

GenEx – Exclusive Meson Generator

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QCD at LHC: forward physics and UPC collisions of heavy ions

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- generator for exclusive processes in high energy collisions,
- processes that can be generated:
 - $p + p \rightarrow p + \pi^- + \pi^+ + p$
 - $p + p \rightarrow p + K^- + K^+ + p$
 - bremsstrahlung
- plans include:
 - resonant production of:
 $f_0(500)$, $f_0(980)$, $f_0(1370)$, $f_0(1500)$, $f_2(1270)$, $f_2(1520)$, ρ^0 ,
 - vector and tensor Pomeron exchange,
 - absorption effects.

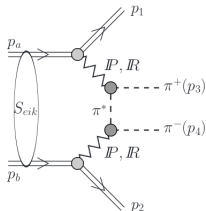
First version of GenEx generator is available online:

<https://github.com/rkycia/GenEx>,

and the description in <http://arxiv.org/abs/1411.6035>

Exclusive $\pi^-\pi^+$ production

$$p + p \rightarrow p + \pi^- + \pi^+ + p$$



Model based on:

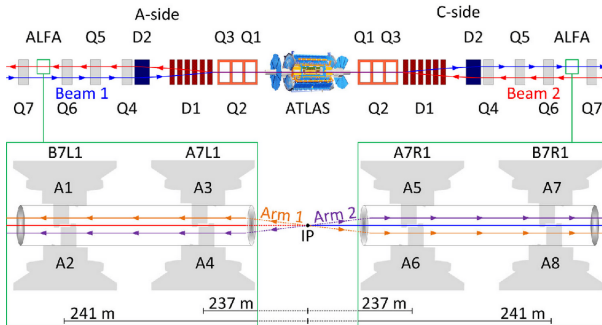
P. Lebiedowicz, O. Nachtmann and A. Szczurek: *Exclusive central diffractive production of scalar and pseudoscalar mesons; tensorial vs. vectorial pomeron.*, Annals of Physics **344** (2014) 301-339

Predictions for ALFA detector:

R. Staszewski, P. Lebiedowicz, M. Trzebinski, J. Chwastowski and A. Szczurek: *Exclusive $\pi^-\pi^+$ Production at the LHC with Forward Proton Tagging.* Acta Physica Polonica B vol. **42** (2011) page 1861.

- GenEx generator will be further developed – new processes, and features will be implemented,
- to control changes, tool for quick comparison of versions was needed,
- my task was to create first version of such tool,
- example: $p + p \rightarrow p + \pi^- + \pi^+ + p$ process, ALFA detector and $\beta^* = 90 \text{ m}$ optics.

ALFA Detector



ALFA: Absolute Luminosity For ATLAS:

- located 240 m from the ATLAS Interaction Point,
- Roman pots – detectors can be inserted into the beam-pipe and take data ~ 1 mm from the beam,
- main goal: measure elastic scattering,
- operations during special LHC runs with so called high- β^* optics,
- position resolution: ~ 30 μm in x and y.

Analysis using ALFA detectors

Measurement is assumed to be done using $\beta^* = 90\text{ m}$ optics. Since ALFA are horizontal Roman pots, any p_y component is important (for the acceptance).

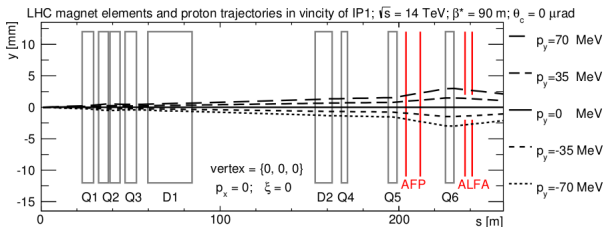


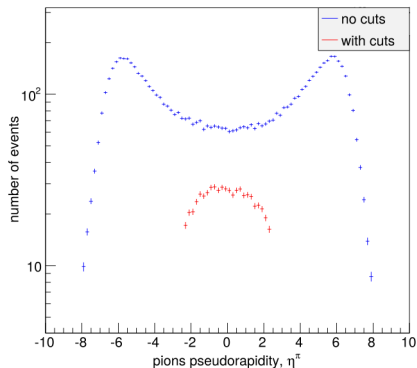
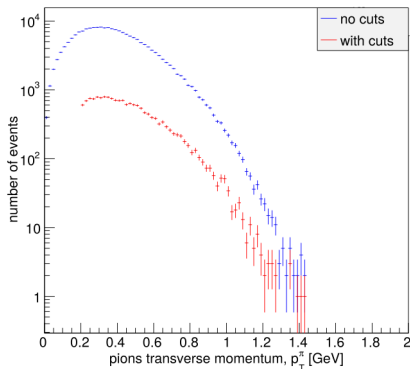
Figure : Transverse momentum dependence of the proton trajectory for LHC optics for $\sqrt{s} = 14\text{ TeV}$.

Therefore proton transverse momentum, $|p_y^p| > 50\text{ MeV}$.

In addition, pions have to be visible in ATLAS:

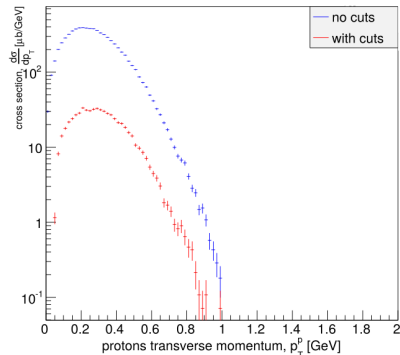
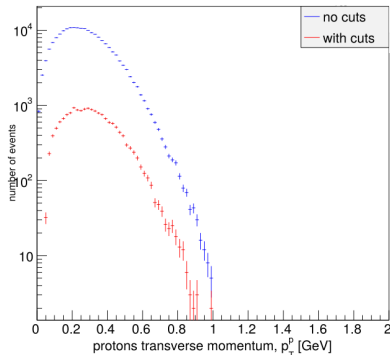
- pion transverse momentum, $p_T^\pi > 200\text{ MeV}$,
- pion pseudorapidity, $|\eta^\pi| < 2.5$,

Pions distribution



Pions transverse momentum (left) and pseudorapidity (right) for exclusive pion production for sample with cuts (blue points) and without cuts (red points).

Protons distribution



Protons transverse momentum for exclusive pion production for sample with cuts (blue points) and without cuts (red points).

- First version of GenEx generator is available online.
- New processes and features will be added.
- Tool for code comparison was created.
- As example, simple analysis for ALFA detectors and $\beta^* = 90\text{ m}$ optics was shown.

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Thank you for your attention!

