

THIN WALL RECOMBINATION CHAMBER FILLED WITH NITROGEN

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1. Introduction

Parallel plate recombination ionization chambers can be used in mixed radiation fields, for determination of:

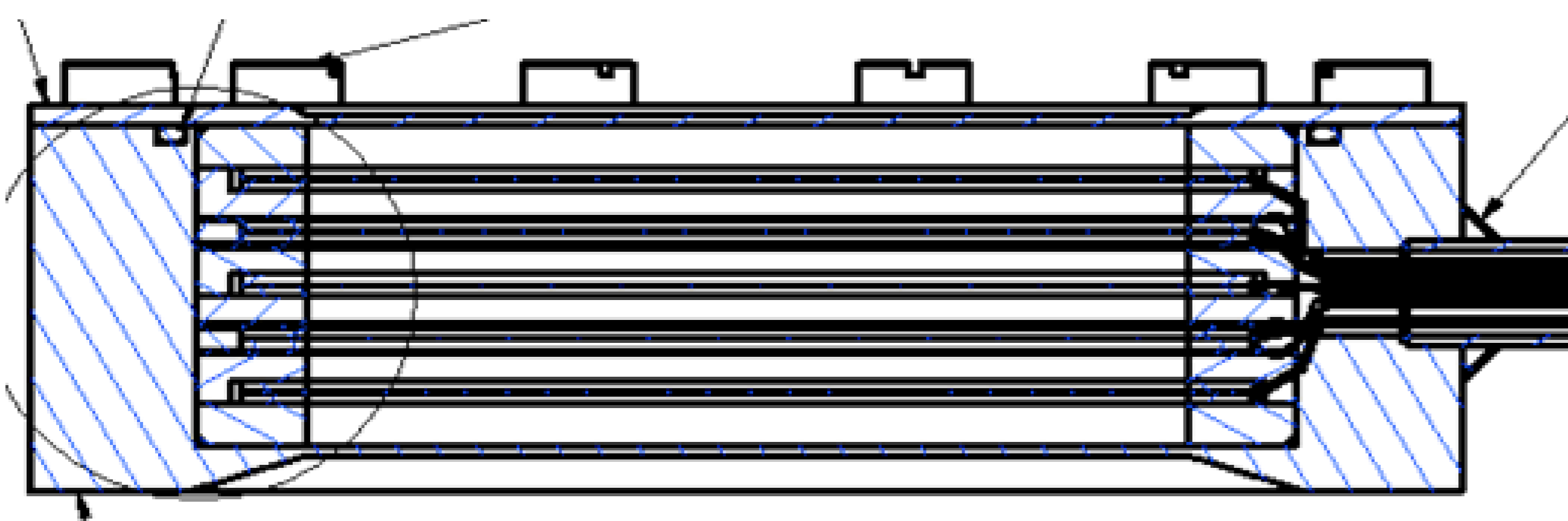
- total absorbed dose,
- gamma and high-LET dose components
- radiation quality.

They can operate correctly in broad range of neutron and gamma radiation energies e.g. at accelerators and nuclear reactors [1].

2. Objectives

- a) To design a chamber for measurements of (n,p) dose in thermal and epithermal neutron beams, with moderate gamma component to the absorbed dose e.g. BNCT beams [2].
- b) Dosimetric properties of the chamber should be determined by the atomic composition of the gas – easy to change.

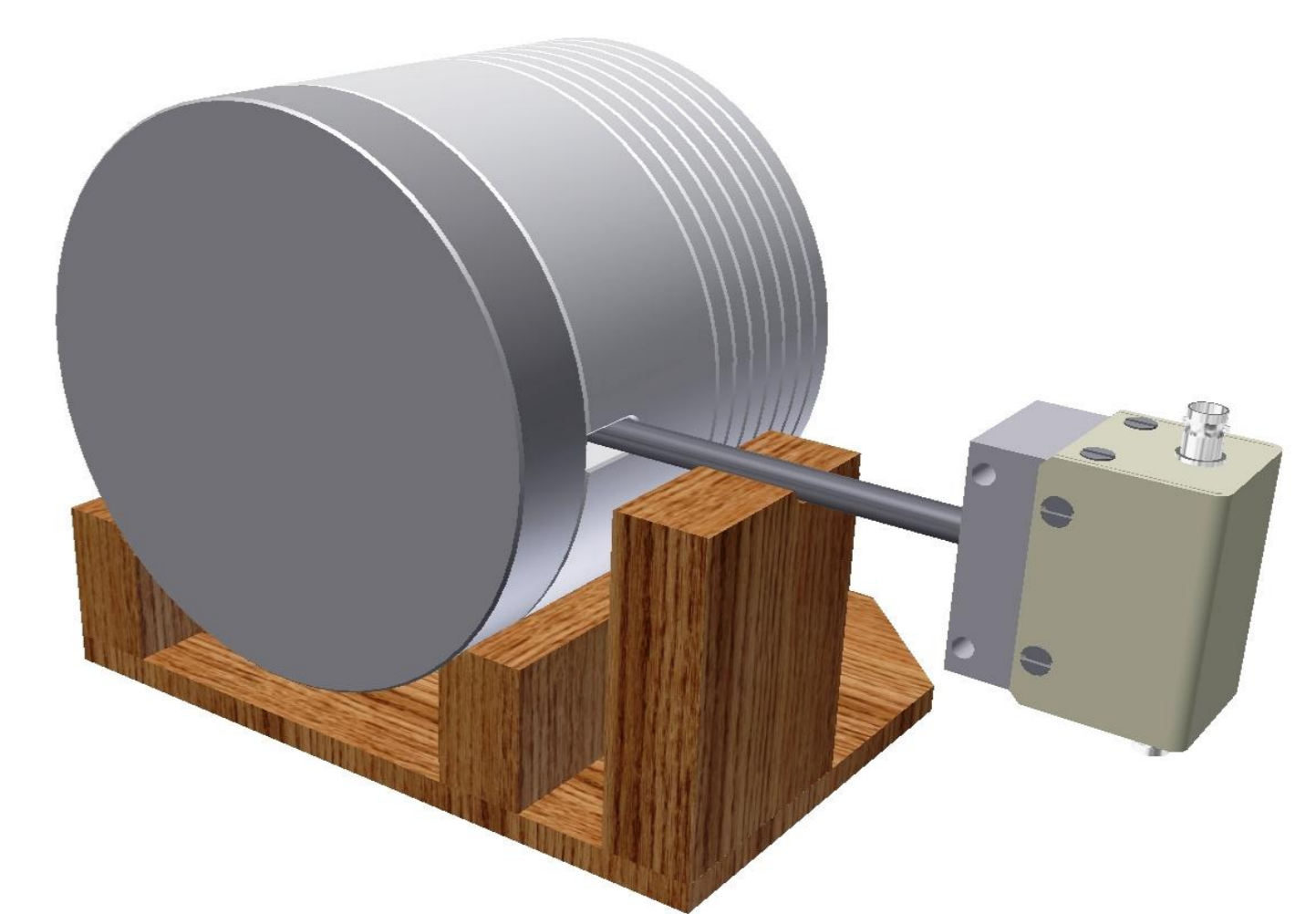
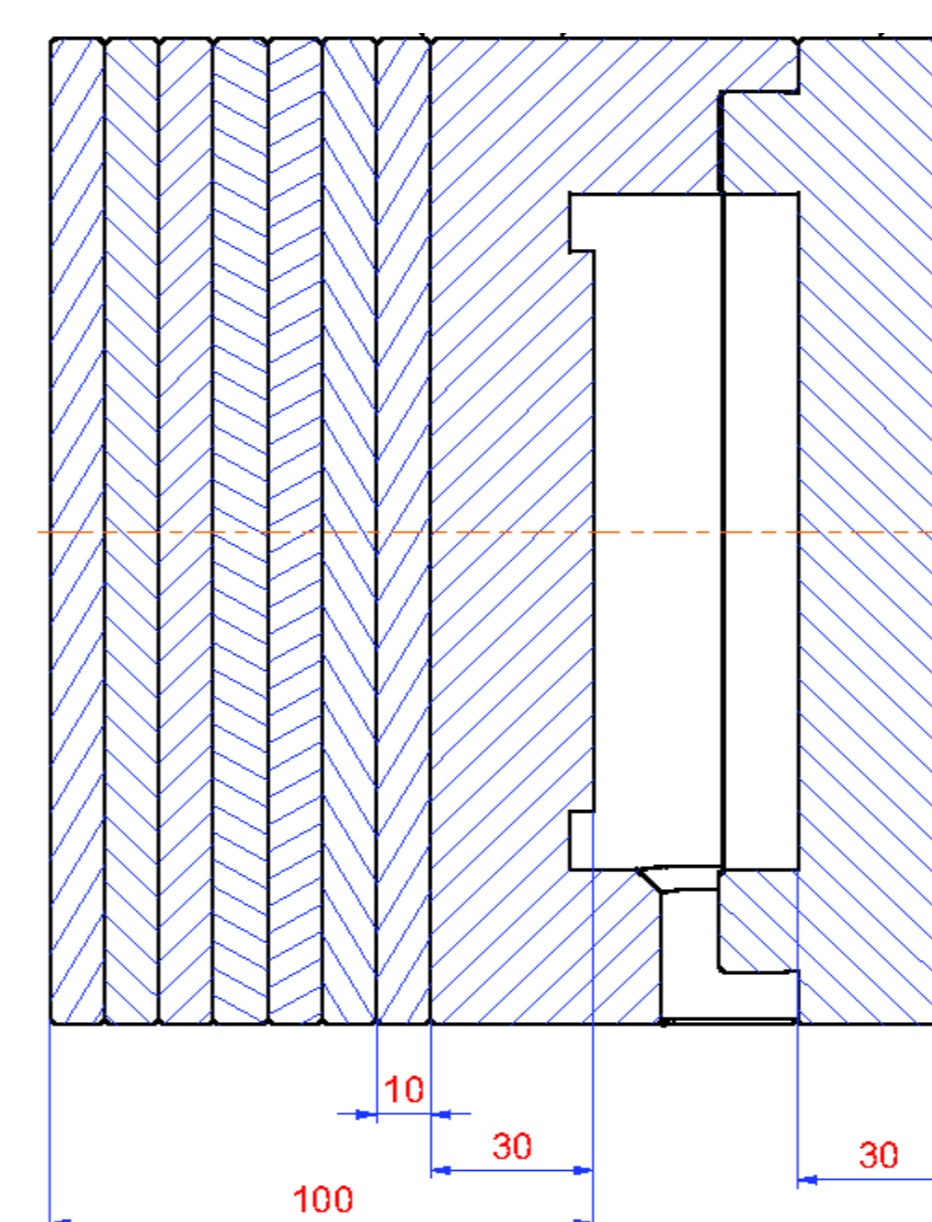
3. Design



- Five thin electrodes with diameter of 80 mm,
- Electrodes - mylar foil attached to titanium rings.
- Distance between electrodes - 5 mm
- Total sensitive volume - about 100 cm³.
- Housing made with titanium (GRADE 5)
- Low activation in thermal neutron beams.
- Thickness of the front wall - 1 mm.
- Can be filled with different gases up to 1 MPa.



The signal of the chamber can be modified by use of polyethylene cups.



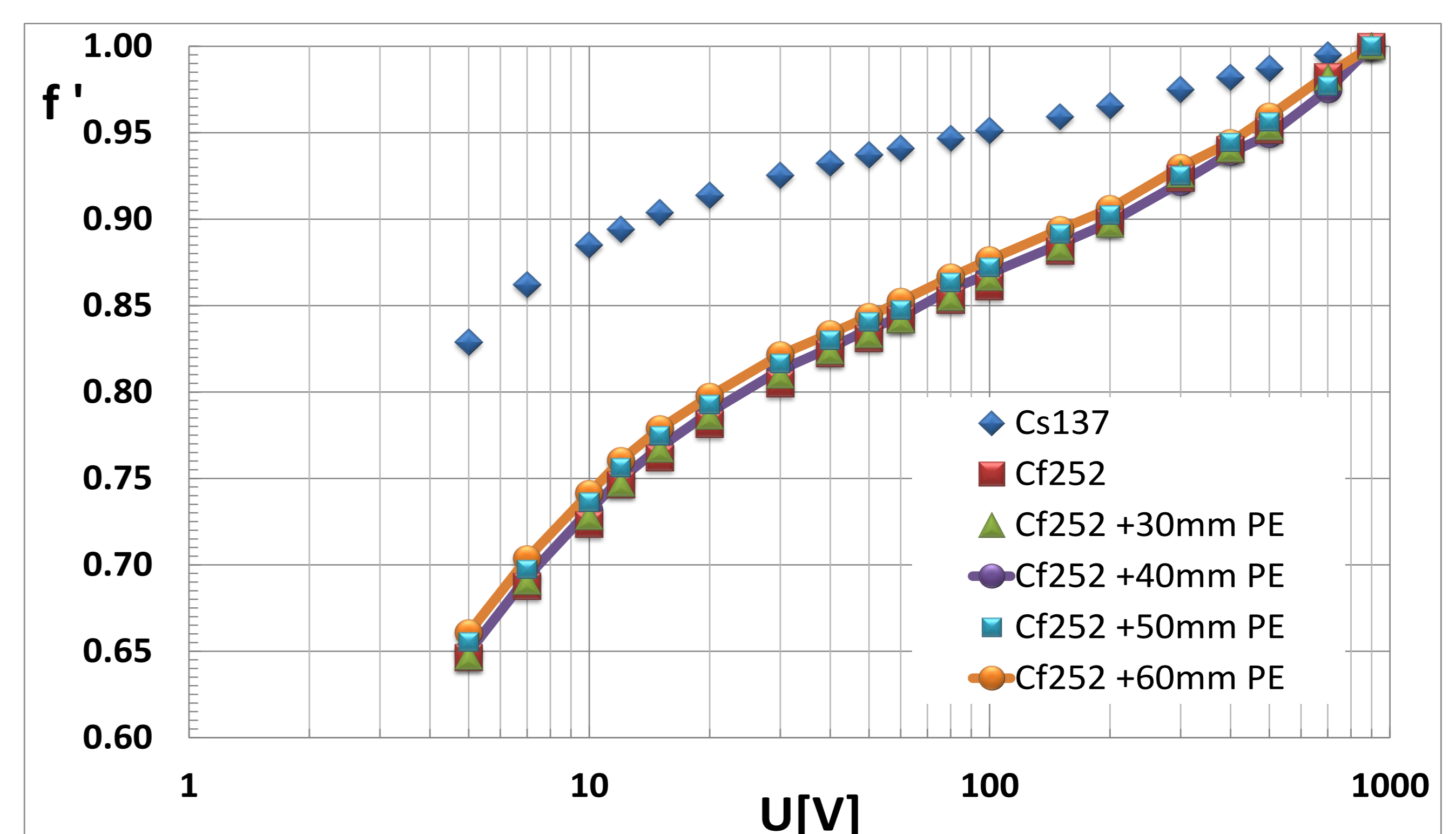
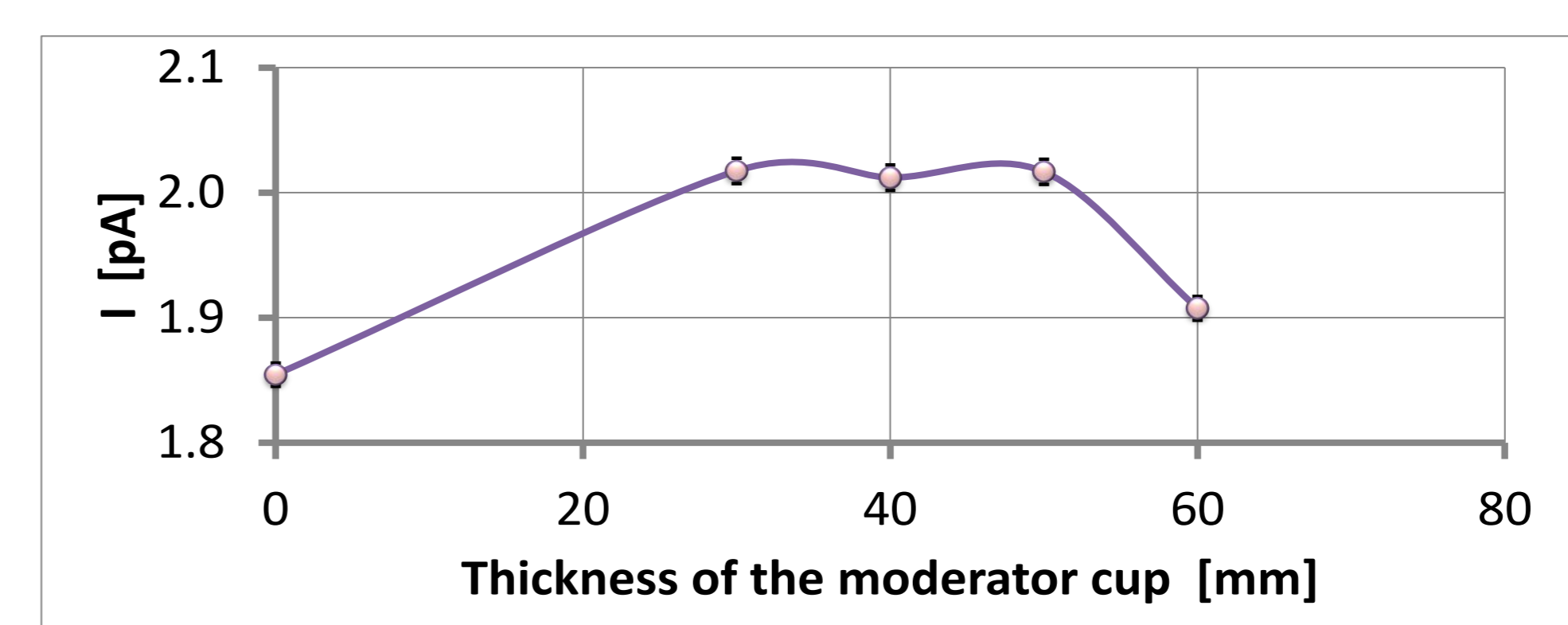
4. Method

- Recombination chamber filled with nitrogen - up to 0.6 MPa.
- Doses due to gammas and thermal neutrons are separated by recombination microdosimetric method (RMM) [3].

5. Measurements

Saturation curves were determined:

- in radiation fields of ¹³⁷Cs and ²⁵²Cf (figures below)
- in radiation field of ²³⁹Pu-Be
- in thermal neutron beam from a horizontal channel of nuclear reactor Maria in NCBJ in Świerk.



6. Conclusion

- Dependence of the signal and the shape of the saturation curve on the moderator thickness, combined with RMM makes it possible to determine the dose due to neutron capture on ¹⁴N at different depths in tissue.

References

1. N. Golnik: "Recombination Methods in the Dosimetry of Mixed Radiation", Institute of Atomic Energy, Swierk, Poland IAE -20/A, ISSN 1232-5317 (1996).
2. P. Tulik, N. Golnik: "Studies of recombination chambers filled with nitrogen for BNCT dosimetry", Nukleonika, 54(4), 255-259. (2009).
3. N. Golnik: "Microdosimetry using a recombination chamber: method and applications", Radiat. Prot. Dosim., 61, 125-128 (1995).