LPCC

LHC Physics Centre at CERN

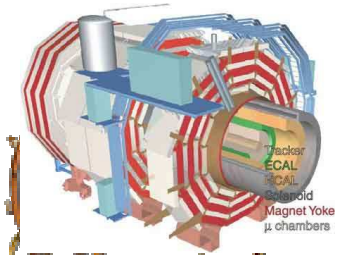
MB&UE Working Group Meeting

February 7 & 8, 2011

Kaons, Protons & Antiprotons

Rick Field

University of Florida



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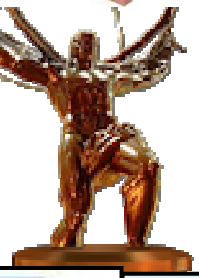
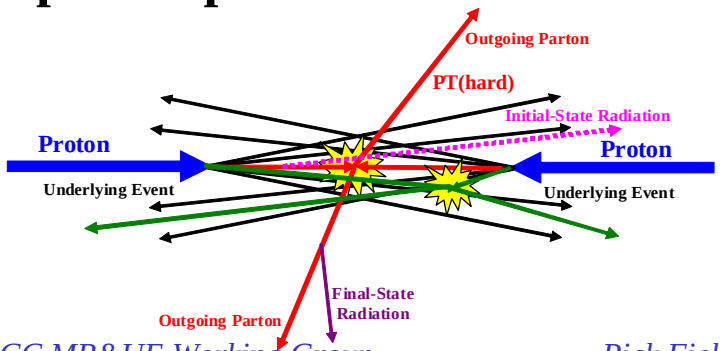


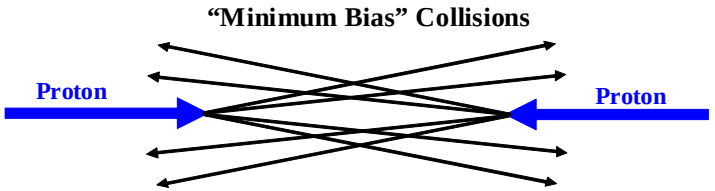
ATLAS

Outline of Talk

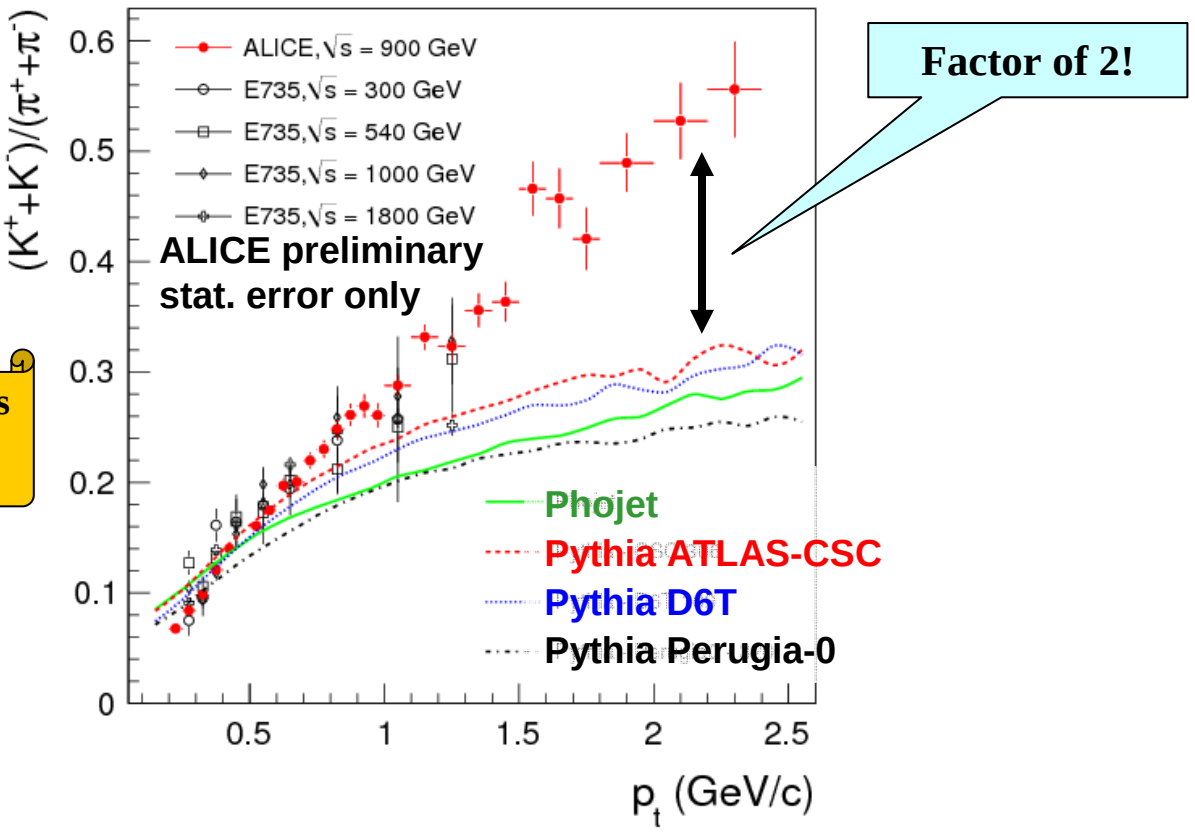
➡ **PYTHIA 6.4 Tune Z1: Charged kaon, proton, and antiproton production in min-bias collisions.**

➡ **PYTHIA 6.4 Tune Z1: Charged kaon, proton, and antiproton production in the underlying event.**





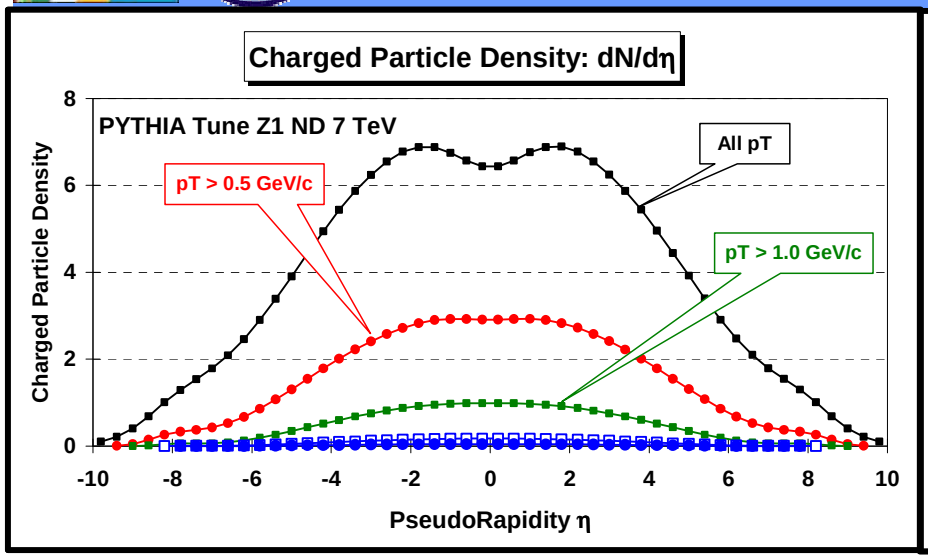
Strange Particle Production

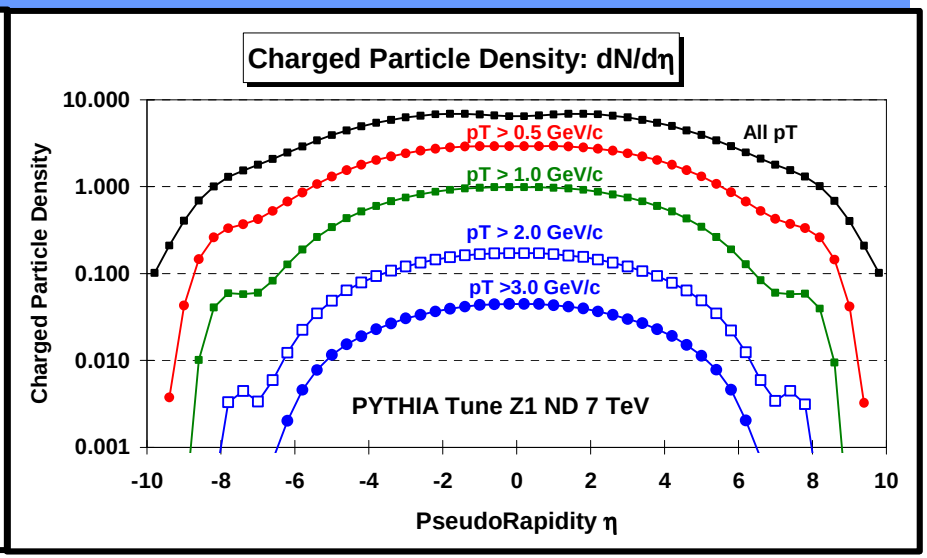


Jan Fiete Grosse-Oetringhaus
LPCC MB&UE Meeting
September 2010

- **A lot more strange mesons at large p_T than predicted by the Monte-Carlo Models!**
- **K/π ratio fairly independent of the center-of-mass energy.**

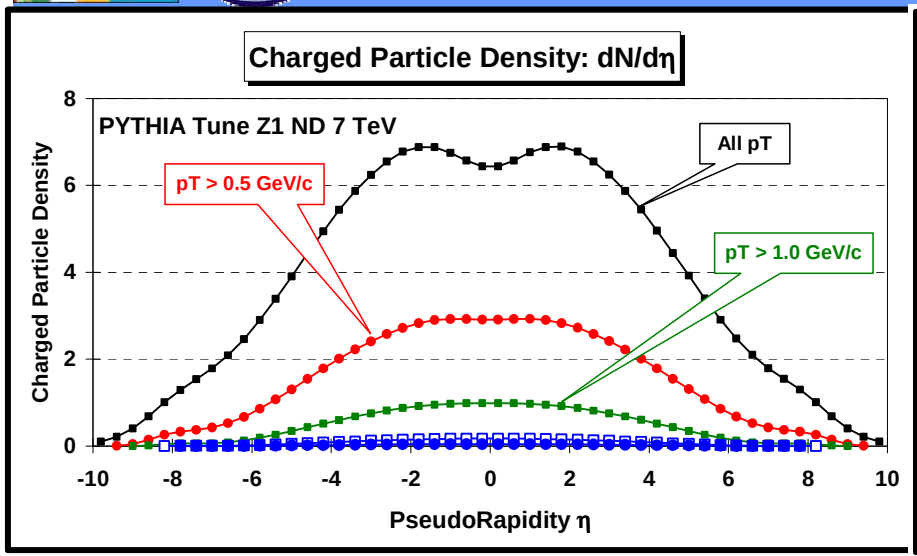
Charged Particle dN/dη 7 TeV

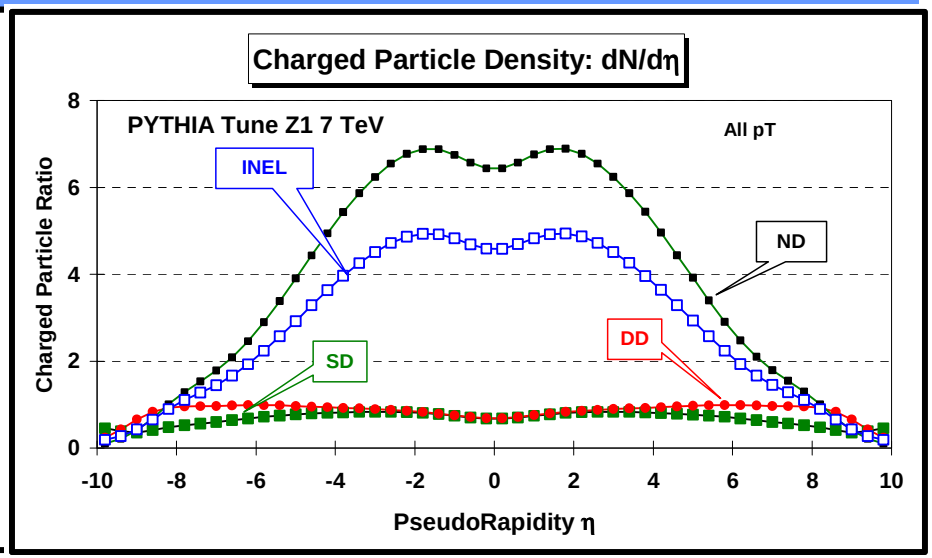




➡ **Charged particle (direct, including leptons) pseudorapidity distribution, dN/dη (ND), at 7 TeV for all p_T, p_T > 0.5 GeV/c, p_T > 1.0 GeV/c, p_T > 2.0 GeV/c, and p_T > 3.0 GeV/c from Tune Z1.**

Charged Particle dN/dη 7 TeV





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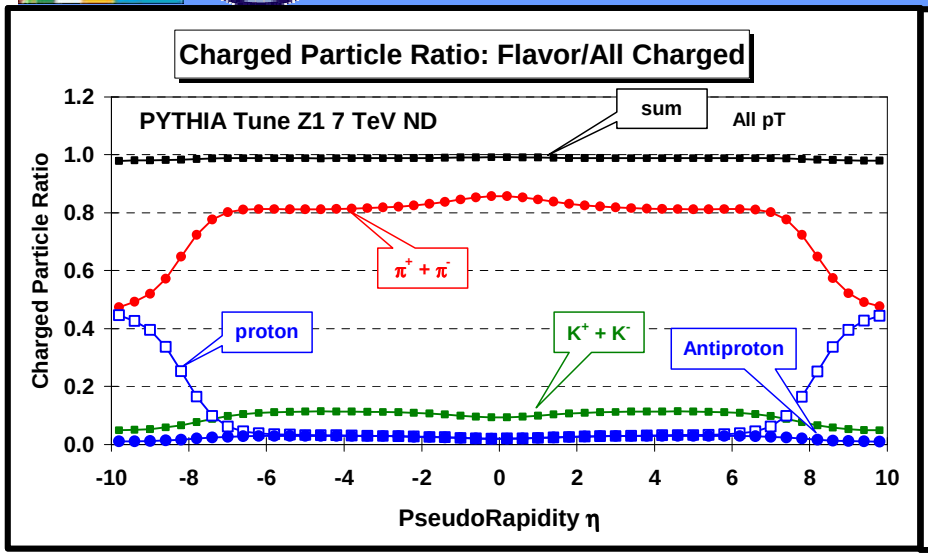
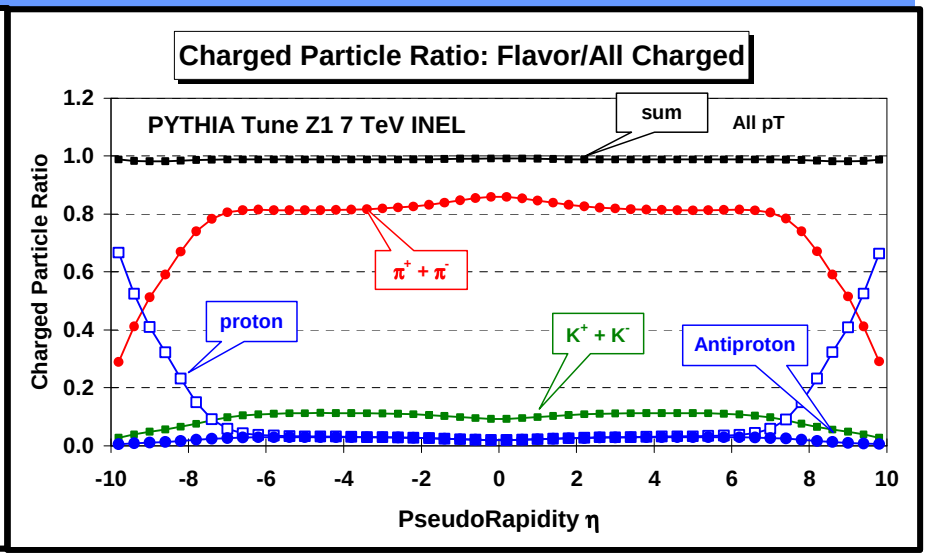
- **Charged particle (direct, including leptons) pseudorapidity distribution, dN/dη, at 7 TeV for all p_T from Tune Z1. Shows the individual contributions from ND, SD, DD, and INEL = ND + SD + DD.**

Charged Particle dN/dη 7 TeV





- **Charged particle ratios versus η at 7 TeV (ND all p_T). Shows ($\pi^+ + \pi^-$)/(all charged), ($K^+ + K^-$)/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.**

- **Charged particle ratios versus η at 7 TeV (INEL = ND + SD +DD all p_T). Shows ($\pi^+ + \pi^-$)/(all charged), ($K^+ + K^-$)/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.**

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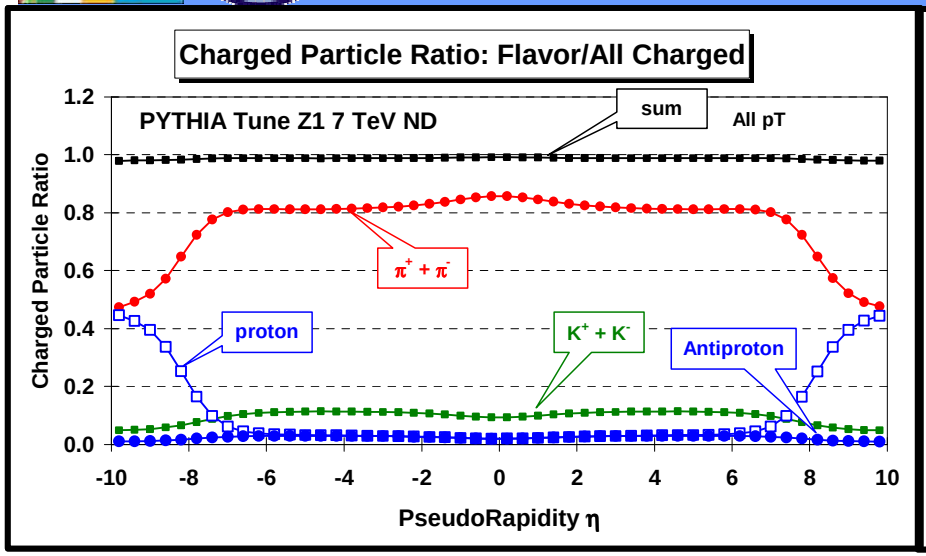

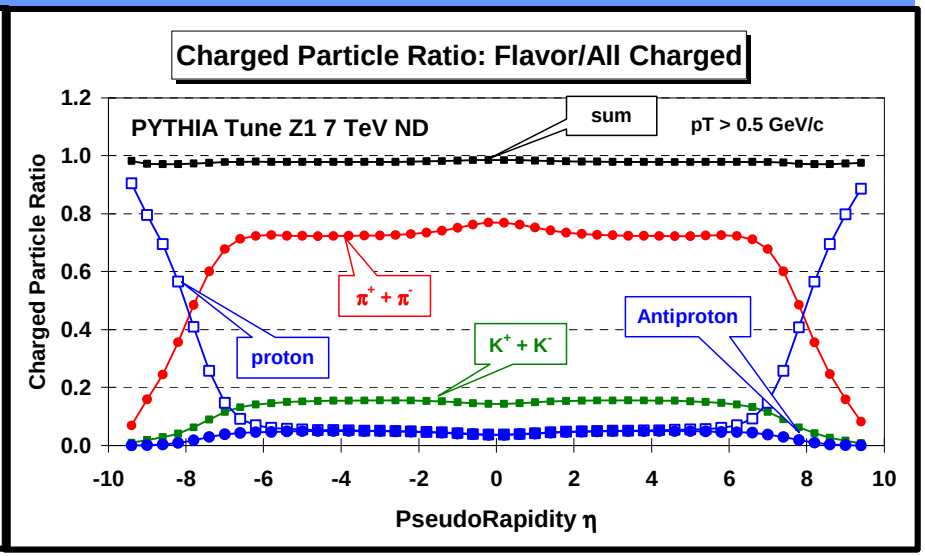

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- **Charged particle ratios versus η at 7 TeV (ND $p_T > 0.5$ GeV/c). Shows ($\pi^+ + \pi^-$)/(all charged), ($K^+ + K^-$)/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.**

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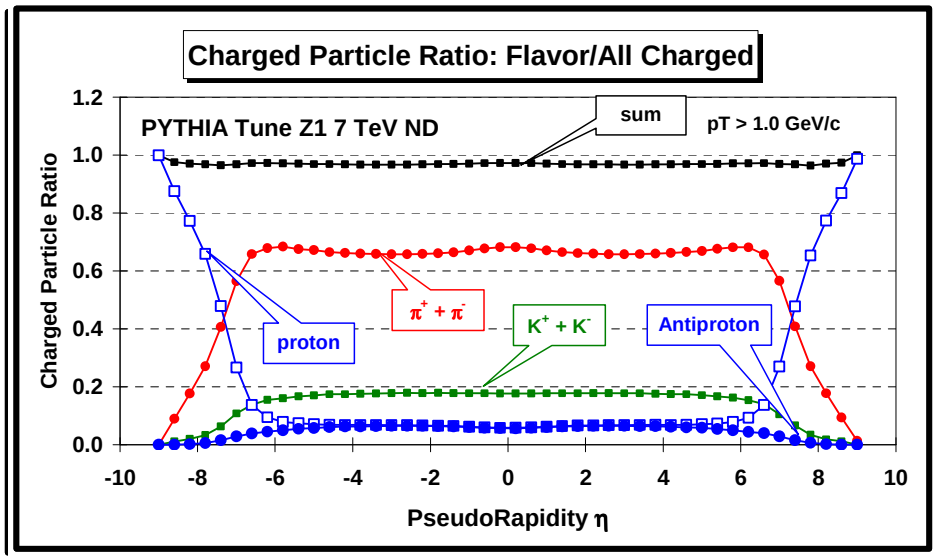

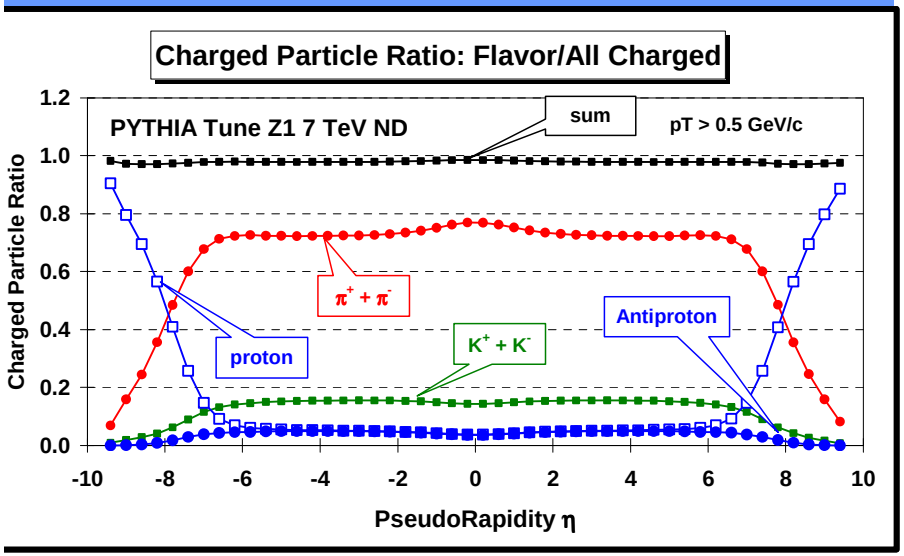

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- **Charged particle ratios versus η at 7 TeV (ND $p_T > 1.0$ GeV/c). Shows ($\pi^+ + \pi^-$)/(all charged), ($K^+ + K^-$)/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.**

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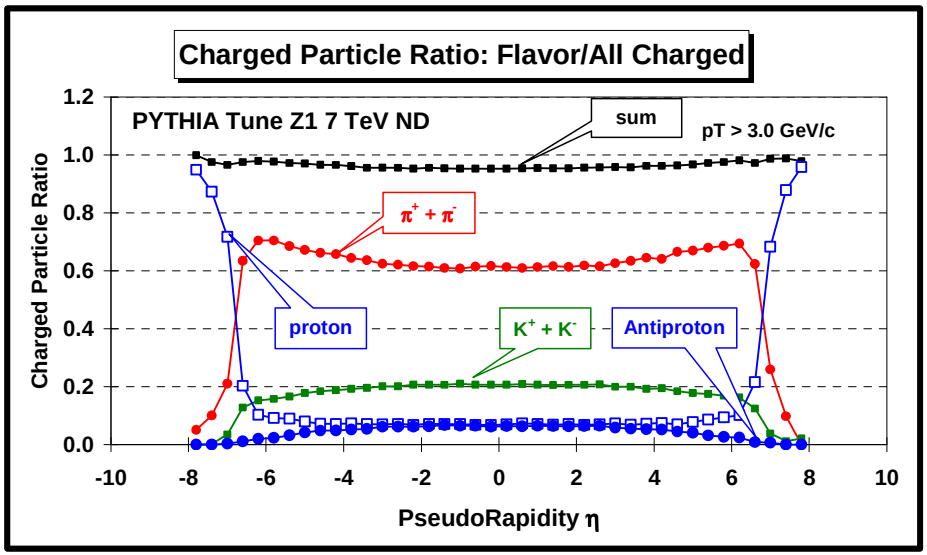

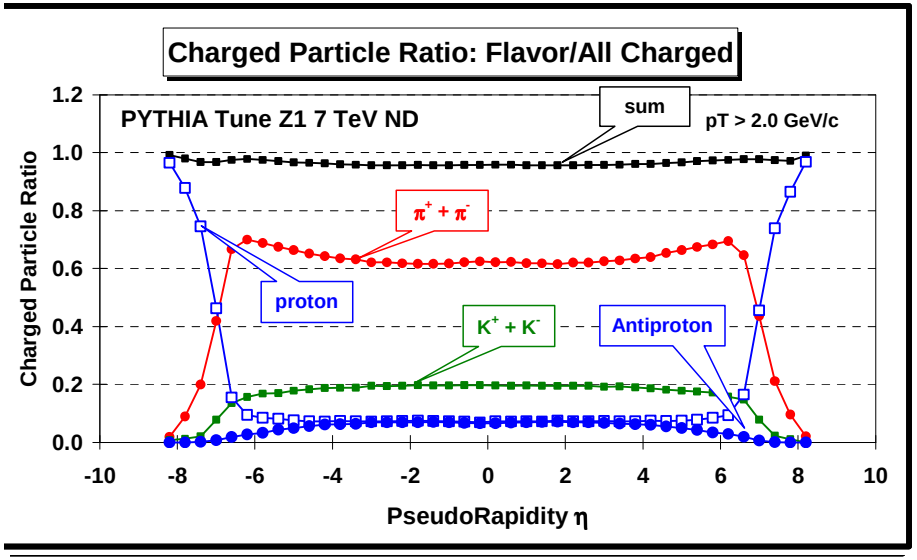

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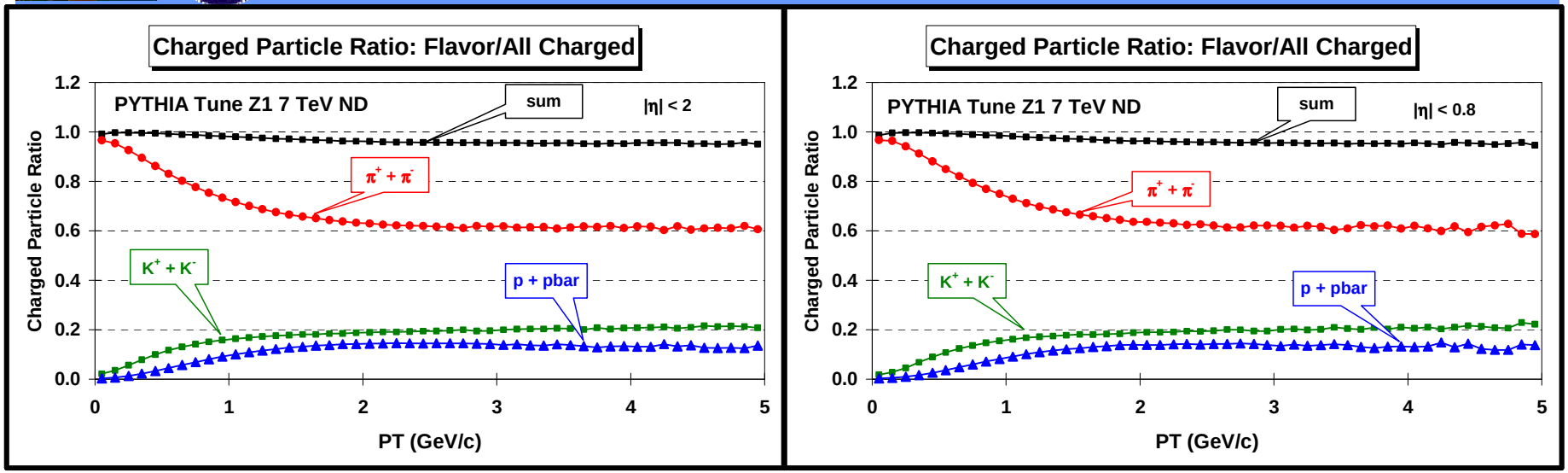
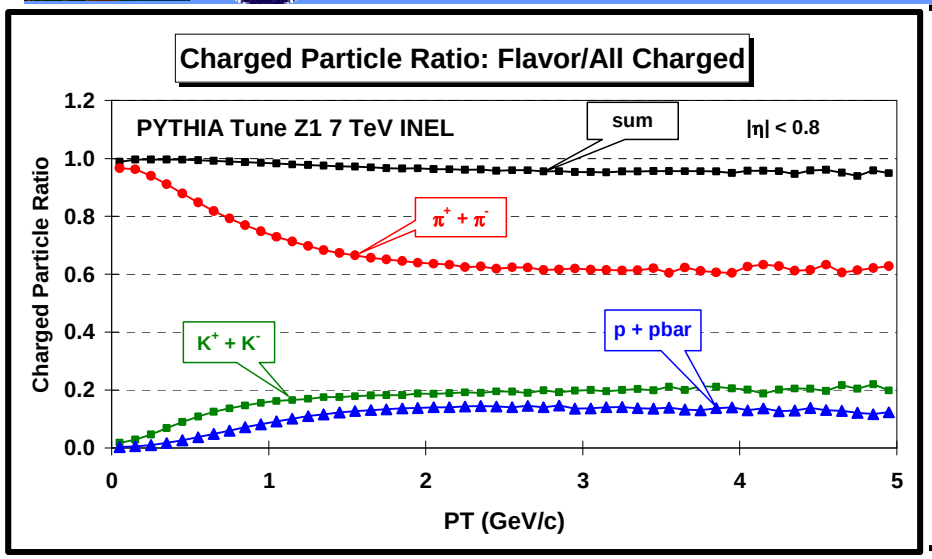
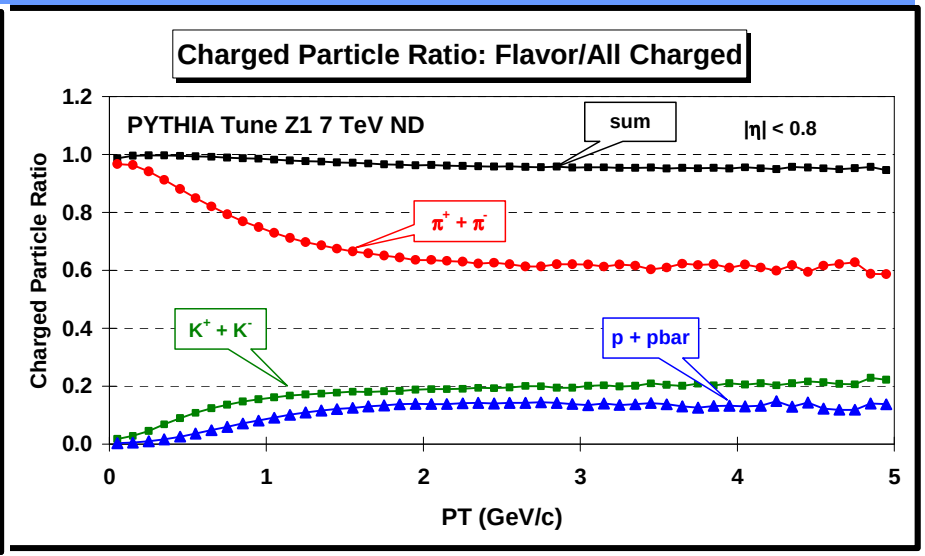
Charged Particle Ratios



- **Charged particle ratios versus p_T at 7 TeV (ND $|\eta| < 2$). Shows $(\pi^+ + \pi^-)$/(all charged), $(K^+ + K^-)$/(all charged), (p + pbar)/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p +$ pbar.**
- **Charged particle ratios versus p_T at 7 TeV (ND $|\eta| < 0.8$). Shows $(\pi^+ + \pi^-)$/(all charged), $(K^+ + K^-)$/(all charged), (p + pbar)/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p +$ pbar.**

Charged Particle Ratios





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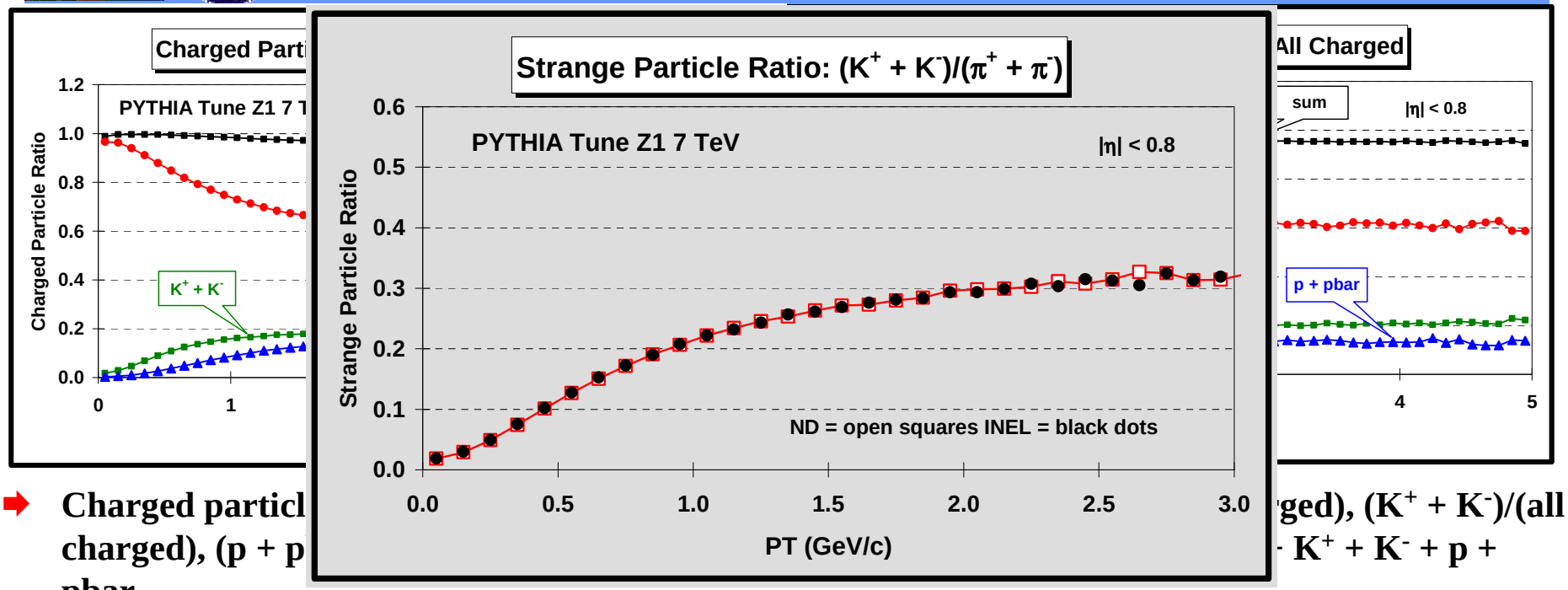

- Charged particl … ged), $(K^+ + K^-)$/(all charged), (p + p … $K^+ + K^-$ + p + pbar.
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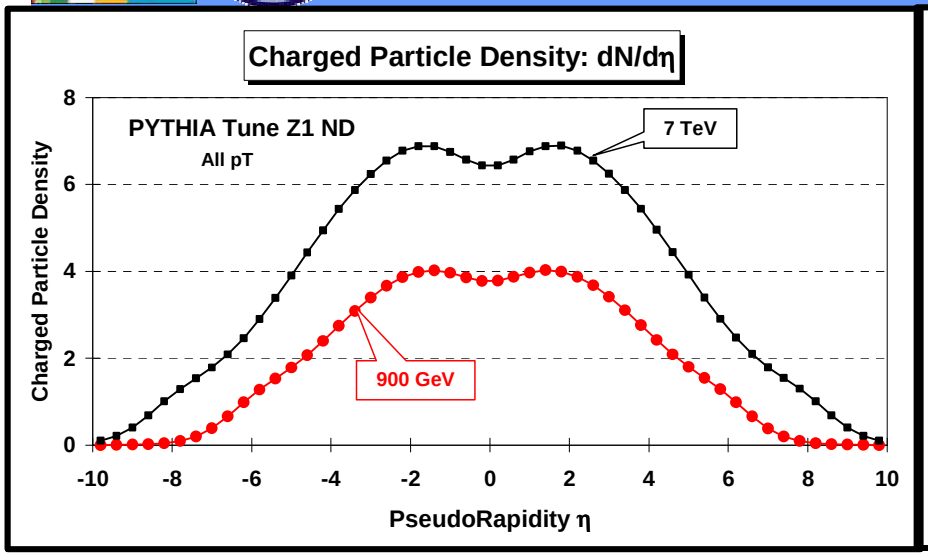

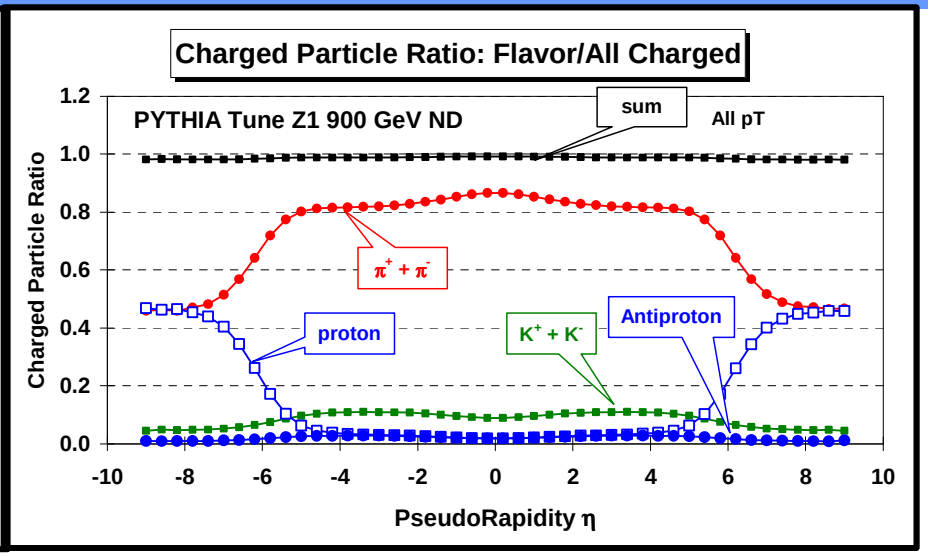

- **Charged particle (direct, including leptons) pseudorapidity distribution, dN/dη (ND all pT), at 7 TeV and 900 GeV from Tune Z1.**
- **Charged particle ratios versus η at 900 GeV (ND all p_T). Shows $(\pi^+ + \pi^-)$/(all charged), $(K^+ + K^-)$/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.**

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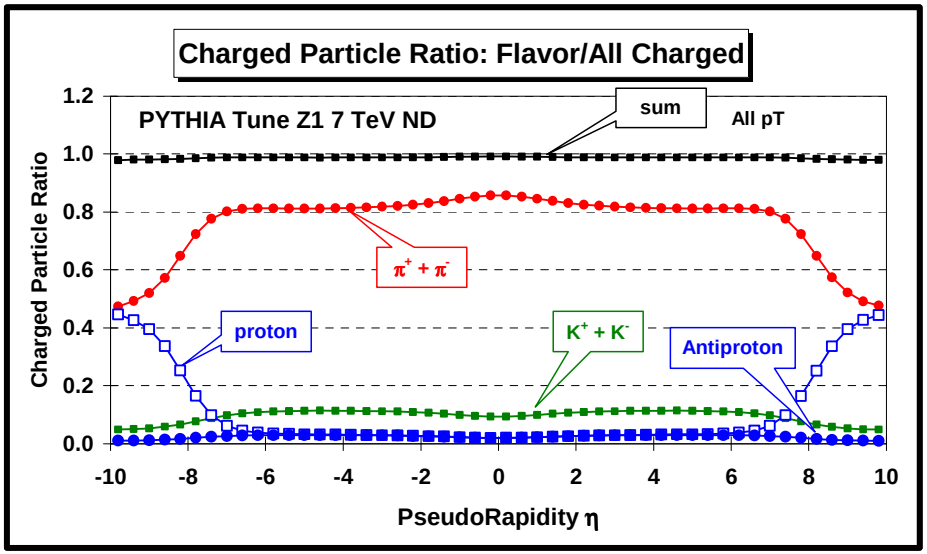

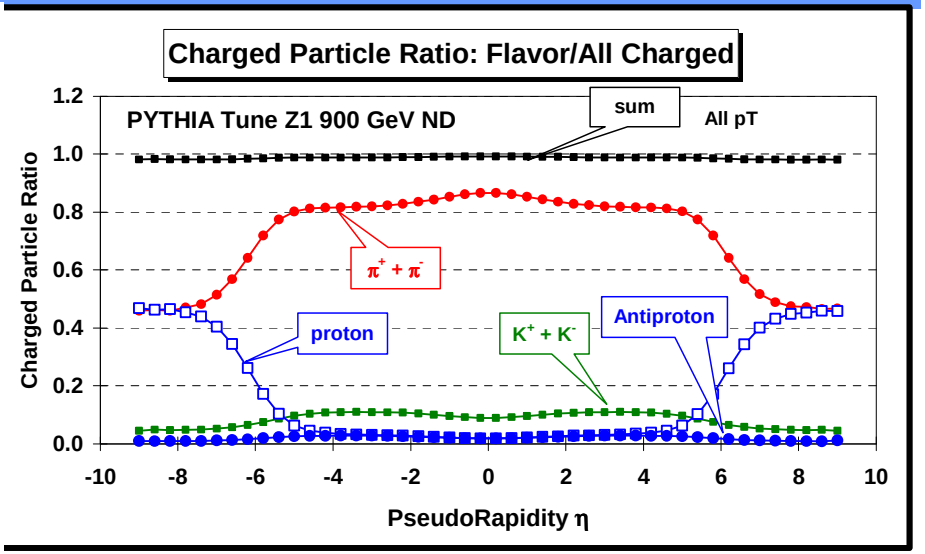

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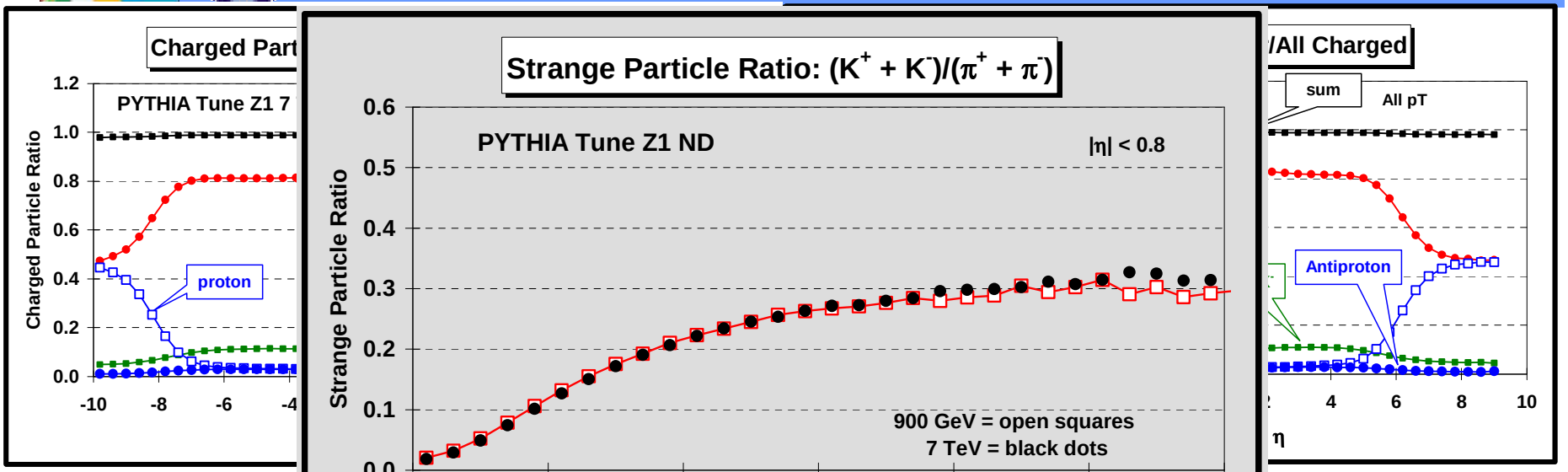
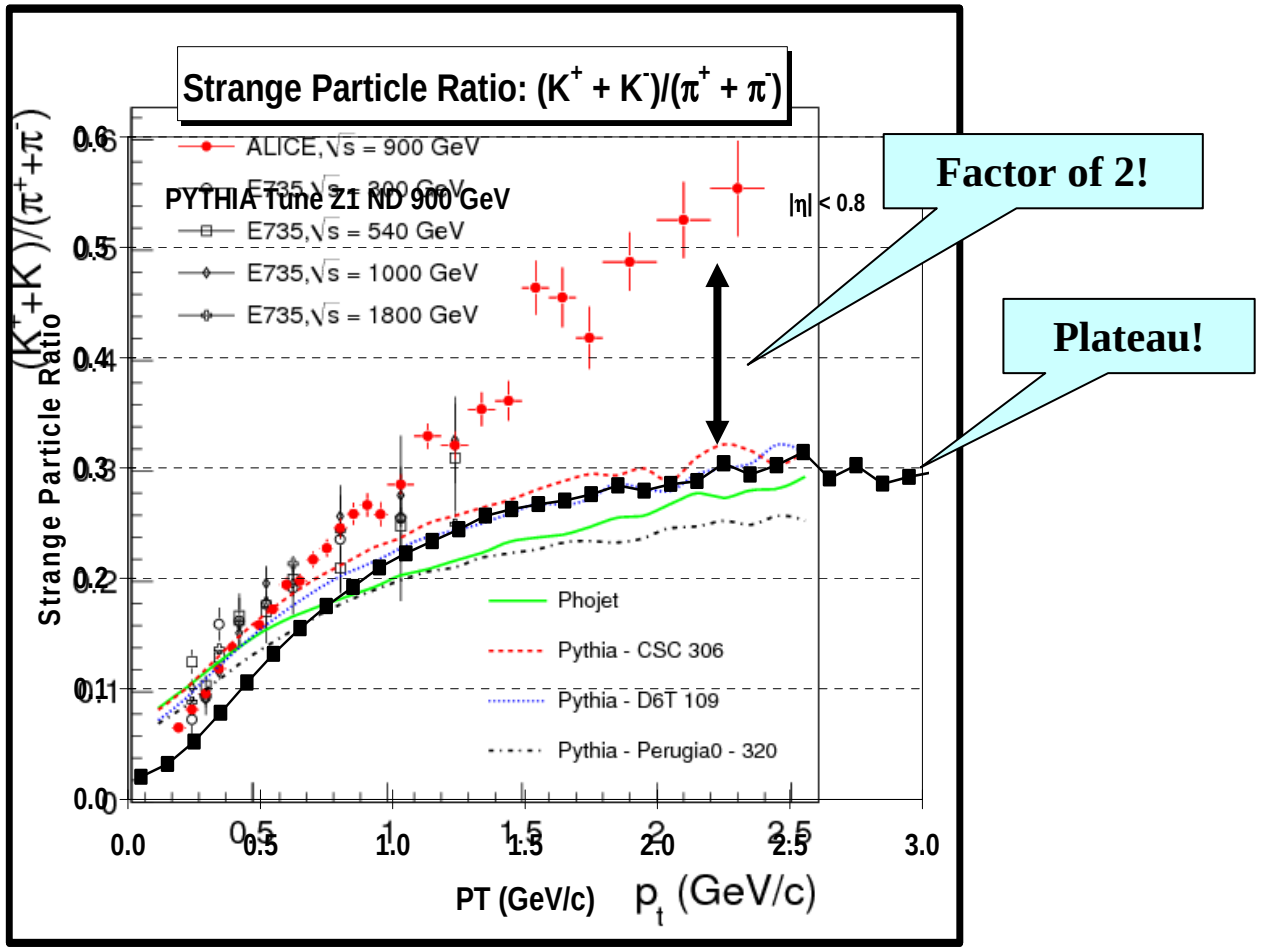


- Charged parti … η (ND all pT), at 7 TeV and 900 G

- Charged particle ratios versus η at 900 GeV (ND all p_T). Shows $(\pi^+ + \pi^-)$/(all charged), $(K^+ + K^-)$/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.

- Charged particle ratios versus η at 7 TeV (ND all p_T). Shows $(\pi^+ + \pi^-)$/(all charged), $(K^+ + K^-)$/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.

Strange Particle Production



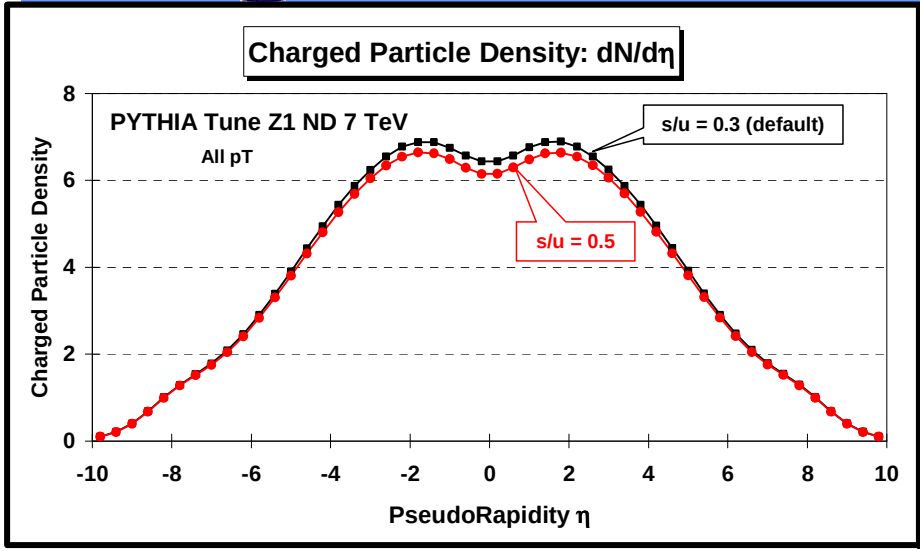
➡ **A lot more strange mesons at large p_T than predicted by the Monte-Carlo Models and a different shape of the curve!**

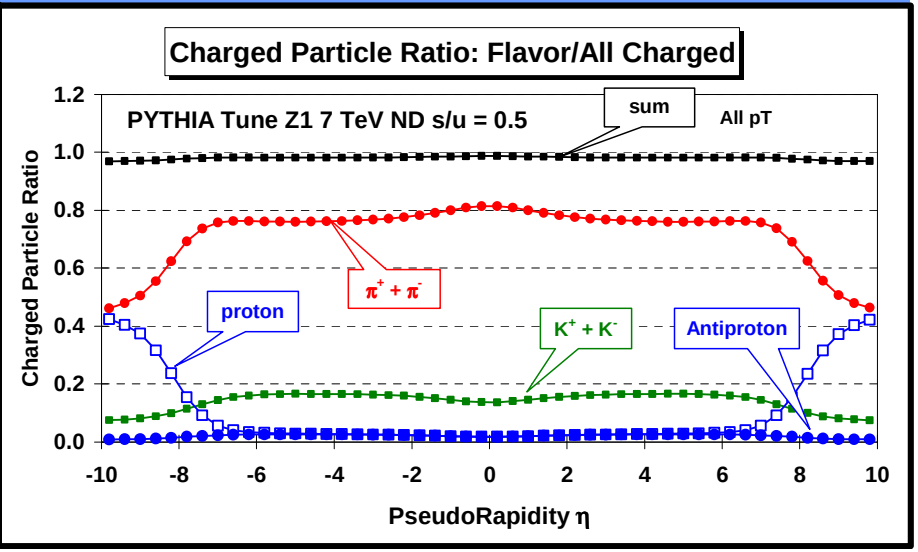
PYTHIA Fragmentation Parameters

- **PARJ(1) : (D = 0.10) is P(qq)/P(q), the suppression of diquark-antidiquark pair production in the colour field, compared with quark–antiquark production.**
- **PARJ(2) : (D = 0.30) is P(s)/P(u), the suppression of s quark pair production in the field compared with u or d pair production.**
- **PARJ(3) : (D = 0.4) is (P(us)/P(ud))/(P(s)/P(u)), the extra suppression of strange diquark production compared with the normal suppression of strange quarks.**
- **PARJ(4) : (D = 0.05) is (1/3)P(ud1)/P(ud0), the suppression of spin 1 diquarks compared with spin 0 ones (excluding the factor 3 coming from spin counting).**

Look at the affect of changing PARJ(2) from 0.3 to 0.5!

Charged Particle Ratios





- **Charged particle (direct, including leptons) pseudorapidity distribution, dN/dη (ND all pT), at 7 TeV for PARJ(2) = s/u = 0.3 (default) and PARJ(2) = s/u = 0.5 from Tune Z1.**
- **Charged particle ratios versus η at 7 TeV (ND all p_T) with PARJ(2) = s/u = 0.3 (default) and PARJ(2) = s/u = 0.5 from Tune Z1. Shows ($\pi^+ + \pi^-$)/(all charged), ($K^+ + K^-$)/(all charged), proton/(all charged), antiproton/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.**

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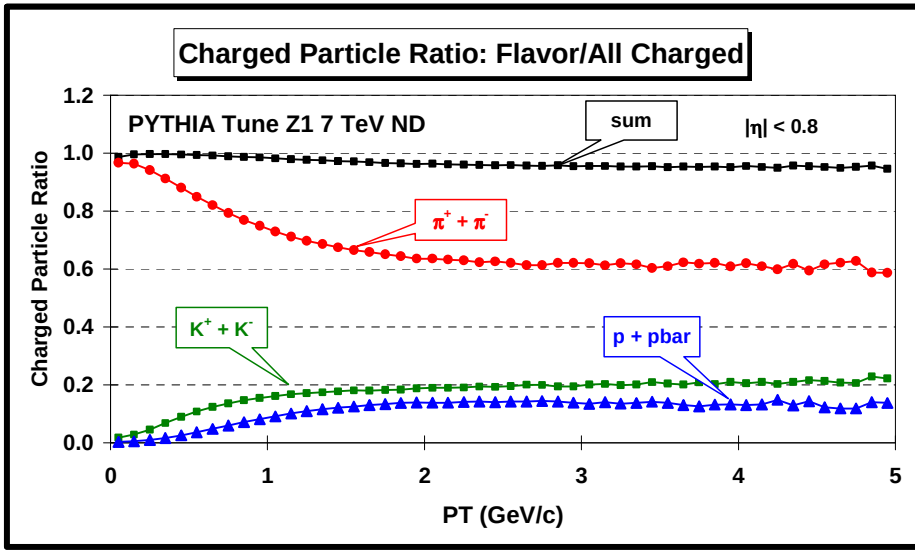

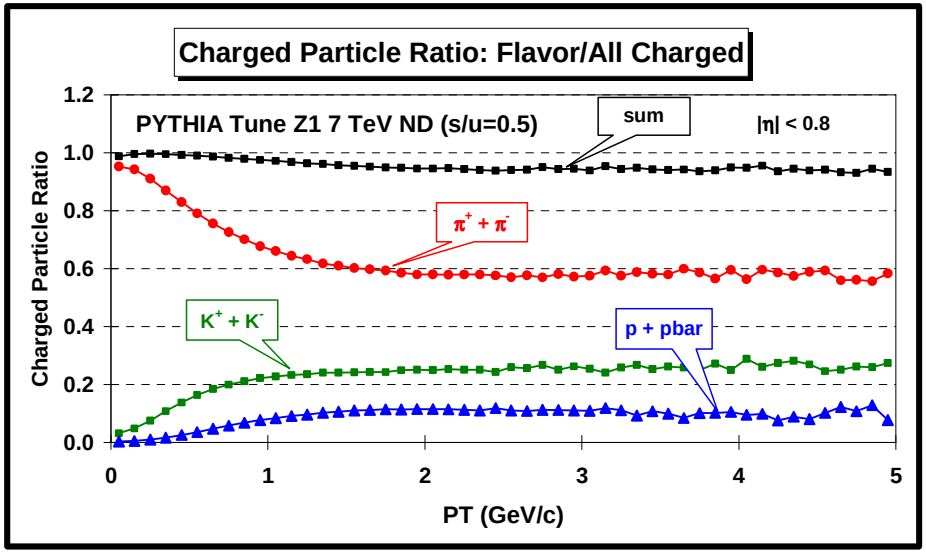

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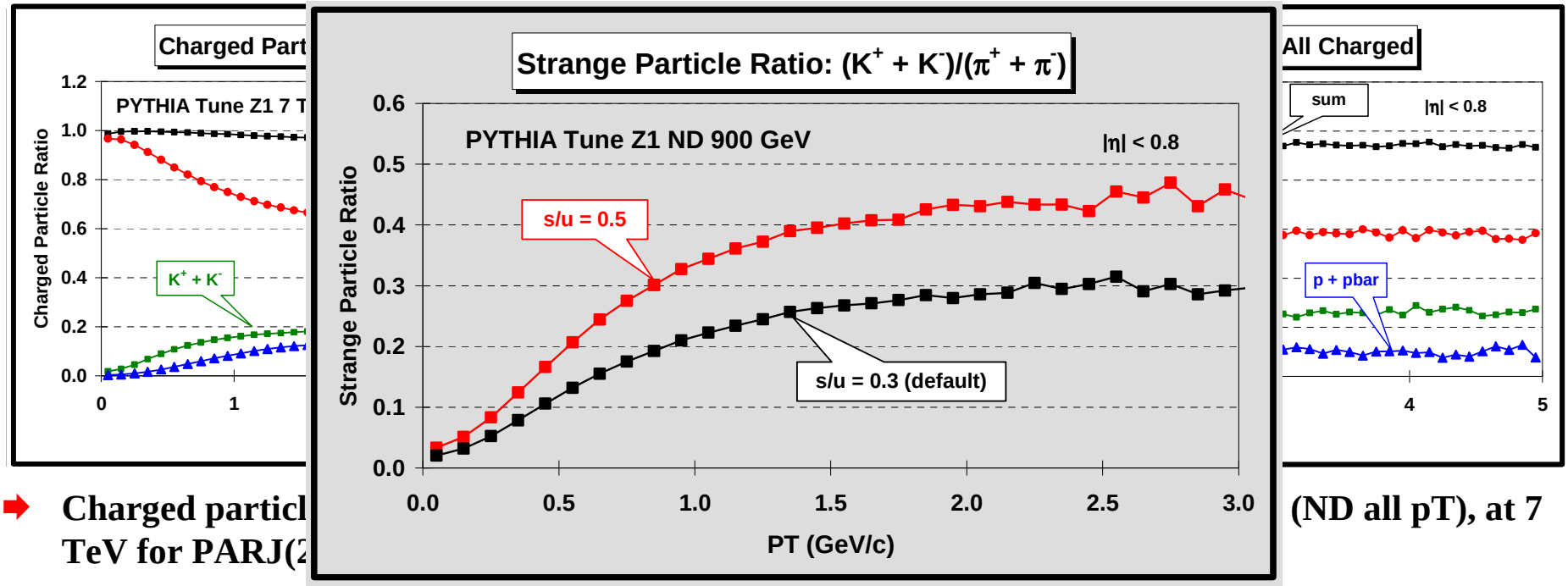
- **Charged particle ratios versus p_T at 7 TeV (ND $|\eta| < 0.8$) with PARJ(2) = s/u = 0.3 (default) and PARJ(2) = s/u = 0.5 from Tune Z1. Shows ($\pi^+ + \pi^-$)/(all charged), ($K^+ + K^-$)/(all charged), (p + pbar)/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- + p + pbar$.**

Charged Particle Ratios



- Charged particl (ND all pT), at 7 TeV for PARJ(2

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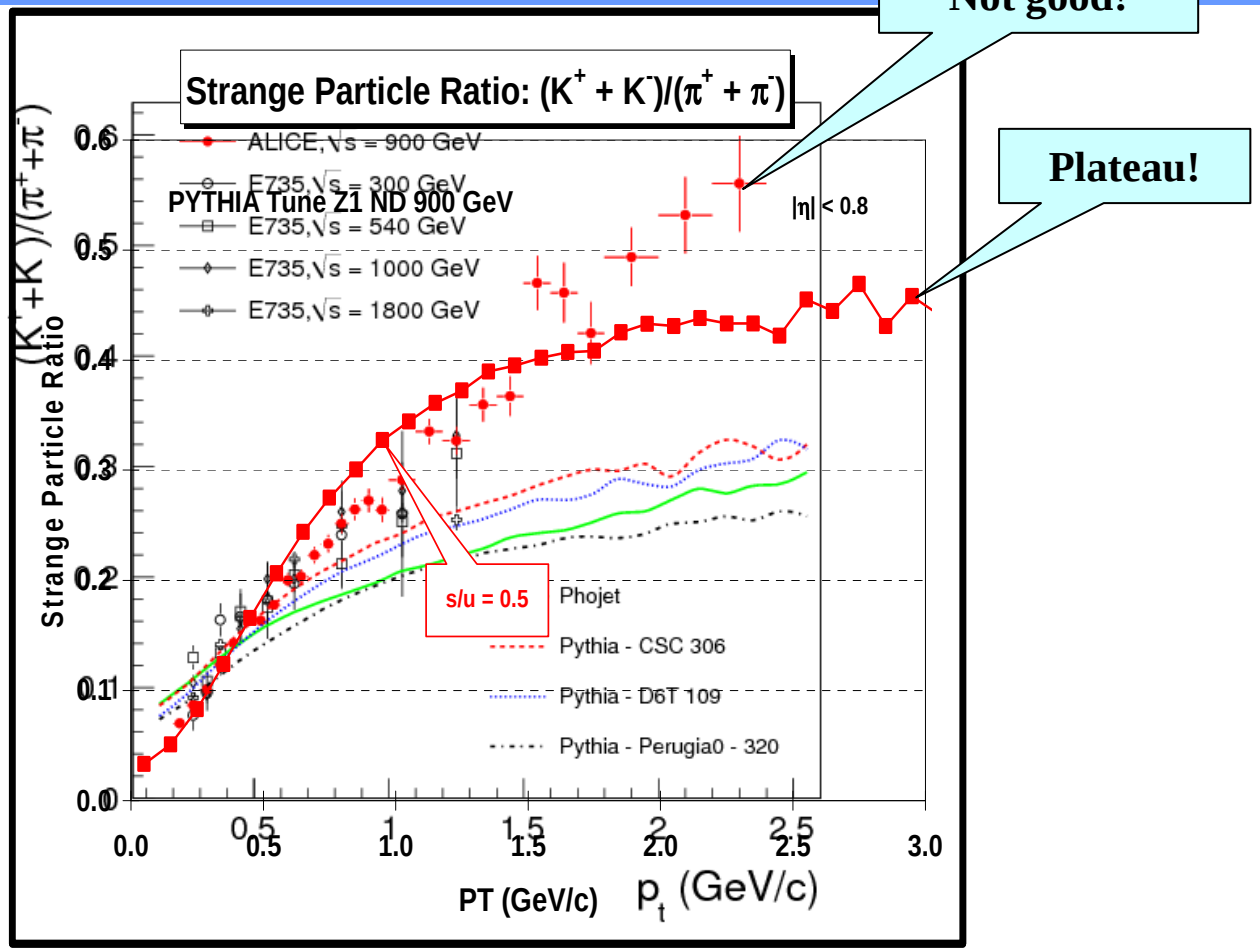
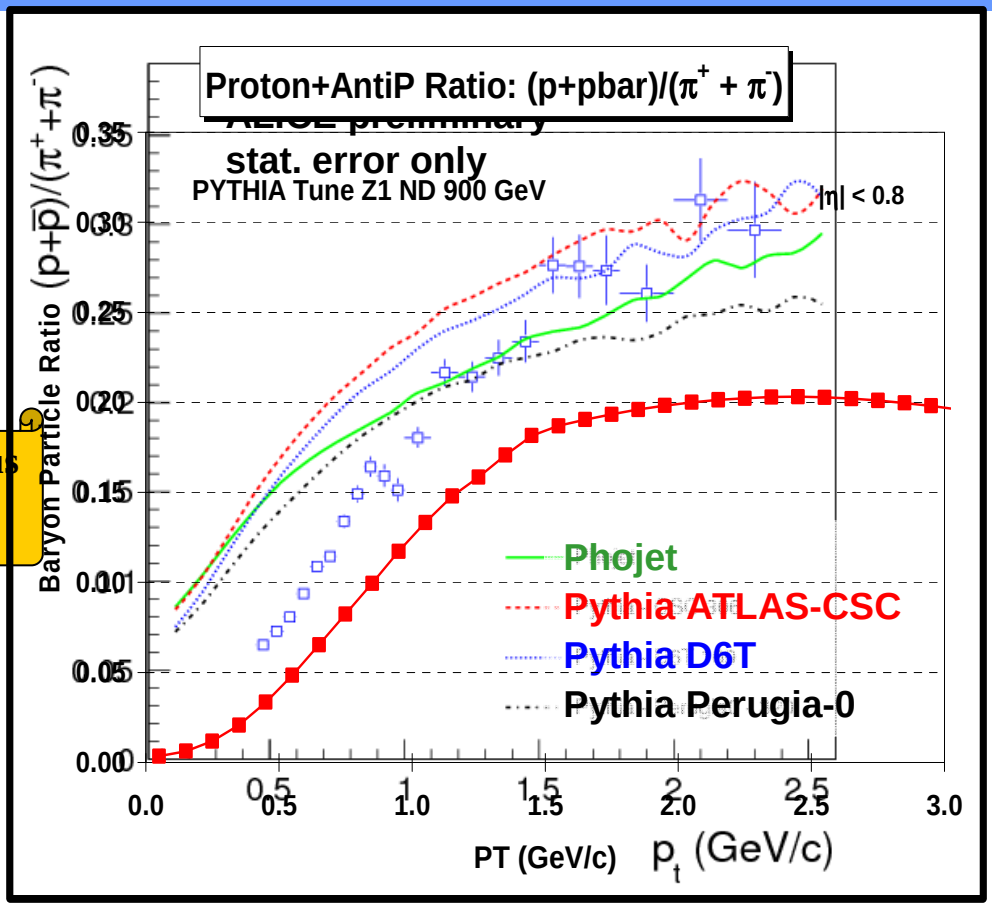
Strange Particle Production



- **A lot more strange mesons at large p_T than predicted by the Monte-Carlo Models and a different shape of the curve!**

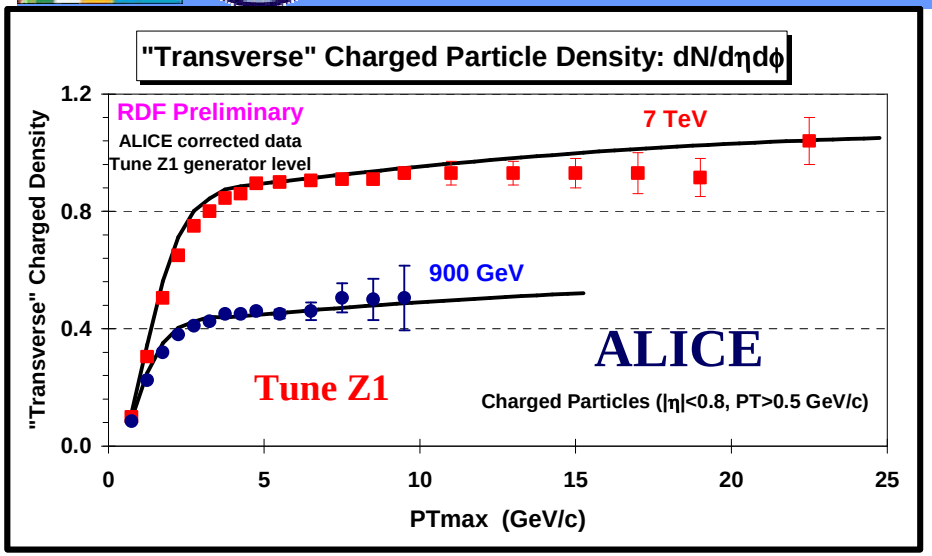
Protons & Antiprotons

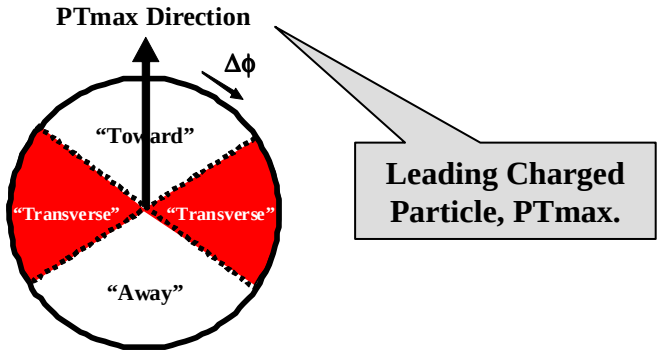


Jan Fiete Grosse-Oetringhaus
LPCC MB&UE Meeting
September 2010

➡ **Tune Z1 (ND) does not get this right either and this curve does not depend on PARJ(2)!**

The Underlying Event



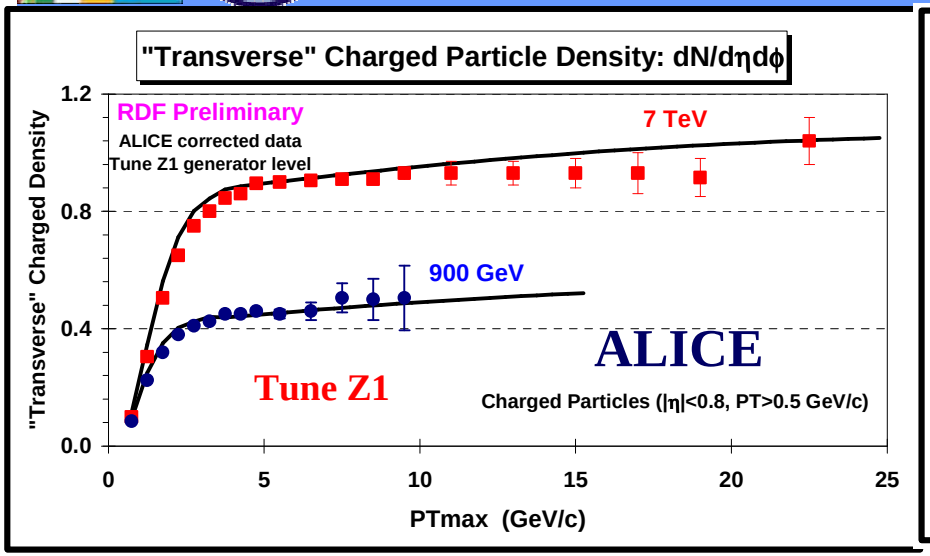


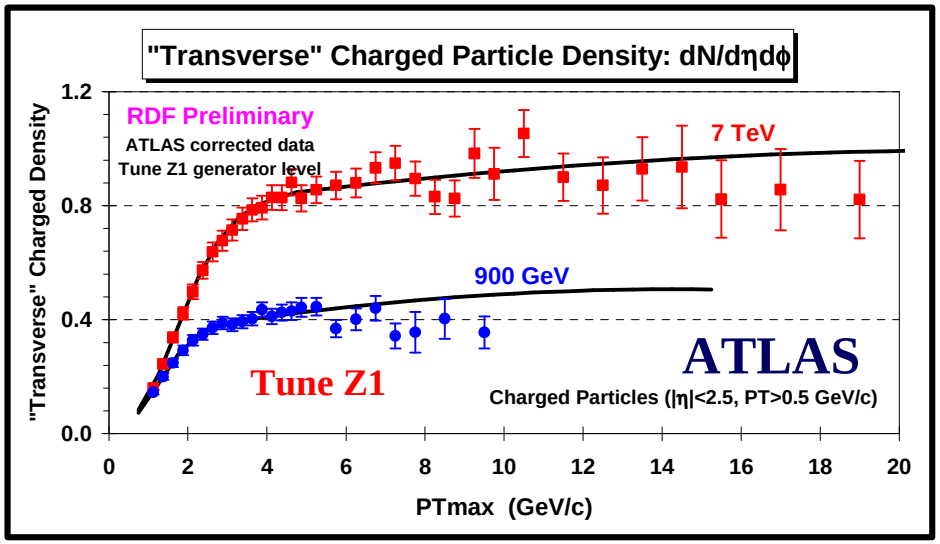
- **ALICE preliminary data at 900 GeV and 7 TeV on the "transverse" charged particle density, dN/dηdϕ, as defined by the leading charged particle (PTmax) for charged particles with $p_T > 0.5$ GeV/c and $|\eta| < 0.8$. The data are corrected and compared with PYTHIA Tune Z1 at the generator level.**

I read the points off with a ruler!

ALICE UE Data: Talk by S. Vallero
MPI@LHC 2010 Glasgow, Scotland
November 30, 2010

The Underlying Event





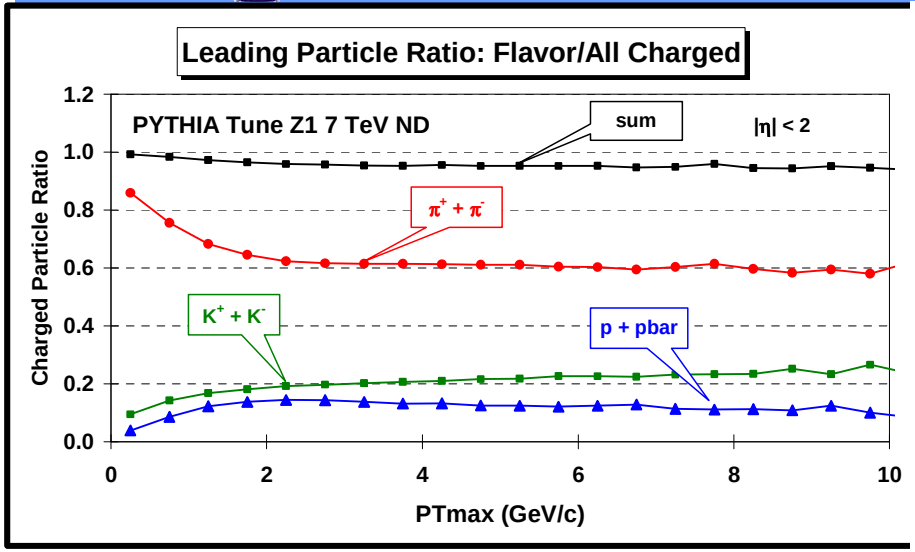
- **ALICE preliminary data at 900 GeV and 7 TeV on the "transverse" charged particle density, dN/dηdϕ, as defined by the leading charged particle (PTmax) for charged particles with $p_T > 0.5$ GeV/c and $|\eta| < 0.8$. The data are corrected and compared with PYTHIA Tune Z1 at the generator level.**

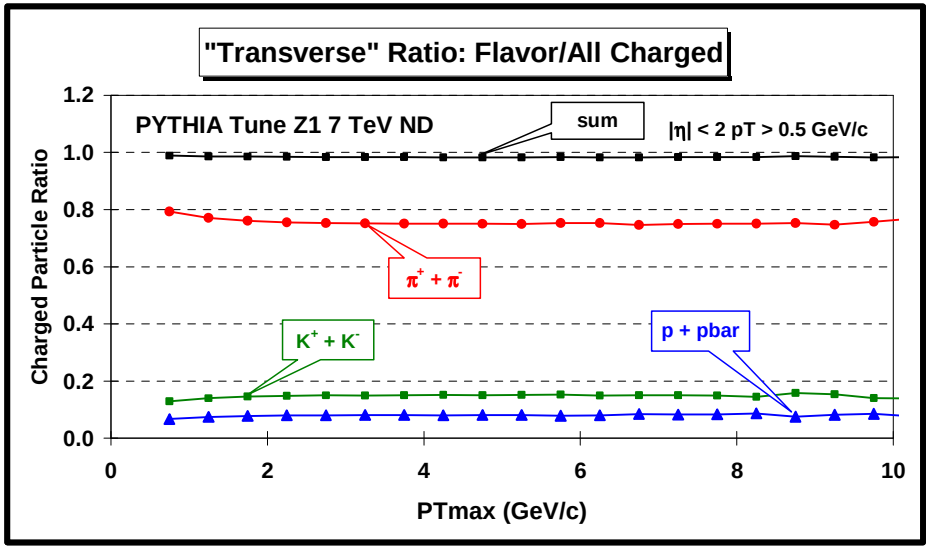
- **ATLAS preliminary data at 900 GeV and 7 TeV on the "transverse" charged PTsum density, dPT/dηdϕ, as defined by the leading charged particle (PTmax) for charged particles with $p_T > 0.5$ GeV/c and $|\eta| < 2.5$. The data are corrected and compared with PYTHIA Tune Z1 at the genererator level.**

I read the points off with a ruler!

ATLAS Note: ATLAS-CONF-2010-029
May 29, 2010

"Transverse" Particle Ratios





- **Leading charged particle ratios versus p_T at 7 TeV ($|\eta| < 2.0$). Shows $(\pi^+ + \pi^-)$/(all charged), $(K^+ + K^-)$/(all charged), (p + pbar)/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- +$ p + pbar.**

- **Charged particle ratios in the "transverse" region ($p_T > 0.5$ GeV/c, $|\eta| < 2.0$) versus the leading charged particle, PTmax, at 7 TeV. Shows $(\pi^+ + \pi^-)$/(all charged), $(K^+ + K^-)$/(all charged), (p + pbar)/(all charged), and sum/(all charged), where sum = $\pi^+ + \pi^- + K^+ + K^- +$ p + pbar.**

Summary

- **So far no luck at fitting the min-bias charged kaon to charged pion ratio. Increasing s/u produces more strange particles, but the shape of the curve versus p_T is different! But I am just getting started at this!**
- **Also not getting the protons + antiprotons right. Changing PARJ(2) does nothing here! Must check out some of the other parameters**
- **The Monte-Carlo models are constrained by LEP data. Must make sure that I do not destroy the agreement with the LEP data!**
- **We need a better understanding and modeling of diffraction!**