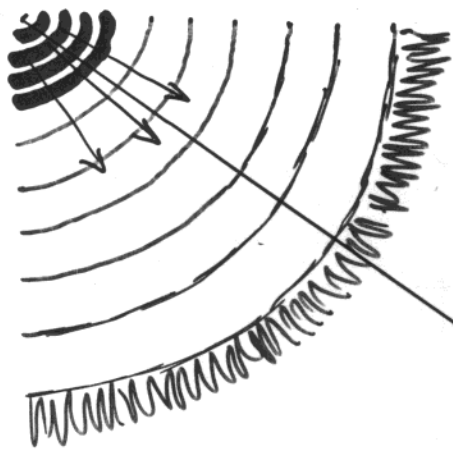


**RADIATIVE DECAYS
OF ν_e IN MATTER
AND SOLAR DEFICIT**

VENICE 23.02.99

RADIATIVE DECAY OF ν



$$\nu_0 \rightarrow \nu' + \gamma \quad ?$$

SN87 $\frac{\tau_{\nu e}}{m} > 6 \cdot 10^{15} \frac{s}{eV}$

PRL 62 (89) 505

if $E_\gamma \sim \frac{E_\nu}{2}$



- Case of degenerated masses

Bugey PL B207 (88) 217

excludes decays with $\frac{\sum m}{m} > 10^{-7}$

- New potential loophole:

decays inside the Sun

700 000 km with densities up to 150 g/cm

DECAYS IN MATTER

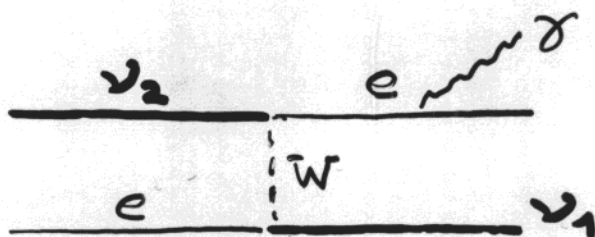
- Radiative decay in vacuum



GIM suppressed

$$\Gamma_{\nu} = (7 \cdot 10^{43} \text{ s})^{-1} \left(\frac{m_2}{1 \text{ eV}}\right)^5 |U_{12} U_{22}|^2$$

- In matter



Coherent interaction on atomic e^-

$$\frac{\Gamma_m}{\Gamma_{\nu}} \sim 10^{24} \left(\frac{N_e}{10^{24} \text{ cm}^{-3}}\right)^2 \left(\frac{1 \text{ eV}}{m_2}\right)^4 F(\nu)$$

Applies only to ν (not $\bar{\nu}$)

- In the Sun

- ν_e

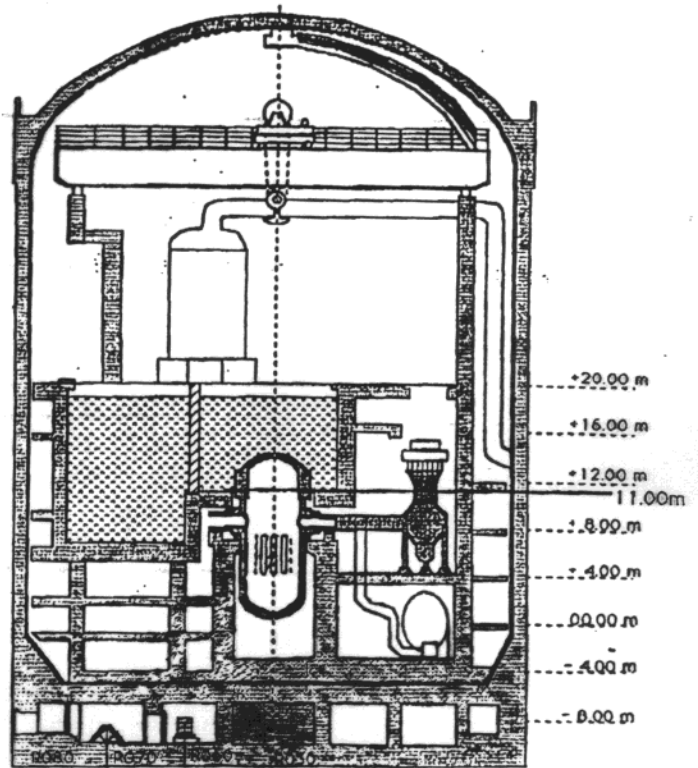
- high density $\int \rho^2 \ell = 8.7 \cdot 10^8 \text{ km} (\text{g/cm}^3)^2$

- needs $\frac{\Gamma_m}{m} \approx 10^{-7} \frac{\text{s}}{\text{eV}}$

ν_e AT A REACTOR

Bugey
2800 MW
 $\Rightarrow 5 \cdot 10^{20} \bar{\nu}_e / s$

But also
 ν_e source



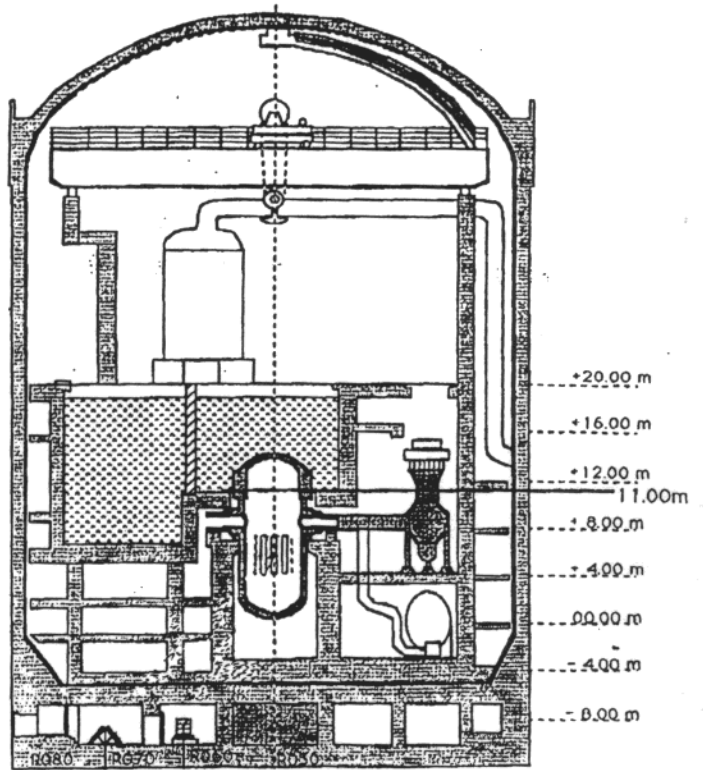
Neutron activation of reactor core
and containment vessel $\Rightarrow {}^{55}\text{Fe} \quad {}^{51}\text{Cr}$

e^- capture $\rightarrow \nu_e$ monochromatic lines

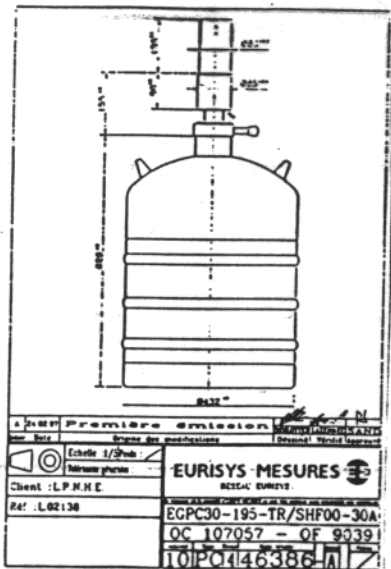
			$\nu_e / \bar{\nu}_e$
${}^{55}\text{Fe}$	230 keV	2.6 y	$2.5 \cdot 10^{-4}$
${}^{51}\text{Cr}$	750 keV	28 d	$2.5 \cdot 10^{-4}$

$7 \cdot 10^{16} \nu_e / s$ 230 keV + 750 keV

even after reactor stop



THE EXPERIMENT



HP Ge crystal

140 cm³

15 m from

reactor core

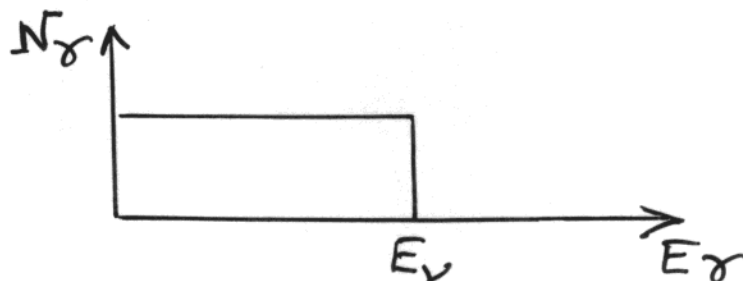
Live time 4200 s

$\Rightarrow 5 \cdot 10^{14} \nu_e$ of 230 keV
 " " " 750 keV

Kinematics of $\nu_e \rightarrow \nu' + \gamma$

• Majorana ν with $m_2 \ll m_1$

\Rightarrow Flat E_γ distribution



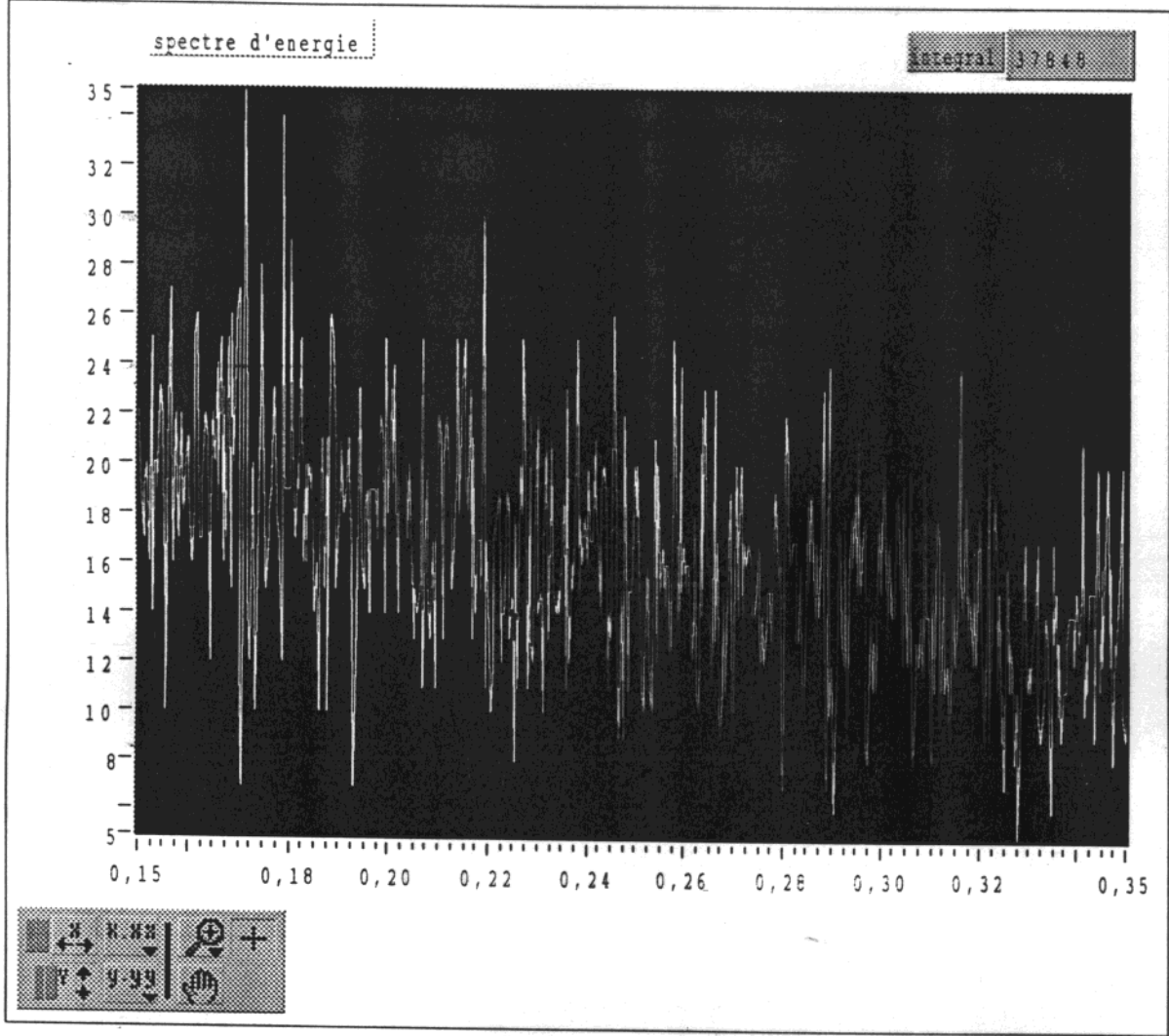


SpectPeaks.vi

D:\TONIC DATA Buqey\SpectPeaks.vi

Last modified on 25/11/98 at 16:32

Printed on 25/11/98 at 16:34



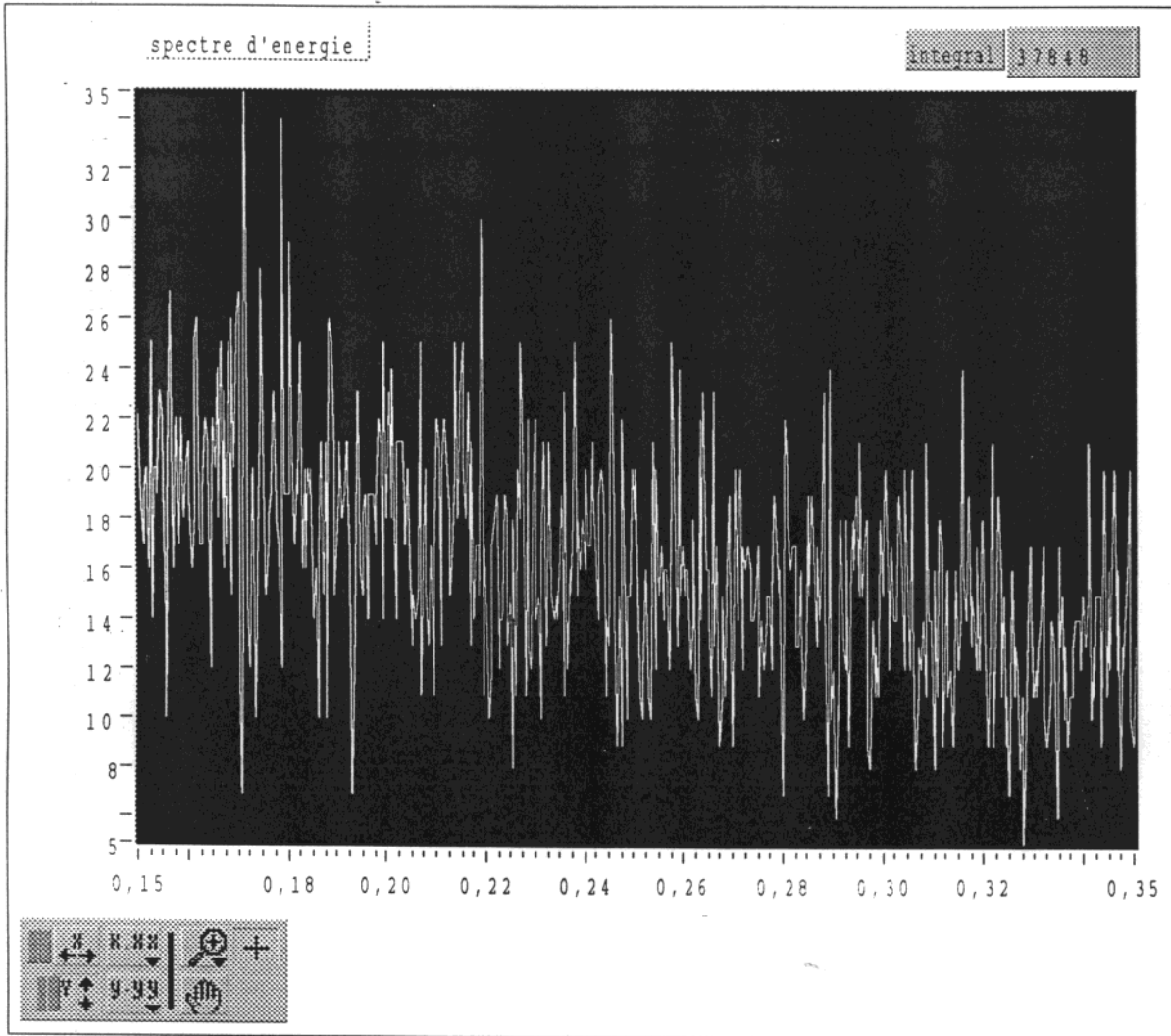


SpectPeaks.vi

D:\TONIC DATA Buqey\SpectPeaks.vi

Last modified on 25/11/98 at 16:32

Printed on 25/11/98 at 16:34



RESULT (PREL.)

No signal !

5 cm of decay length

$5 \cdot 10^{14}$ ν_e of 230 keV

$$P = \frac{5 \cdot 10^{14} \times 0.05 \text{ m(eV)}}{230 \cdot 10^3 \cdot 3 \cdot 10^8 \tau(s)}$$

$$\frac{\tau_m}{m} > 3 \cdot 10^{-4} \frac{s}{eV}$$

cannot explain solar deficit !

"Best" limit on radiative decays
of ν_e

$$\tau_\nu(m)^3 > 5 \cdot 10^{20} F(\nu) s eV^3$$

$$F(\nu) \sim 1 \quad \text{or} \quad F(\nu) \rightarrow 4 \frac{m}{E} \quad ?$$

even with pessimistic calculation

$$\tau_\nu > \dots 10^{16} s \quad \text{for } 1eV \nu_e$$

Better than SN87 !