

LHCv

Y.Itow

Nagoya LHCf meeting

7 Apr 2017

Zero degree ν at LHC

ECFA LHC workshop, CERN 90-10

F.Vannucci, IPNHE-93-03

- LHC 0-degree : ν -beam from pp-collisions
- Fully parasitic “clean” ν -beam line
- Intensive prompt ν_τ source in sub-TeV
- Try to first detection of $\nu\tau$ interactions
 - Later 4 events detected by DONUT at FNAL in 1997 (published in 2000)

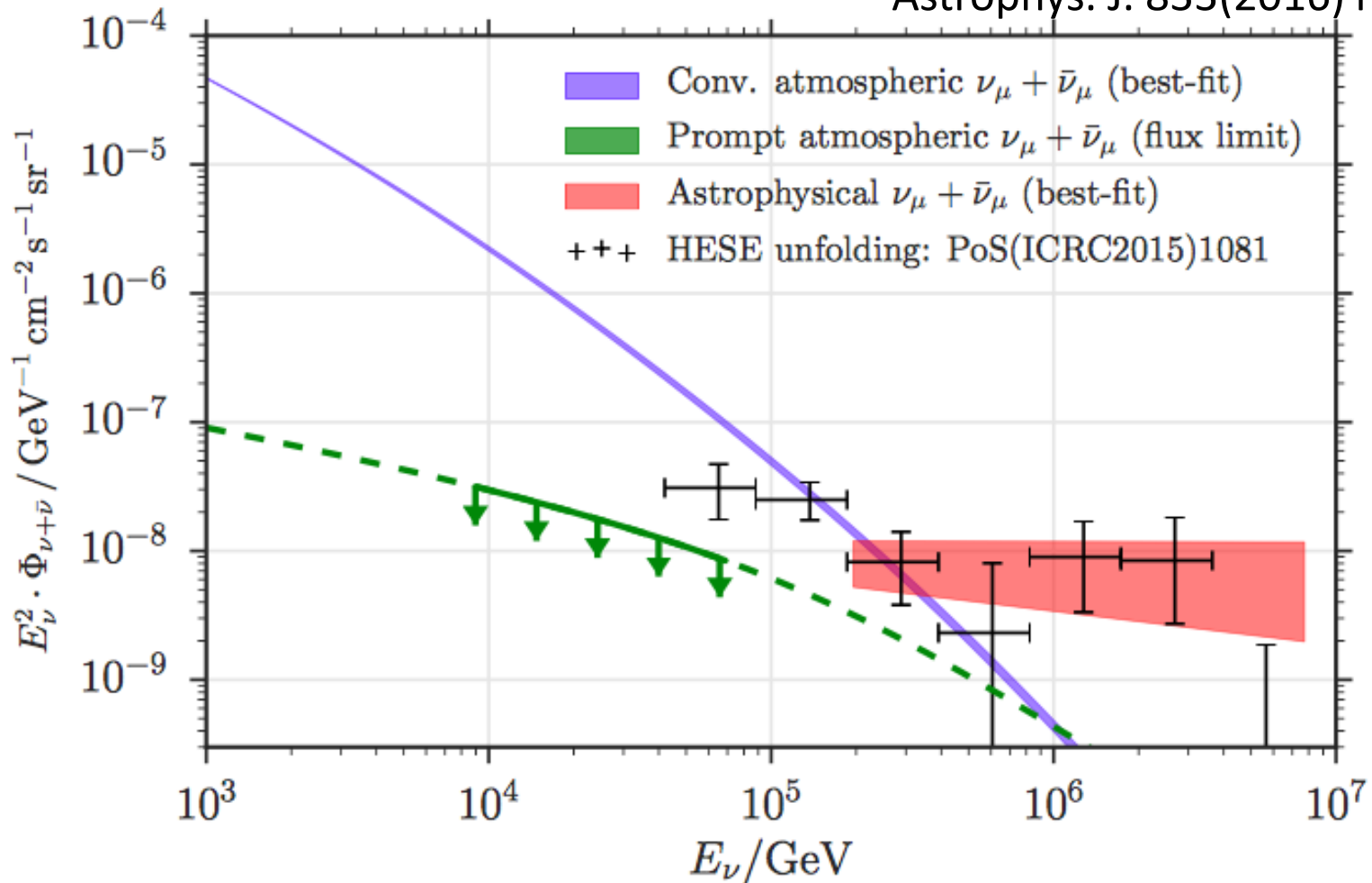
Some new motivation ?

- Atmospheric prompt ν from charm (i.e. IceCube)
- UHE ν production from 10^{17} eV CR
- Study 10^4 $\nu\tau$ interactions
- Diffractive heavy quark production
- And,...
- $\nu\tau$ - $\nu\chi$ oscillations ?
- Non-standard ν interaction at TeV ? (nuTeV@FNAL)
- Heavy neutral lepton from $\sqrt{s}=13$ TeV ?

IceCube sub-PeV neutrinos

IceCube collaboration

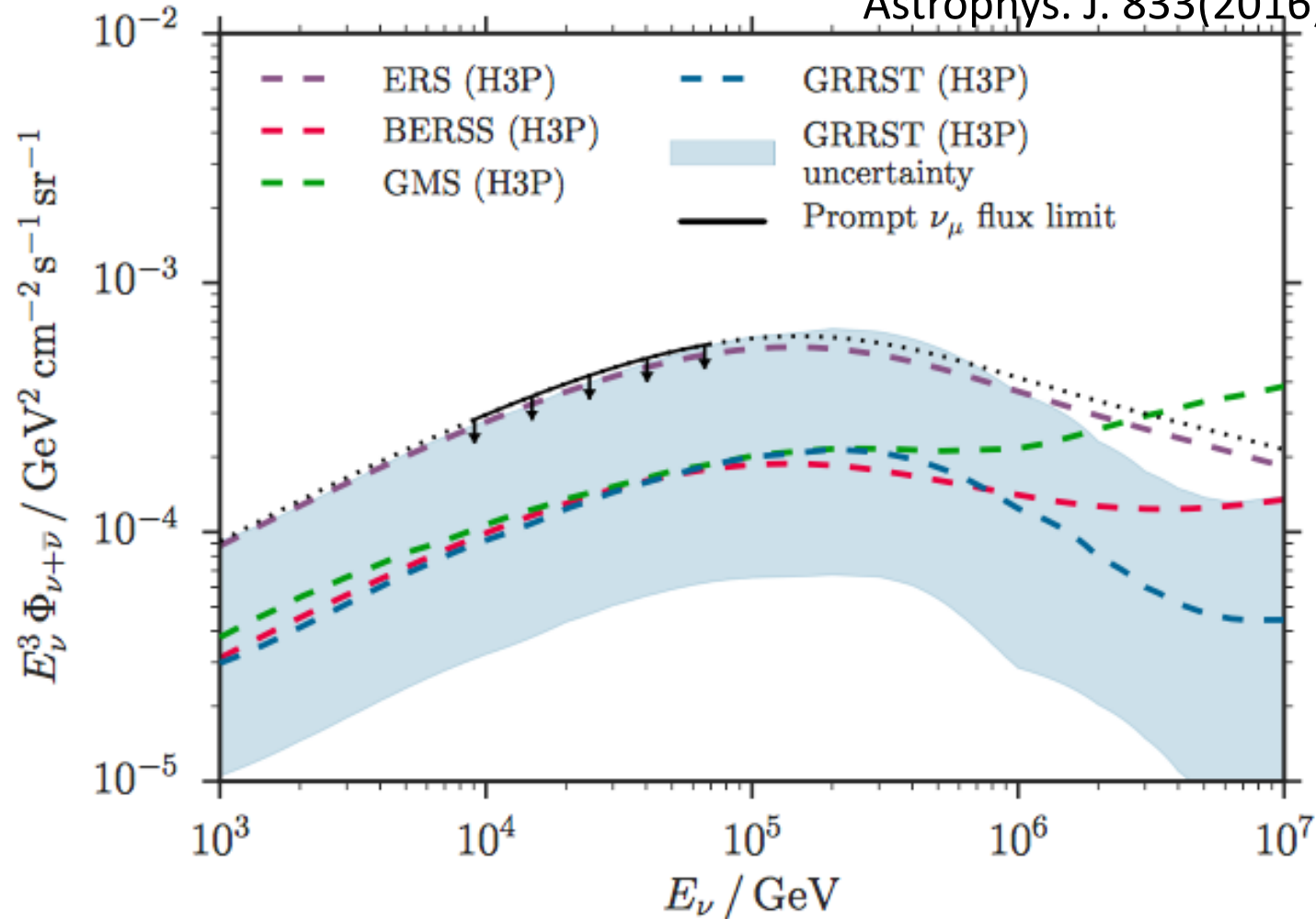
Astrophys. J. 833(2016) no.1,3



Atmospheric prompt ν_μ constraint and uncertainty

IceCube collaboration

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ν_τ flux and yields

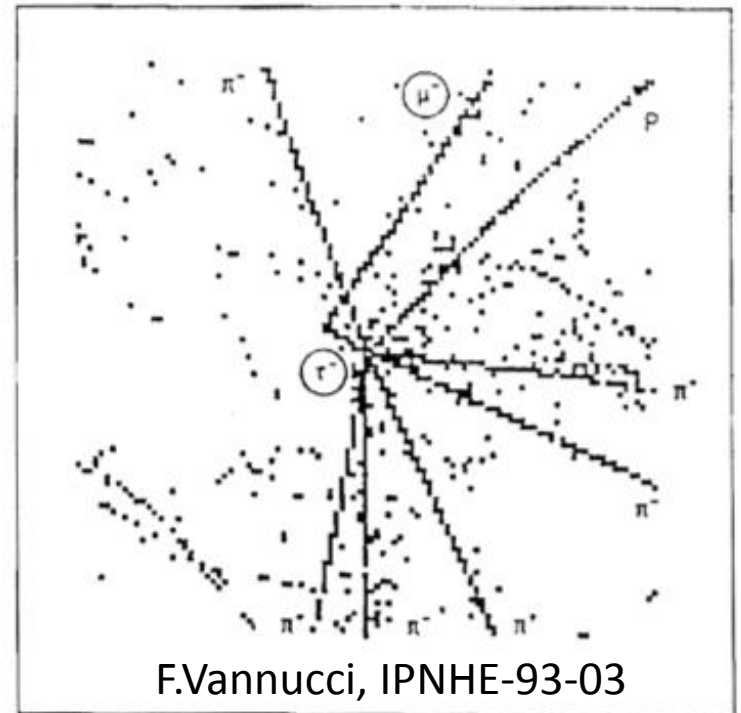
F.Vannucci, IPNHE-93-03

- $D_s \rightarrow \tau \nu_\tau$ (4% branching)
- $L=10^{34}$ cm²s⁻¹ w/ 1year (10^7 sec)
- $\sim 10^{11}$ ν_τ in 2-mrad in 500–800 GeV
- $\sim 10^{12}$ ν_τ in 20-mrad in 100–200 GeV
- $\sim 10^{13}$ ν_τ in 200-mrad in <100GeV
- $\nu_\tau : \nu_\mu, \nu_e \sim 1:10$

$\sigma \sim 10^{-36}$ cm², 1t target in 2-mrad (10^6 g= $6e^{29}$ p)
 $\Rightarrow 10^{11}\nu_\tau/\text{yr} \rightarrow 10^4 \nu_\tau$ events/yr

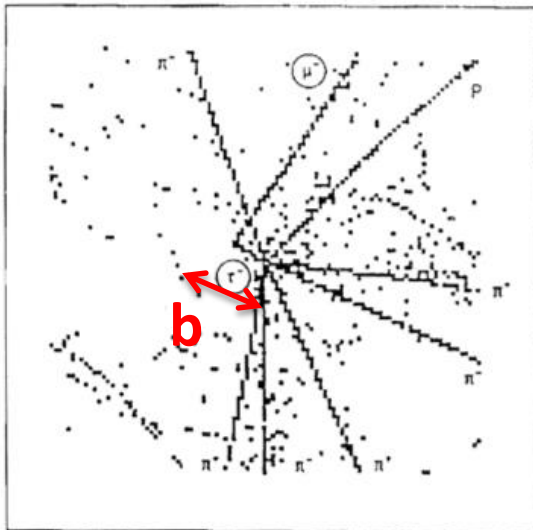
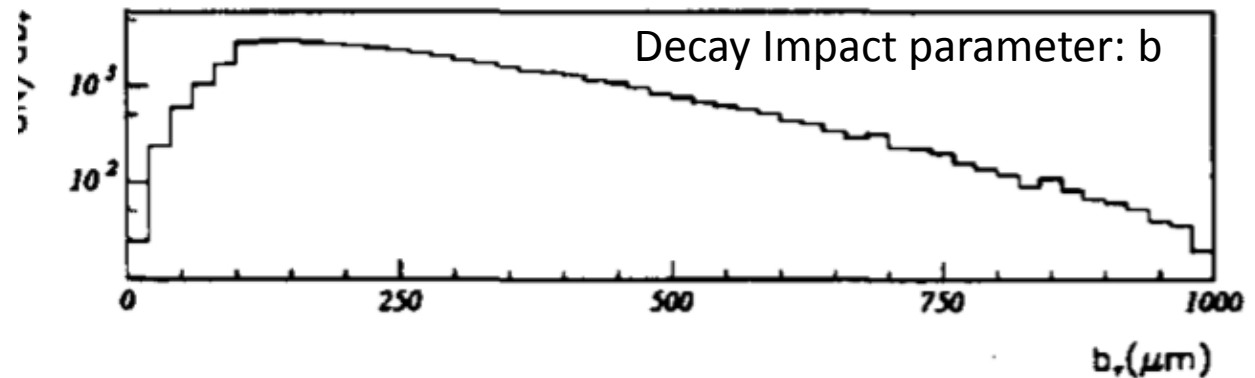
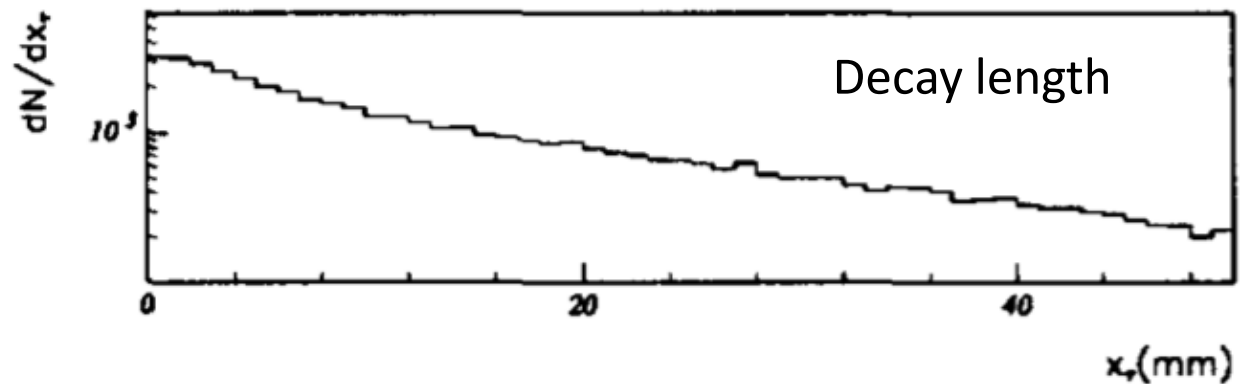
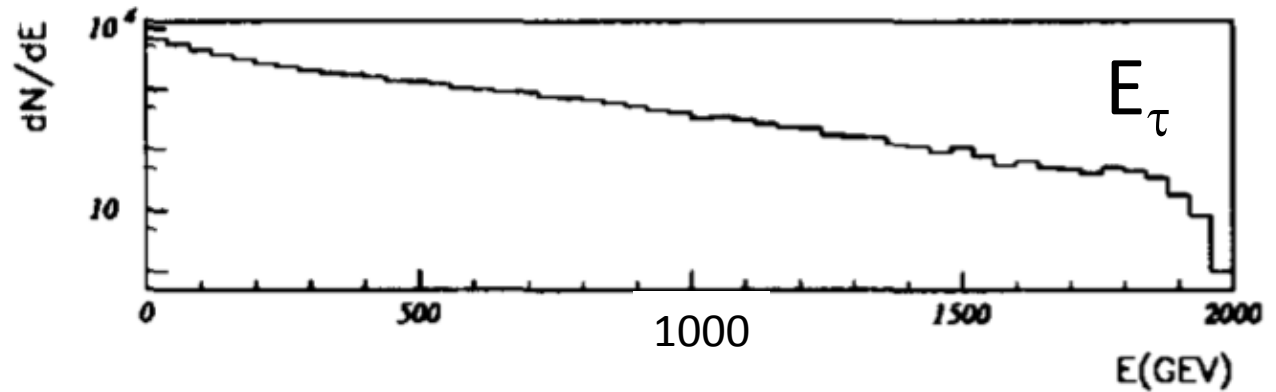
ν_τ detection

- Kink search (double bang showers)
 - $\nu_\tau + A \rightarrow \tau + \text{hadronic shower}$
 - $\tau \rightarrow e\nu\nu(17\%), \mu\nu\nu(17\%), \pi\nu(17\%), \square$
 - $c\tau = 75\mu\text{m}, m_\tau = 1.77\text{GeV}$,
 - For $E_\tau = 300\text{GeV}: \tau_L = 13\text{mm}$
- Missing P_T
 - Momentum in-balance in transversal plane



ν and τ spectrum

- $E_\nu = 0.2 - 2 \text{ TeV}$,
ave. $\sim 0.7 \text{ TeV}$

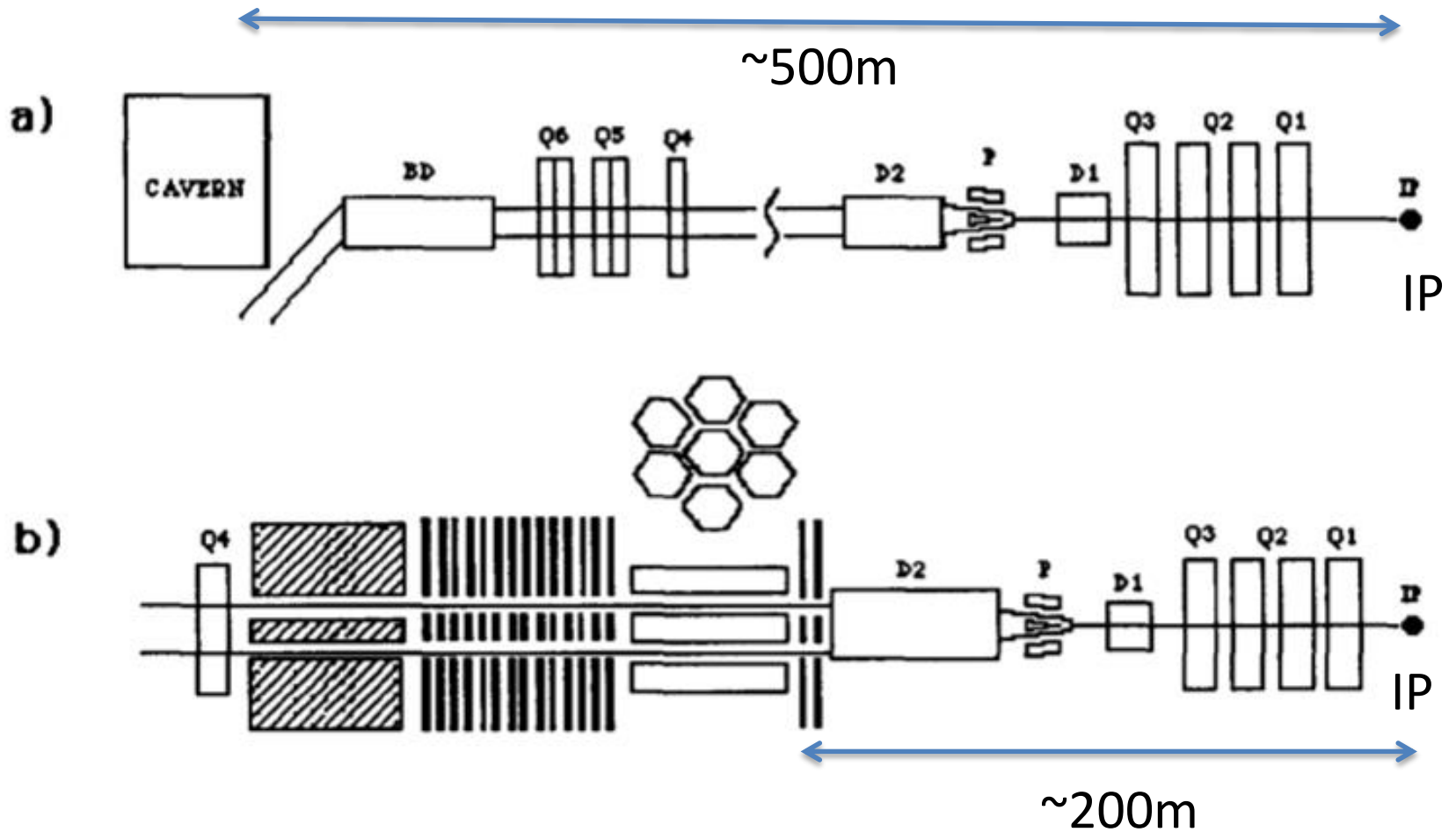


Detector (2-mrad acceptance, 1t scale)

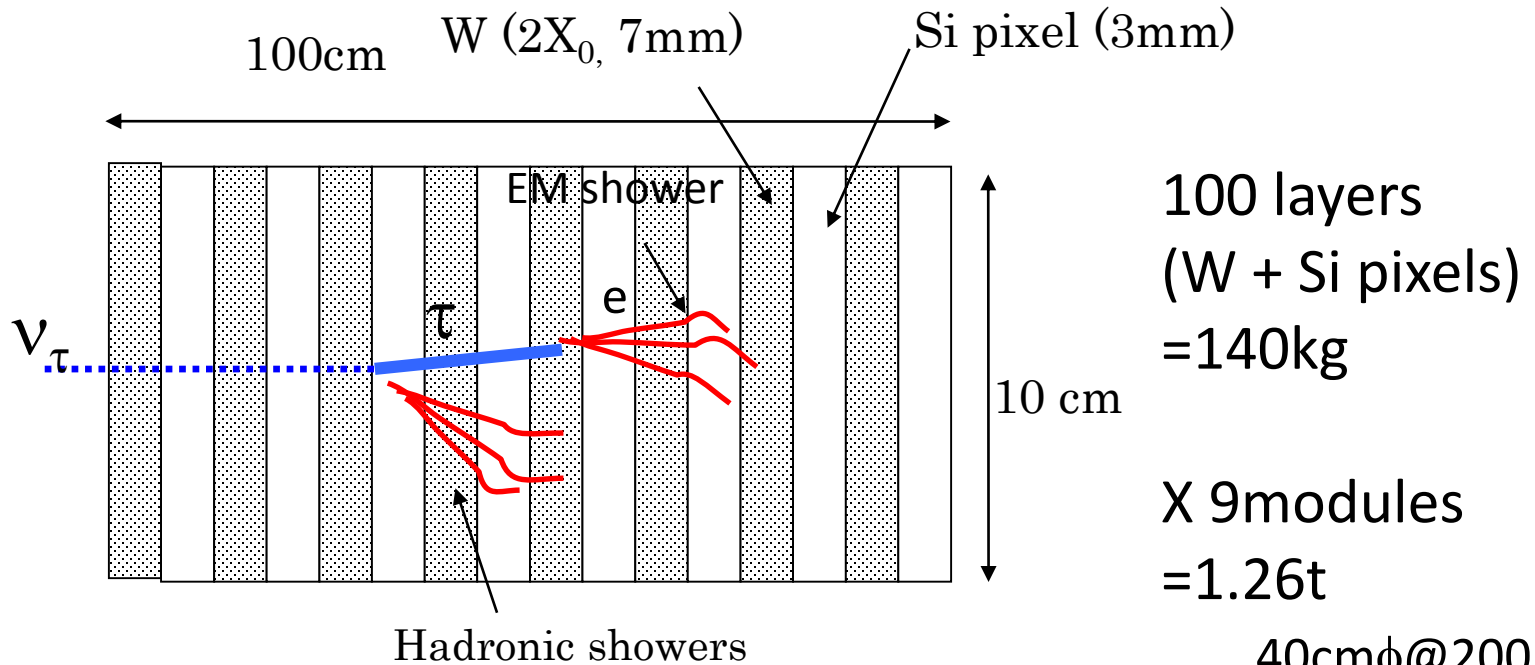
- Key-1 : Contain TeV EM showers
- Key-2 : Micro-vertex :Double-bang showers
- W-sampling pixel-imaging calorimeter
- Lq Ar or Lq Xe TPC, or water Cherenkov?

Possible location

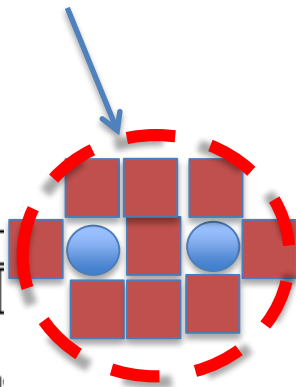
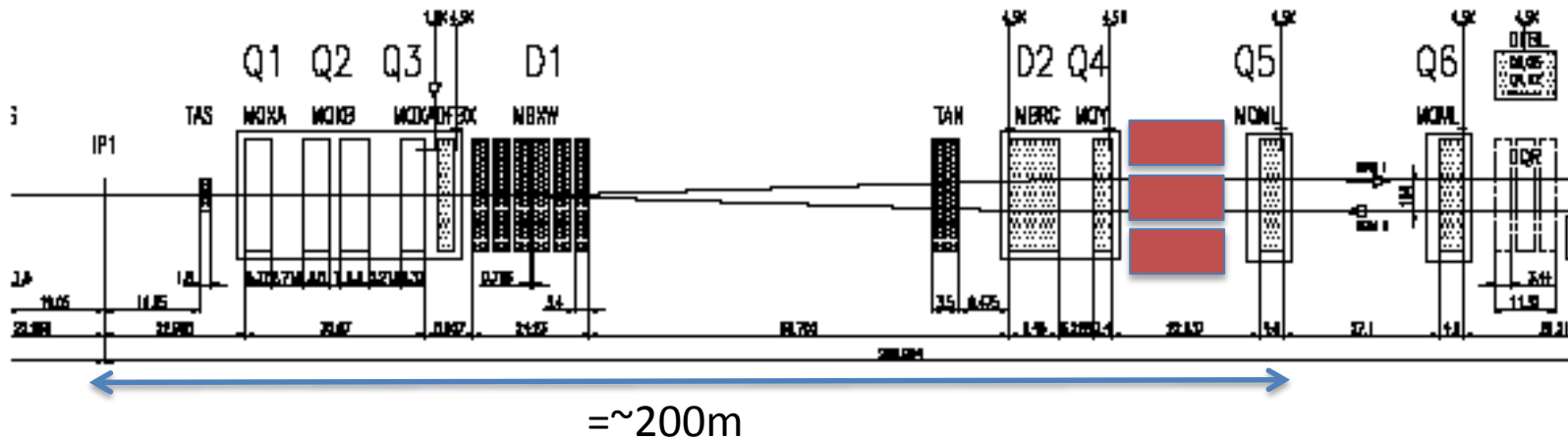
E.Fernandez,
Nucl.Phys B (Proc.Suppl)31 (1993) 326



A la LHCf setup



ATLAS



Synergy/Competition to SHIP

Beam dump exp. w/

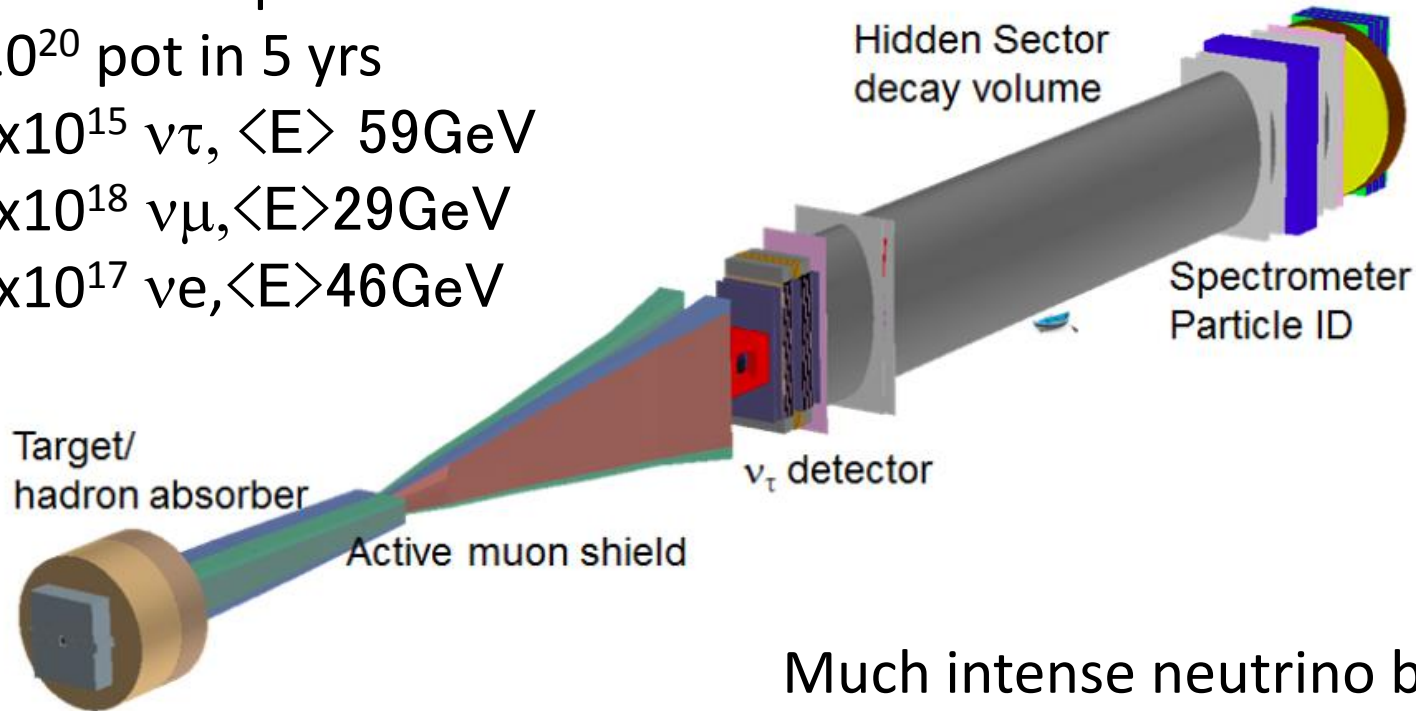
SPS 450 GeV p

2×10^{20} pot in 5 yrs

5.7×10^{15} ν_τ , $\langle E \rangle$ 59 GeV

7.2×10^{18} ν_μ , $\langle E \rangle$ 29 GeV

3.7×10^{17} ν_e , $\langle E \rangle$ 46 GeV



Much intense neutrino beams
 ν_τ detection with emulsion
Hidden photon search
Much lower collision E, E ν
\$200M projects !

To be considered

- Physics impact ? At least,
 - atmospheric prompt ν flux
 - Study $\nu\tau$ interactions (but compete with SHIP)
 - Anything else ?
- Cost ?
- Feasibility of $\nu\tau$ tagging ?
- BG neutrinos from n-TAN collisions ?