the Nuons model

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Leptons

Life

Decays

μ^- DECAY MODES	Fraction (Γ_j/Γ)	Co
$e^-\overline{\nu}_e\nu_\mu$	≈ 100%	
$e^-\nu_e\nu_\mu\gamma$	[d] (1.4±0.4) %	
$e^-\nu_e\nu_\mu e^+e^-$	[e] (3.4±0.4) × 10^{-5}	

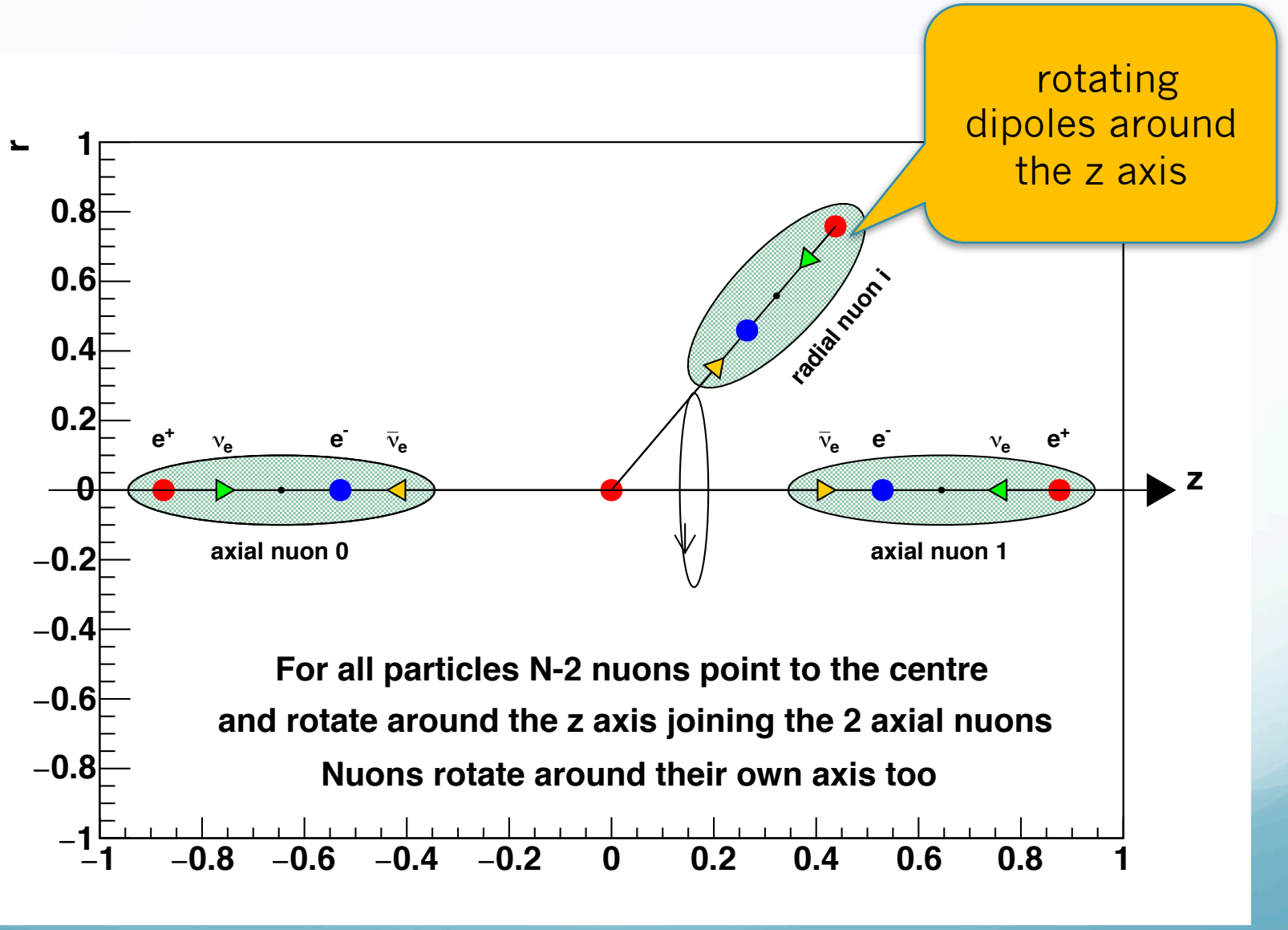
π^0 DECAY MODES	Fraction (Γ_j/Γ)	Confidence level	(M
2γ	(98.798±0.032) %		S=1.1
$e^+e^-\gamma$	(1.198±0.032) %		S=1.1
γpositronium	(1.82 ±0.29) × 10^{-9}		
$e^+e^+e^-e^-$	(3.14 ±0.30) × 10^{-5}		
e^+e^-	(6.2 ±0.5) × 10^{-8}		
4γ	< 2	× 10^{-8}	CL=90%
$\nu\nu$	[e] < 2.7	× 10^{-7}	CL=90%
$\nu_e\overline{\nu}_e$	< 1.7	× 10^{-6}	CL=90%
$\nu_\mu\nu_\mu$	< 1.6	× 10^{-6}	CL=90%
$\nu_\tau\nu_\tau$	< 2.1	× 10^{-6}	CL=90%
$\gamma\nu\overline{\nu}$	< 6	× 10^{-4}	CL=90%

π^+ DECAY MODES	Fraction (Γ_j/Γ)	Confidence level	(MeV/c)
$\mu^+\nu_\mu$			
$\mu^+\nu_\mu\gamma$			
$e^+\nu_e$			
$e^+\nu_e\gamma$			
$e^+\nu_e\pi^0$			
$e^+\nu_e e^+e^-$			
$e^+\nu_e\nu\overline{\nu}$			
γpositronium			
$e^+e^+e^-e^-$	±0.30) × 10		
e^+e^-	(6.2 ±0.5) × 10^{-8}		
4γ	< 2	× 10^{-8} CL=90%	
$\nu\overline{\nu}$	[e] < 2.7	× 10^{-7} CL=90%	67
$\nu_e\overline{\nu}_e$	< 1.7	× 10^{-6} CL=90%	67
$\nu_\mu\overline{\nu}_\mu$	< 1.6	× 10^{-6} CL=90%	67
$\nu_\tau\overline{\nu}_\tau$	< 2.1	× 10^{-6} CL=90%	67
$\gamma\nu\overline{\nu}$	< 6	× 10^{-4} CL=90%	67

Particles decay into electrons & neutrinos

Let's imagine a world of particles composed of electrons & neutrinos

Nuon : a building block



Building a particle with N dipoles

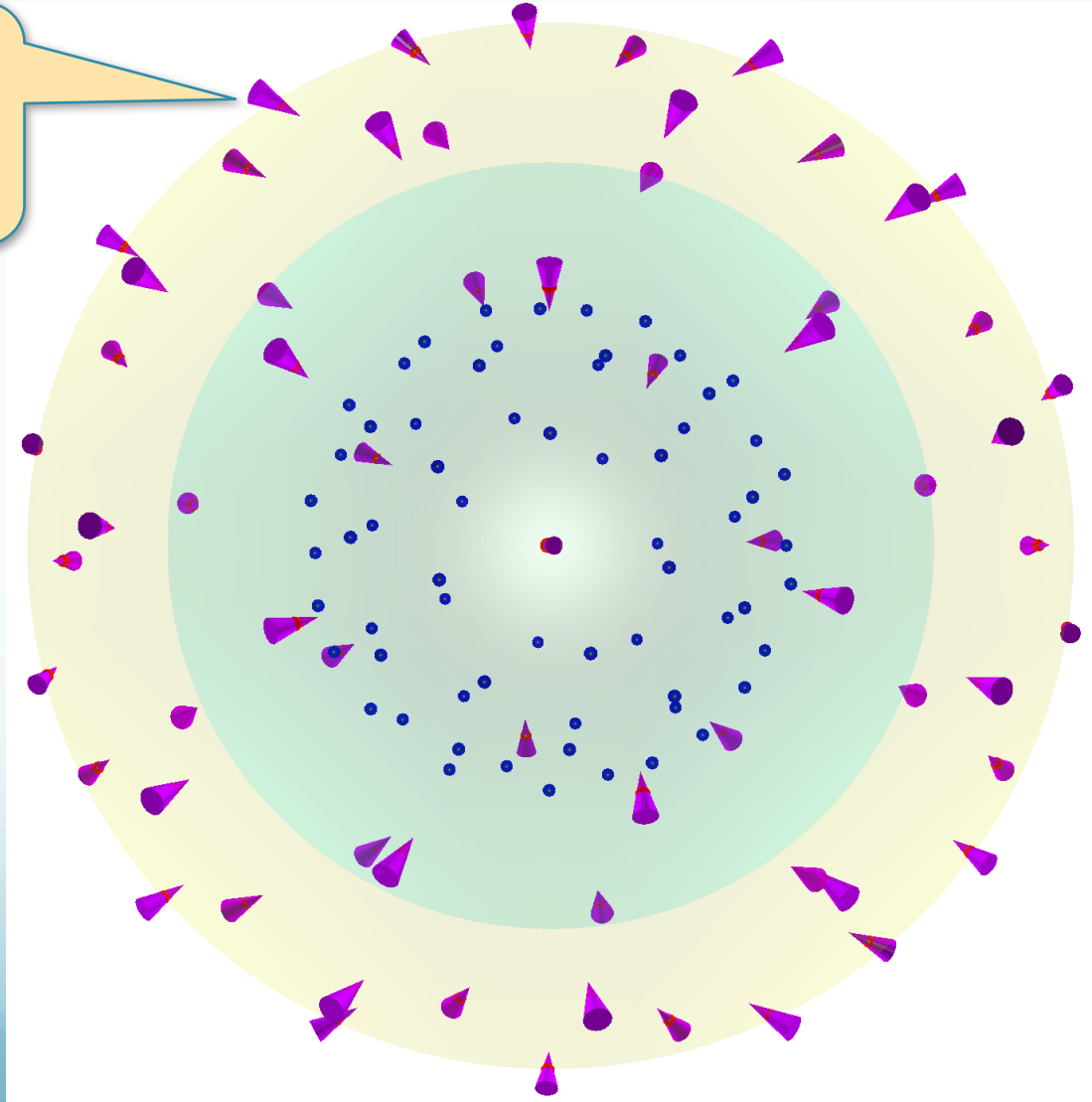
- Positive particles: N(e+e-) + (e+ at the center)
- Negative particles: N(e-e+) + (e- at the center)
- Neutral particles:
  - N(e+e-) + (e+e-nubar) at the center
    - or
  - N(e-e+) + (e+e-nu) at the center

Building a particle with N dipoles

- Take a cube (1 fermi cube)
- Generate N points (x[N], y[N], z[N]), centers of each nuon inside this cube. x[0]=x[1]=y[0]=y[1]=0
- The distance between e+ and e- is a free parameter.
- The nuons are forced to point to the center of the cube.
- With MINUIT, we minimize the function
  - f = Sum(qi*qj/dij^2 + alpha*(rmean^2 – rij^2))
- to get the stable positions of the x[N], y[N], z[N] points

Picture during the minimisation step

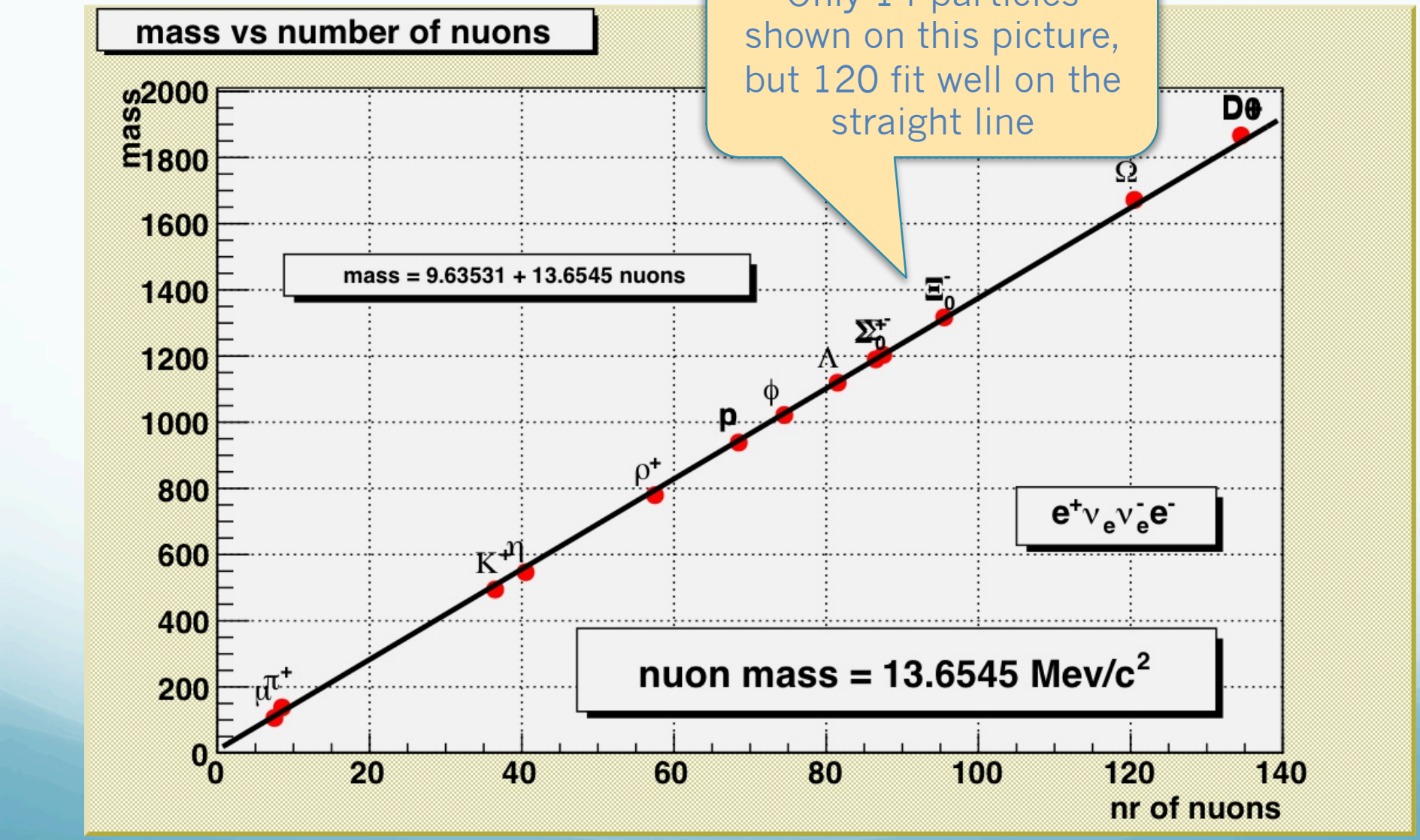
The cone indicates the force direction and size



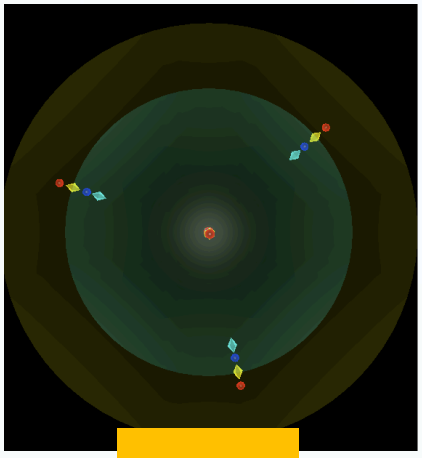
mass

- With MINUIT, we have found the N nuons positions in a given particle.
- Now we assume that this system rotates.
- As a first approximation we assume that the mass is equal to the energy of the system in rotation.
- M = omega^2 x Inertia = k*sum(r(i)^2)

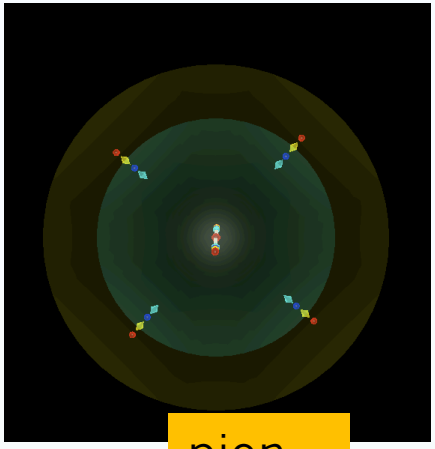
Mass vs number of nuons



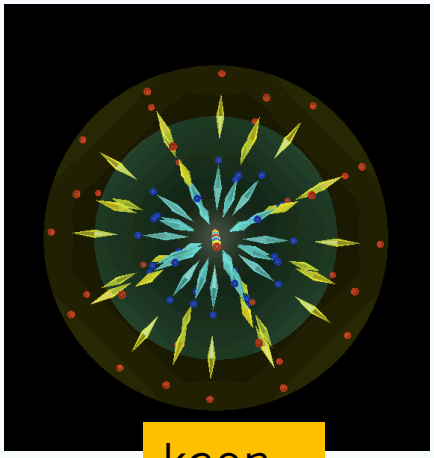
some particles



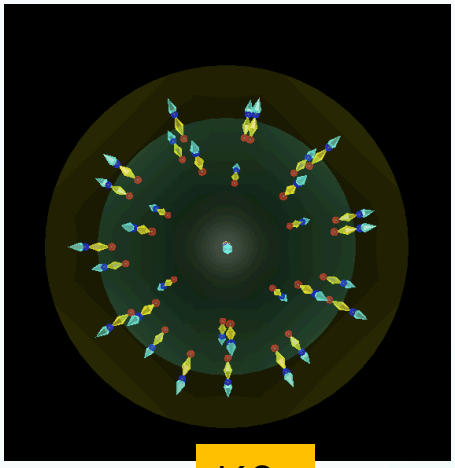
muon



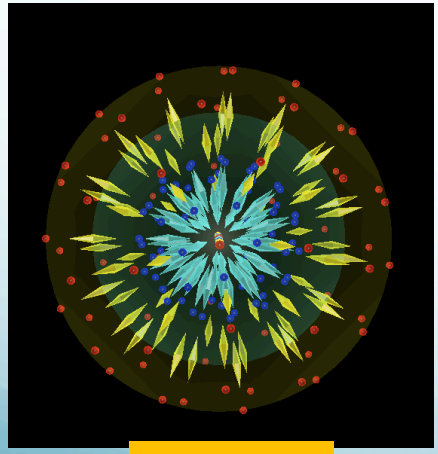
pion



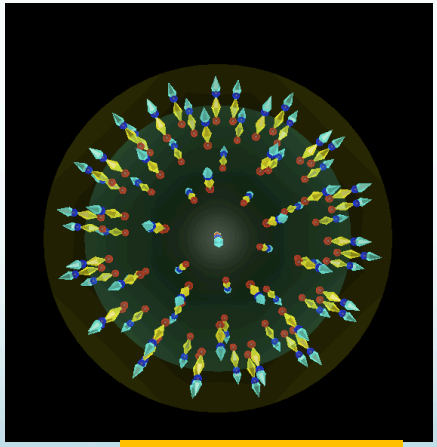
kaon



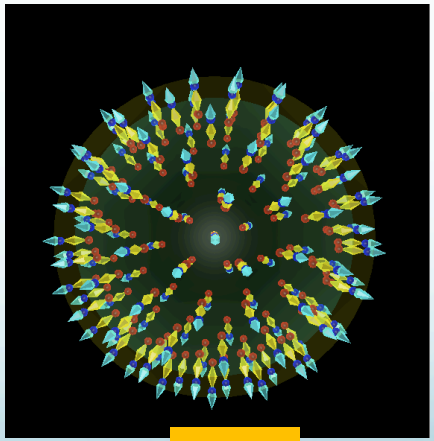
K0



proton



Lambda

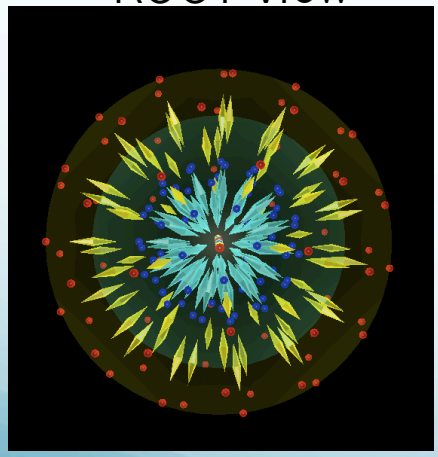


D0

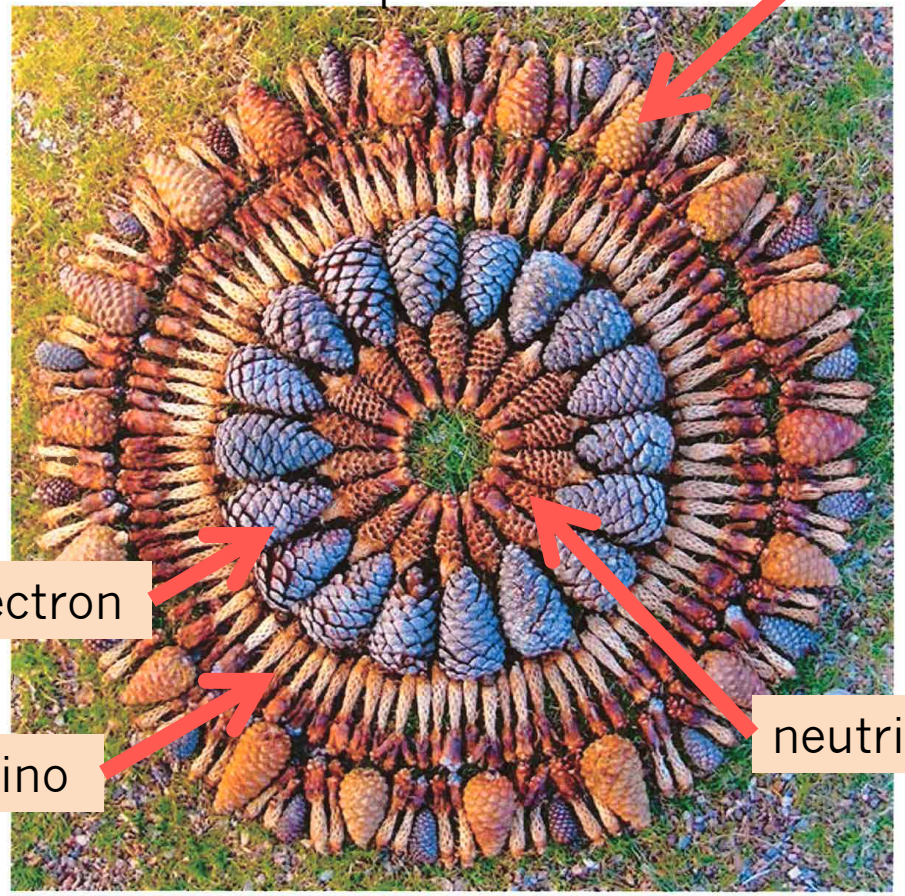
Proton Views

Engineer view

ROOT view



Artist/spiritual view



particle

mass

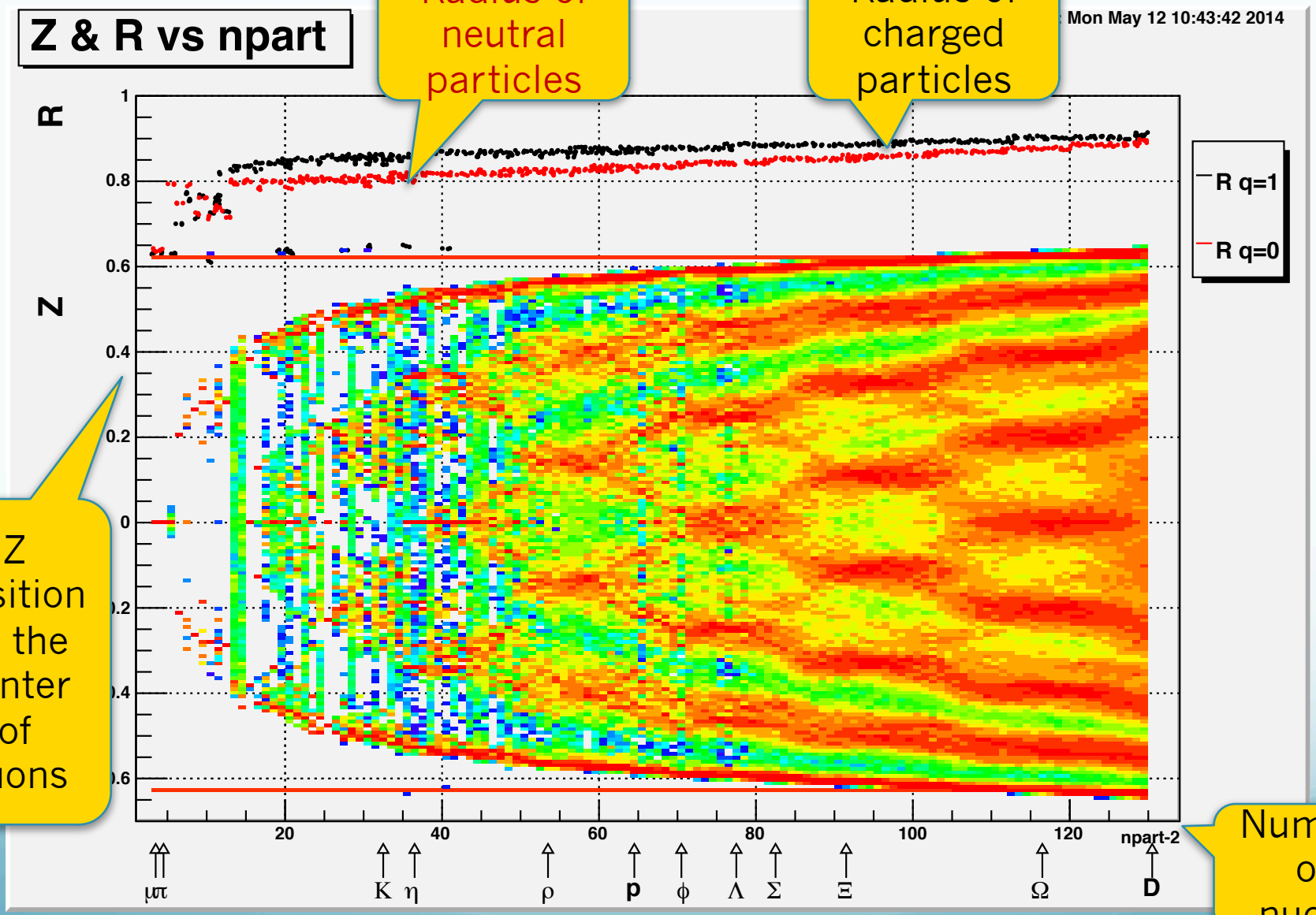
Magnetic moment

fi dall_41185.root with 1103 events Sat Aug 8 18 4:1 2015

nuons	quarks	spin	rings	PDG mass (MeV)	nuons model (MeV)	PDG-nuons PDG	mmexp/mmq (μn)	mm_nuons (μn)	life time PDG (seconds)
μ^+ 3		1/2	1	105.658	105.652 [1.8e-05]	-5.29e-05 (2335)	8.89/?? -7.31e-08	8.893 -1321.9± 0.03	2.2e-06
π^+ 4	$u\bar{d}$	0	1	139.57 R = 0.663	140.018 [0.0088] R = 0.63275	0.00321 (9817)	?? 2.27e-06	0.012 -1585.9± 4	2.6e-08
π_0 4	$(u\bar{u}-d\bar{d})/\sqrt{2}$	0	1	134.976	134.899 [7.4e-06]	-0.000568 (4859)	-?? -0.0284	0.100 -194.19± 2e-05	8.4e-17
K^+ 32	$u\bar{s}$	0	2	493.677	493.613 [2.8]	-0.000129 (13726)	?? -5.97e-06	1.750 349.7± 0.007	1.24e-08
K_0 32	$d\bar{s}$	0	2	497.614	497.353 [2.8]	-0.000524 (14415)	-?? -0.217	0.053 -2586.7± 0.0009	5.11e-08
η 36	$(u\bar{u}+d\bar{d}-2s\bar{s})/\sqrt{6}$	0	2	547.853	547.897 [9]	8.09e-05 (9648)	-?? -0.244	0.051 -3049.7± 0.02	3.5e-08
ρ^+ 52	$u\bar{d}$	1	3	770	767.841 [3.8]	-0.0028 (8657)	2±0.5/? -2.58e-05	3.009 1082.7± 0.01	4.5e-24
ω_0 53	$(\bar{u}u+d\bar{d})/\sqrt{2}$	1	3	782	781.327 [1.8]	-0.000861 (2329)	-?? -0.359	-2.359 -5257.5± 0.01	7.8e-23
p 64	uud	1/2	3	938.272 R = 0.8768	938.268 [3.5] R = 0.876822	-3.96e-06 (12392)	2.793/2.79 -5.98e-06	2.793 1708.4± 0.02	1e+40
n 64	udd	1/2	3	939.565	939.795 [3.9]	0.000245 (13408)	-1.913/1.86 -0.432	-1.957 -6862.9± 0.02	885.7
ϕ 70	$s\bar{s}$	1	5	1019.45	1021.24 [1.1]	0.00176 (2338)	-?? -0.472	-1.799 -7788.8± 0.08	1.55e-22
Λ 77	uds	1/2	3.5	1115.7	1118.38 [0.38]	0.0024 (2241)	-0.613/0.61 -0.518	-1.641 -8924.9± 7e+02	2.63e-10
Σ^+ 82	uus	1/2	3.5	1189.37	1191.58 [0.8]	0.00186 (1681)	2.458/2.69 9.54e-05	2.587 2903.9± 0.02	8.02e-11
Σ_0 82	uds	1/2	3.5	1192.64	1189.01 [1.1]	-0.00304 (1819)	-0.61/0.82 -0.551	-1.543 -9748.1± 6e+02	7.4e-20
Σ^- 83	dds	1/2	3.5	1197.45	1205.63 [0.85]	0.00683 (1675)	-1.16/1.04 -4.19e-05	-2.578 2979.3± 0.02	1.48e-10
Ξ^- 91	dss	1/2	4	1321.7	1319.86 [1.3]	-0.00139 (1188)	-0.651/0.51 0.000167	-2.513 3615.3± 0.02	1.64e-10
Ξ_0 91	uss	1/2	4	1314.8	1314.92 [1.3]	9.23e-05 (1388)	-1.25/1.44 -0.61	-1.393 -11267± 0.07	2.9e-10
Ω^- 116	sss	3/2	4.5	1672.45	1676.82 [0.6]	0.00261 (1165)	-2.02/1.83 2.15e-05	-2.370 5977.9± 0.04	8.21e-11
D+ 130	$c\bar{d}$	0	5.5	1869.6	1878.32 [1.3]	0.00467 (1194)	?? -0.000182	1.815 7542.4± 0.09	1.04e-18
D0 130	$c\bar{u}$	0	5.5	1864.8	1861.21 [1.3]	-0.00192 (1350)	-?? -0.856	0.030 -18480± 0.5	4.1e-17

fnorm = 5000 r0min = 0.63 fmass = 17.286 vnuon = 0.05977 0.00175264

Some patterns

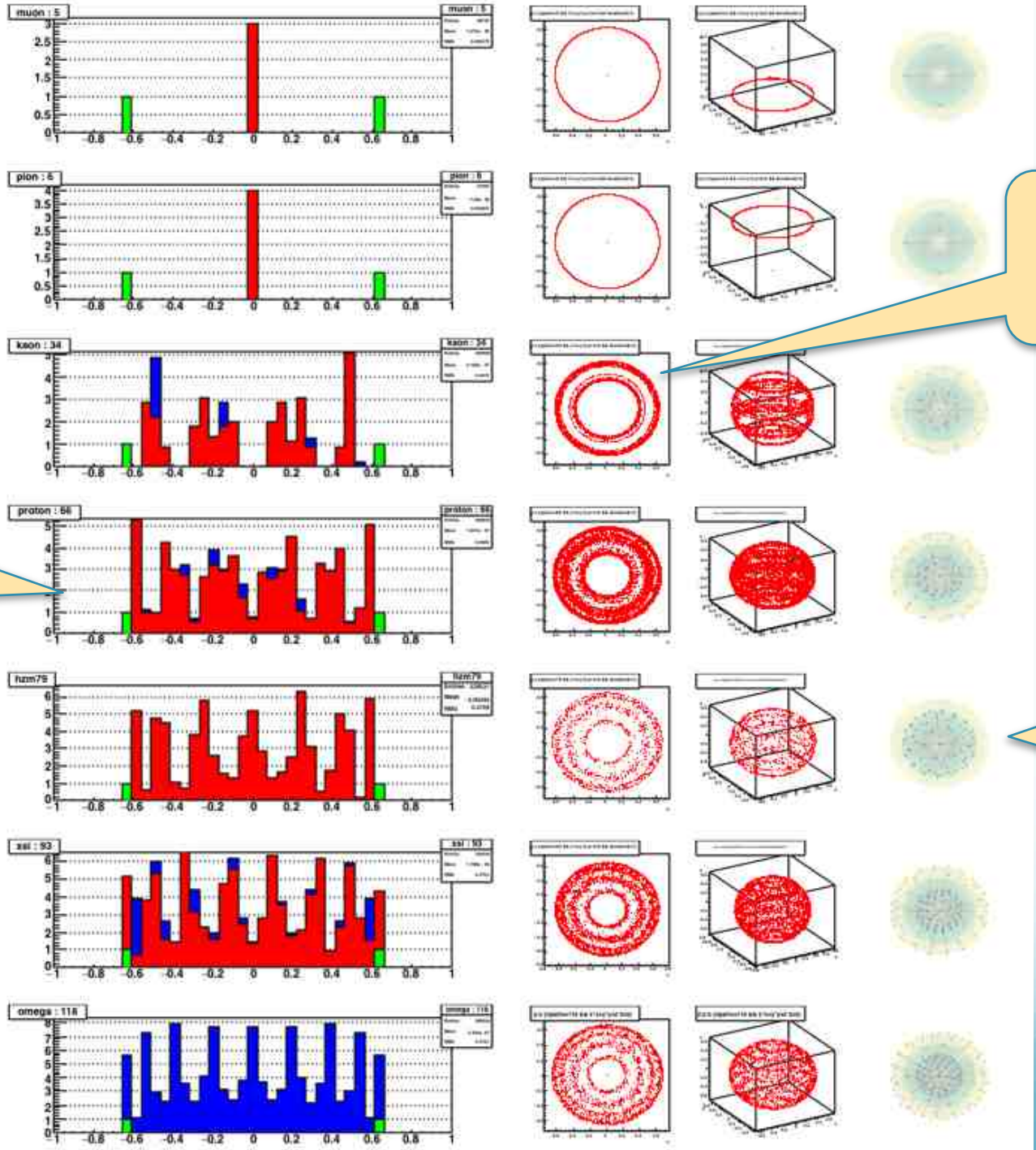


Radius of neutral particles

Radius of charged particles

Z position of the center of nuons

Number of nuons

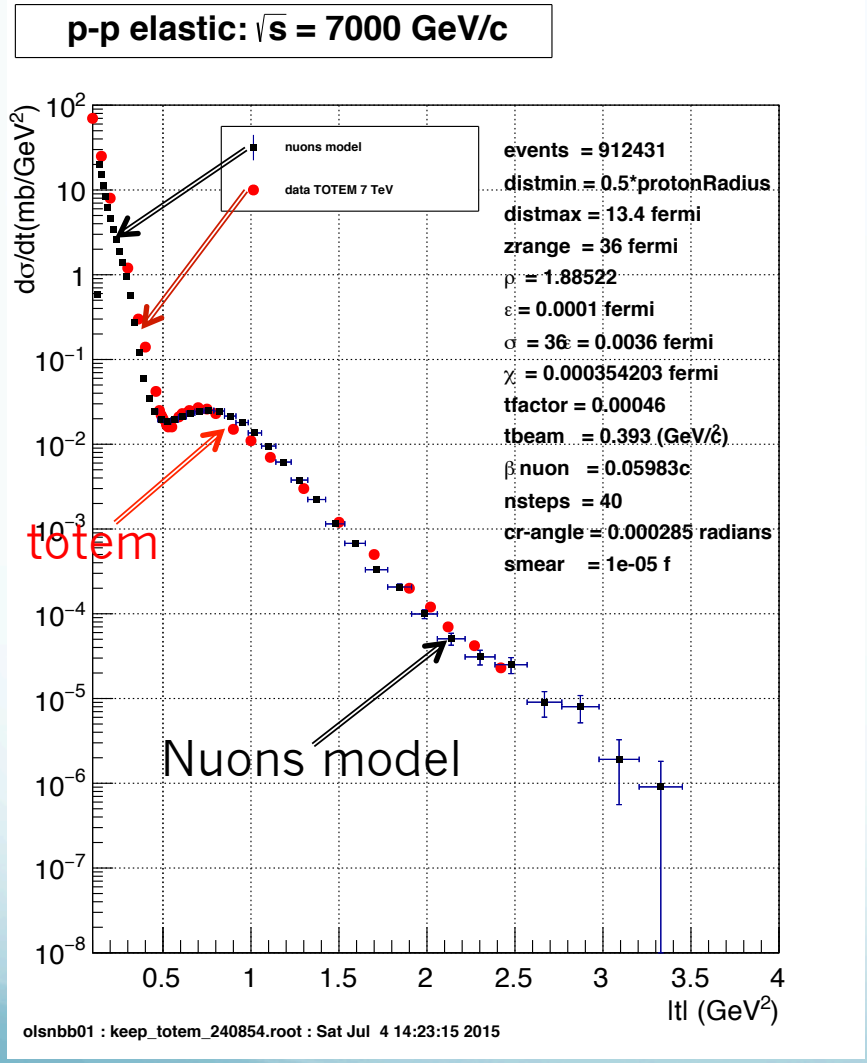


Radial view

Z center of nuons

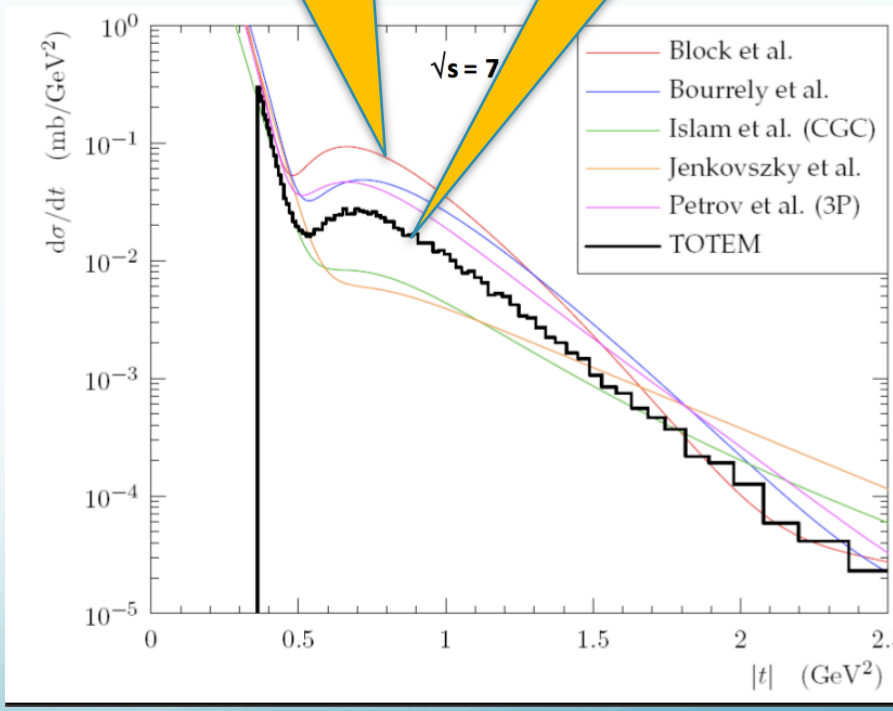
3-D views

pp elastic at 7 TeV

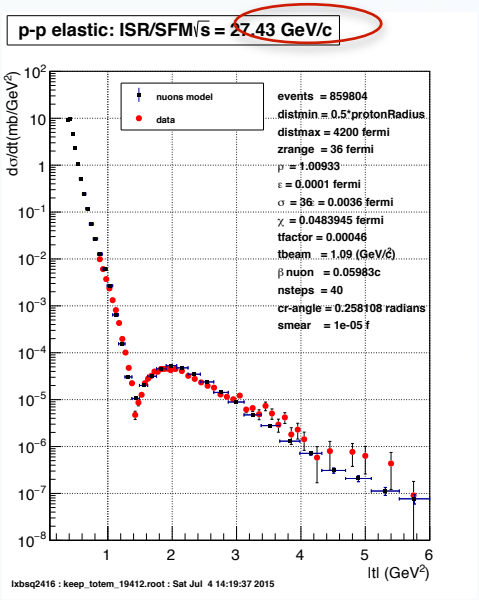


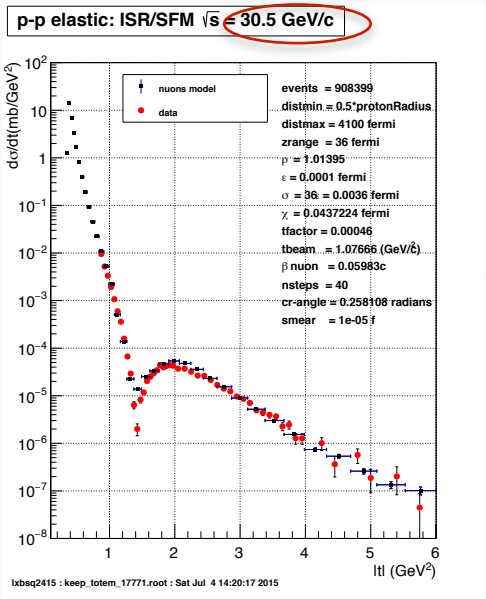
Theoretical predictions from various models

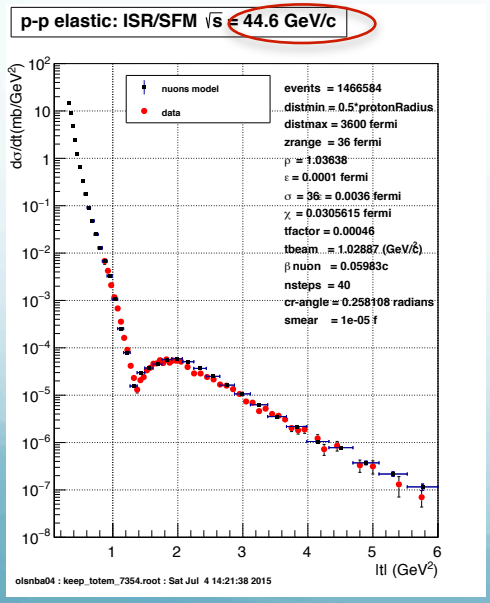
TOTEM results at 7 TeV

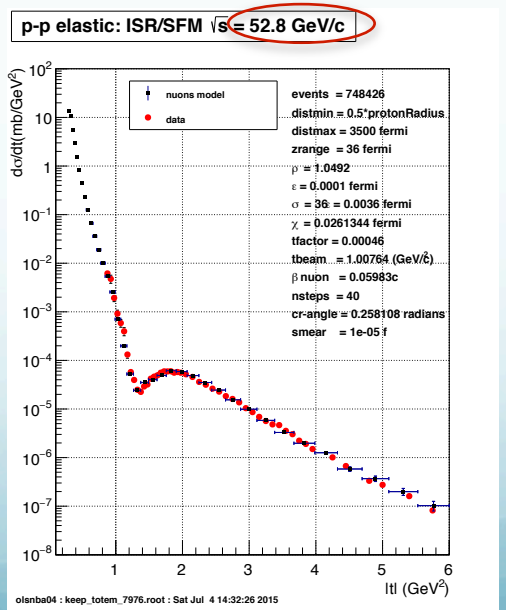


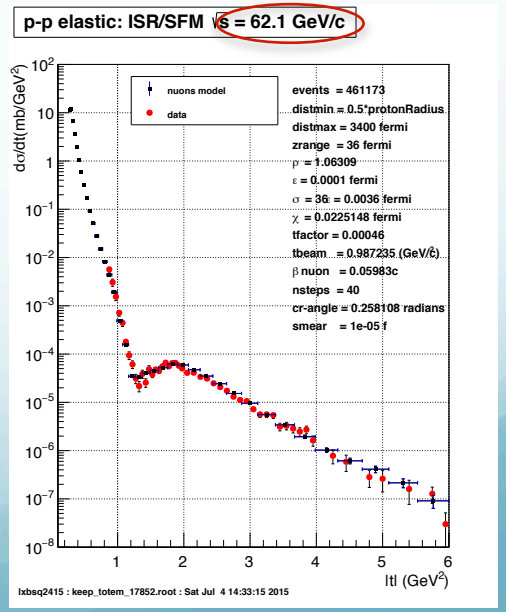
pp elastic ISR



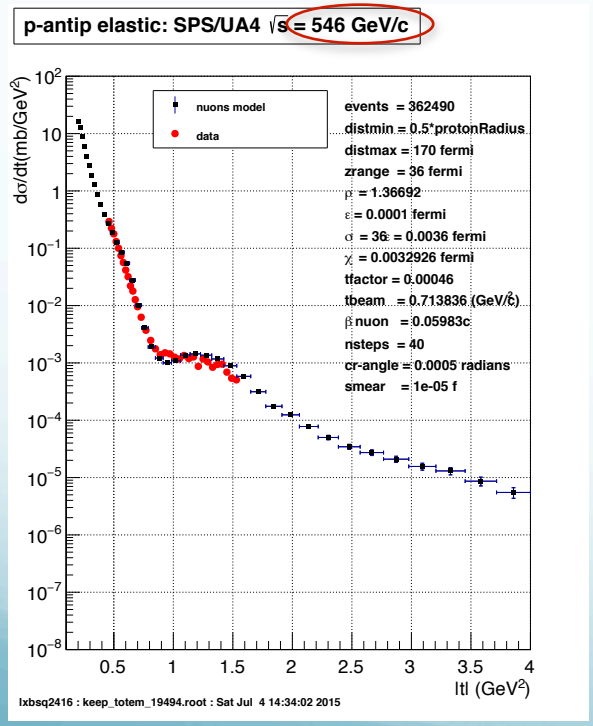


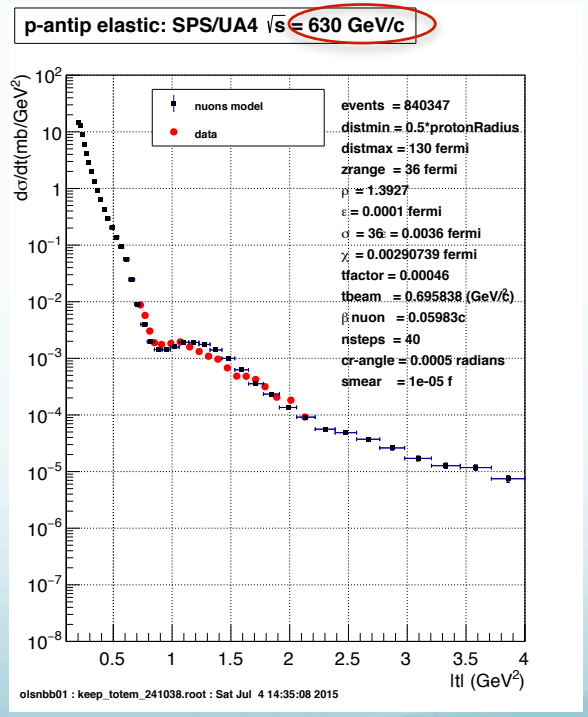


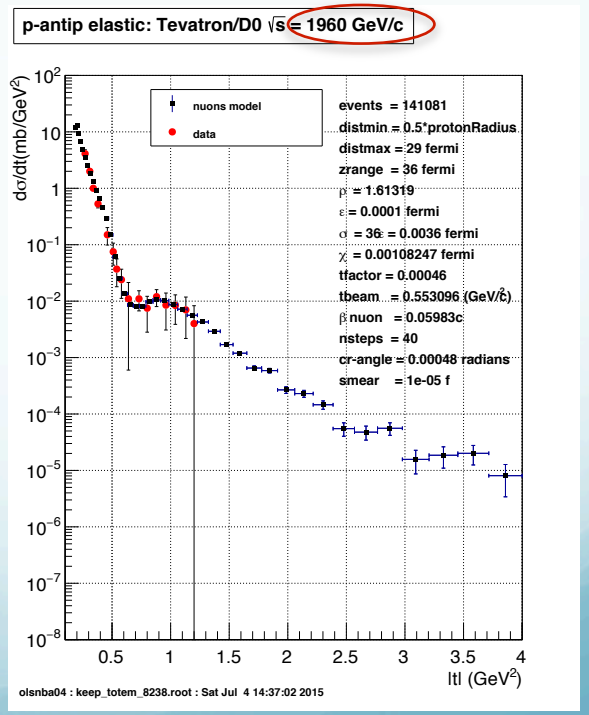




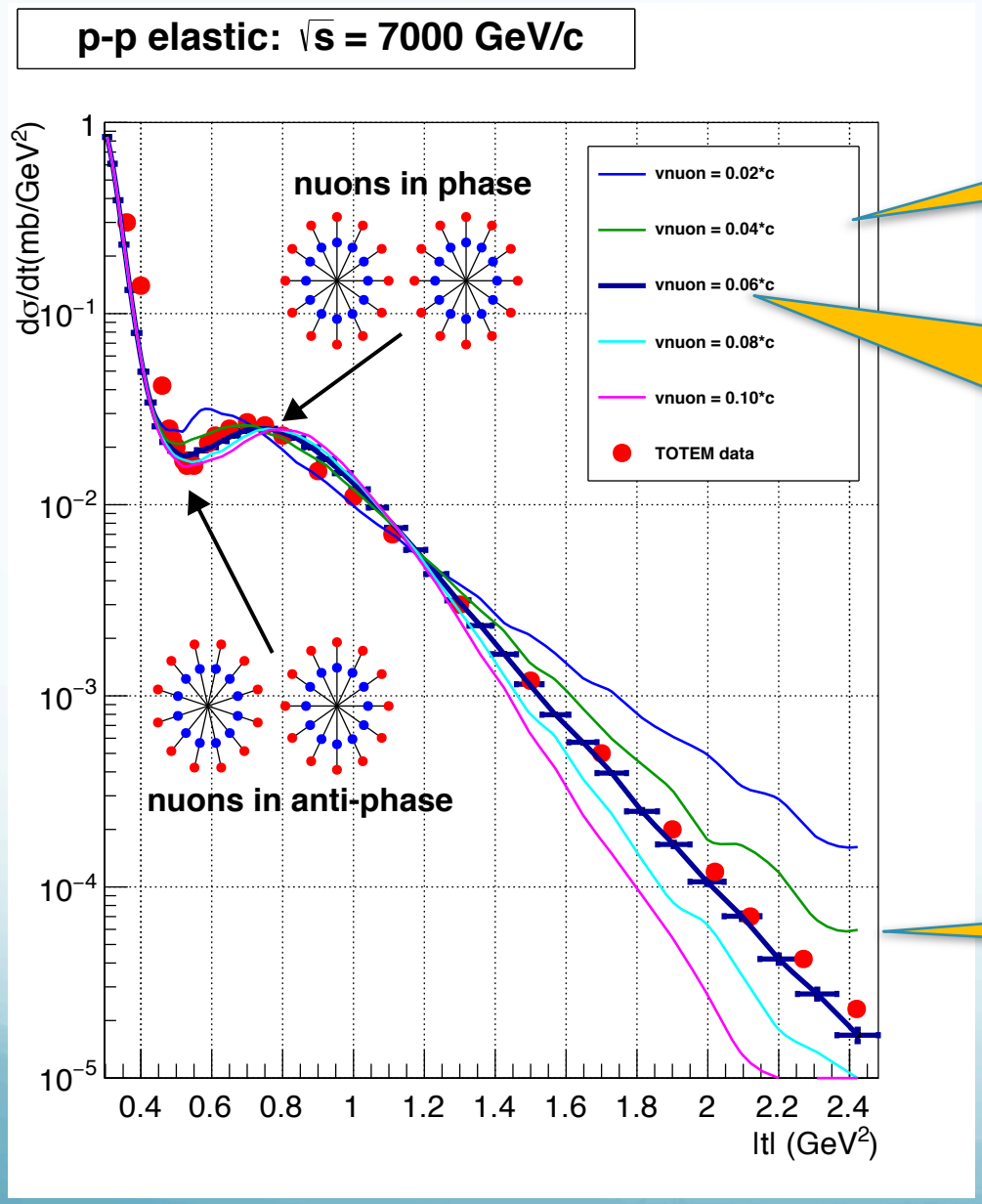
p-pbar elastic







Dip and maximum

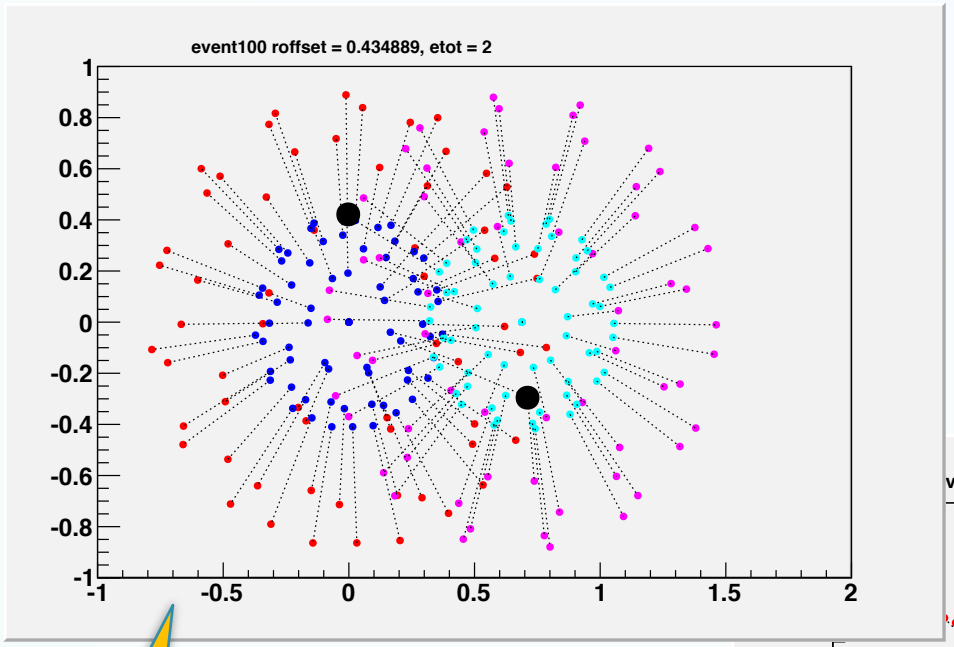


Vnuon = orbital speed of the positrons

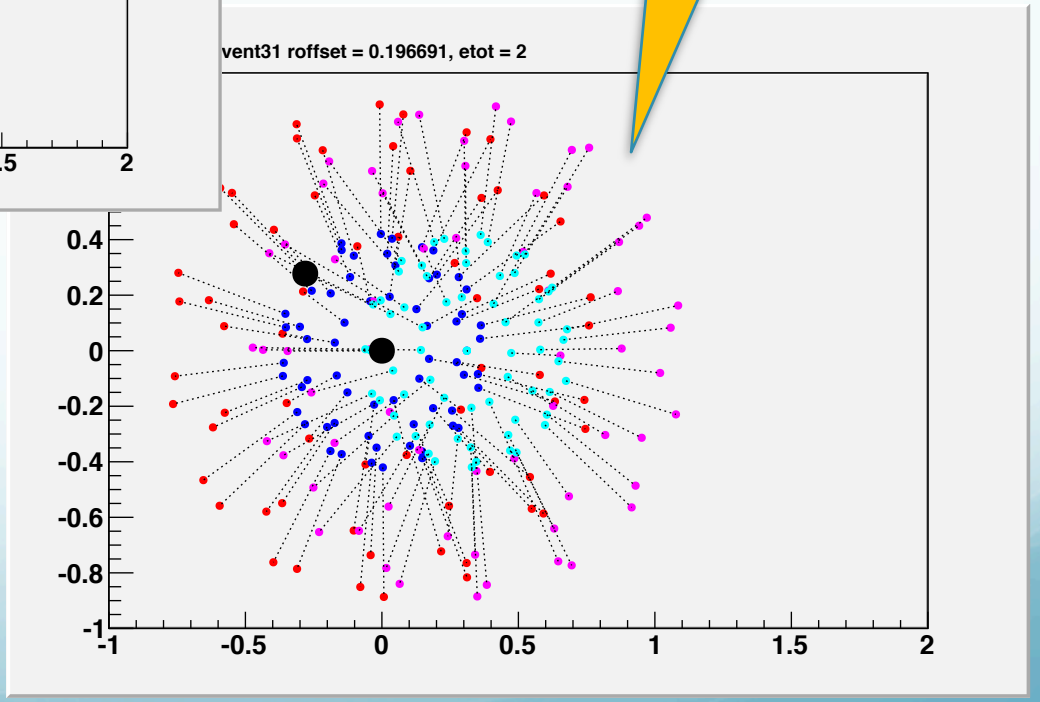
The best value Vnuon=0.06 is in perfect agreement with Vnuon=0.0598 for magnetic moments

Vnuon effect is only visible above 1 TeV

Collisions

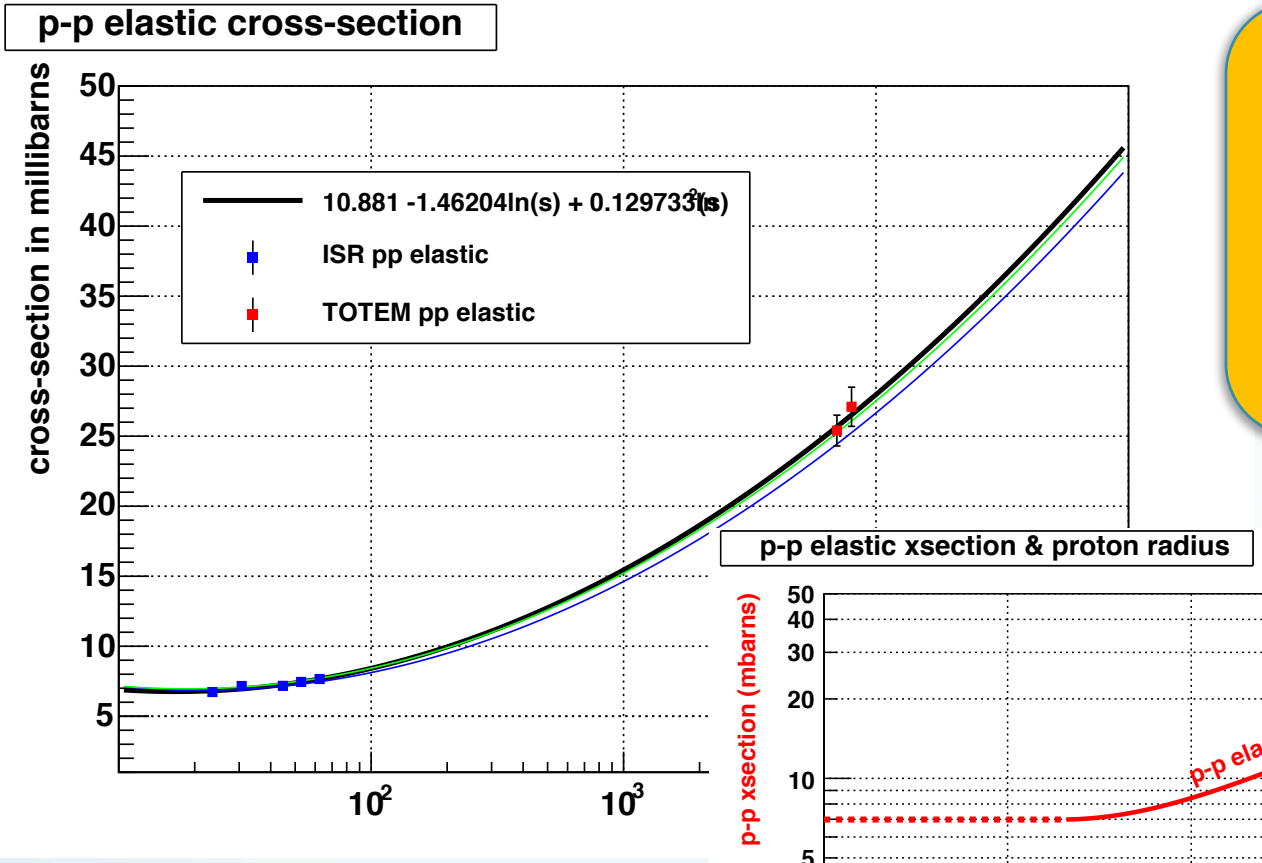


Axial-radial and radial-radial collisions

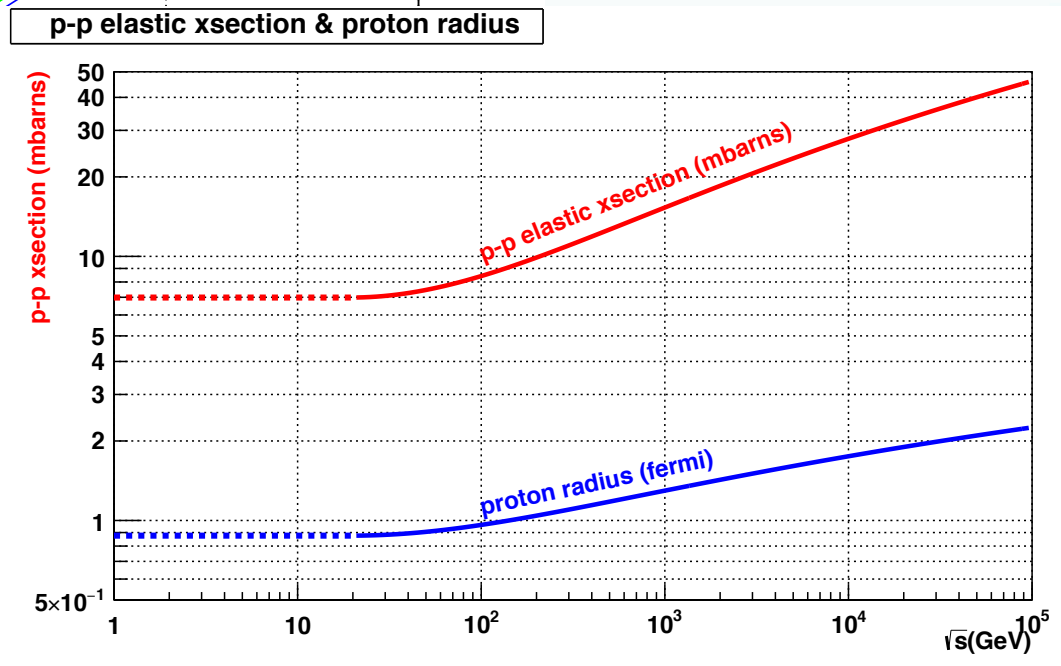


radial-radial collisions

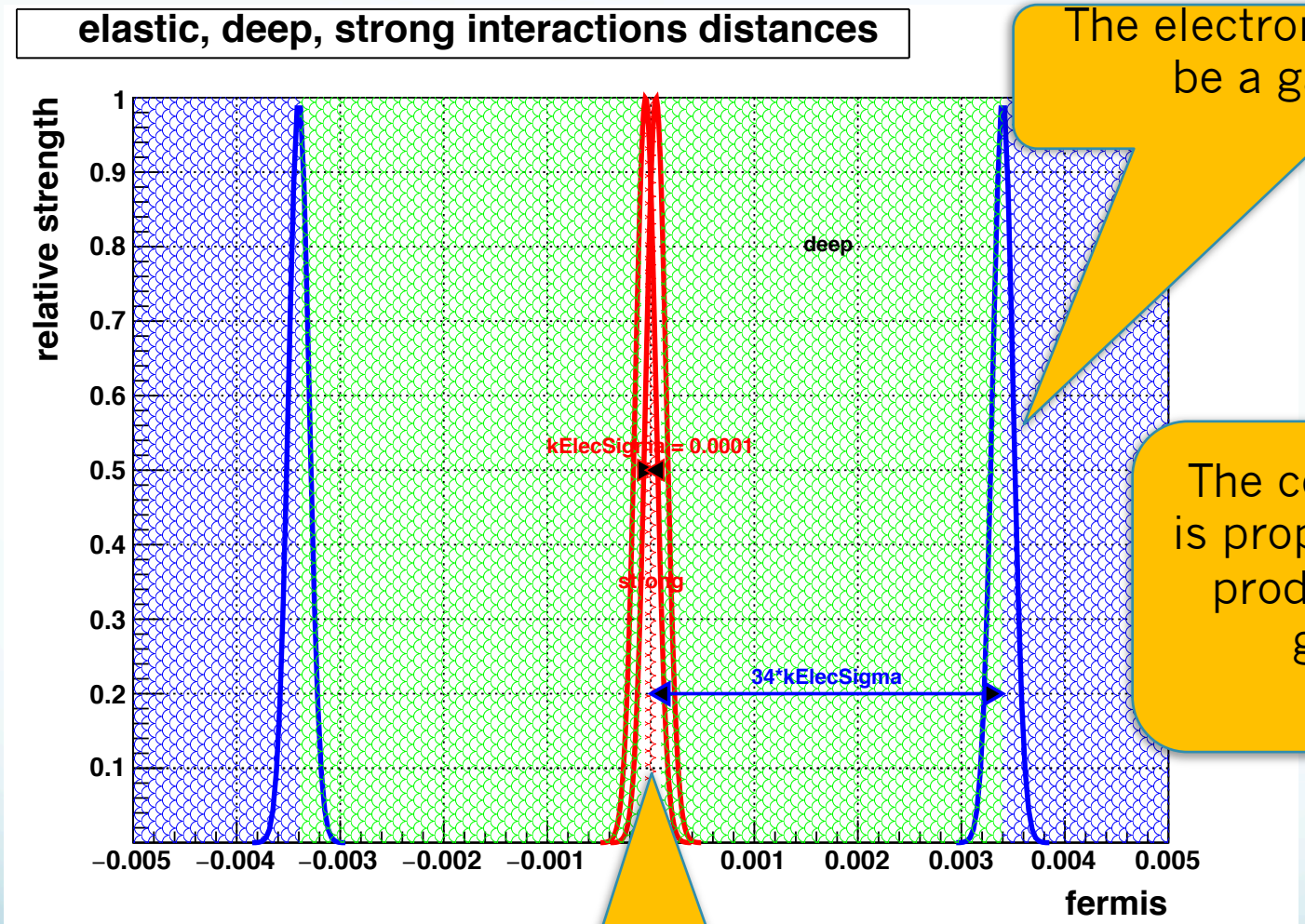
Proton Radius



The proton radius is taken as the sqrt(elastic cross-section) normalized to proton radius at rest



Collision Probability

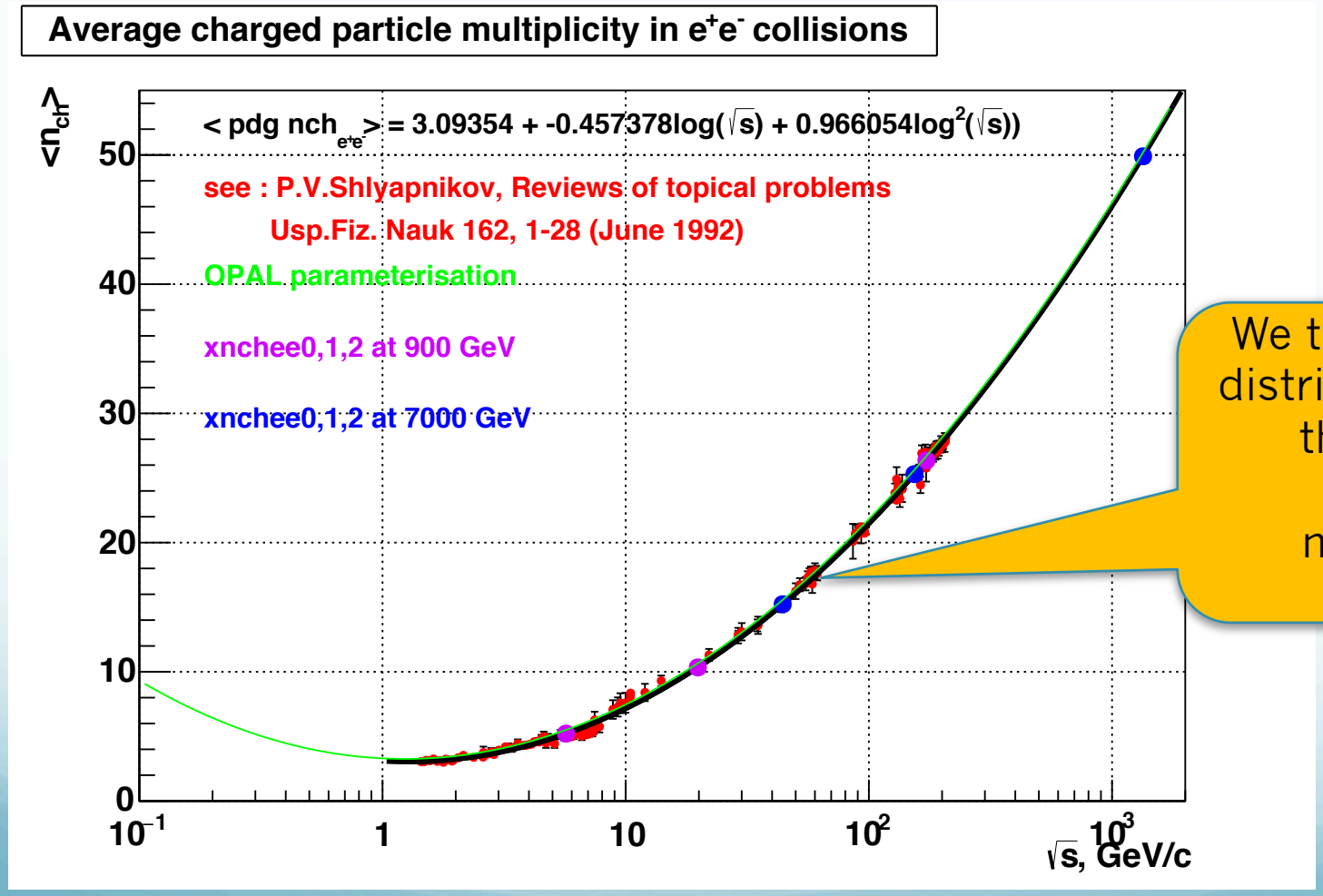


The electrons are assumed to be a gaussian wave

The collision energy is proportional to the products of the 2 gaussians

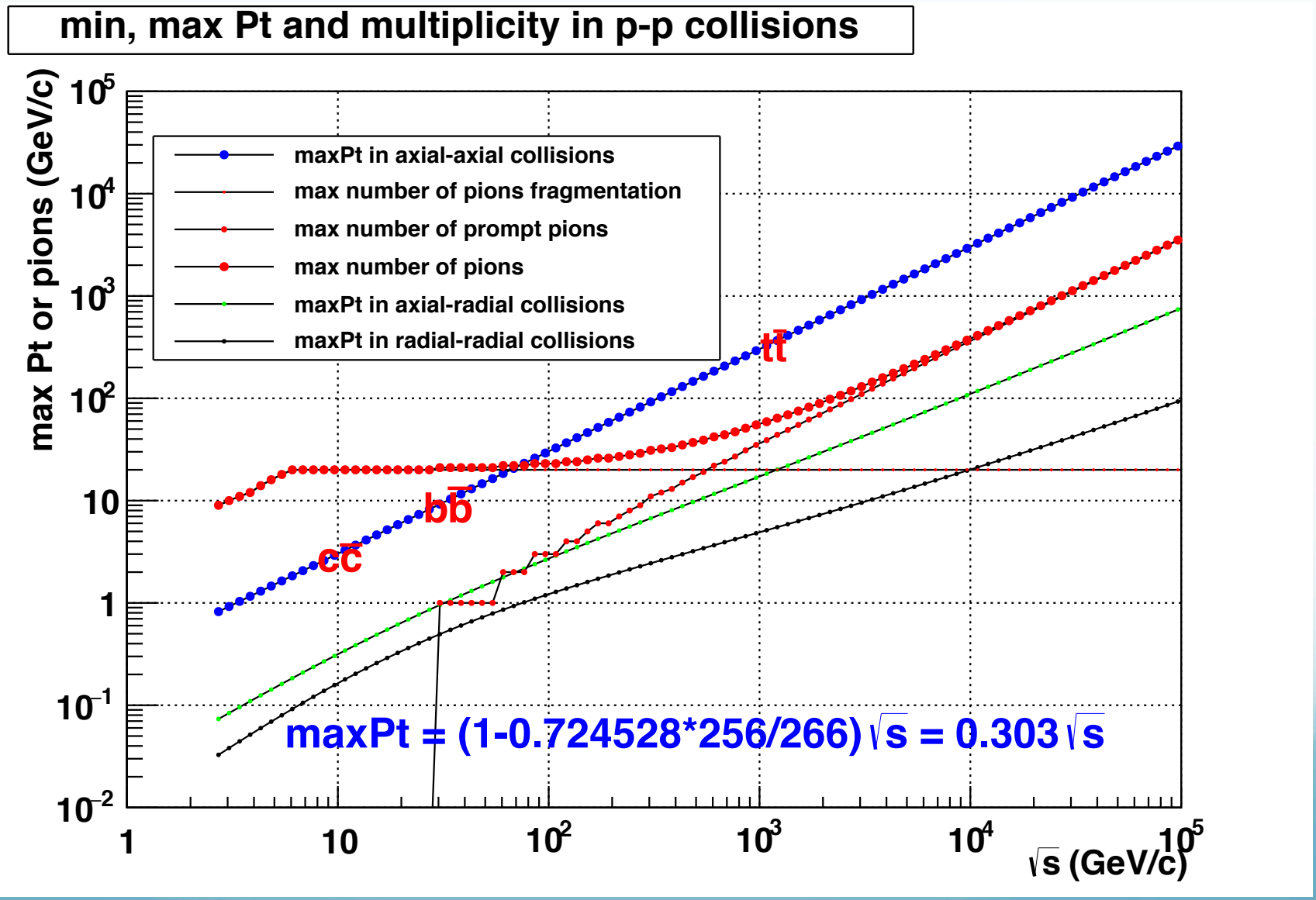
kElecSigma = 0.0001 fermi

Collision products

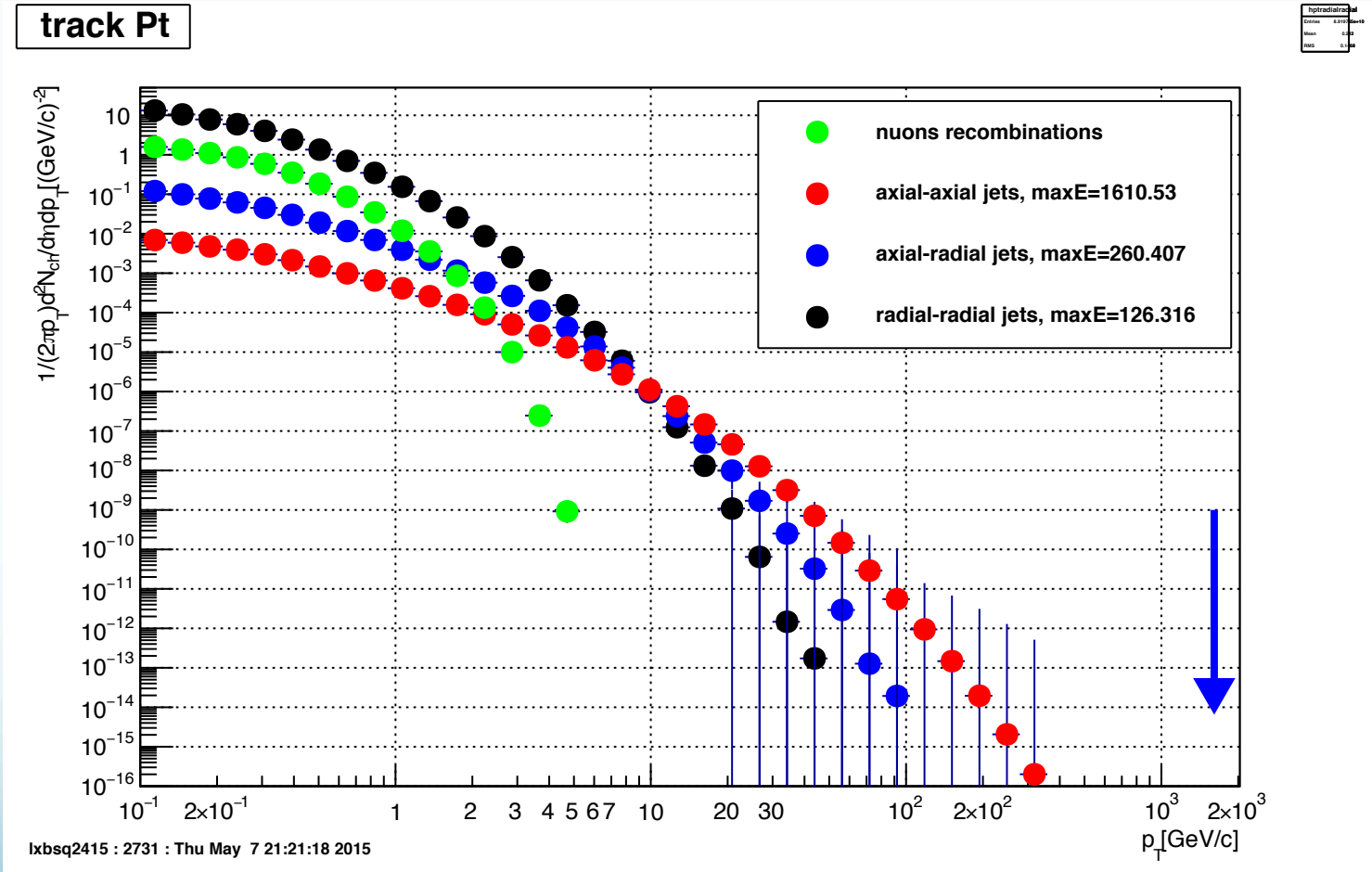


We take a Poisson distribution around the average particles multiplicity

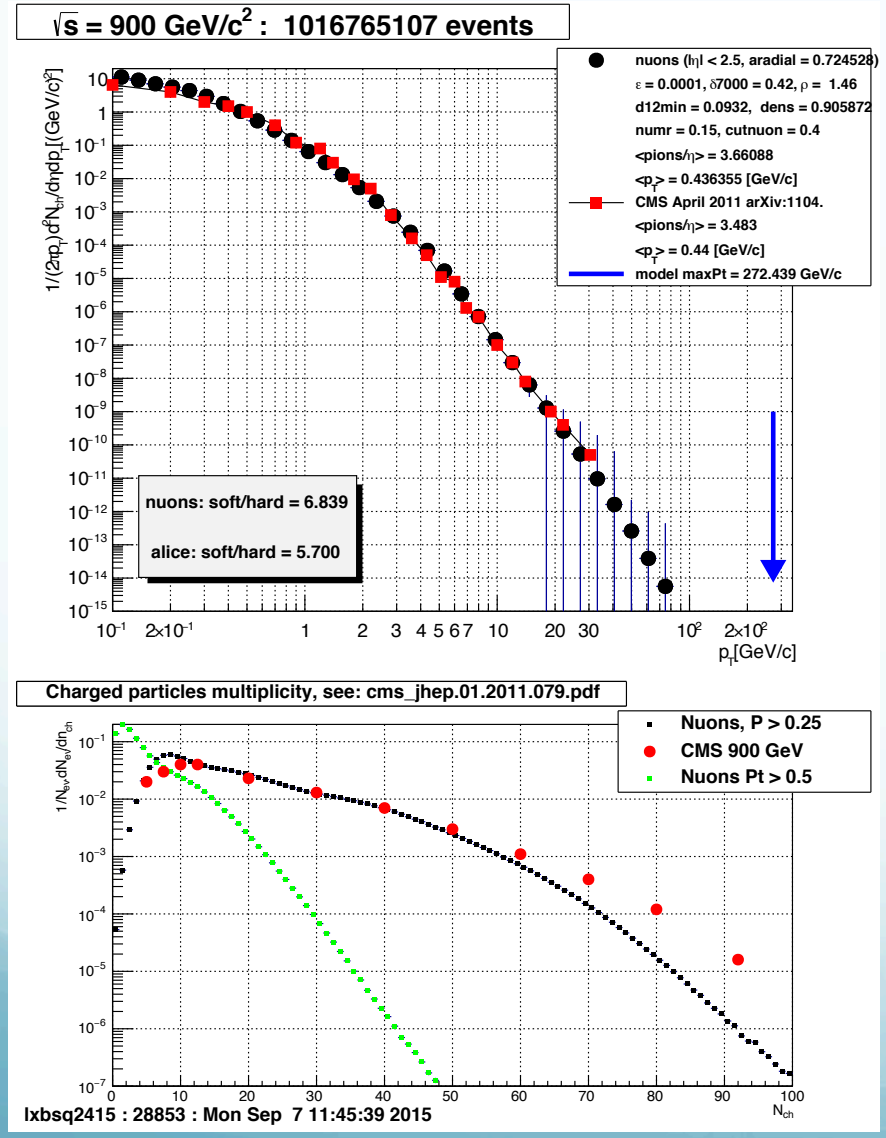
Some simple estimators



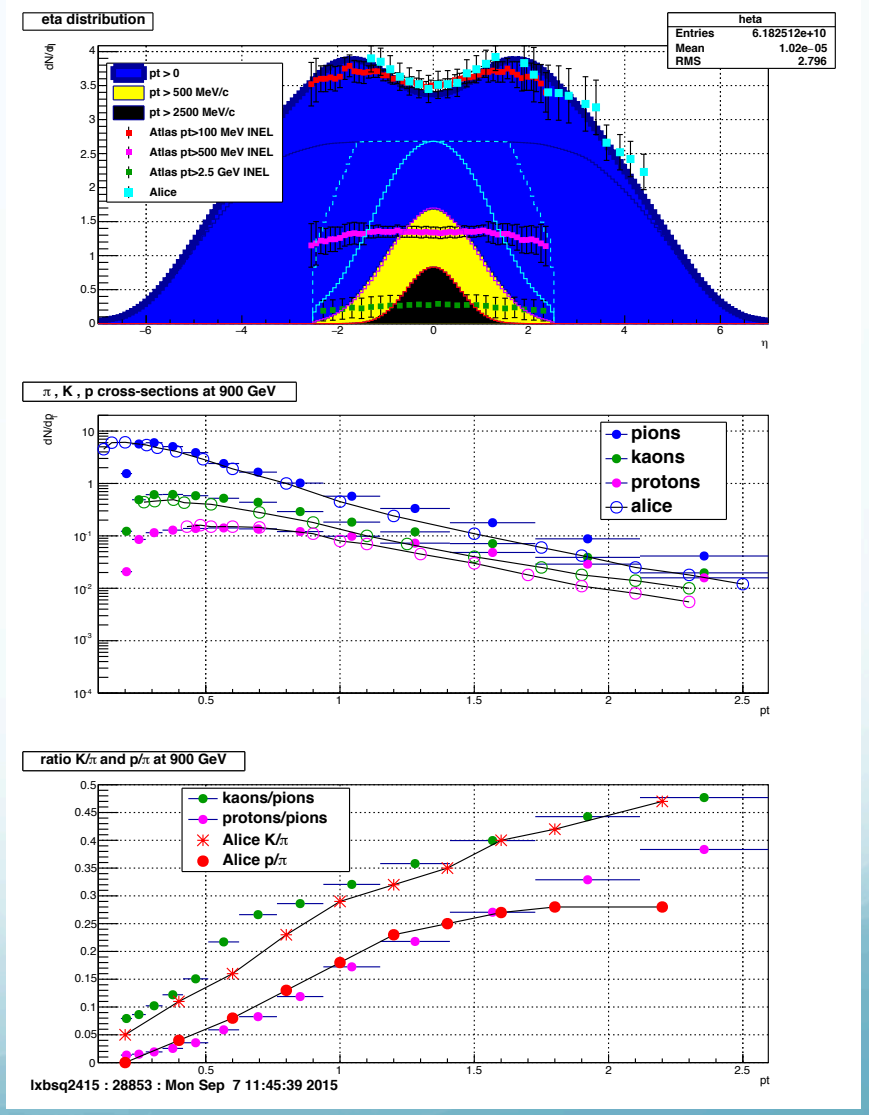
Collision types and Pt



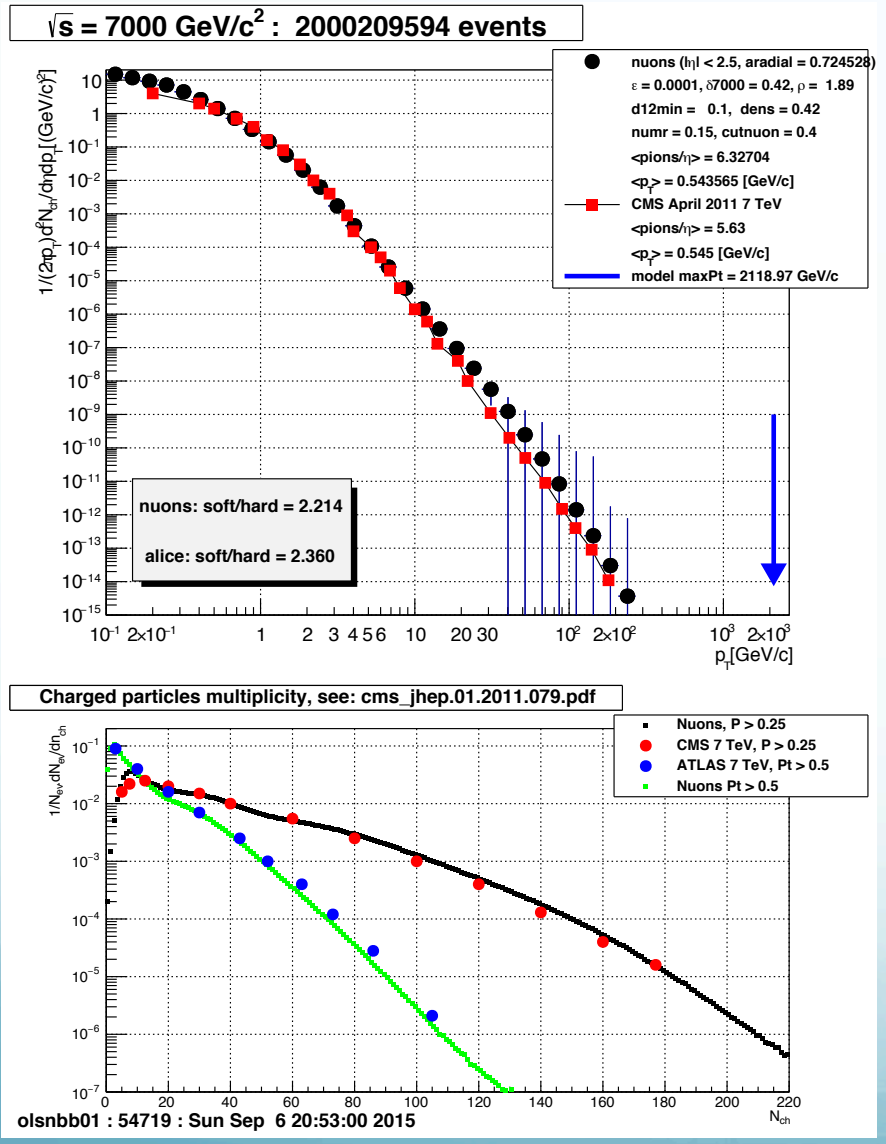
900 GeV


√s = 900 GeV/c² : 1016765107 events
nuons (|η| < 2.5, aradial = 0.724528)
ε = 0.0001, δ7000 = 0.42, ρ = 1.46
d12min = 0.0932, dens = 0.905872
numr = 0.15, cutnuon = 0.4
<pions/η> = 3.66088
<p_T> = 0.436355 [GeV/c]
CMS April 2011 arXiv:1104.
<pions/η> = 3.483
<p_T> = 0.44 [GeV/c]
model maxPt = 272.439 GeV/c
nuons: soft/hard = 6.839
alice: soft/hard = 5.700
1/(2πp_T) d²N_ch/dηdp_T [(GeV/c)⁻²]
p_T[GeV/c]

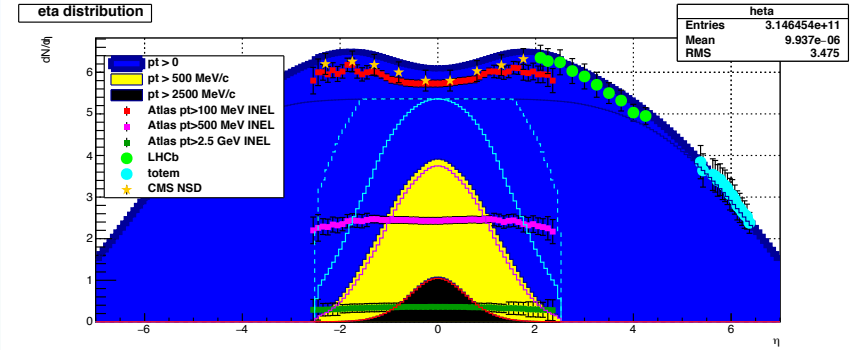
Charged particles multiplicity, see: cms_jhep.01.2011.079.pdf
Nuons, P > 0.25
CMS 900 GeV
Nuons Pt > 0.5
1/N_ev dN_ev/dn_ch
N_ch
lxbsq2415 : 28853 : Mon Sep 7 11:45:39 2015

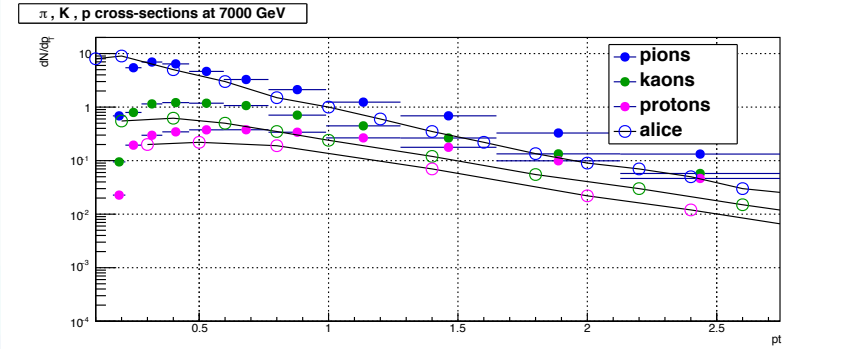

eta distribution
heta
Entries 6.182512e+10
Mean 1.02e-05
RMS 2.796
pt > 0
pt > 500 MeV/c
pt > 2500 MeV/c
Atlas pt>100 MeV INEL
Atlas pt>500 MeV INEL
Atlas pt>2.5 GeV INEL
Alice
dN/dη
η
π , K , p cross-sections at 900 GeV
pions
kaons
protons
alice
dN/dp
pt
ratio K/π and p/π at 900 GeV
kaons/pions
protons/pions
Alice K/π
Alice p/π
pt
lxbsq2415 : 28853 : Mon Sep 7 11:45:39 2015

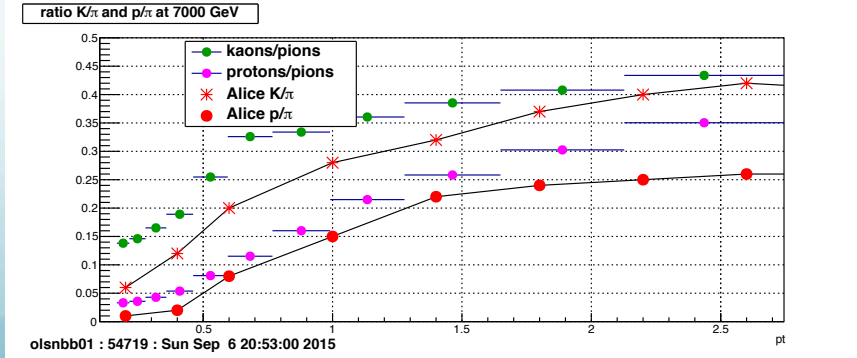
7 TeV


√s = 7000 GeV/c² : 2000209594 events
nuons (|η| < 2.5, aradial = 0.724528)
ε = 0.0001, δ7000 = 0.42, ρ = 1.89
d12min = 0.1, dens = 0.42
numr = 0.15, cutnuon = 0.4
<pions/η> = 6.32704
<p_T> = 0.543565 [GeV/c]
CMS April 2011 7 TeV
<pions/η> = 5.63
<p_T> = 0.545 [GeV/c]
model maxPt = 2118.97 GeV/c
nuons: soft/hard = 2.214
alice: soft/hard = 2.360
1/(2πp_T)d²N_ch/dηdp_T [(GeV/c)⁻²]
p_T[GeV/c]

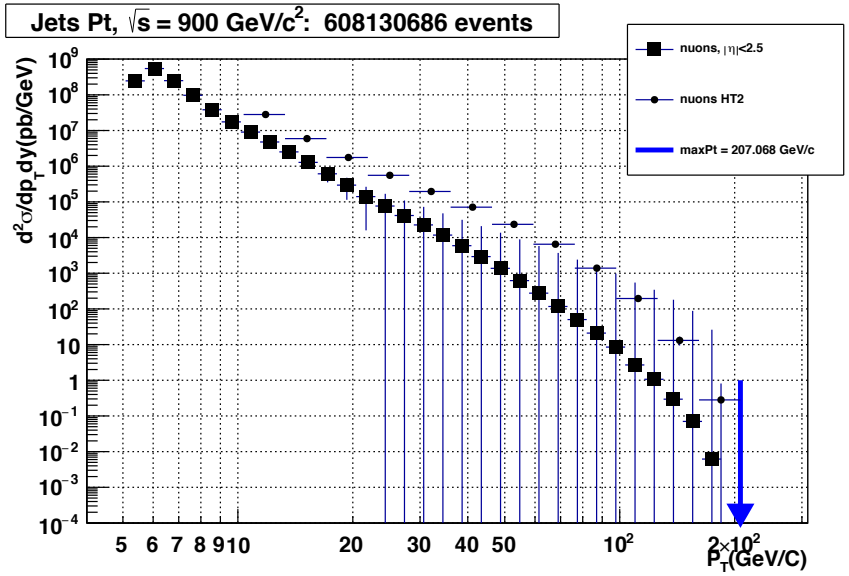
Charged particles multiplicity, see: cms_jhep.01.2011.079.pdf
Nuons, P > 0.25
CMS 7 TeV, P > 0.25
ATLAS 7 TeV, Pt > 0.5
Nuons Pt > 0.5
1/N_ev dN_ev/dn_ch
N_ch
olsnbb01 : 54719 : Sun Sep 6 20:53:00 2015

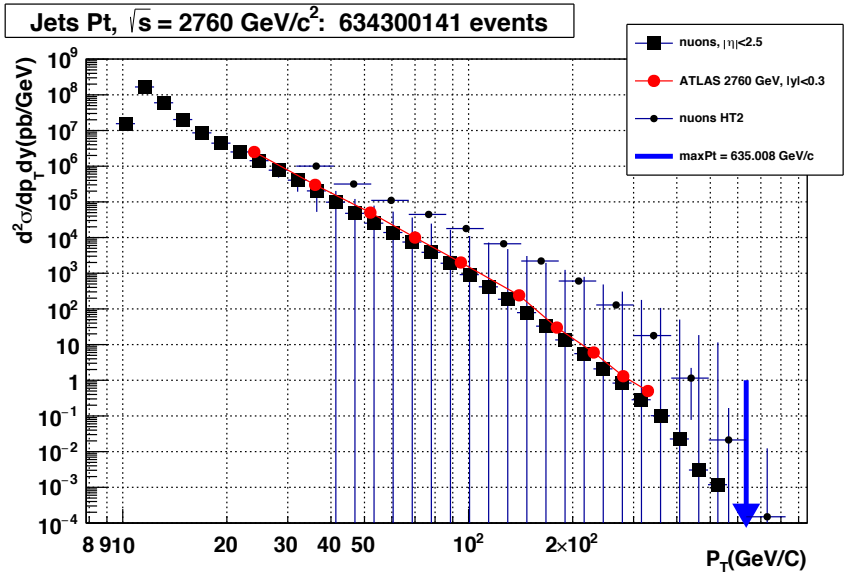

eta distribution
heta
Entries 3.146454e+11
Mean 9.937e-06
RMS 3.475
pt > 0
pt > 500 MeV/c
pt > 2500 MeV/c
Atlas pt>100 MeV INEL
Atlas pt>500 MeV INEL
Atlas pt>2.5 GeV INEL
LHCb
totem
CMS NSD
dN/dη
η

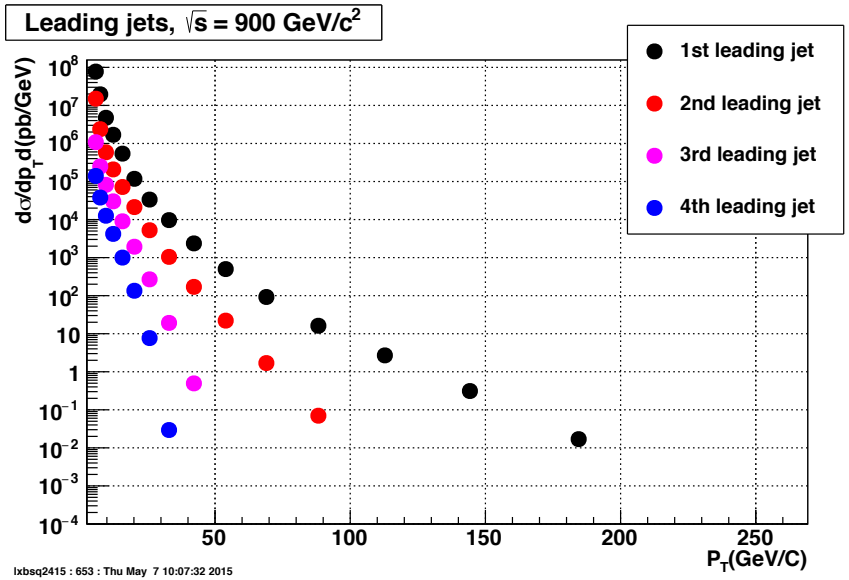

π , K , p cross-sections at 7000 GeV
pions
kaons
protons
alice
dN/dp_t
pt

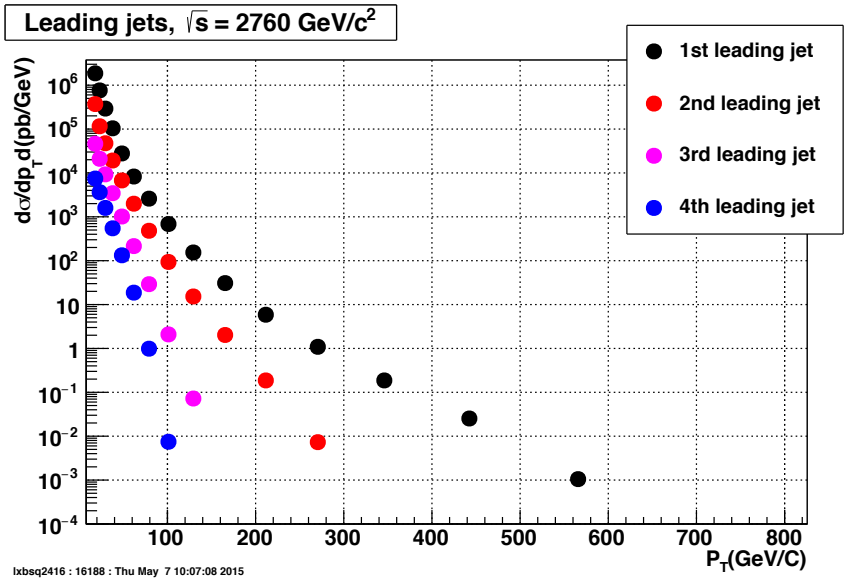

ratio K/π and p/π at 7000 GeV
kaons/pions
protons/pions
Alice K/π
Alice p/π
pt
olsnbb01 : 54719 : Sun Sep 6 20:53:00 2015

Jets 0.9, 2.76 TeV

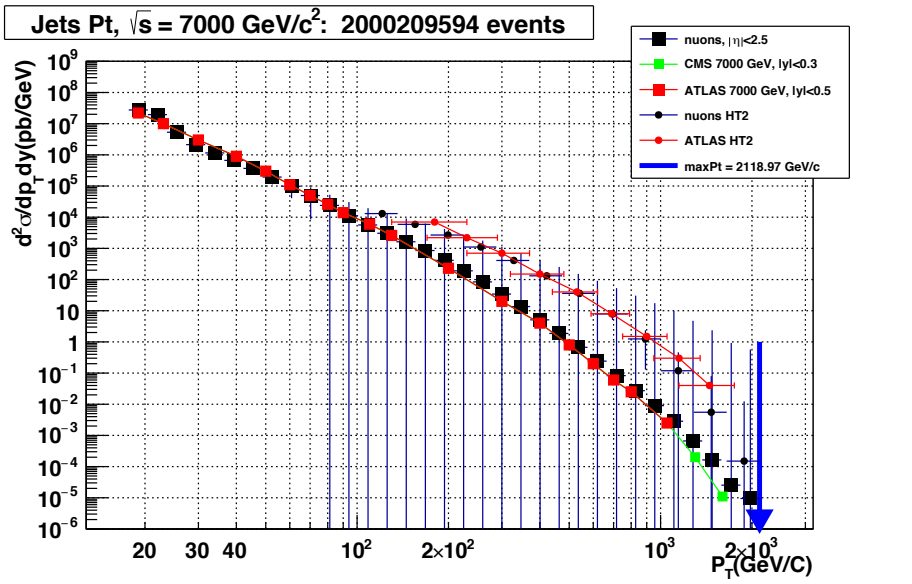


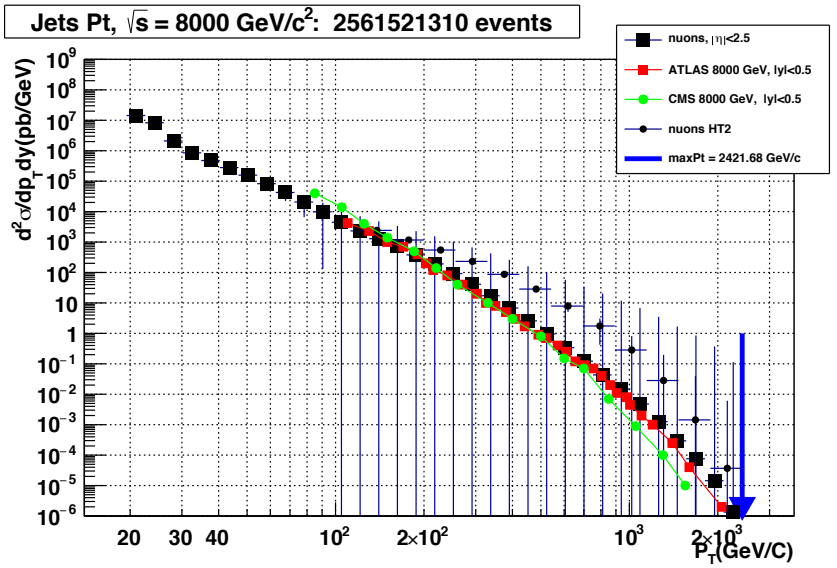


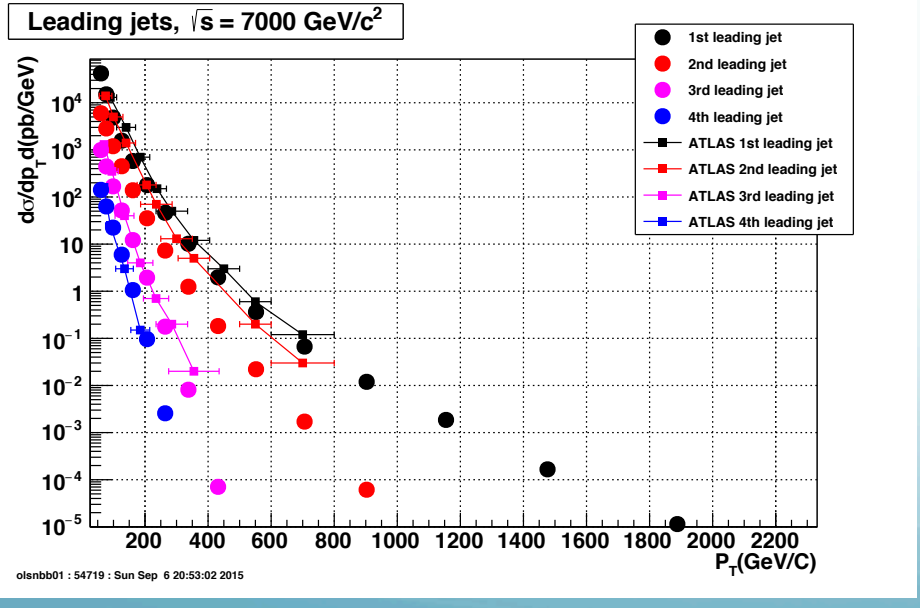


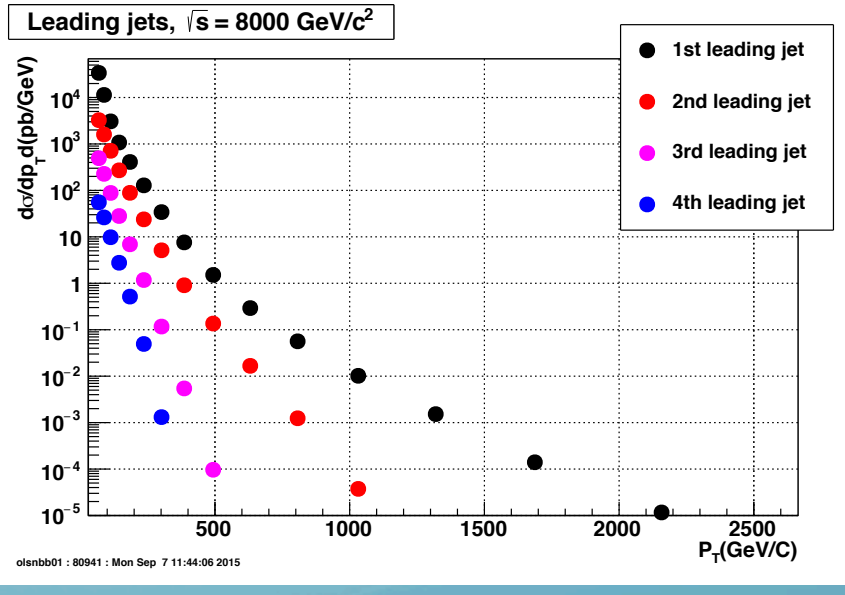


Jets 7, 8 TeV

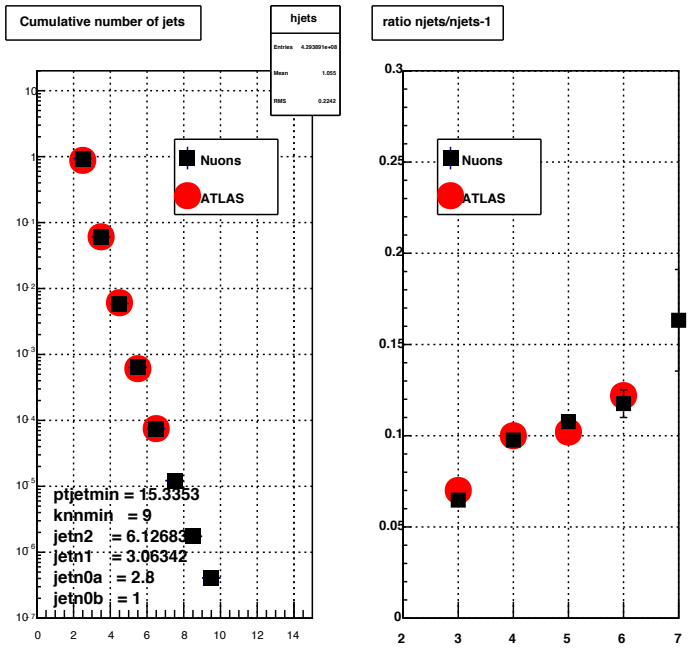

Jets Pt, √s = 7000 GeV/c²: 2000209594 events
nuons, |η|<2.5
CMS 7000 GeV, |y|<0.3
ATLAS 7000 GeV, |y|<0.5
nuons HT2
ATLAS HT2
maxPt = 2118.97 GeV/c
d²σ/dp_T dy(pb/GeV)
P_T(GeV/C)


Jets Pt, √s = 8000 GeV/c²: 2561521310 events
nuons, |η|<2.5
ATLAS 8000 GeV, |y|<0.5
CMS 8000 GeV, |y|<0.5
nuons HT2
maxPt = 2421.68 GeV/c
d²σ/dp_T dy(pb/GeV)
P_T(GeV/C)

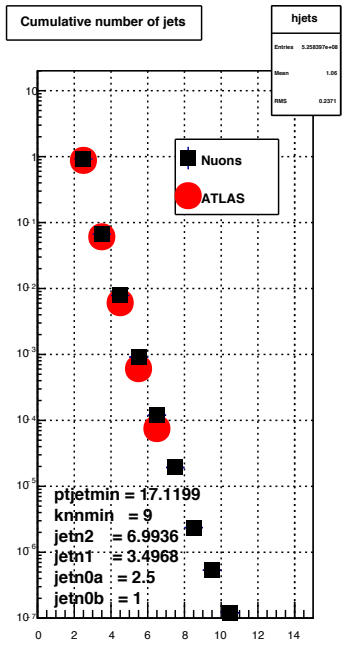

Leading jets, √s = 7000 GeV/c²
1st leading jet
2nd leading jet
3rd leading jet
4th leading jet
ATLAS 1st leading jet
ATLAS 2nd leading jet
ATLAS 3rd leading jet
ATLAS 4th leading jet
dσ/dp_T d(pb/GeV)
P_T(GeV/C)
olsnbb01 : 54719 : Sun Sep 6 20:53:02 2015

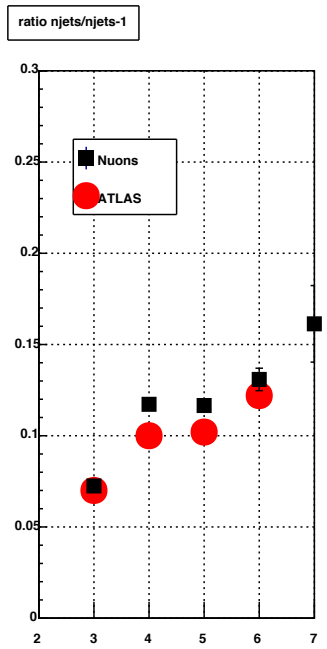

Leading jets, √s = 8000 GeV/c²
1st leading jet
2nd leading jet
3rd leading jet
4th leading jet
dσ/dp_T d(pb/GeV)
P_T(GeV/C)
olsnbb01 : 80941 : Mon Sep 7 11:44:06 2015

Inclusive Jets



7 TeV





8 TeV

Jets vs event Multiplicity

Jets compared to CMS data at $\sqrt{s}$ = 7000 GeV/c^2 : 2000209594 events

		$10< N_{ch}\leq 30$	$30< N_{ch}\leq 50$	$50< N_{ch}\leq 80$	$80< N_{ch}\leq 110$	$110< N_{ch}\leq 140$
events %	data	0.581	0.264	0.130	0.0219	0.0024
	nuon	0.581	0.263	0.137	0.0176	0.0015
p_T^{ch} particle	data	0.68 ± 0.01	0.75 ± 0.01	0.80 ± 0.01	0.85 ± 0.01	0.88 ± 0.01
	nuon	0.67	0.74	0.76	0.80	0.88
	pythia6Z2	0.67	0.74	0.80	0.85	0.90
p_T^{UE}	data	0.65 ± 0.01	0.71 ± 0.01	0.74 ± 0.01	0.76 ± 0.01	0.77 ± 0.01
	nuon	0.67	0.73	0.75	0.80	0.88
	pythia6Z2	0.65	0.70	0.74	0.76	0.77
p_T^{ij}	data	1.90 ± 0.02	1.64 ± 0.02	1.45 ± 0.01	1.32 ± 0.01	1.24 ± 0.01
	nuon	2.16	1.64	1.57	1.69	1.59
	pythia6Z2	1.86	1.62	1.44	1.33	1.29
p_T^{ijl}	data	3.65 ± 0.05	3.37 ± 0.04	3.15 ± 0.03	2.96 ± 0.03	2.86 ± 0.03
	nuon	3.55	2.94	2.84	3.02	2.97
	pythia6Z2	3.59	3.33	3.10	2.97	3.05
p_T^{ch} jet	data	6.85 ± 0.06	7.04 ± 0.09	7.18 ± 0.09	7.46 ± 0.11	7.81 ± 0.10
	nuon	7.01	6.89	6.80	7.31	8.16
	pythia6Z2	7.01	7.20	7.30	7.64	8.15
ch.jets/event pt>5	data	0.054 ± 0.004	0.287 ± 0.014	0.84 ± 0.03	2.13 ± 0.09	3.68 ± 0.15
	nuon	0.045	0.134	0.259	0.521	0.704
	pythia6Z2	0.067	0.304	0.87	2.12	3.95
ch.jets/event pt>30	data	$(3.2 \pm 0.5)10^{-5}$	$(3.4 \pm 0.4)10^{-4}$	$(1.5 \pm 0.1)10^{-3}$	$(4.3 \pm 0.4)10^{-3}$	$(1.0 \pm 0.1)10^{-2}$
	nuon	$(6.1 \pm 0.1)10^{-5}$	$(3.5 \pm 0.0)10^{-4}$	$(0.4 \pm 0.0)10^{-3}$	$(3.6 \pm 0.0)10^{-3}$	$(1.2 \pm 0.0)10^{-2}$
	pythia6Z2	$(2.7 \pm 0.3)10^{-5}$	$(3.5 \pm 0.2)10^{-4}$	$(1.4 \pm 0.2)10^{-3}$	$(5.7 \pm 0.4)10^{-3}$	$(2.1 \pm 0.1)10^{-2}$

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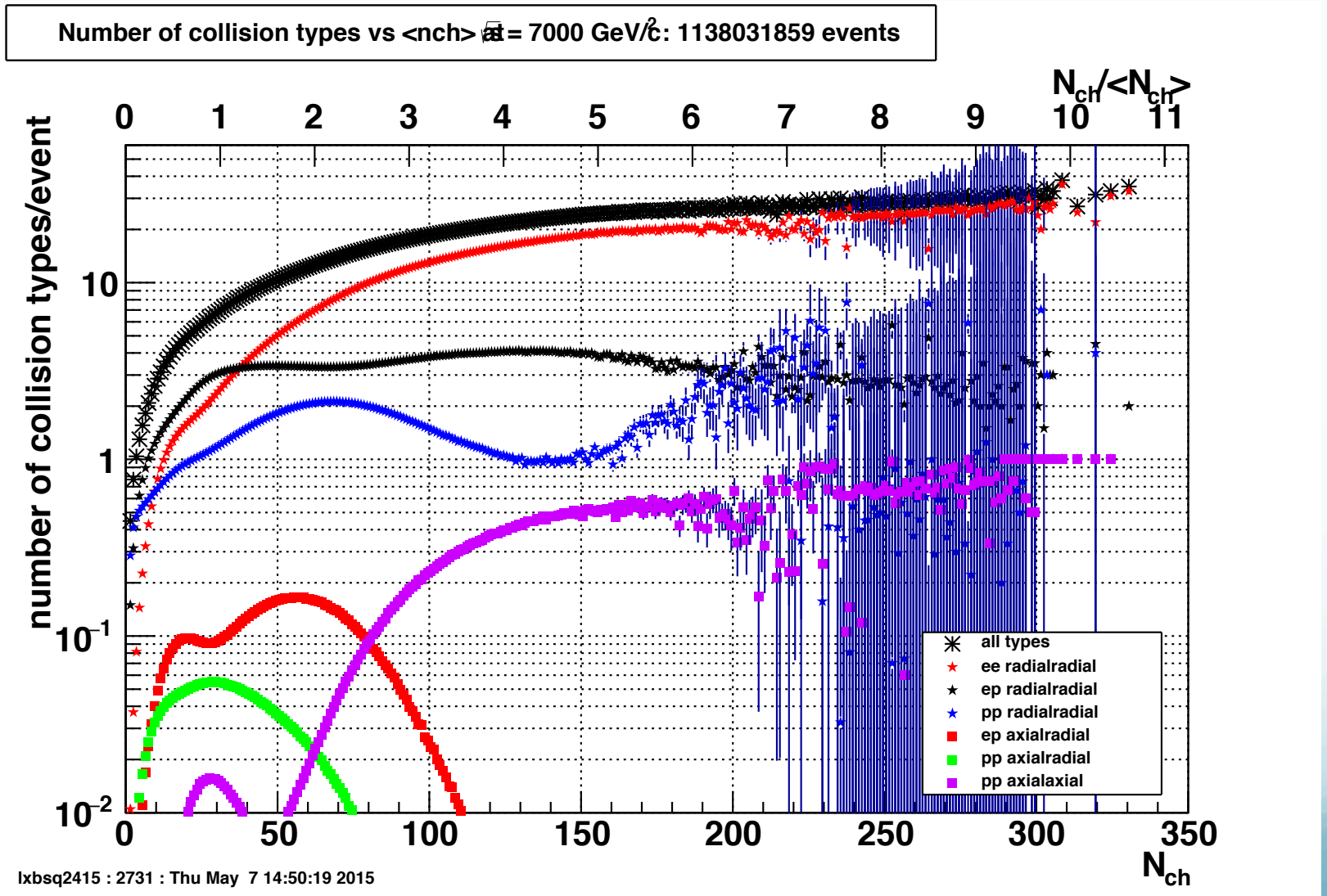
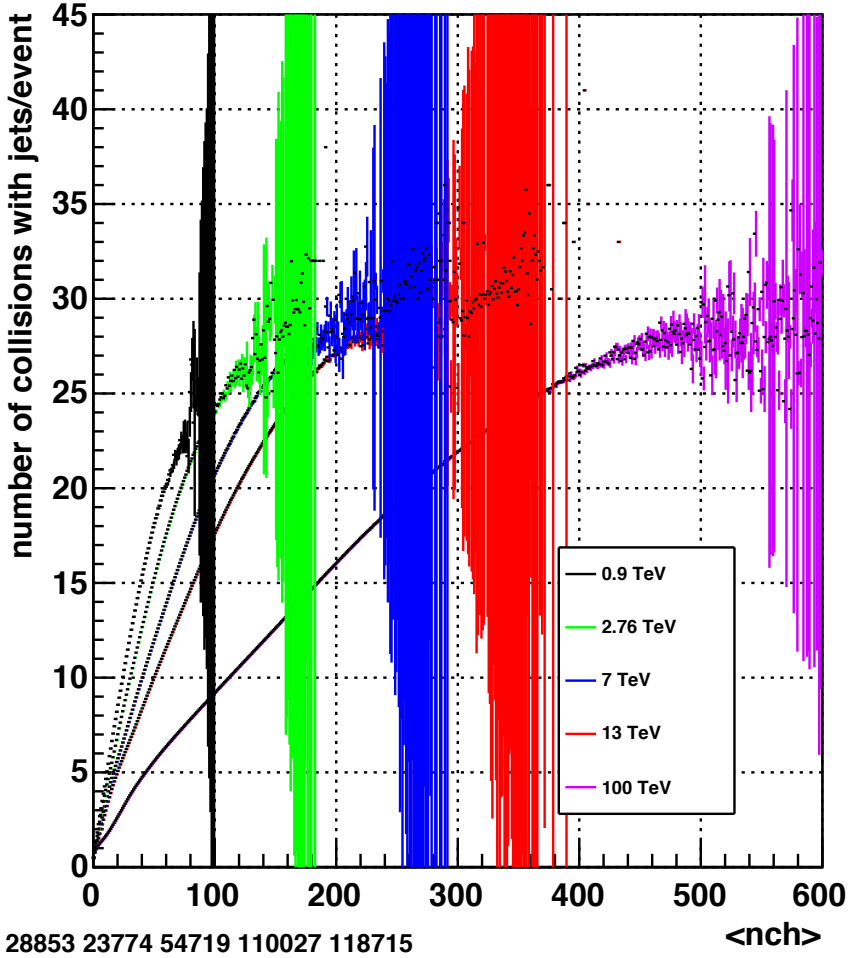
see : CERN-PH-EP/2013-195 (arXiv:submit/0825507)

Collision types vs multiplicity

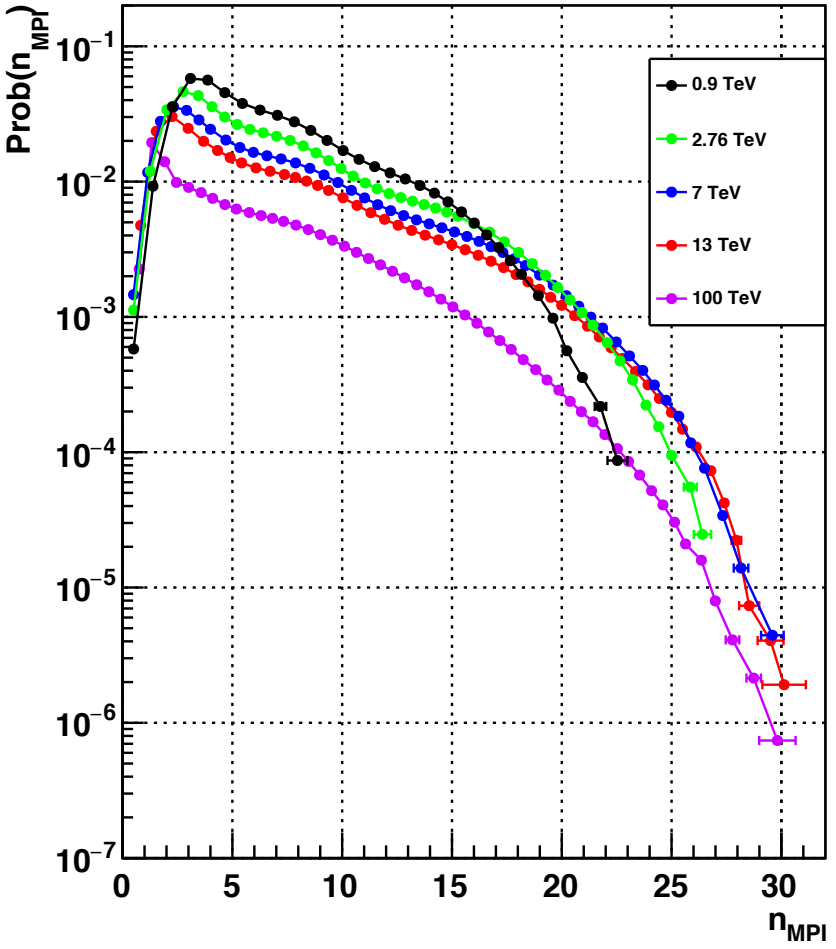


MPI vs Energy and multiplicity

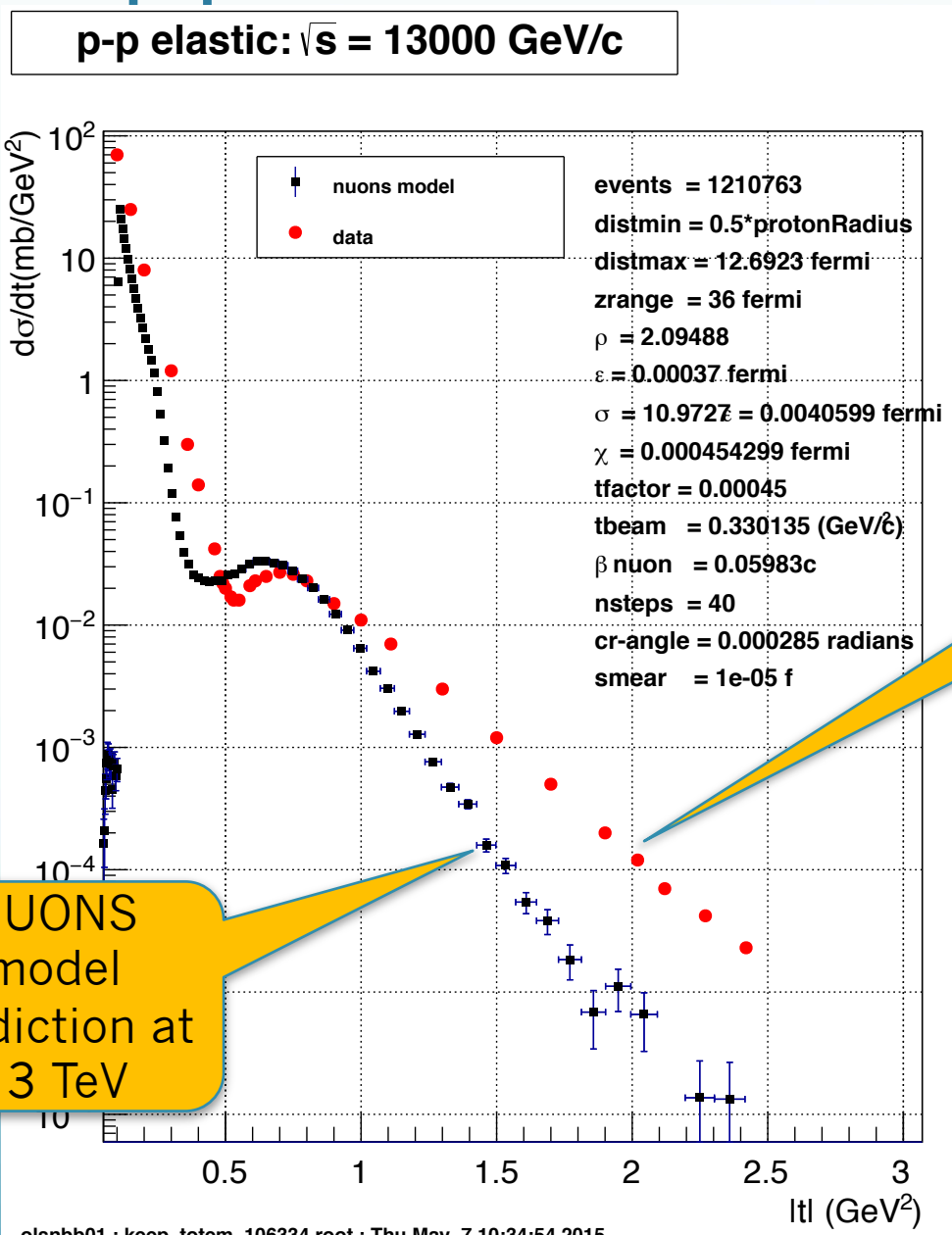
number of collisions vs multiplicity



Probability of Multiple Interactions

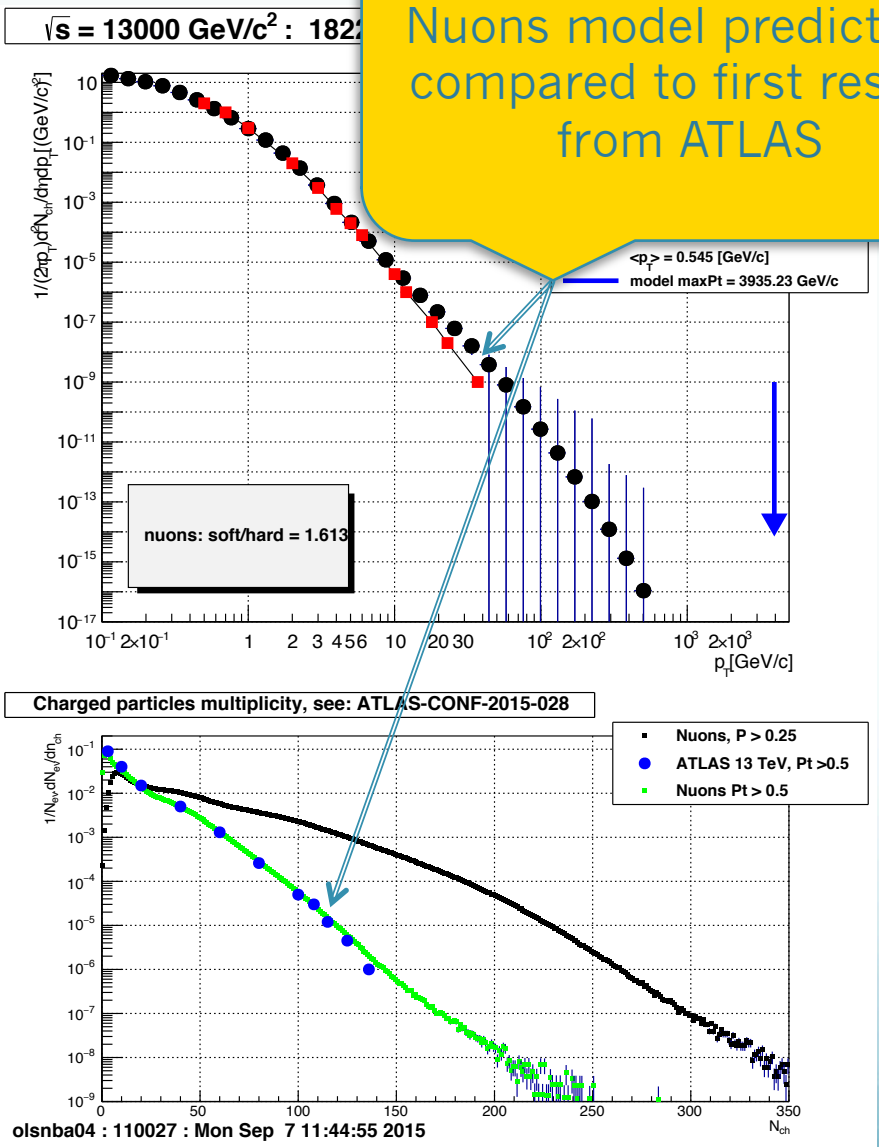
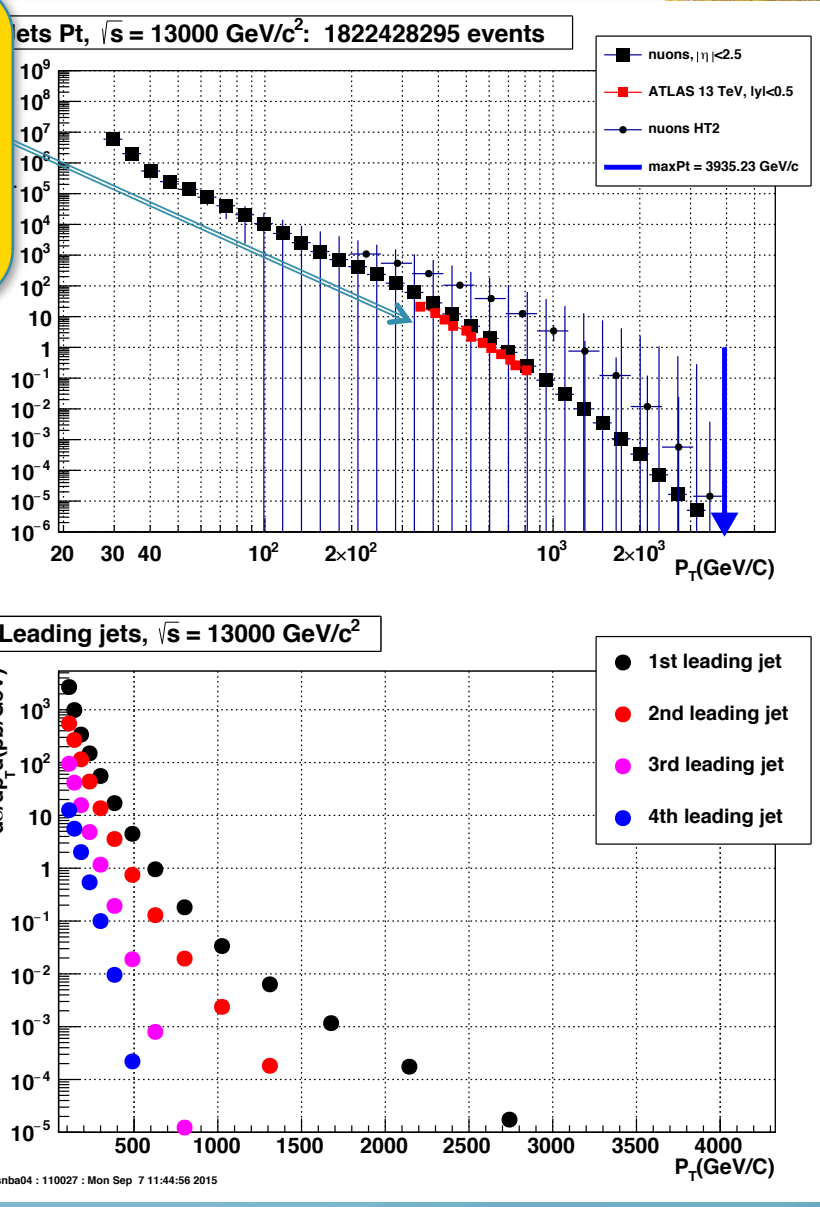


pp elastic at 13 TeV



NUONS model prediction at 13 TeV

TOTEM results at 7 TeV

Collisions at 13 TeV

Nuons model predictions compared to first results from ATLAS