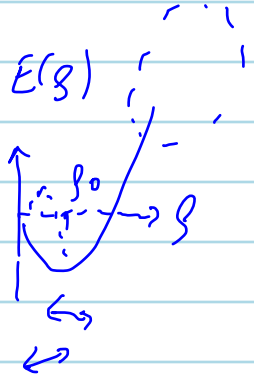
MID '80 $A + \Delta$? $E^{?} = E\left(\frac{N-Z}{A}\right)$

$p + \Delta$

$^3He + \Delta$



$E\{f\}$

σ $X_1 + X_2 \to X_1' + X_2'$ $N + N \to N + \Delta$

RATES ↪ $\pi + N$

σ - EXPT $\Delta + \Delta$

↪ $\pi + N$

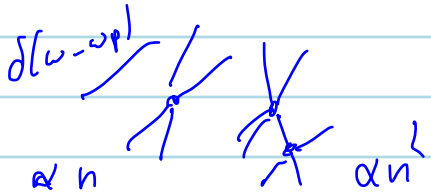
DETAILED BALANCE

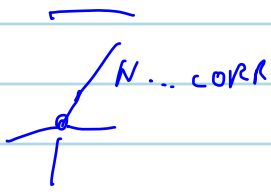
$$|\mathcal{M}_{\rightarrow}|^2 = |\mathcal{M}_{\leftarrow}|^2$$

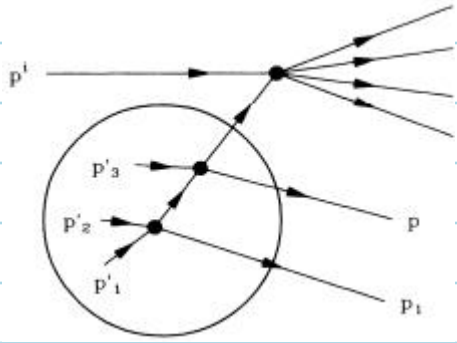
GENERAL AGREEMENT AT HIGH ENERGIES

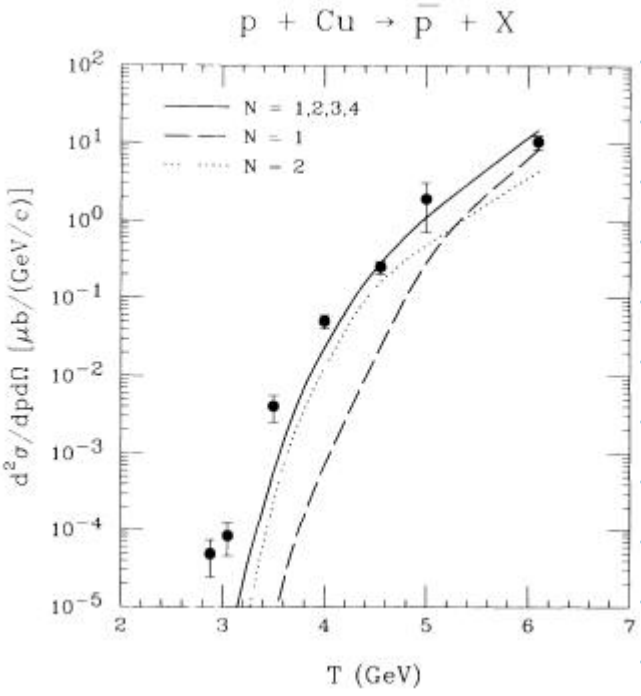
N, π, Δ K, Λ N^* ρ ω

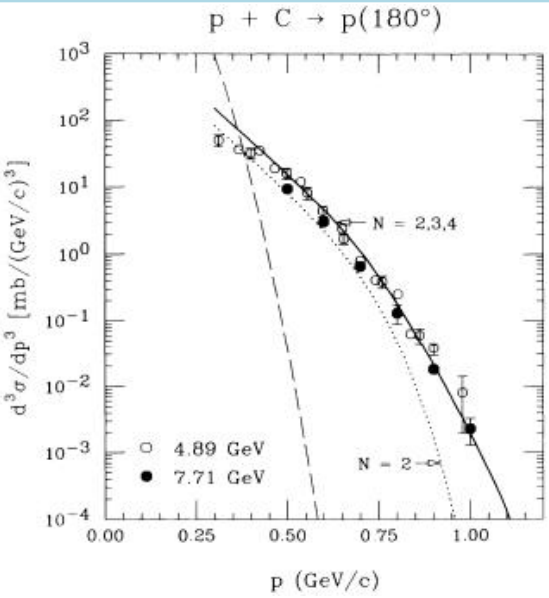
$N + (N)_{CORR} \to$











SUBTHRESHOLD KAON PRODUCTION

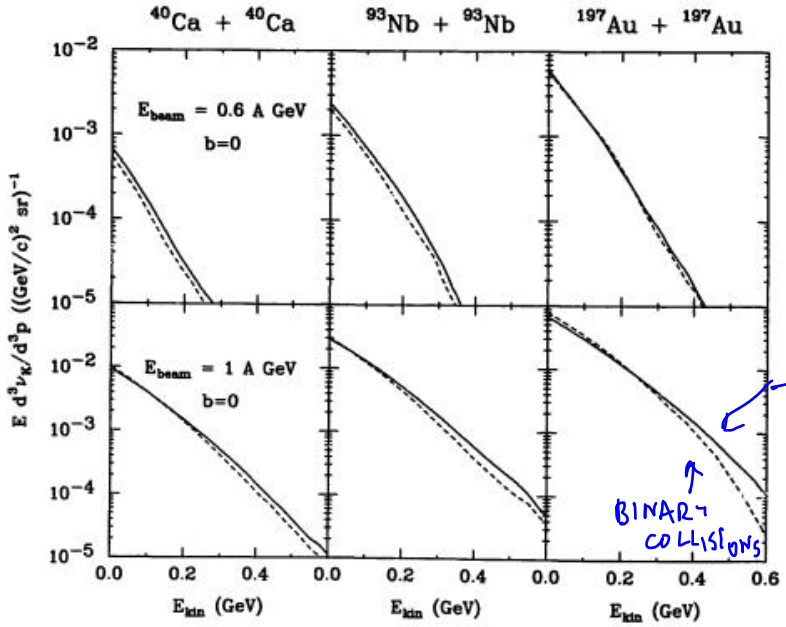
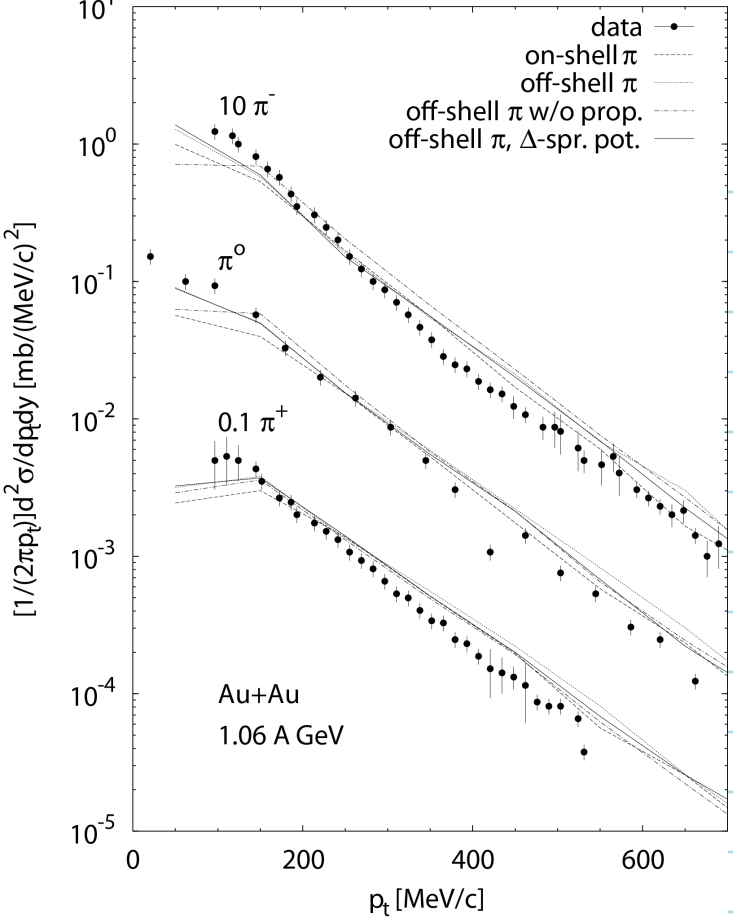
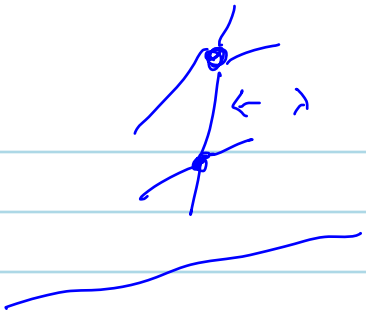
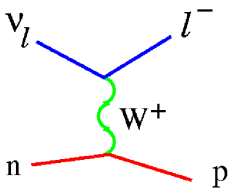


Fig. 4. The invariant K^+ energy spectrum as a function of the kinetic energy of the kaon at $\theta = 90°$ in the overall c.m. frame.

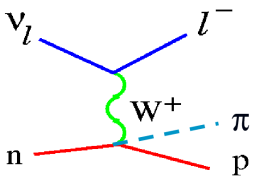




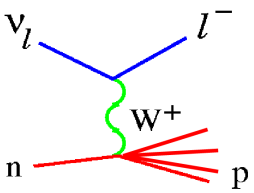
CCQE

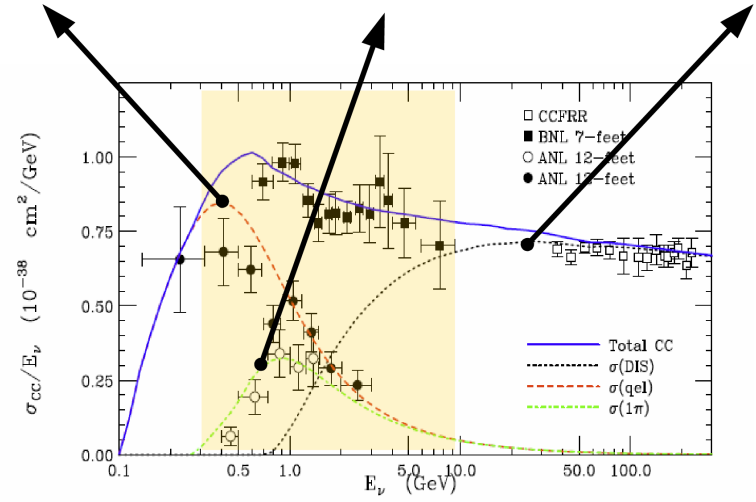


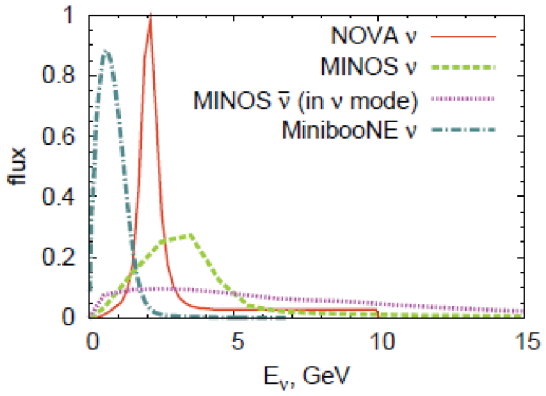
1-pion

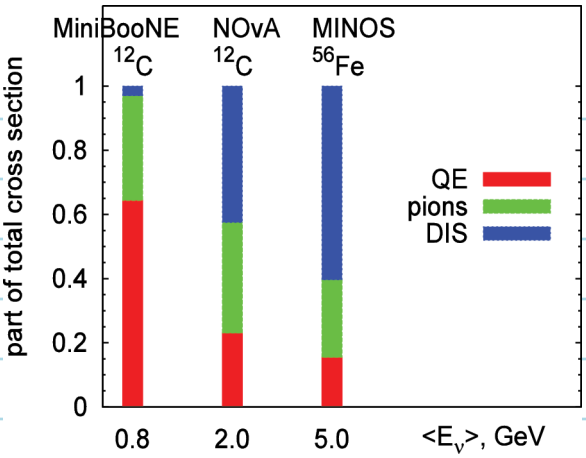


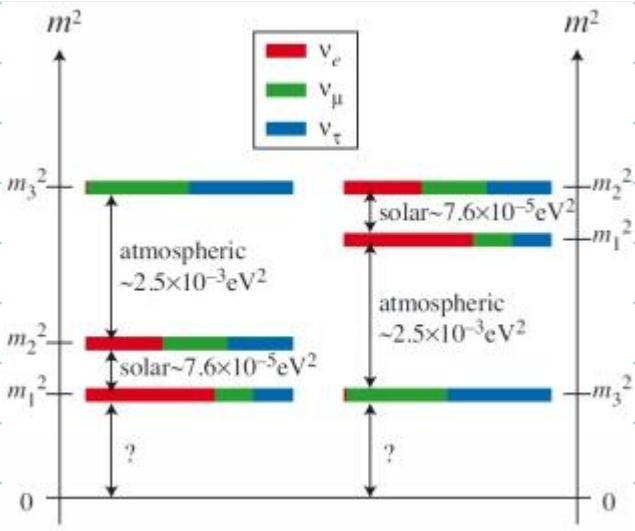
DIS (= „>1 pion“)











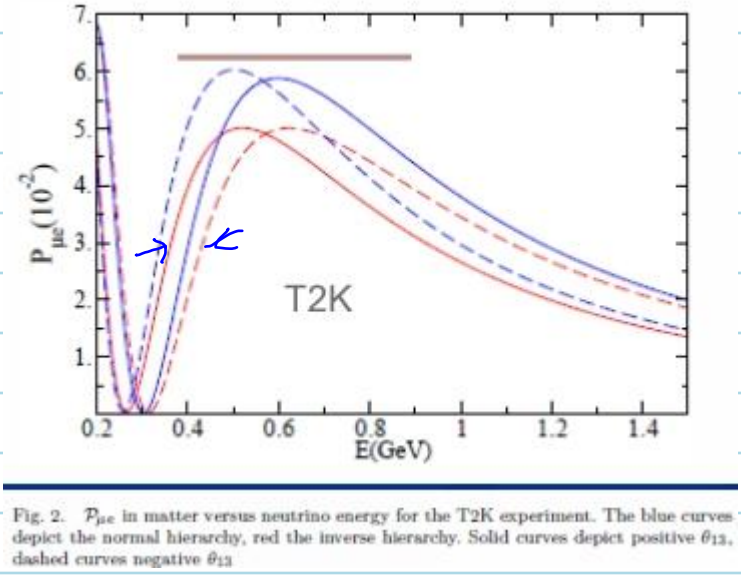
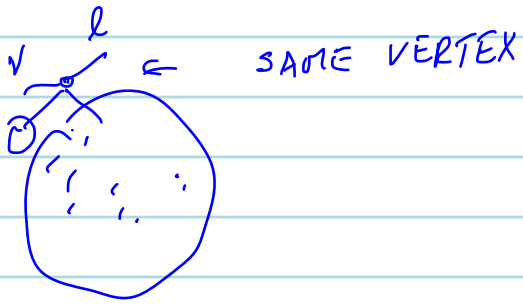


Fig. 2. $\mathcal{P}_{\mu e}$ in matter versus neutrino energy for the T2K experiment. The blue curves depict the normal hierarchy, red the inverse hierarchy. Solid curves depict positive θ_{13}, dashed curves negative θ_{13}

~ 50-100 MeV ACCURACY NEEDED

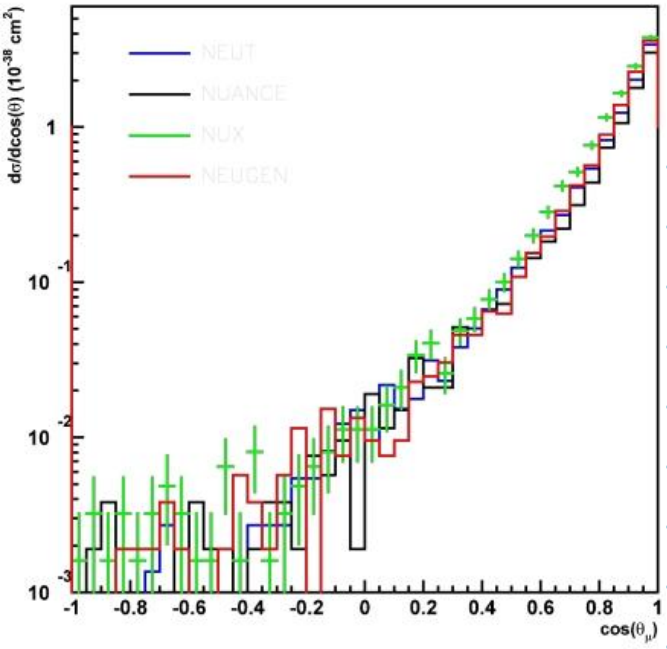


NUANCE

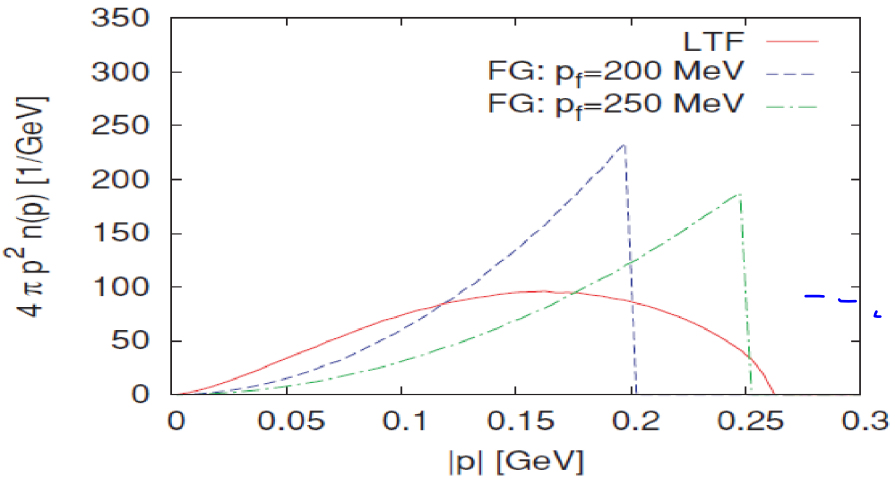
FERMI GAS MODEL

CONSTANT FERMI MOMENTUM

K - PHASE-SPACE SHRINKING FACTOR



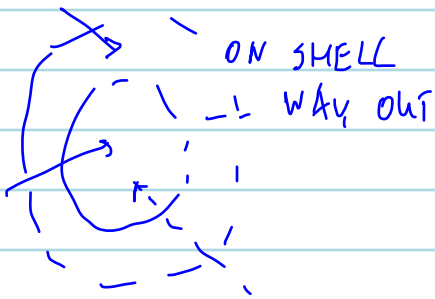
E_ν = 1 GeV



$S(p, \omega)$

↑ ENERGY

$\int d^3r\, S(p, \omega, \rho(r))$



NEUT: FERMI-GAS MODEL

TWEAKED Δ DECAY ↙

RESCATTERING: CASCADE MODEL + MEAN FREE PATH

↑

GENIE: HADRONIZATION: PYTHIA & KNO SCALING

FERMI GAS / SPECTRAL FUNCTION

CASCADE MODEL

ANY TRANSPORT MODEL + EW VERTEX

GIBUU: MOST INVESTMENT DONE

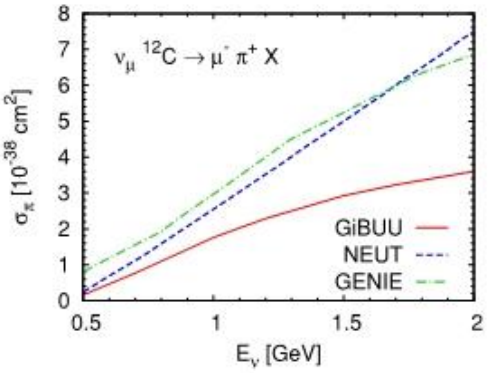
NUCLEAR TRANSPORT: PHENOMENOLOGY W/MICROSCOPIC JUSTIFICATIONS

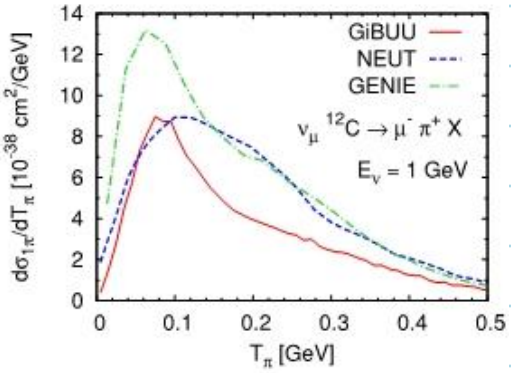
- CASCADE MODEL (SIMPLE, ANTIQUE
- MOLECULAR DYNAMICS ? FLUCTUACTIONS?
- BOLTZMAN EQ ← GOOD ENOUGH

MANY YEARS OF EXPERIENCE

NOT THAT MANY LOOSE ENDS

IN HIGH-EN DOMAINS





← TOO BIG DISCREPANCIES RELATIVE TO TRANSPORT STANDARDS

? OTHER MODELS !

→ COMPETITION