The Conjecture of the Neutrino Emission
from the Metal Hydrides

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The 7-th International Workshop on Anomalies in Hydrogen/Deuterium Loaded Metals,
Sept. 22-25, 2006, Asti, ITALY
Anomalies in H/D Loaded Metals

- Chemistry
- Cells
- Calorimeter

3 D fusion

- Nuclear Physics
- Accelerator
- Detector

2 D long life

Neutrino Emission

High Energy Physicist
Prediction of Selective Resonant Tunneling

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


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

(CMNS)

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

Long Life-Time Resonance of (D,D) or (D,P)
Experimental Confirmation: 3-Body Reaction

1993, Kasagi, \( d + (d+d) \rightarrow p + \alpha + n \),

\( 17 \text{ MeV} \) \( 6.5 \text{ MeV} \)

1997, Takahashi, \( d + (d+d) \rightarrow He^3 + T \)

\( (4.75 \text{ MeV}) \) \( (4.75 \text{ MeV}) \)

Life-time of \( (d+d) \) Resonance \(~ 10^4 \text{ Sec.} \)

\( p + (d + d) \rightarrow p + He^4 \)

\( 19.1 \text{ MeV} \) \( 4.77 \text{ MeV} \)
Electron-catalyzed fusion-1

\[ d + d + e \rightarrow ^4H^* + \nu_e \ (Electron \ Capture) \]

\[ ^4H^* \rightarrow ^4He^* + \bar{\nu}_e + e \]

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

\[ p + p \rightarrow D + \nu_e + e^+ \ (Bethe's \ Solar \ Model) \]

\[ d + d \rightarrow ^4H^* + \nu_e + e^+ \ (Positron \ Emission) \]

\[ ^4H^* \rightarrow ^4He^* + \bar{\nu}_e + e \]

\[ d + d \rightarrow ^4He^* + \bar{\nu}_e + \nu_e + e^+ + e \ (Q = 23.8MeV) \]

\[ 22.8MeV \]
Electron-catalyzed fusion-2

\[ p + d + e \rightarrow T^* + \nu_e \quad (\text{Electron Capture}) \]

\[ T^* \rightarrow ^3\text{He}^* + \tilde{\nu}_e + e \]

\[ p + d \rightarrow ^3\text{He}^* + \tilde{\nu}_e + \nu_e \quad (Q = 5.494\text{MeV}) \]

\[ p + d \rightarrow T^* + \nu_e + e^+ \quad (\text{Positron Emission}) \]

\[ T^* \rightarrow ^3\text{He}^* + \tilde{\nu}_e + e \]

\[ p + d \rightarrow ^3\text{He}^* + \nu_e + \tilde{\nu}_e + e^+ + e \quad (5.494\text{MeV}) \]

\[ 4.472\text{MeV} \]
Figure 1. $\beta$ radiation from a preliminary run of April 21, 1992 (negligible nobles).
Fig. 2. Beta spectrum of Pd cathode piece after D₂O electrolysis and application of closed-system analytical method. Ordinate: Incremental counts per 5-channel interval in 20 minutes.

Fig. 3. Beta spectrum of secondary tritium standard: Tritiated H₂O (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.
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 $6 \times 10^{12}$/sec.

“excess heat” power of 6 mW.

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

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

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

\[ d + d \rightarrow ^4He^* + \bar{\nu}_e + \nu_e, (Q = 23.8 \text{MeV}) \]

\[ p + d \rightarrow ^3He^* + \bar{\nu}_e + \nu_e, (Q = 5.494 \text{MeV}) \]
Various Physics Targets with wide energy range

- Neutrino electron elastic scattering: $\nu + e^- \rightarrow \nu + e^-$
- Neutrino Geophysics: verification of earth evolution model
- Neutrino Physics: precision measurement of oscillation parameters
- Neutrino Cosmology: verification of universe evolution

- 7Be solar neutrino
- Geo-neutrino
- Reactor neutrino
- Supernova relic neutrino etc.

Visible energy [MeV]

- Neutrino Astrophysics: verification of SSM

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)
(3) Purification of Scintillation Liquid

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

further reduced to $10^{-7}$. 
(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
  - \( \alpha \), (Helium);
  - \( \beta \), (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)

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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.
Temperature Effect in Electron Screening

Figure 1. The $S(E)$ factor of d(d, p)t for Pt at $T = 20^\circ C$ and $300^\circ C$, 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

<table>
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<tr>
<th>Material</th>
<th>$T$ (°C)</th>
<th>$U_s$ (eV)</th>
<th>Solubility $y^c$</th>
<th>$n_{eff}^b$</th>
<th>$n_{eff}$ (Hall)$^d$</th>
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<tr>
<td>Pt</td>
<td>20</td>
<td>675 ± 70</td>
<td>0.06</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>100</td>
<td>530 ± 40</td>
<td>0.06</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>200</td>
<td>530 ± 40</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>465 ± 38</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>540</td>
<td>430 ± 70</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co</td>
<td>20</td>
<td>640 ± 70</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>480 ± 60</td>
<td>0.02</td>
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$T$-dependence of Pt and Co

| Ti       | −10  | 2.1  |
|          | 50   | 1.1  |
|          | 100  | 0.26 |
|          | 150  | 0.23 |
|          | 200  | 1.7 ± 0.7 | 4 ± 1 |

$T$-dependence of Ti

Groups 3 and 4 and lanthanides

| Sc       | 200  | 320 ± 50 | 0.11 |
| Y        | 200  | 270 ± 75 | 0.09 |
| Zr       | 200  | 205 ± 70 | 0.13 |
| Lu       | 200  | 265 ± 70 | 0.08 |
| Hf       | 200  | 370 ± 70 | 0.04 |
| La       | 200  | 245 ± 70 | 0.09 |
| Ce       | 200  | 200 ± 50 | 0.11 |
| Nd       | 200  | 190 ± 50 | 0.08 |
| Sm       | 200  | 314 ± 60 | 0.08 |
| Eu       | 200  | 120 ± 60 | 0.05 |
| Gd       | 200  | 340 ± 85 | 0.08 |
| Tb       | 200  | 340 ± 80 | 0.18 |
| Dy       | 200  | 340 ± 70 | 0.09 |
| Ho       | 200  | 165 ± 50 | 0.07 |
| Er       | 200  | 360 ± 80 | 0.05 |
| Tm       | 200  | 260 ± 80 | 0.05 |
| Yb       | 200  | 110 ± 40 | 0.13 |

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.
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
\[ \frac{\sigma}{E} = \frac{14\%}{\sqrt{E (\text{MeV})}} \]
\[ \sigma_{\text{vertex}} = 14\text{cm} \]
\[ \sim 200 \ 8'' \text{PMT/模块} \]
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、有天然放射性