AMBER- Physics Simulations for a new experiment at CERN

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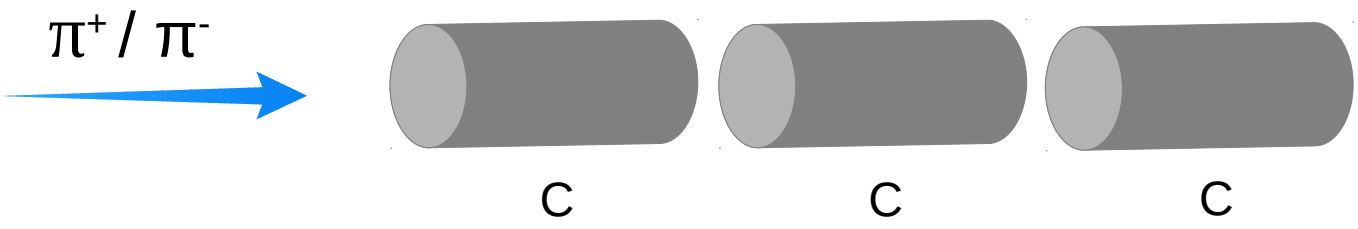
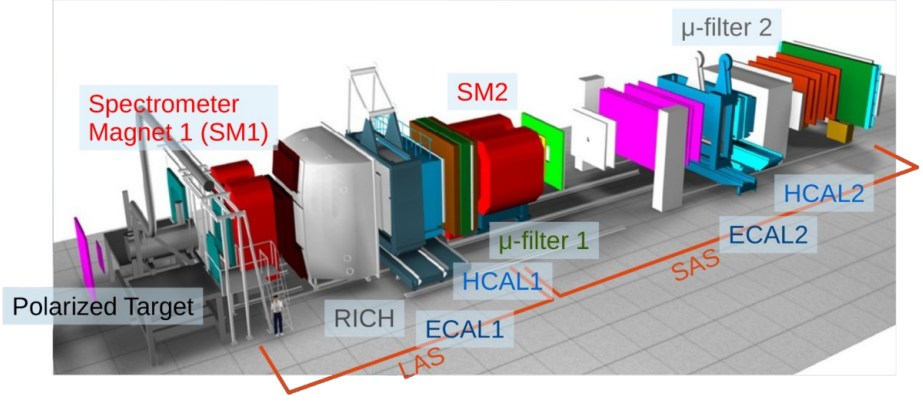
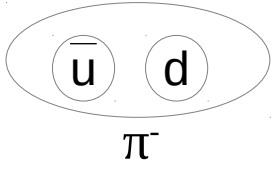
AMBER

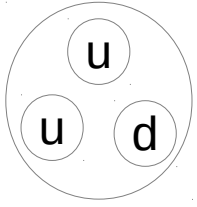
- New project for a fixed target experiment at CERN;
- Learn about quarks and gluons dynamics inside different species of hadrons;
- M2 beam line will be used to investigate the parton structure of light mesons using the Drell-Yan process.

Experimental Apparatus



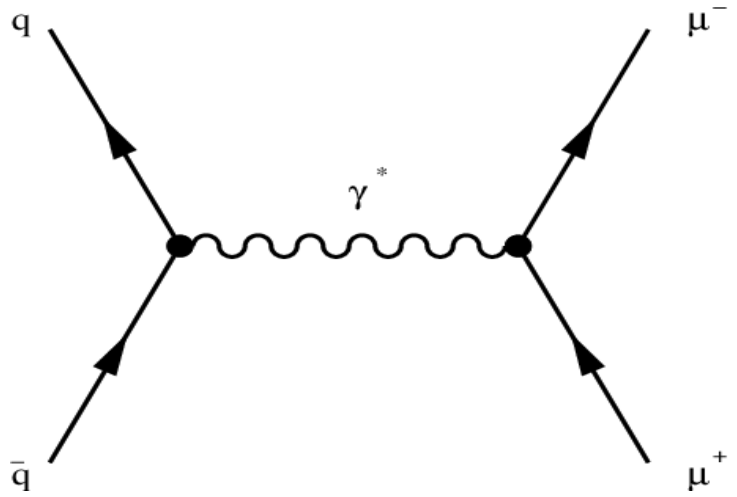






Drell-Yan

- It is a very rare process;
- Consists in the annihilation of a quark and an anti-quark, producing a virtual photon, which will decay into a pair of muon and anti-muon.

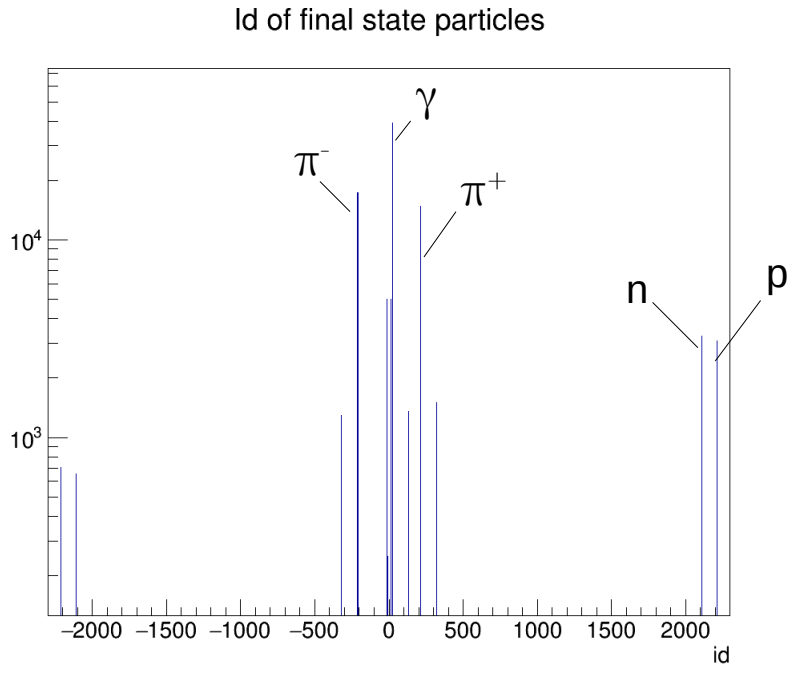


Pythia

- Simulates the Drell-Yan Process;
- A pion with 190 GeV collides with a nucleon (at rest);
- Only the decay channel $\gamma^* \Longrightarrow \mu^+ \mu^-$ is selected;
- Dimuons Mass: from 4 to 9 GeV/c^2 .

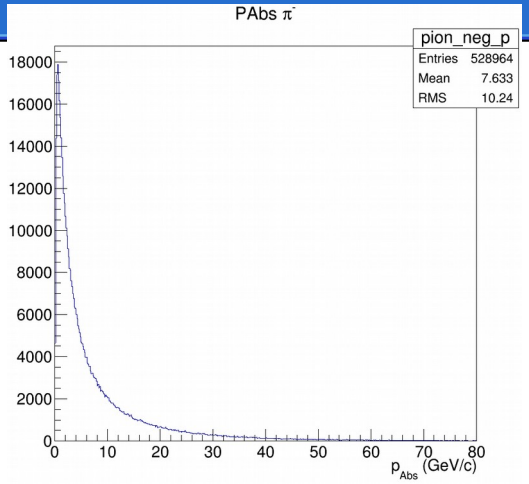
Final State Particles

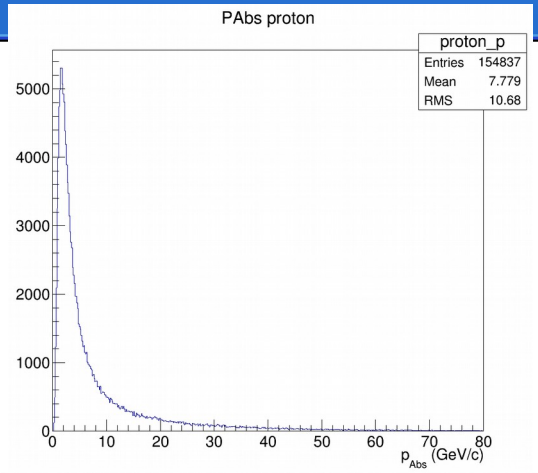
- The average charge multiplicity per event is 7.5.
- π^- /π^+ induced Drell-Yan lead to very similar final state abundances. For π^+ we have:

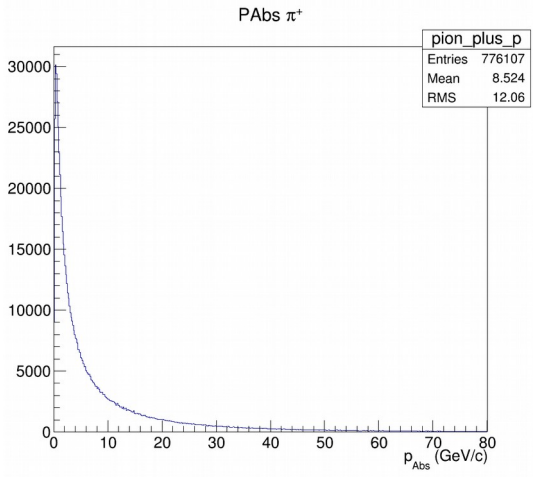


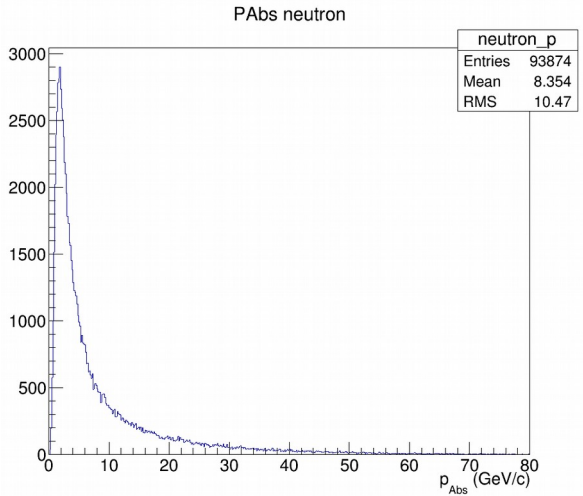
γ	41.7%
π^-	14.1%
π^+	20.7%
n	2.5%
p	4.4%

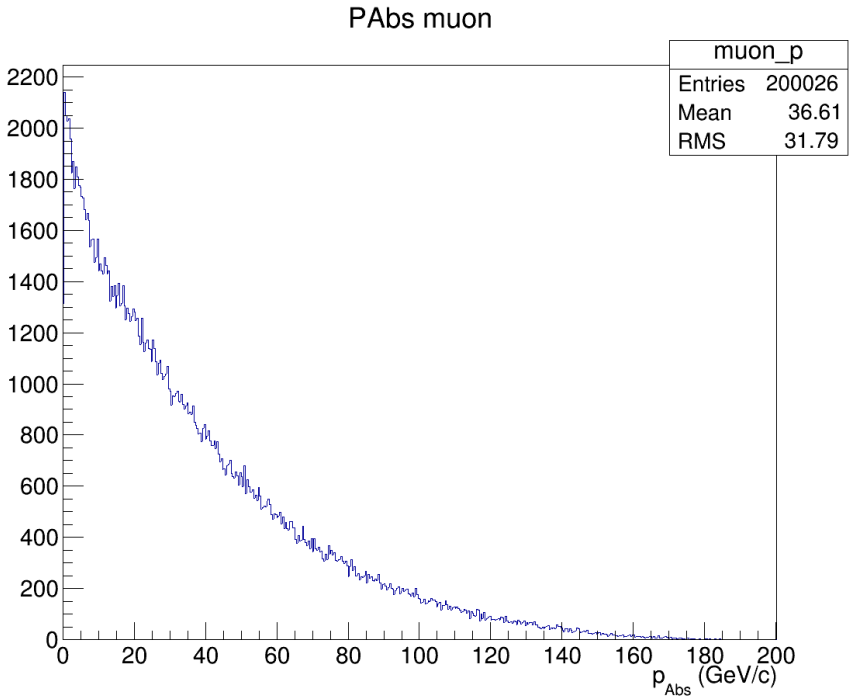
Momentum of Final State Particles



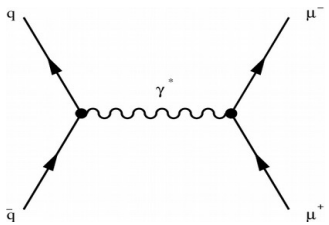








Cross Sections



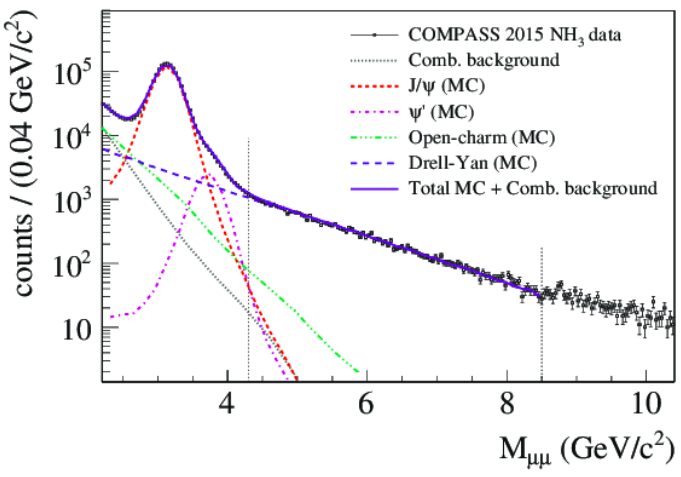
Leading Order

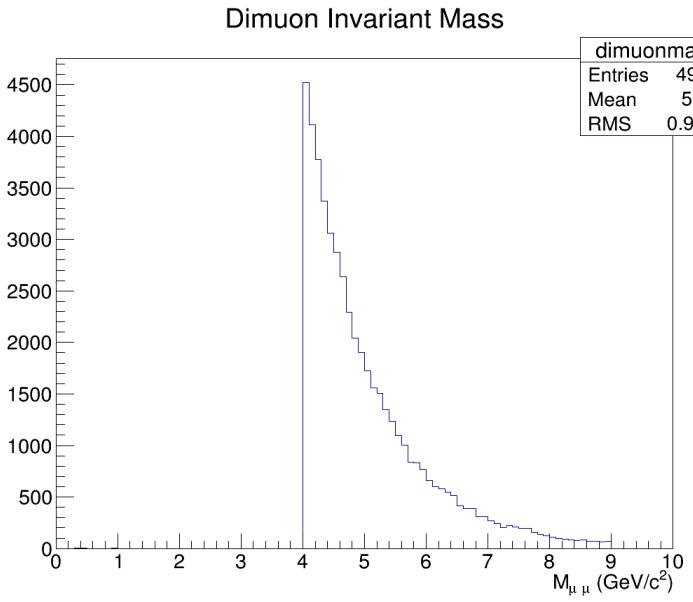
		uud	udd
beam \ target		p	n
$\bar{u}d$	π^-	0.1460	0.07531
	π^+	0.03494	0.05141

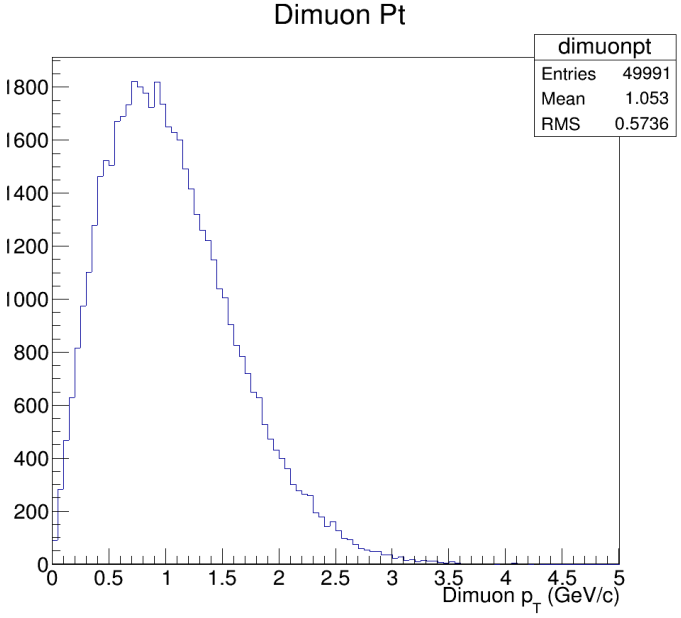
(nb)

- The cross sections measured experimentally come with a factor of 2.

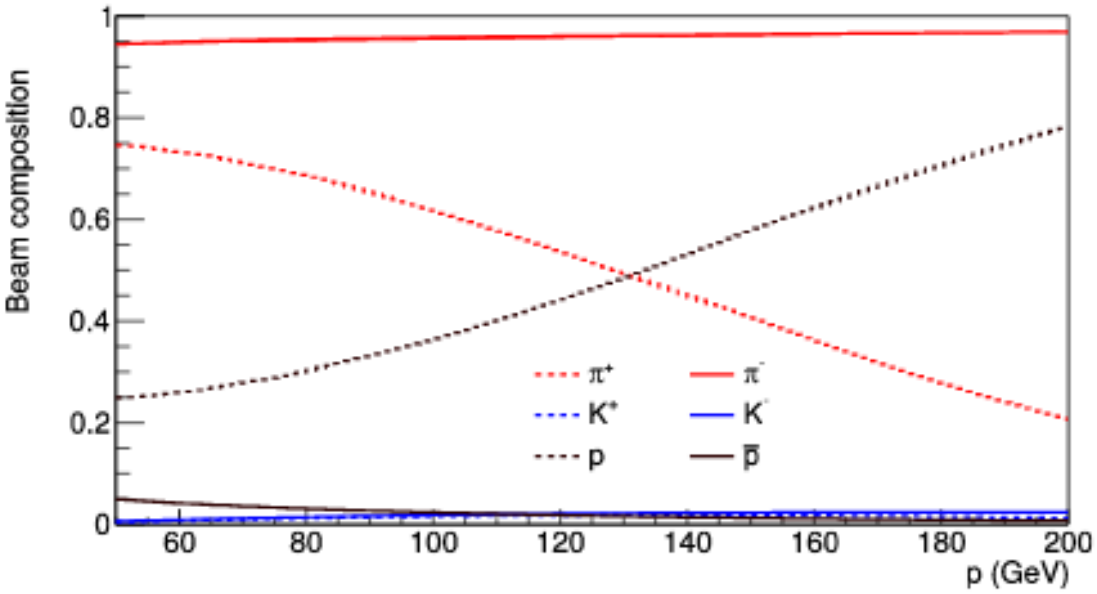
Invariant Mass of the Dimuon







Beam



The beam is not only made of pions;

We have a positive hadronic beam with:

- 75% of protons;
- 25% of π^{+}.

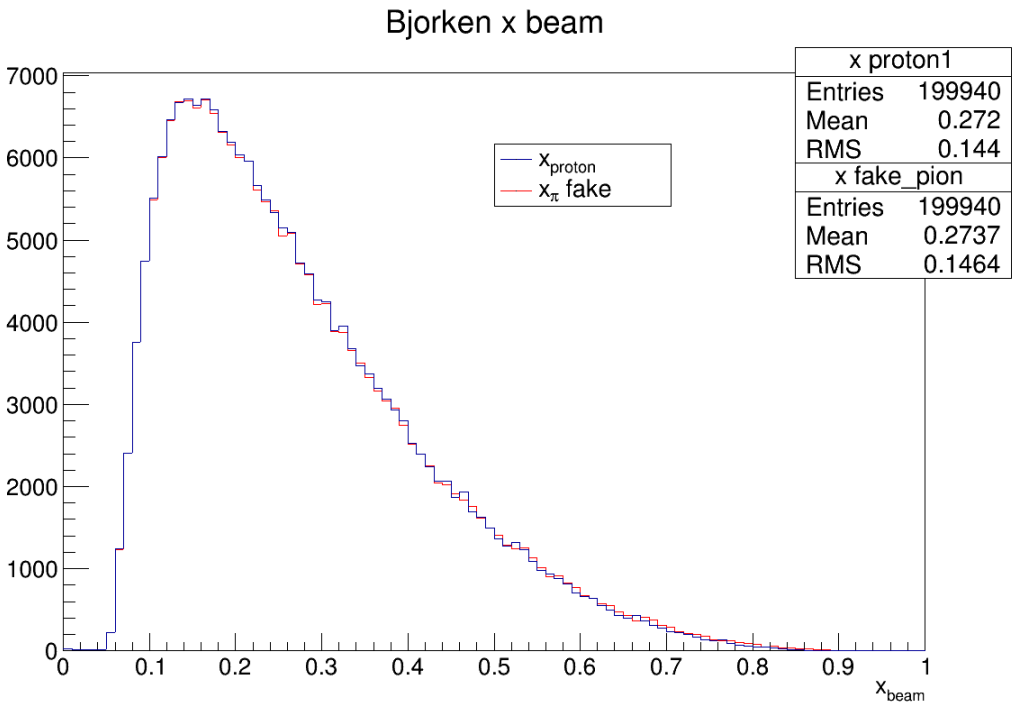
Detectors identifying the particles.

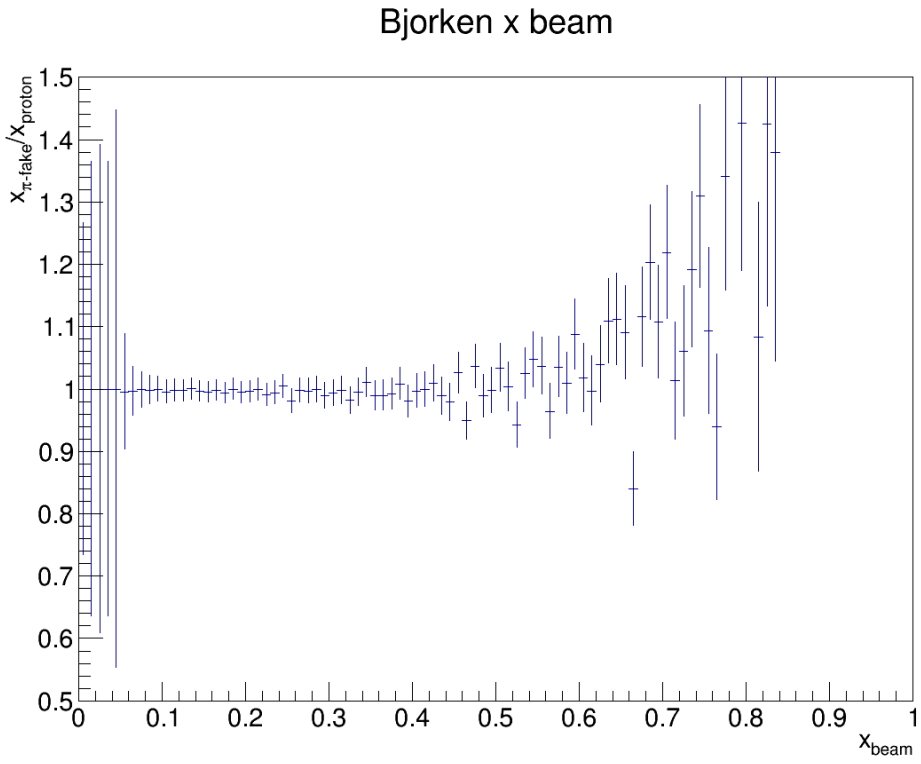
Proton misindentification as a pion

- Simulated the effect of misidentifying a proton as a π^+
- Studied this effect on Drell-Yan kinematical variables such as: Bjorken x and the Feynman x.

Bjorken X: misid effect

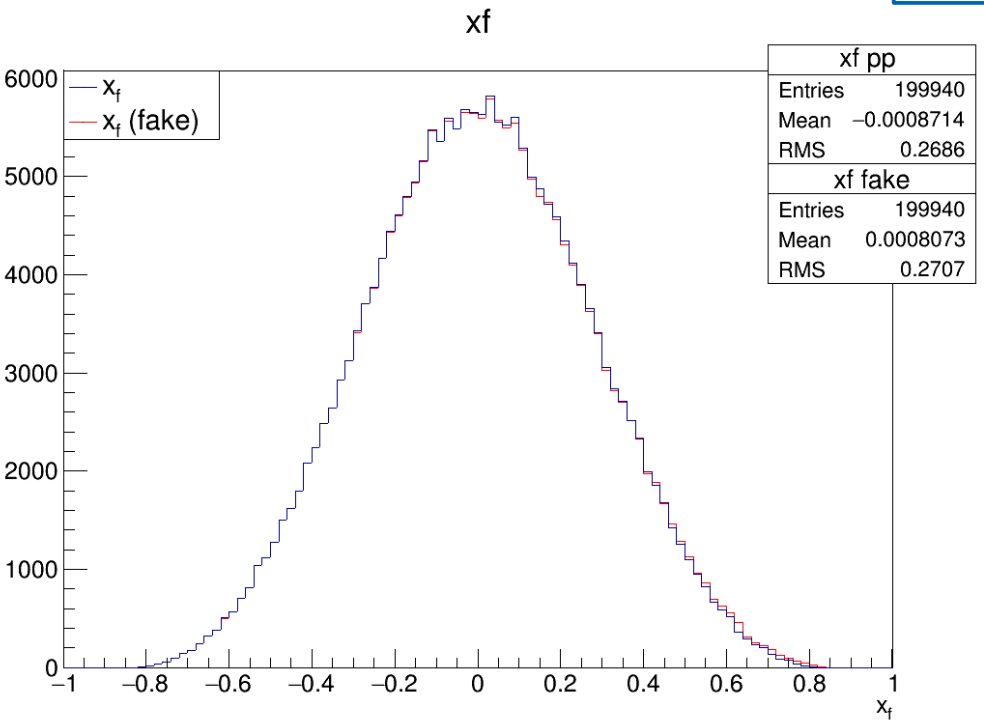
Corresponds to the fraction of momentum of the quark annihilated with respect to the hadron.

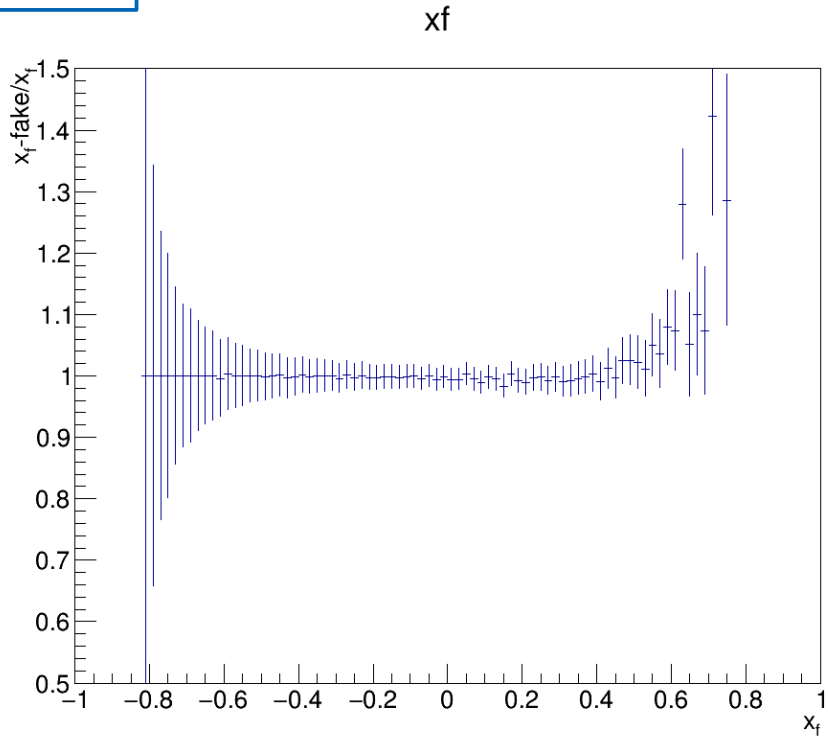




Feynman x

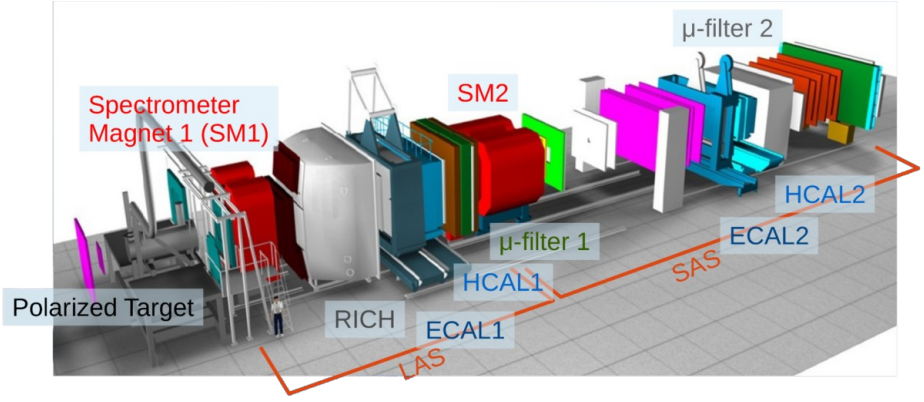
$$x_F = x_\pi - x_N$$





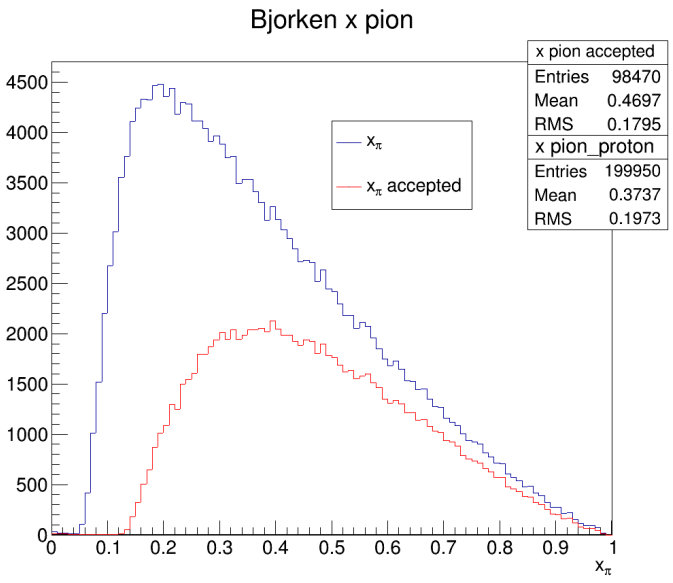
Detector's Acceptance

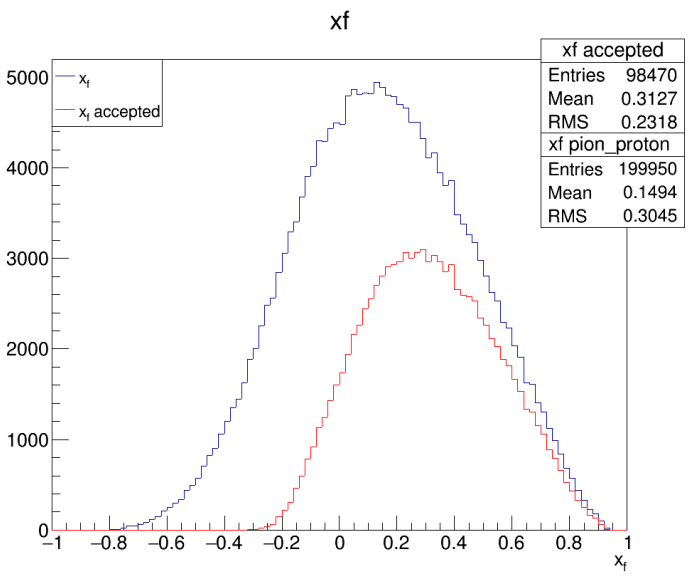
- In order to simulate real experiments' results, I narrowed the angle θ of the final state muons produced.

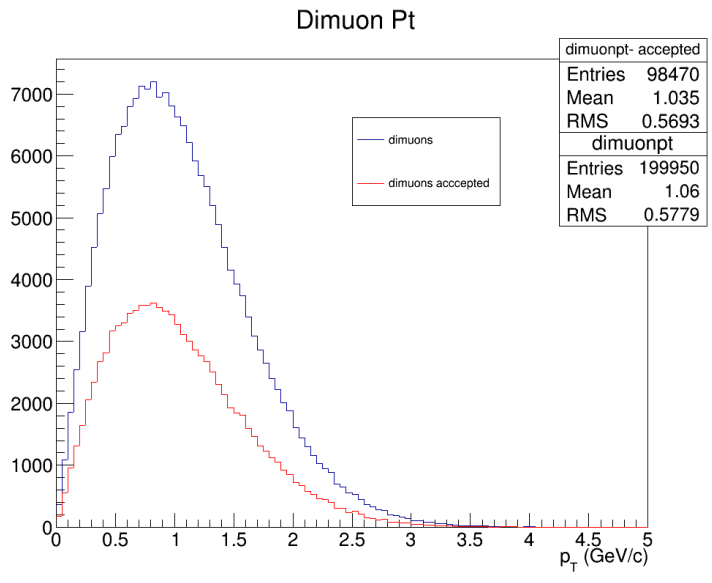


- Both in $25 < \theta_{\mu} < 160$ (mrad)
- One in $25 < \theta_{\mu} < 160$ and the other in $8 < \theta_{\mu} < 45$ (mrad).
- Acceptance ~49%.

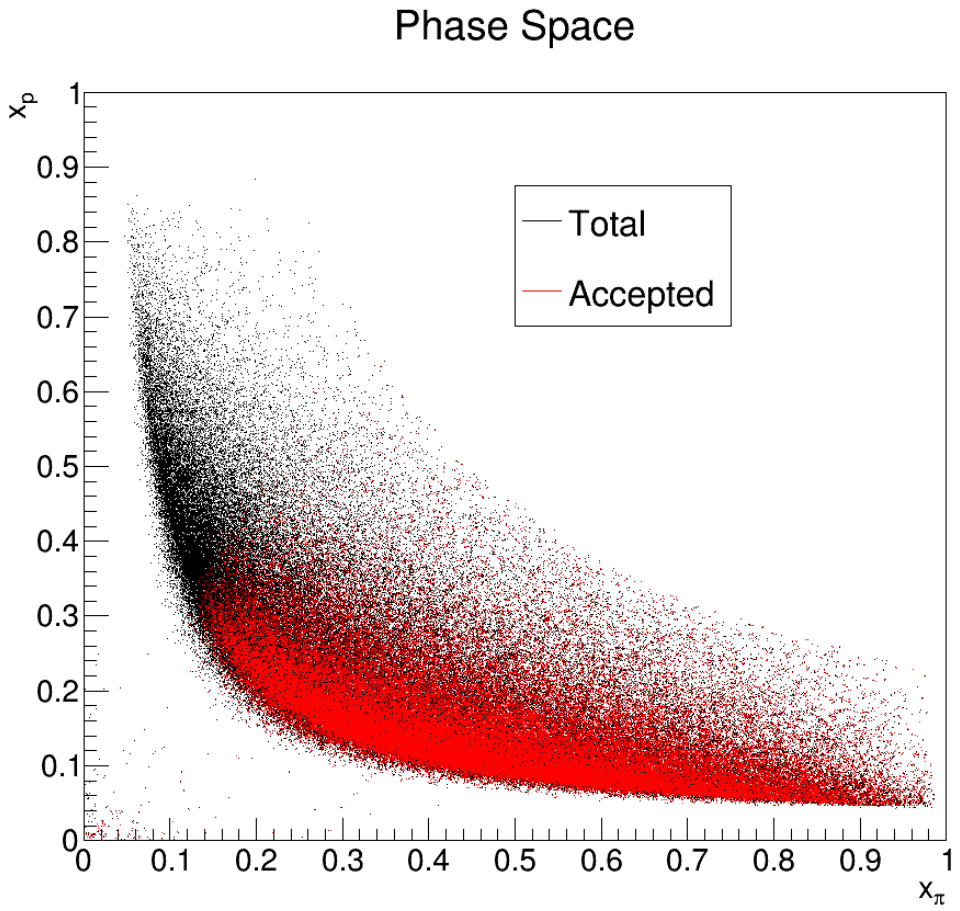
Drell-Yan Kinematical Variables







Phase Space



QUESTIONS?