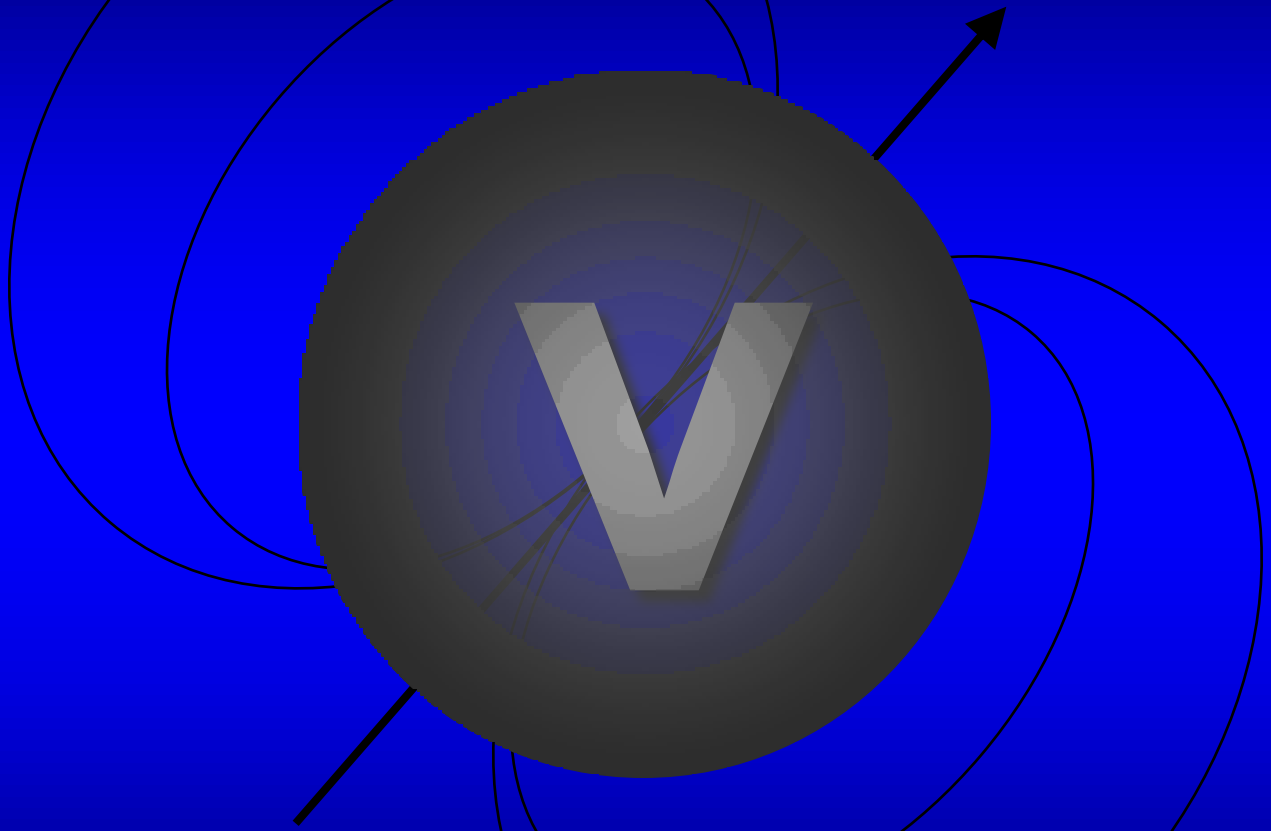
V.Egorov

JINR Dubna
ITEP Moscow

GEMMA-2



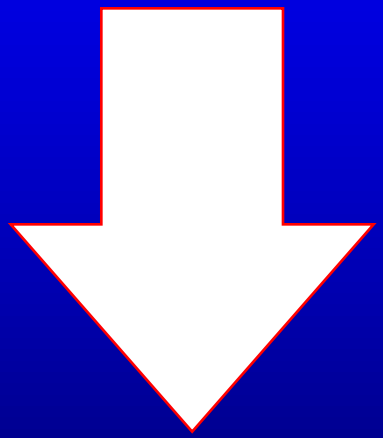
search for the Neutrino Magnetic Moment

Phase-1: 13 months (08.2005-09.2006)
= 216 days ON + 77 days OFF

Phase-2: 19 months (09.2006-05.2008)
= 283 days ON + 42 days OFF

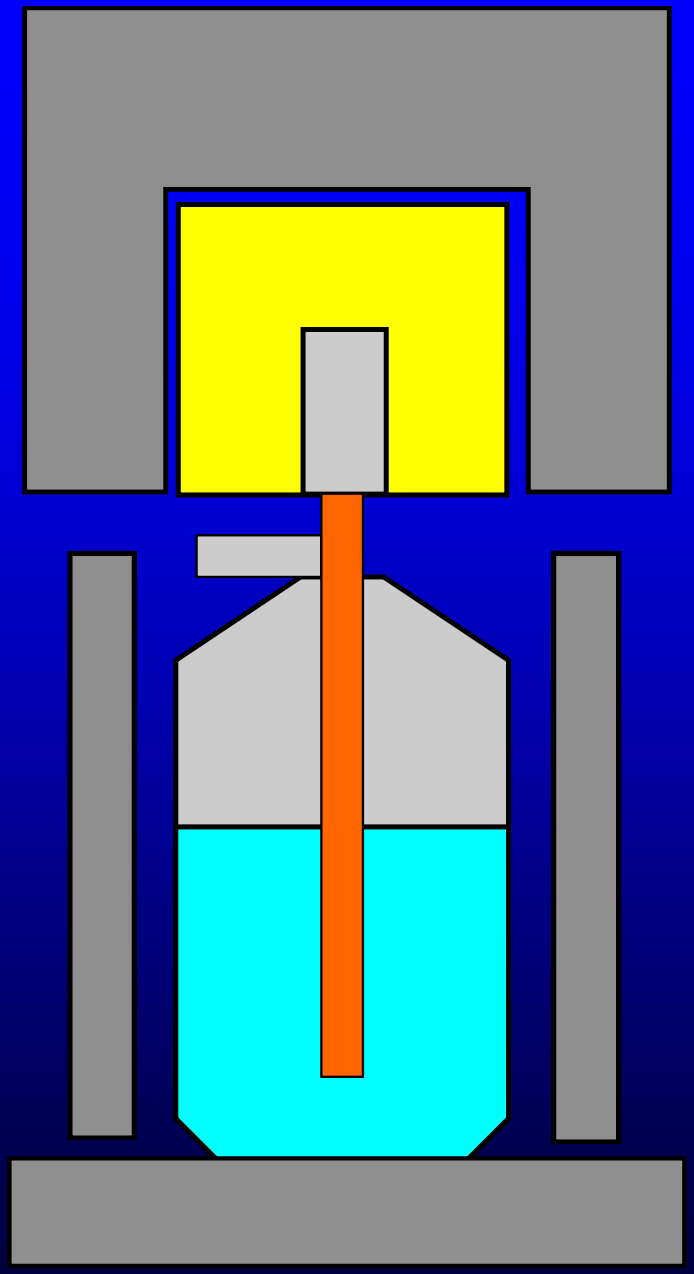
Phase-3: 18 months (05.2008-11.2009)
— data analysis is in progress…
(~2.8×10^{-11} μ_B)

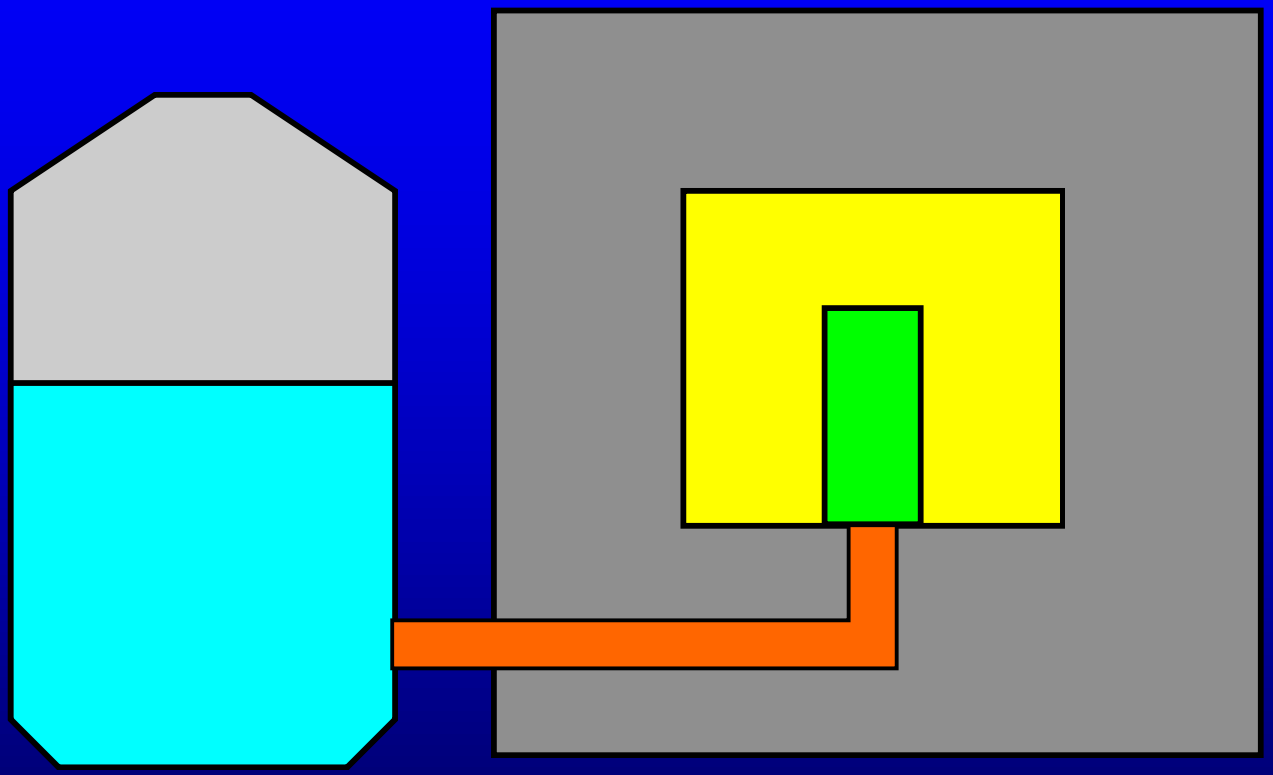
We are close to a principle limitation of the existing apparatus



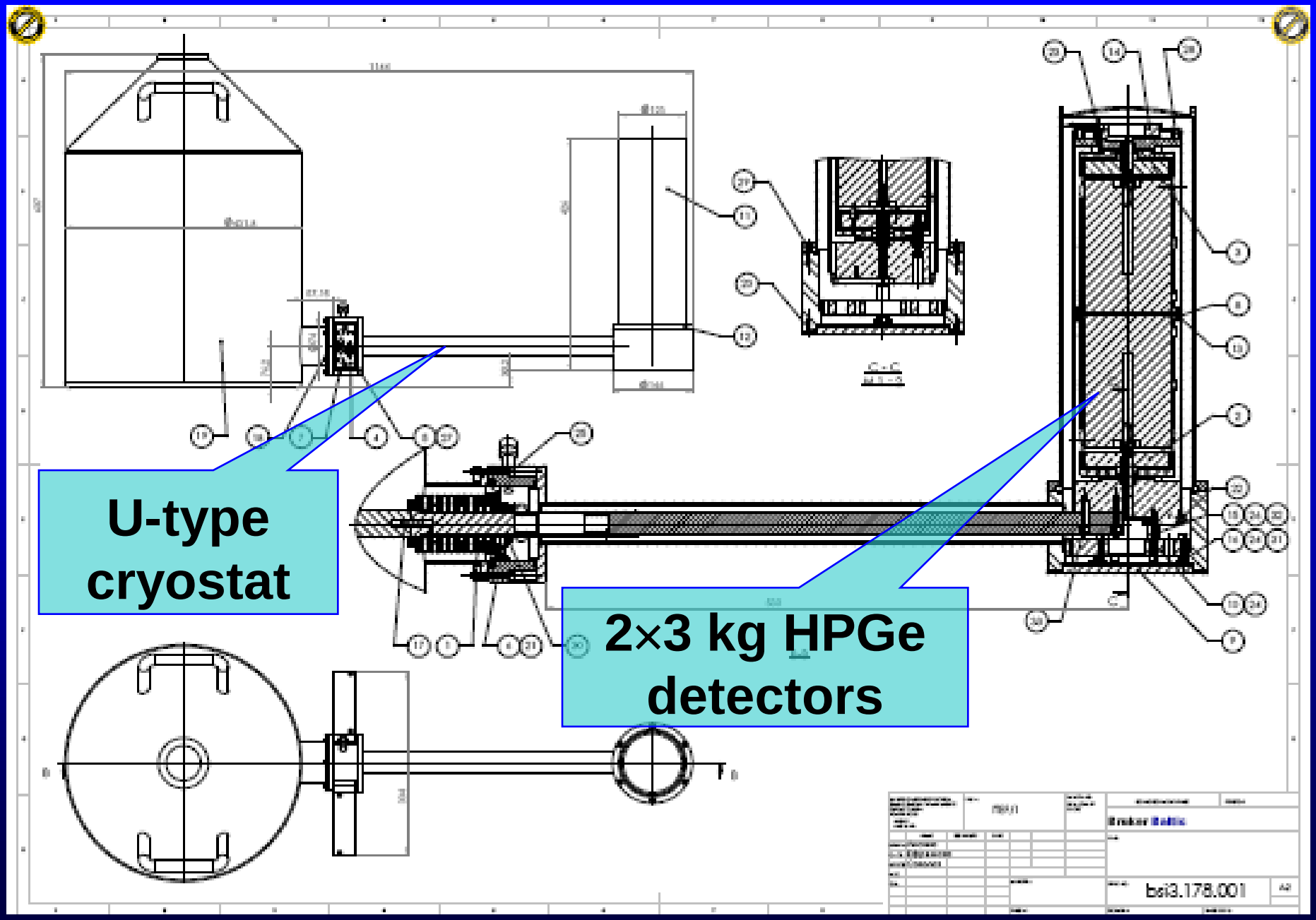
need to upgrade

GEMMA-1 → GEMMA-2

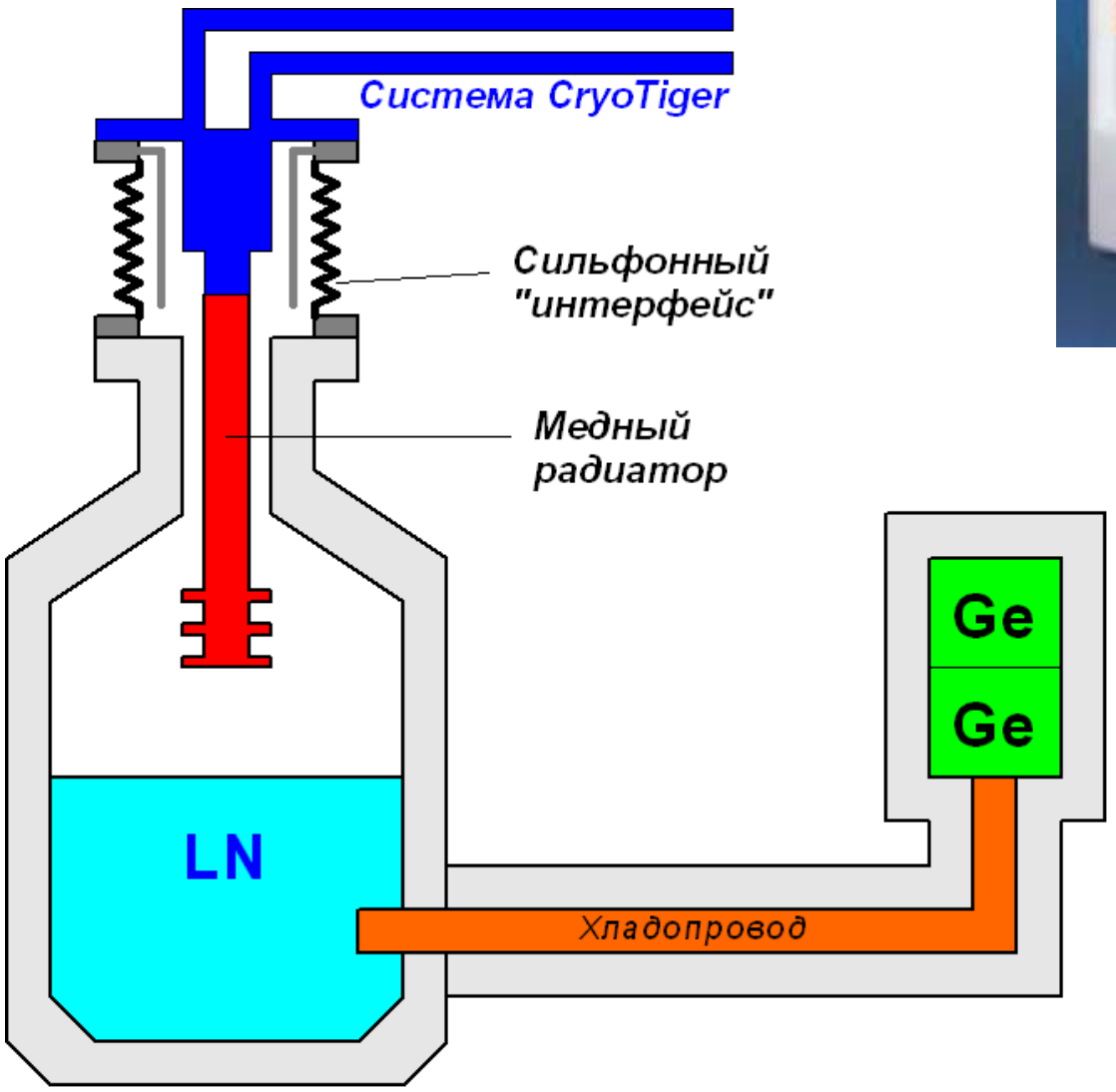




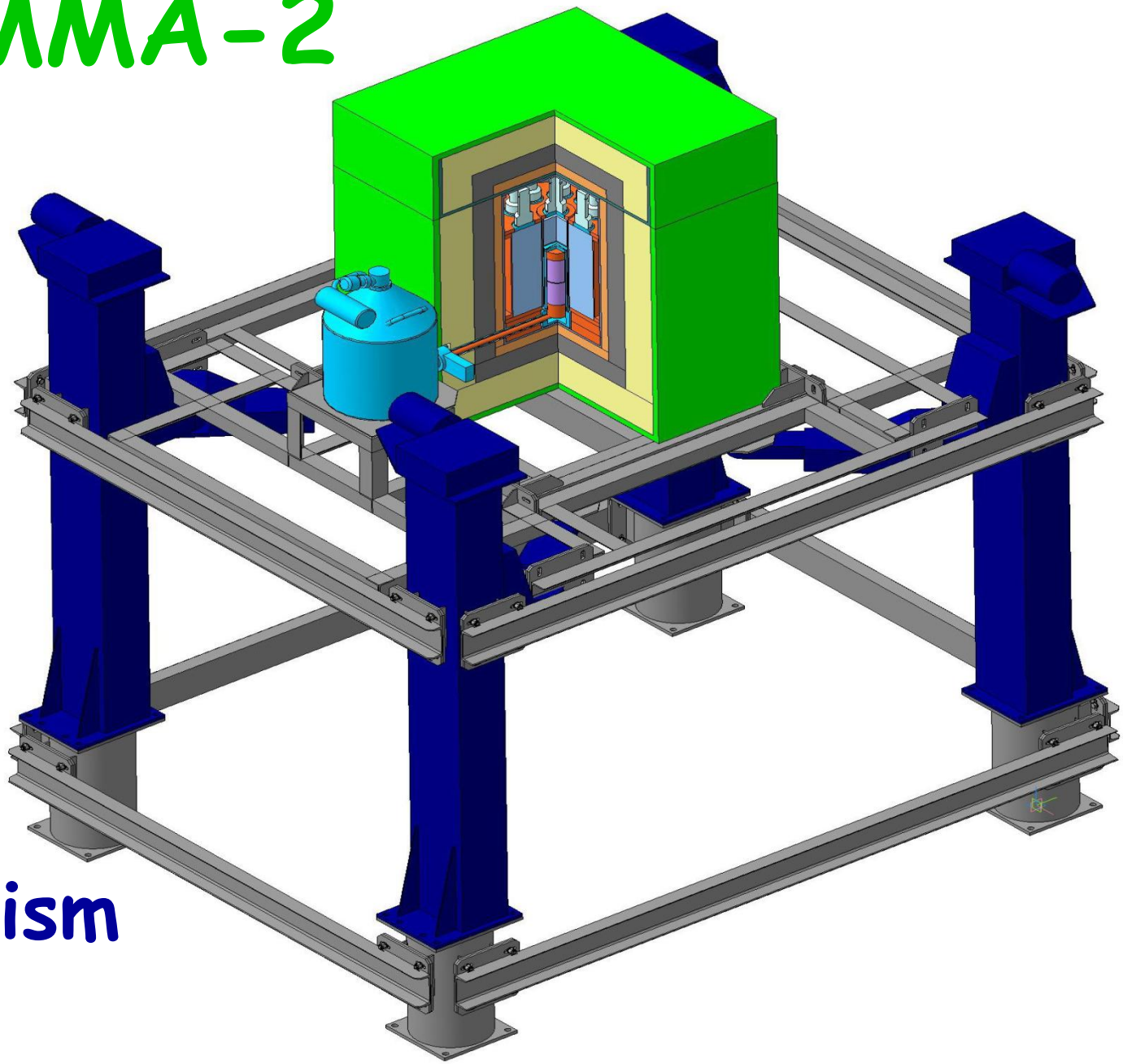
Reduce external background by (1.5 - 2.0)


U-type cryostat
2×3 kg HPGe detectors
bsi3.178.001


CRYOTIGER


Система CryoTiger
Сильфонный
"интерфейс"
Медный
радиатор
Ge
Ge
LN
Хладопровод

GEMMA-2



Lifting mechanism


#2: 14 m
#3: 10 m
KNPP
Udomlya
Russia

Upgrade 2010': GEMMA-2

HPGe:	1.5 kg ⇒ 6 kg
E-threshold:	**3.0 ⇒ 1.5 keV**
Cryostat:	std ⇒ U-type
Reactor unit:	**#2 ⇒ #3**
Distance:	14 m ⇒ 10 m (movable)
ν-flux:	**2.7 ⇒ 5.0 $\times 10^{13}$**

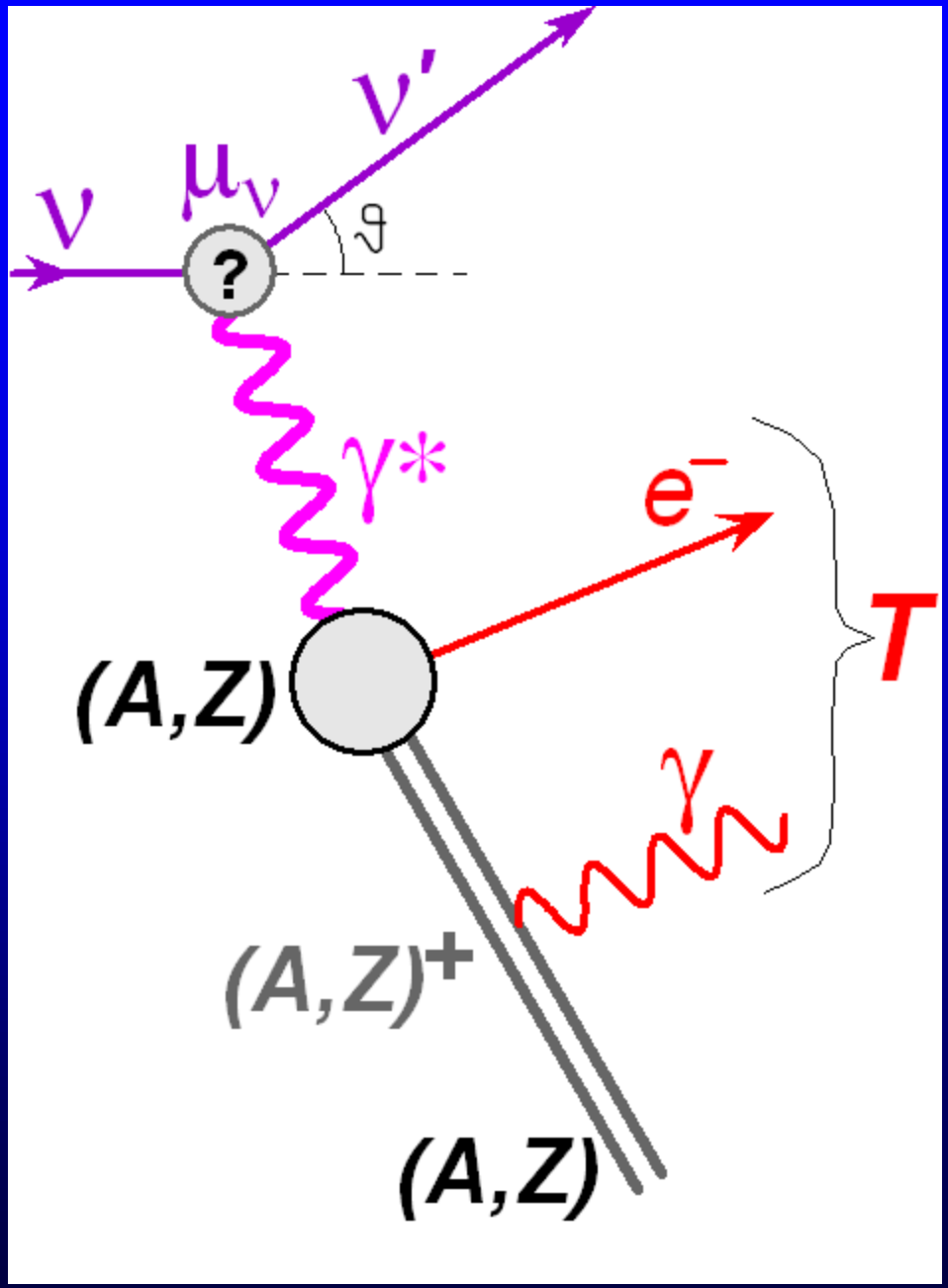
$$\lim(\mu_\nu) \quad \propto \quad \frac{\sqrt[4]{B}}{\sqrt[2]{\Phi}\ \sqrt[4]{M}\ \sqrt[4]{t}} \quad \sim \quad \frac{\sqrt[4]{0.5}}{\sqrt[2]{2}\ \sqrt[4]{4}} \quad \simeq \quad 0.42$$

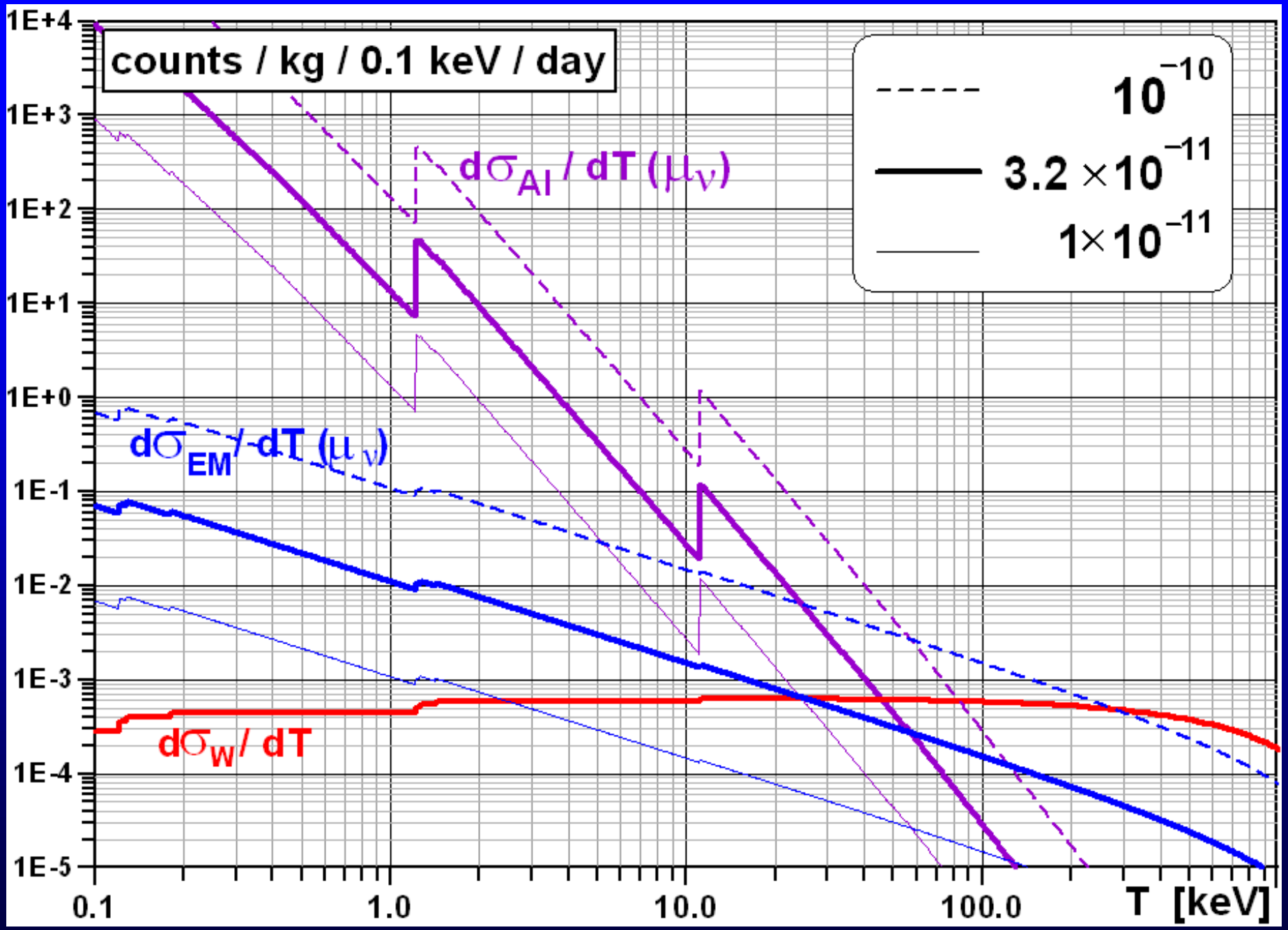
Expect : $(3.2 \rightarrow 1.5) \times 10^{-11} \mu_B$

Energy threshold: ?...

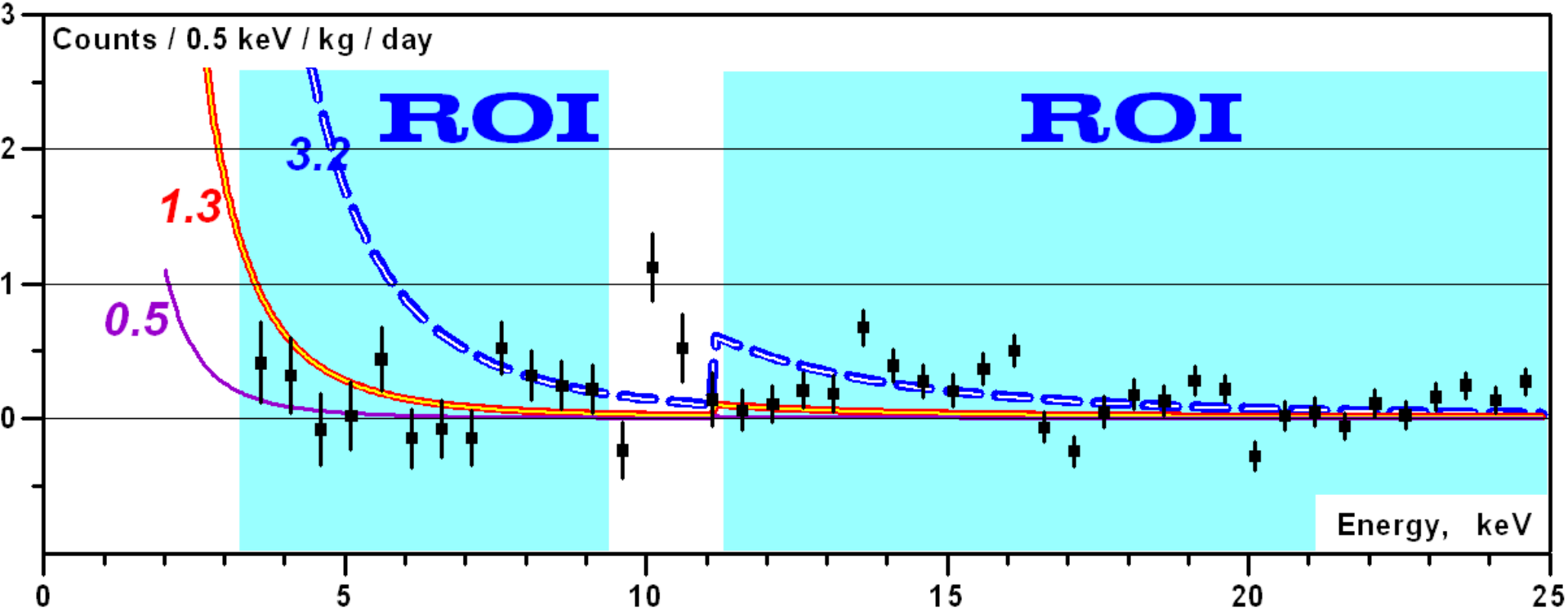
H.T.Wong,
H.-B.Li, S.-T.Lin
(TEXONO)
[hep-ph/1001.2074]

When the wavelength of the virtual photon γ^* becomes comparable to an atomic size (i.e., at T< 10 keV), it can interact with the atom as a whole and cause photoelectric effect




counts / kg / 0.1 keV / day
10^{-10}
3.2×10^{-11}
1×10^{-11}
$d\sigma_{Al} / dT\ (\mu_\nu)$
$d\sigma_{EM} / dT\ (\mu_\nu)$
$d\sigma_W / dT$
1E+4
1E+3
1E+2
1E+1
1E+0
1E-1
1E-2
1E-3
1E-4
1E-5
0.1
1.0
10.0
100.0
T [keV]

Expected count rate
calculated with the Atomic Ionization
for $\mu_\nu = (\ \mathbf{3.2},\ \mathbf{1.3}\ \text{and}\ \mathbf{0.5}\ ) \times 10^{-11}\ \mu_B$



Phase-2 experimental points

GEMMA NME limits (Phases 1+2)

NMM interaction taken into account

FE	FE+AI
$3.2 \times 10^{-11}\ \mu_B$	$5.0 \times 10^{-12}\ \mu_B$

mainly SYSTEMATIC

The low energy region is much more important than even was expected…

Future perspectives

Ge detectors with very low threshold (~ 300 eV)

RFBR grant

Intrigue:

- M.B.Voloshin *[hep-ph/1008.2171]* :
  - AI-effect is negligible.
- TEXONO *[private communication]* :
  - there are mistakes
  - but Voloshin is not right

Questions to theorists:

- Is the AI effect real ?
- Magnitude - ?