Possible future plans with LHCb

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LHCf Collaboration meeting

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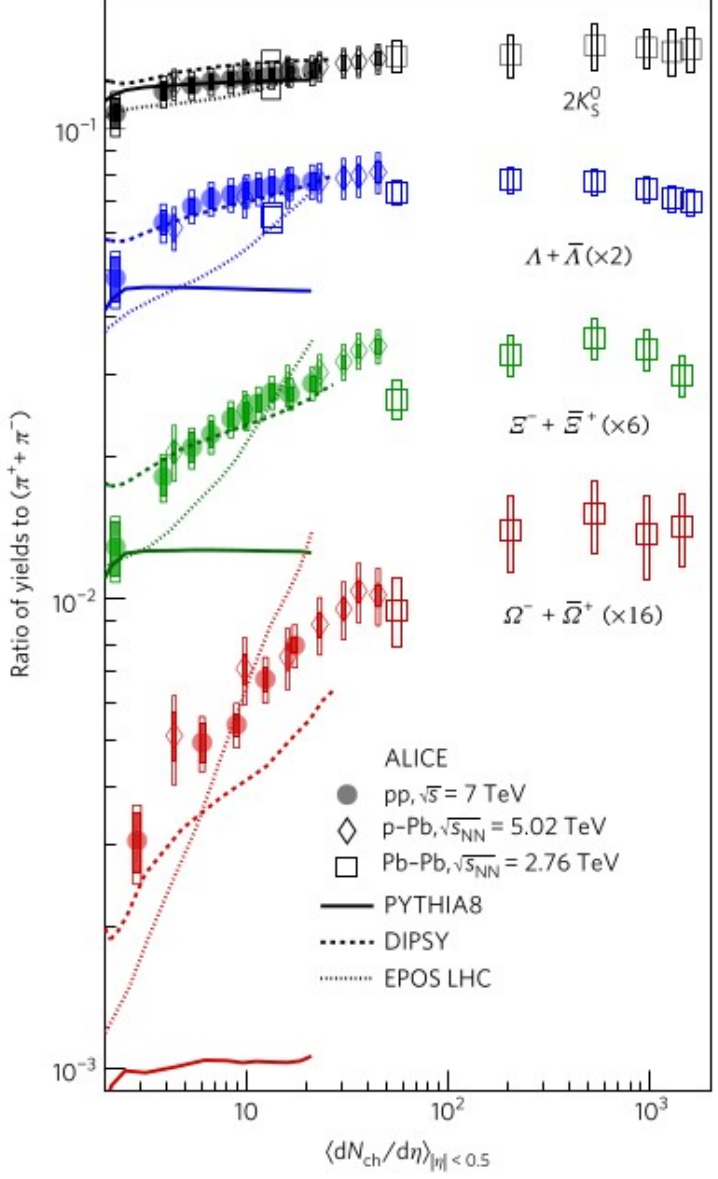
Introduction

This presentation was moved by the discussions I had with Hans Dembinski and SMOG people at this workshop.

We continued the discussions with LHCb people in Firenze, but it seems quite unlikely that we can move Arm1/2 to IP8

The ideas were the following:

- use LHCf at η~7 (magnet)
- use LHCf at η>8 with SMOG



LHCb potential

LHCb is a very interesting experiment for cosmic rays community because of two different regions:

- It is in the spot to perform crucial measurements of <u>strange baryon production at large rapidities,</u> which could solve the **muon puzzle** supporting the approach of so called *core-corona* models

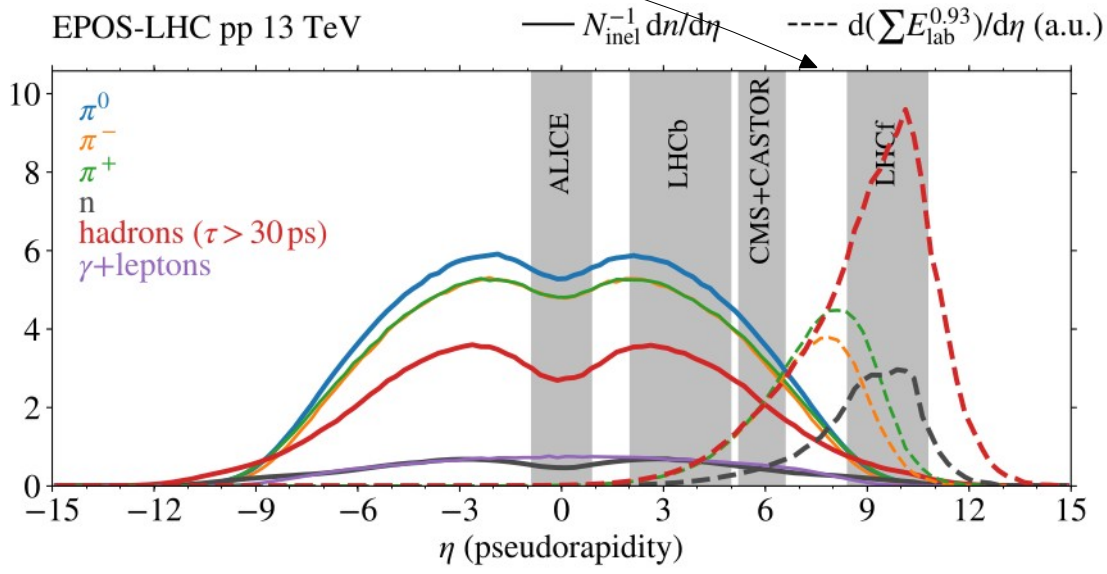
- SMOG system allows for precise measurements of <u>forward production</u> in p-p, p-He,… with different target and different energies up to √s~115 GeV, which are critical for **gamma rays/cosmic rays**

First idea:
Focus on muon puzzle

Idea by Hans Dembinski

Hans is working on a study for a forward ECAL+HCAL calorimeter in LHCb to be installed at a distance of about 19 m corresponding to η~7

This is mainly motivated by the measurement of (probably inclusive) charge hadron productions which is very relevant for EAS physics case



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First idea:
A detector around η~7

Idea by Hans Dembinski

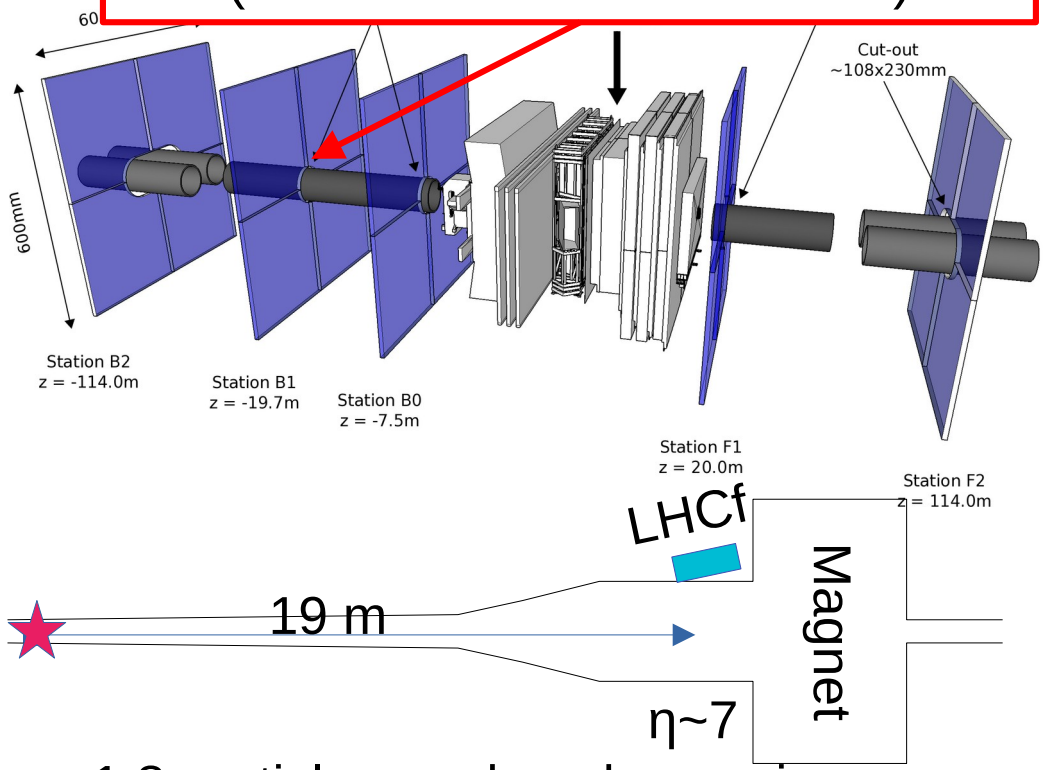
He says that LHCf could be a perfect choice for the ECAL since it allows for cost reduction and well matches the ECAL design requirements

I don't know which is the current status of this idea but I believe it is difficult to bring LHCf there since:

- LHCf in this region would be small
- LHCf is designed for front entrance
- Beam pipe material is problematic

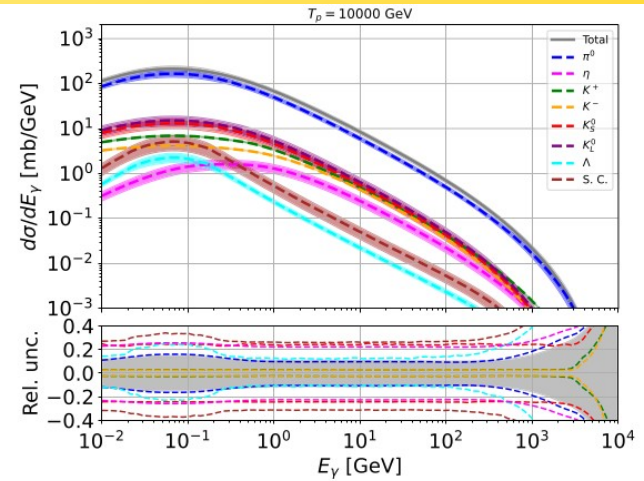
However, it could be interesting to investigate this idea with Hans and, eventually, to participate to the realization of this new detector

I guess something like here
(Herschel will be dismantled)



1.8 particles per bunch crossing

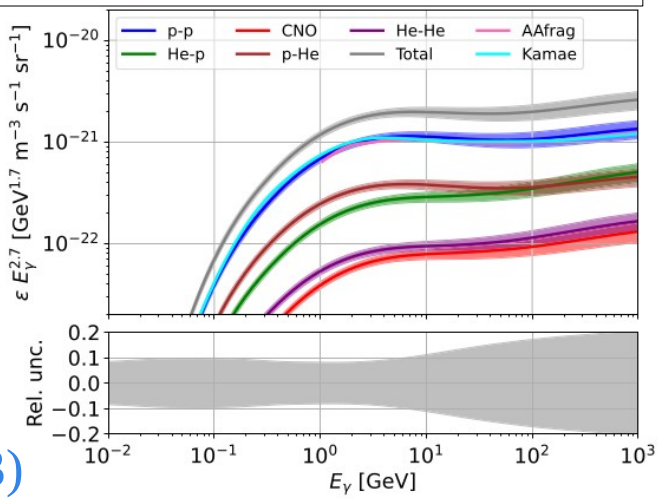
Second idea:
Focus on gamma rays



CR interactions are fundamental to understand the contribution to diffuse gamma-ray background and to understand the π^0 *component* background in point sources

In order to improve the accuracy of the present result, new data from colliders are needed. Specifically, data is required on the Lorentz invariant cross section, and not only on the total cross section, for π^0 productions. The most important kinetic parameter space is $p_T \lesssim 1$ GeV, a large coverage in x_R and beam energies in the LAB frame covering from a few tens of GeV to at least a few TeV. It would be important to get the same measurements also on a He target. Being interested in the γ rays produced in the Galaxy, it would also be practical to have data on the inclusive γ-ray production cross section, and not only on the individual channels.

Current photon production cross section estimations have 10-20% uncertainty coming from the limited availability of experimental data



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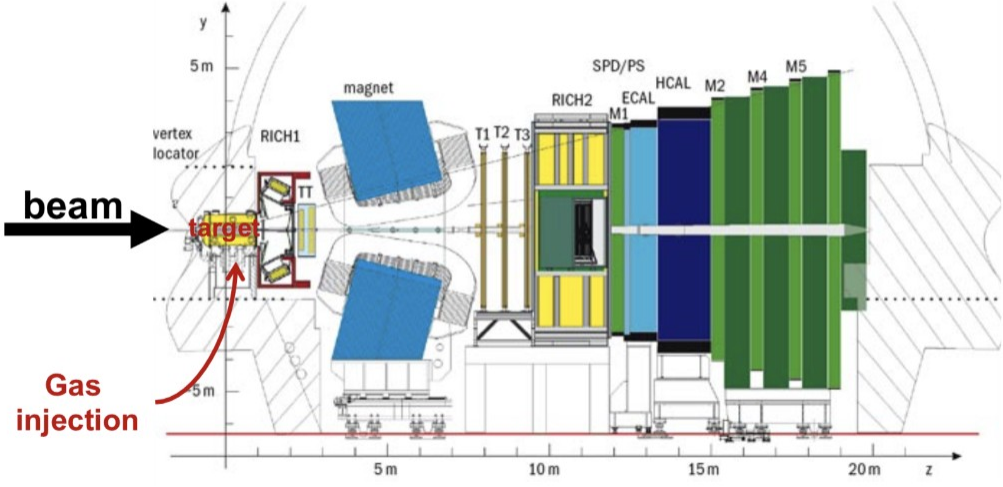
Second idea:
A detector at η>8

Apart from a necessary consideration of the physics case, there are several technical challenges in this solution:

- does LHCf fit the IP8 TAN size?
- is LHCf enough radiation hard?

In addition, at present it is not possible to separate beam-beam from ”beam-SMOG” collisions.

In principle there is an equivalent TAN structure at 150 m from IP8



LHCb SMOG2 system allows to inject noble gases, H_2, D_2, N_2, and O_2 to study the production in fixed target configuration up to $\sqrt{s}$ = 115 GeV

Second idea:
Quick look at the physics case

I considered 10^7 events generated using EPOS-LHC in p(7TeV)-p(rest)

I have checked the distributions in a 62 cm annulus at 150 m from IP

In my feeling, even ignoring the application to gamma-ray physics, physics case is similar to LHCf one (I have not checked about π^0 and η):

- Feynman scaling
- p-light ion production

However, it may be not enough considering hardware challenges that must be faced and solved (compared to what we did at RHIC)