^{37}Ar production for the test purposes

Dzhonrid Abdurashitov
INR, Moscow

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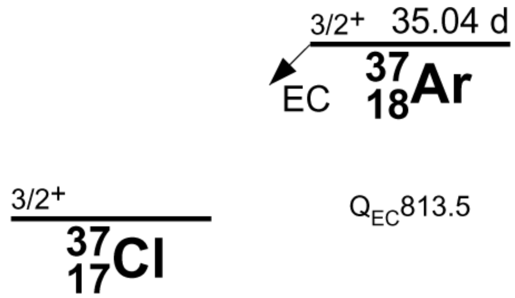
REPORT TOPICS

- ^{37}Ar motivation
- KCl target preparation
- irradiation under 7 MeV proton beam
- extraction of ^{37}Ar
- counting in proportional counter
- conclusions

^{37}Ar motivation for KATRIN



Principal radiations produced
in the decay of ^{37}Ar

Sum energy of Auge elect-rons, keV	Energy of X-ray, keV	Percent of all decays	Decay mode
2.82	0.0	81.5	K
0.27	0.0	8.9	L
0.02	0.0	0.9	M
0.20	2.62	8.2	K
0.01	2.81	0.5	L

Low energy electron source for check
the storage of electrons (at elementary level)

^{37}Ar motivation for KATRIN

Possible production: ^{40}Ca(n,α)^{37}Ar for the SAGE
1 MegaCurie neutrino source

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Measurement of the response of a Ga solar neutrino experiment to neutrinos from a ^{37}Ar source

J. N. Abdurashitov, V. N. Gavrin, S. V. Girin, V. V. Gorbachev, P. P. Gurkina, T. V. Ibragimova, A. V. Kalikhov, N. G. Khairnasov, T. V. Knodel, V. A. Matveev, I. N. Mirmov, A. A. Shikhin, E. P. Veretenkin, V. M. Vermul, V. E. Yants, and G. T. Zatsepin
Institute for Nuclear Research of the Russian Academy of Sciences, Moscow RU-117312, Russia

III. SOURCE PRODUCTION

The source was made by irradiating calcium oxide in the fast neutron breeder reactor BN-600 at Zarechny, Russia. The total fast flux at this reactor is 2.3×10^{15} neutrons/(cm^2 s), of which 1.7×10^{14} neutrons/(cm^2 s) have energy above the

TABLE IV. Gas content of the ^{37}Ar source 47.5 h prior to the reference time in percentage by volume. The uncertainty shown is statistical; there are additional systematic components whose sum is no more than 0.8%.

H_2	^{37}Ar	^{38}Ar	^{39}Ar	^{40}Ar
0.26 ± 0.07	96.57 ± 0.13	1.87 ± 0.06	0.35 ± 0.03	0.95 ± 0.03

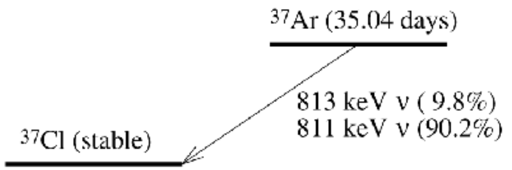


FIG. 2. ^{37}Ar decay scheme showing the neutrino energies.

^{37}Ar motivation for KATRIN

Possible production of ^{37}Ar:

Thermal neutron irradiation:

$^{36}Ar(n,\gamma)^{37}Ar$
expensive
side reactions (^{39}Ar, ..)

Fast neutron irradiation of CaO:
(SAGE 1 MCi neutrino source)

$^{40}Ca(n,\alpha)^{37}Ar$
side reactions (H_2, ^{39}Ar, ..)

Irradiation of KCl (NaCl) with protons:

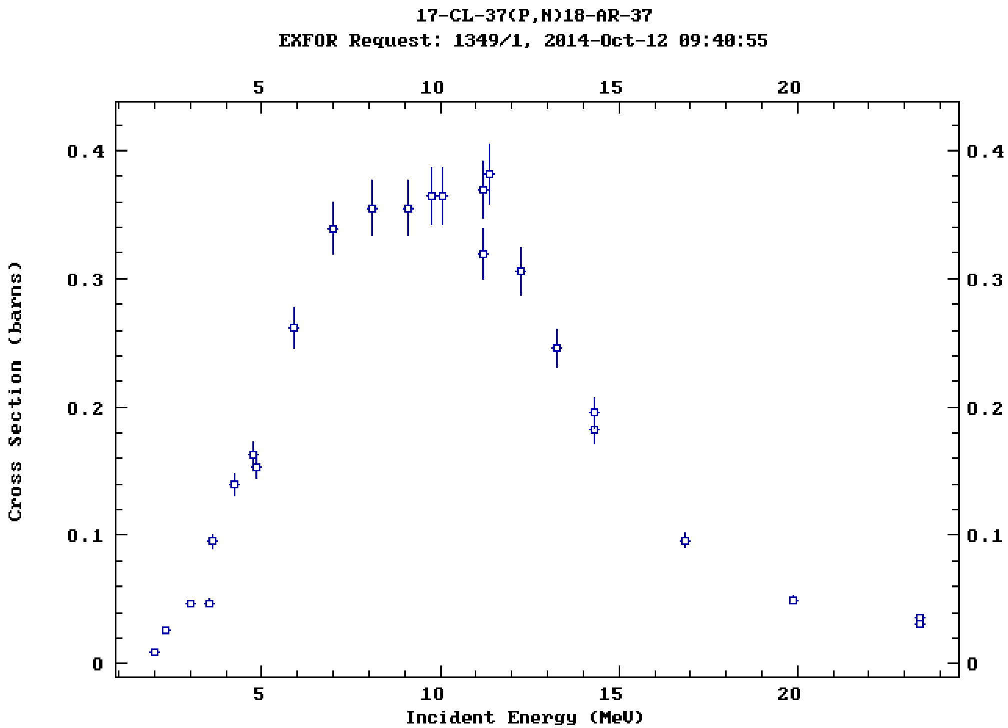
$^{37}Cl(p,n)^{37}Ar$
clean, no side reactions
at low energy

(^{35}Cl; ^{37}Cl) + p – X => (^{35}Ar; ^{37}Ar)

no room for ^{39}Ar (β^-, 269 years)
and for ^{42}Ar (β^-, 33 years)

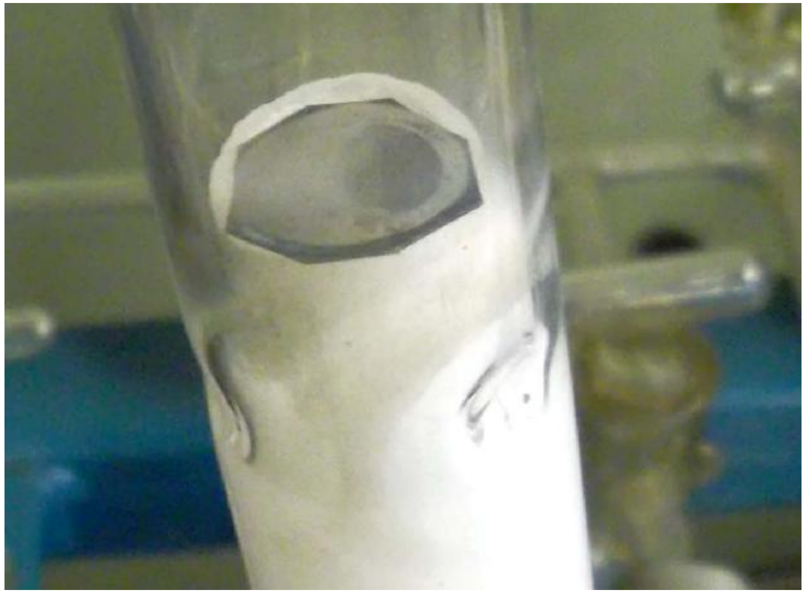
KCl target irradiation

MSU cyclotrone: E_p= 7 MeV, I_p= 2 μA, T=2 hours, defocused beam
(very old one) ~ 10 Wt of heat at Nb plate

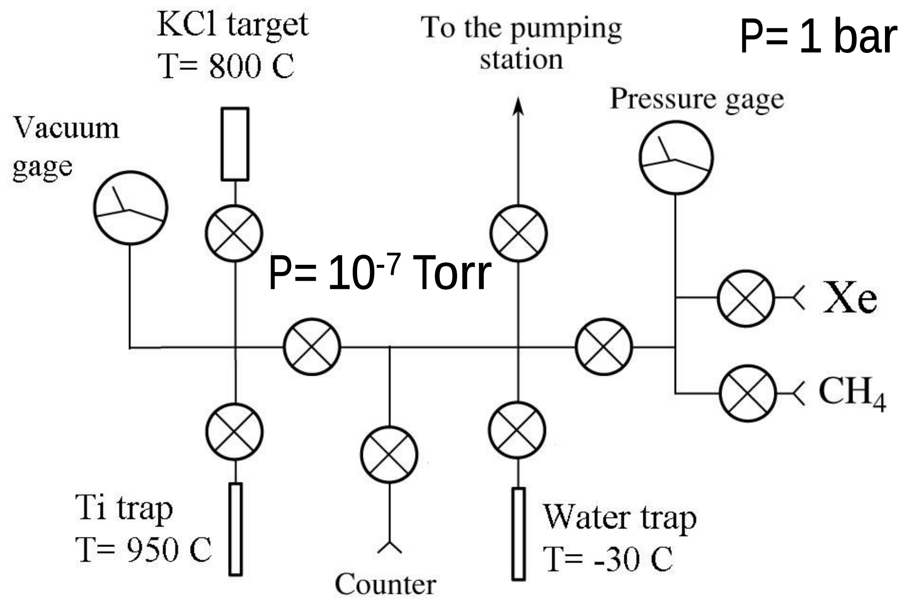


Cross section: 0.35 barns at 7 MeV
Expected Intensity: ~42 kBq
EOB: 20 Dec 2013

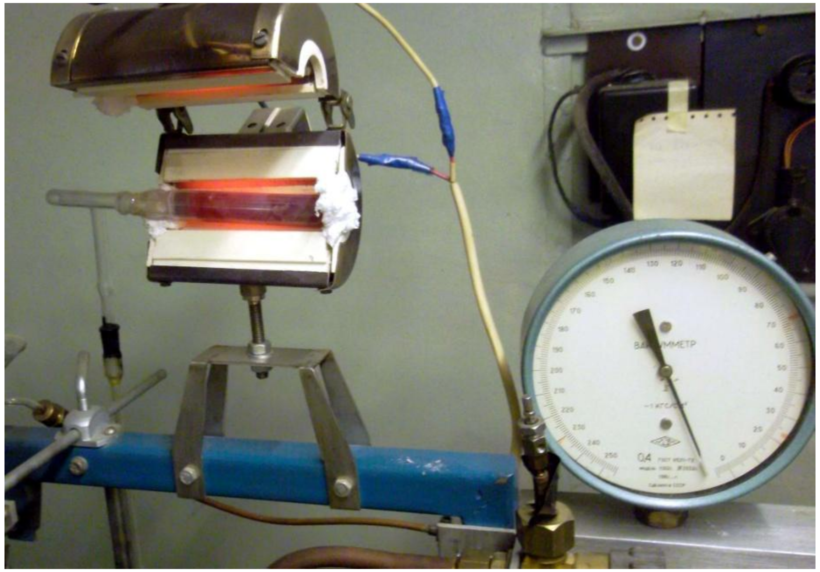
The target:
-10 x 10 x 2 mm Nb plate
-10 μm film of KCl
-vacuum deposition at 10^{-7} Torr

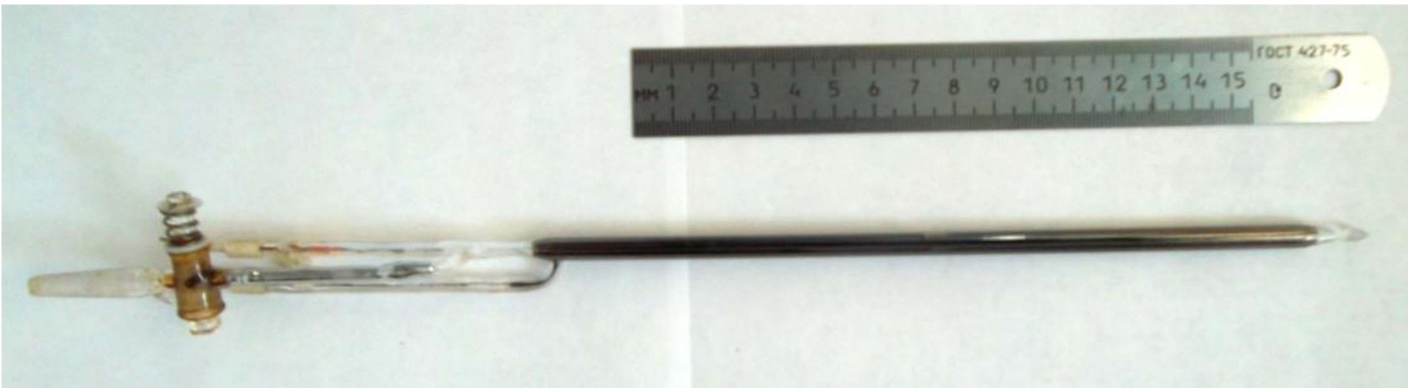


Extraction of ^{37}Ar and counter filling



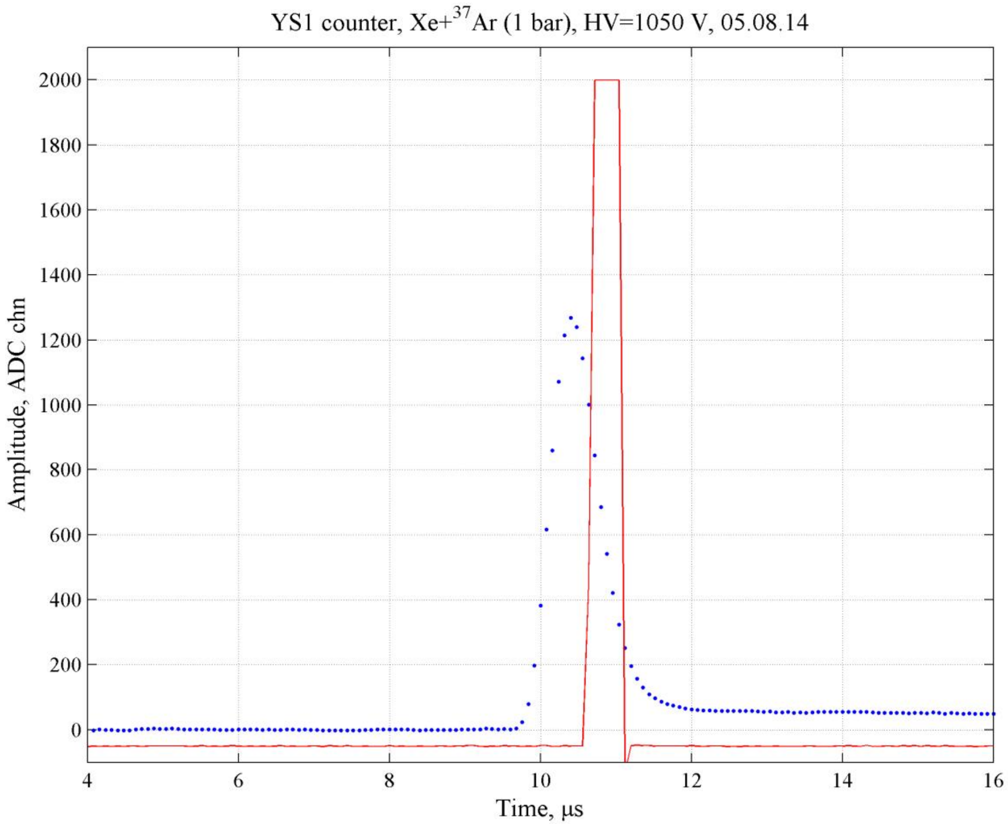
Titanium powder trap in oven





Counter:
- quartz tube Ø4 mm
- carbon 1 µm film
- 0.98 volume efficiency

Counting of ^{37}Ar in proportional counter

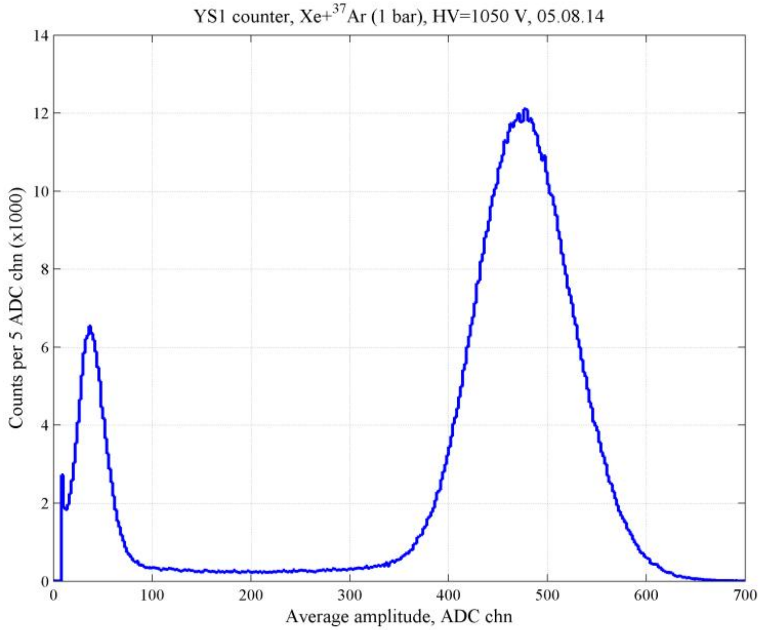


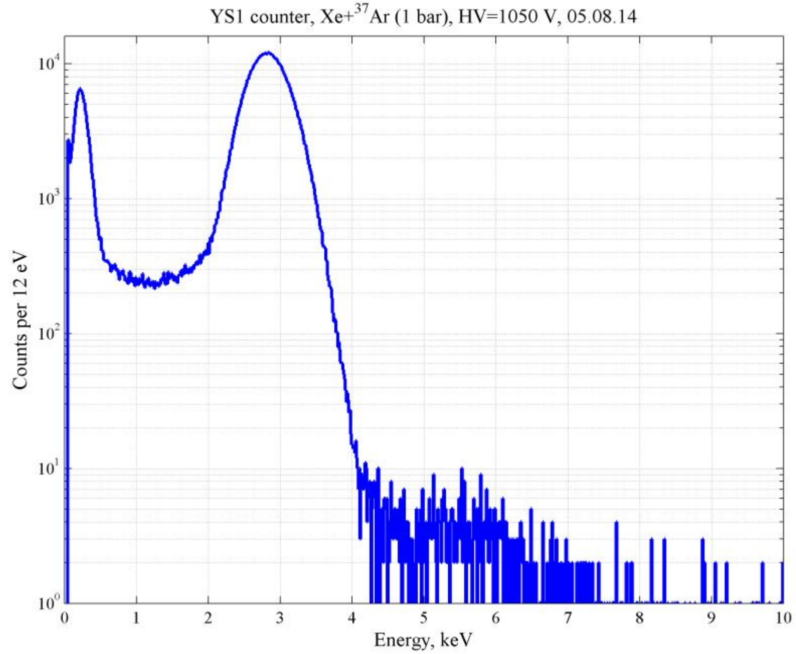
Charge preamplifier:
τ = 60 µs

Amplifier:
shaping time 0.5 µs

Flash ADC:
12 bit, 100 MS/s

Counting of ^{37}Ar in proportional counter





Statistics: 10^6 events threshold ~100 eV rate 430 s^{-1} (05.08.14)

Rate at EOB (6.6 half lives): ~42 kBq ----- just the same

Peak at 5.6 keV is due to pile-up

Conclusions

-Technology of pure ^{37}Ar production is available and can be reproduced/improved

- Samples of ^{37}Ar are under full precize control

- wide range of intensities 0.1 Bq to 10 kBq can be provided with accuracy of 1%

THANKS TO

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