# ATLAS ID material studies with photon conversions

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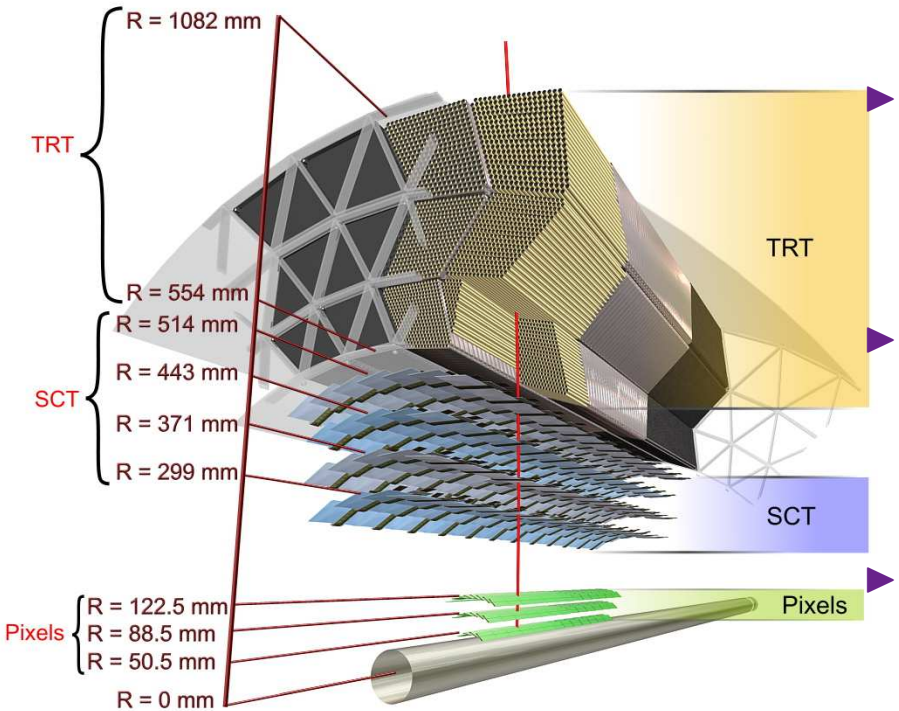
# Introduction

Why studying the Inner Detector material?

- Calibration of the electromagnetic calorimeter (precise knowledge of the electron energy loss before the calorimeter.)
- Precise MC simulation based on the material.

# INNER DETECTOR




Detectors inside the ID:

- Silicon Pixel Detector (accurate measurement of vertices)
- Semiconductor Tracker (precise measurement of the particle momentum)
- Transition Radiation Tracker (eases the pattern recognition)

# ESTIMATION OF THE INNER DETECTOR MATERIAL

- The ID material affects the track trajectories (Bremsstrahlung effects). So by the time the electrons leave the SCT they've already lost between 20% and 50% of their energy.

- On the other hand, among 10% to 50% of photons convert into electron-positron pair. The probability of a photon converting in any given layer of the ID, is proportional to the amount of material in that layer.

# USE OF PHOTON CONVERSIONS AS A TOOL TO MAP THE POSITION AND AMOUNT OF MATERIAL

Radiation wavelenght:
7/9 of the mean free path for photon conversion .

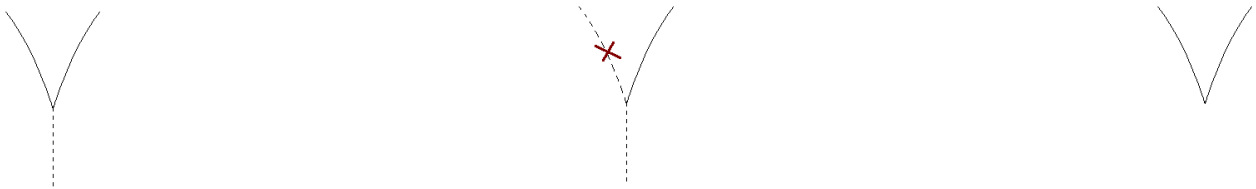
$$X_0 = \frac{716,4 g cm^{-2} A}{Z(Z+1) ln(287\sqrt{Z})}$$

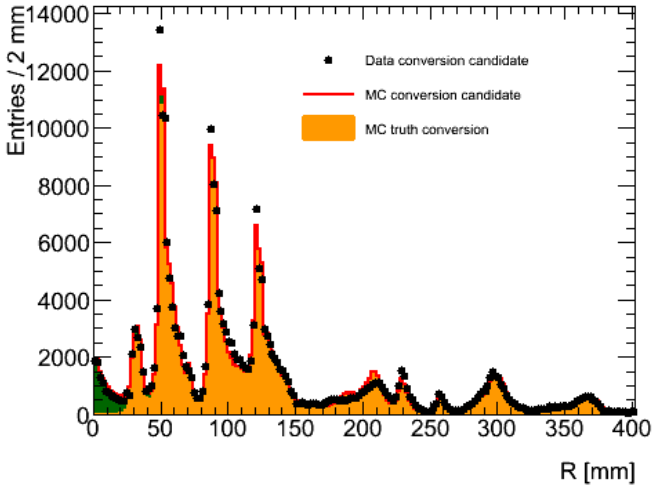
We can relate the fraction ($F_{conv}$) of photons converted in a localized amount of material, with $X_0$:

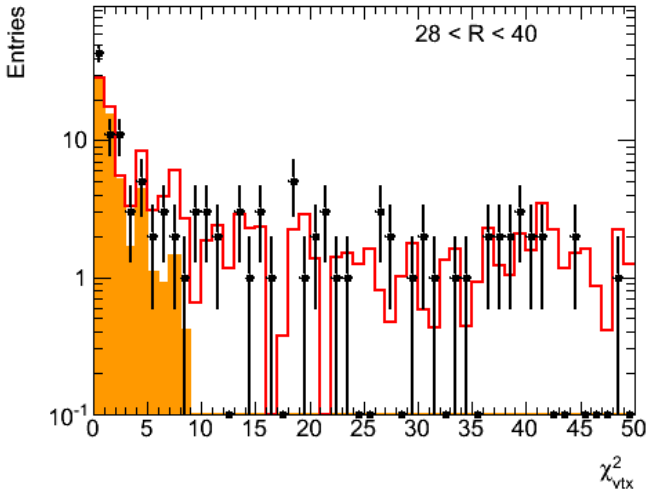
$$\frac{X}{X_0} = -\frac{9}{7} ln(1 - F_{conv})$$

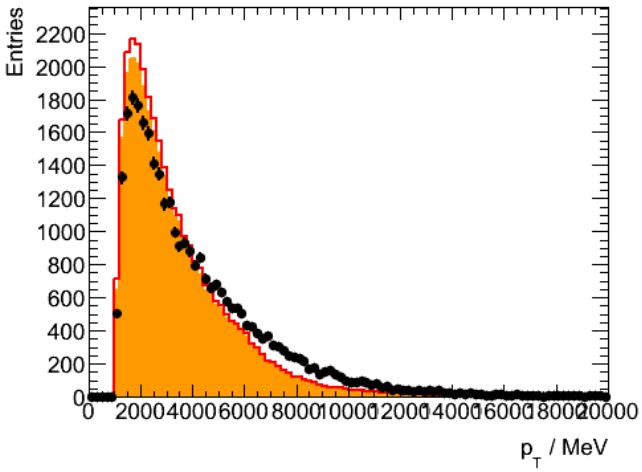
$$F_{conv} = \frac{N_{reco}}{N_{tot}} \frac{F_{comb} F_{mis}}{\varepsilon} \frac{1}{exp(-\frac{7}{9} M_{up})}$$

$N_{reco}$: number of reconstructed photon conversions in the material under investigation.
$F_{comb}$: correction factor for combinatorial background.
$N_{tot}$: total number of photons produced at the primary vertex.
$\varepsilon$: conversion reconstruction and selection efficiency.
$M_{up}$: integrated radiation lenght of the material under consideration.

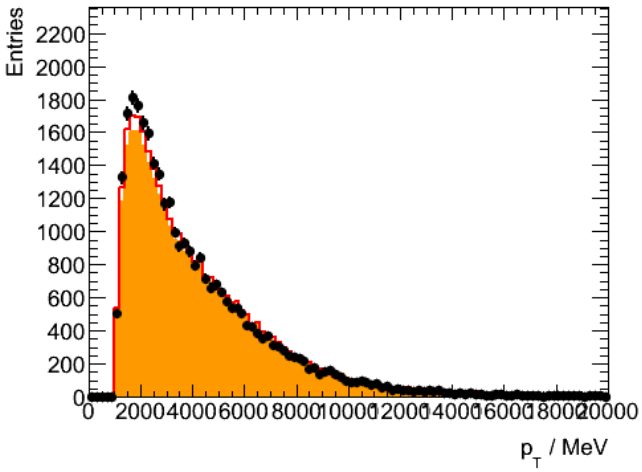




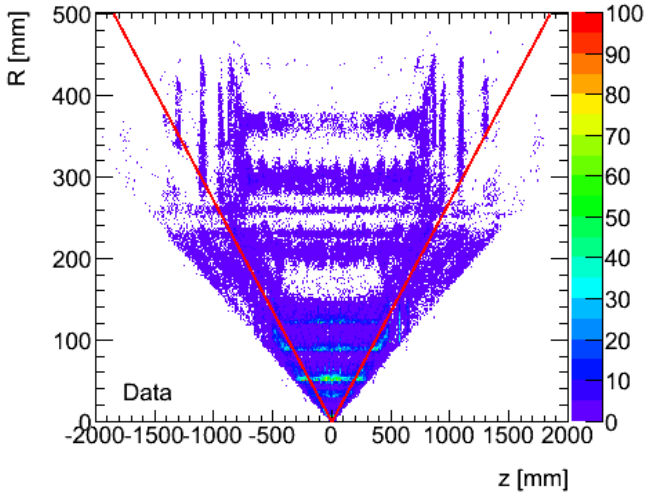



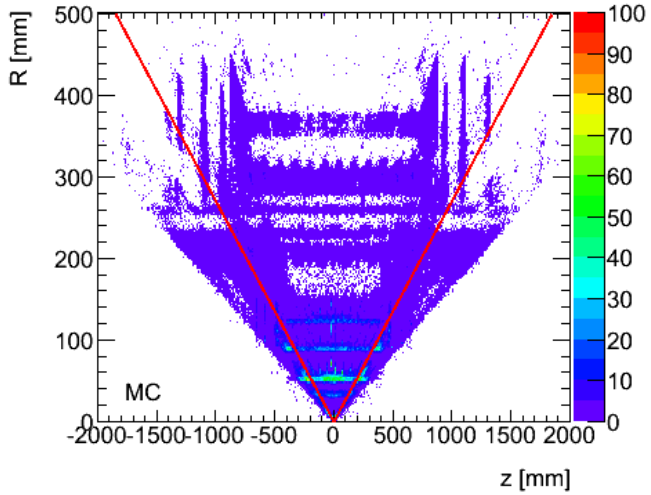




pT distribution with no reweight




pT distribution with reweight


R [mm]
z [mm]
Data


R [mm]
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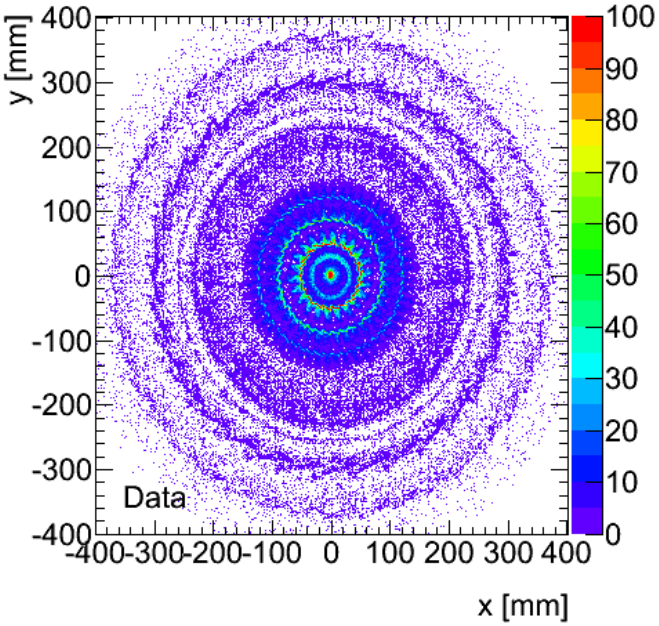
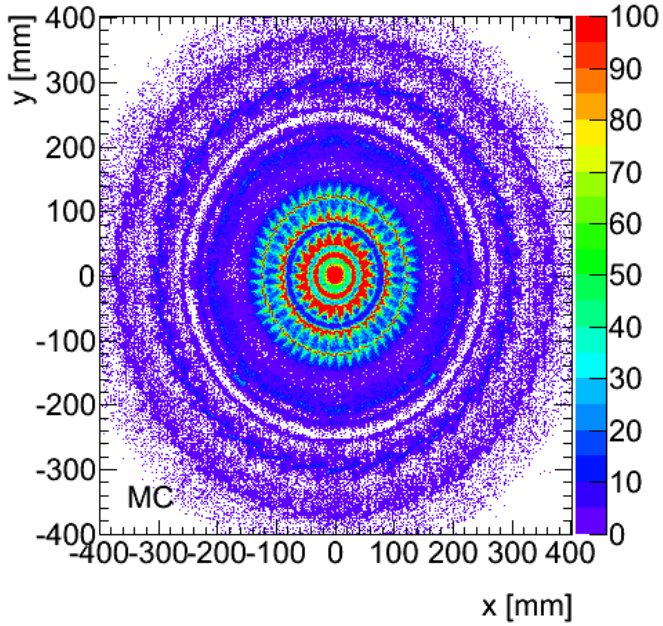
MC


y [mm]
x [mm]
Data


y [mm]
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MC

# CONCLUSIONS

- Photon conversions are an important tool to map the inner detector material.
- Obtained detailed understanding of the material distribution with the current analysis.
- Results were improving the MC simulation.