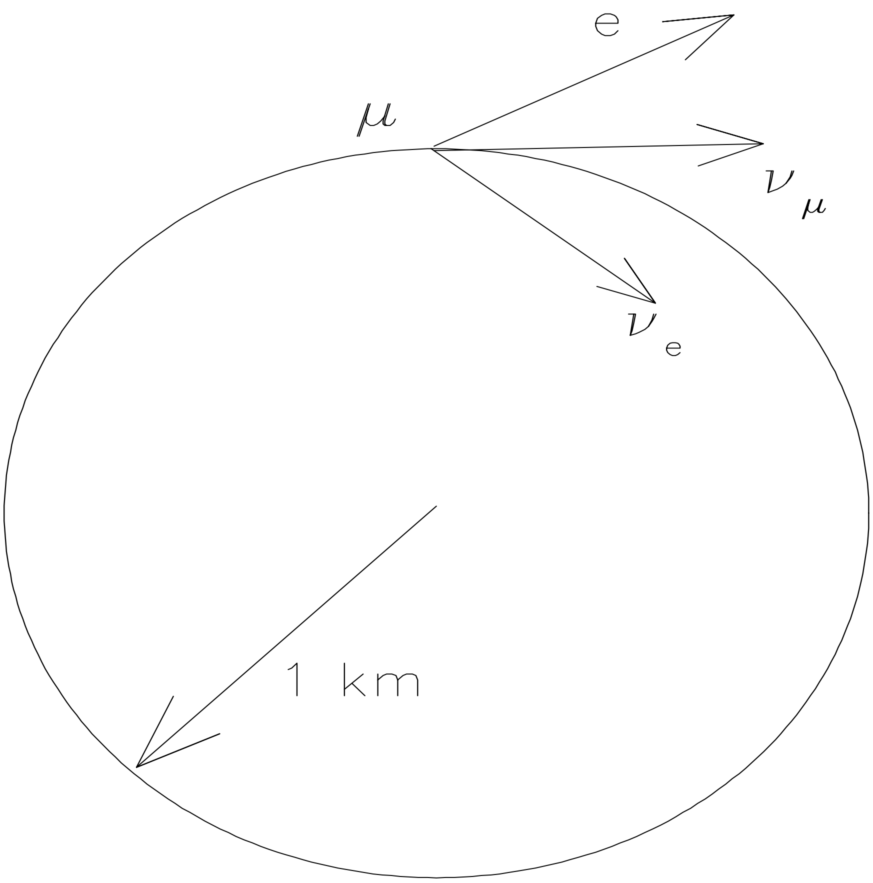
Neutrino-Induced Radiation Hazard



Muon Decay

$$\mu^- ==> \nu_\mu + \overline{\nu}_e + e^-$$
$$\mu^+ ==> \overline{\nu}_\mu + \nu_e + e^+$$

Typical opening angle:

$$\theta_\nu \approx \frac{1}{\gamma_\mu}$$

For 2 TeV muons

$$\theta_\mu \approx 50\,\mu rad$$

ν INTERACTIONS (DIS)

TeV-scale NEUTRINOS interact primarily through Deep Inelastic Scattering (DIS) on nucleons (N)

$$\nu_{\substack{\mu \\ e}} + N \longrightarrow$$

$$\substack{\mu \\ e} + Hadrons \; (75\%)$$

$$\nu + Hadrons \; (25\%)$$

Producing the particles:

Hadron showers	*meters*	$\approx$ 40% of E_T
Electromag. showers	*meters*	$\approx$ 20% of E_T
Muons	*km*	$\approx$ 20% of E_T
Neutrino		$\approx$ 20% of E_T

Question: isn't the neutrino cross-section very small?

$\sigma_{\nu N}^{total} \approx$

$7 \times 10^{-36}\, cm^2 \times E_\nu[TeV]$

The off-site dose limit is:

$10\, mrem/year =$

$600\, TeV/kg/year$ (for min.ion.radiation)

$\approx Energy\, of\, 10^3 \nu's$

The small cross-section is compensated by:

$$6 \times 01^{26}\ \mathrm{N/kg}$$

$$2 \times 10^{21}\ \nu/\mathrm{year}$$