

Large-angle hadron production cross-sections for the neutrino factory

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Introduction

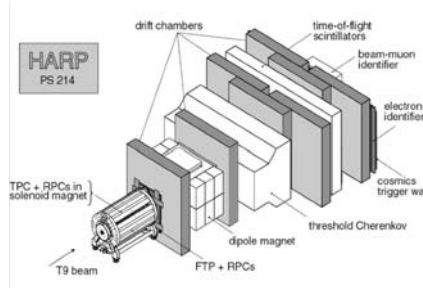
Precise spectra of secondary hadrons from the interaction of protons and pions with nuclei are, inter alia, of importance for the understanding of the characteristics of muons from the decay of pions generated by the proton driver of a future neutrino factory.

Surprisingly, hadron production cross-sections are uncertain within factors of up to three.

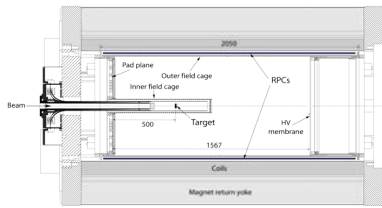
The HARP experiment at the CERN PS took data in 2001 and 2002 with proton and pion beams with momentum between 1.5 and 15 GeV/c. It was the first 4π detector dedicated to the measurement of secondary hadron spectra. The detector comprised a forward spectrometer and a large-angle spectrometer. This poster is exclusively concerned with data from the HARP large-angle spectrometer.

The latter consists of a cylindrical TPC that measures p_T and the polar angle θ of tracks, and their specific ionization dE/dx . Timing RPCs that surround the TPC measure time of flight with a view to complementing and corroborating particle identification.

Detector characteristics & performance



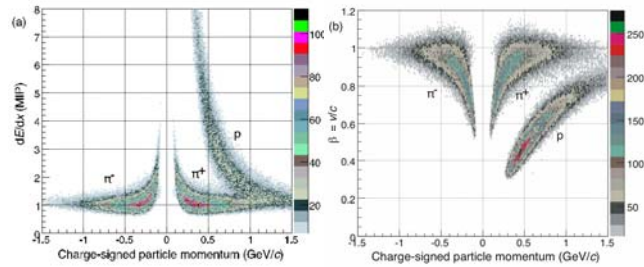
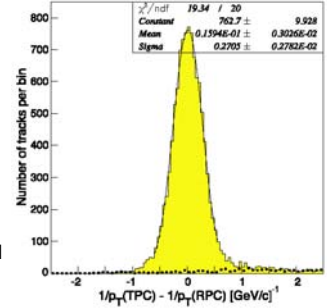
Large-angle spectrometer TPC and RPCs inside 0.7 T solenoidal magnet



- TPC**
- $\sigma(1/p_T) \approx 0.20 \text{ (GeV/c)}^{-1}$
 - $\sigma(\theta) \approx 9 \text{ mrad}$
 - $\sigma(dE/dx)/(dE/dx) \approx 0.16$

- RPCs**
- Efficiency $\approx 98\%$
 - $\sigma(\text{TOF}) \approx 175 \text{ ps}$

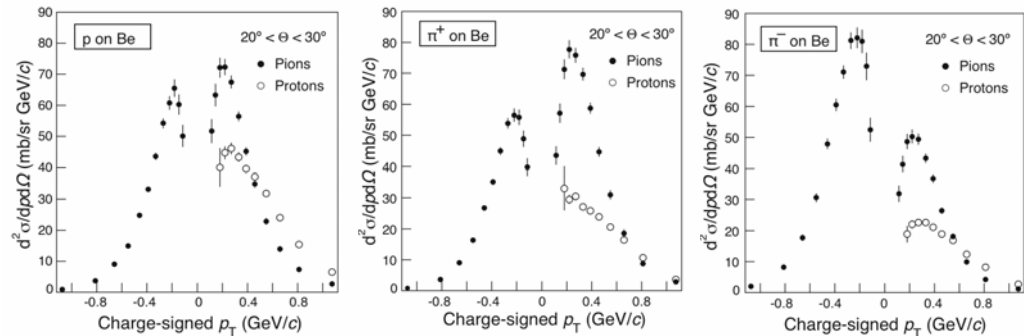
Good particle identification by combining dE/dx from TPC and TOF from RPCs



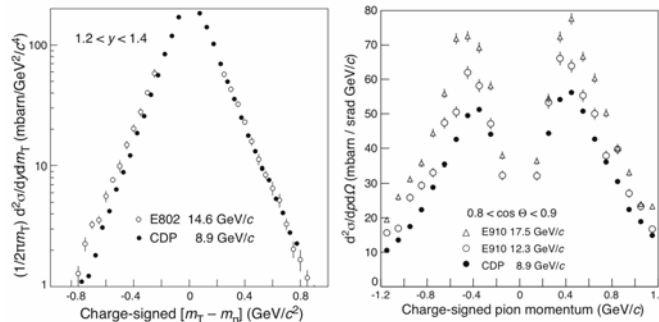
Inclusive cross-sections

Examples of inclusive cross-sections of proton and π^\pm production on a 5% λ_{abs} Be target by incoming protons and pions as a function of p_T , here for the polar angle range $20^\circ < \theta < 30^\circ$.

Double-differential inclusive cross-sections with a typical precision of a few per cent are available in tabular form in Ref. [2] for the full polar angle acceptance of $20^\circ < \theta < 125^\circ$. We also give charged kaon and deuteron production cross-sections, albeit with less precision.

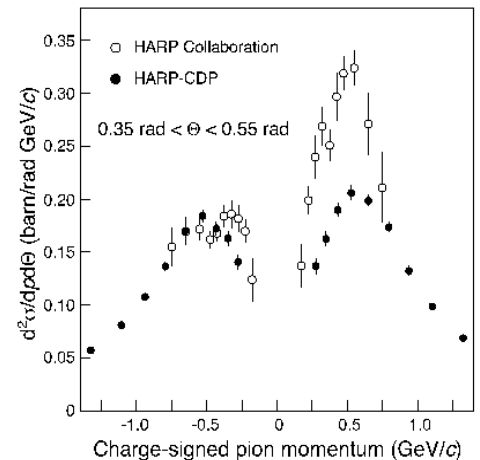


Comparison with E802, E910, HARP Collaboration



▪ **Left:** Good agreement of our inclusive cross-sections with results from earlier experiments (E802 and E910) at Brookhaven.

▪ **Right:** Striking disagreement between our results and those obtained by the HARP Collaboration. Note that the same raw data have been analysed, however, with completely different reconstruction and analysis algorithms.



References

[1] V. Ammosov et al., NIM A588 (2008) 294 and NIM A578 (2007) 119

[2] A. Bolshakova et al., Cross-sections of large-angle hadron production in proton- and pion-nucleon interactions I: beryllium nuclei and beam momenta of +8.9 GeV/c and -8.0 GeV/c, submitted as CERN-PH-EP preprint, available at: <http://harp-cdp.web.cern.ch/harp-cdp/Bepub.ichep08contribution.pdf>