

VHE Neutrino Detectability with Ashra

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Ashra Collaboration meeting
University of Hawaii

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Toho HEP Lab.

Location: Funabashi, Chiba
30min to Narita, 30min to Tokyo,
2hr drive to I CRR and to KEK

◆ CHORUS, OPERA (CERN-GranSasso)

Neutrino oscillation experiments with the emulsion-hybrid-detector

◆ Belle(KEK)

Aerogel Cherenkov Counter

◆ Hyper-nuclei, heavy ions etc.

Employing emulsion technique



Man Power

S. Ogawa

M. Yasuda (M1) : Image pipeline and trigger

+ 2 more graduate students from this April:

Simulation and trigger system



Neutrino Detection with Ashra

Fluorescence signature

- Deeply penetrated air shower
- Earth (Ocean) skimming tau neutrinos

Cherenkov signature

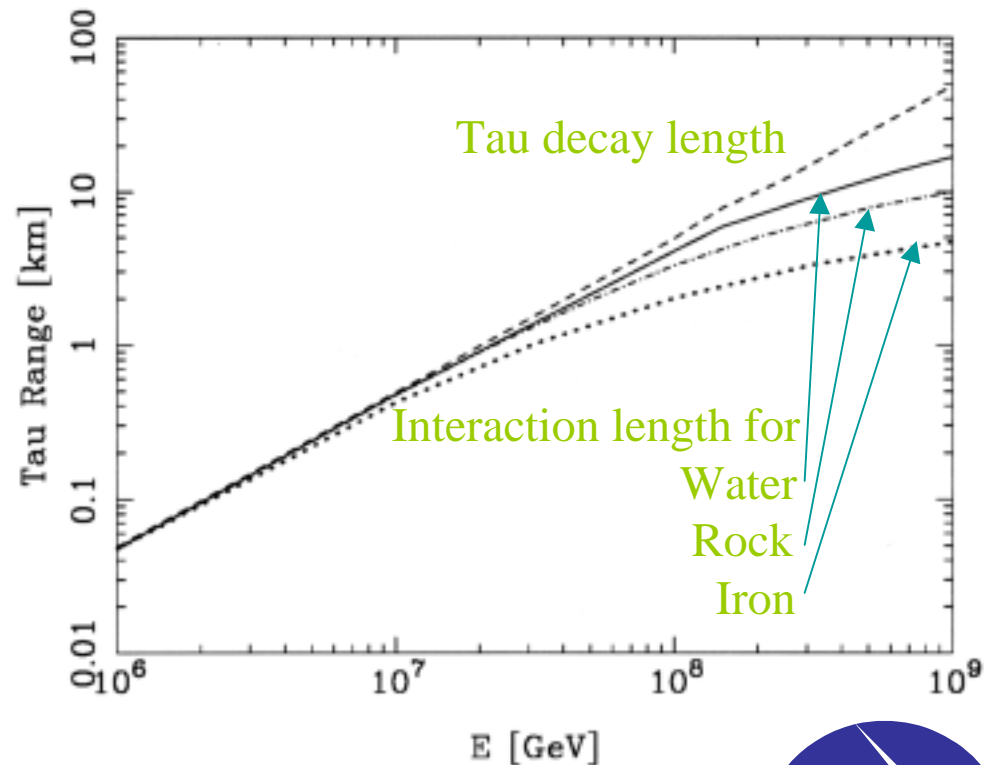
- Mount penetrated tau neutrinos



Interaction and decay length of taus

- ◆ $E_\nu < 10^{17} \text{eV}$
Decay within the earth
- ◆ $E_\nu > 10^{17} \text{eV}$
Tau energy loss in the earth

$R_{\text{decay}} \sim 49 \text{km}$
 $\Lambda_{\text{int}} \sim 17 \text{km}$ in water
@ $E_\tau = 10^{18} \text{eV}$



* S. Iyer Dutta, M. H. Reno, I. Sarcevic, D. Seckel Phys. Rev. D63(2001)094020



Earth Skimming tau flux

GRB- , GZK- require 100km²/ as effective detection area.

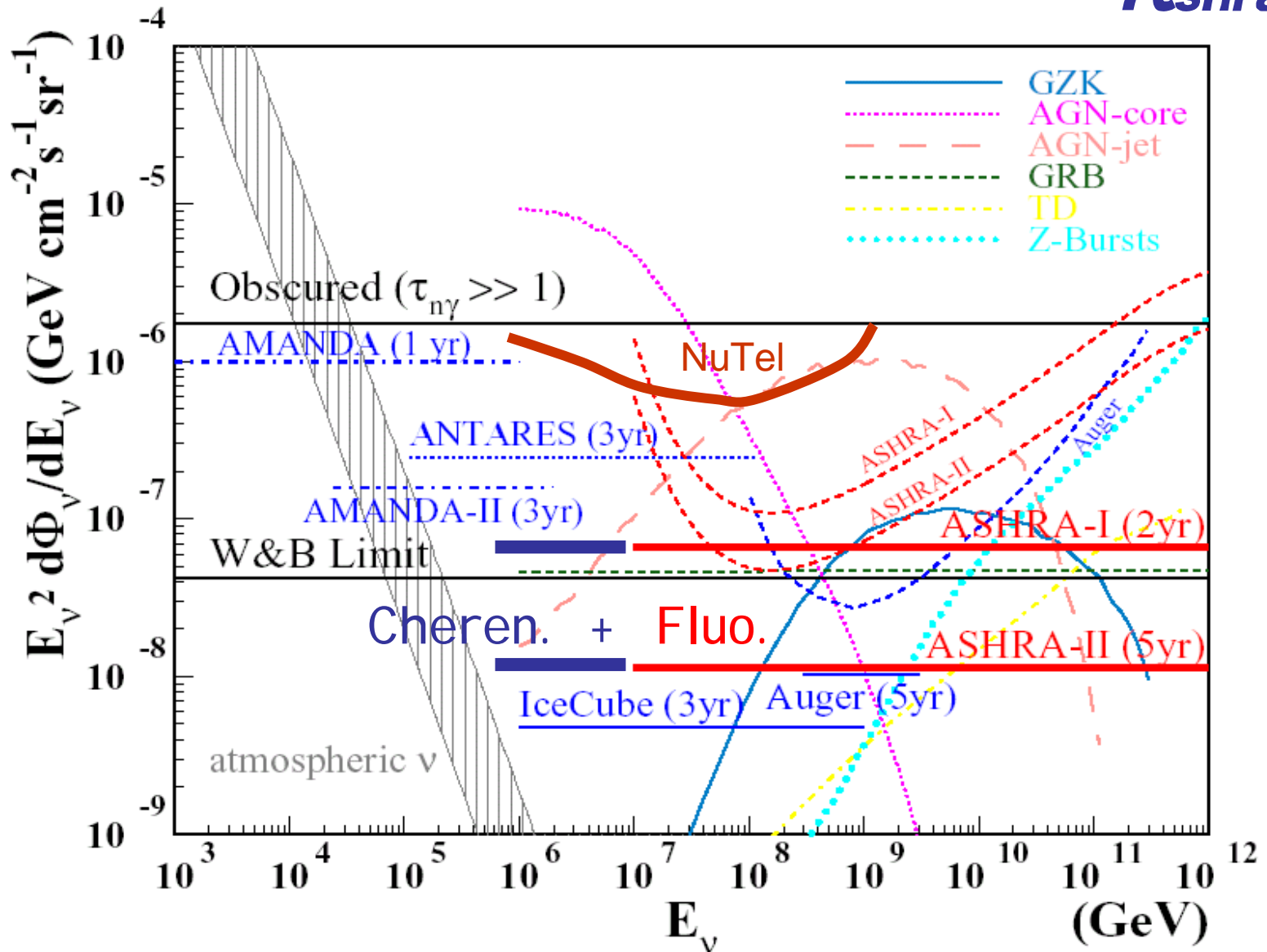
=> km³-water detector is difficult. => advantage of air-light detector

(km ⁻² yr ⁻¹ sr ⁻¹)	AGN		GRB		GZK	
	Full	Approx	Full	Approx	Full	Approx
$10^6 \leq E/\text{GeV} \leq 10^7$	2.23	2.12	9.63×10^{-3}	1.05×10^{-2}	7.38×10^{-5}	2.08×10^{-5}
$10^7 \leq E/\text{GeV} \leq 10^8$	4.89	5.12	7.12×10^{-3}	6.82×10^{-3}	1.14×10^{-2}	1.90×10^{-2}
$10^8 \leq E/\text{GeV} \leq 10^9$	1.95×10^{-1}	1.52×10^{-1}	5.39×10^{-4}	4.63×10^{-4}	8.17×10^{-2}	8.47×10^{-2}
$10^9 \leq E/\text{GeV} \leq 10^{10}$			1.13×10^{-5}	1.24×10^{-5}	3.31×10^{-2}	3.52×10^{-2}

* Tseng, et al. PR D68, 063003 (2003)



Sensitivity



Competition



	ASHRA- phase2	Auger	IceCube	AGASA	HiRes
Start Year	2007 ?	2005 ?	2010 ?	1990	1998
Det. Method [Readout Device]	Fluo. + Cerenkov [IIT+CMOS]	Gnd + Fluo. [PMT]	Wat Cerenkov [PMT]	Gnd [PMT]	Fluo. [PMT]
Point Accuracy(°)	0.01~0.02	1.0~2.0	0.4	1.0~2.0	0.5~0.8
Protons / yr ($>10^{20}$eV)	34	41	--	1	6
s / yr AGN ($>10^{16}$ eV)	26	27	16	--	<1
GZK	2	--	--	--	--
Cost (\$)	12M	50M	200M?	2M	6M

Conclusions

- Excellent sensitivity to VHE-neutrinos by simultaneous observation of fluorescence and Cherenkov lights
- Cost and schedule advantages to Auger and IceCube



First Observation !

