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# Photon Tagging Experiment At MAX-lab

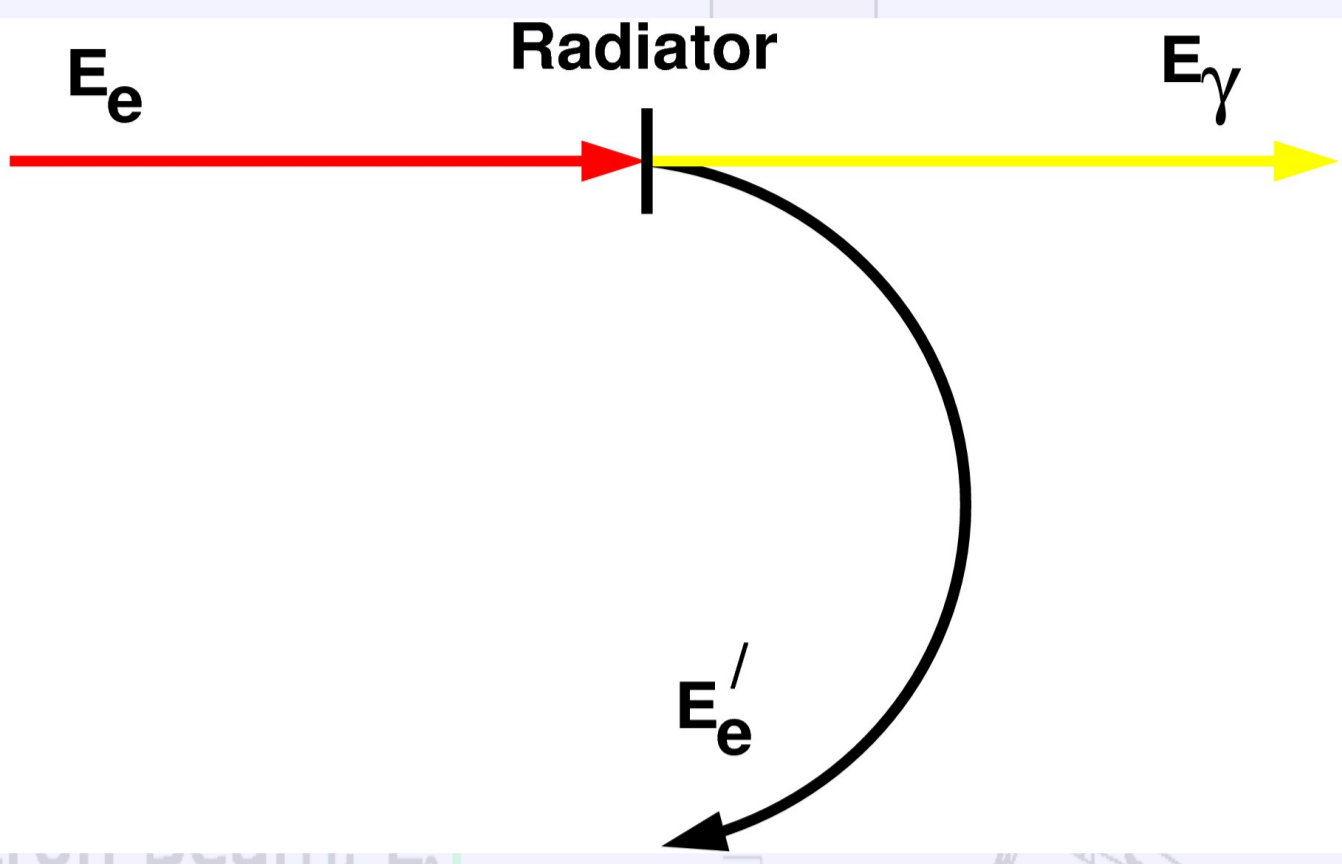


Mohsen Meshkian<sup>1</sup>, Kevin Fissum<sup>2</sup>

1. LTH, Lund University, Sweden

2. Dept. of Nuclear Physics, Lund University, Sweden

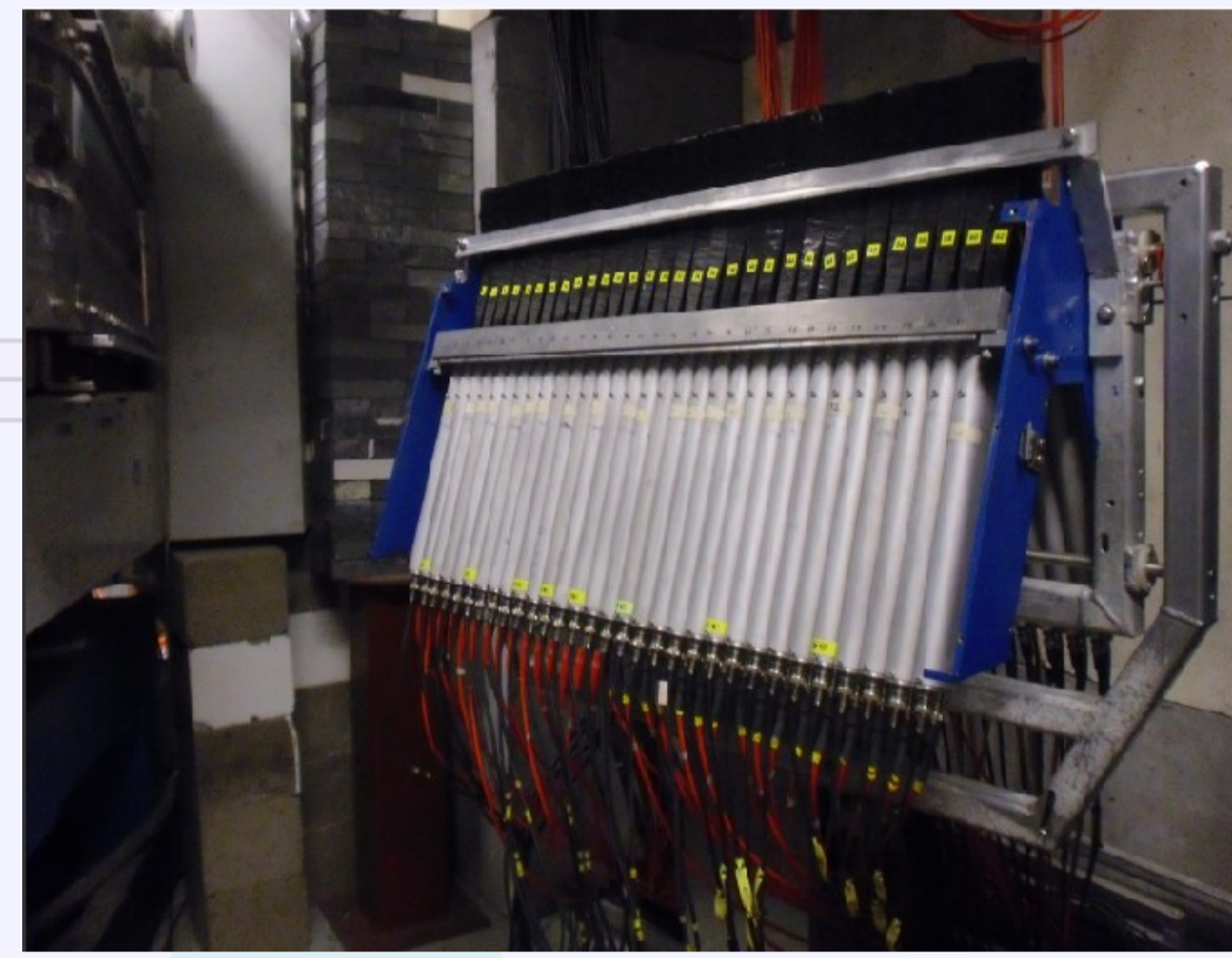
## The Electron Beam



In the bremsstrahlung process, the incident electron beam with the energy  $E_e$ , interacting with a thin radiator, producing bremsstrahlung. By measuring the energy of a post-bremsstrahlung electron,  $E_e'$ , the photon energy,  $E_\gamma$ , is known:

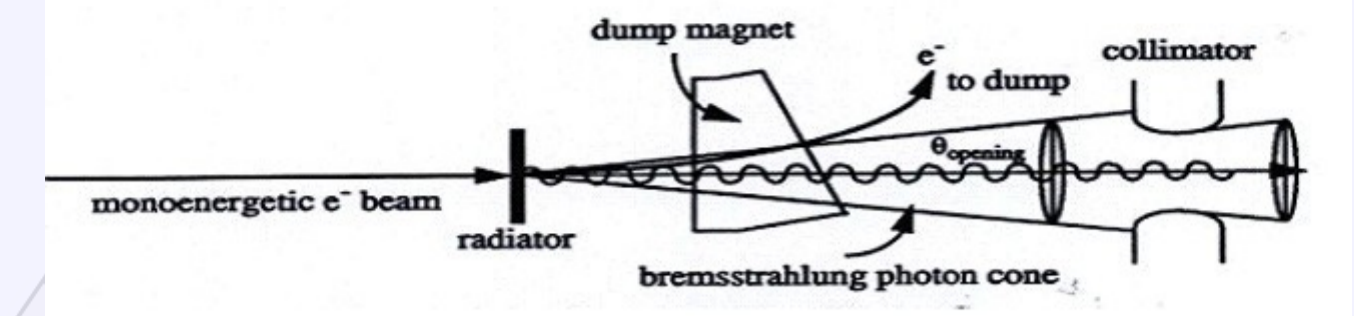
$$E_\gamma = E_e - E_e'$$

## The Focal Plane Array



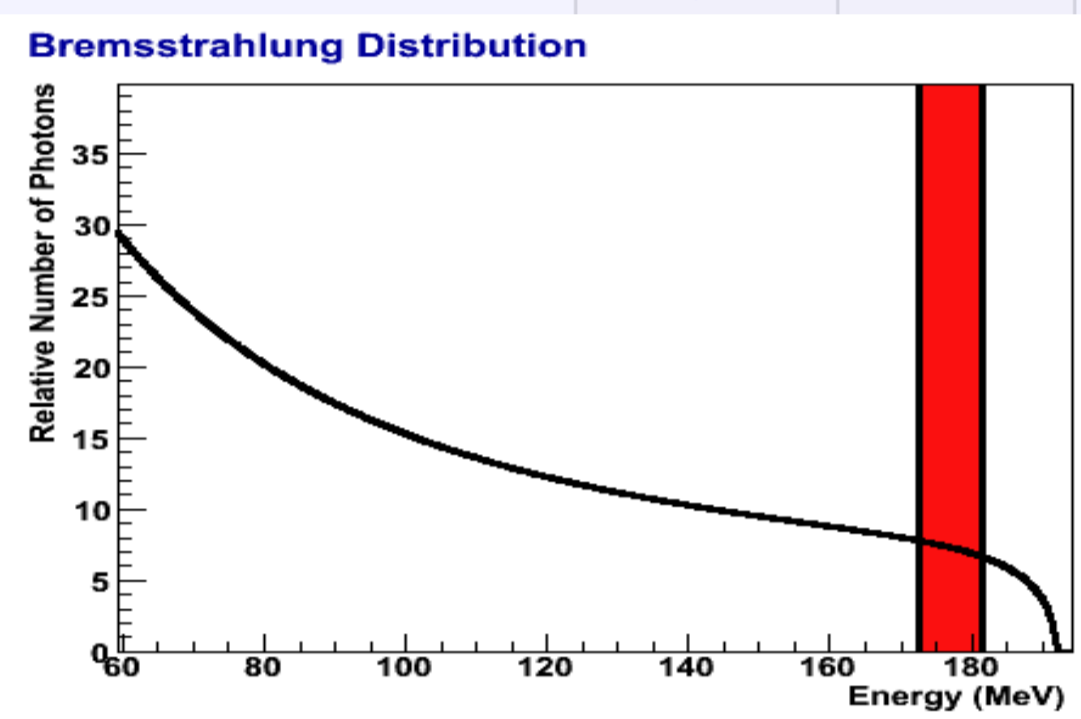
The focal plane consists of 63 plastic scintillators, arranged in two rows with a 100% overlap. When pairing these detectors the focal plane will consist of 31 channels, which deliver a signal when hit by an electron. A signal processed from a channel corresponds to a photon, which was radiated from the electron detected in that particular channel.

## The Photon Beam



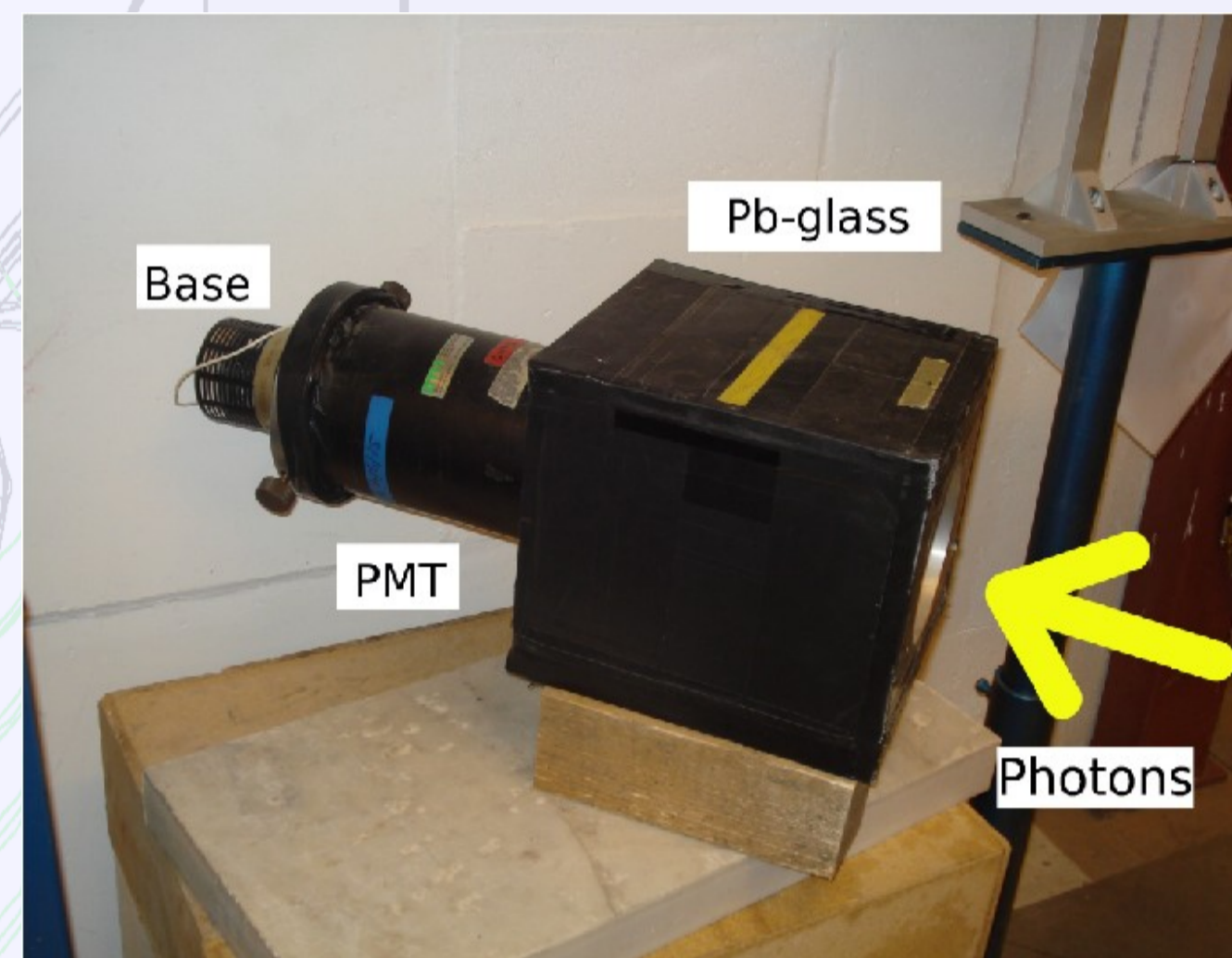
Bremsstrahlung photons are emitted in a conical distribution in the forward direction. Since the target is located downstream of the radiator, the spread of the cone may be large enough so that some fraction of the bremsstrahlung photons can actually miss the target. Because of this, a collimator is situated after the spectrometer magnet. This limits the beam size and ensures that every single bremsstrahlung photon will strike the target.

## Photon Energy Range



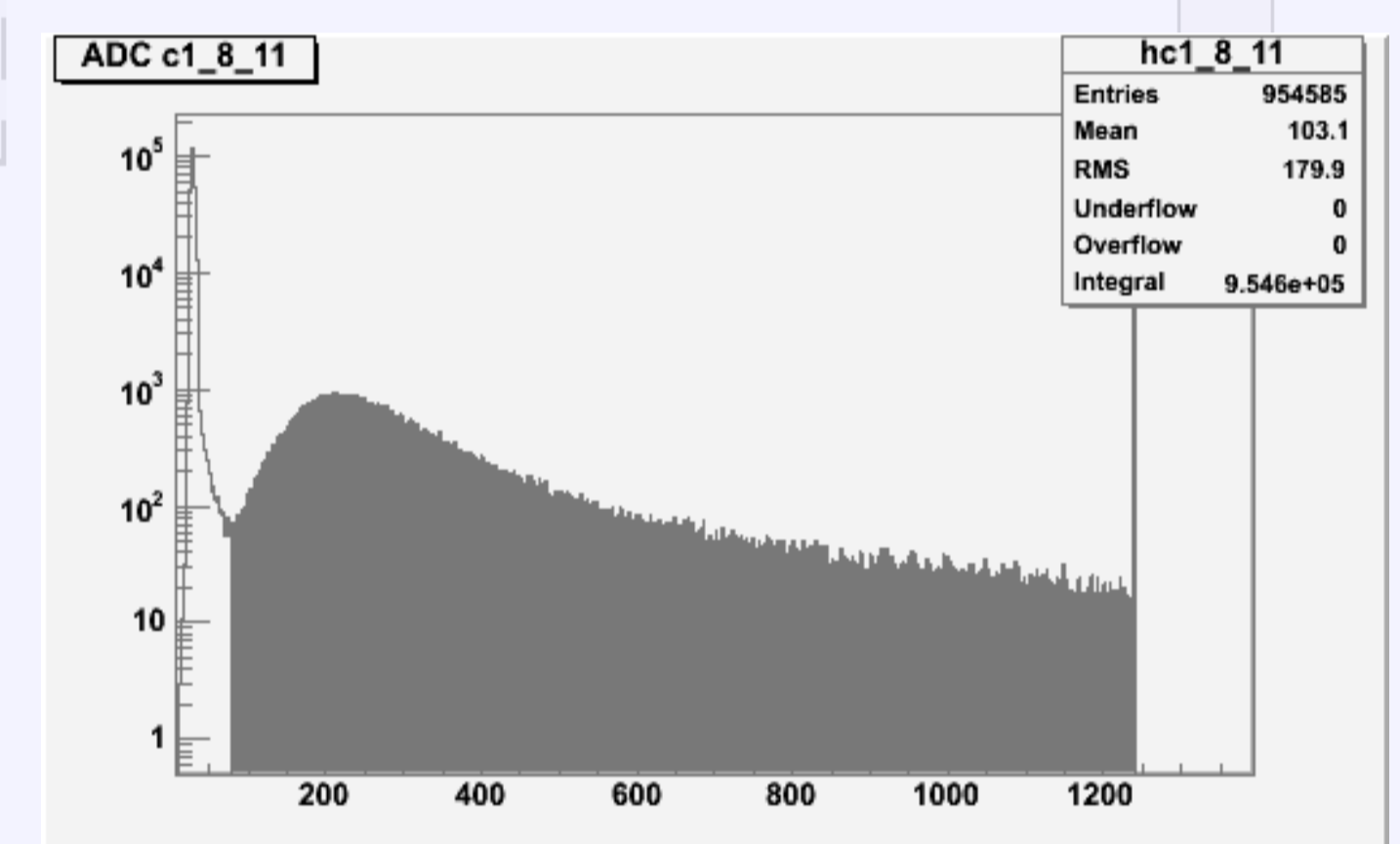
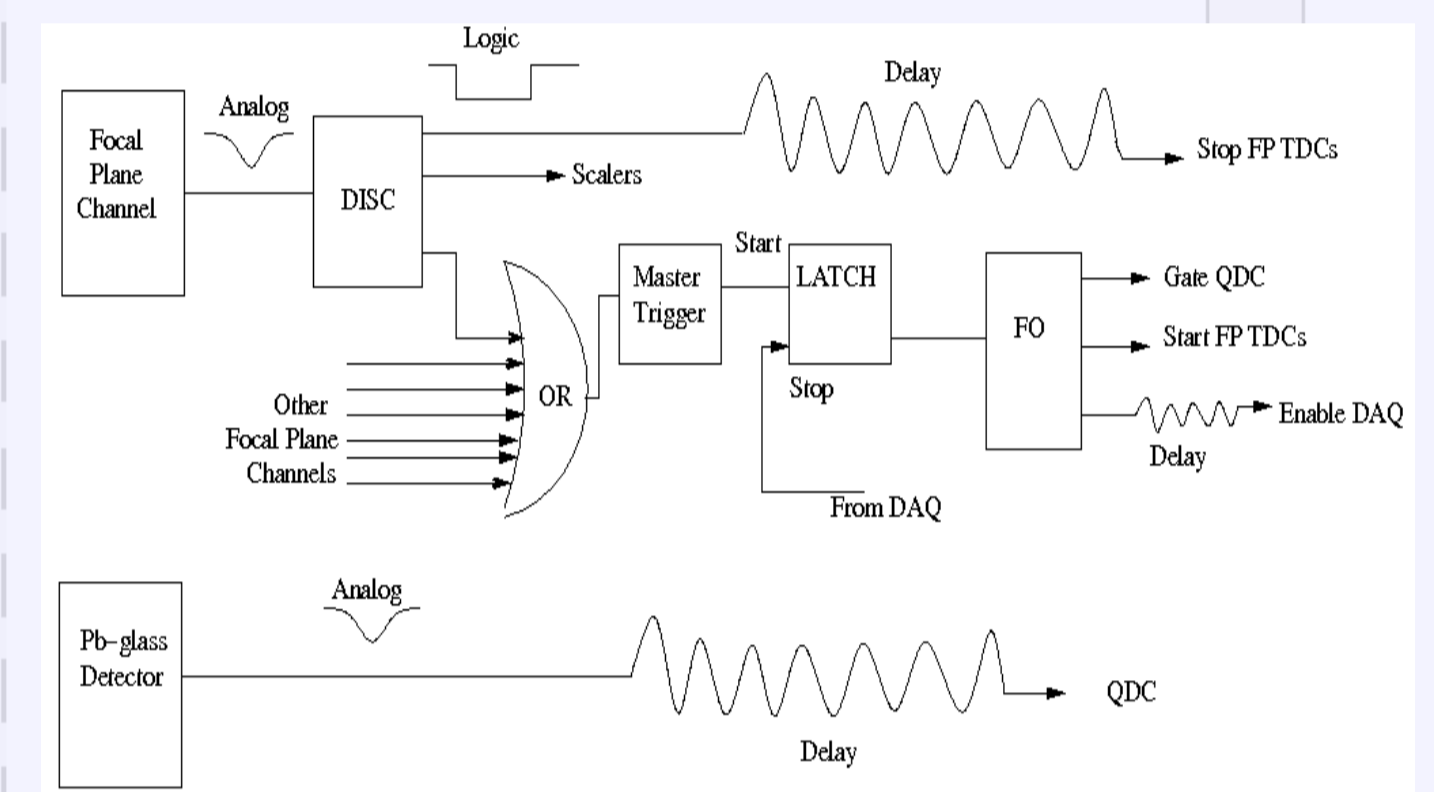
The bremsstrahlung distribution with the tagged-photon energy range.  $E_e$  indicates the energy of the incoming electrons, which is the highest possible energy the photons can gain.

## The Pb glass Detector



For tagging measurements at MAX-lab a lead glass detector is used for detecting photons at low rates. A high energy photon in matter may be converted to an electron-positron pair which then emit energetic bremsstrahlung photons. The particle shower will result in emission of a flash light, which is proportional to the incident photon energy. The flash light will then be transformed into an electrical signal inside the photomultiplier (PMT), and the signal is then used for data acquisition.

## Tagging Efficiency



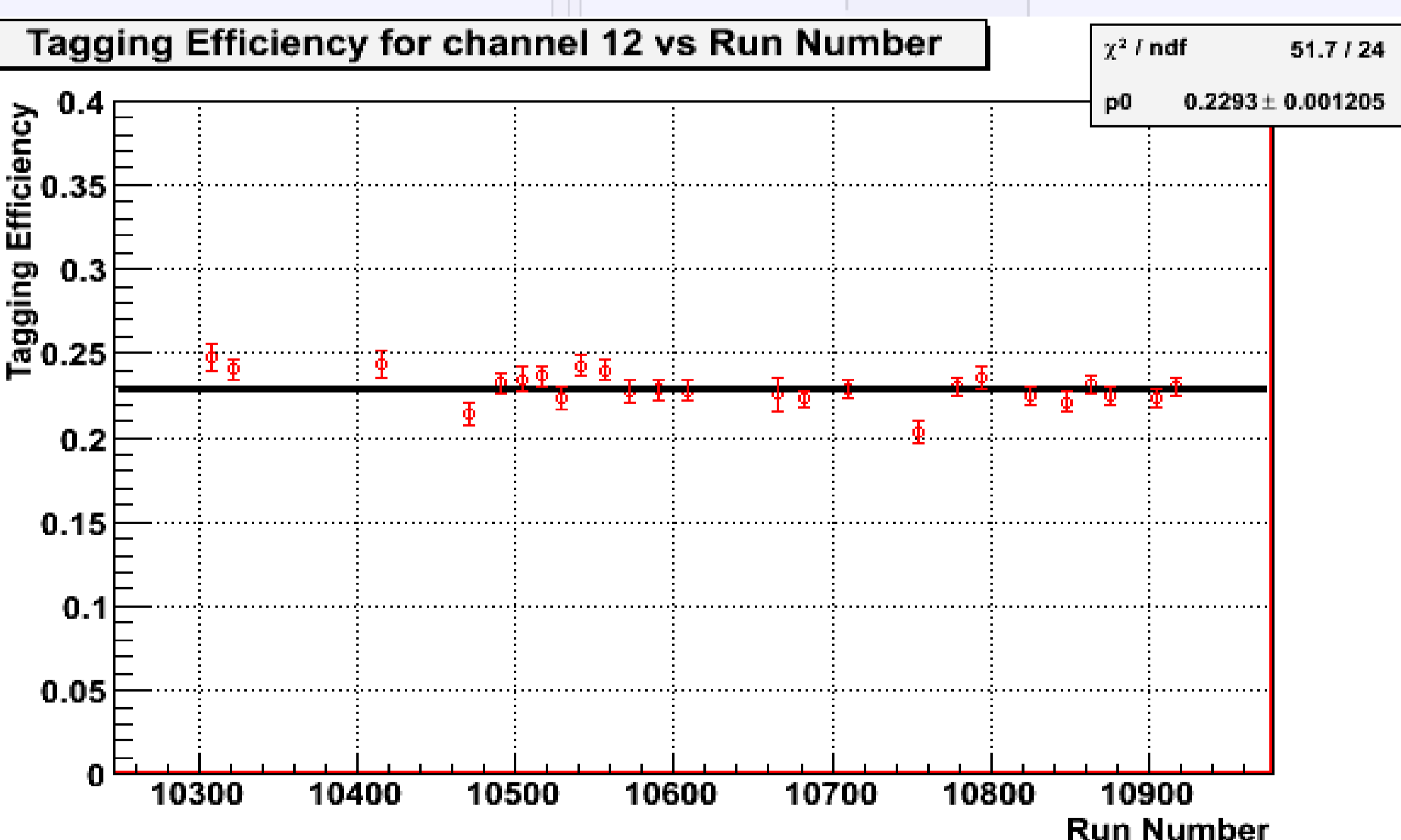
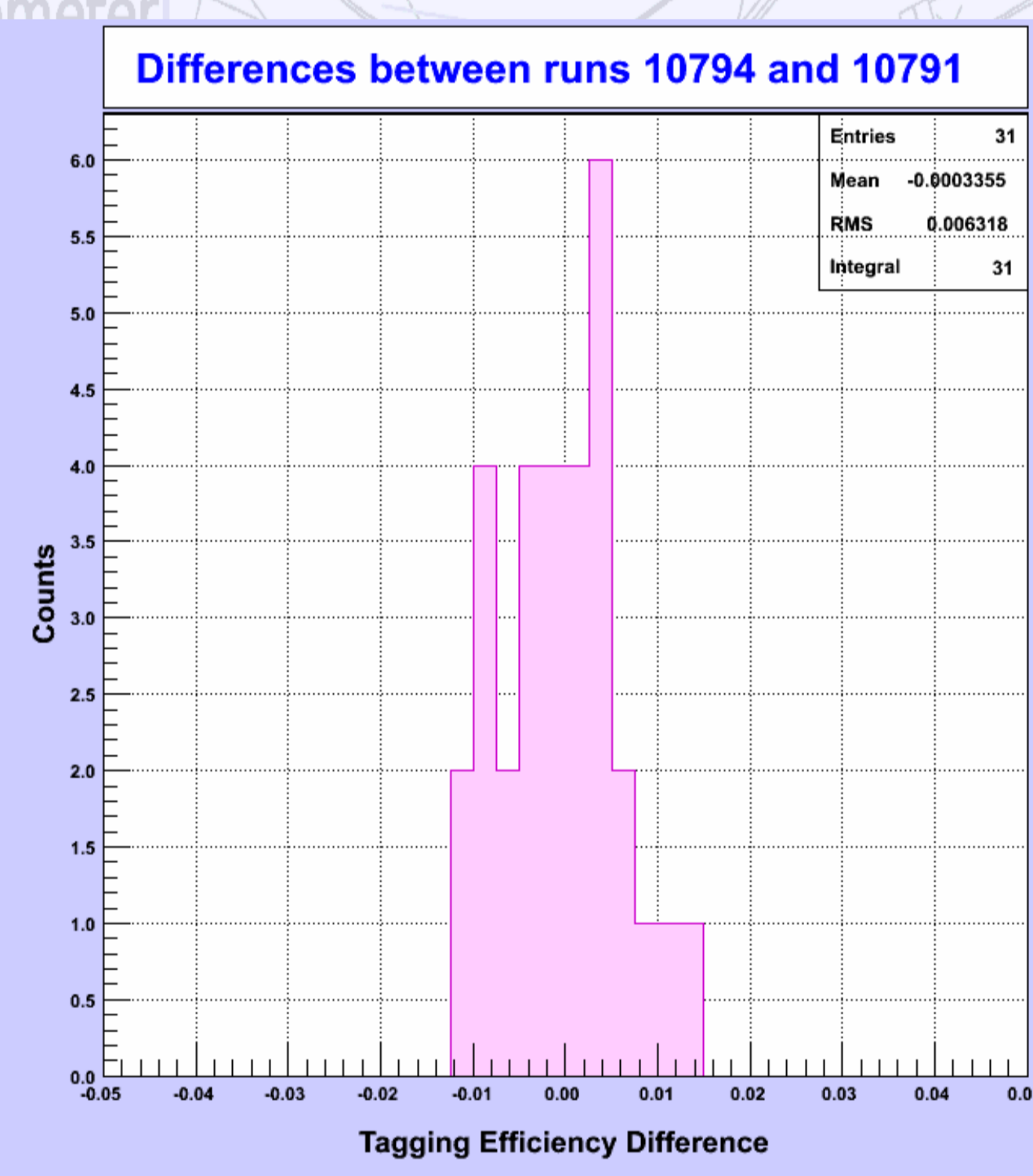
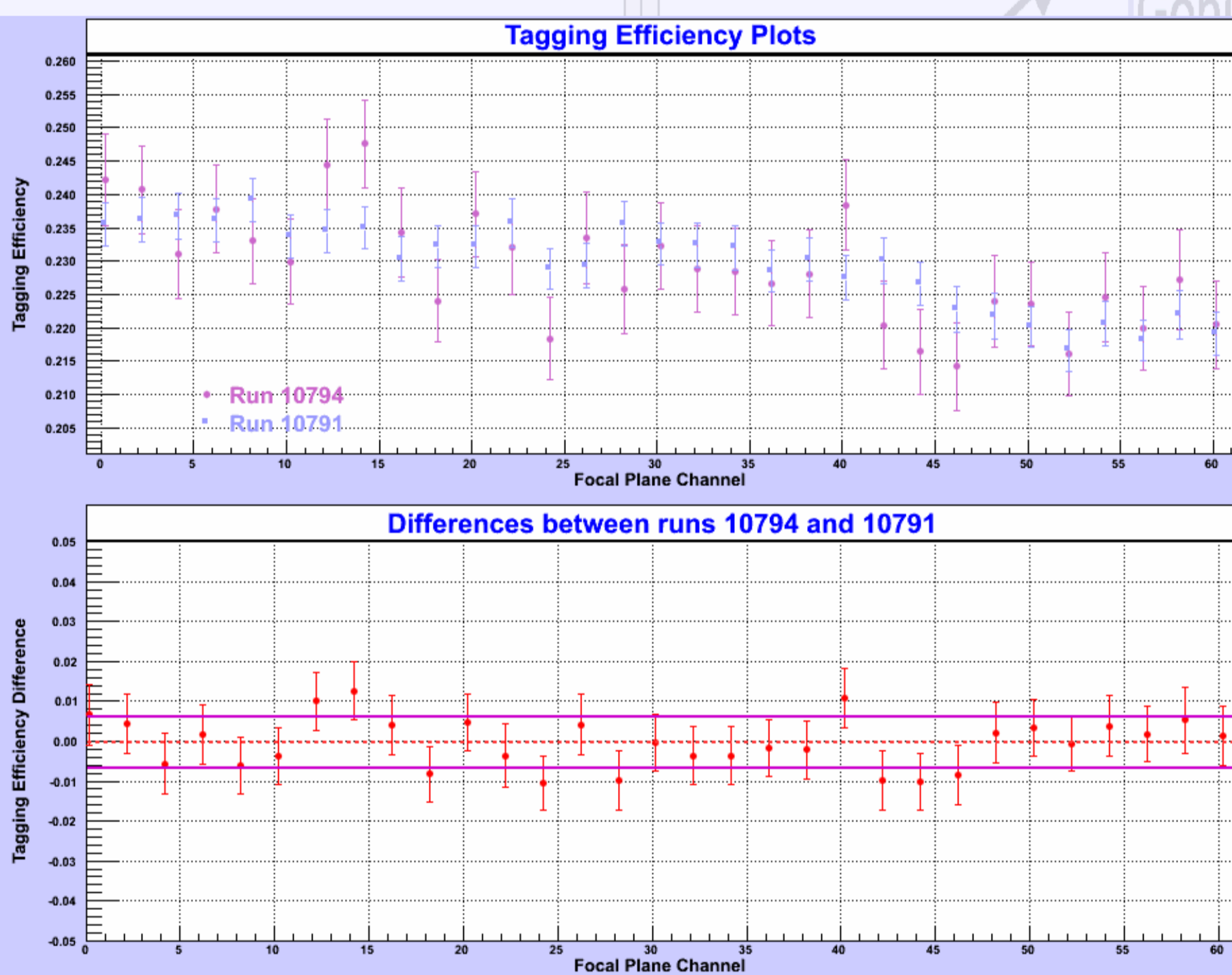
## Results

Tagging efficiency measurements were done for both FP OR trigger and Pb glass trigger. The figure shows the comparison in tagging efficiency between a Pb glass trigger and a FP OR trigger. In the ideal case the difference would be zero.

The ratio between the number of photons in the target and the number of electrons registered in the focal plane is called tagging efficiency, and is given by:

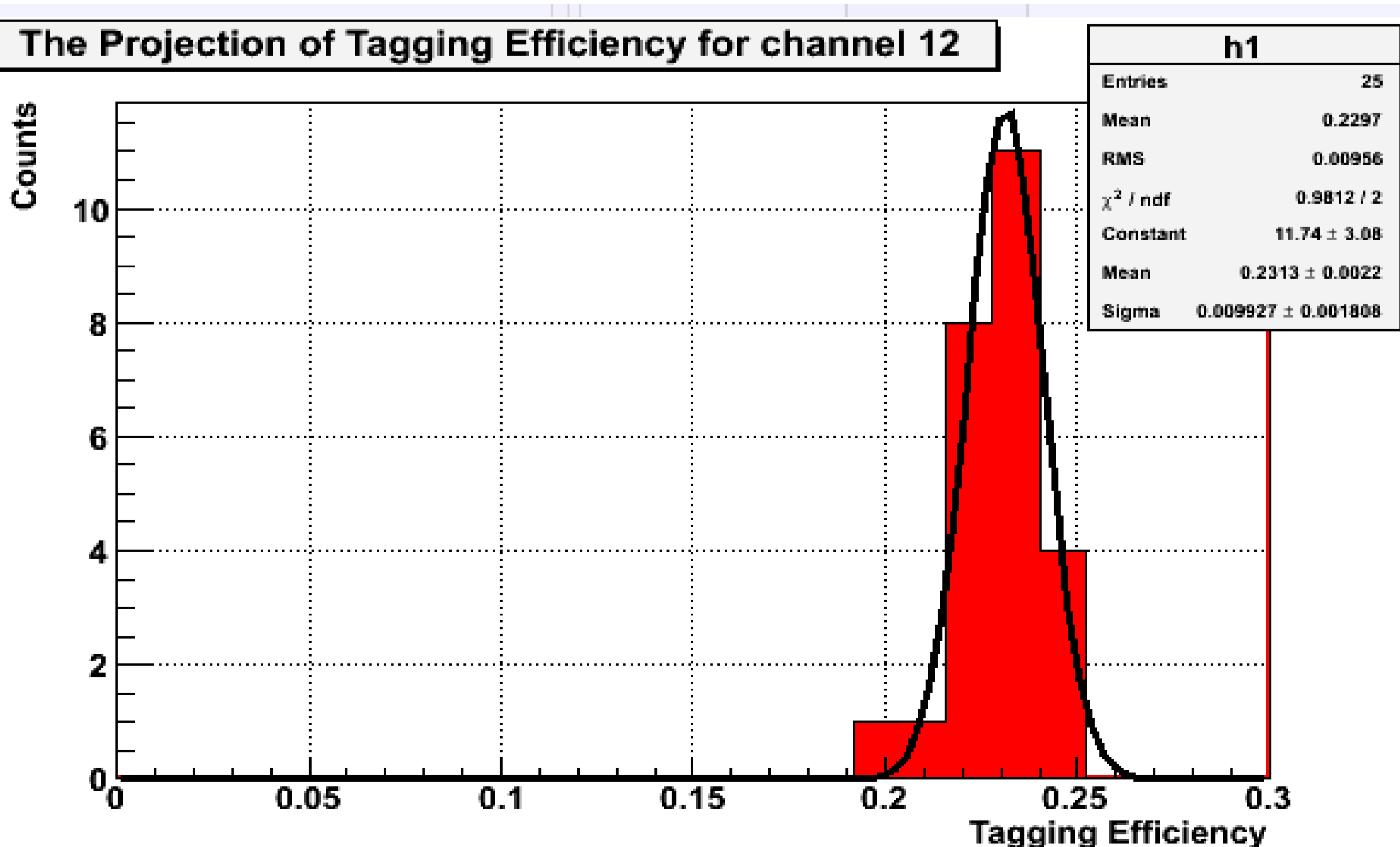
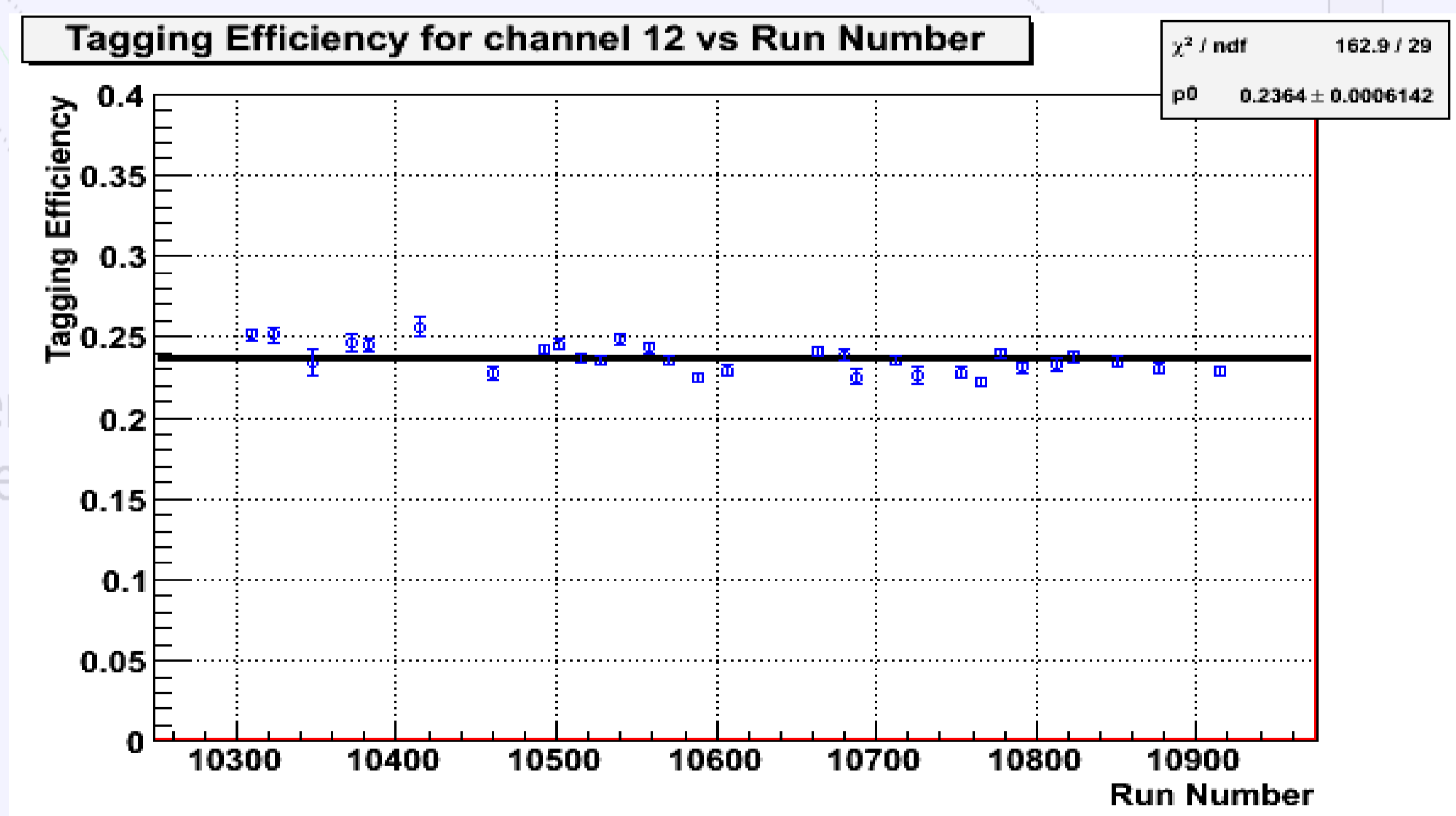
$$\epsilon_{\text{tagg}} = N_\gamma / N_{\text{fp}}$$

The total integral of the plot above corresponds to the number of electrons, while the integral of the marked area corresponds to the number of photons.



## Results

The tagging efficiency for channel number 12 is shown for the two triggers for the data taken during run periods June 2011 and September 2011. The right figure shows the tagging efficiency for the FP OR trigger and for the Pb glass is shown by the left figure.



These figures show the projections of the tagging efficiency for each of the triggers for the mentioned run periods. For the FP OR the mean tagging efficiency is 23.7% and it is ~23% for the Pb glass trigger, in this particular channel.

