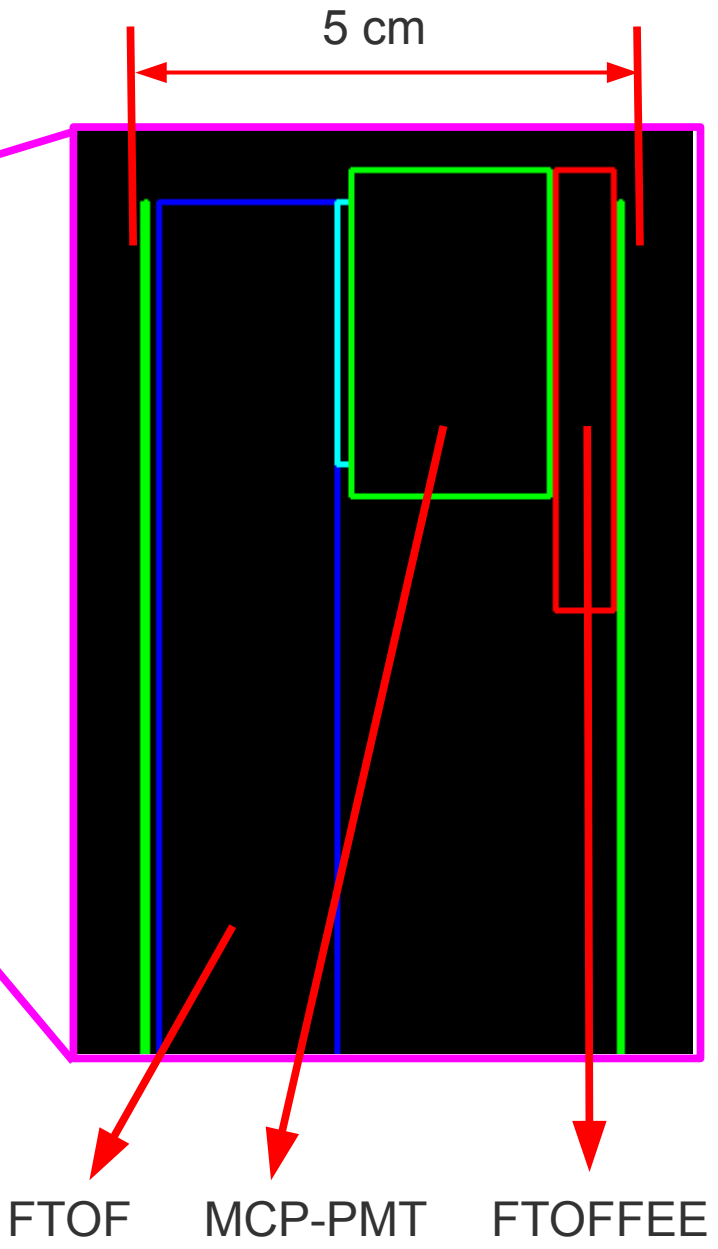
→ The Touschek background is negligible (2-3 orders of magnitude less) in comparison to the one caused be the radiative Bhabha.

Gammas	~ 77 kHz/cm^2
Neutrons	~ 12 kHz/cm^2
Photo electrons	~ 460 kHz/cm^2
Doses	~1.4 kRad/year

BACKUP

FTOF and FTOFFEE geometry reminder





- FTOF is made of 12 1.5 cm thick quartz tiles.
- 14 MCP-PMTs connected from the top of each quartz tile.
- Front end electronics (FEE) are connected to each MCP-PMT.

Background photoelectrons estimation

The number of detected photoelectrons can be described with this formula:

$$N_{d.p.e.} = \int E_g E_c N_0 \sin^2(\theta_c)/\lambda^2 \, dx \, d\lambda$$

x - is the length of the track in the radiator

λ - wavelength of the photons

E_g - geometrical efficiency of the photon collection. In general this is a function of the position and direction of the track.

E_c - conversion factor from photons to photoelectrons. This is defined by the quantum efficiency of the photocathode and the collection efficiency of the PMT.

θ_c - Cherenkov angle

Production and propagation of the Cherenkov light is not implemented in Bruno yet for FTOF. Consequently the most precise method to estimate number of detected p.e. is to use a standalone full simulation of the FTOF detector and the information from Bruno about particles entering FTOF as input.

Other method (Proposed by Jerry) is to sum up at each step the number of detected p.e.:

$$N_{d.p.e.} = 26 \sum L_i[cm](1 - 1/n^2/\beta_i^2)$$ L_i, β_i are available in Bruno

NOTE this formula valid only for BaBar DIRC detector