GEM-TN-93-390

Hit Rate Estimation for the GEM Central Tracker and Muon System

Y.V. Fisyak

November 15, 1993

Abstract;

It is presented the results obtained during studying of radiation environment for the GEM detector which has not been included in the GEM TDR. It is given fluxes of neutrons, γ's and charged particles for the shielded variant of the detector. It is considered the influence of magnetic field on the fluxes. It is given hit rates due to different particle types. The calculation is based on the full GEM GEANT simulation (SIGEM v2.2) with GCALOR.

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Introduction

Herein it is presented results obtained during the GEM detector radiation environment studys with the global GEM GEANT simulation[1] with GCALOR[2] and which has not been included in the GEM TDR[3]. The results are devoted to the following topics:

- the fluxes of neutrons,γ's and charged particles[4] due to the primary interactions
- the fluxes due the beam-gas interactions
- the comparison of the fluxes with and without magnetic field
- hit structure — the percentage of hit due to different particle types.

Neutron, γ and charged particle fluxes due to primary interactions

The fluxes have been calculated for the SSC luminosity $10^{33} cm^{-2} \times s^{-1}$ i.e. 100 MHz primary interaction.

In Fig.1-2 it is presented neutron, γ and charged particle fluxes for barrel (R = 420, 630 and 850 cm) and endcap (Z = 620, 110 and 1600 cm) muon system and for barrel (R = 10, 30 and 80 cm) and endcap (Z = 10, 80 and 150 cm) Central Tracker.

Neutron flux in the muon system is at level about 800 Hz/cm^2 in the first two layers of the muon barrel and 550 Hz/cm^2 in the third one. In the first endcap chambers the average neutron flux is 4 kHz/cm^2 and fall down to 600 kHz/cm^2 for the third layer. The γ/neutron ration is about 0.5. The charged particle flux ($\equiv$ hit rate) is about $1 \div 10$ Hz/cm^2.

In Fig.3-4 it is given the fluxes from beam-gas interaction which corresponds to 2 MHz interaction rate in $\pm$50m beam pipe. The flux due to beam-gas interaction is at the level $\sim$ 5% from one from the interaction point.

Fluxes with and without magnetic field

One of the problem for comparison of the presented results and the results obtained with LAHET/MCNP code[5] is accounting of an influence of magnetic field. LAHET/MCNP package has no magnetic field. In Fig.5-8 is is presented comparison of the neutron/γ fluxes obtained in SIGEM with and without magnetic field on the same 20 events in the

[1] Yu.Fisyak et al., "SIGEM Progress report on Global GEANT Simulation for GEM", GEM TN-93-438

[2] C.Zeitnitz, T.A. Gabriel, "The GEANT-CALOR Interface", III International Conference for Calorimetry in High Energy Physics, Corpus Christi, 1992

[3] GEM Technical Design Report, GEM-TN-93-262, SSCL-SR-1219

[4] The charged particles include charged pions, kaons, protons and antiprotons, electors and positrons which has been produced in the primary and secondary interaction including electrons and positrons produced by γ's originated from (n,γ) reaction.

[5] "Radiation Calculations using LAHET/MCNP/CINDER90", Proceedings of the II International Conference on Calorimetry in High Energy Physics, Corpus Christi, LA-UR-89-3014, Oct. 1992

central tracker (at R = 10, 30 and 80 cm versus Z and at Z = 10, 80 150 cm versus R) and the muon system (at the muon chamber position: at R = 420, 630 and 850 cm versus Z and at Z = 620, 1110 and 1600 cm versus R). The flux without magnetic field (left shaded) is systematically higher than one with magnetic field (right shaded) but at maximum the difference is about factor 2.

Hit rate structure

In Fig.9 and Fig.10 it presented the hit rate structure — the percentage of hit due to different particle types for barrel and endcap, respectively. For the muon barrel and endcap hit rate due to electron, positrons and γ's is 96.8% and 77.2 %, respectively.

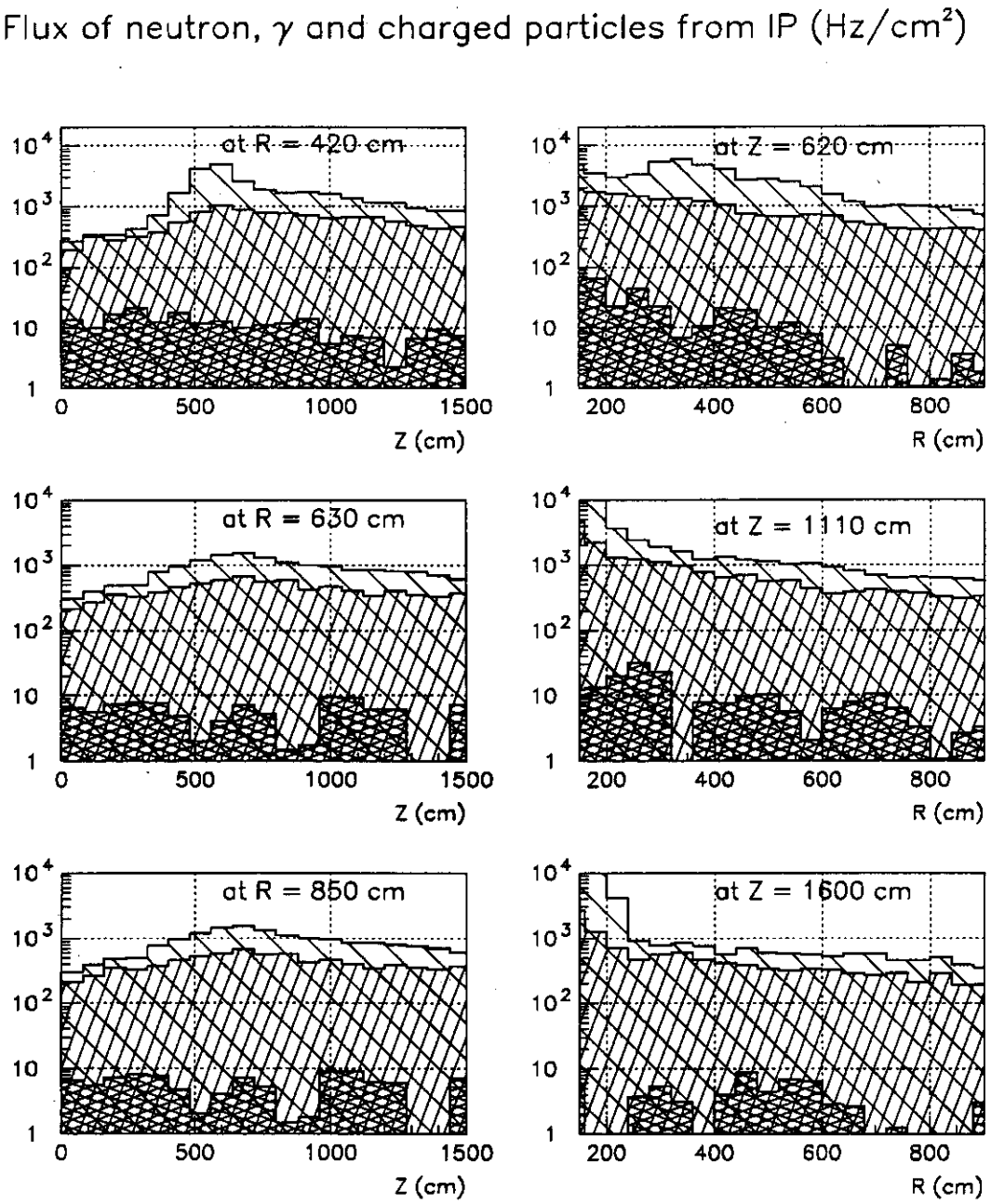

Figure 1: Neutron (right shaded), γ (left shaded) and charged particles (shaded) fluxes from primary interactions in the GEM Muon system

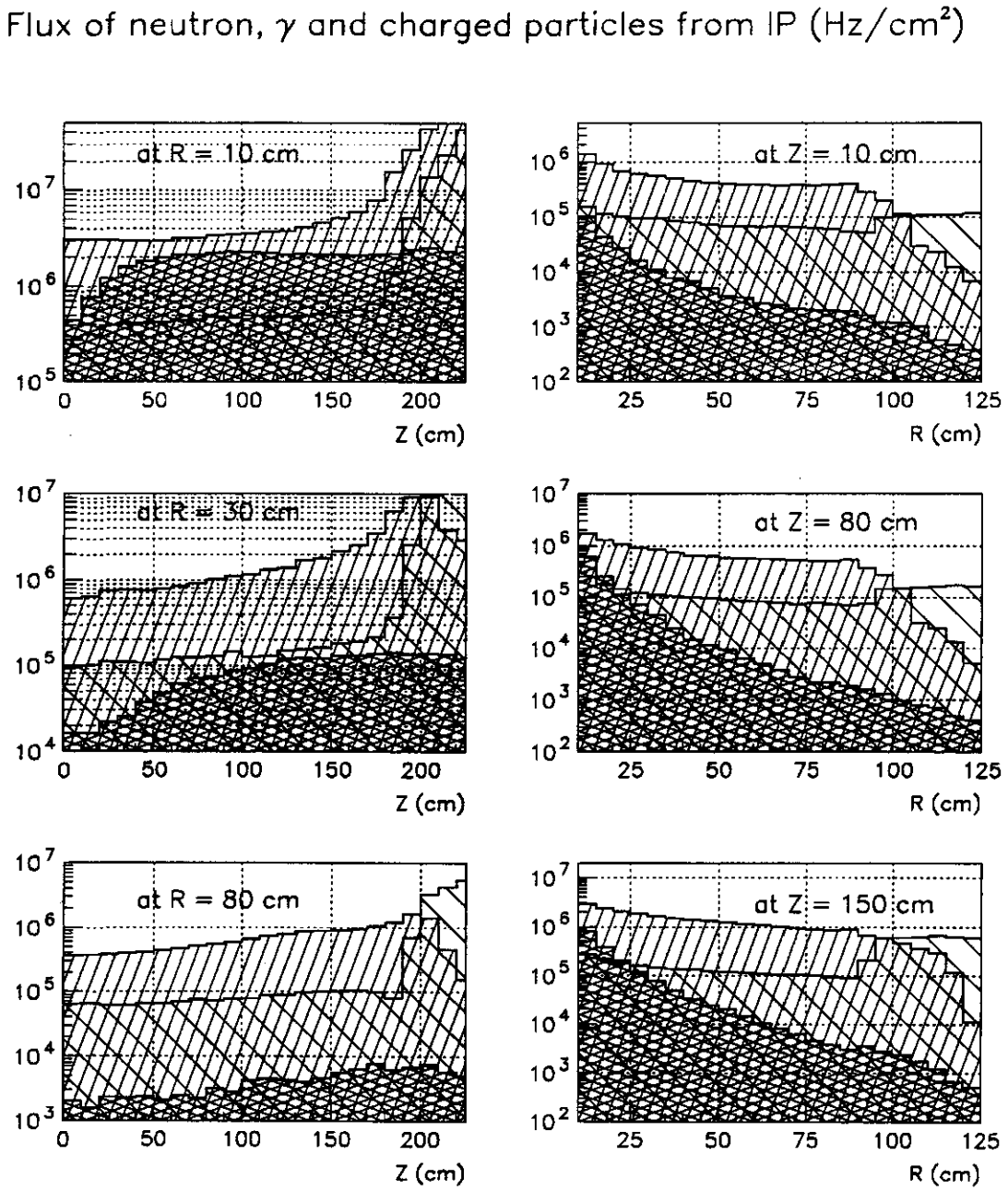

Figure 2: Neutron (right shaded), γ (left shaded) and charged particles (shaded) fluxes from primary interactions in the GEM Central Tracker system

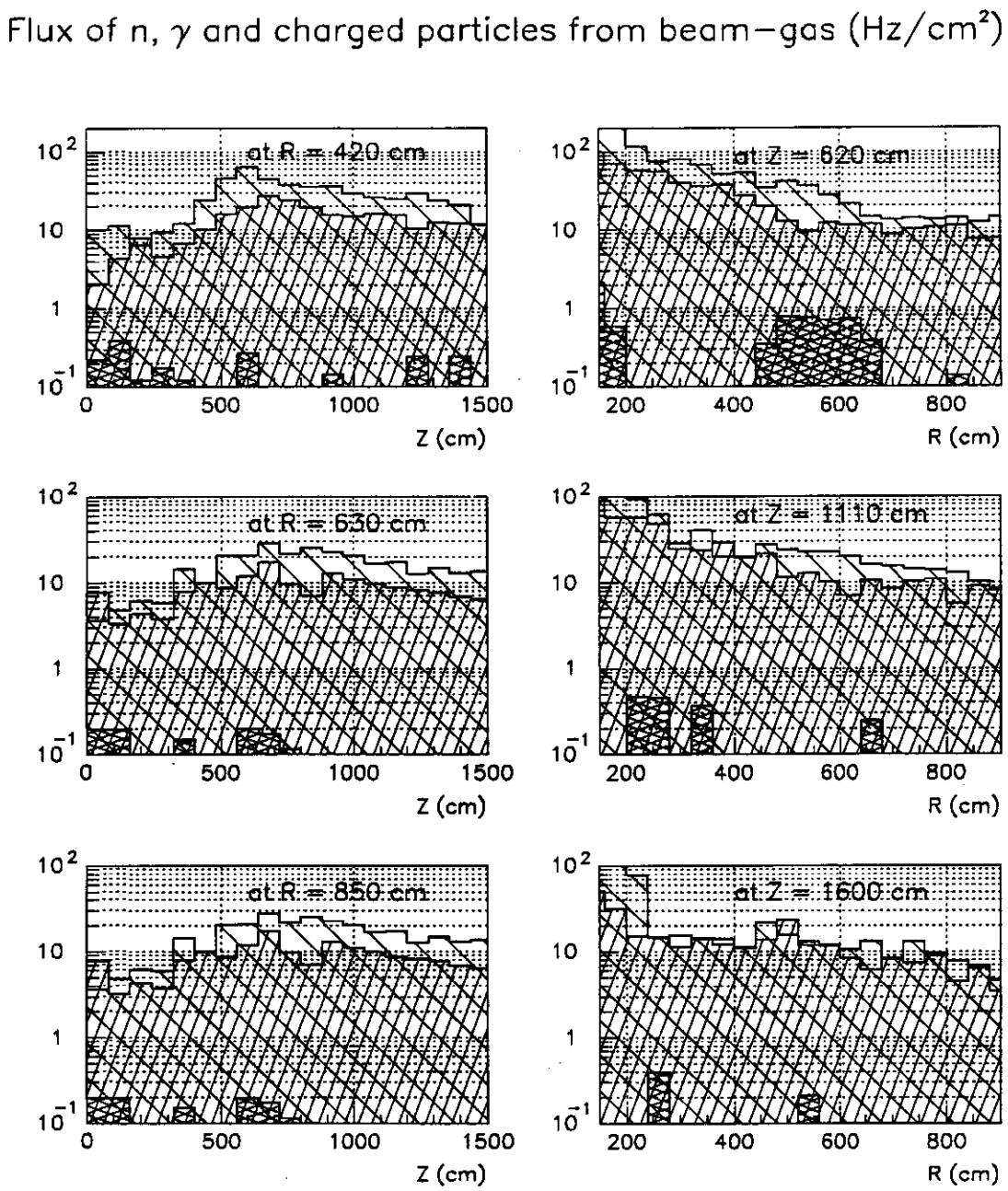

Figure 3: Neutron (right shaded), γ (left shaded) and charged particles (shaded) fluxes from beam gas interactions in the GEM Muon system

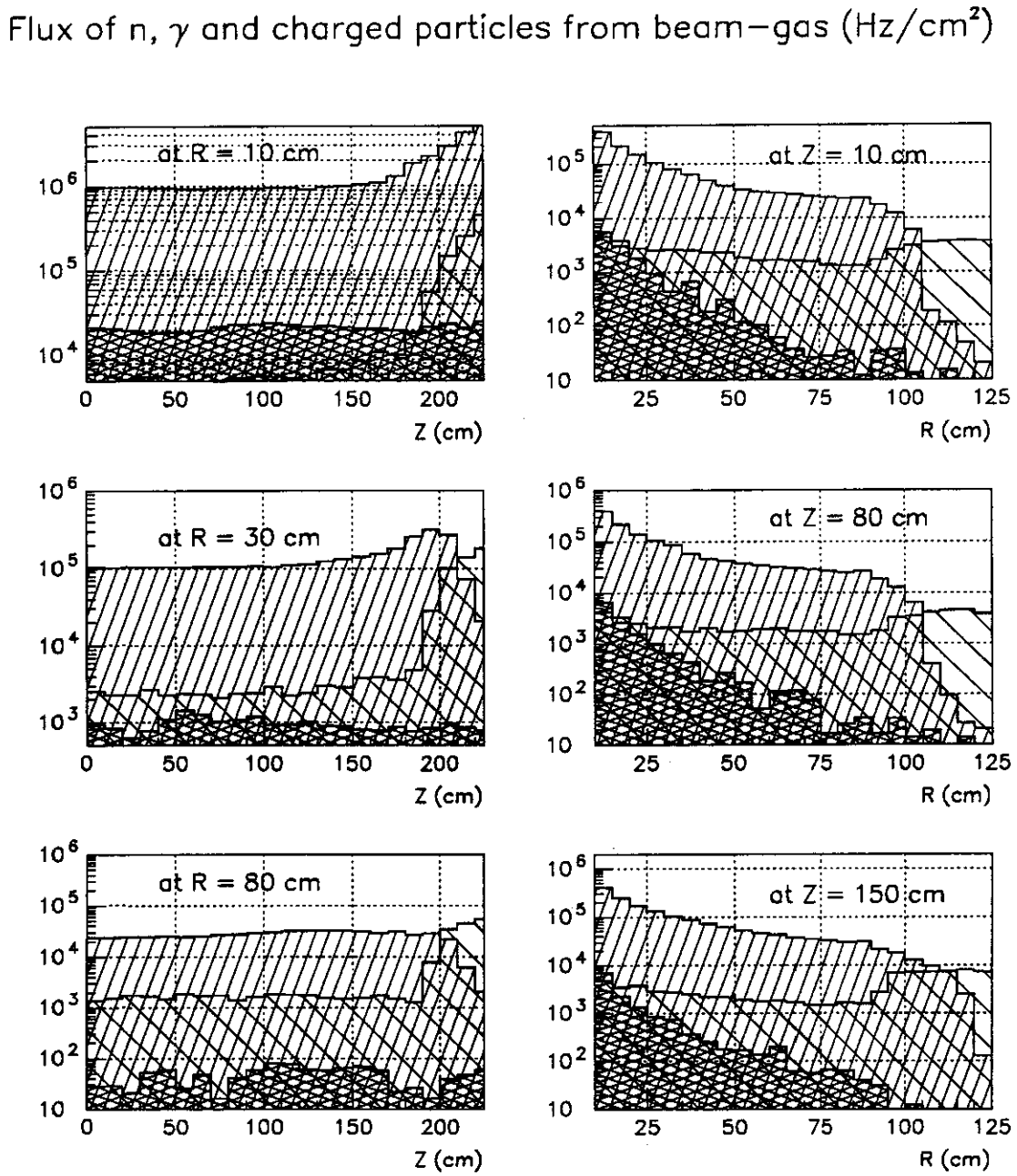

Figure 4: Neutron (right shaded), γ (left shaded) and charged particles (shaded) fluxes from beam gas interactions in the GEM Central Tracker system

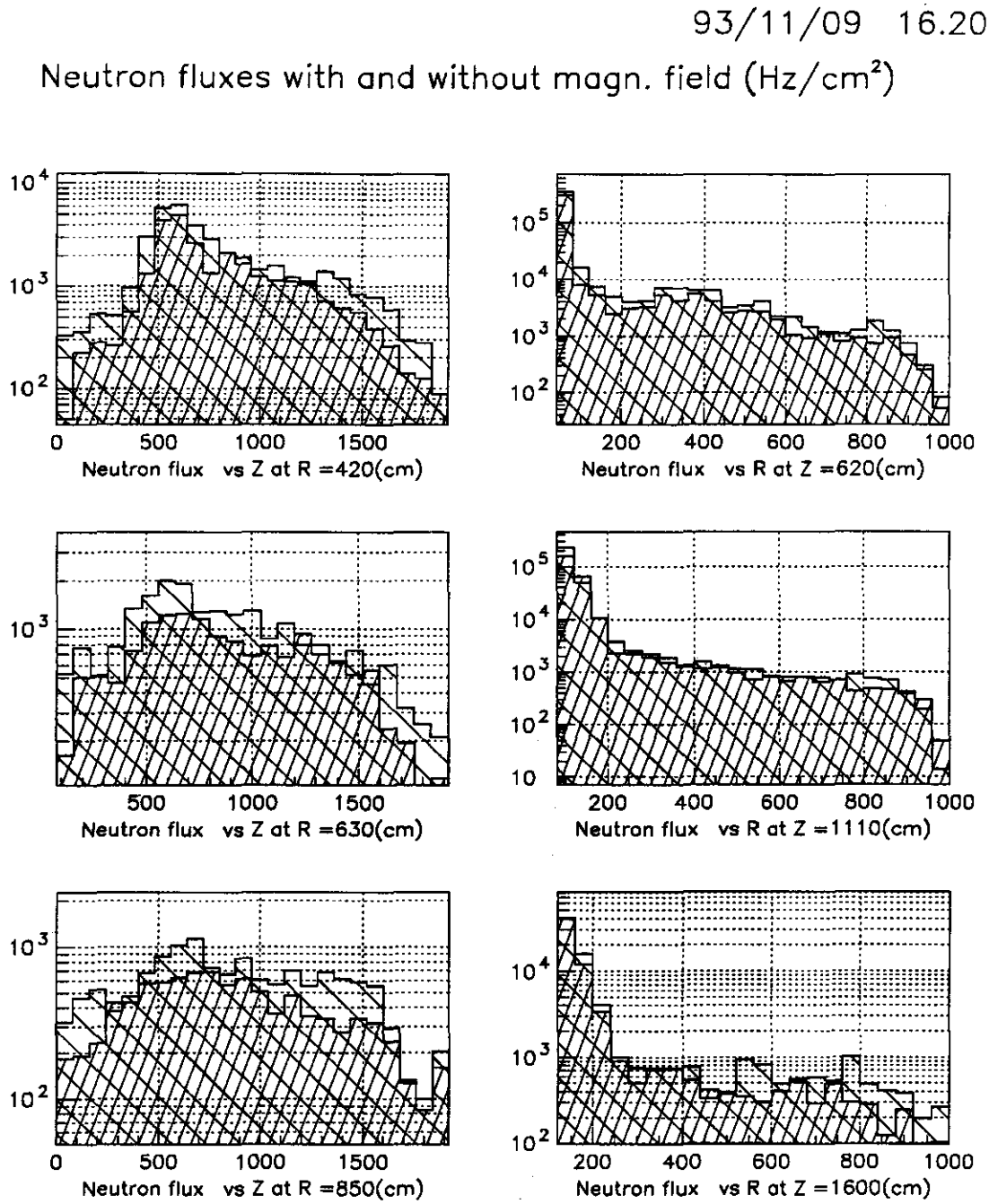

Figure 5: Comparison of neutron fluxes obtained for the same 20 event sample with (right shaded) and without (left shaded) magnetic field in the GEM Muon system

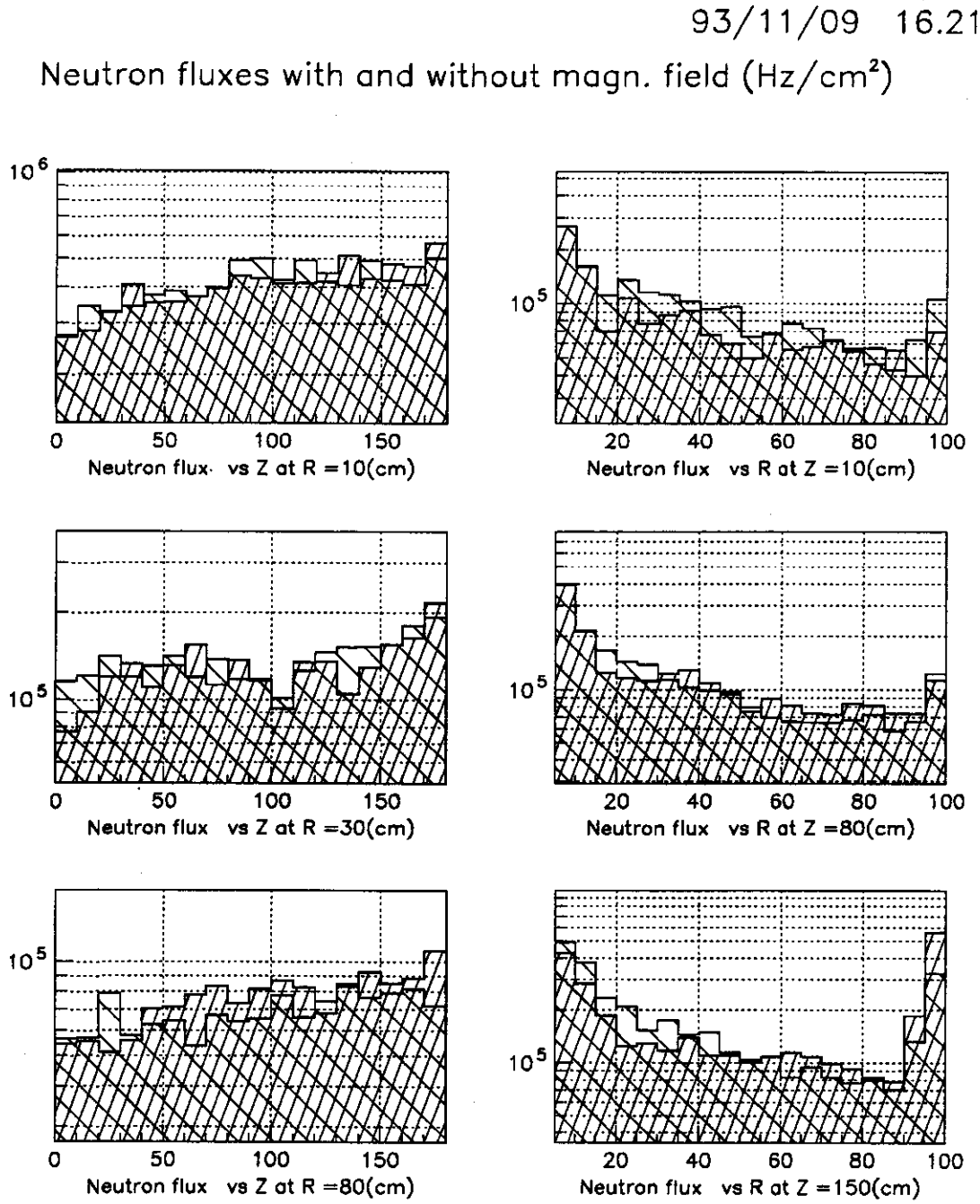

Figure 6: Comparison of neutron fluxes obtained for the same 20 event sample with (right shaded) and without (left shaded) magnetic field in the GEM Central Tracker system

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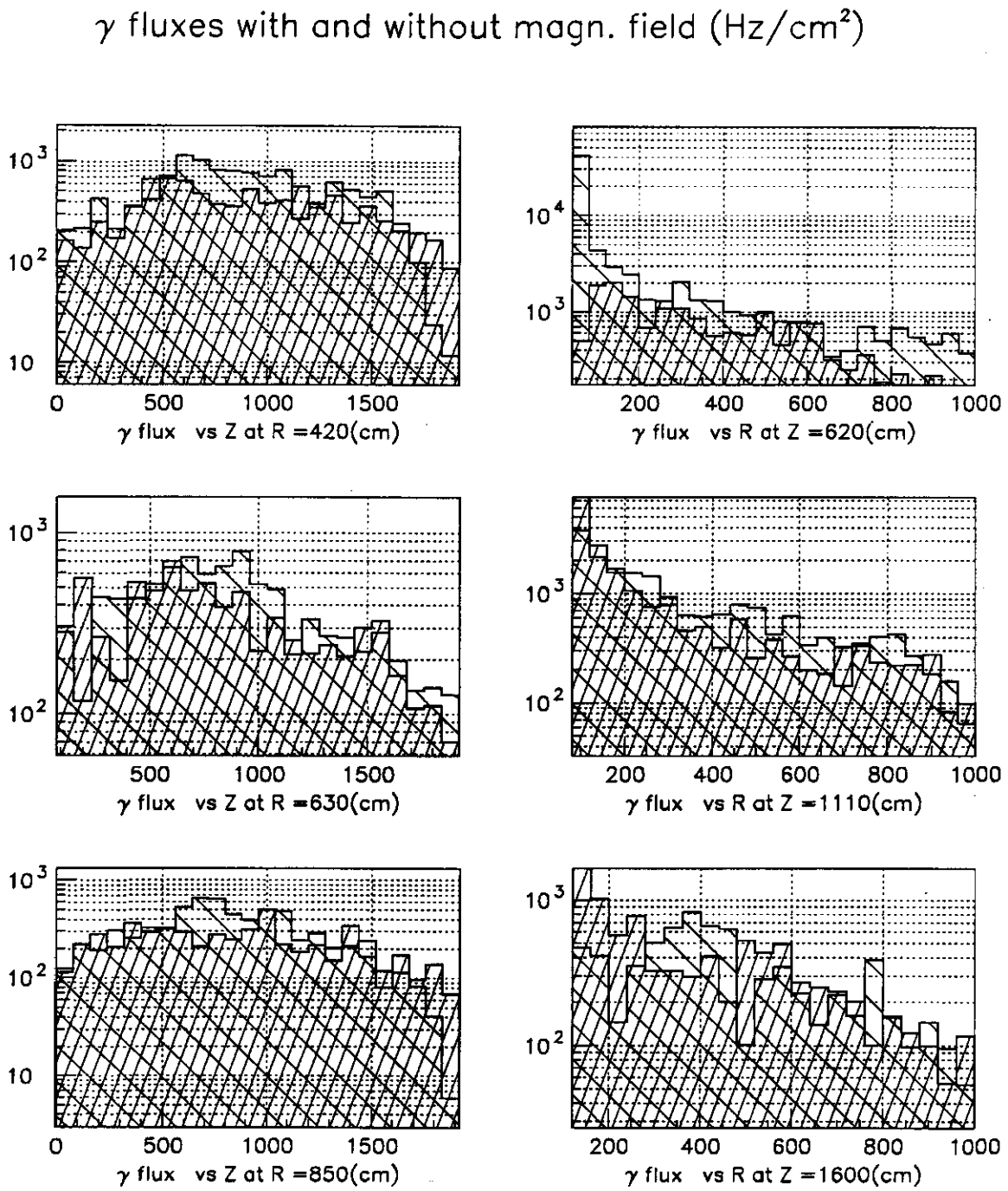

Figure 7: Comparison of γ fluxes obtained for the same 20 event sample with (right shaded) and without (left shaded) magnetic field in the GEM Muon system

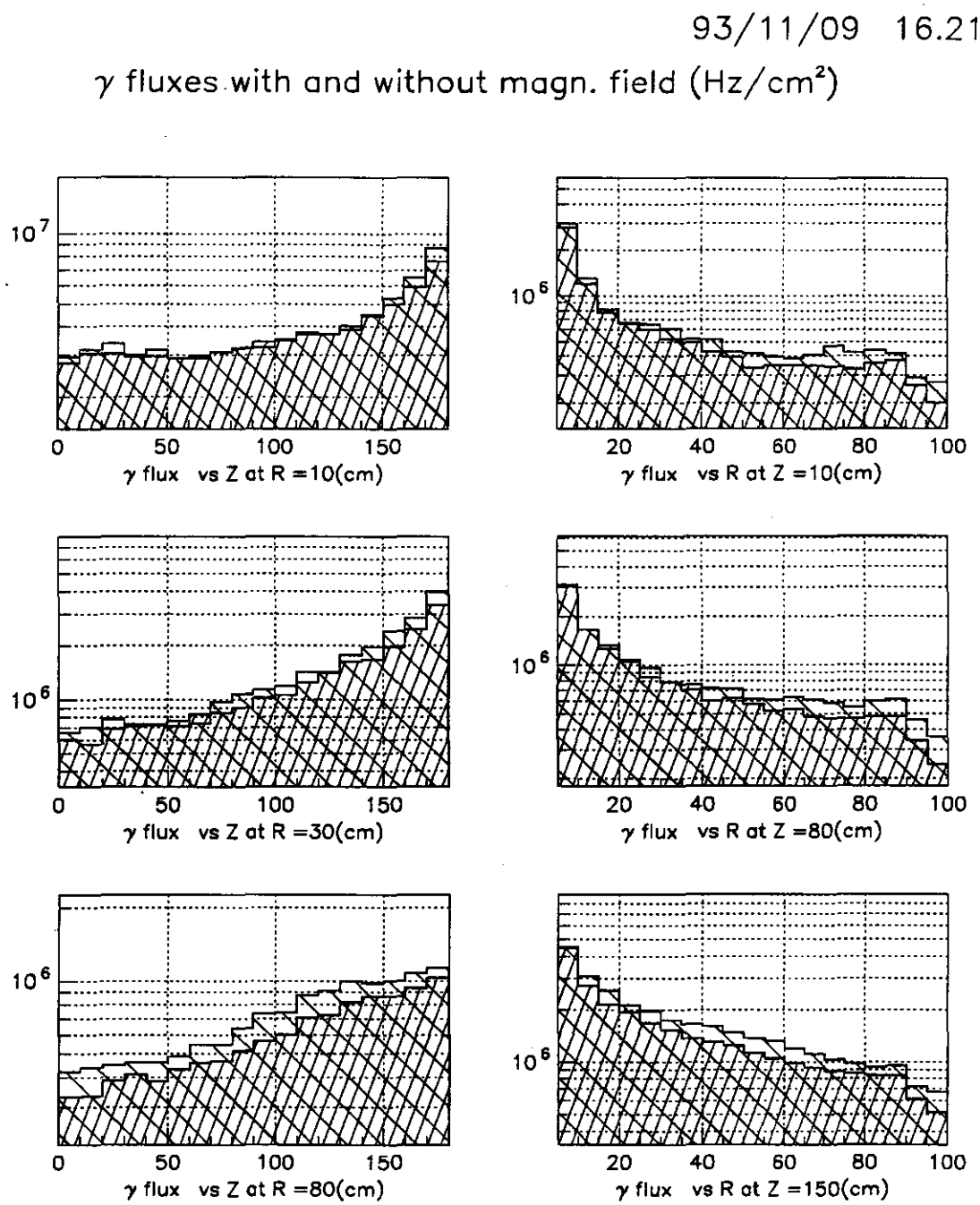

Figure 8: Comparison of γ fluxes obtained for the same 20 event sample with (right shaded) and without (left shaded) magnetic field in the GEM Central Tracker system

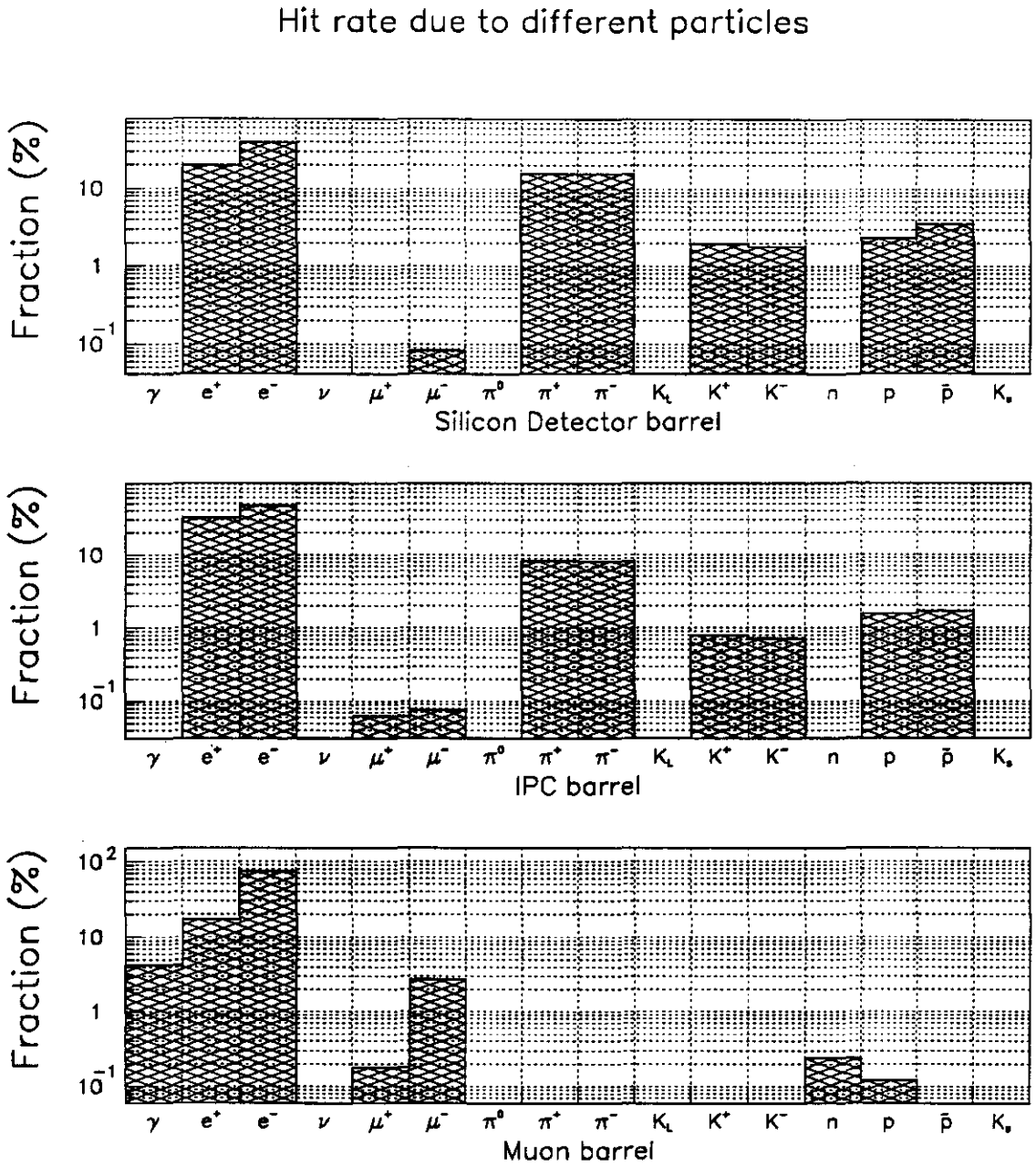

Figure 9: Hit rate in the barrel track and muon system due to different particle types

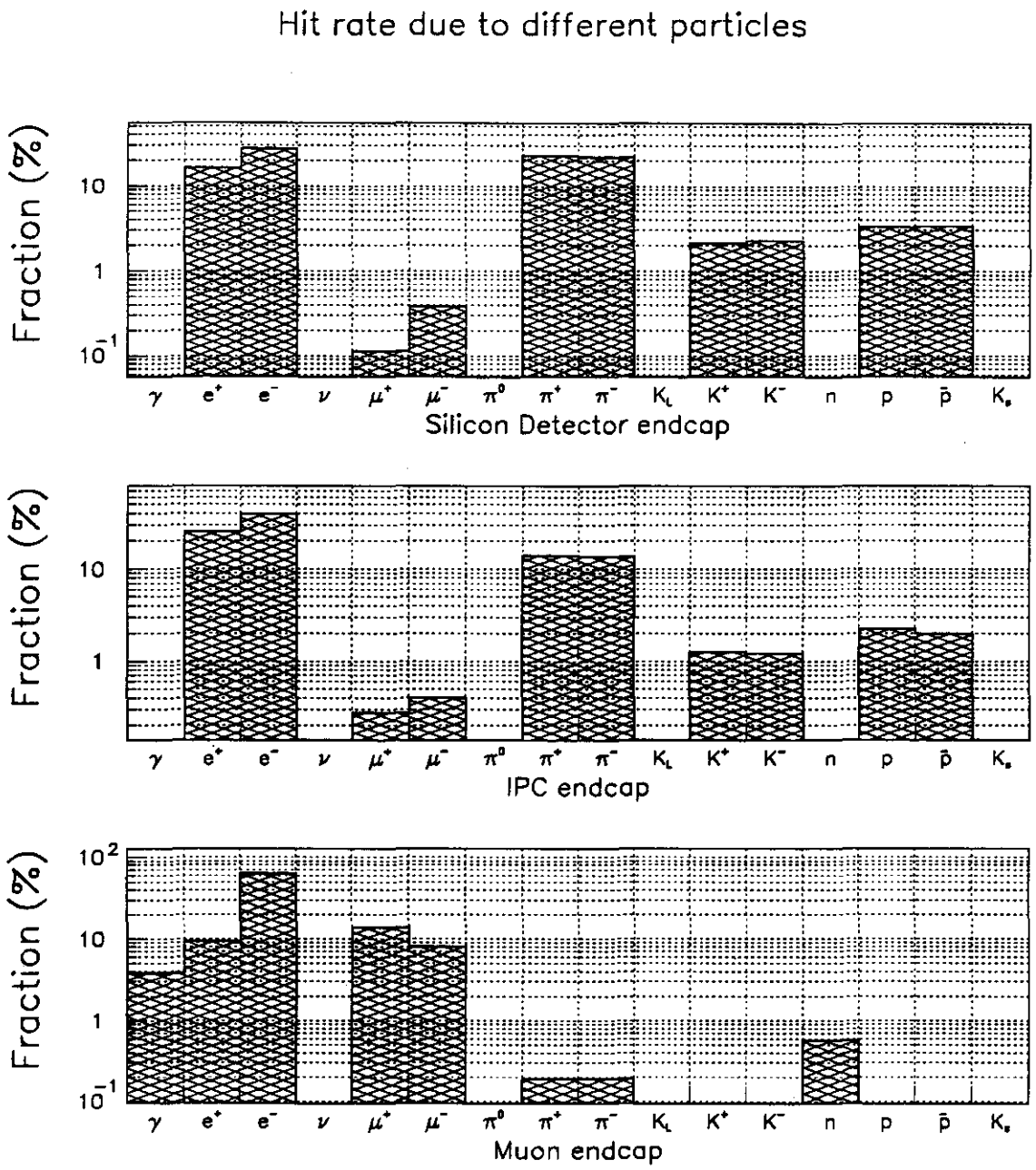

Figure 10: Hit rate in the endcap track and muon system due to different particle types