AN INFLUENCE OF THE TDCR SYSTEM SETTINGS ON THE RADIONUCLIDES STANDARDIZATION

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Distressing fact

Activity values of the same source determined using two various LS-counters in our laboratory, TDCR and TDCRG, were permanent different (^{3}H of about 0.7 %, ^{14}C of about 0.5 %).

Both triple counters were set in compliance with generally accepted principles (anode HV in the midst of plateau, discrimination threshold below 1-electron pulse).

The same counting code was used (Poisson statistics, Birks function with the same *kB* parameter value).

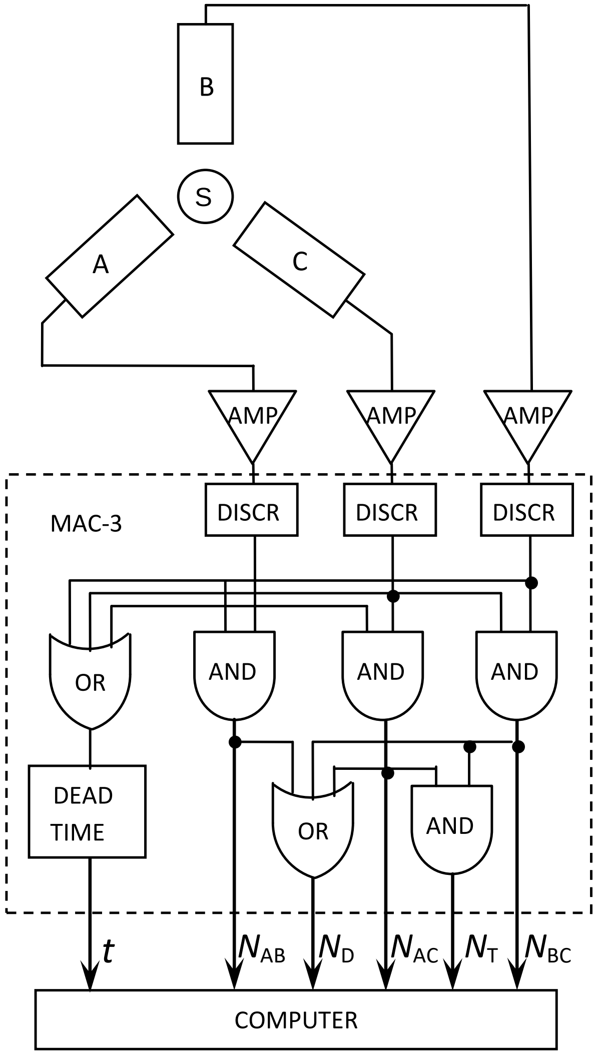
Questions

- What should be principles of the correct settings of the triple counter?
- Comparison of the same source (^{3}H or ^{14}C) measurement results in the TDCR and TDCRG counter
- Influence of the discrimination threshold setting
- Influence of the anode HV setting
- Influence of various methods of the detection efficiency modification (PM-tubes defocusing, optical filters)

TDCR system

Triple-to-Double Coincidence Ratio counter

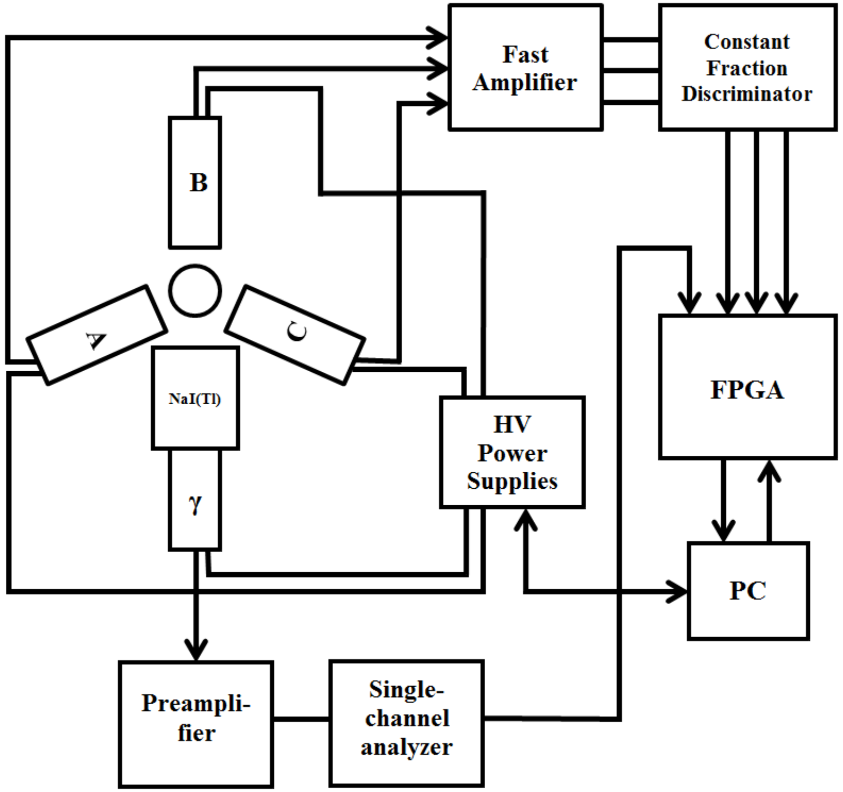
Coincidence unit	MAC3 with 3 amplitude discriminators
3 PMTs	Burle 8850
Anode HV	2750 V (midst of plateau)
1^{st} dynode HV	660 V
PMTs defocusing	660 V – 390 V
Discrimination threshold	~ 1 V



TDCRG system

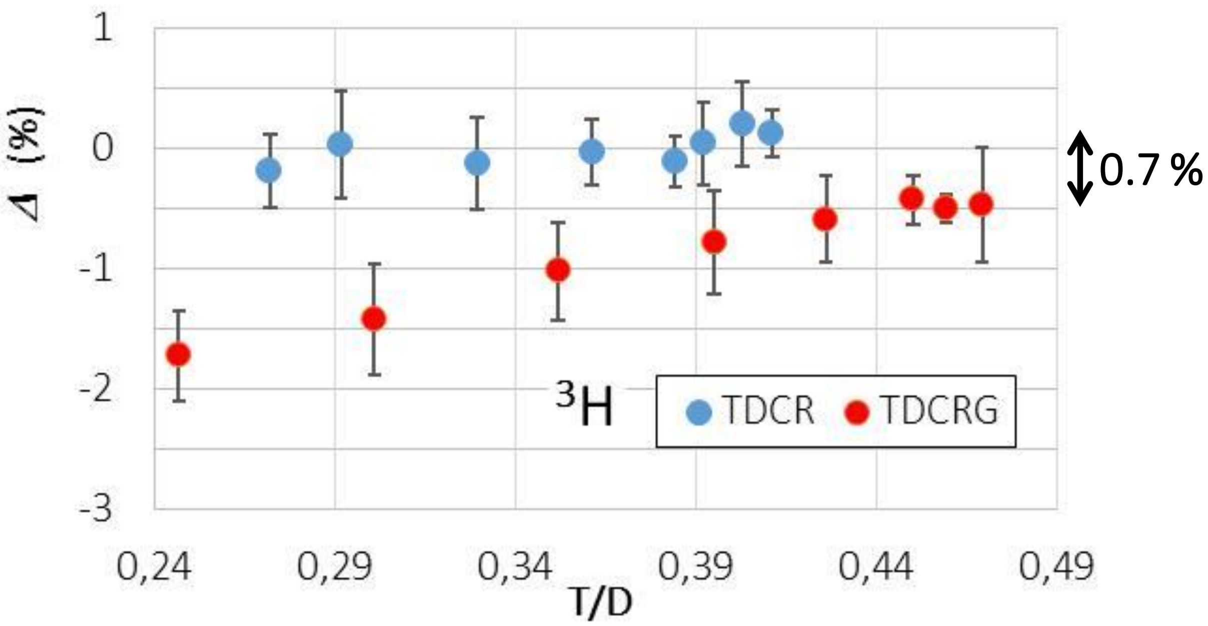
4π(LS)-γ coincidence counter with the TDCR detector in β-channel and NaI(Tl) detector in γ-channel

Coincidence unit	BAD-1 (FPGA) with CAEN N842 constant fraction discriminator
3 PMTs	ET Enterprises 9214B
γ-channel	NaI(Tl) 3”×3” detector
Anode HV	2000 V (midst of plateau)
1^{st} dynode HV	300 V
PMTs defocusing	290 V – 15 V
Discrimination threshold	~ 50 mV



^{3}H measurements

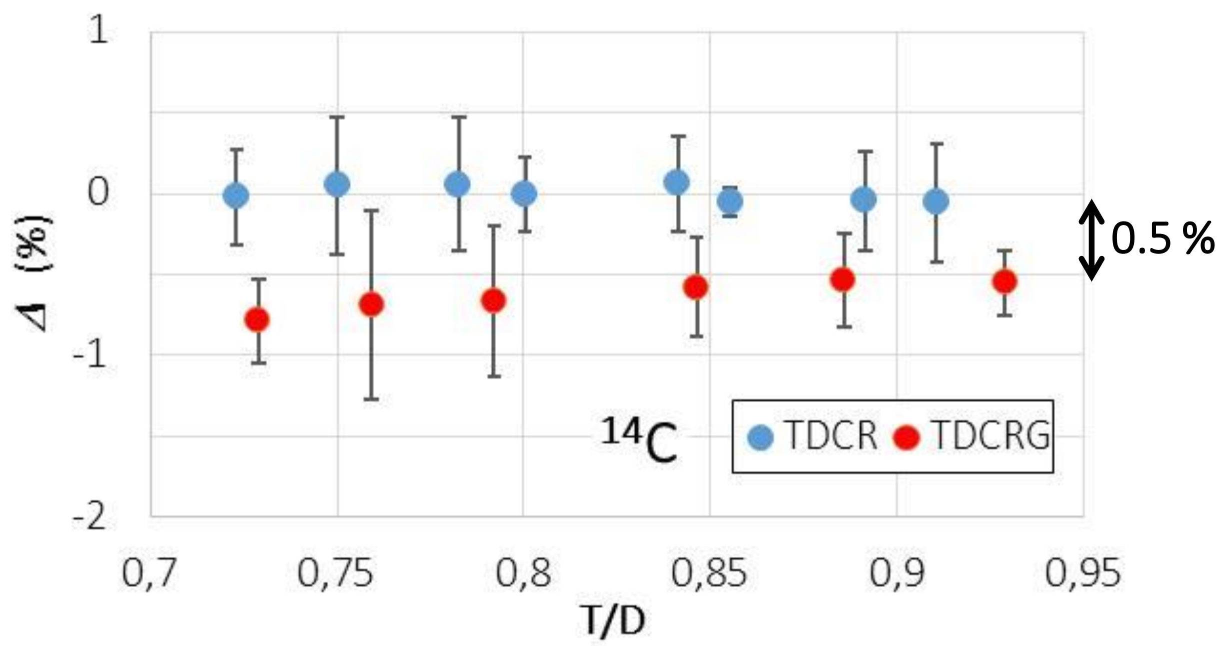
- One ^{3}H control source measured **in both systems**
- Ultima Gold scintillator
- Glass vial
- Detection efficiency was changed by **PMTs defocusing**
- Time of ^{3}H source measurement in each counter: 6h



Results of calculation $\Delta = (A - \bar{A}_{TDCR}) / \bar{A}_{TDCR}$ for selected $kB = 0.010$ cm MeV^{-1}
Uncertainties: σ (k = 2)

^{14}C measurements

- One ^{14}C control source measured **in both systems**
- Ultima Gold scintillator
- Glass vial
- Detection efficiency was changed by **PMTs defocusing**
- Time of ^{14}C source measurement in each counter: 6h

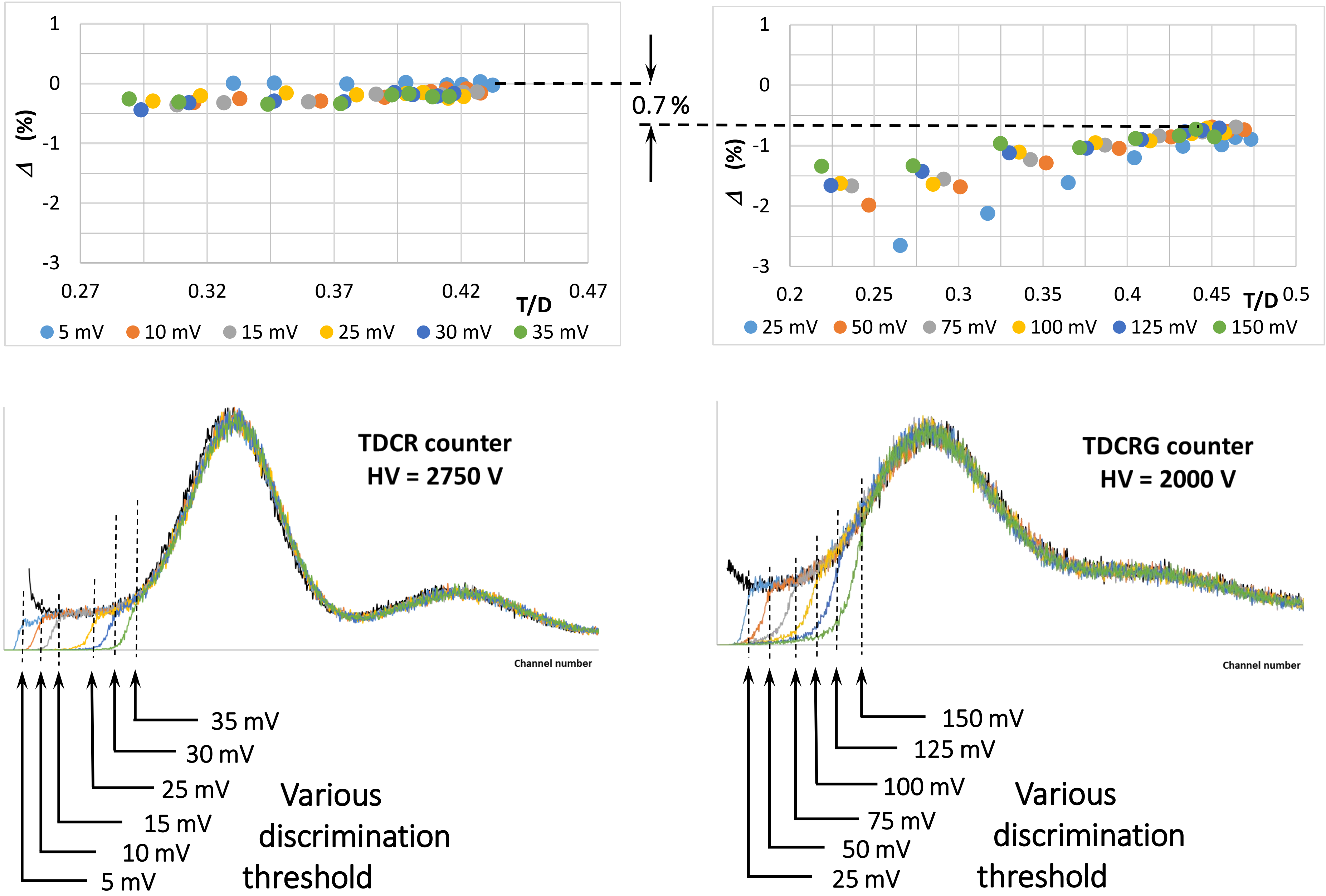


Results of calculation $\Delta = (A - \bar{A}_{TDCR}) / \bar{A}_{TDCR}$ for selected $kB = 0.010$ cm MeV^{-1}

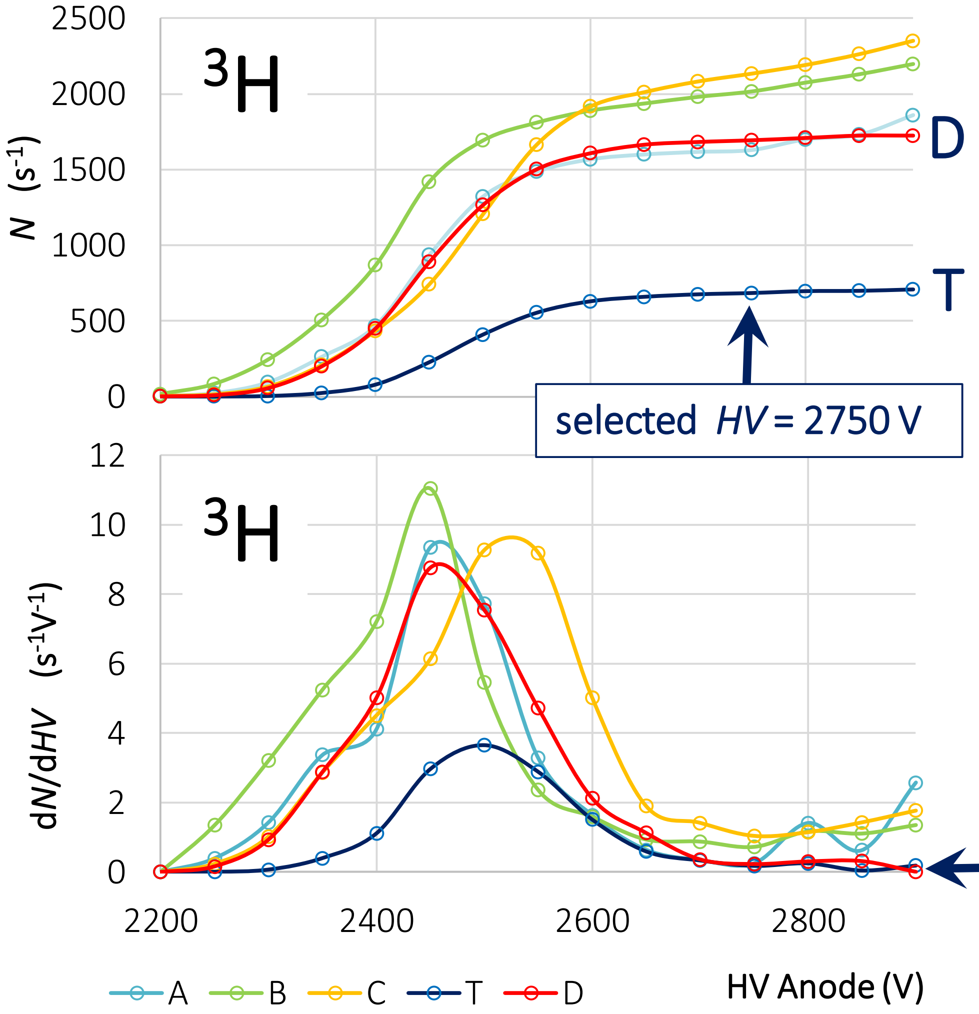
Uncertainties: σ (k = 2)

^{3}H

- One source in glass vial
- Both detectors were used with a common electronics system
- Detection efficiency was changed by **PMTs defocusing**



TDCR system characteristics

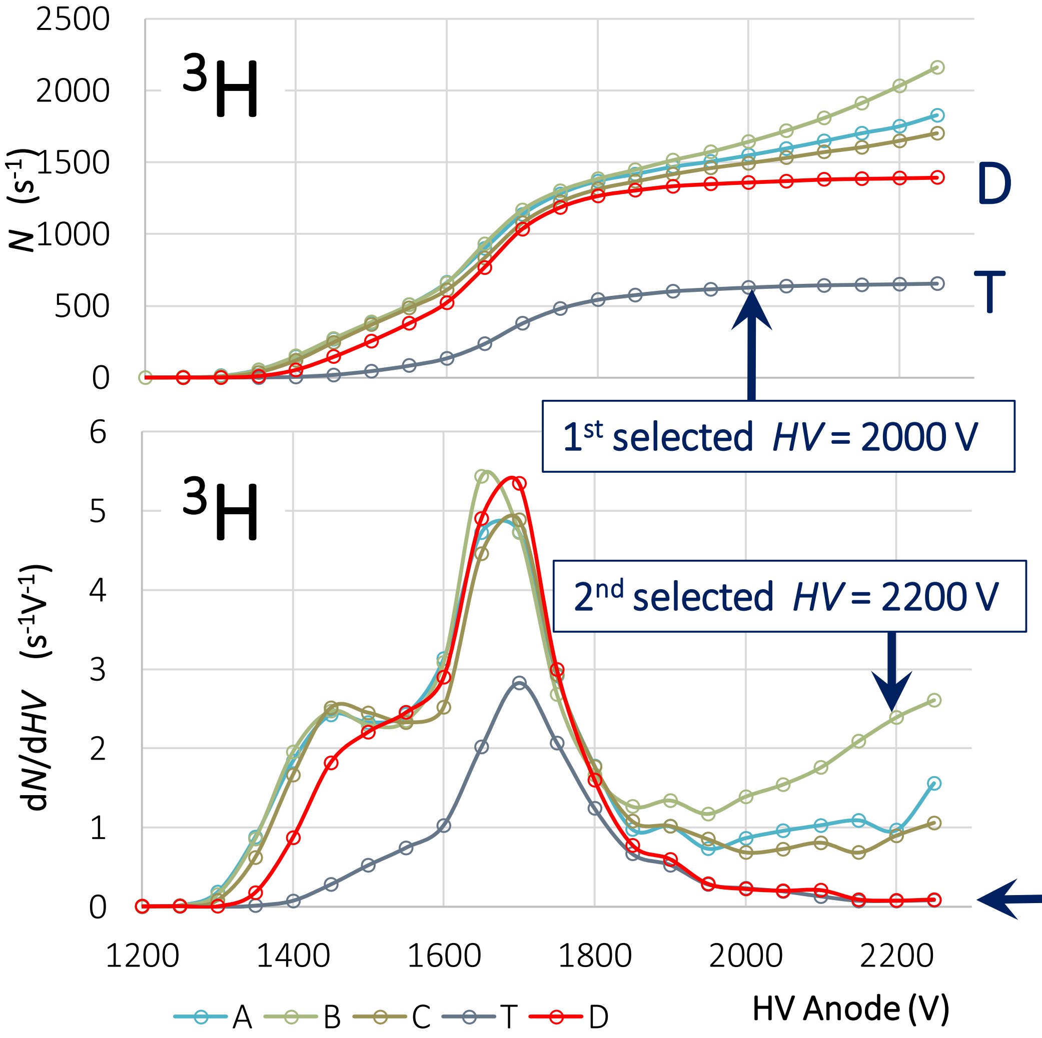


Counting rates *N* vs. anode HV

Differential counting rates d*N*/d(*HV*) vs. anode HV

flat characteristics *N*(*HV*) means full saturation

TDCRG system characteristics

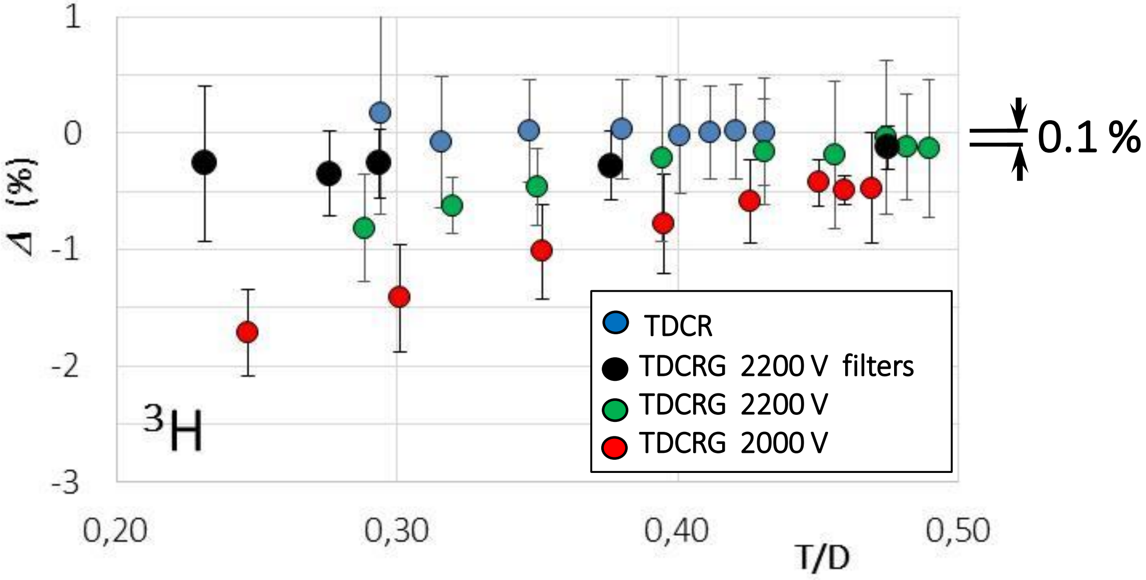


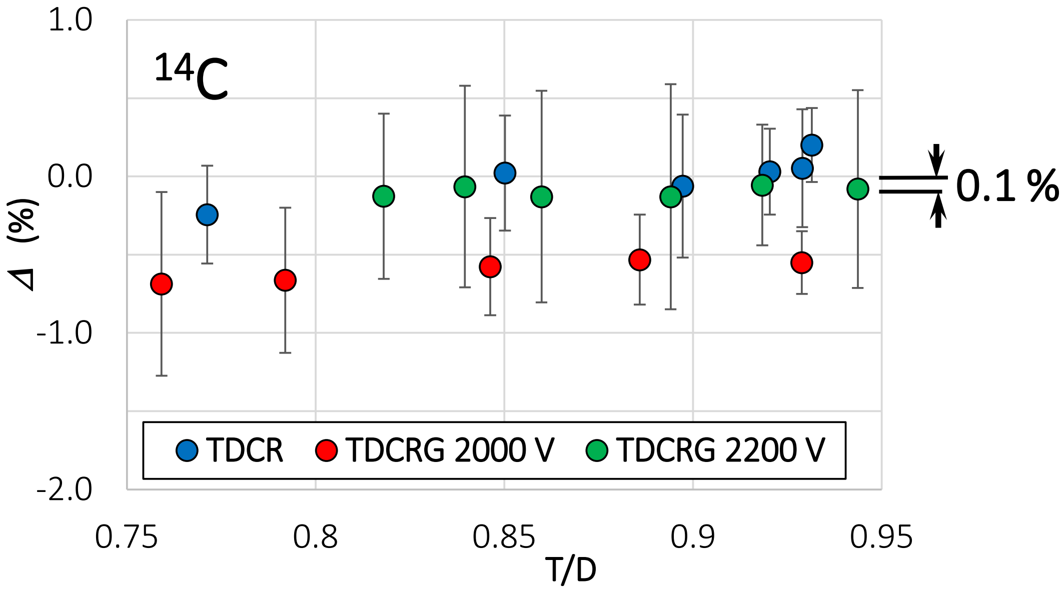
Counting rates N vs. anode HV

Differential counting rates dN/d(HV) vs. anode HV

flat characteristics $N(HV)$ means full saturation

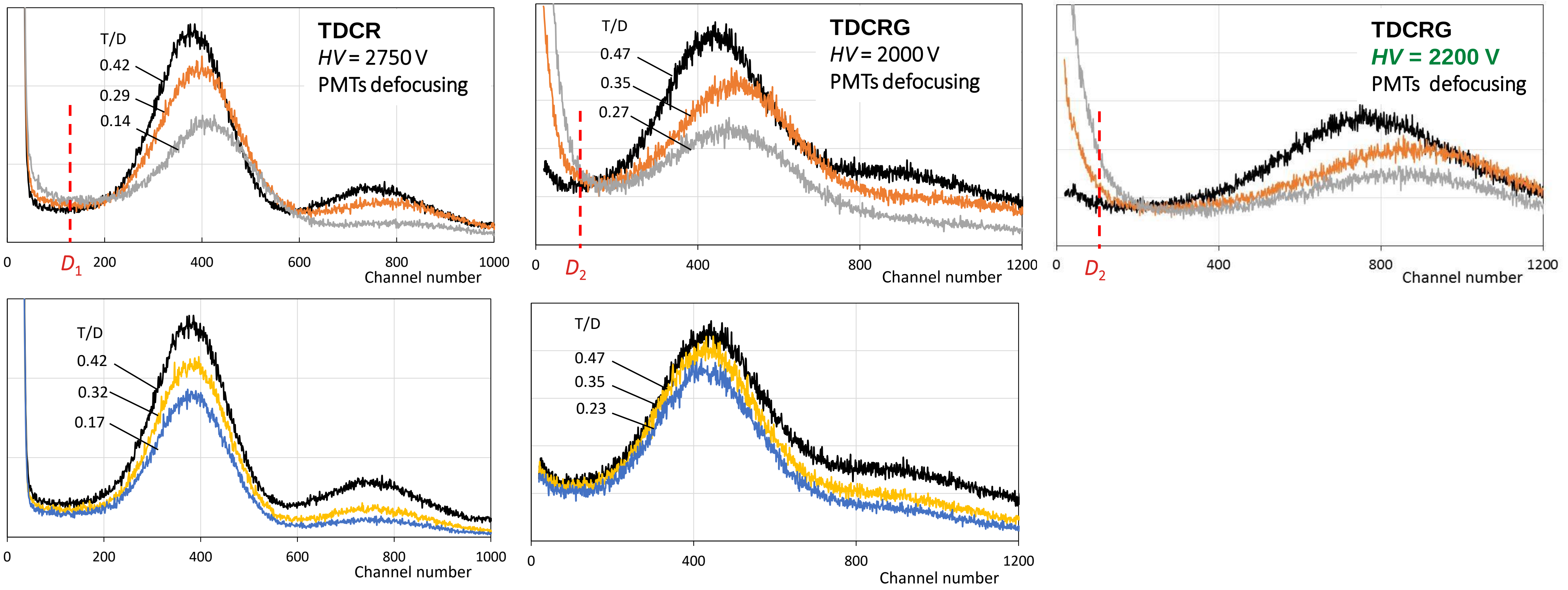
^{3}H and ^{14}C repeated measurements





- The same sources measured **in both systems** during 6h ; $\Delta = (A - \bar{A}_{TDCR}) / \bar{A}_{TDCR}$
- Ultima Gold scintillator; frosted vials
- **PMTs defocusing**
- **Increased anode HV in the TDCRG system from 2000 V to 2200 V**
- **Optical filters** in the TDCRG system, **2200 V**

^{3}H spectra from 9th dynode



- The above spectra illustrate somehow our measurement problems
- PMTs were not designed for defocusing!

Summary

- A criterion of the working point selection in the triple LS-counter should be full saturation of the T and D coincidence HV characteristics.
- The source activity determined when counting efficiency is changed using defocusing of the photomultipliers can be not correct.

  In case of **ET Enterprises 9214B** PMTs defocusing, the activity determined is not correct.
- The source activity determined when counting efficiency is changed using optical filters is correct.
- In optimal working conditions of **Burle 8850** and **ET Enterprises 9214B** photomultipliers variation of the discrimination threshold below 1-electron pulse has no influence on the determined source activity.

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Thank you for attention!