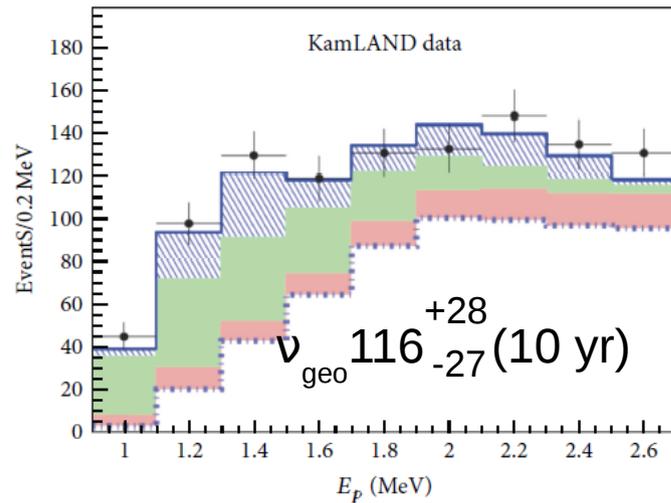
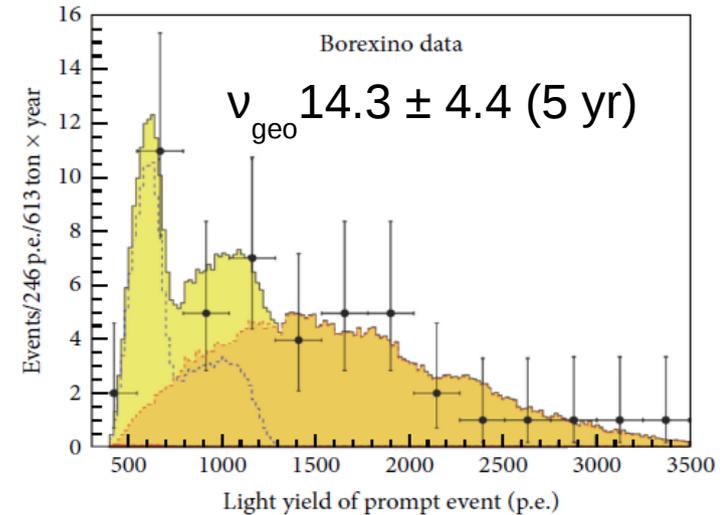


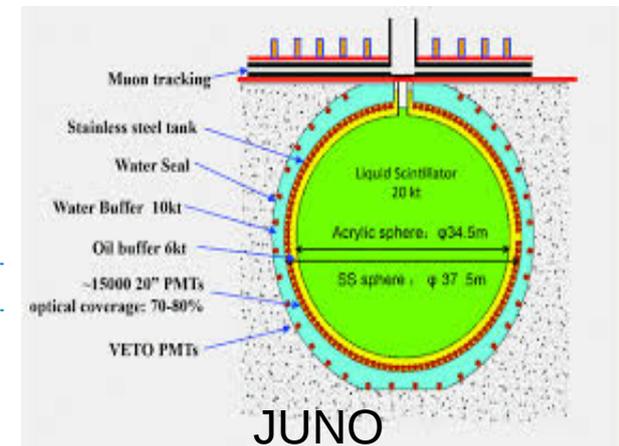
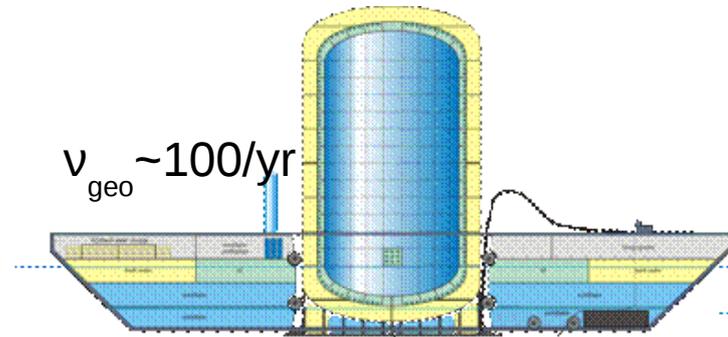
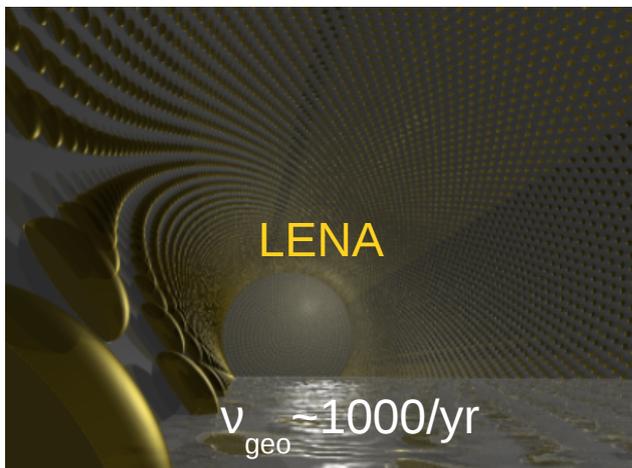
A better detector for Geoneutrinos?



..... Best-fit reactor $\bar{\nu}_e$ ▨ Best-fit geo $\bar{\nu}_e$
 ■ Accidental — Best-fit reactor $\bar{\nu}_e + \text{BG}$
 ■ $^{13}\text{C}(\alpha, n)^{16}\text{O}$ + best-fit geo $\bar{\nu}_e$



--- Best fit geo- $\bar{\nu}_e$ ■ Reactor- $\bar{\nu}_e$ signal
 --- Best fit reactor- $\bar{\nu}_e$ ■ Geo- $\bar{\nu}_e$ signal



$\nu_{\text{geo}} \sim 700/\text{yr}$

Jaime Dawson, Didier Kryn, Eric Bréelle

Geoneutrino Detectors

O. Šrámek et al. / Earth and Planetary Science Letters 361 (2013) 356–366

AIM: Observe the Mantle

- Very Large Liquid Scintillator
- U/Th series ($> 1.8 \rightarrow 3\text{MeV}$)
- Limited directionality
- Location
 - Low Crust Flux
 - Far from reactors!
- Transportable/Multiple Detectors

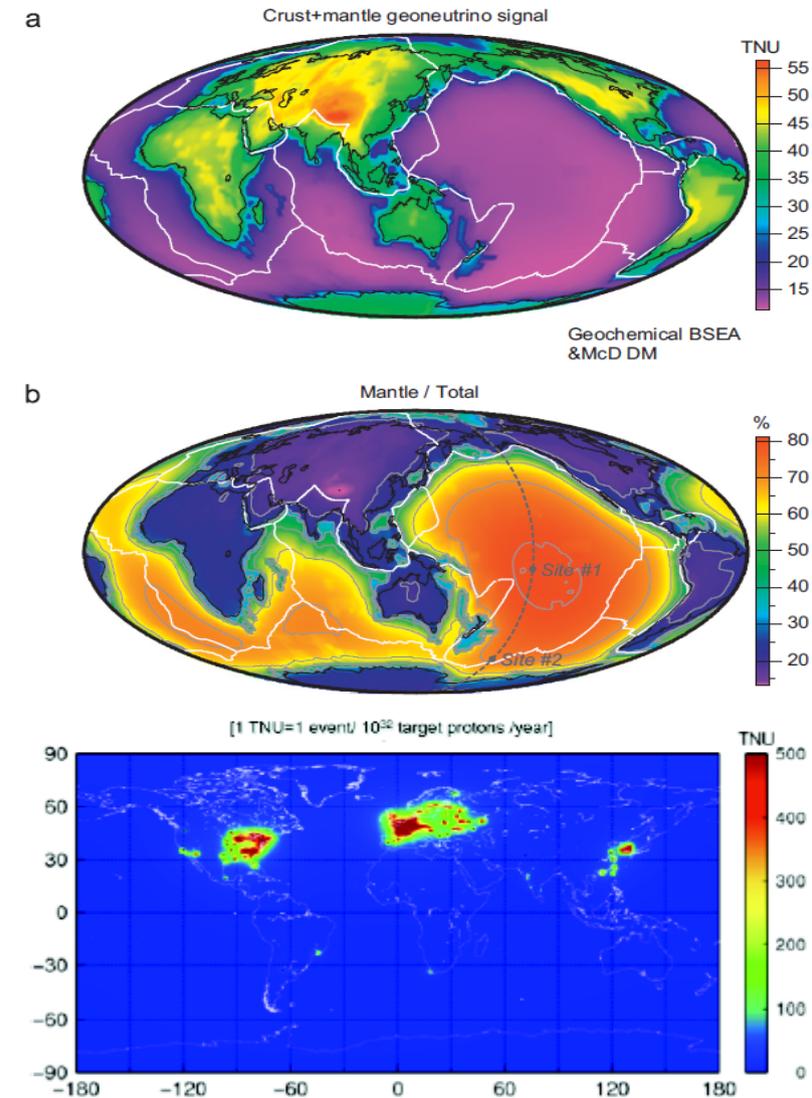
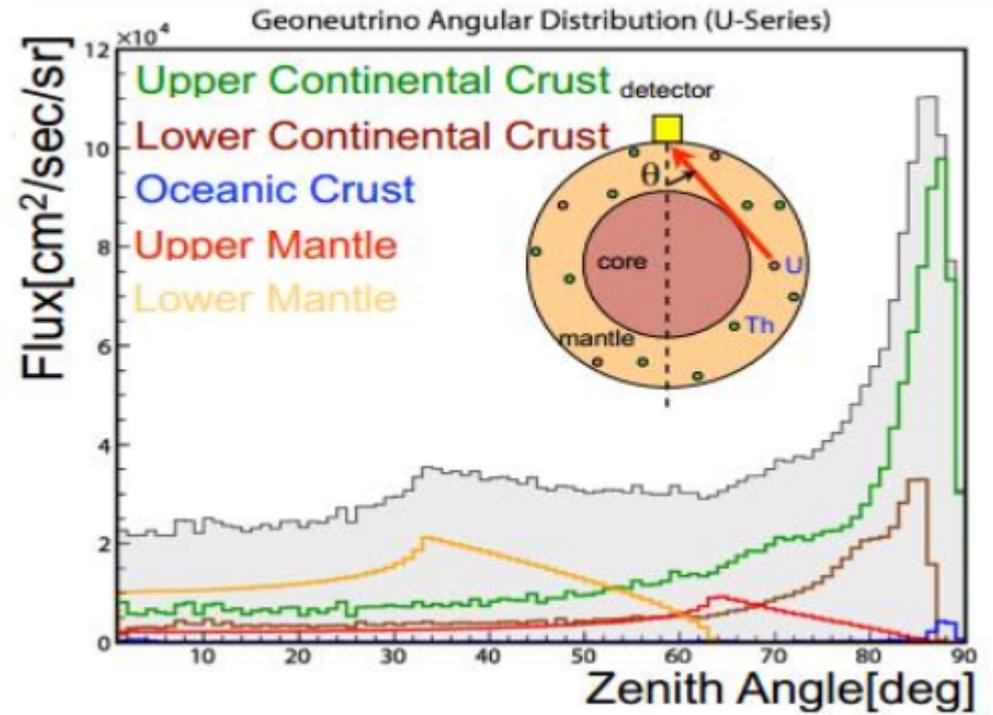
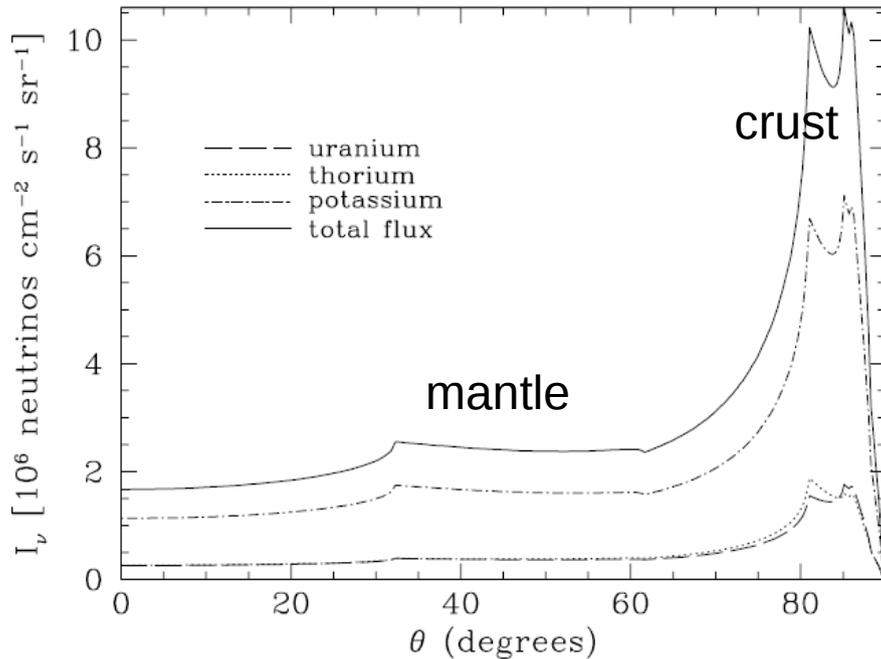
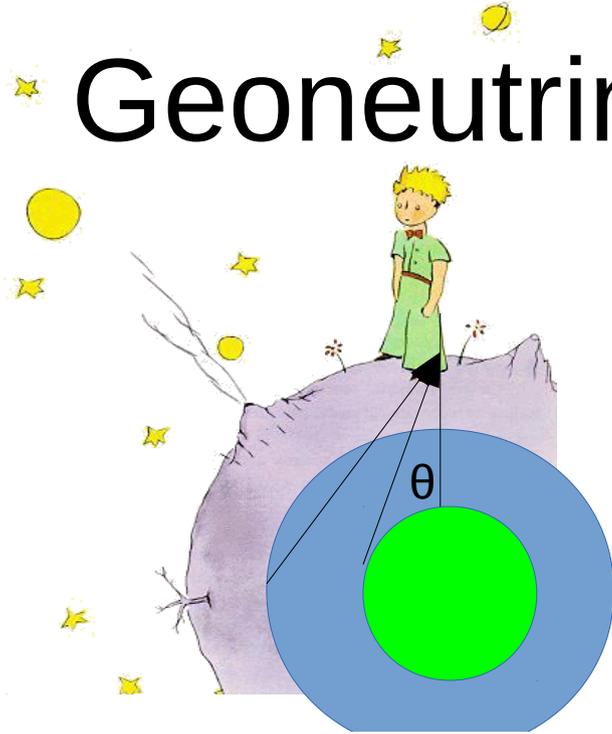


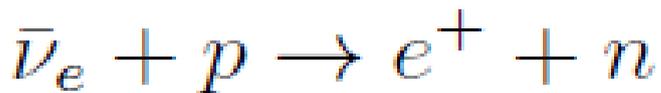
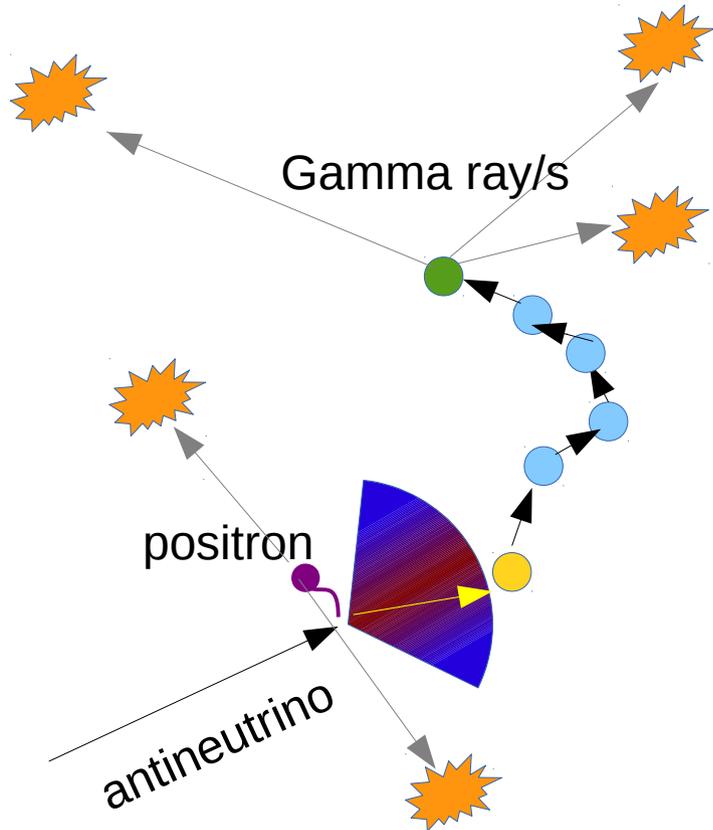
Figure 5: Reactor $\bar{\nu}_e$ signal (expressed in TNU) in the world as in the middle of 2012, calculated in [67].

Geoneutrino Angular Dependence



HanRan, whhep14

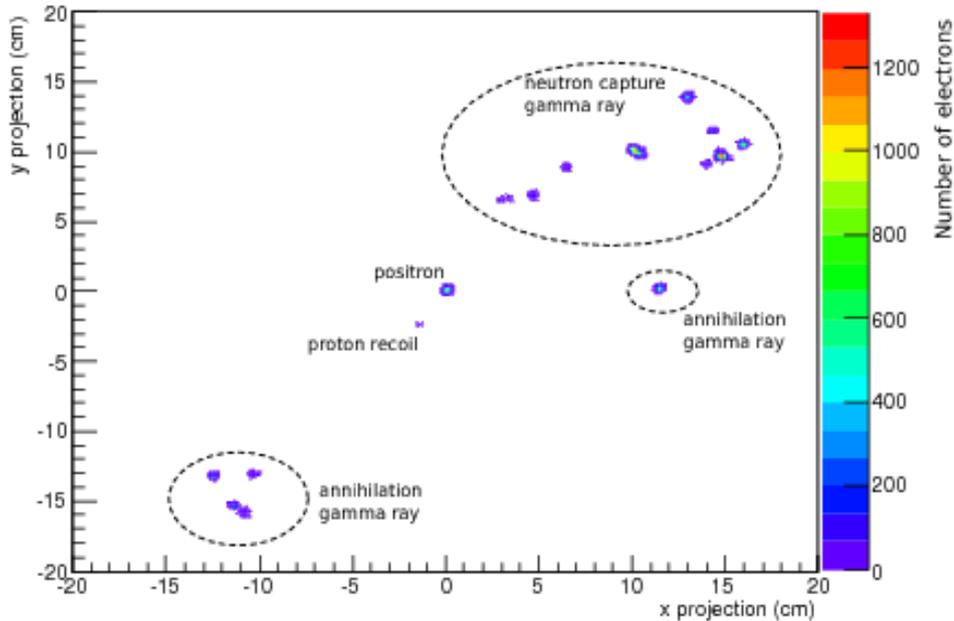
Measure Anti-Neutrino Direction



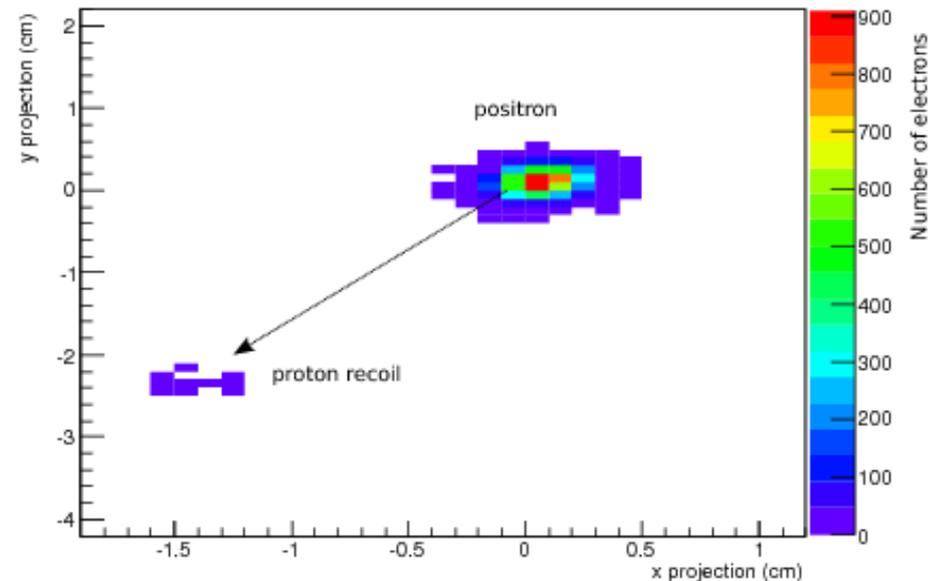
- Neutron Emission Direction
 - Angular emission probability
 - Max (15° - 30° @ 2-3 MeV)
- Further smearing
 - Multiple neutron elastic scatters
 - Detections of
 - positron position
 - neutron capture position

Hydrogenous TPC

- New idea!
- Image the interaction (3D)
- Identify positron and first proton recoil



- Measure angles for E-neutrino > 2 MeV



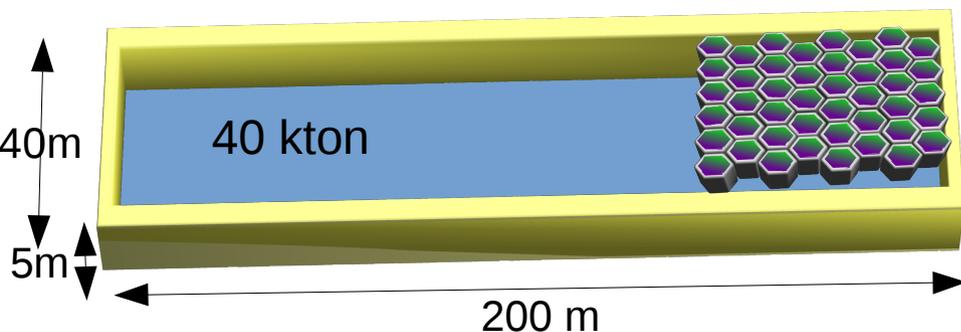
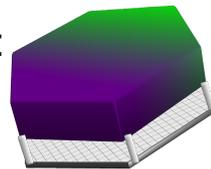
Directional Geoneutrino Detector



Number of interactions detected during 1 year on target of 10^{32} H atoms [TNU]

	Borexino [TNU]	KamLAND [TNU]
LOC [32]	9.7 ± 1.3	17.7 ± 1.4
ROC [16]	$13.7^{+2.8}_{-2.3}$	$7.3^{+1.5}_{-1.2}$
Total crust:	$23.4^{+3.1}_{-2.6}$	$25.0^{+2.1}_{-1.8}$
CLM [16]	$2.2^{+3.1}_{-1.3}$	$1.6^{+2.2}_{-1.0}$
Mantle [16]	8.7	8.8
Total	$34.3^{+4.4}_{-2.9}$	$35.4^{+3.0}_{-2.1}$

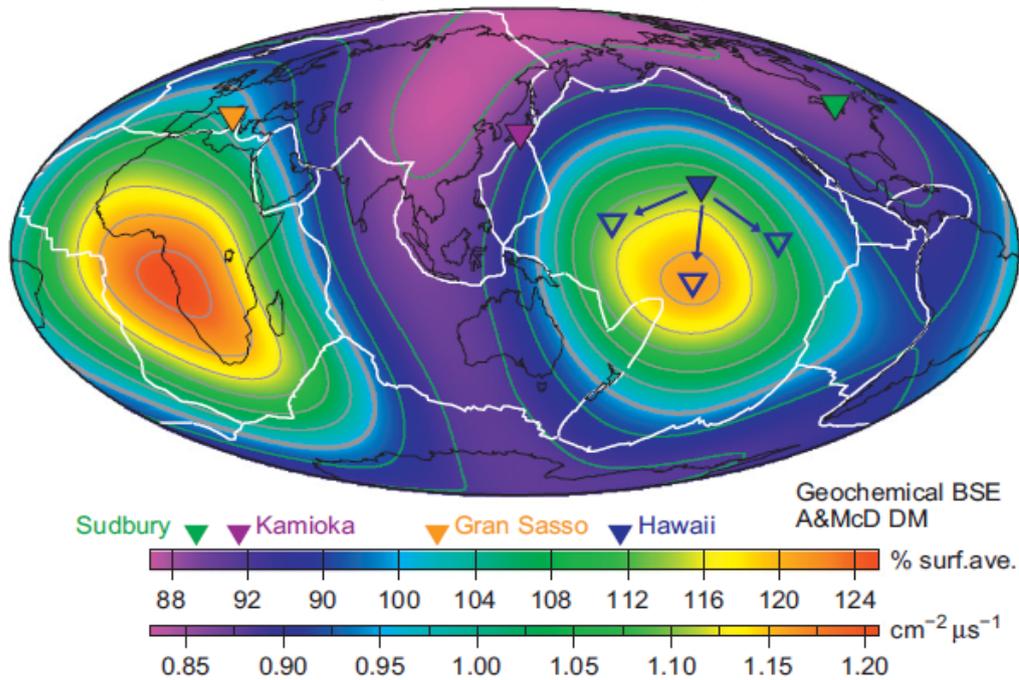
100s of modules with:
photodetectors,
optical system &
grids



For 1 kton scintillator $\sim 10^{32}$ H atoms

- Pseudocumene $0.6 \cdot 10^{32}$
- TMGe $0.55 \cdot 10^{32}$
- TMP $0.95 \cdot 10^{32}$
- CH_4 $1.5 \cdot 10^{32}$

Mantle geoneutrino flux ($^{238}\text{U}+^{232}\text{Th}$)



Conclusion

Directional Detectors

- Desired technology
 - New detector concept
- Can be located in existing and future planned deep labs
 - Crust thickness unimportant
 - Nearby Reactors (less worrying)
- Answer questions about U/Th distribution

