

# LVD: an apparatus to study the cosmic ray penetrating components

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840 counters  
1x1x1.5m each

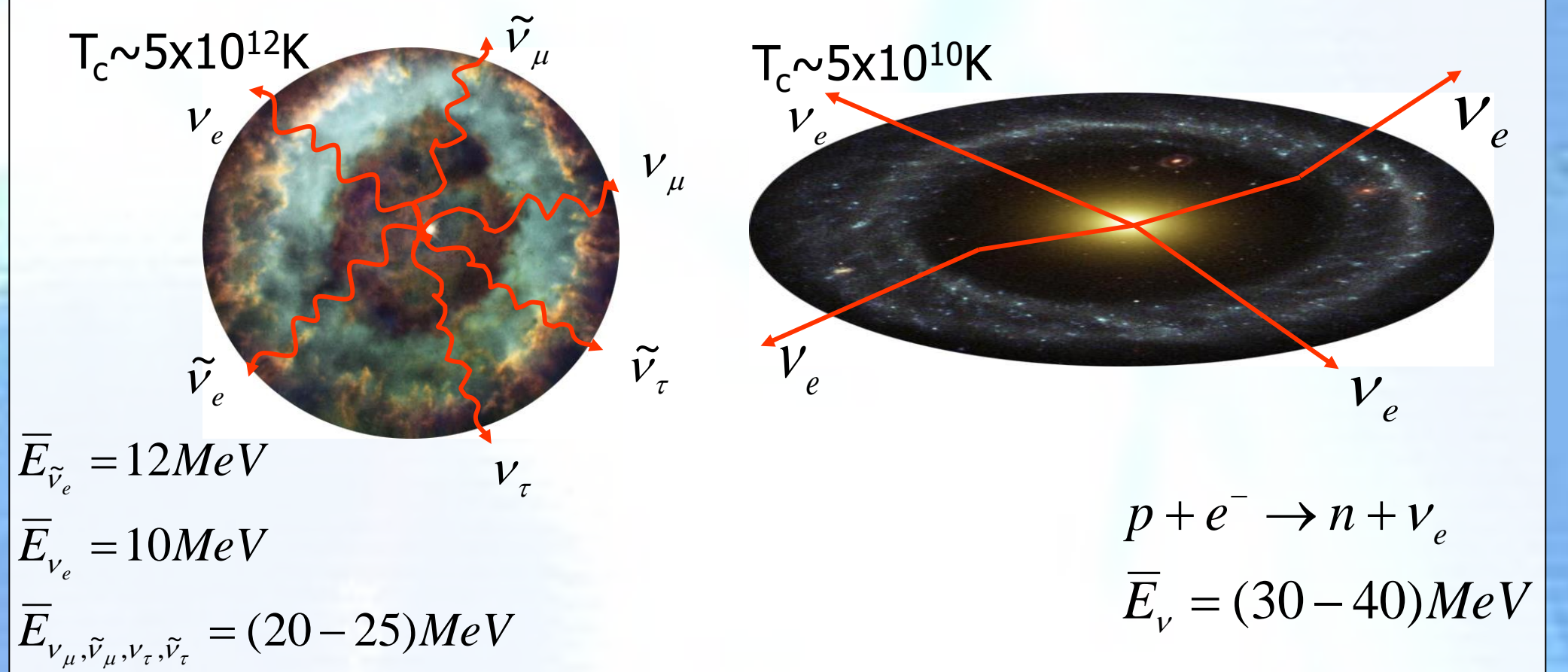
Data taking trigger:  
 $\epsilon_{th} = 4\text{MeV}$  (inner counters)  
 $\epsilon_{th} = 7\text{MeV}$  (external counters)

$H_{min} = 3650 \text{ m.w.e.}$   $\langle E_{\mu} \rangle = 280 \text{ GeV}$   
 $E_{\mu}^{th} = 2.2 \text{ TeV}$  at sea level

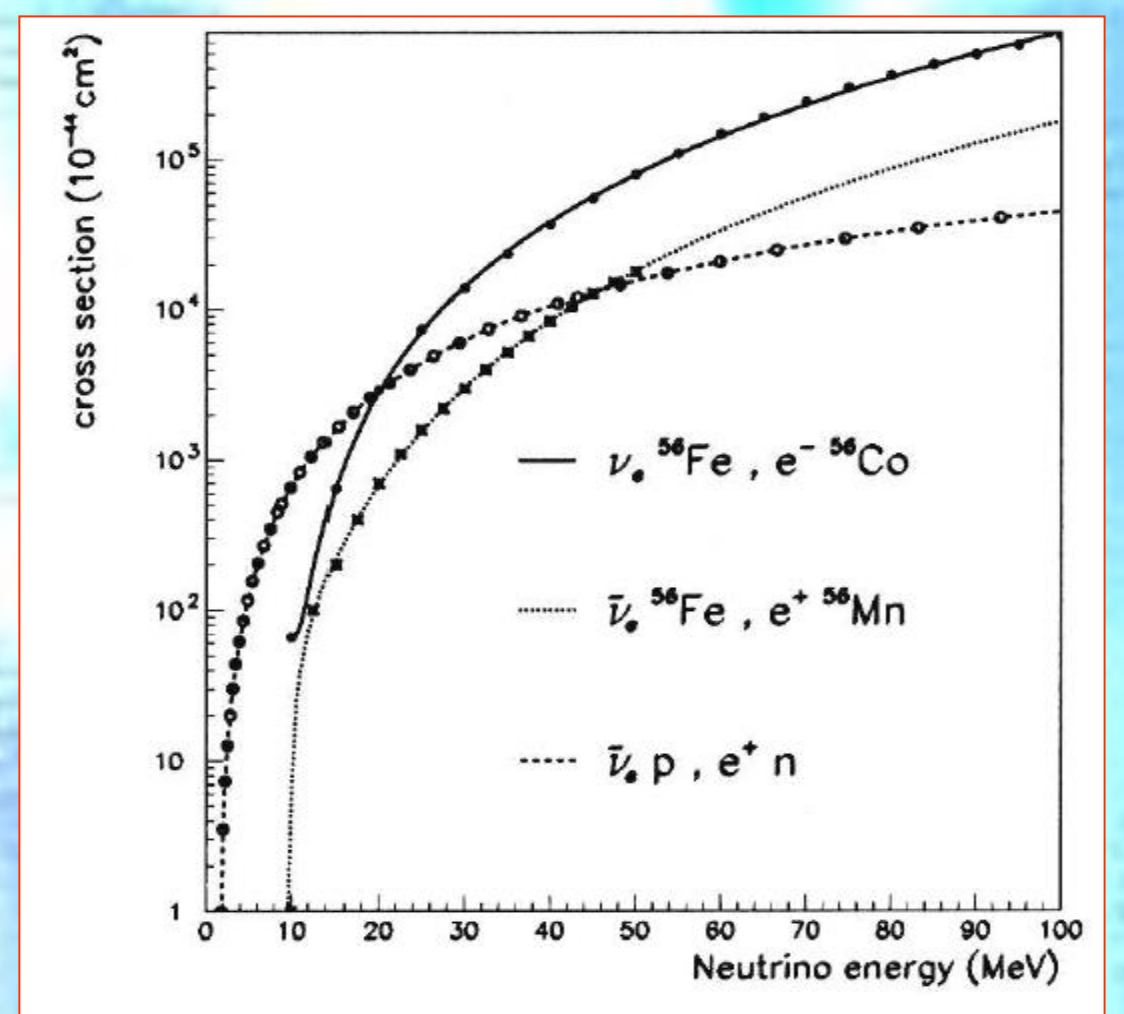
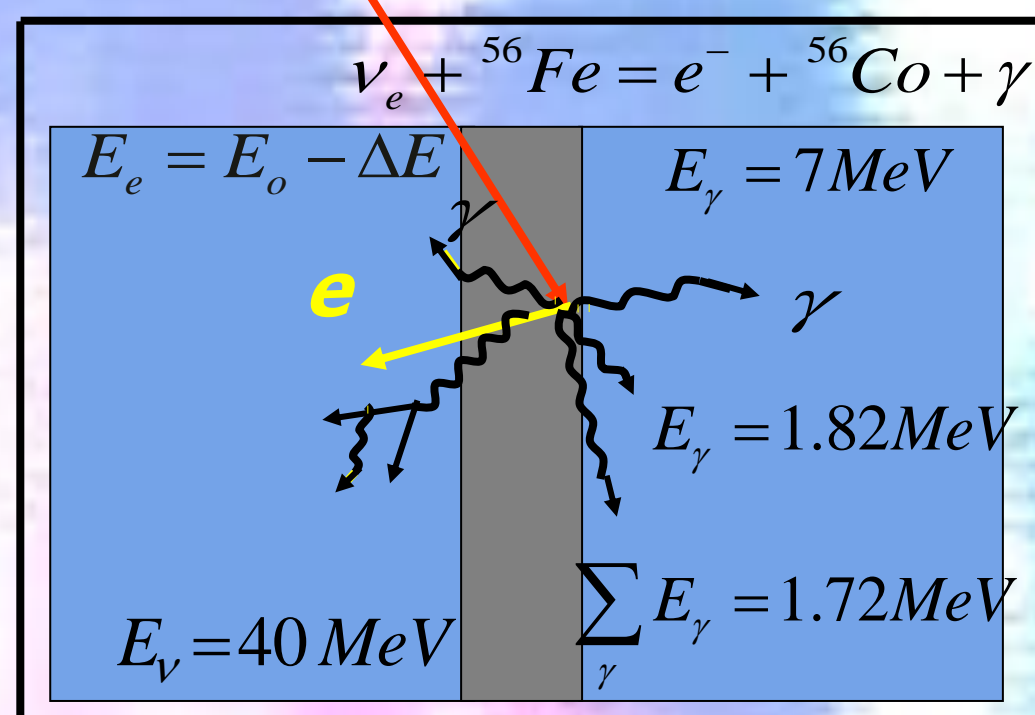
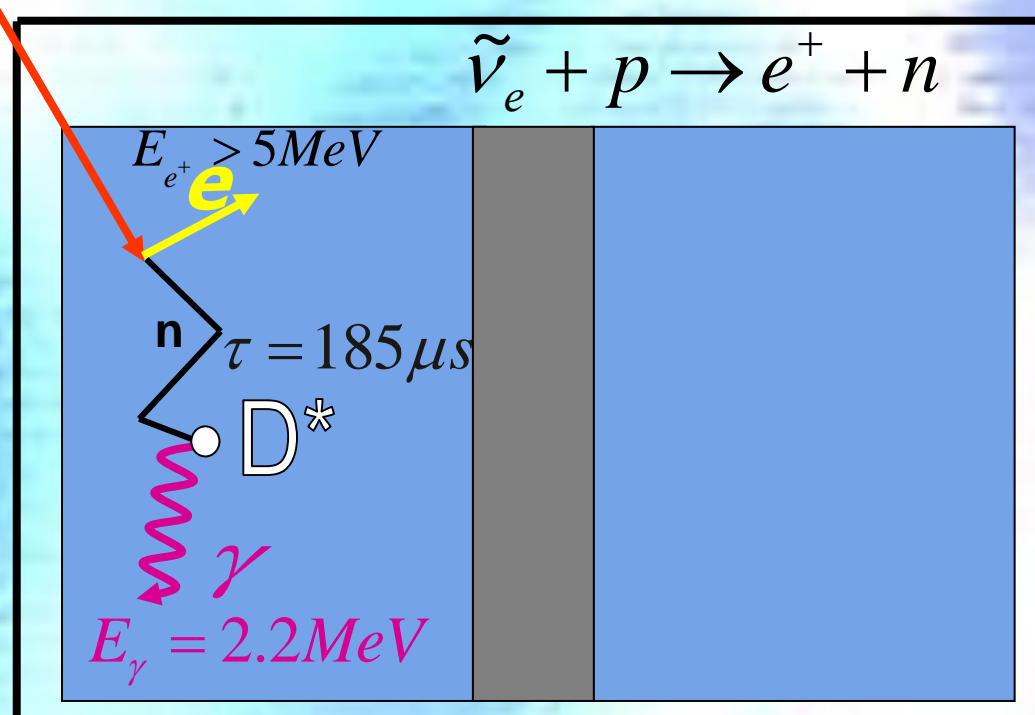
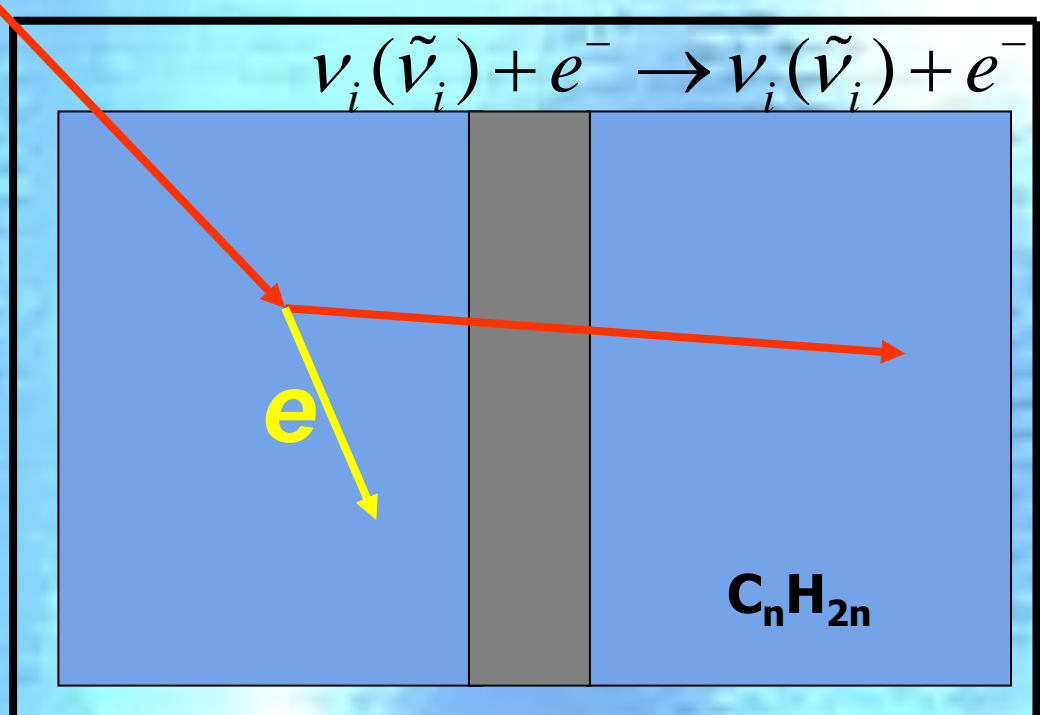
Event duration – 1 ms,  $E$ -resolution:  $\sim 30\%$   $\epsilon = 1-5 \text{ MeV}$   
 $\epsilon_{th} = 0.6 \text{ MeV}$  (inner counter)  $\sim 20\%$   $\epsilon \geq 5 \text{ MeV}$   
 $t$ -resolution:  $\sim 70 \text{ ns}$

The standart model

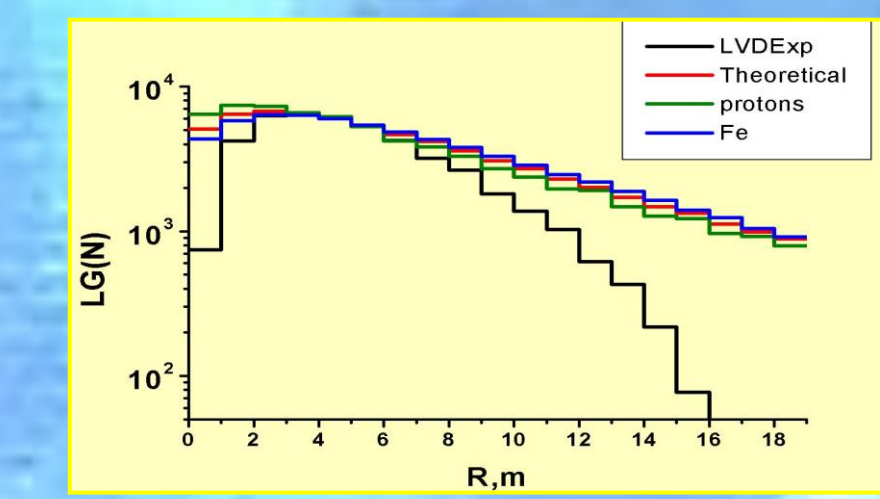
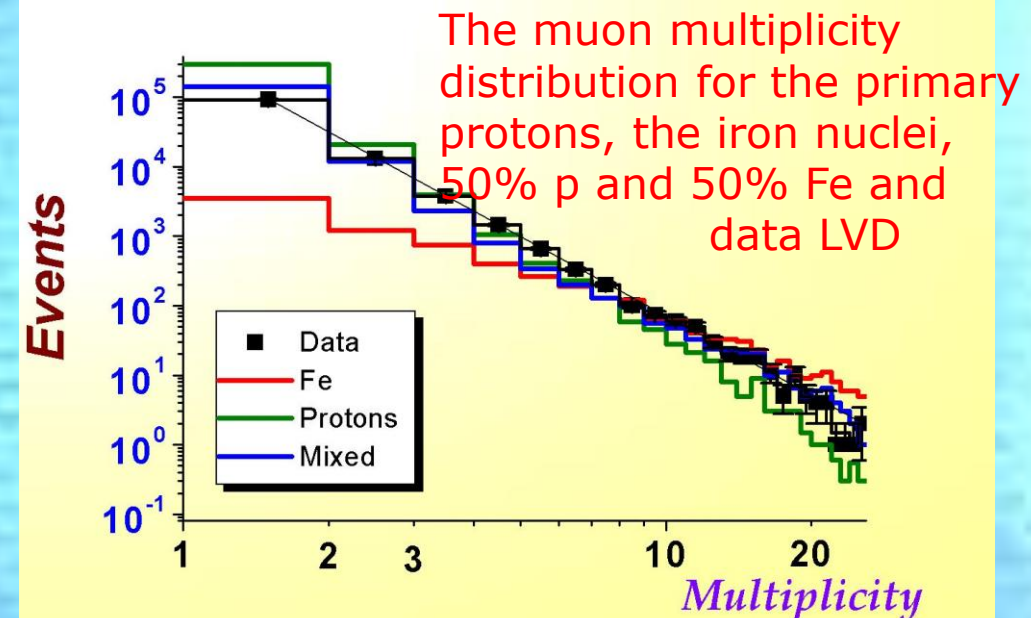
The model of rotating collapsar



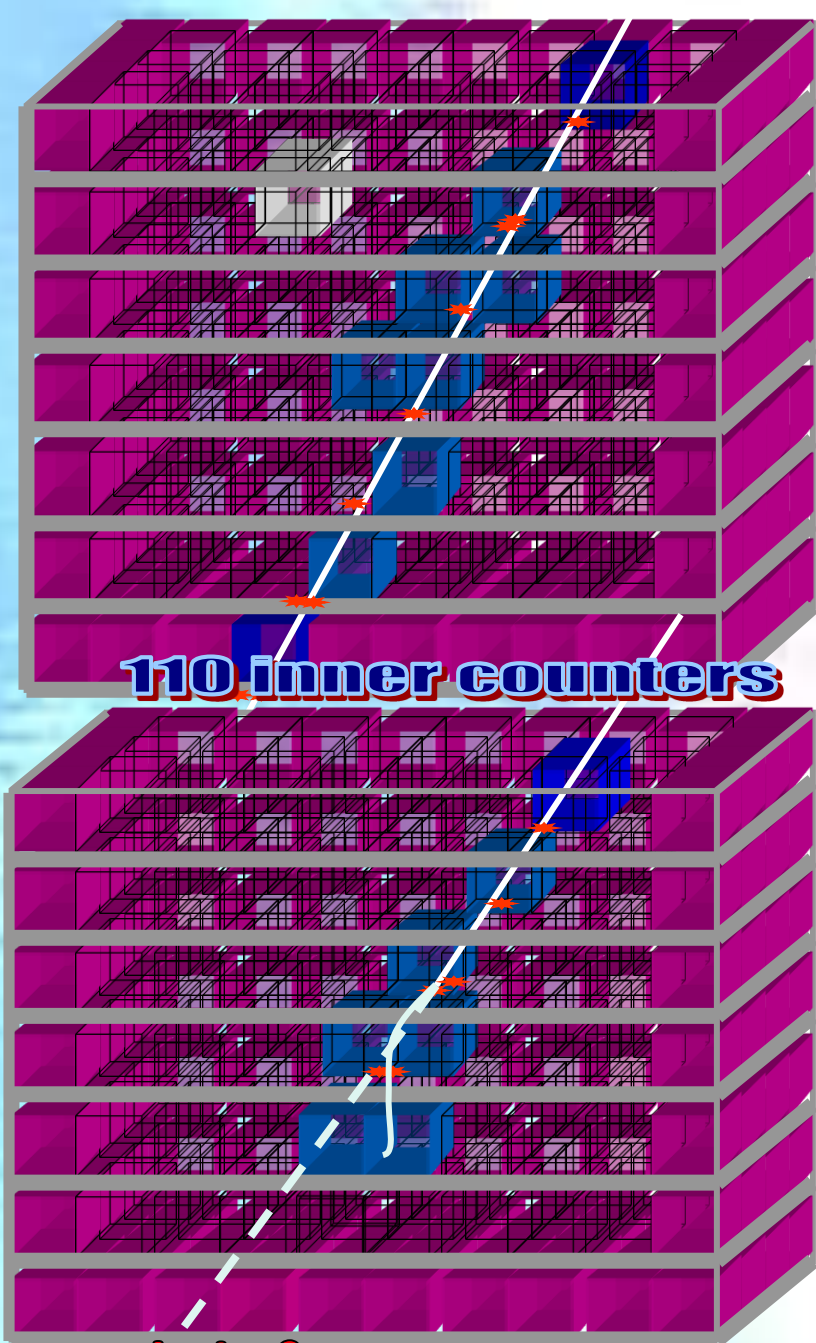
The duration of search for neutrino bursts from collapsing stars is 14 years. Taking into account the results of other detectors the frequency of collapses in our Galaxy is less than 1/(16 years) at 95% c.l.



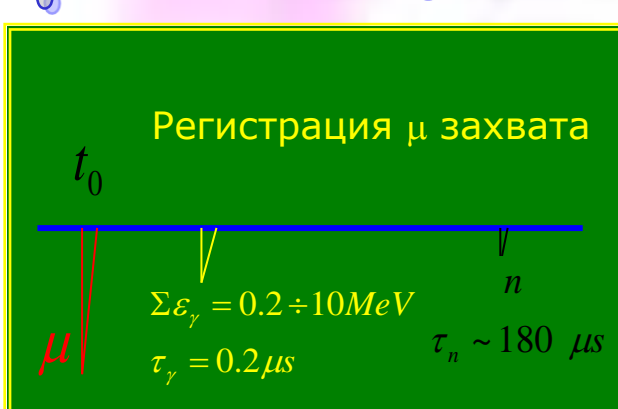
## Muons and muon bundles



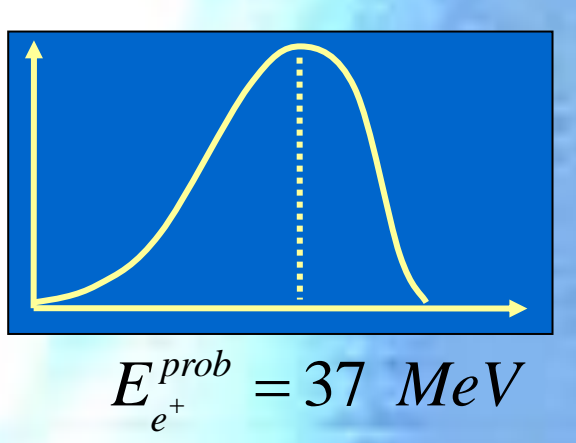
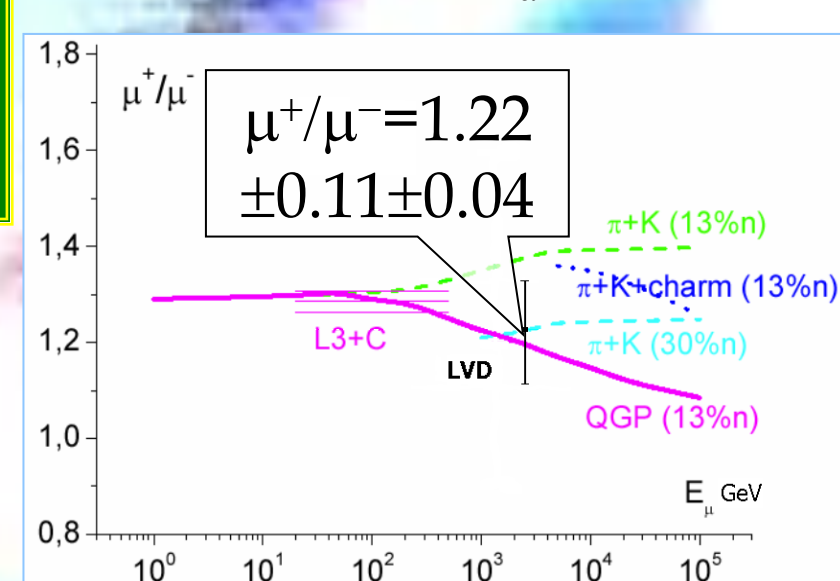
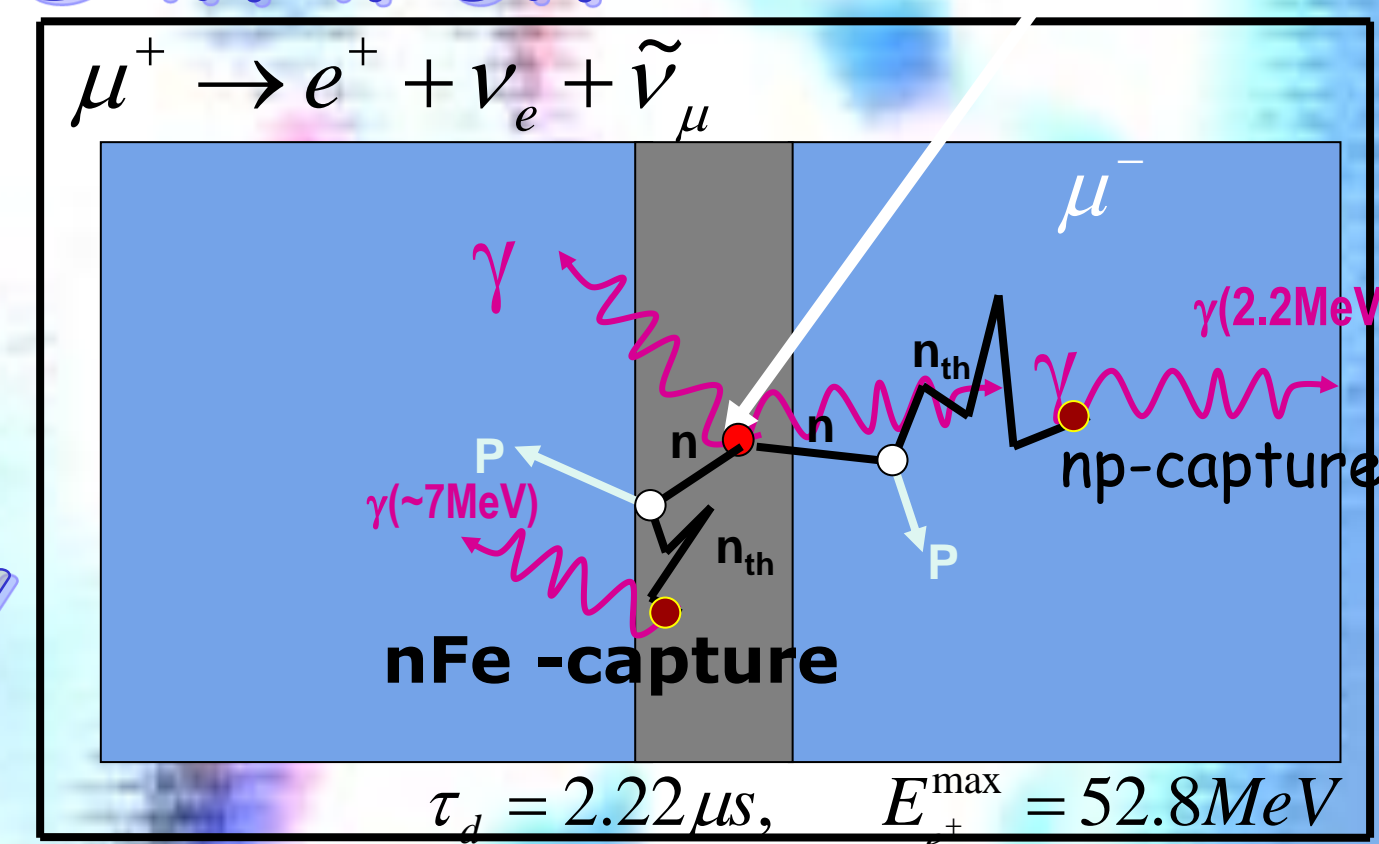
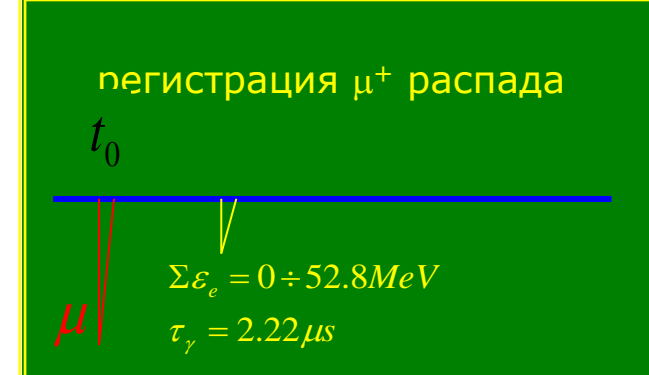
Distributions of distance between various muon pairs in a cascade for the primary protons, iron nuclei and the standard mass composition.



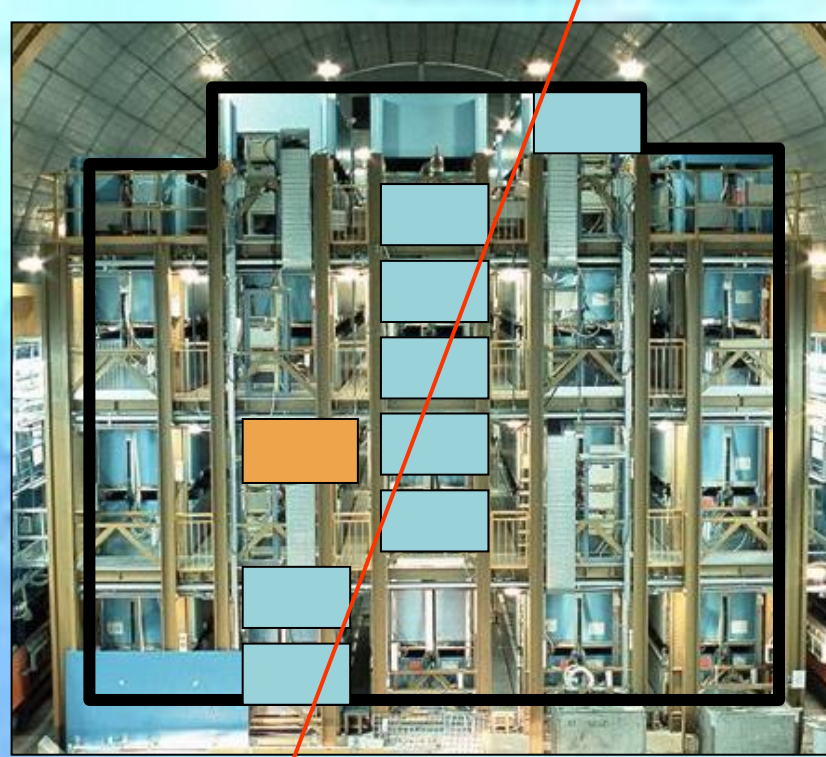
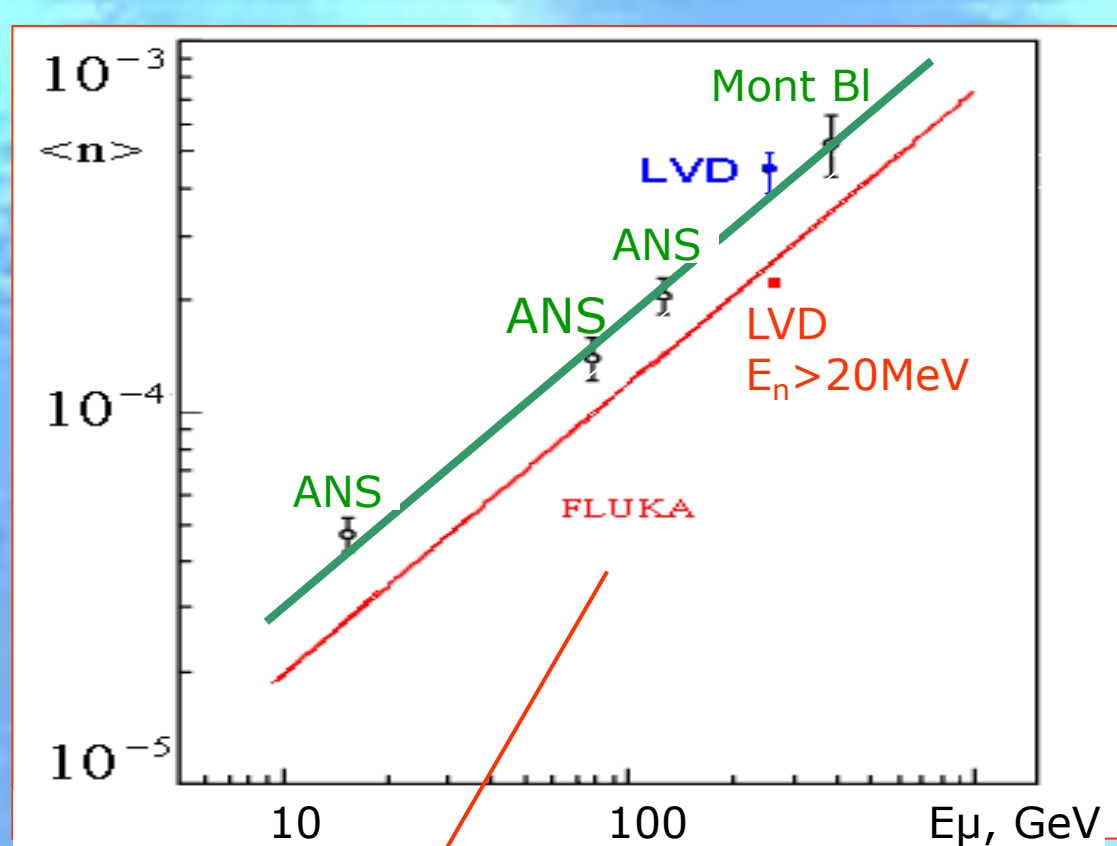
## Muon stopping in LVD structure $\mu^-$ capture in iron



$\mu^+$  decay

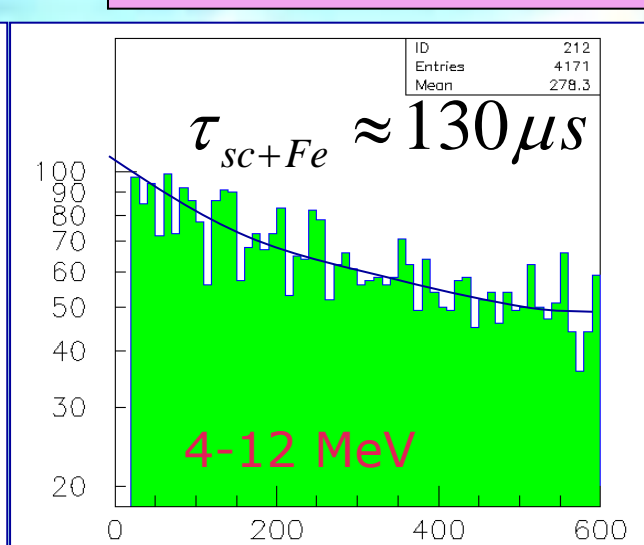
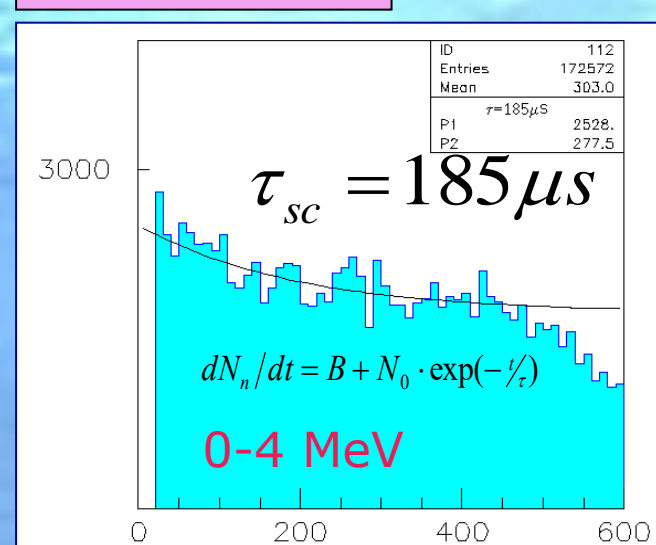


## The measurement of Neutron yield from Muons



$n^{56}\text{Fe} \rightarrow {}^{57}\text{Fe}^* \rightarrow {}^{57}\text{Fe} (\gamma), 91.7\%$   
 $n^{54}\text{Fe} \rightarrow {}^{55}\text{Fe}^* \rightarrow {}^{55}\text{Fe} (\gamma), 5.8\%$   
 $n^{35}\text{Cl} \rightarrow {}^{36}\text{Cl}^* \rightarrow {}^{36}\text{Cl} (\gamma), 75.8\%$

$np \rightarrow D^* \rightarrow D\gamma$



## Radon concentration in Hall A

