The Conjecture of the Neutrino Emission from the Metal Hydrides

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Anomalies in H/D Loaded Metals

Chemistry

Cells

Calorimeter

3 D fusion

2 D long life

Neutrino Emission

Nuclear Physics

Accelerator

Detector

High Energy Physicist

Prediction of Selective Resonant Tunneling

$$\sigma = \frac{\pi}{k^2} \frac{-4W_i}{W_r^2 + (W_i - 1)^2}$$

(Hot Fusion)
Fusion Engng. & Design (2006)

$$j = \frac{\hbar k}{\mu} \frac{W_i}{aW_r^2 + bW_r + cW_i^2 + d};$$

(CMNS)

$$W \equiv Cot\delta \equiv W_r + iW_i; \quad W_i^2 = \frac{d}{c}$$

Long Life-Time Resonance of (D,D) or (D,P)

Experimental Confirmation: 3-Body Reaction

$$1993,\quad Kasagi,\quad d+(\underbrace{d+d}_{In\ Titanium})\rightarrow \overbrace{p}^{17\ MeV} + \underbrace{\alpha}_{6.5MeV} + n,$$

$$1997,\quad Takahashi,\quad d+(d+d)\rightarrow \underbrace{He^{3}}_{(4.75MeV)} + \underbrace{T}_{(4.75MeV)}$$

Life-time of (d+d) Resonance ~ 10^4 Sec.

$$p+(d+d)\rightarrow \underbrace{p}_{19.1MeV} + \underbrace{He^{4}}_{4.77MeV}$$

Electron-catalyzed fusion-1

$$d + d + e \rightarrow {}^4H^* + \nu_e \quad (Electron\ Capture)$$

$$ {}^4H^* \rightarrow {}^4He^* + \tilde{\nu}_e + e$$

$$d + d \rightarrow {}^4He^* + \tilde{\nu}_e + \nu_e, (Q = 23.8 MeV)$$

$$p + p \rightarrow D + \nu_e + e^+ \quad (Bethe's\ Solar\ Model)$$

$$d + d \rightarrow {}^4H^* + \nu_e + e^+ \quad (Positron\ Emission)$$

$$ {}^4H^* \rightarrow {}^4He^* + \tilde{\nu}_e + e$$

$$d + d \rightarrow {}^4He^* + \underbrace{\tilde{\nu}_e + \nu_e}_{22.8 MeV} + e^+ + e \quad (Q = 23.8 MeV)$$

Electron-catalyzed fusion-2

$$p + d + e \rightarrow T^{*} + \nu_{e} \quad (\textit{Electron Capture})$$

$$T^{*} \rightarrow {}^{3}He^{*} + \tilde{\nu}_{e} + e$$

$$p + d \rightarrow {}^{3}He^{*} + \tilde{\nu}_{e} + \nu_{e} \quad (Q = 5.494 MeV)$$

$$p + d \rightarrow T^{*} + \nu_{e} + e^{+} \quad (\textit{Positron Emission})$$

$$T^{*} \rightarrow {}^{3}He^{*} + \tilde{\nu}_{e} + e$$

$$p + d \rightarrow {}^{3}He^{*} + \underbrace{\nu_{e} + \tilde{\nu}_{e}}_{4.472 MeV} + e^{+} + e \quad (5.494 MeV)$$

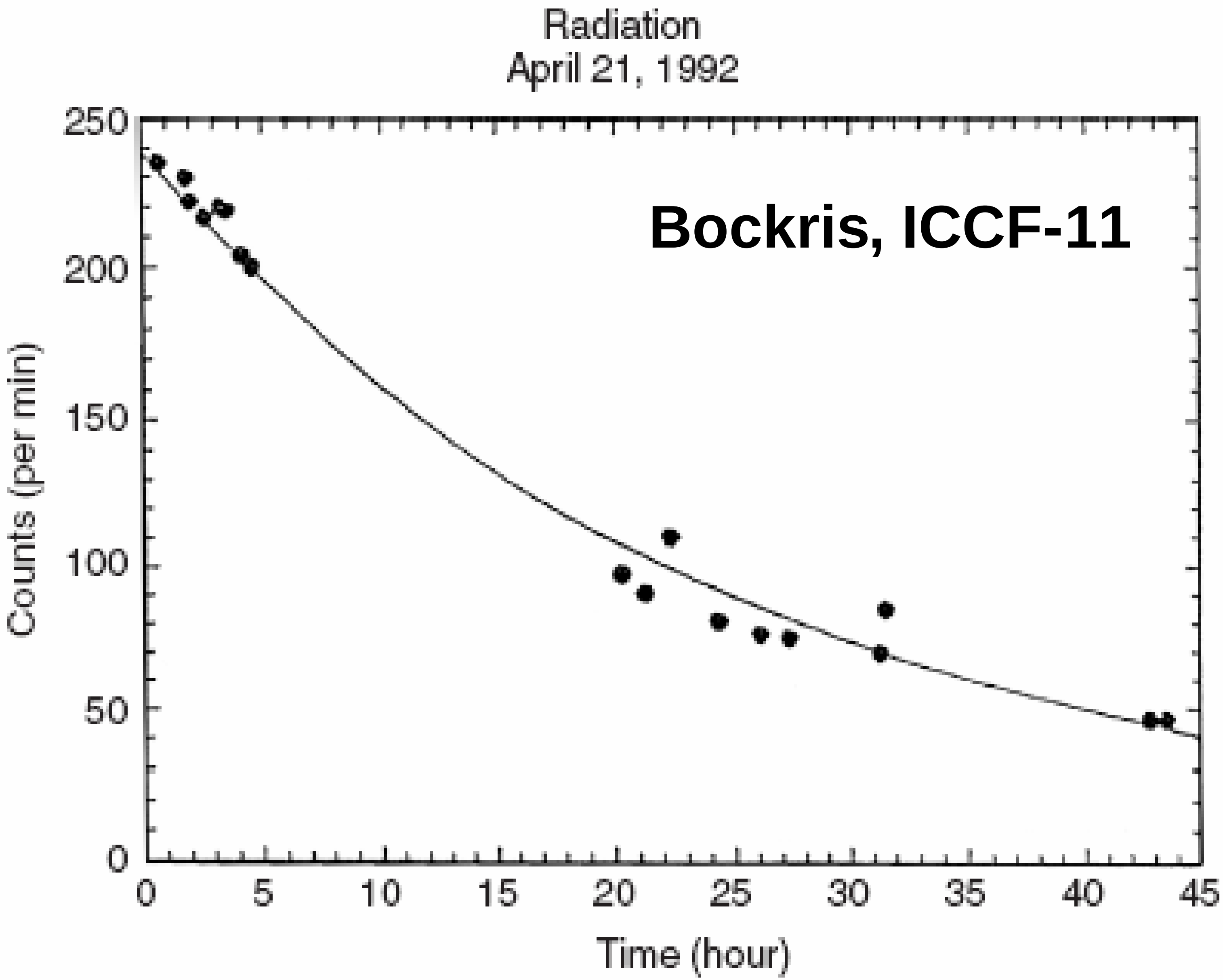


Figure 1. β radiation from a preliminary run of April 21, 1992 (negligible nobles).

F.G.Will
ICCF-4
β-Spectrum

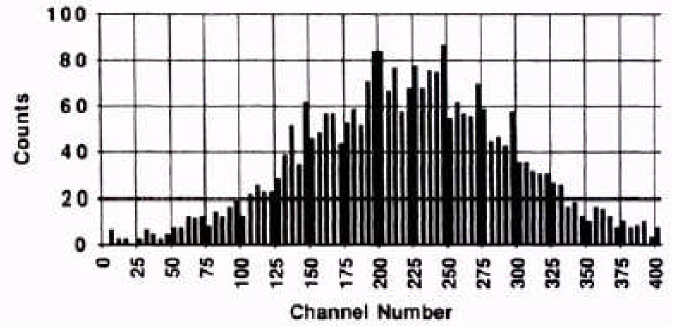


Fig. 2. Bela spectrum of Pd cathode piece after D_2O electrolysis and application of closed-system analytical method.[6] Ordinate: Incremental counts per 5-channel interval in 20 minutes.

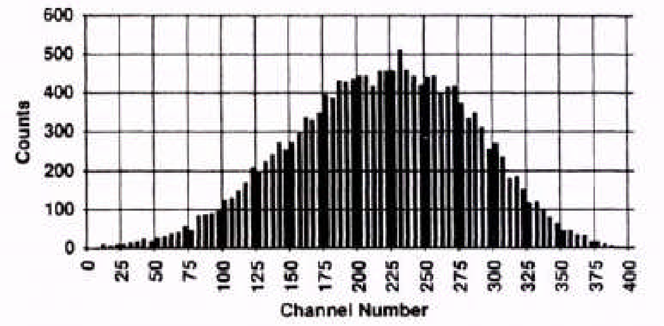


Fig. 3 Beta spectrum of secondary tritium standard: Tritiated H_2O (1000 dpm) in Beckman scintillation cocktail. Ordinate: Counts per 5 channels per minute.

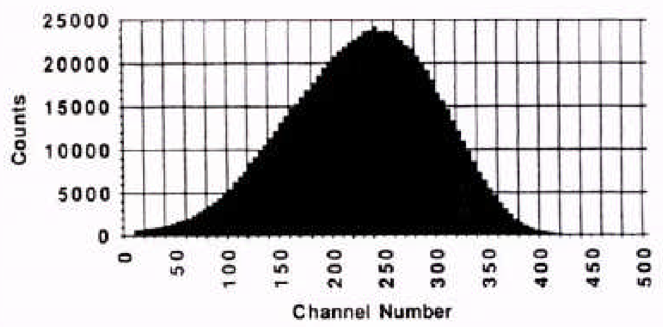


Fig. 4 Beta spectrum of water-free primary tritium standard supplied by Beckman. Ordinate: Counts per 5 channels per minute.

Kamiokande---SuperKamiokande---KamLAND

- Sensitivity.

- Energy.

- Purification of Scintillation Liquid

- Volume

Neutrino Emission—Feasibility of Detection

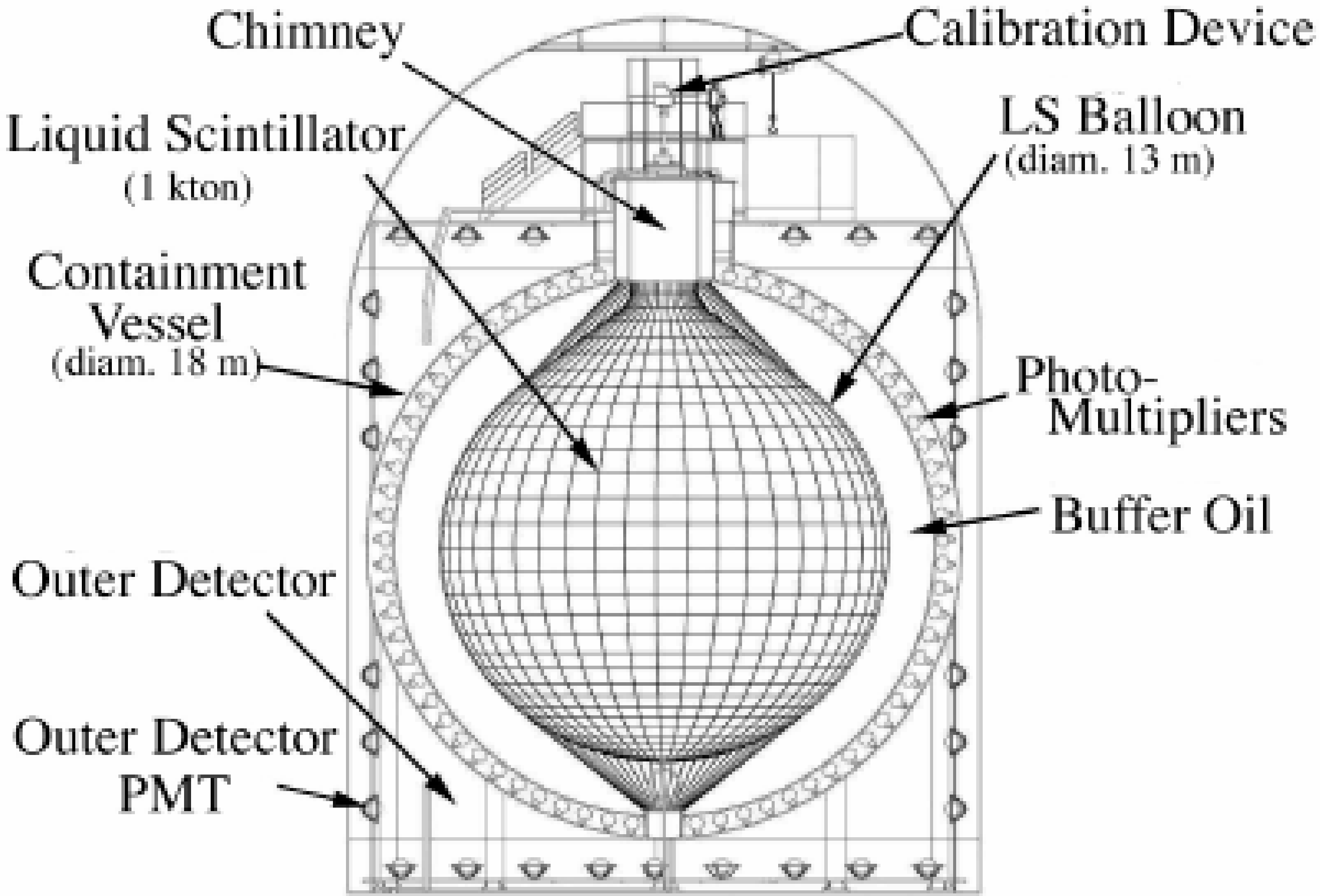


FIG. 1: Schematic diagram of the KamLAND detector.

(1)**Sensitivity**.

neutrino flux of **10^6** /sec/ cm^2.

The diameter of **13** meters.

a neutrino source intensity of **6×10^{12}**/sec.

"excess heat" power of **6 mW.**

(the **recoil** energy due to the neutrino emission.)

(2)<u>Energy.</u>

solar neutrino,
the fission reactor neutrino,
the geo-neutrino;

if the energy of the unknown neutrino source is **greater then 5 MeV**.

$$d + d \rightarrow {}^{4}He^{*} + \tilde{\nu}_e + \nu_e, (Q = 23.8 MeV)$$

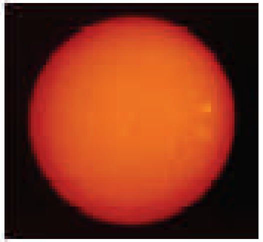
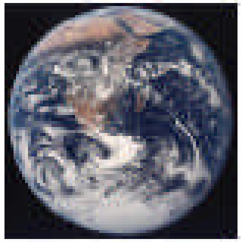
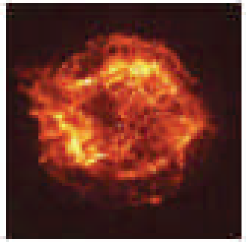
$$p + d \rightarrow {}^{3}He^{*} + \tilde{\nu}_e + \nu_e, (Q = 5.494 MeV)$$

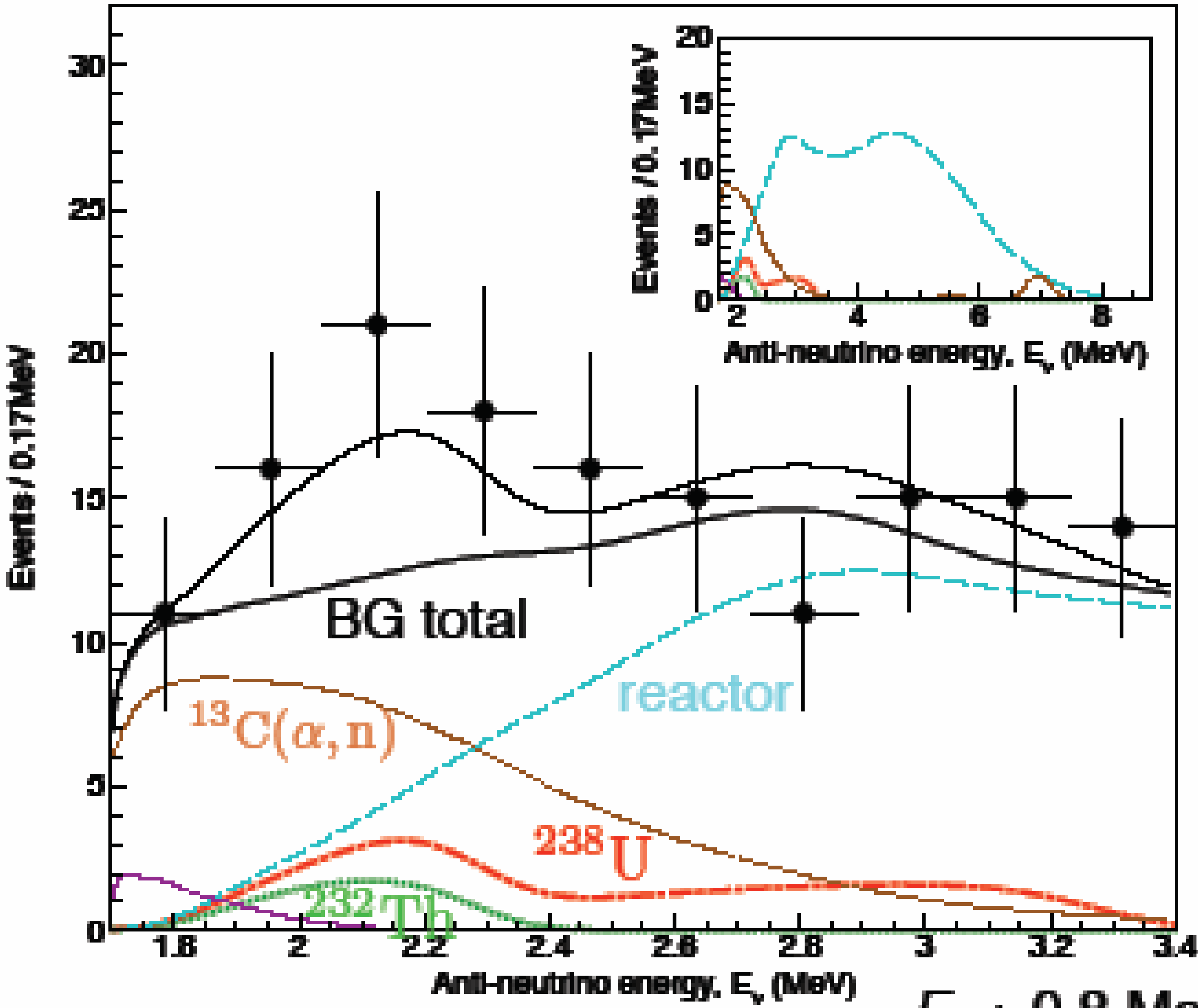
Various Physics Targets with wide energy range

Visible energy [MeV]: 0.4 — 1.0 — 2.6 — 8.5

neutrino electron elastic scattering
$\nu + e^- \rightarrow \nu + e^-$

inverse beta decay
$\bar{\nu}_e + p \rightarrow e^+ + n$

^{7}Be solar neutrino	geo-neutrino	reactor neutrino	supernova relic neutrino etc.
			
Neutrino Astrophysics	Neutrino Geophysics	Neutrino Physics	Neutrino Cosmology
verification of SSM	verification of earth evolution model	Precision measurement of oscillation parameters	verification of universe evolution
forthcoming 2nd phase	Nature Vol. 436 #7050 499-503	1st results PRL 90, 021802 (2003) 2nd results PRL 94, 081801 (2005)	Solar $\bar{\nu}_e$ PRL 92, 071301 (2004)



Events / 0.17MeV
BG total
reactor
$^{13}C(\alpha,n)$
^{238}U
^{232}Th
Anti-neutrino energy, E_ν (MeV)
Events / 0.17MeV
Anti-neutrino energy, E_ν (MeV)

$E_p + 0.8$ MeV

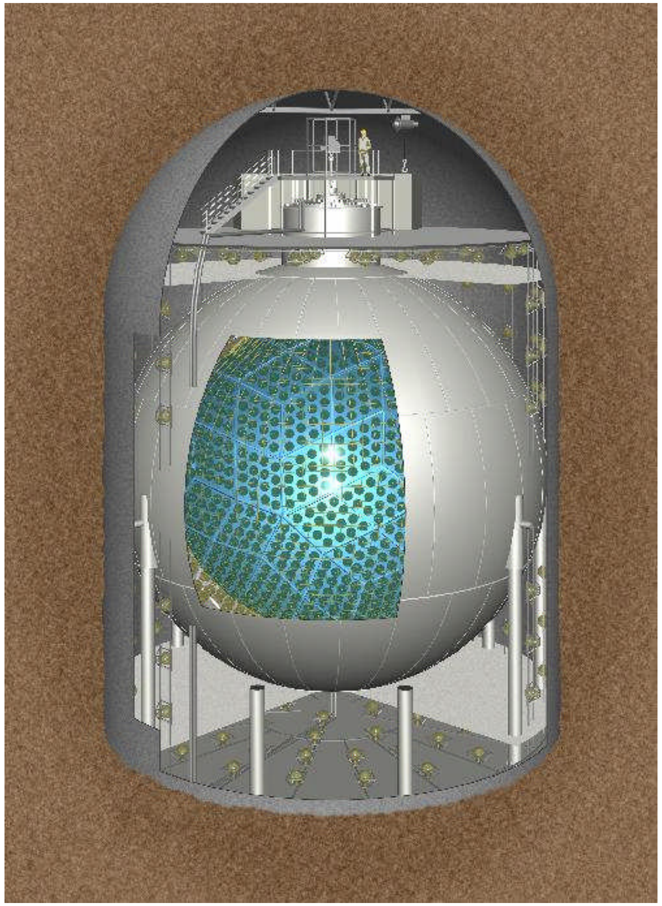
(3) Purification of Scintillation Liquid

impurity is at the level of $\mathbf{10^{-5}}$**.**

further reduced to $\mathbf{10^{-7}}$**.**

(4)Volume

a factor of **10 to 100** just based on the volumetric effect.



Nuclear Energy with No Nuclear Contamination

- **Neutron**
- **Gamma Rays**
- **Charged Particles**

  α,(Helium);

  β,(X-rays);

- **Neutrino**

  The Best Nuclear Radiation;

  Confirmation of the Nuclear Origin;

  Detectable.

Opportunity & Challenge for CMNS

- **500 Billions Euros, 7 years**
- **10 Thematic Priorities**

  (Energy, Environment)
- **4 Countries in EU**
- **1 EU Coordinator**
- **1 Industry member**
- **Volunteer Reviewers**

3 among 36 experts of EURATOM(FP-6)

BÄVERSTAM	ULF	SE	SWEDISH RADIATION PROTECTION INSTITUTE	PUBLIC RESEARCH CENTRES
GADÓ	JÁNOS	HU	MTA KFKI ATOMIC ENERGY RESEARCH INSTITUTE	PUBLIC RESEARCH CENTRES
IMEL	GEORGE	US	ARGONNE NATIONAL LABORATORY	PUBLIC RESEARCH CENTRES
NIWA	OHTSURA	JP	KYOTO UNIVERSITY	HIGHER EDUCATION ESTABLISHMENTS
O'SULLIVAN	PATRICK J	IE	NRG (NUCLEAR RESEARCH AND CONSULTANCY GROUP)	PRIVATE / COMMERCIAL RESEARCH CENTRES
ROYEN	JACQUES	BE	OECD NUCLEAR ENERGY AGENCY	INTERNATIONAL RESEARCH CENTRES
VAN LUIK	ABRAHAM	US	US DEPARTMENT OF ENERGY	OTHERS
VASA	IVO	CZ	NUCLEAR RESEARCH INSTIUTE REZ PLC	PRIVATE / COMMERCIAL RESEARCH CENTRES
WEISS	WOLFGAN	DE	FEDERAL OFFICE FOR RADIATION PROTECTION	PUBLIC RESEARCH CENTRES

Cooperation – Collaborative research

10 thematic priorities

1. Health
2. Food, agriculture and Biotechnology
3. Information and Communication Technologies
4. Nanosciences, Nanotechnologies, Materials and new Production Technologies
5. Energy
6. Environment (including climate change)
7. Transport (including aeronautics)
8. Socio-Economic Sciences and the Humanities
9. Security
10. Space

Conclusions (5)

This presentation was nothing more than common sense!

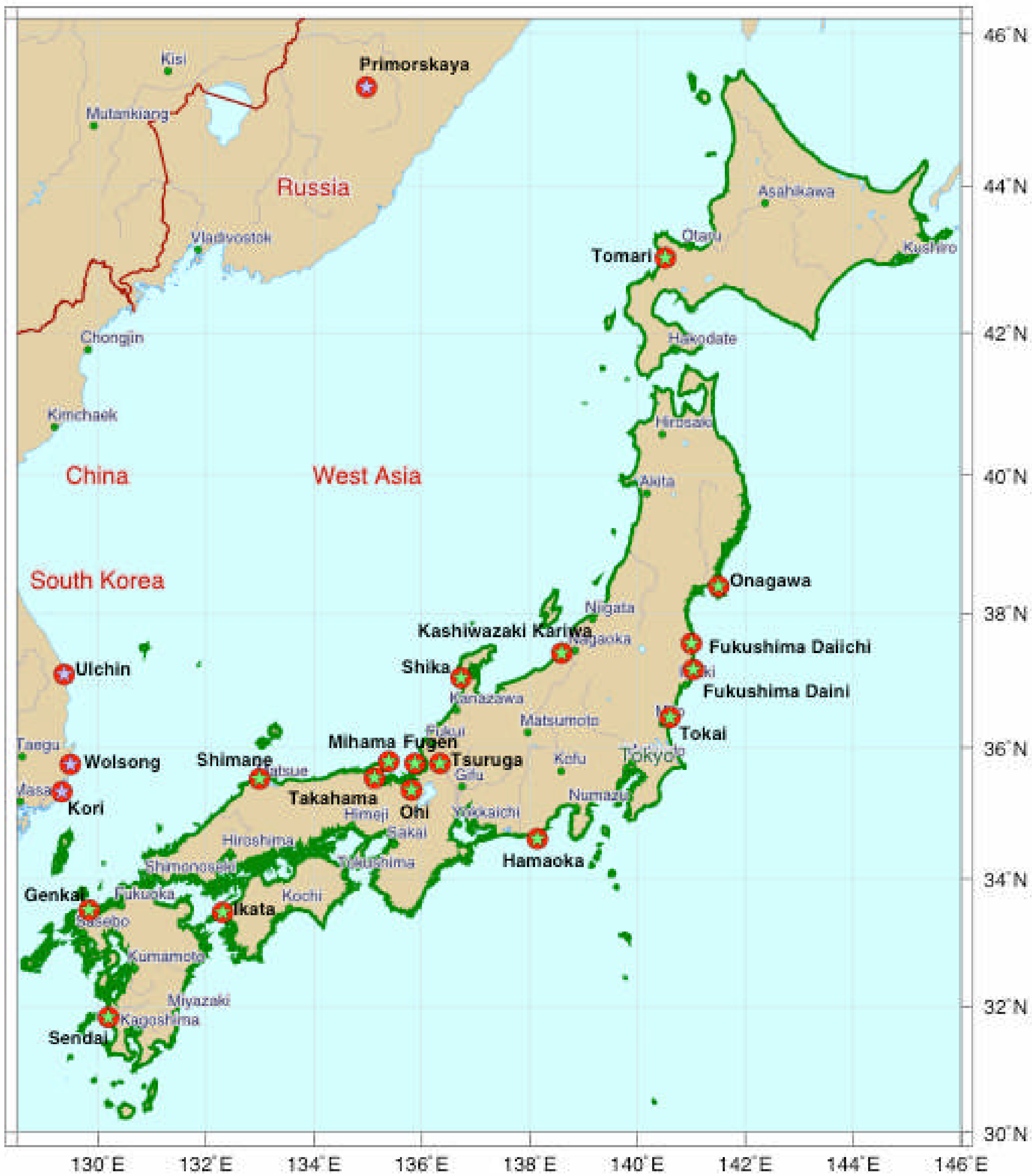
Why not get a thorough understanding of the process and

volunteer to be an expert-evaluator yourself !

It's easy: **http://www.cordis.lu/experts/fp6_candidature.htm**

GOOD LUCK & thanks for your attention.

http://cordis.europa.eu/experts/fp6_candidature.htm


Primorskaya
Kisi
Mutankiang
Russia
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Chongjin
Kimchaek
China
West Asia
South Korea
Ulchin
Taegu
Wolsong
Kori
Genkai
Fukuoka
Sasebo
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Sendai
Ikata
Kochi
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Hiroshima
Shimane
Matsue
Takahama
Mihama
Fugen
Tsuruga
Ohi
Himeji
Sakai
Tokushima
Gifu
Yokkaichi
Fukui
Kanazawa
Shika
Kashiwazaki Kariwa
Niigata
Nagaoka
Matsumoto
Kofu
Numazu
Hamaoka
Tokyo
Tokai
Fukushima Daiichi
Fukushima Daini
Onagawa
Akita
Hirosaki
Hakodate
Tomari
Otaru
Asahikawa
Kushiro
46°N
44°N
42°N
40°N
38°N
36°N
34°N
32°N
30°N
130°E
132°E
134°E
136°E
138°E
140°E
142°E
144°E
146°E

Temperature Effect in Electron Screening

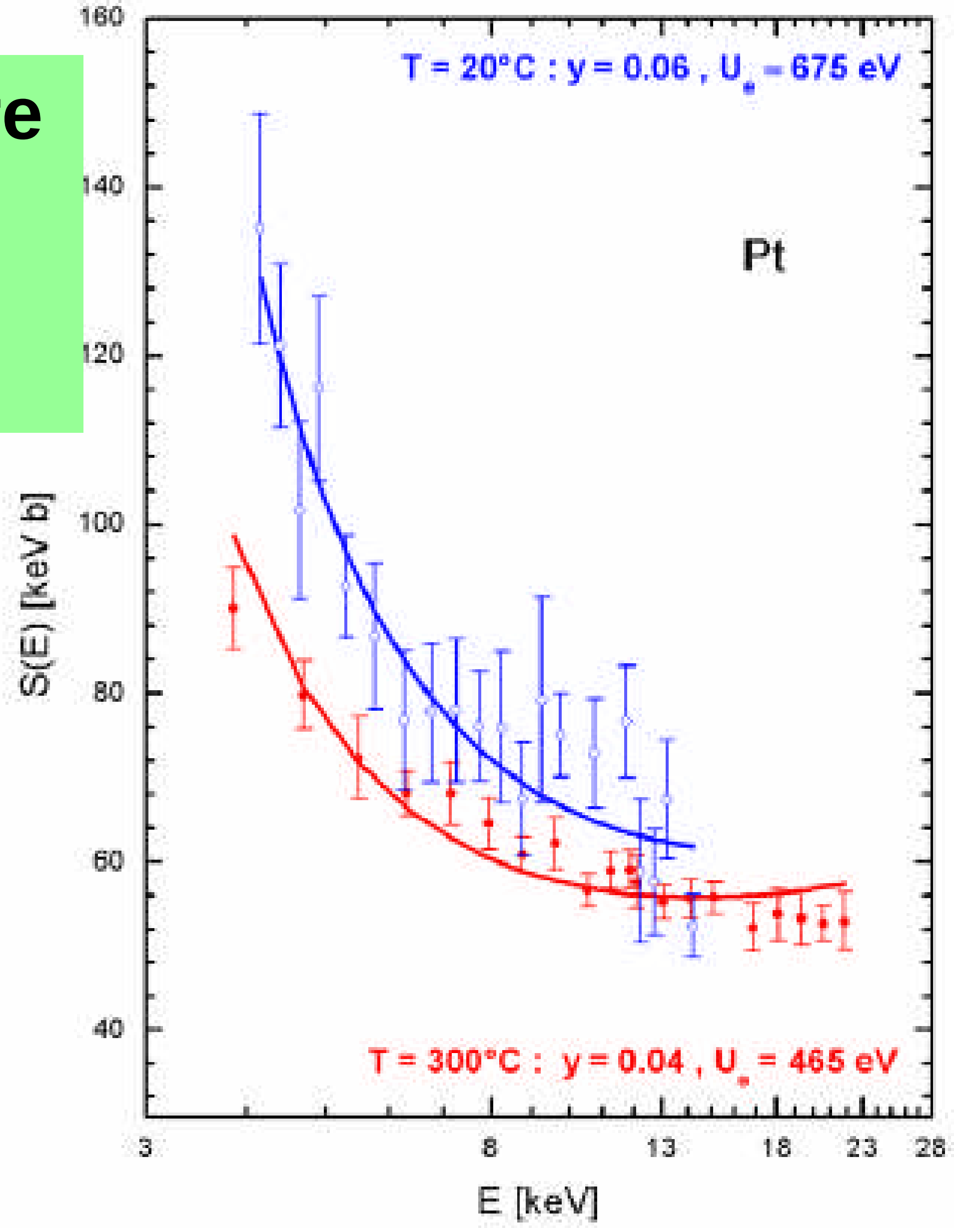


Figure 1. The $S(E)$ factor of d(d, p)t for Pt at $T = 20\,°C$ and $300\,°C$, with the deduced solubilities y. The curves through the data points include the bare $S(E)$ factor and the electron screening with the given U_e values.

Temperature Effect in Electron Screening

F. Raiola, Ruhr Univ. Bochum, Germany

Table 1. Summary of results[a].

Material	T (°C)	U_e (eV)[b]	Solubility y[c]	n_{eff}[b]	n_{eff} (Hall)[d]
		T-dependence of Pt and Co			
Pt	20	675 ± 70	0.06		
	100	530 ± 40	0.06		
	200	530 ± 40	0.05		
	300	465 ± 38	0.04		
	340	480 ± 70	0.04		
Co	20	640 ± 70	0.14		
	200	480 ± 60	0.02		
		T-dependence of Ti			
Ti	−10	⩽30	2.1		
	50	⩽50	1.1		
	100	250 ± 40	0.26		
	150	295 ± 40	0.23		
	200	290 ± 65	0.20	1.7 ± 0.7	4 ± 1
		Groups 3 and 4 and lanthanides			
Sc	200	320 ± 50	0.11	2.6 ± 0.8	2.2 ± 0.4
Y	200	270 ± 75	0.09	2.6 ± 1.4	2.7 ± 0.5
Zr	200	205 ± 70	0.13	1.1 ± 0.7	(1.1 ± 0.2)
Lu	200	265 ± 70	0.08	2.2 ± 1.2	3.4 ± 0.7
Hf	200	370 ± 70	0.04	4.0 ± 1.5	(3.2 ± 0.6)
La	200	245 ± 70	0.09	2.4 ± 1.4	2.9 ± 0.6
Ce	200	200 ± 50	0.11	1.5 ± 0.7	(1.2 ± 0.2)
Nd	200	190 ± 50	0.08	1.4 ± 0.7	(2.2 ± 0.4)
Sm	200	314 ± 60	0.08	3.5 ± 1.3	10 ± 2
Eu	200	120 ± 60	0.05	0.8 ± 0.8	
Gd	200	340 ± 85	0.08	4.2 ± 2.1	2.2 ± 0.4
Tb	200	340 ± 80	0.18	3.9 ± 1.8	
Dy	200	340 ± 70	0.09	4.9 ± 2.0	1.5 ± 0.3
Ho	200	165 ± 50	0.07	0.9 ± 0.5	
Er	200	360 ± 80	0.05	4.3 ± 1.9	6 ± 1
Tm	200	260 ± 80	0.05	2.2 ± 1.4	1.0 ± 0.2
Yb	200	110 ± 40	0.13	0.4 ± 0.3	(0.6 ± 0.1)
		Insulator			
C	200	<50	0.15		

[a] For details, see [11].
[b] Error contains no systematic uncertainty in the energy dependence of stopping power.
[c] Estimated uncertainty is about 20% for the determination of the absolute cross section and thus for the solubility.
[d] From the observed Hall coefficient, with an assumed 20% error; the numbers in brackets are for hole carriers.

大亚湾反应堆中微子实验

曹 俊

中国科学院•高能物理所

中国物理学会 • 2006秋季会议

中微子探测器

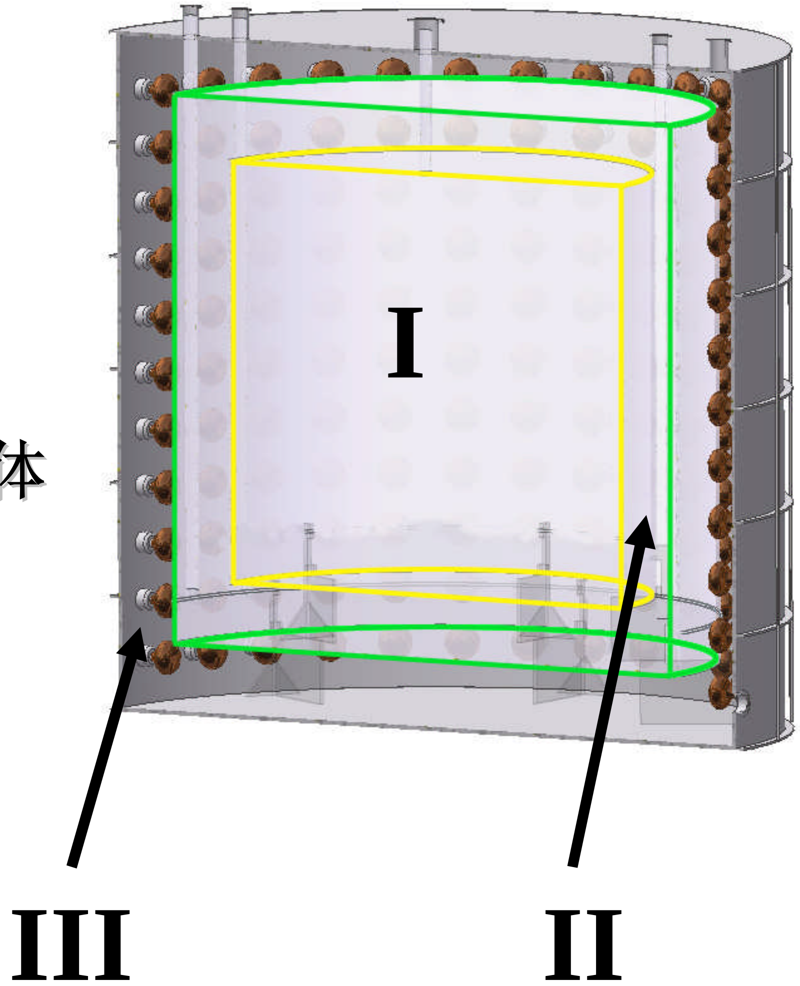
探测器模块化
- 近点各两个，远点四个
- 每个20吨靶质量，总重100吨
- 直径5米，高5米

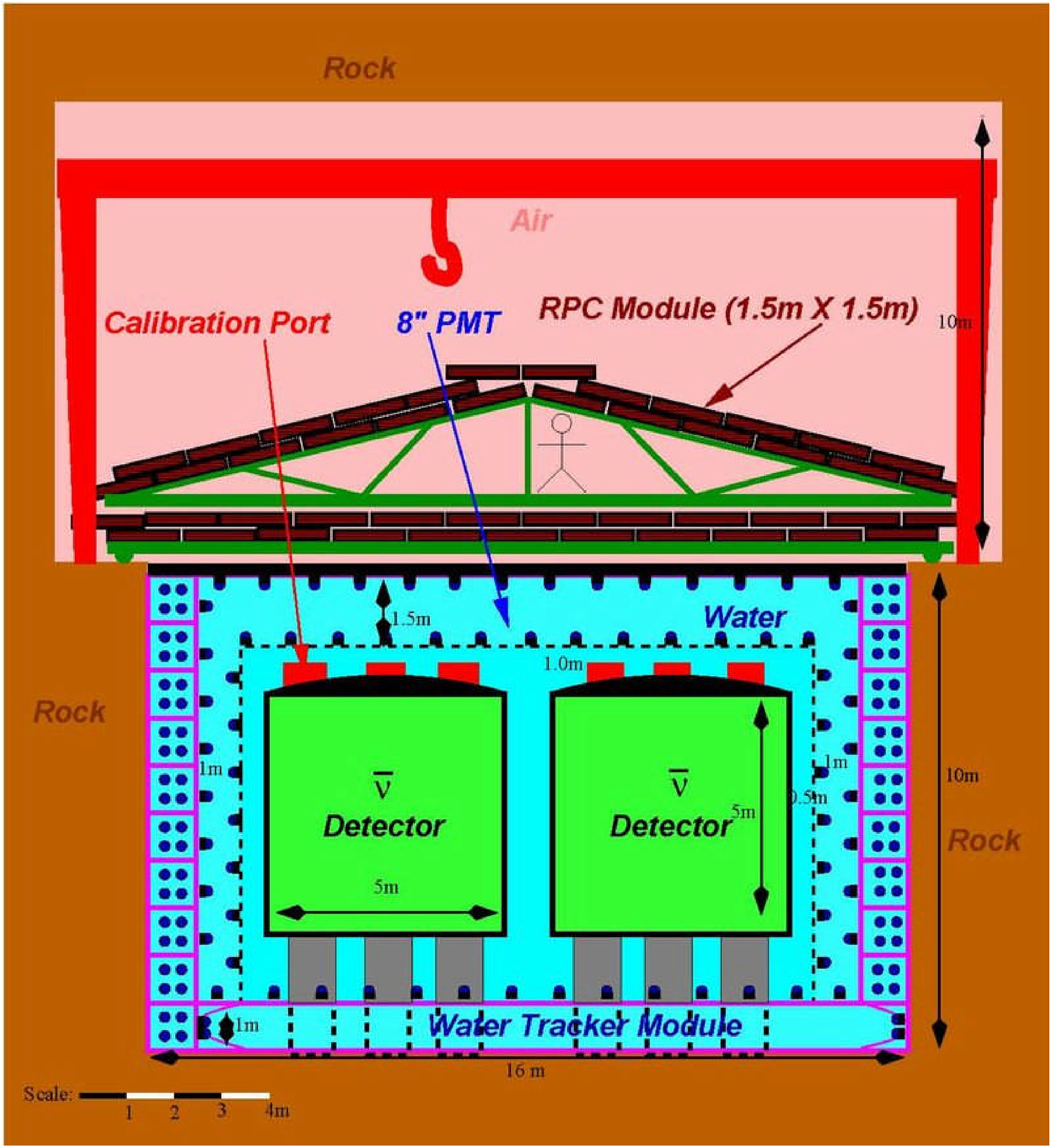
三层结构：
- I. 靶层：掺钆液体闪烁体
- II. 集能层：普通液闪
- III. 屏蔽层：矿物油

上下端面加反射层
- 降低造价
- 简化结构

$\frac{\sigma}{E} \sim \frac{14\%}{\sqrt{E(\mathrm{MeV})}}, \quad \sigma_{\mathrm{vertex}} = 14\mathrm{cm}$

~200 8”PMT/模块

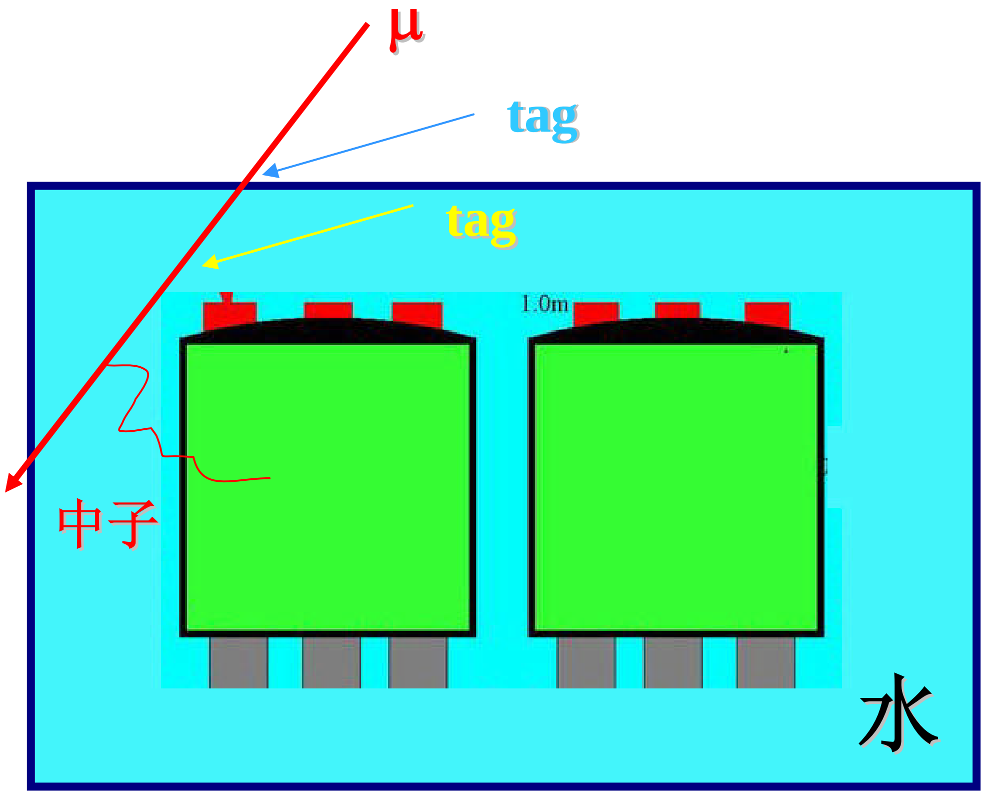




实验大厅

- 中微子探测器放在水池中，被**2.5**米的水屏蔽
- 水池兼做宇宙线探测器
- 水池外围另有一层反符合探测器
  - **RPC**
  - 水箱探测器

水屏蔽层



- 宇宙线在岩石和水中产生的快中子可以飘移到中心探测器，形成本底→两层反符合，效率>99.5%
- 岩石的天然放射性→压低~10^7倍
- 其它材料如水泥：价格高、有天然放