# "Dark Helium" in LENR

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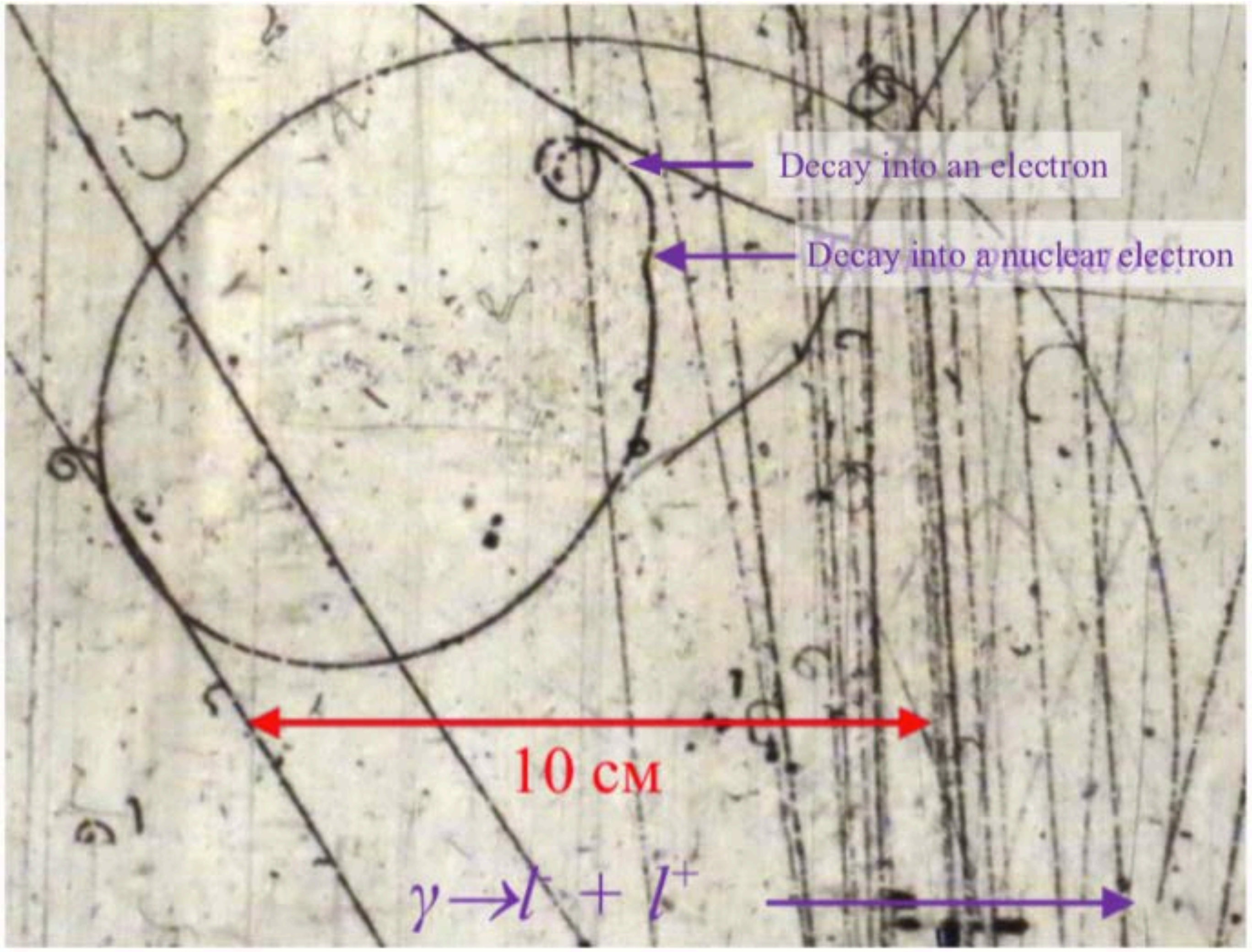
# Recall: nuclear electron webinar

* Recall my nuclear electron presentation in February
* A neutron is a composite particle of a proton and a nuclear electron
* Nuclei comprise protons and nuclear electrons



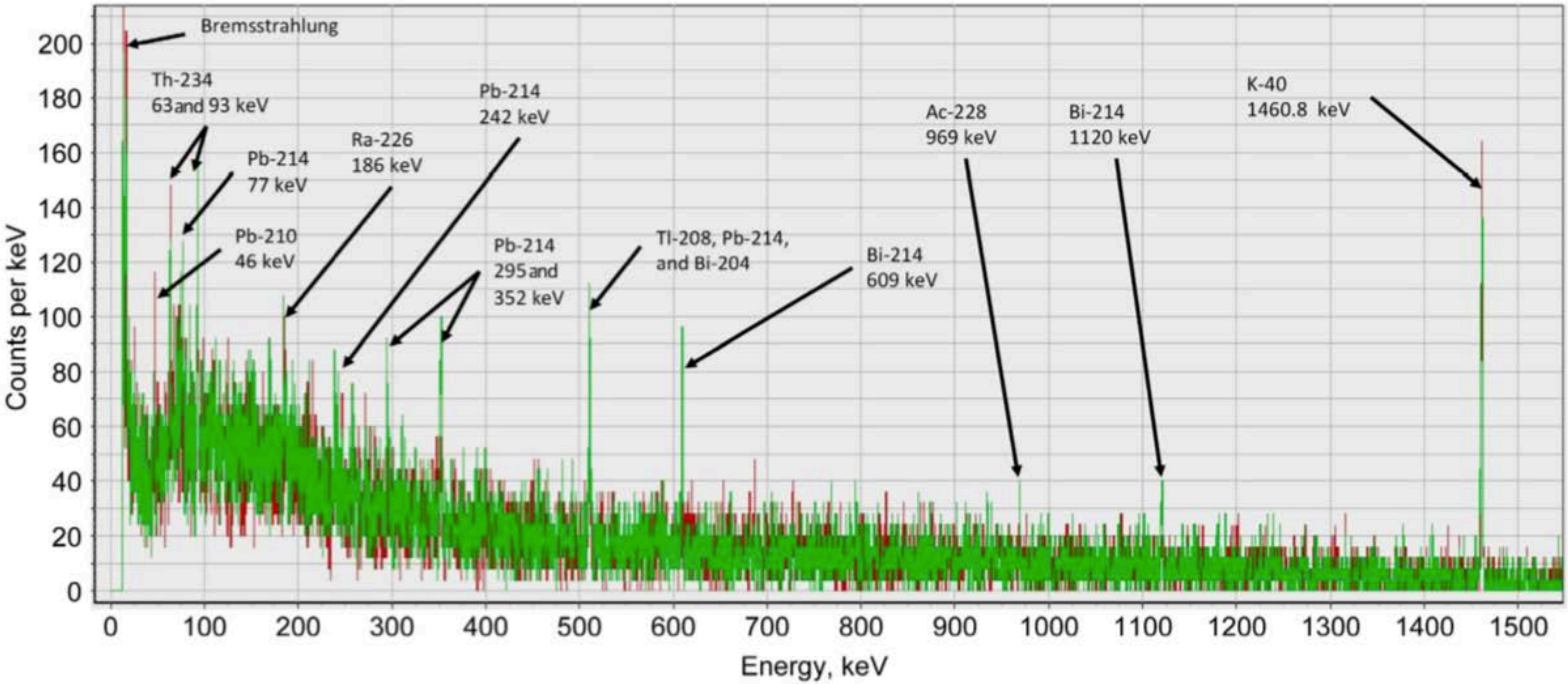

| | $e^-$ | $e_n^-$ |
|---|---|---|
| Charge | -1 | -1 |
| Isospin | 0 | -1 |
| Mass | 511 keV | 1553.5 keV |
| Half-life | stable | $\sim 10^{-11}$ s |

A comparison between the $e^-$ and $e_n^-$ particles.

# $^{210}Pb$ to $^{214}Pb$ transmutation experiment

* Study of 2 MeV irradiation effect: B. M. Steinetz et al "Experimental Observations of Nuclear Activity in Deuterated Materials Subjected to a Low-Energy Photon Beam", arXiv:1704.00694 (2017)

* The gamma spectrum of an already irradiated lead material, before (red signal) and after (green signal) a 4-hour run of 2 MeV photon irradiation:




*How did $^{210}Pb$ transmute to $^{214}Pb$? The involved experiment run was performed with hydrated sample in the lead chamber, which did not emit neutrons. Regarding the lead material itself, neutron photo-dissociation requires >6.7 MeV for any of its isotopes, which is far larger than the applied photon energy.

# $^{210}Pb$ to $^{214}Pb$ transmutation experiment

What requires less than 2 MeV energy is to strip away an alpha particle and two electrons from any lead isotope. The remaining lead nucleus appears to have lost "four neutrons". In order to generate $^{210}$Pb to $^{214}$Pb transmutation, the involved alpha particle and two nuclear electrons must be emitted together in a bound state. We therefore propose the following photo-dissociation reaction:

$$^{208}Pb \quad \overrightarrow{2\,MeV\,\gamma} \quad ^{204}Pb + (^4He + 2e_n^-)_{bound}$$

The above reaction scheme is the only reasonable explanation for the observed transmutations, which occur upon the subsequent absorption of $(^4He + 2e_n^-)_{bound}$ particles. We note that the resulting $^{214}$Pb isotope decays back to $^{210}$Pb via the consecutive emission of two electrons and an alpha particle, and never decays via neutron emission.

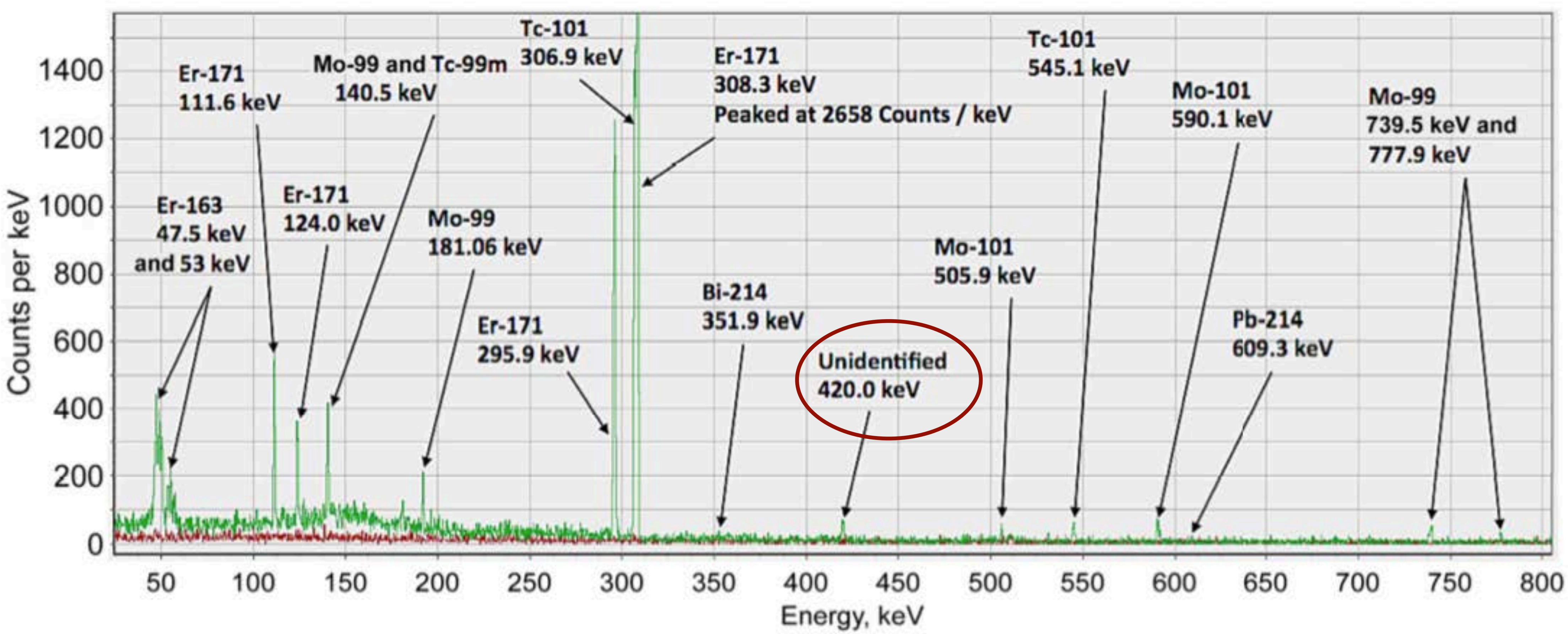
$$^{210}Pb + (^4He+2e_n) \rightarrow {}^{214}Pb$$

# $^{210}Pb$ to $^{214}Pb$ transmutation experiment

* The literature refers to ($^4He+2e_n$) as "tetraneutrons", as it was some nuclear experiments.

* Researchers of high-energy collisions propose the existence of bound "tetra-neutrons" with 420 keV binding energy, and also mention prior experimental studies that obtained the same binding energy value: T. Faestermann et al "Indications for a bound tetraneutron", Physics Letters B, Volume 824 (2022)

* The already discussed 2 MeV photon irradiation experiment also found the 420 keV peak in some runs, labelled as "Unidentified":



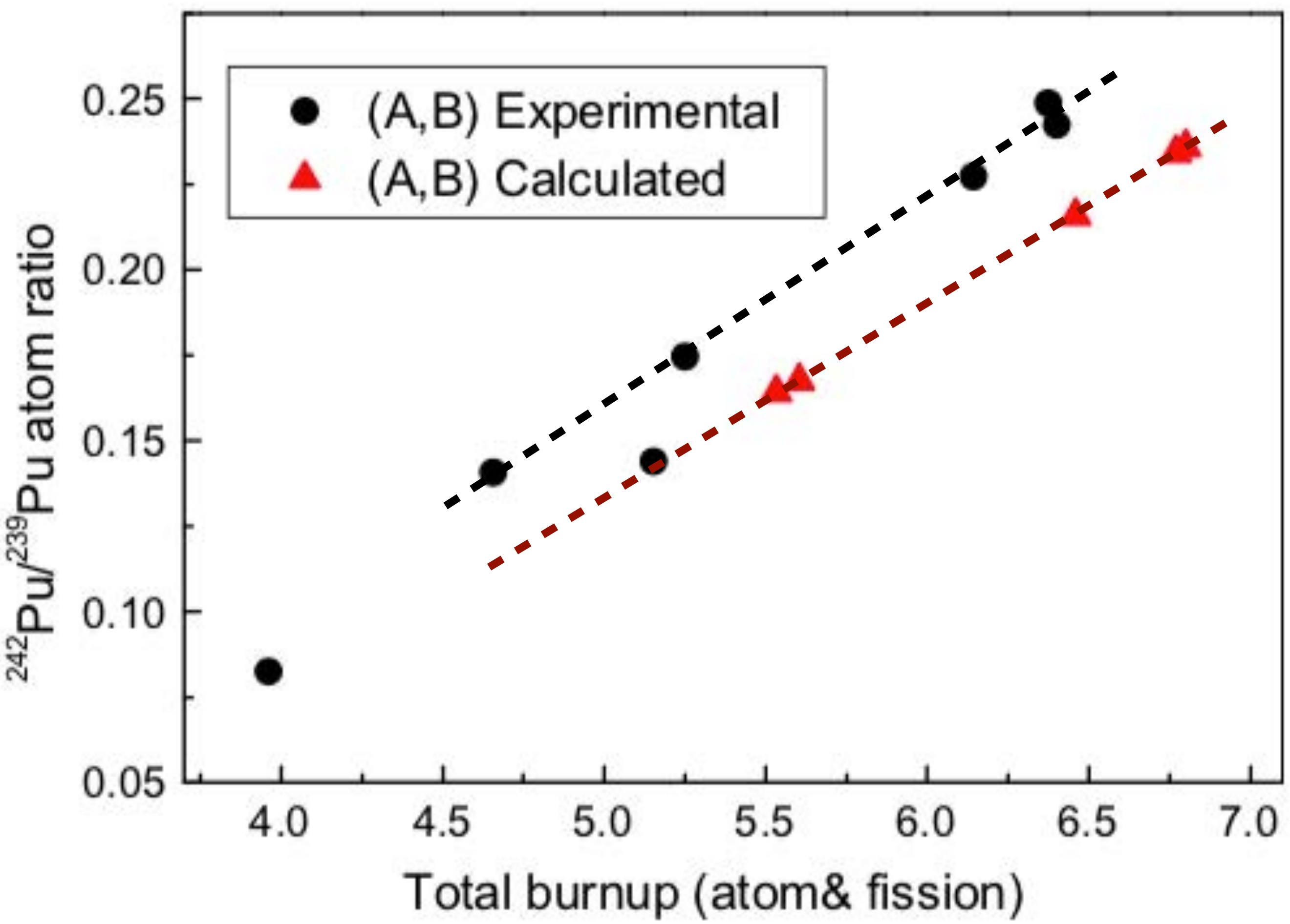
# Pu isotopes in a nuclear reactor

* In nuclear reactors, neutron absorption generates Pu from U. The production of $^{242}Pu$ from of $^{238}U$ requires 4 neutron captures.

* A single step production reaction for $^{242}Pu$:

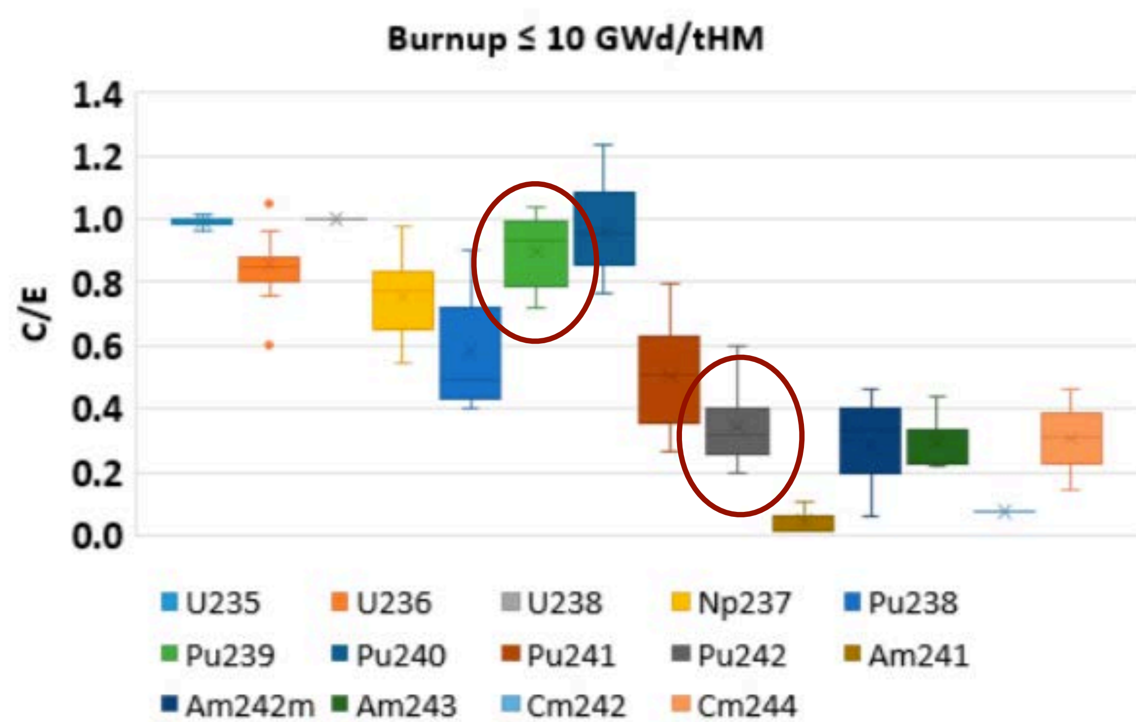
$$^{238}U + (^{4}He + 2e_n) \rightarrow {}^{242}U \rightarrow {}^{242}Np \rightarrow {}^{242}Pu$$

The first excess amount of $^{242}Pu$ was noticed in 2015: 15-20% excess at high burnup rate




*dx.doi.org/10.1016/j.net.2015.08.002*

A recent systematic fuel study found 3 times the expected $^{242}Pu$ at low burnup rate (when probability of 4 neutron captures is low). Notice the correct $^{239}Pu$ calculation




*doi.org/10.3390/en15093041*

# Neutral particle emission from W

* Alexander Parkhomov presented the experimental evidences of neutral particle emission from halogen lamps operated by elevated voltage.

* This neutral particle cannot be neutron, as i) it would make the reactor radioactive, and ii) its emission is very endothermic from any tungsten isotope.

* An exothermic emission of a neutral particle from tungsten:

$$^{186}W \rightarrow {}^{182}W + ({}^{4}He + 2e_n)$$

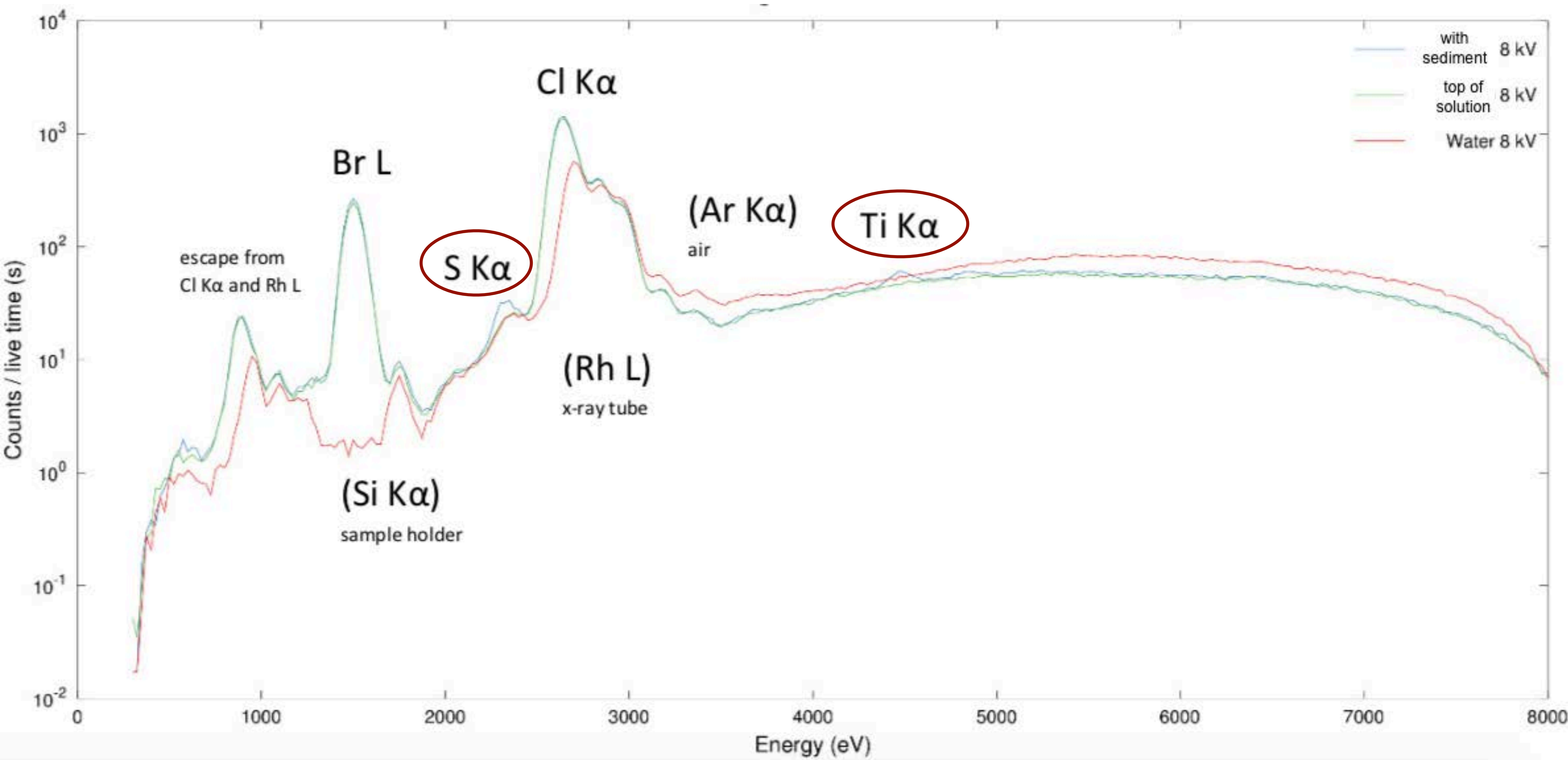
# “Dark Helium” induces Br fission

* In my experiment, a halogen lamp was operated at 300V voltage, and immersed in a concentrated lithium-halide solution.

* The solution comprises LiCl : LiBr : $H_2O$ in 1 : 5 : 8 mass ratio. After the lamp was turned off, I took a 20 $cm^3$ sample from the solution. This sample was a clear liquid, but after some time a sediment appeared in it. I analyzed the composition of this liquid by XRF method, which measures the presence of any element above magnesium. Specifically, we measured the composition in the clear liquid part of the sample and in the sediment containing part of the sample

# “Dark Helium” induces Br fission

XRF analysis result:



# “Dark Helium” induces Br fission

* While a hypothetical Br→S+Ti fission matches the masses of stable isotopes, it is slightly endothermic for any combination of isotopes.

* However, upon the capture of ($^4He+2e_n$) by a bromine nucleus, the overall fission reaction becomes exothermic:

$$^{79}Br + (^4He+2e_n) \rightarrow {}^{34}S + {}^{49}Ti + 3e_n$$

# What causes "Dark Helium" emission from W?

Key practical question: is the ($^4He+2e_n$) emission from tungsten triggered by a threshold **temperature**, **current density**, or **phonon density** limit?

**Thank you for your attention!**