NA49/NA61 vs FLUKA

Update for MINOS+/NOvA beam meeting

Pedro Mediano

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Very quick reminder

- We're comparing FLUKA simulations (with and without PEANUT) with results from NA49.
- 120 GeV proton beam hitting a graphite or hydrogen target.
- Measuring invariant cross-section binned in CMS Feynman X and transverse momentum (x_F, p_T).
- If you didn't see (or don't remember) my previous talks please ask or check the details in the link.

`http://numix-docdb.fnal.gov:8080/cgi-bin/ShowDocument?docid=34`

Weights
Outline

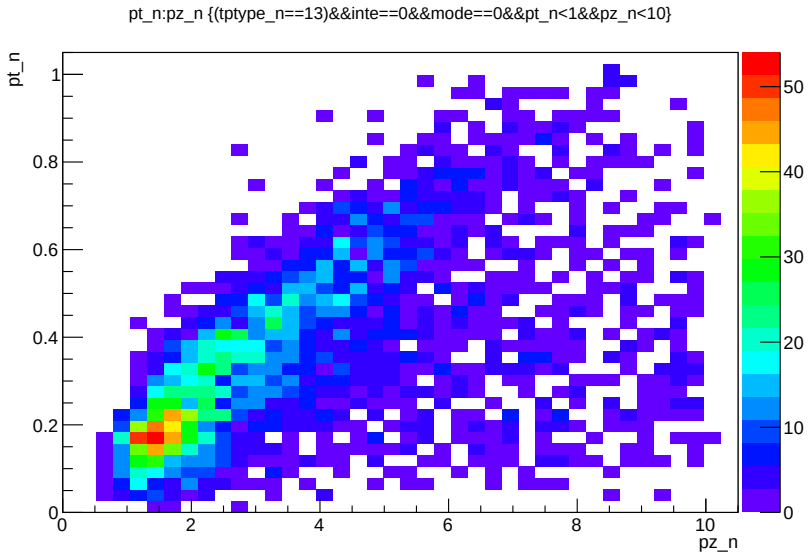
1. Grab a flux file
2. Plot pz:pt distribution of neutrino parents in CC QE events.
3. Interpolate to estimate the values at NA49 bin centres.
4. Use those as weights for FLUKA - NA49 statistics.

Weights
Outline

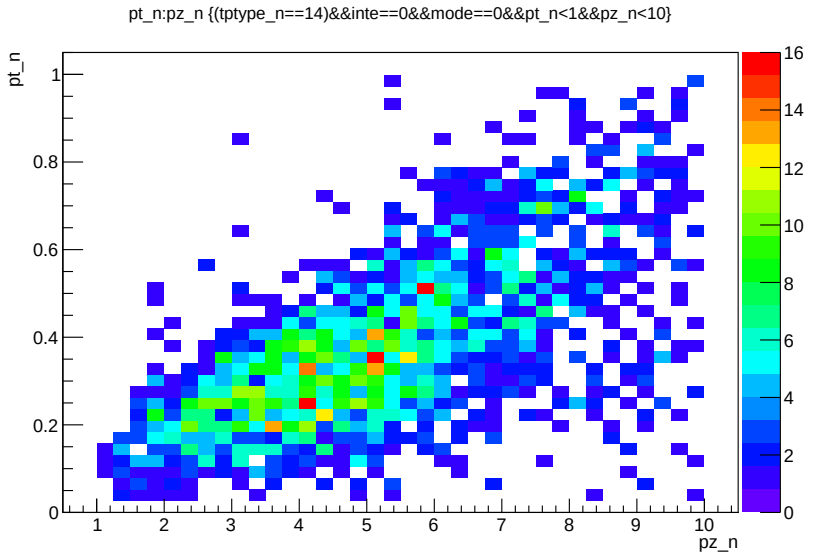
Include certain decay channels to compute different weights for each particle.

$$
\begin{aligned}
\pi^+: &\quad \pi^+ \rightarrow \nu_\mu + \mu^+ \\
\pi^-: &\quad \pi^- \rightarrow \bar{\nu}_\mu + \mu^- \\
K^+: &\quad K^+ \rightarrow \nu_\mu + \mu^+ \\
&\quad K^+ \rightarrow \nu_\mu + \pi^0 + \mu^+ \\
&\quad K^+ \rightarrow \nu_e + \pi^0 + e^+ \\
K^-: &\quad K^- \rightarrow \bar{\nu}_\mu + \mu^- \\
&\quad K^- \rightarrow \bar{\nu}_\mu + \pi^0 + \mu^- \\
&\quad K^- \rightarrow \bar{\nu}_e + \pi^0 + e^-
\end{aligned}
$$

$\pi^{\pm}$ Weights



(a) π^{+} weights



(b) π^{-} weights

NA49 $\pi^{\pm}$ phase space coverage

The region in green is the region plotted in the previous histograms.

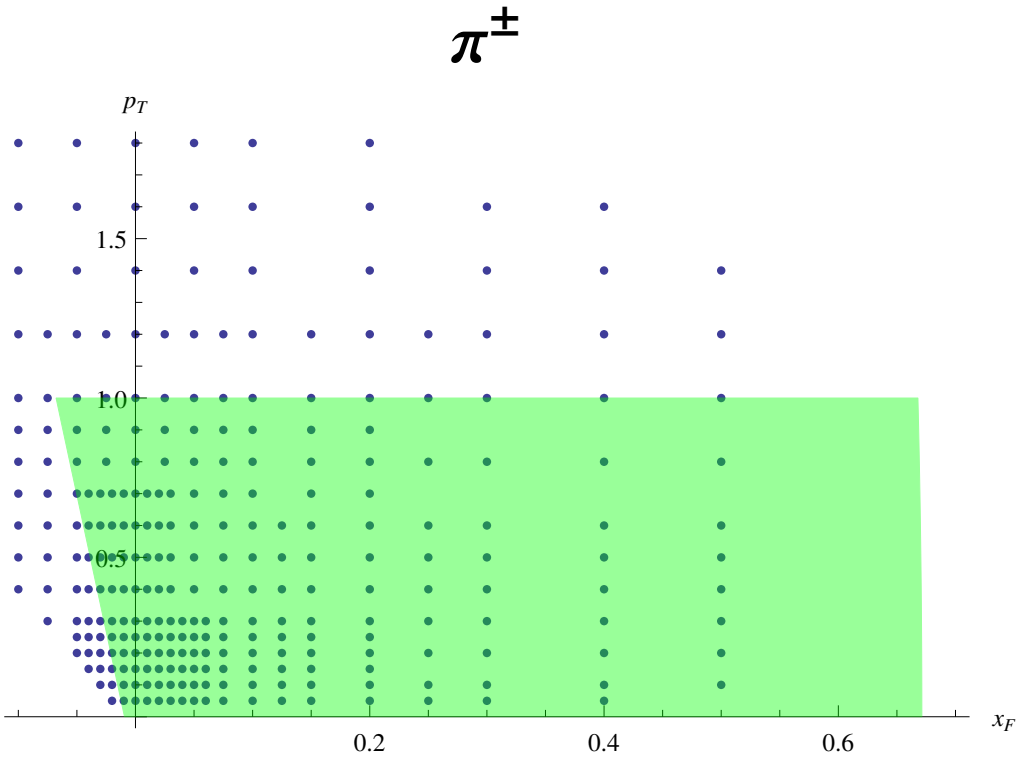
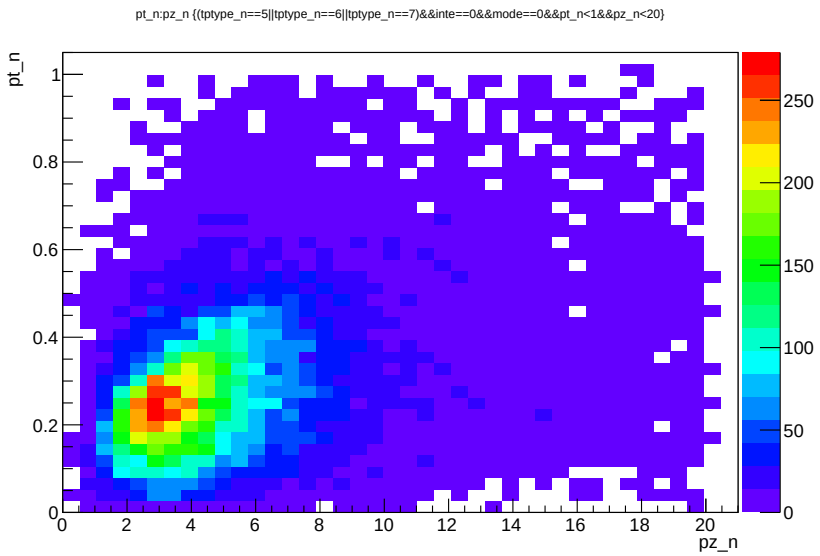
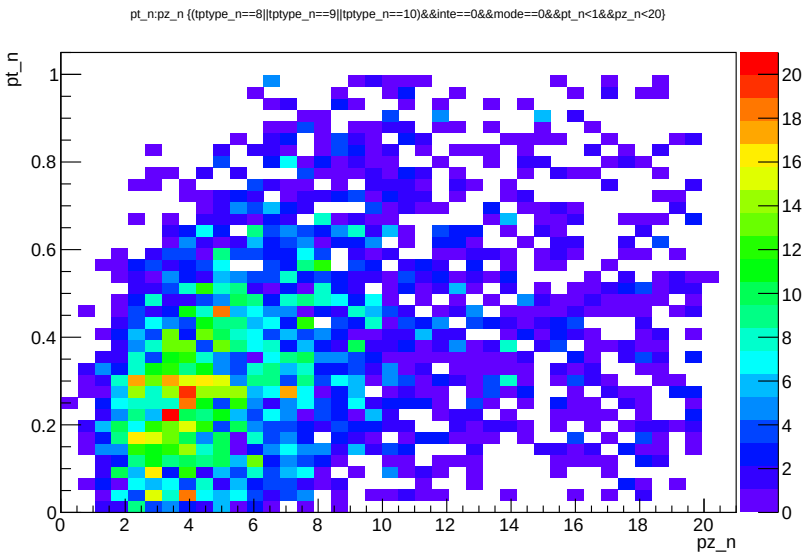


Figure: NA49 bin centers (points) and NDOS-relevant region (green)

$K^{\pm}$ Weights



(a) K^{+} weights



(b) K^{-} weights

NA49 $K^{\pm}$ phase space coverage

The region in green is the region plotted in the previous histograms.

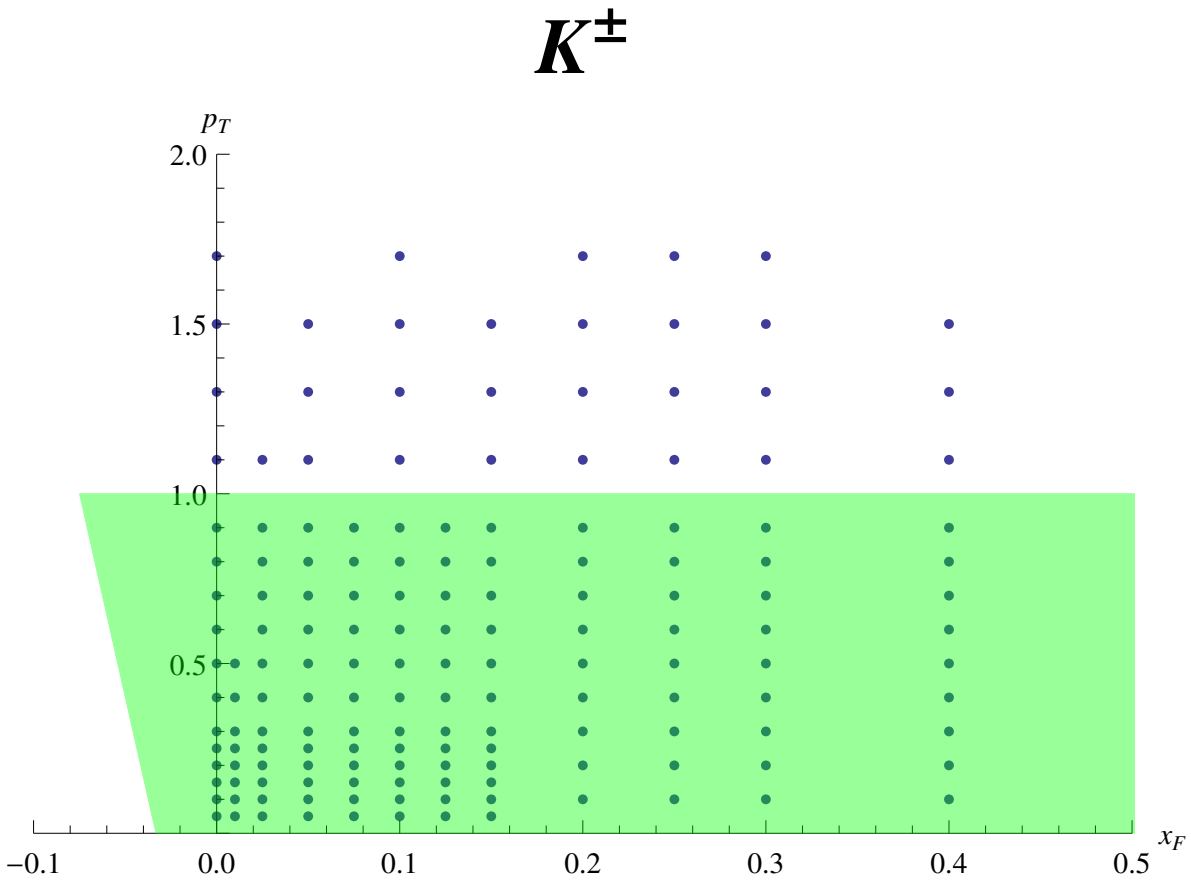


Figure: NA49 bin centers (points) and NDOS-relevant region (green)

Reminder

Comparison

- Standardized differences:

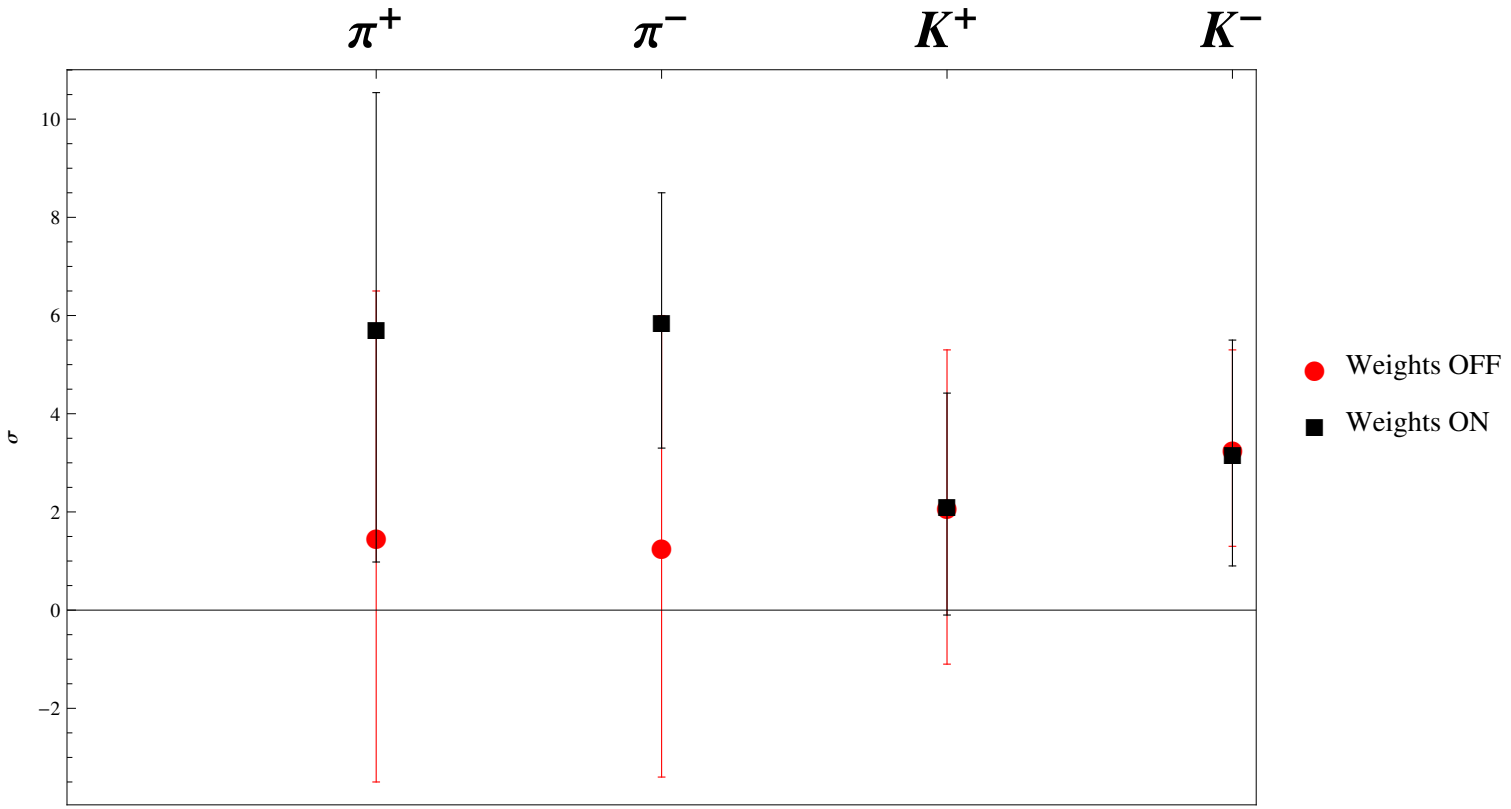
$$z = \frac{f_{FLUKA} - f_{NA}}{\sqrt{\sigma^2_{FLUKA} + \sigma^2_{NA}}}$$

- Relative differences:

$$z = 100 \frac{f_{FLUKA} - f_{NA}}{f_{NA}}$$

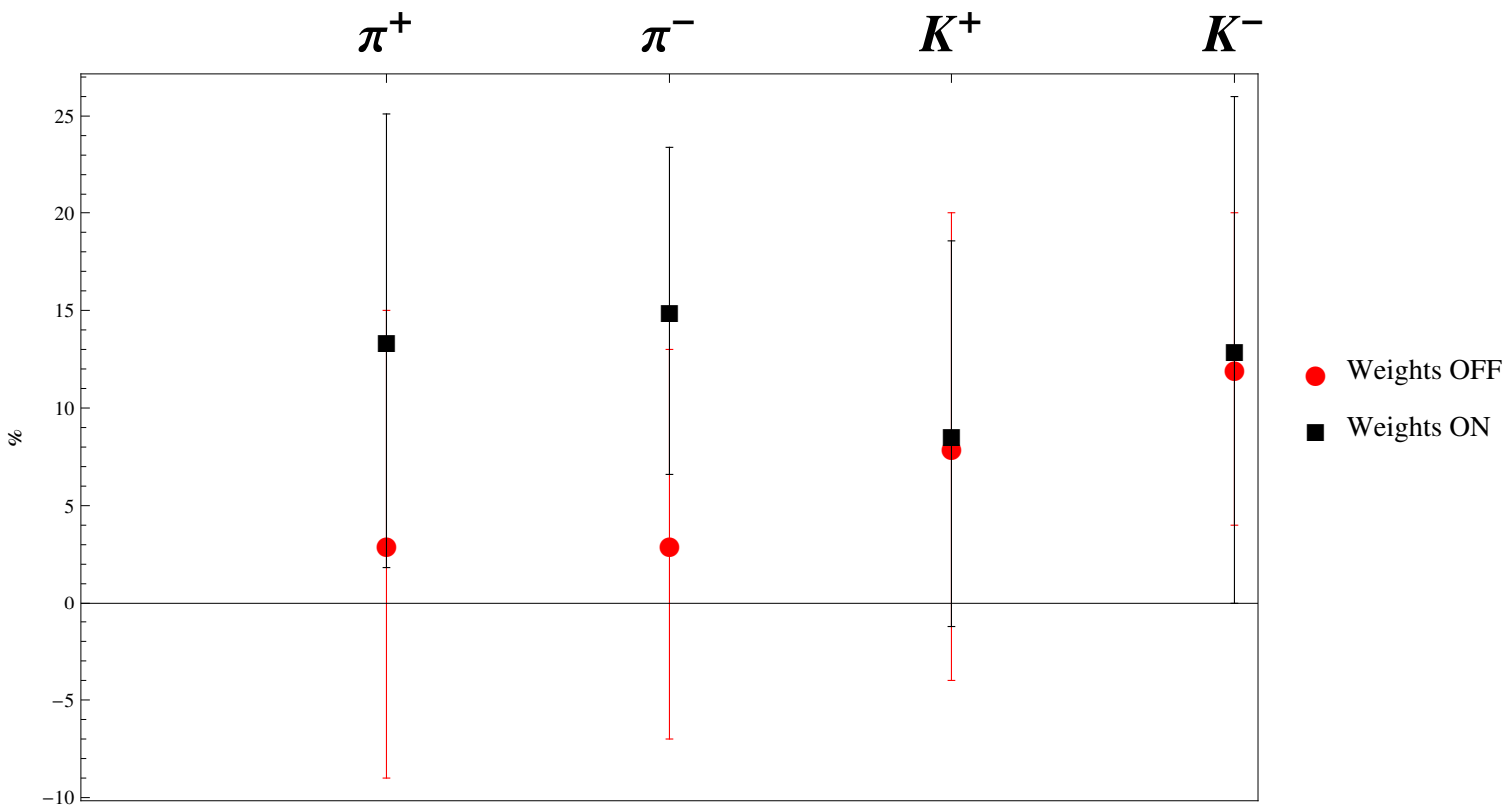
NA49 summary

Fluka (w/ PEANUT) - NA49, Standardized differences



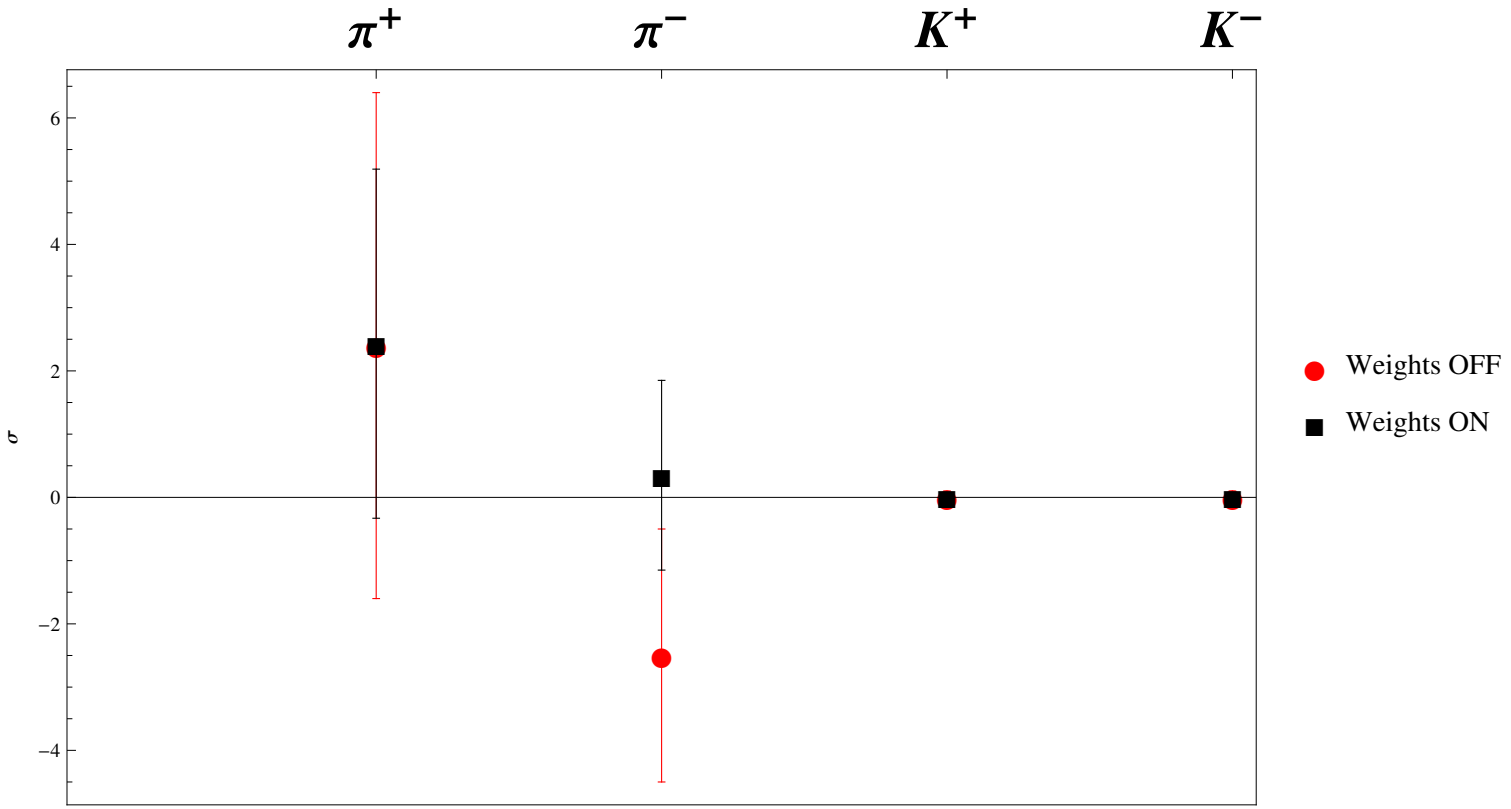
NA49 summary

Fluka (w/ PEANUT) - NA49, Relative differences



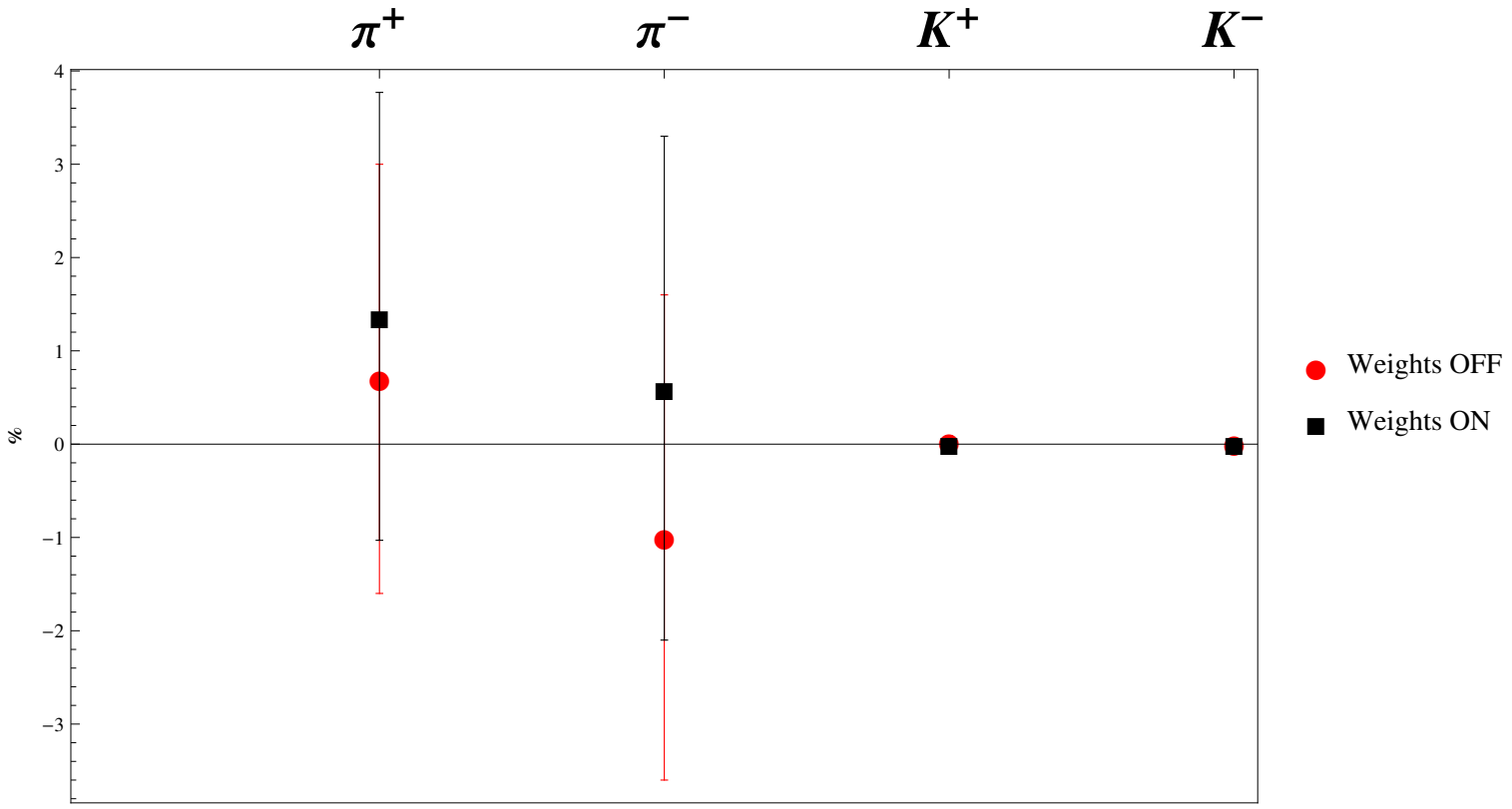
NA49 summary

Fluka (w/ PEANUT) - Fluka (w/o PEANUT), Standardized differences



NA49 summary

Fluka (w/ PEANUT) - Fluka (w/o PEANUT), Relative differences

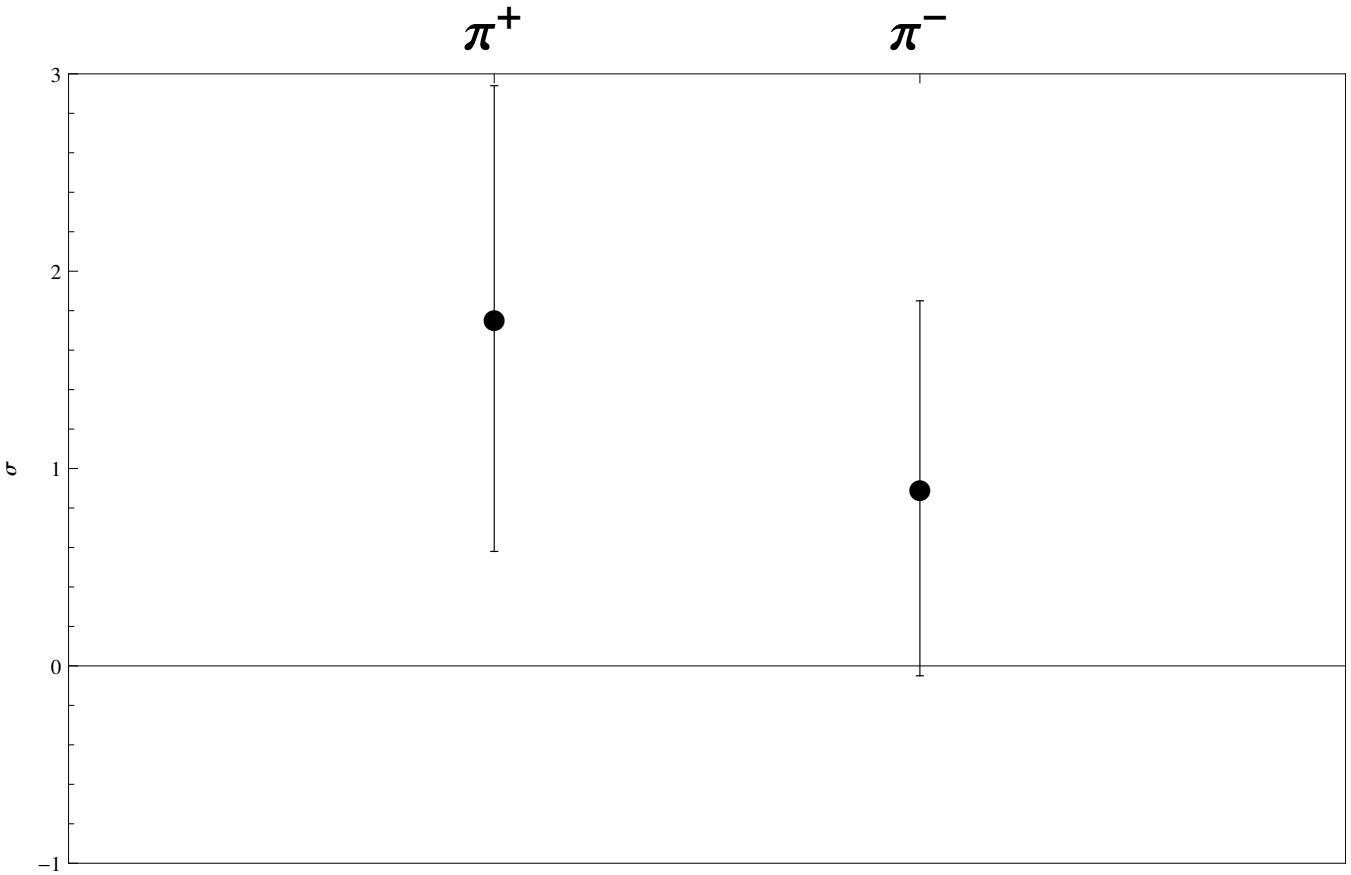


NA61

Note: In the study of NA61 I haven't used weights yet.

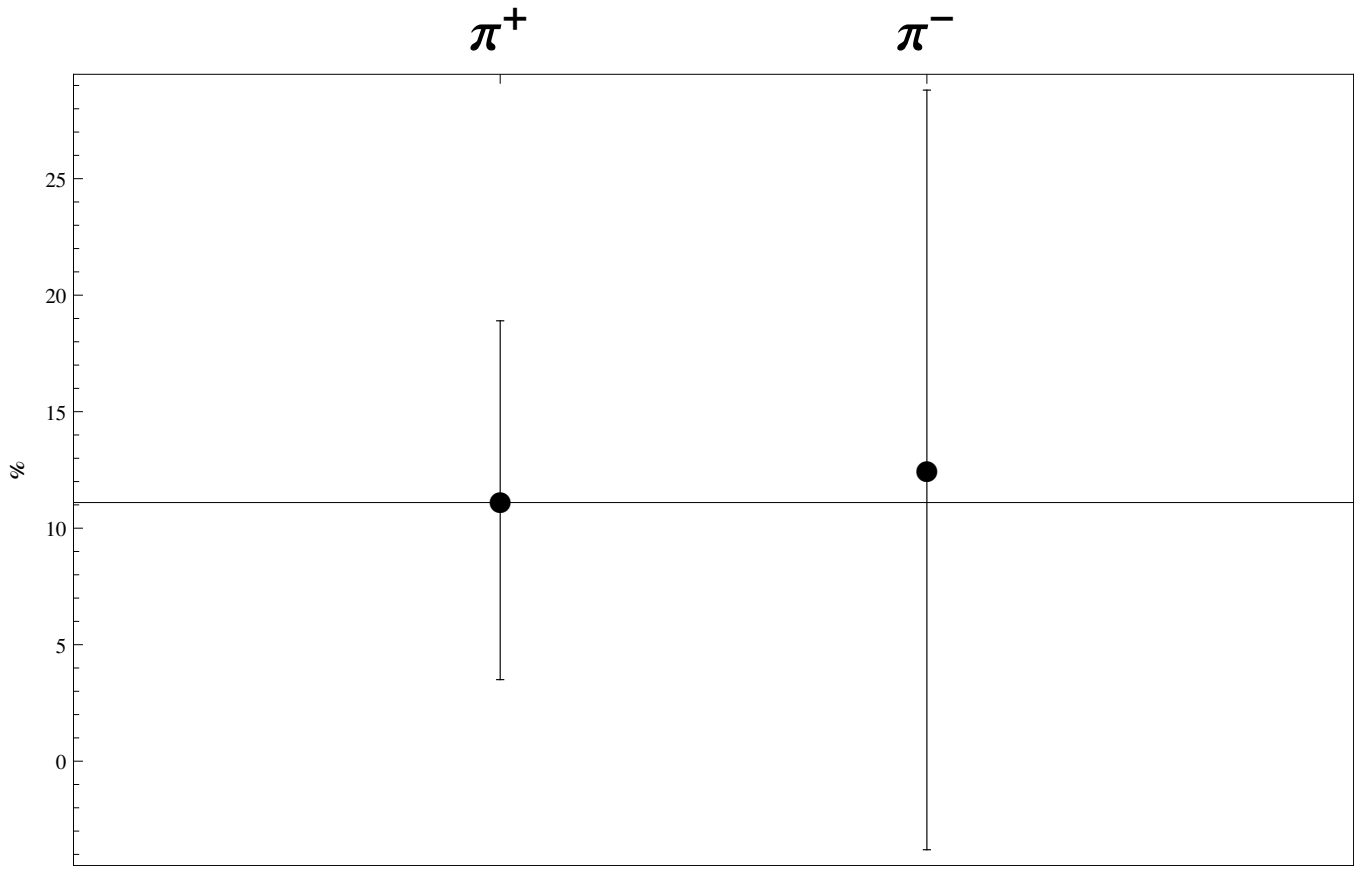
NA61 summary

Fluka (w/ PEANUT) - NA61, Standardized differences



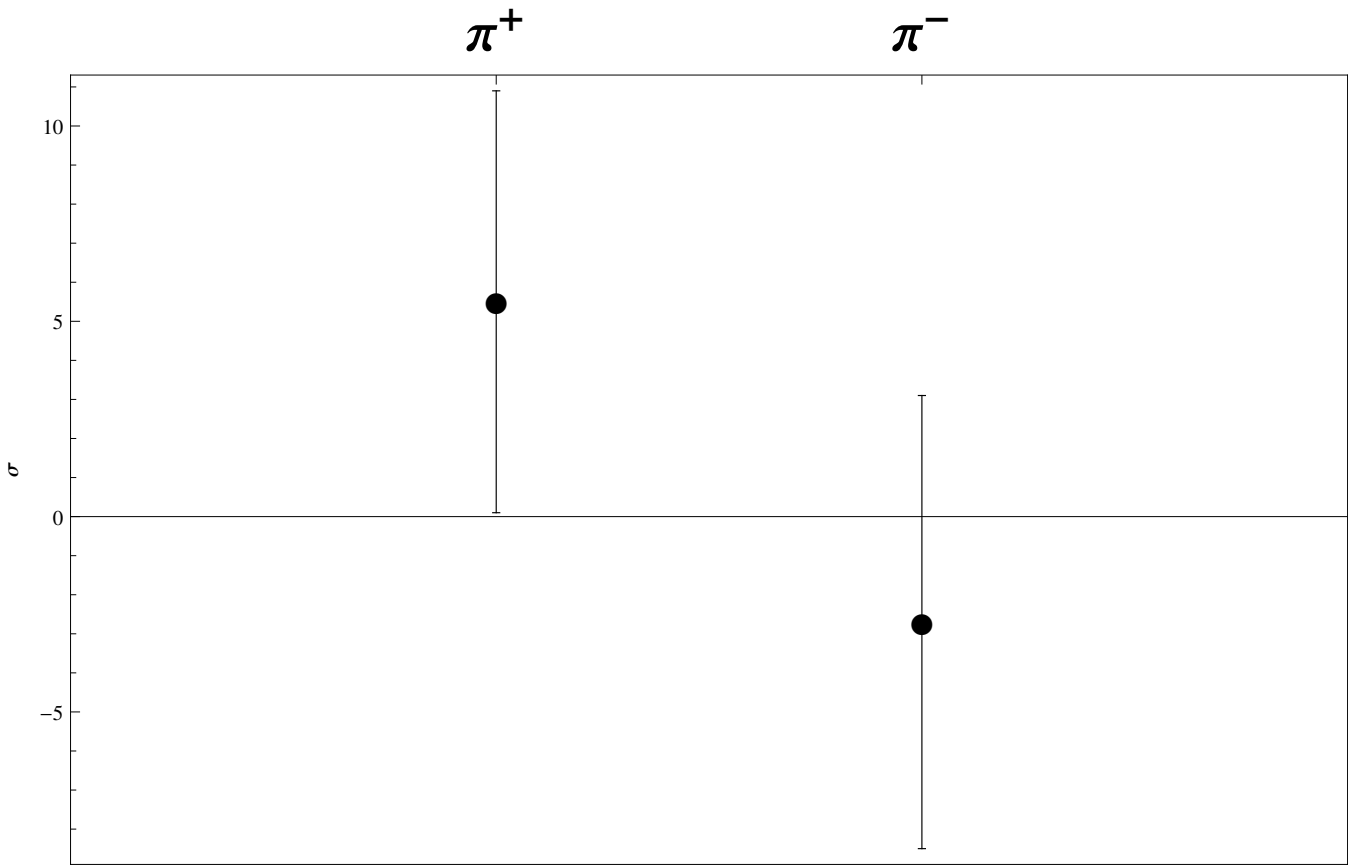
NA61 summary

Fluka (w/ PEANUT) - NA61, Relative differences



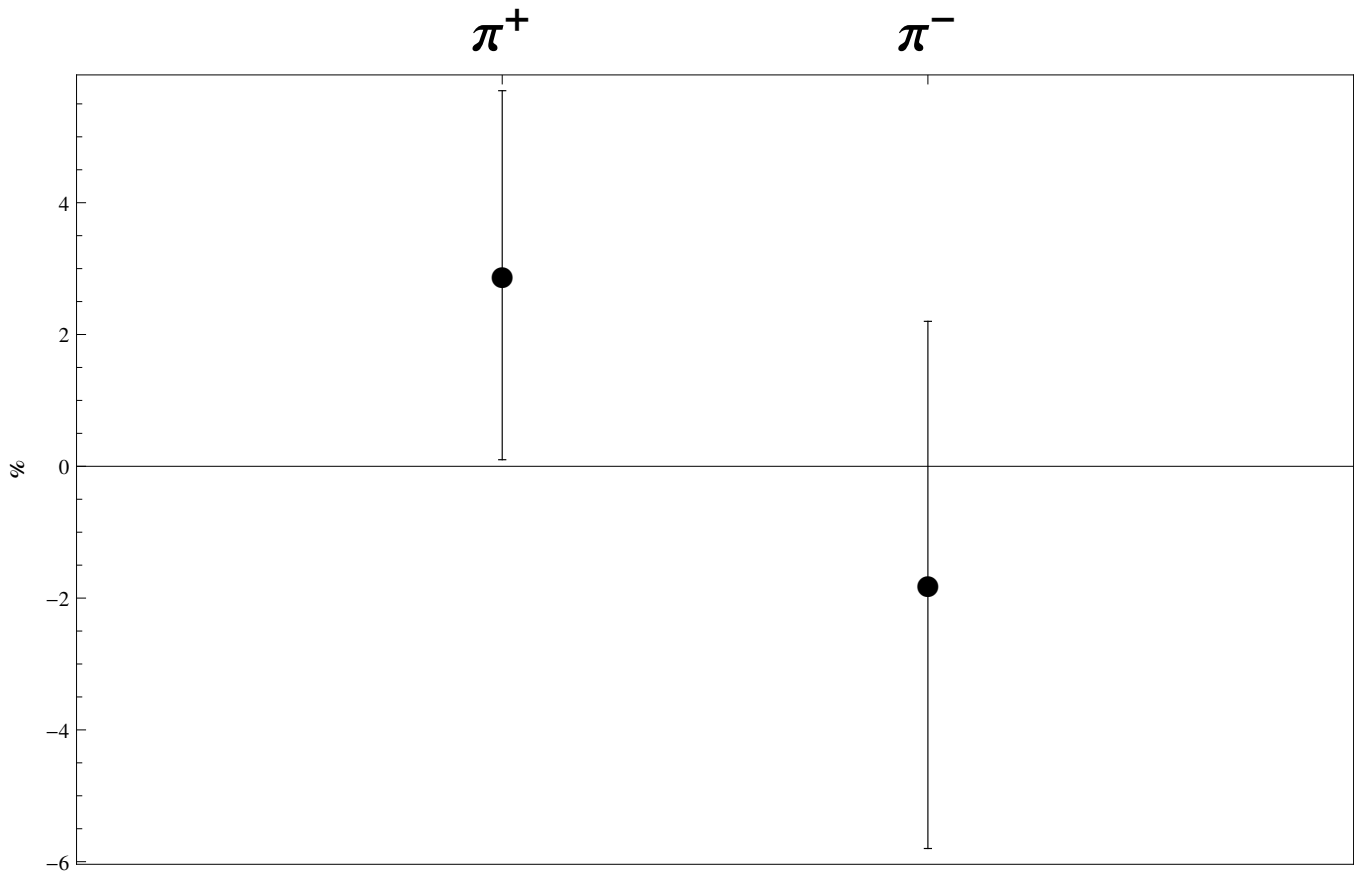
NA61 summary

Fluka (w/ PEANUT) - Fluka (w/o PEANUT), Standardized differences



NA61 summary

Fluka (w/ PEANUT) - Fluka (w/o PEANUT), Relative differences



Next steps

- Incorporate weights to the study using NA61 setup.
- Repeat study at 120GeV using interpolation made by NA49 and NA61.