Beta-strength and anti-neutrino spectra from Total Absorption Spectroscopy of the decay chain $^{142}Cs \rightarrow {}^{142}Ba \rightarrow {}^{142}La$ *

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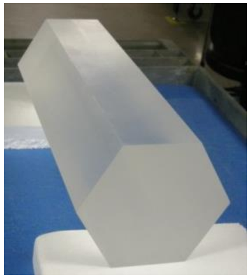

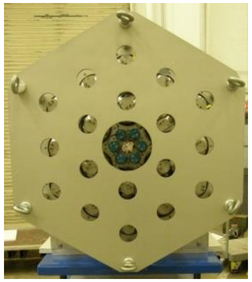

Nuclear fuel cycle:
energy release (γ, β, ν, n) from fission products during nuclear fuel cycle

Nuclear structure:
true β-decay intensities and their nuclear structure origin

Reactor anti-neutrino physics:
understanding of reactor $\overline{\nu}$ energy spectra

HRIBF

Oak Ridge National Laboratory

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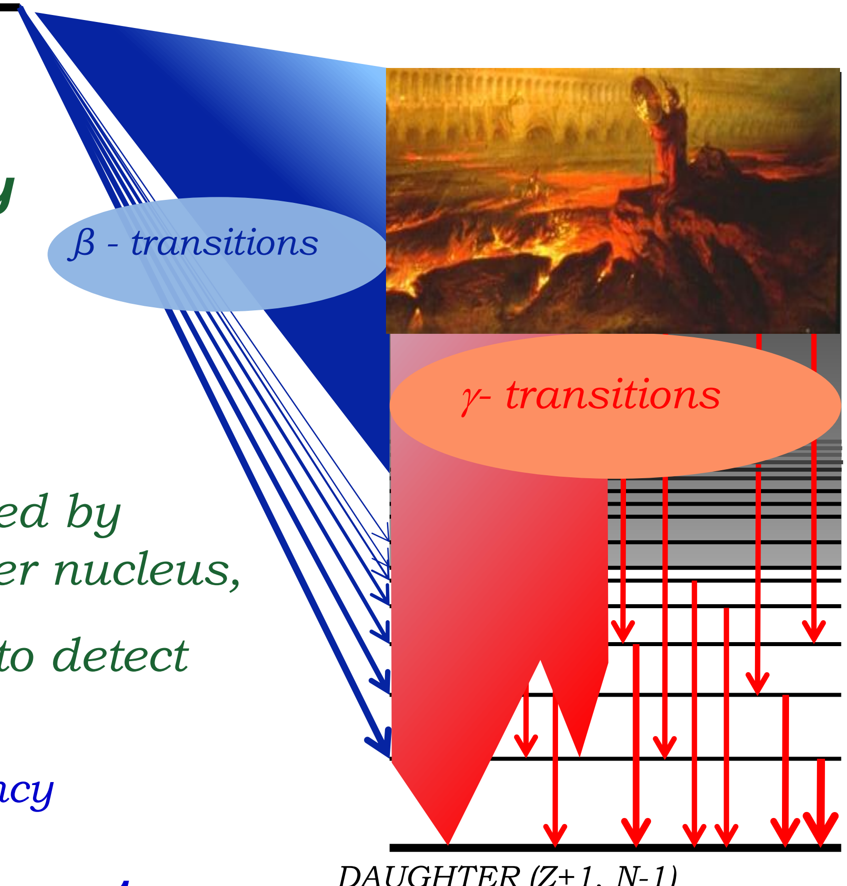
Why total absorption spectroscopy ?

Pandemonium problem in β-decay (complex β-decay)

* many β-transitions (mostly Gamow-Teller) are feeding highly excited states,
* these many, weak β-transitions are followed by the cascades of γ-transitions in the daughter nucleus,
* these weak γ-transitions are very difficult to detect with low efficiency detectors

We used array with a very high efficiency (81%-71% at 300keV-6MeV)

Modular Total Absorption Spectrometer (MTAS)



The true picture of the neutron-rich parent nucleus (Z,N), with many weak β-transitions and following low intensity γ-transitions.

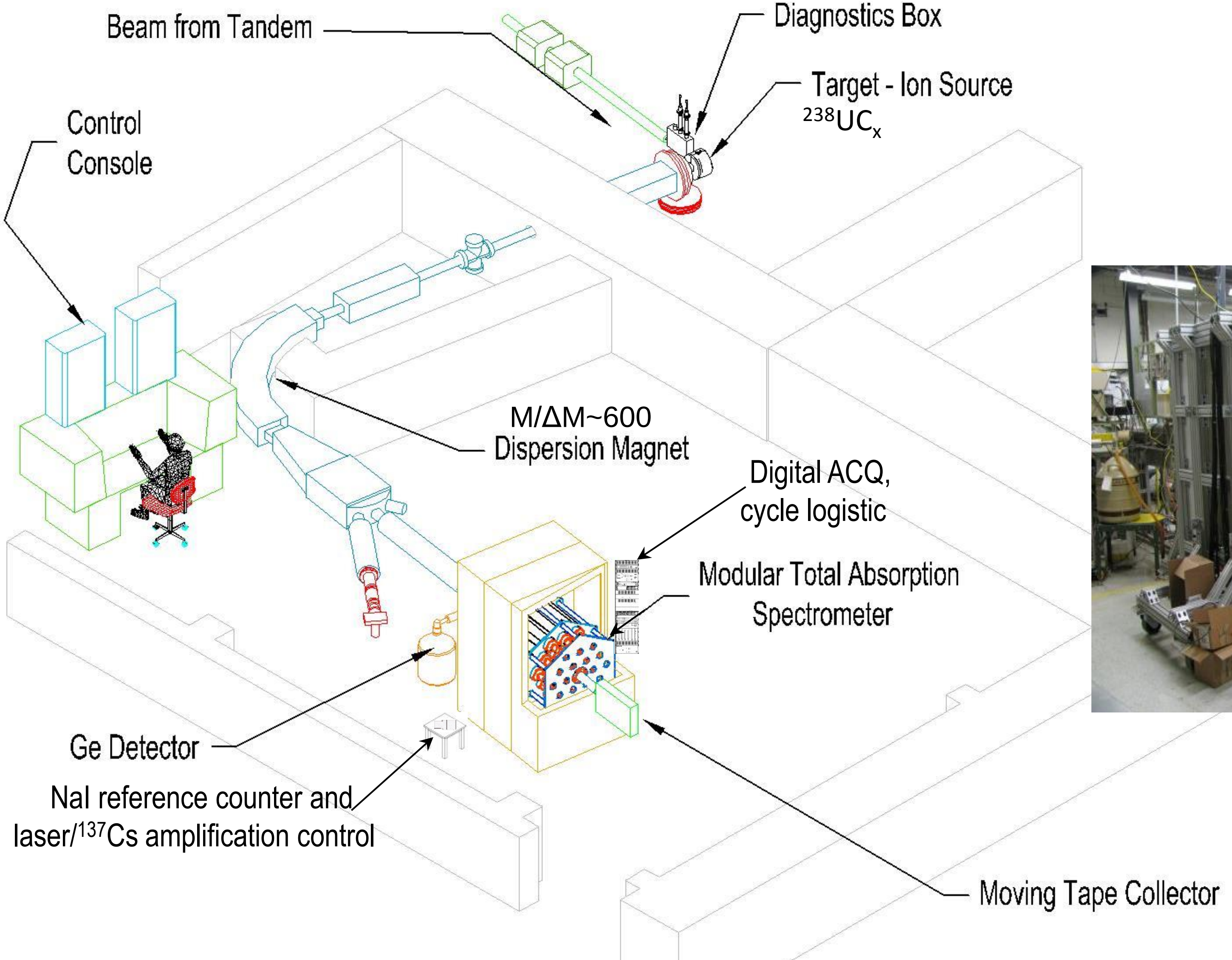
J.Hardy et al., Physics Letters 71 B, 307, 1977 (‘Pandemonium’)

A.Algora et al., PRL 105, 202501, 2010

K.P.Rykaczewski ,Viewpoint in Physics 3, 94, 2010

ORNL's Tandem, on-line mass separator and MTAS.

~ 40-60 nA protons, ~ 40 MeV

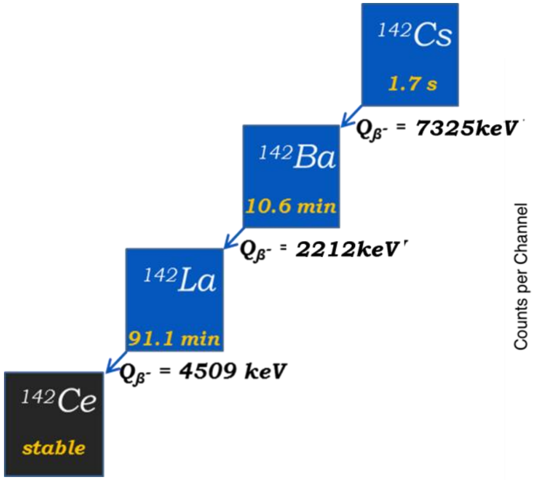


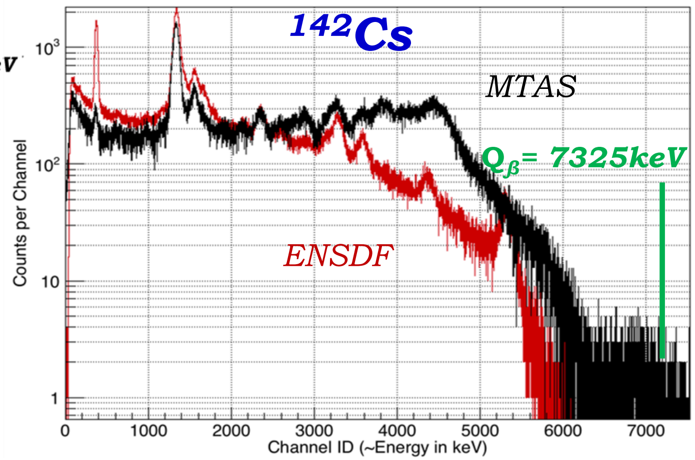
measurement cycle sequence:

ions implantation – beam off and tape movement #1 into MTAS – ***counting***

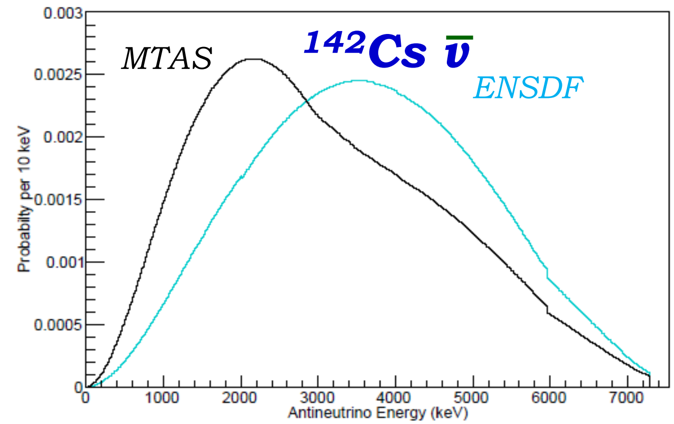
– tape movement #2 out of MTAS

Part of MTAS results for $^{142}Cs \rightarrow {}^{142}Ba \rightarrow {}^{142}La$ chain





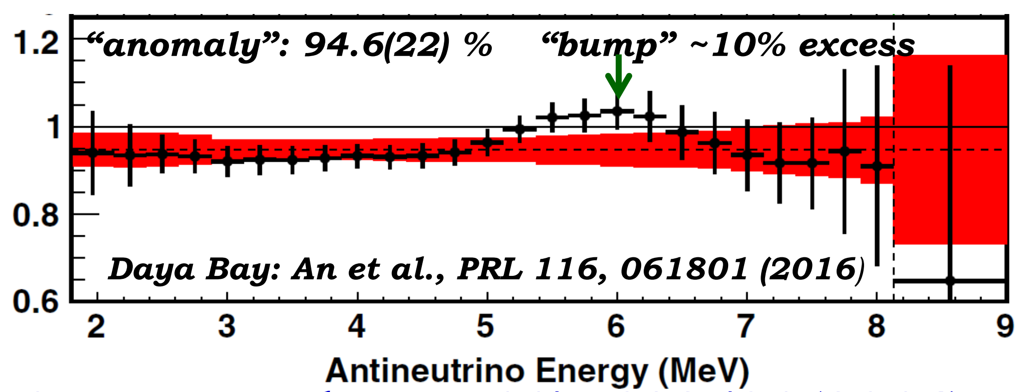
Background subtracted ^{142}**Cs MTAS** *data compared to the simulated MTAS response* ^{142}**Cs** *decay based on the* **ENSDF** *data.*



Calculated ^{142}**Cs** $\bar{\nu}$ *energy spectrum from MTAS data compared to the expected* $\bar{\nu}$ *energy spectrum deduced from the latest ENSDF data.*

Among our conclusions (^{142} Cs decay only):

- *detected vs predicted (Mueller-Huber) reactor anti-neutrino anomaly:* **94.6(22) %** → **95.7(22)%** *(2 σ not 3 σ difference from 100%) The anomaly is reduced.*
- *High-energy "shoulder (bump)" grows (~***10%** *excess →* **~12%** *excess)*



More details - see poster P133 and B.C.Rasco et al., PRL 117, 092501 (2016)