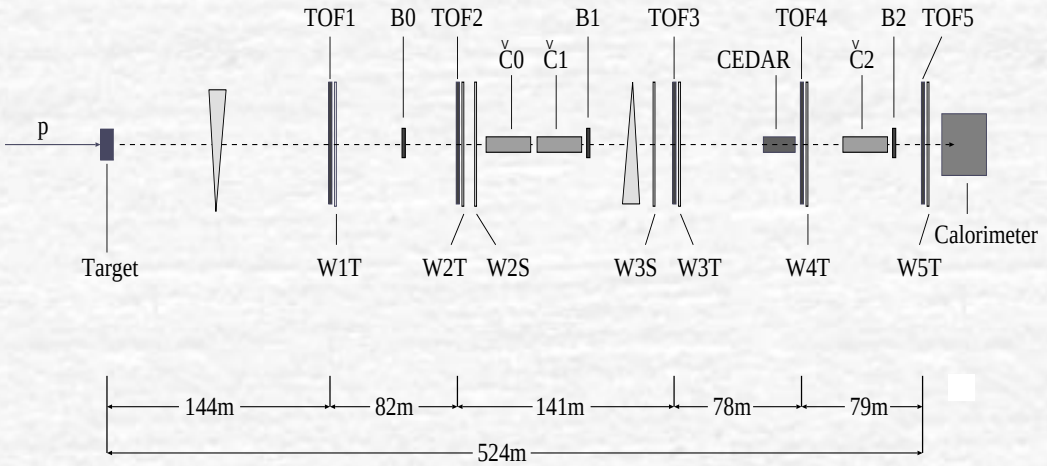
Deuteron production in the NA56/SPY experiment at CERN SPS

NA56 Collaboration

M. Bonesini
Sezione INFN Milano Bicocca

Dipartimento di Fisica G. Occhialini
Universita' di Milano-Bicocca

The Na56/SPY experiment



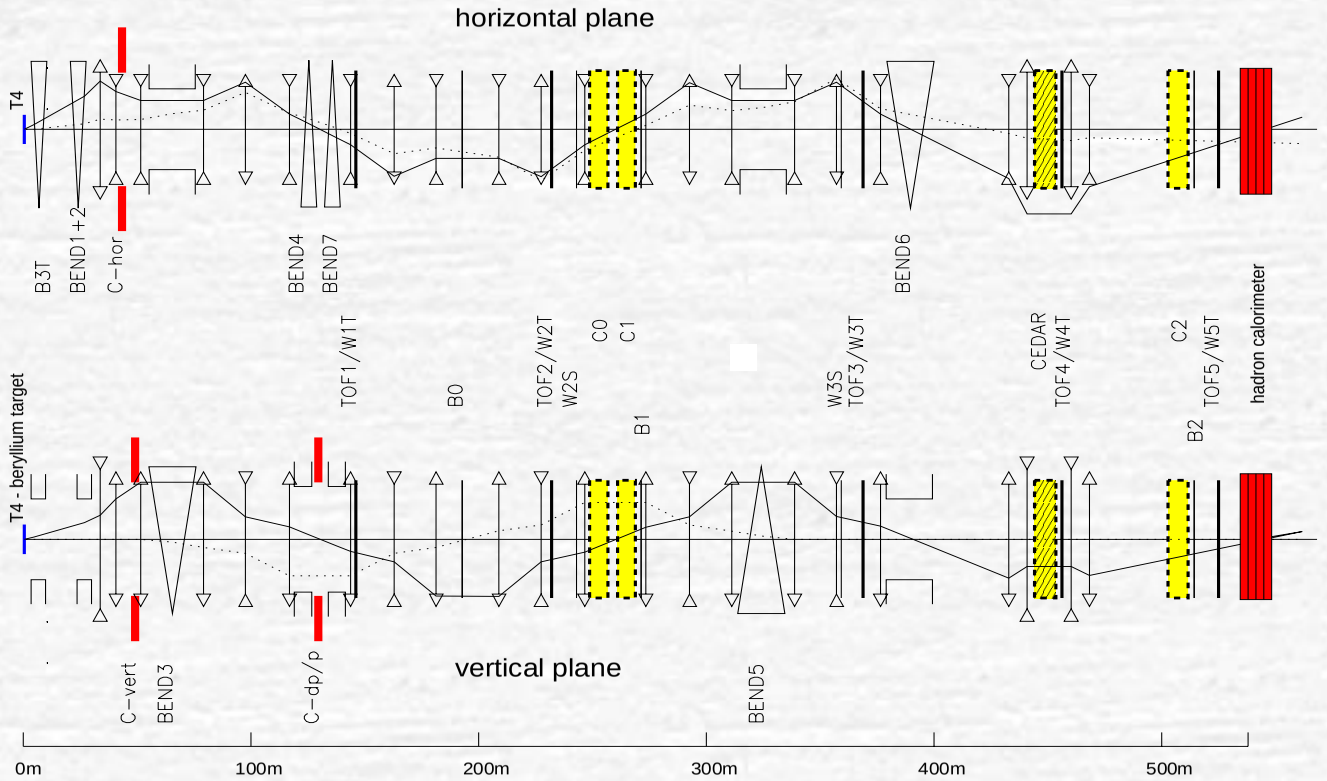
- **Measure π, k, p cross sections by 450 GeV/c p on Be (5-10% precision) ->knowledge of ν spectra**
- **Measure k/π ratio (3% precision) -> knowledge ν_e/ν_μ ratio**

Critical points for such an experimen

- **beamline simulation (spectrometer acceptance) (5 – 10 % precision)**
- **Particle misidentification (< 1%)**
- **Subtraction of long lifetime particles decaying outside the target (K^0_s -> ππ, ...) (< 2%)**
- **Beam momentum determination and K lifetime**
- **->uncertainty on K decay correction (1 %)**
- **Protons on target (2 %)**

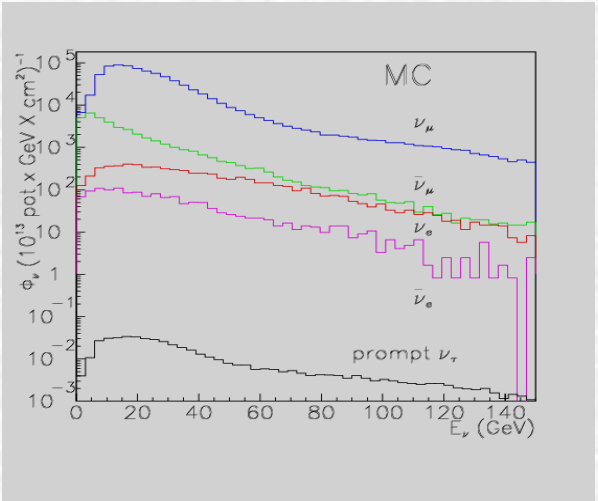
- **Equipped H6 beamline from NA52 experiment in North Area**
- **Primary p flux measured by SEM**
- **Different Be targets (shapes, L)**
- **PID by TOF counters (low momenta) and Cerenkov (high momenta)**

H6 beamline optics

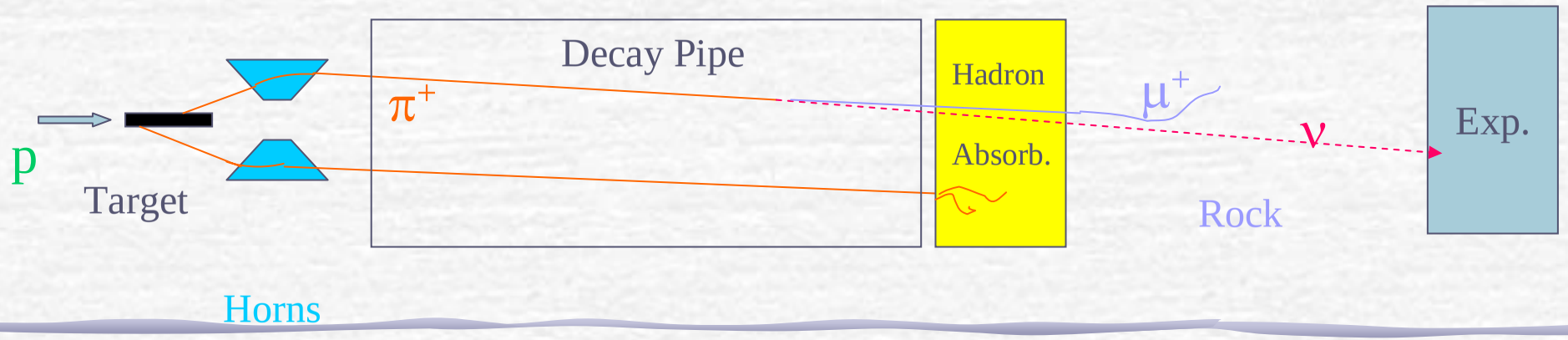


Main physics issue of NA56/SPY: modelling of conventional ν_μ beams (from π decay)

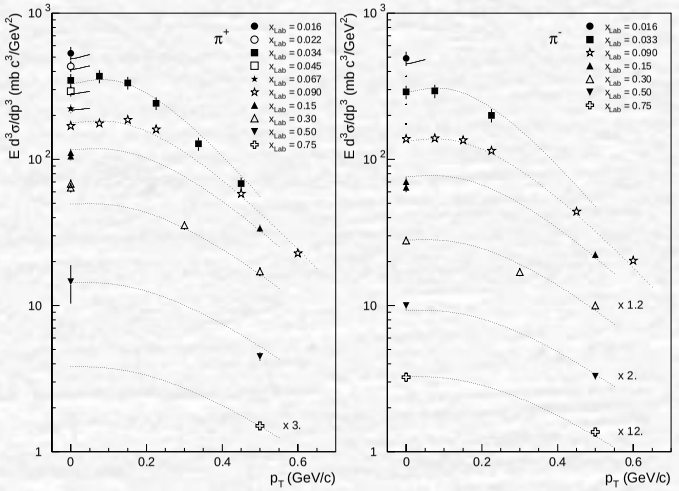
WANF

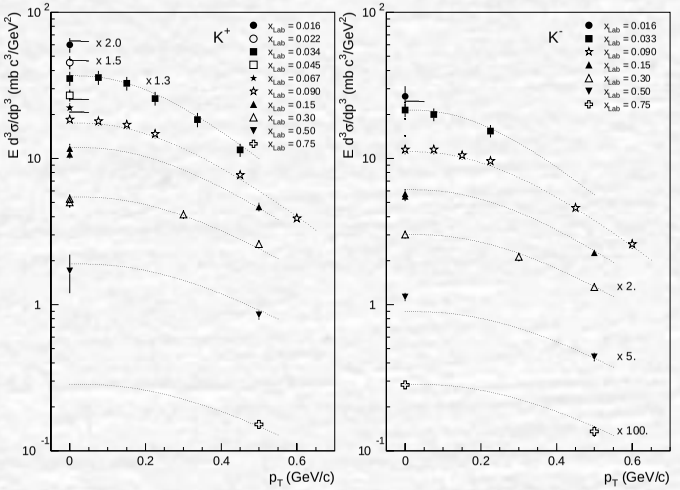


- **Problem in conventional ν_μ beams: a lot of minority components -> needs better knowledge of secondaries production in target**

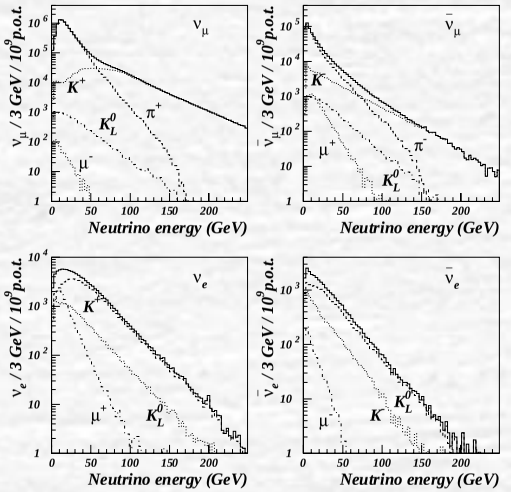


Simulation of conventional ν beamlines

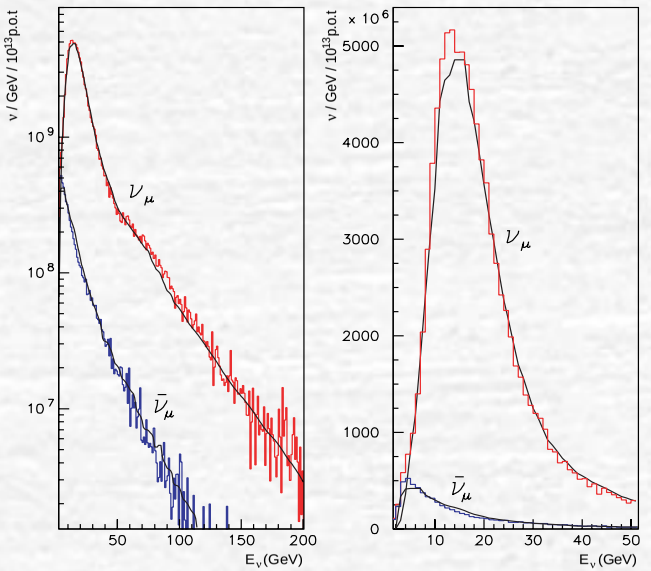




BMPT parametrization of π/K NA56/SPY data or insertion of SPY data inside full MC (FLUKA)



Fluka full simulation (+ reweighting with NA56/SPY data): WANF for NOMAD

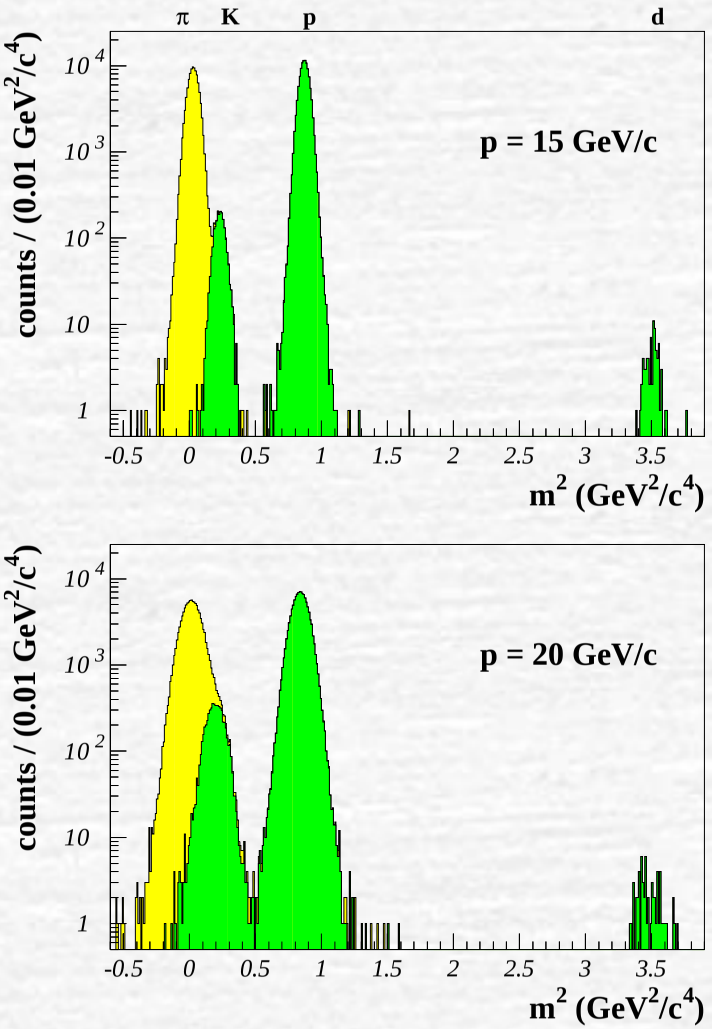


BMPT fast simulation: CHARM II

deuteron analysis

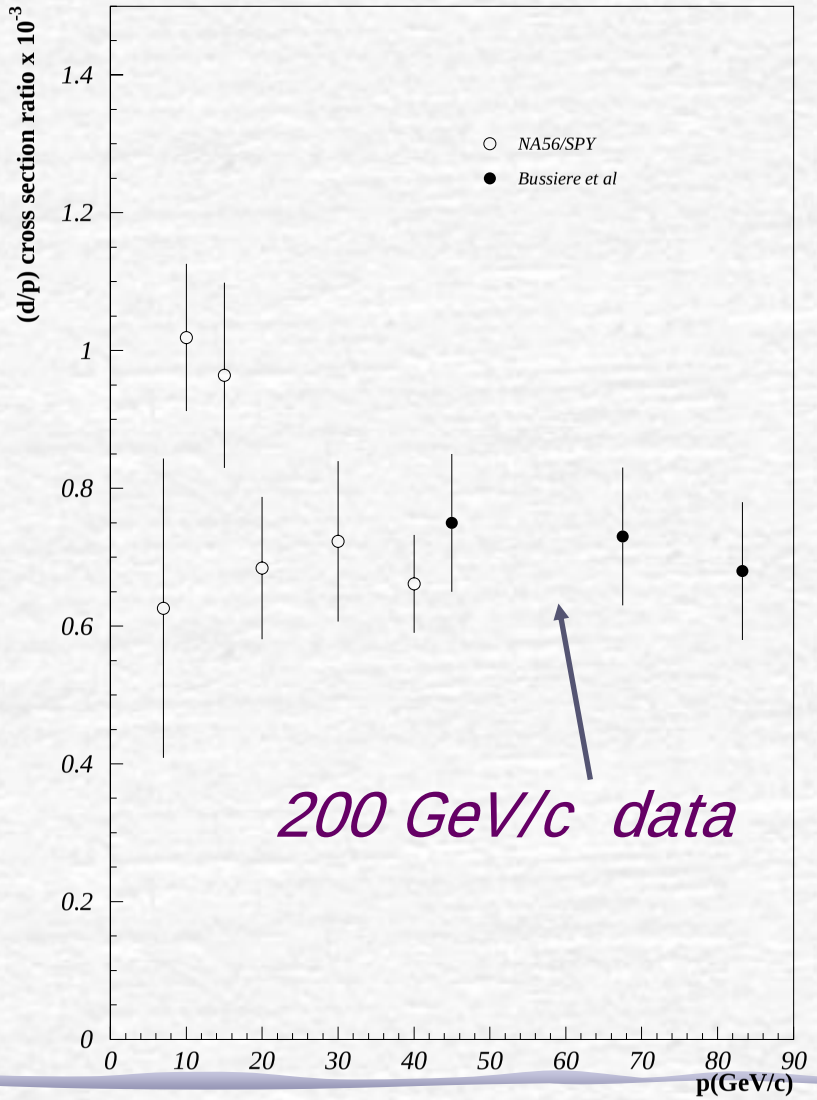
1. From data first extract (d/p) ratio (PID)
2. Compute p cross section $Ed^3\sigma/dp^3$ (H6 beamline acceptance, strange particle decays outside target, extrapolation to zero target length...)
3. Determine d invariant cross section as $(Ed^3\sigma/dp^3)_d = (d/p) * (Ed^3\sigma/dp^3)_p$ as a function of p, p_T

d/p ratio: particle identification at low energy



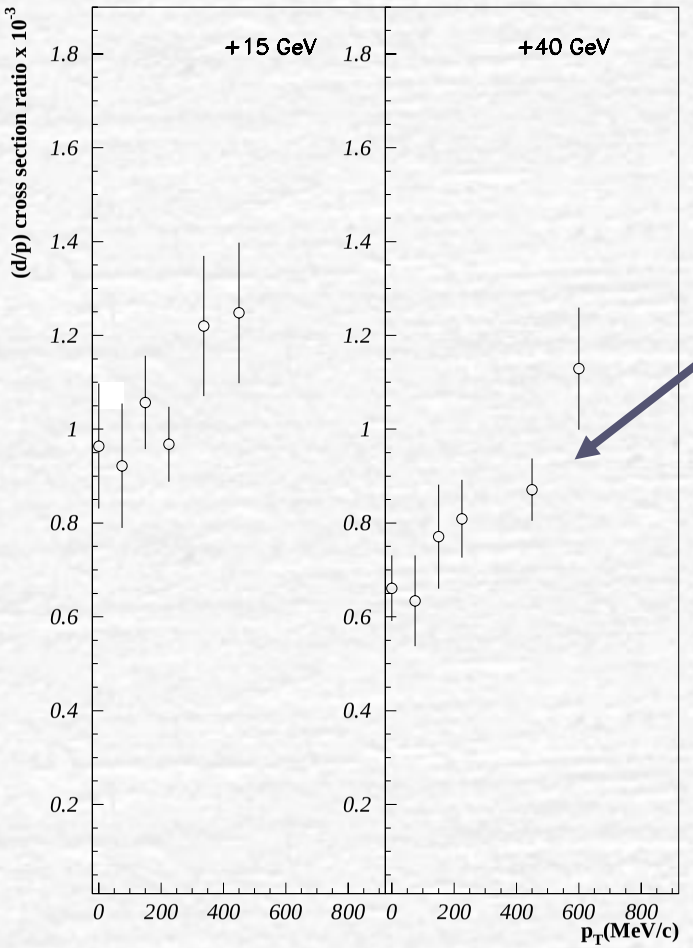
- ***mass reconstruction with TOFs at 15 GeV/c (in colour Cerenkov separation)***
- ***d are distinguished from p by TOF rec. up to 40 GeV/c***

d/p cross section ratio



200 GeV/c data

Angular scan

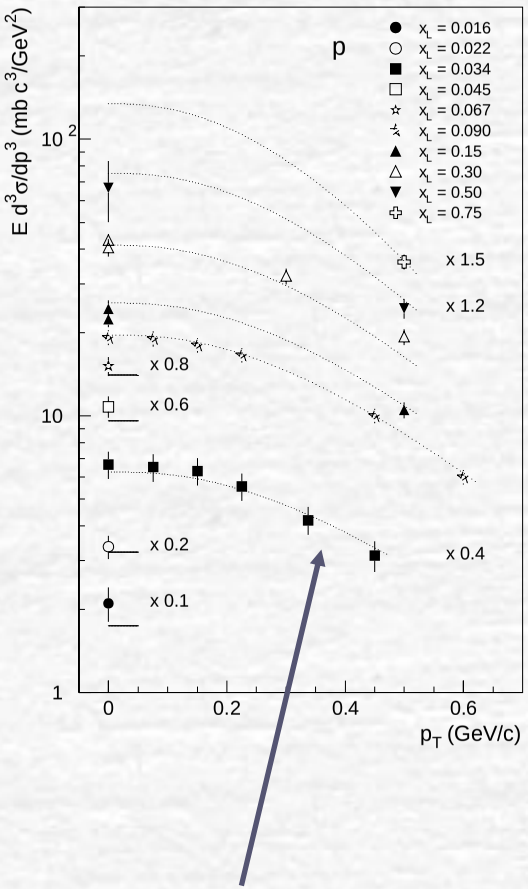


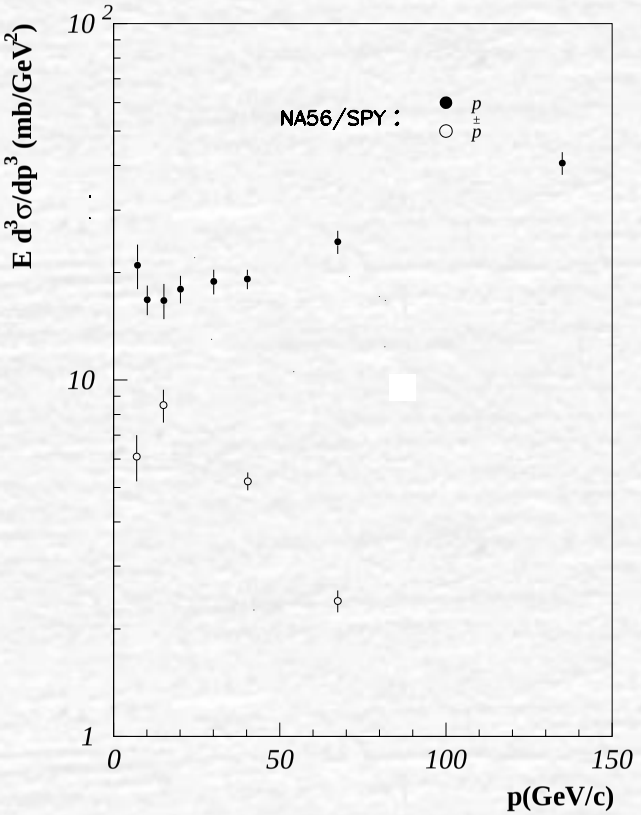
d are more copiously produced at high p_T

Systematics:

- ***Particle dependence of H6 transmission***
- ***Uncertainties in strange part. decays outside target***
- ***Empty target corr.***

NA56/SPY results on proton invariant cross sections

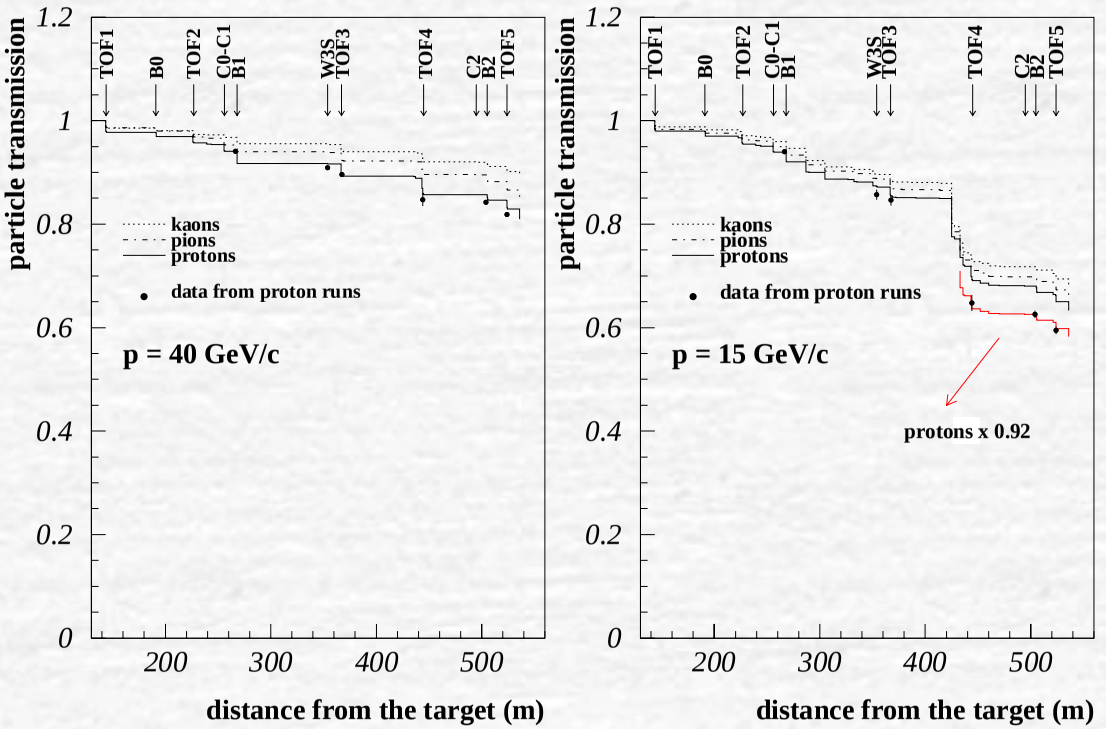




- **Model independent extrapolation to zero target thickness with data (L=100,200,300 mm targets)**
- **Total error 10 % (syst+stat)**

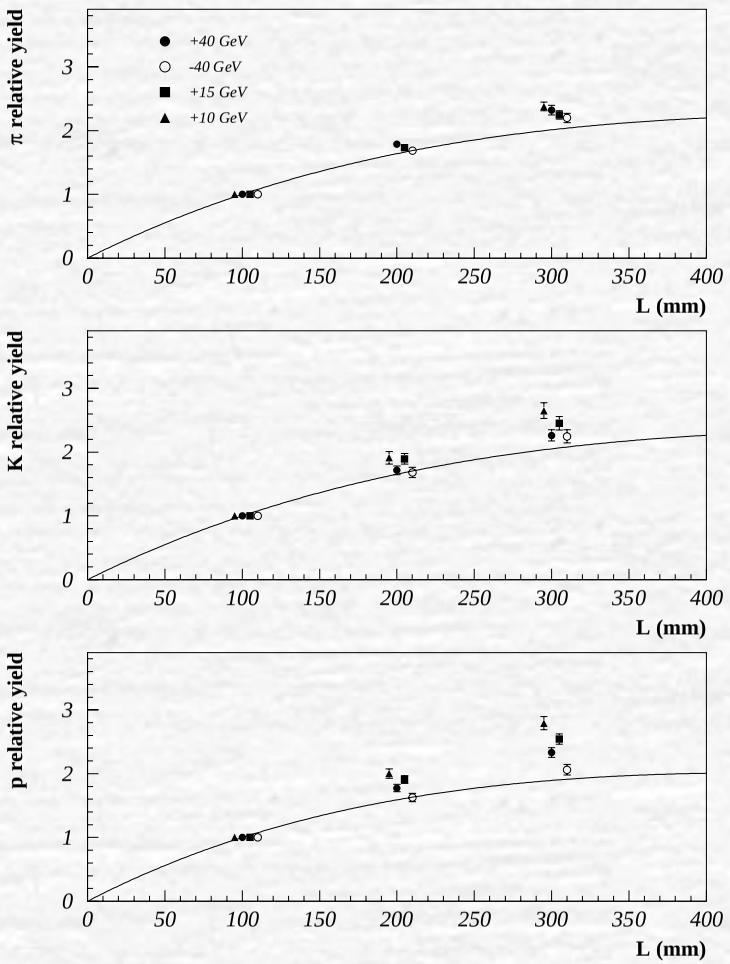
BMPT parametrization

Main points: to compute Yields and $Ed^3\sigma/dp^3$



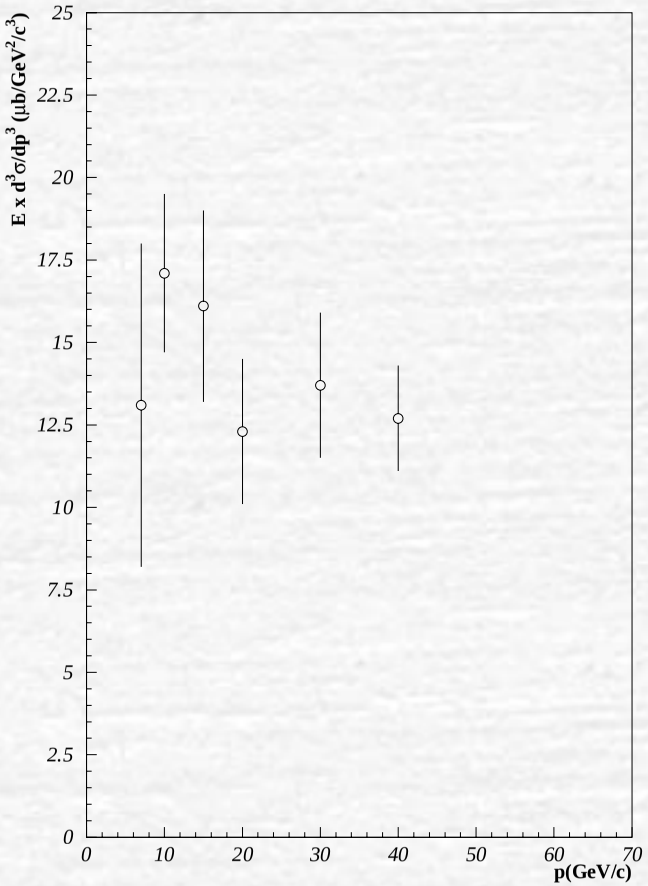
- *strange particle decays outside the target*
- *extrapolation to zero thickness target*
- *H6 beamline acceptance and transmission*

H6 beamline acceptance

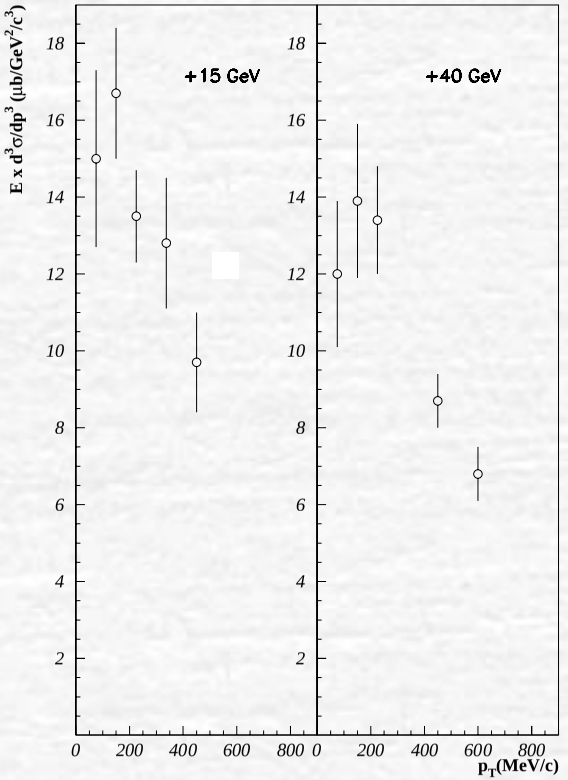


- *data were taken with different target lengths: 100, 200, 300 mm and shapes (slat/rods)*
- *so it was possible to extrapolate to L=0 mm in a model independent way*

deuteron invariant cross section



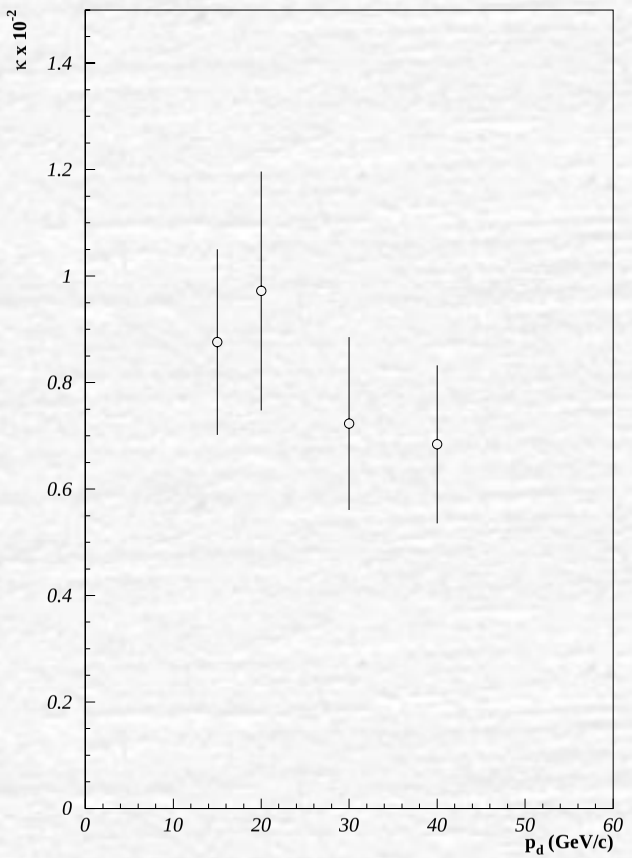
Angular scan



$(Ed^3\sigma/dp^3)_d = (d/p) * (Ed^3\sigma/dp^3)_p$

- *from measured d/p ratio*
- *published NA56/SPY p x-sections*
- *total errors ~12-15% (stat+syst)*

Coalescing model



- ***from forward measurements (p_T~0)***

$\kappa = \sigma_{in} (Ed^3\sigma/dp^3)_d / (Ed^3\sigma/dp^3)^2_p$

$= (0.79 +- 0.05 +- 0.13) \times 10^{-2}$

- ***to be compared with lower energy data (1.5 x10^{-2} V.V. Abramov et al Sov. J. Nucl. Phys. 45 (1987) 845)***
- ***and theor expectations: 4.6 x 10^{-2} (M.A. Braun and V.V. Vechermin Sov.J. Nucl. Phys. 36 (1983) 357)***
- ***no p_d^{-2} dependence seen***

Conclusions

- **d/p cross section ratio and d inv x-section measured in NA56/SPY** (exp mainly devoted to understanding of conventional neutrino beams)
- **Coalescing is not the dominant mechanism** in p+Be interactions at low p_T at variance with Pb+Pb collisions, d are mainly directly produced