Propagation of neutrinos through the Earth

M. de Jong

Weak interactions



Weak interactions

neutral-current

charged-current

• absorption (except v_{τ})

• scattering • $\theta_s \sim \sqrt{2M_N/E_v}$

• energy loss • $y \equiv (E - E')/E$ • $\nu q \Rightarrow f(y) = 1$ • $\nu \overline{q} \Rightarrow f(y) = (1 - y)^2$

Neutrino propagation through the Earth



Neutrino propagation through the Earth

neutral-current

charged-current





less absorption

Scenarios

A. charged-current and neutral current interactions jointly simulated *"realistic"*

B. any interaction is attributed to absorption

C. neutral-currents without energy loss

D. neutral-currents without scattering

E. no neutral-current interactions

"conservative"

"hypothetical"

"hypothetical"

"simplified"

E_{ν}	A		В	R	C		D	E
[GeV]	inside	outside			inside	outside		
1.0e+03	$152,\!220$	430	$152,\!207$	1.00	$152,\!159$	435	$153,\!204$	$153,\!148$
2.0e + 03	$148,\!455$	$1,\!000$	$148,\!418$	1.01	$148,\!484$	986	$150,\!396$	$150,\!409$
5.0e + 03	$139,\!190$	2,982	$139,\!091$	1.02	$139,\!241$	$2,\!936$	$143,\!409$	$143,\!401$
1.0e + 04	$125,\!818$	5,701	$125{,}612$	1.05	$125,\!698$	$5,\!555$	$132,\!922$	$132,\!580$
2.0e + 04	$107,\!884$	$10,\!119$	$107,\!493$	1.1	$107,\!954$	9,581	$118,\!757$	$118,\!290$
5.0e + 04	$77,\!481$	$16,\!007$	$76,\!569$	1.2	$77,\!630$	$14,\!545$	$93,\!852$	$92,\!350$
1.0e + 05	$52,\!249$	18,868	$50,\!977$	1.4	$52,\!115$	$16,\!315$	$70,\!928$	$68,\!236$
2.0e+05	$30,\!390$	$18,\!986$	$28,\!859$	1.7	$30,\!142$	$15,\!136$	$49,\!195$	$45,\!019$
5.0e + 05	$10,\!981$	$14,\!644$	$9,\!621$	2.7	$10,\!797$	9,504	$25,\!479$	$20,\!331$
1.0e + 06	$4,\!032$	$9,\!867$	$2,\!983$	4.7	3,733	4,965	$13,\!861$	8,763
2.0e + 06	$1,\!214$	$5,\!565$	566	12.0	921	1,730	$6,\!782$	2,714
5.0e + 06	313	$2,\!473$	35	80.0	106	223	2,745	335
1.0e+07	182	$1,\!302$	0		18	30	$1,\!465$	31

outside > inside

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"realistic" > "conservative"

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"realistic" \cong neural-current without scattering

Summary & Outlook

- A study has been made of propagation of neutrinos through the Earth
 - larger flux of detectable neutrinos in "realistic" scenario compared to that in "conservative" and "simplified" scenarios
- <u>To my understanding</u>: neutrinos are assumed to go in straight line in current simulations
 - "conservative" or "simplified" scenario?
 - needs to be checked/reconsidered