PHY397K - NUCLEAR PHYSICS - 6

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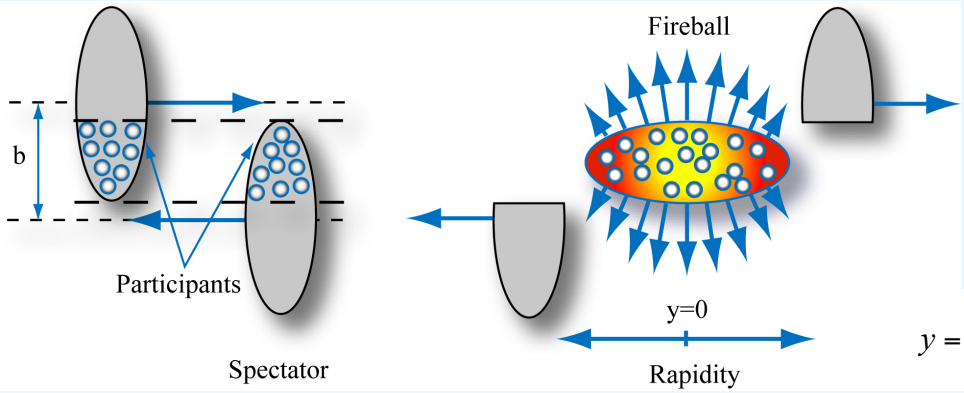
Spring 2015, Unique numbers: 57115
RLM 5.116, TTH 12:30 - 2:00 pm

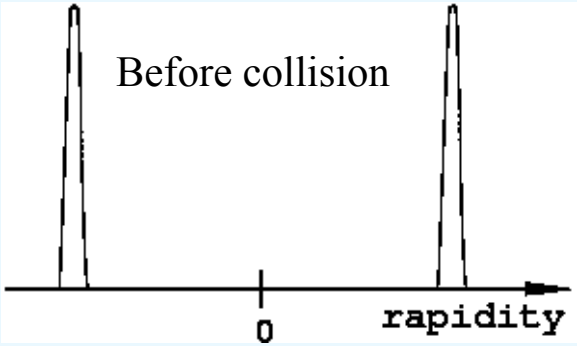
Christina Markert
Office: RLM: 10.305
Phone: 512 471 8834
Email: cmarkert@physics.utexas.edu

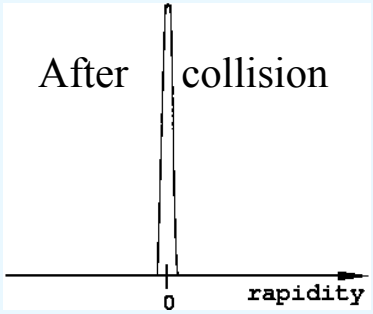
Spectators and Participants

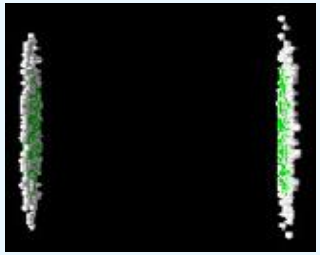


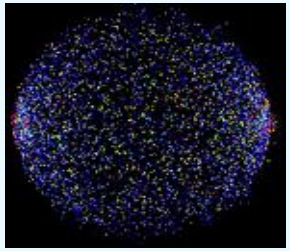
$$y = \frac{1}{2}\log\left(\frac{E + p_z}{E - p_z}\right)$$

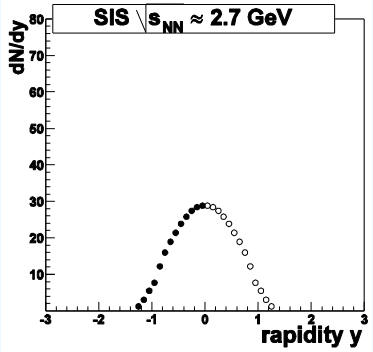
"Velocity" space

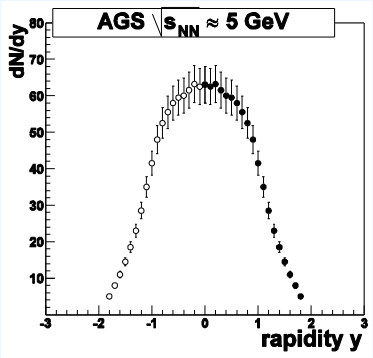


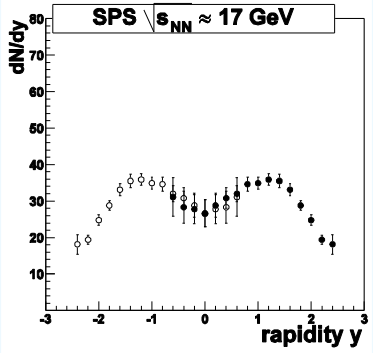








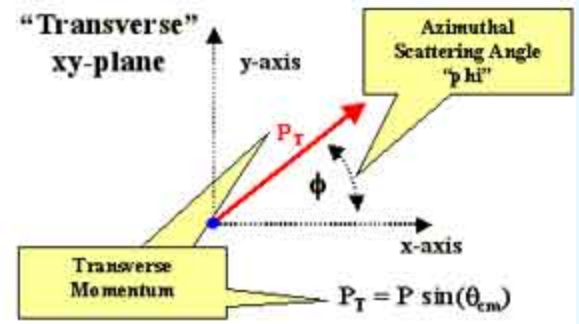


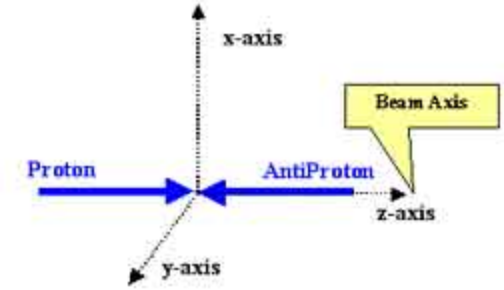


Kinematic Variables

Transverse momentum p_T:

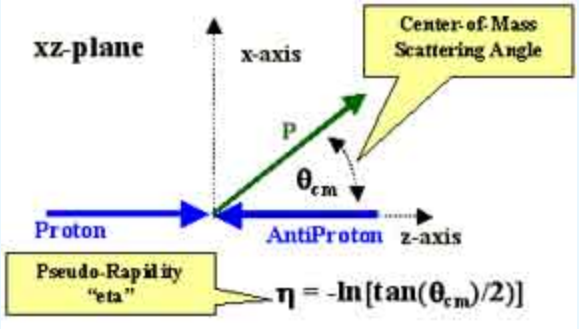
$$p_T = \sqrt{p_x^2 + p_y^2}$$





Rapidity y: (corresponds to longitudinal momentum)

$$y = \frac{1}{2}\log\left(\frac{E + p_L}{E - p_L}\right) \qquad \tanh(y) = p_L / E$$



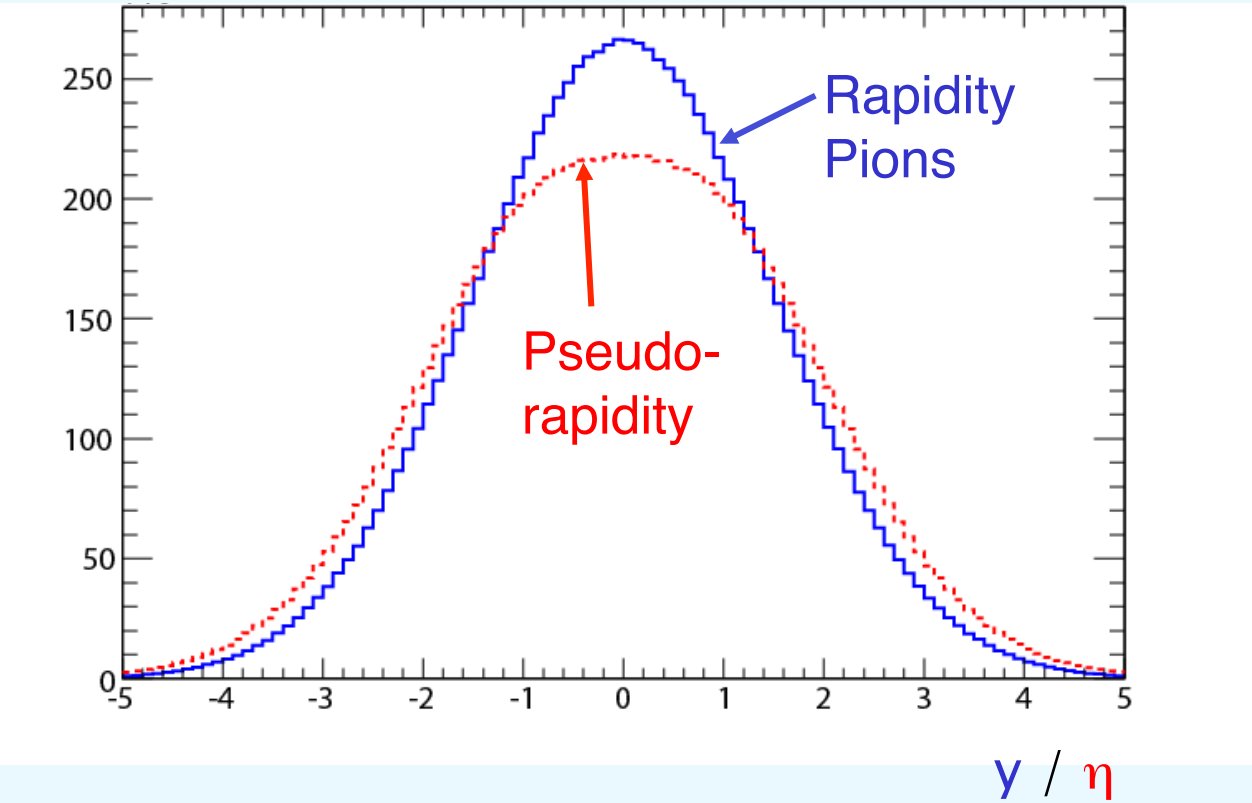
E= energy of particle
p_L = is the longitudinal momentum along the direction of the incident particle

The shape of a rapidity distribution is a invariant under boosts in the z-direction

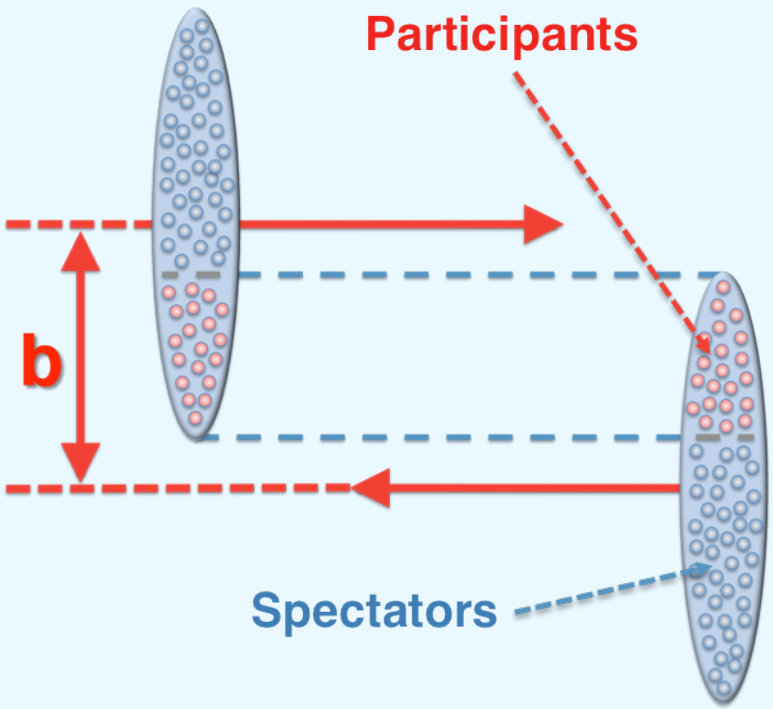
Accelerators: Relativistic heavy ion collisions

Beschleuniger	Ort	HI-Perioden	Max. Energie	Projektile	Experimente
Bevalac	LBNL, Berkeley	1984 - 1993	< 2 *A*GeV	C, Ca, Nb, Ni, Au, ...	Plastic Ball, Streamer Chamber, EOS, DLS
Synchro-Phasotron	JINR, Dubna	1974 - 1985	> 100 *A*MeV		
AGS	BNL, Brookhaven	1986 - 1994	14.5/11.5 *A*GeV	Si, Au	E802, ..., E917
SPS	CERN, Geneva	1986 →	200/158 *A*GeV	O, S, In, Pb	NA34,... , WA80,...
SIS	GSI, Darmstadt	1992 →	2 *A*GeV	Kr, Au	FOPI, KAOS, HADES
RHIC	BNL, Brookhaven	2000 →	$\sqrt{s_{NN}} = 200$ GeV	Cu,Au	STAR, PHENIX, BRAHMS, PHOBOS
LHC	CERN, Geneva	2009 →	$\sqrt{s_{NN}} = 5.5$ TeV	O, Ar, Pb	ALICE, CMS, ATLAS
SIS100/300	GSI, Darmstadt	2019 →	30/45 *A*GeV	Au	HADES, CBM
Nuklotron	JINR, Dubna	2017 →	6 *A*GeV	Au	
NICA	JINR, Dubna	2017 →	$\sqrt{s_{NN}} = 4 - 11$ GeV	Au	MPD

Rapidity ↔ Pseudo Rapidity



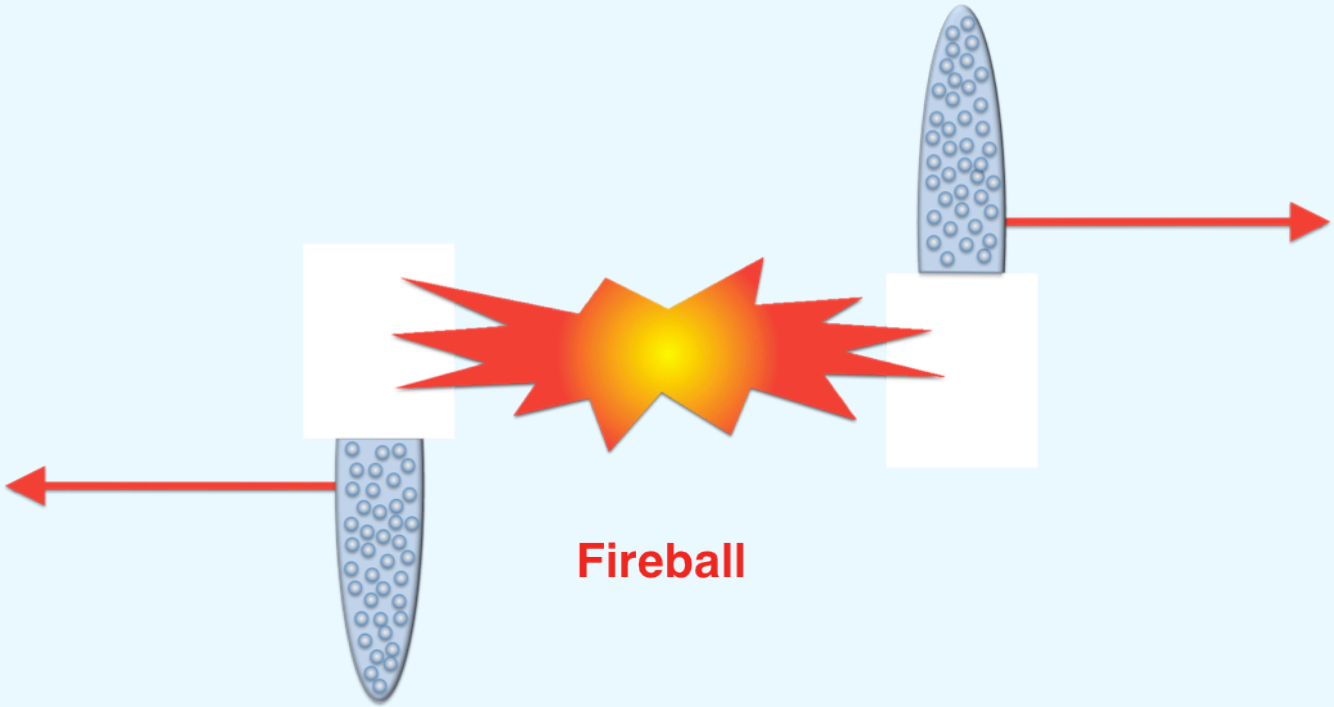
Participant – Spectator



b = Impact Parameter

b=0 => central collision

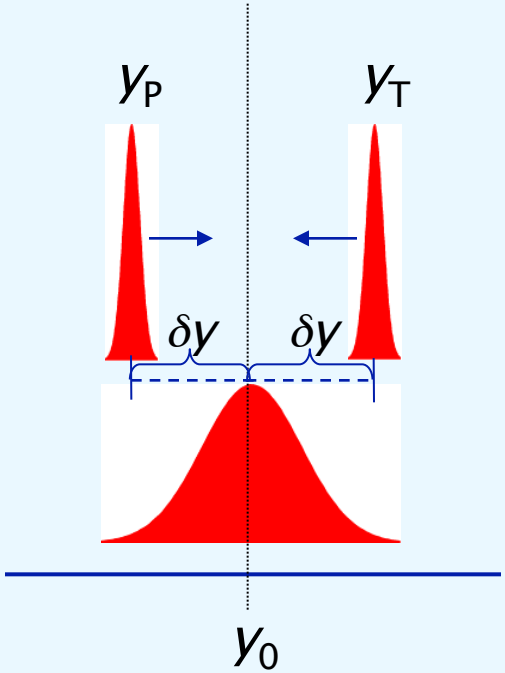
Participant – Spectator



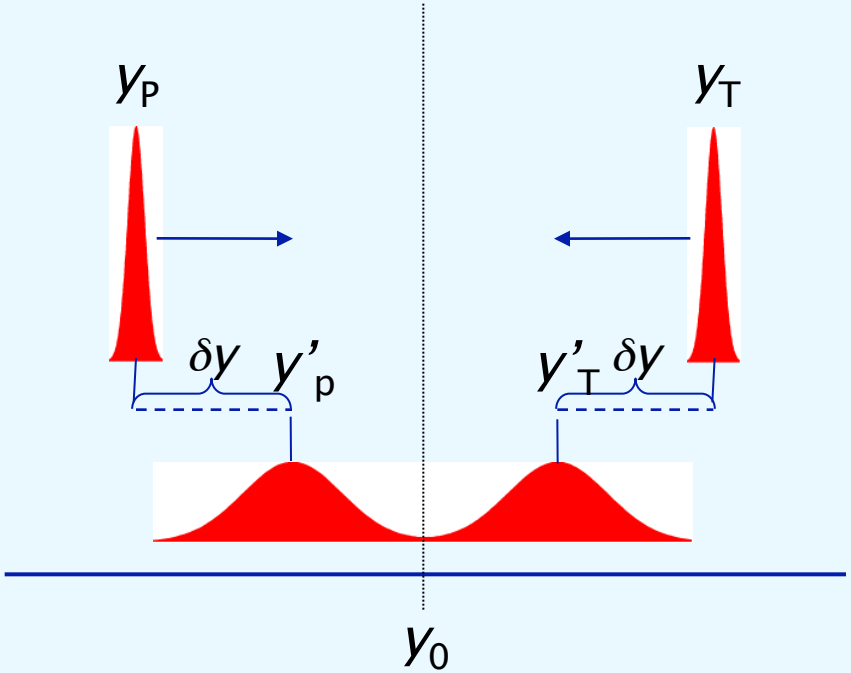
Stopping

Distribution of Baryon production

Low Energy:

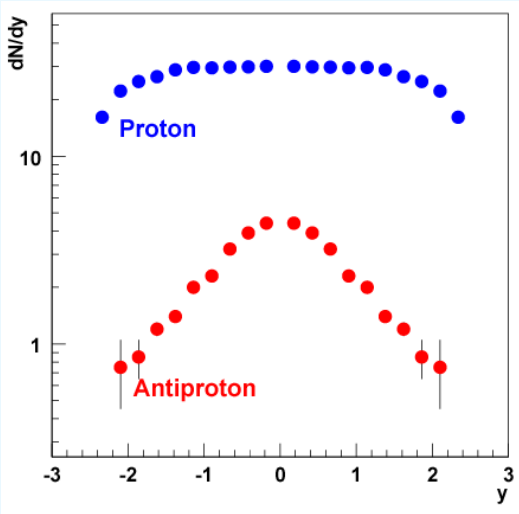


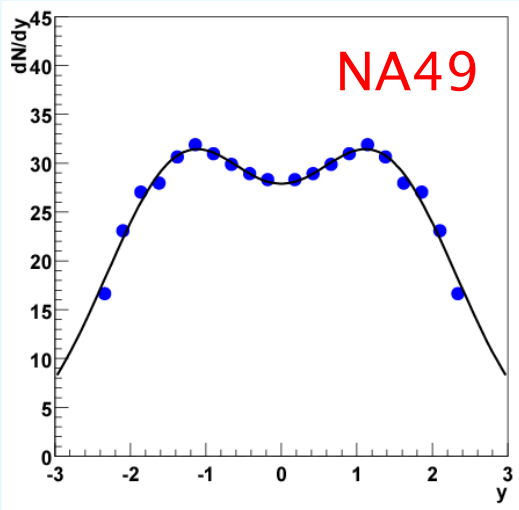
High Energy:



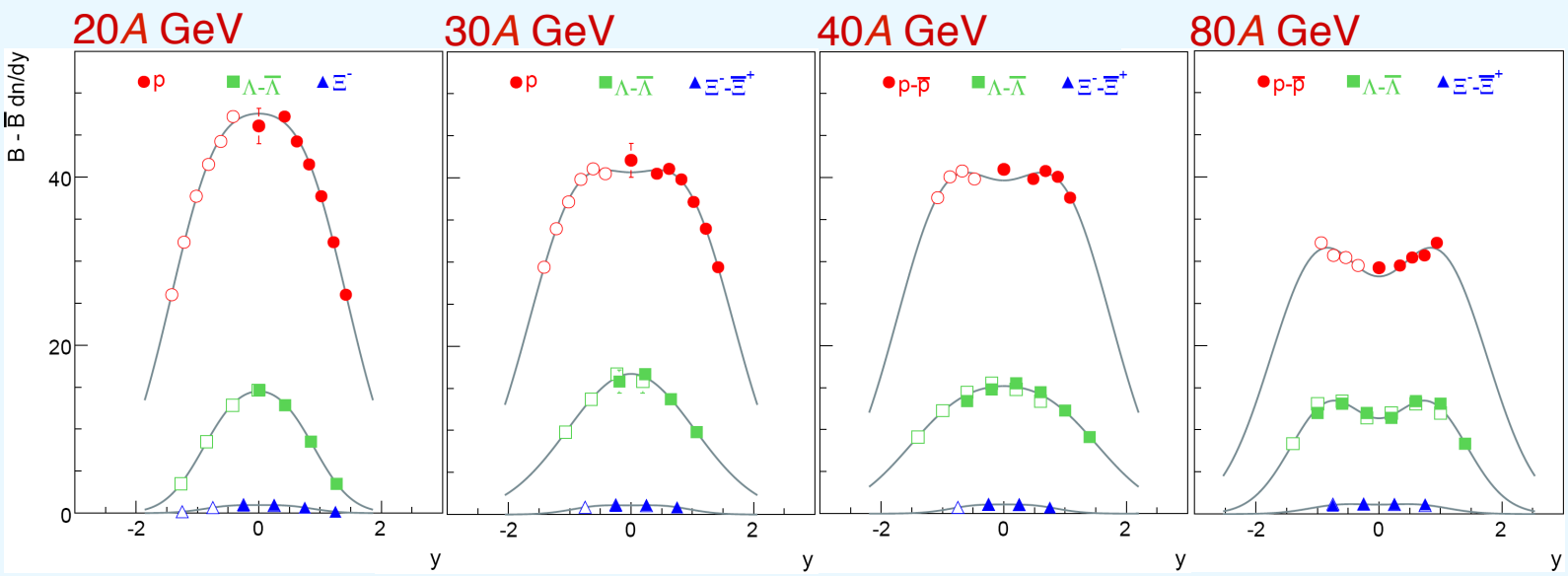
Stopping

Observables : Nett-Proton Distribution





Nett-Baryon Distribution (NA49 – CERN SPS)



More stopping al lower energies

Rapidity distributions of Baryons

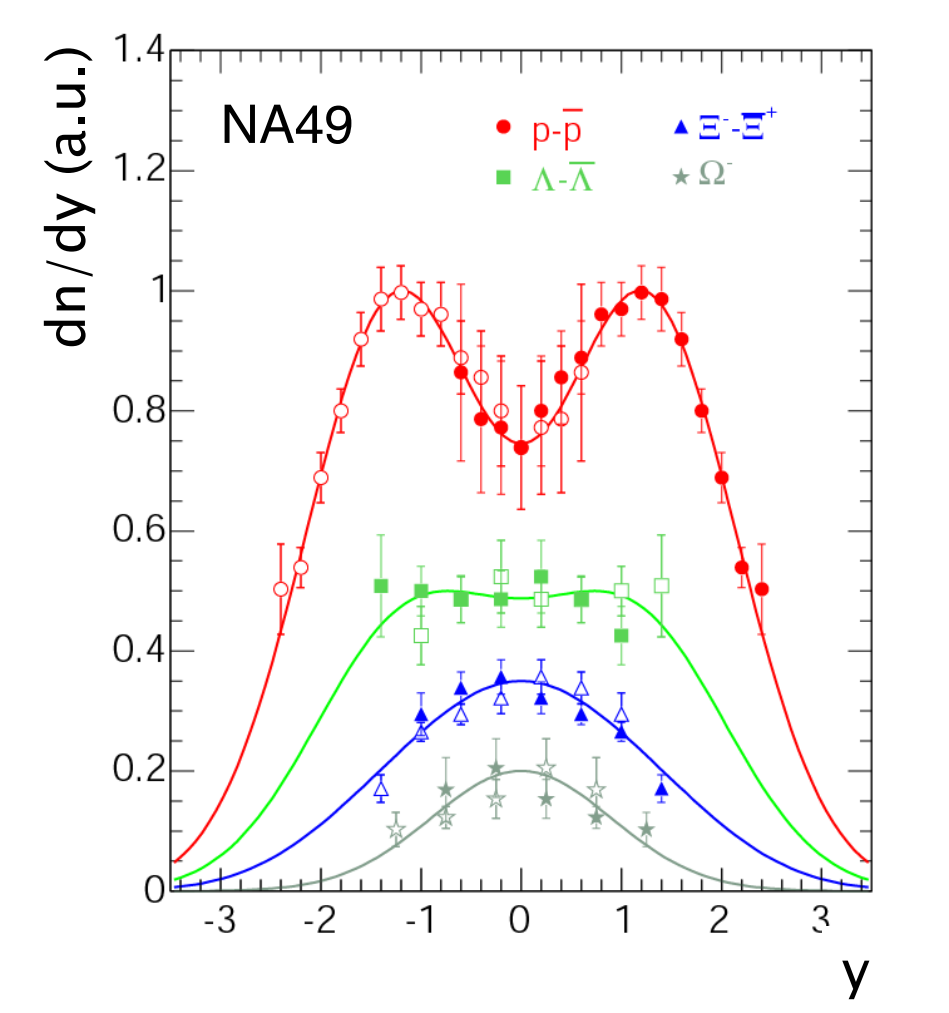
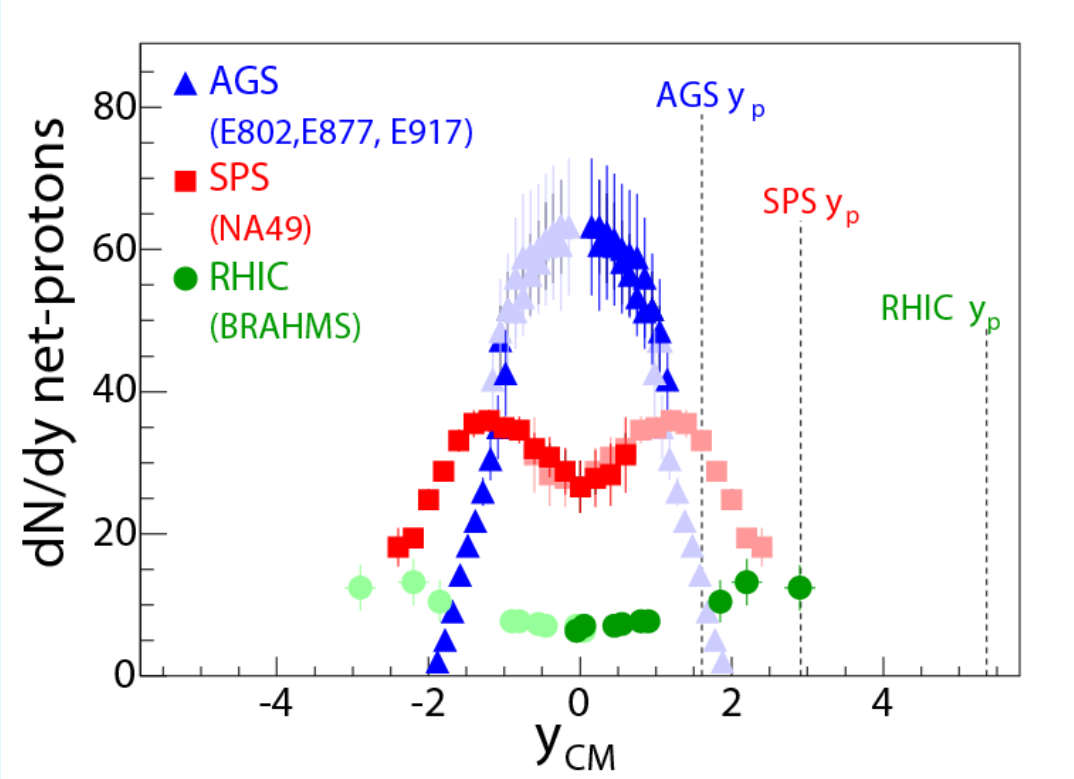
Centrale Pb+Pb, 158 *A*GeV

Nett-Proton:
3 Valenz Quarks (*uud*)

Nett Λs:
2 Valenz (*ud*) +
1 produced Quark (*s*)

Nett Ξs:
1 Valenz (*d*) +
2 produced Quarks (*ss*)

Omegas:
3 produced Quarks (*sss*)



Stopping up to RHIC energies