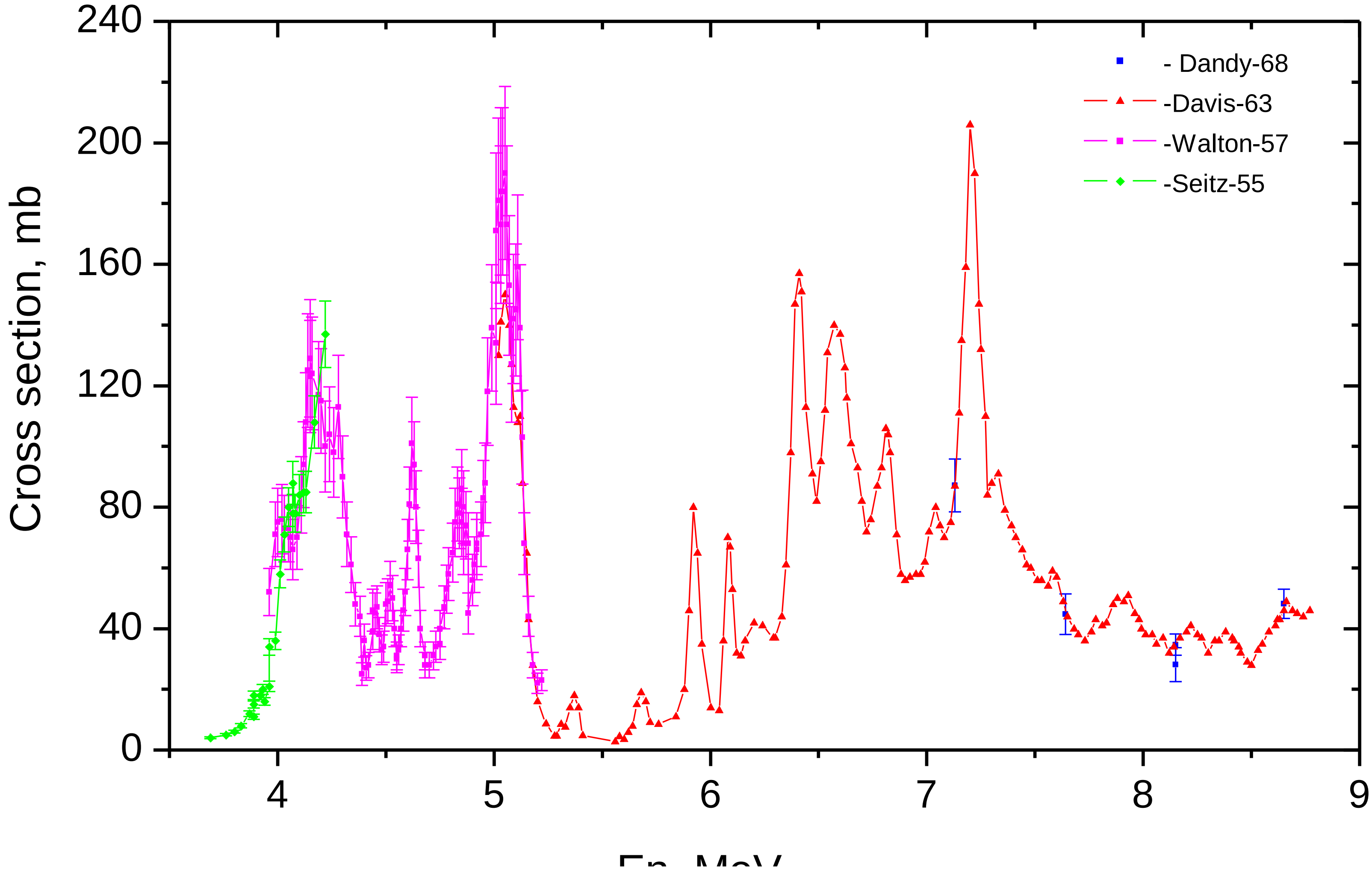
Status and future planes of $^{16}O(n,\alpha)^{13}C$ reaction cross-section investigation at IPPE

V.Khryachkov, I.Bondarenko, V.Pronyaev, P.Prusachenko,

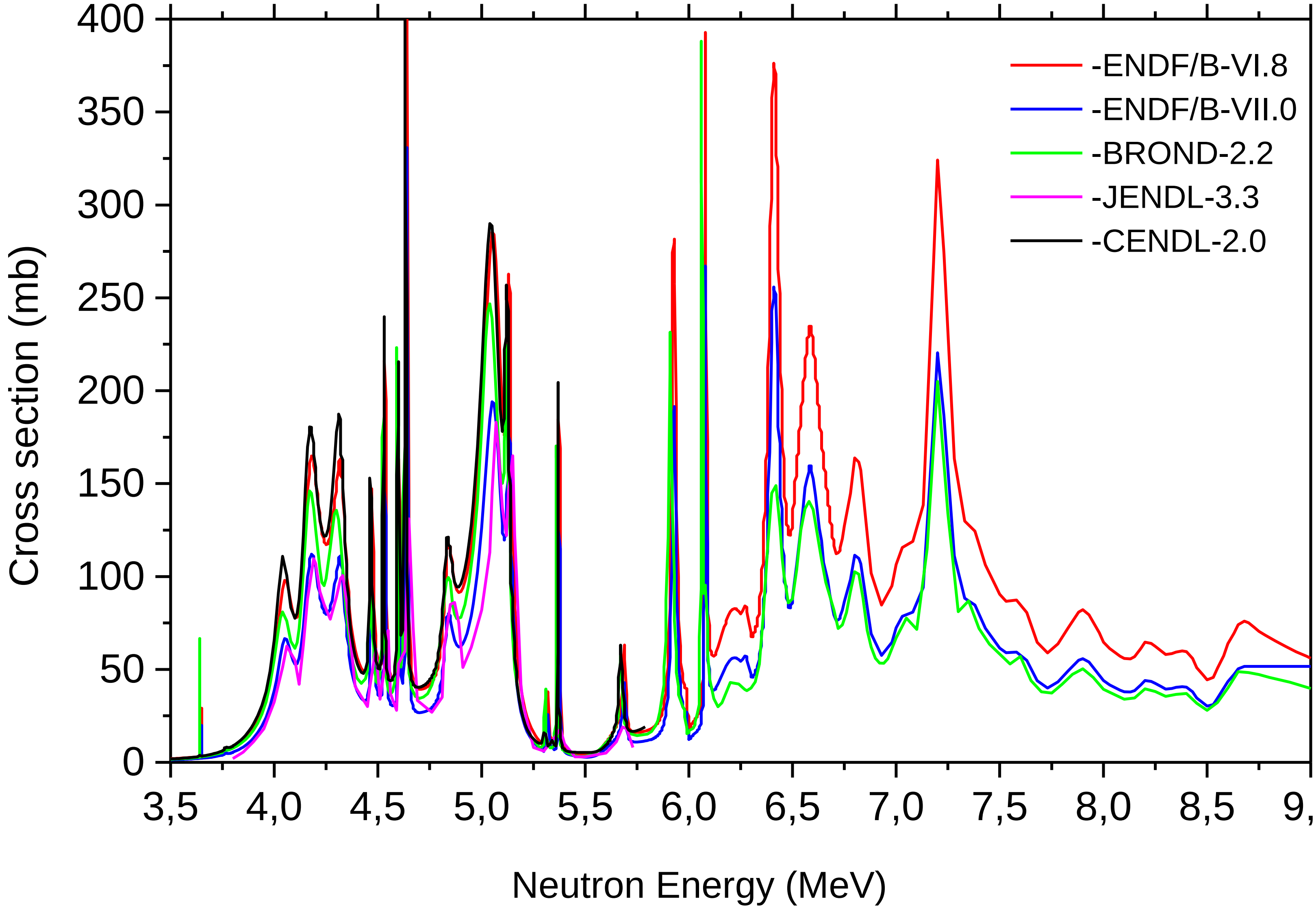
A.Sergachev, N.Semenova, T.Khromyleva

IPPE, Obninsk, Russia

Status of $^{16}O(n,\alpha)$ reaction experimental data to 2005

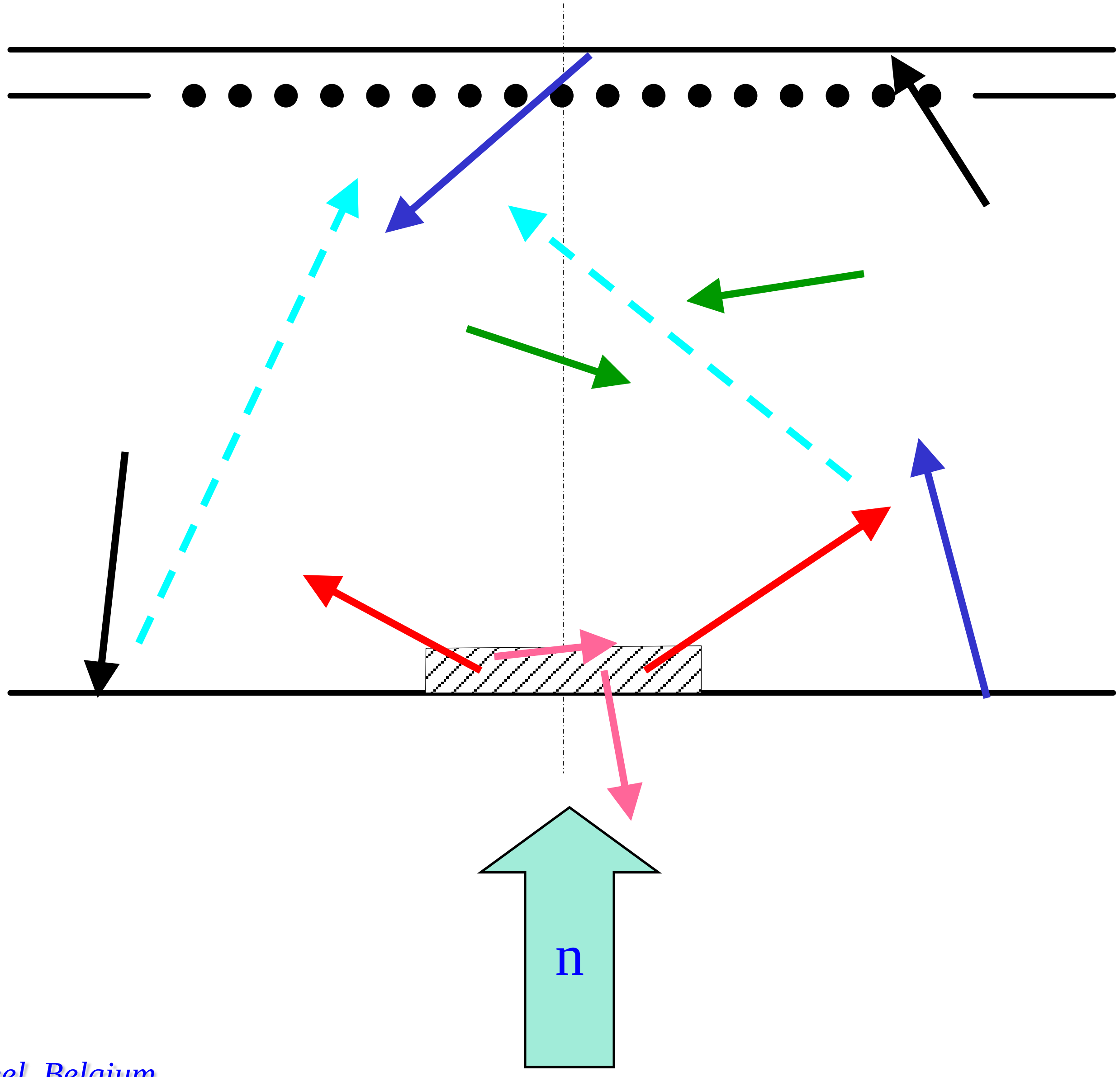


Evaluations for $^{16}O(n,\alpha)$ reaction

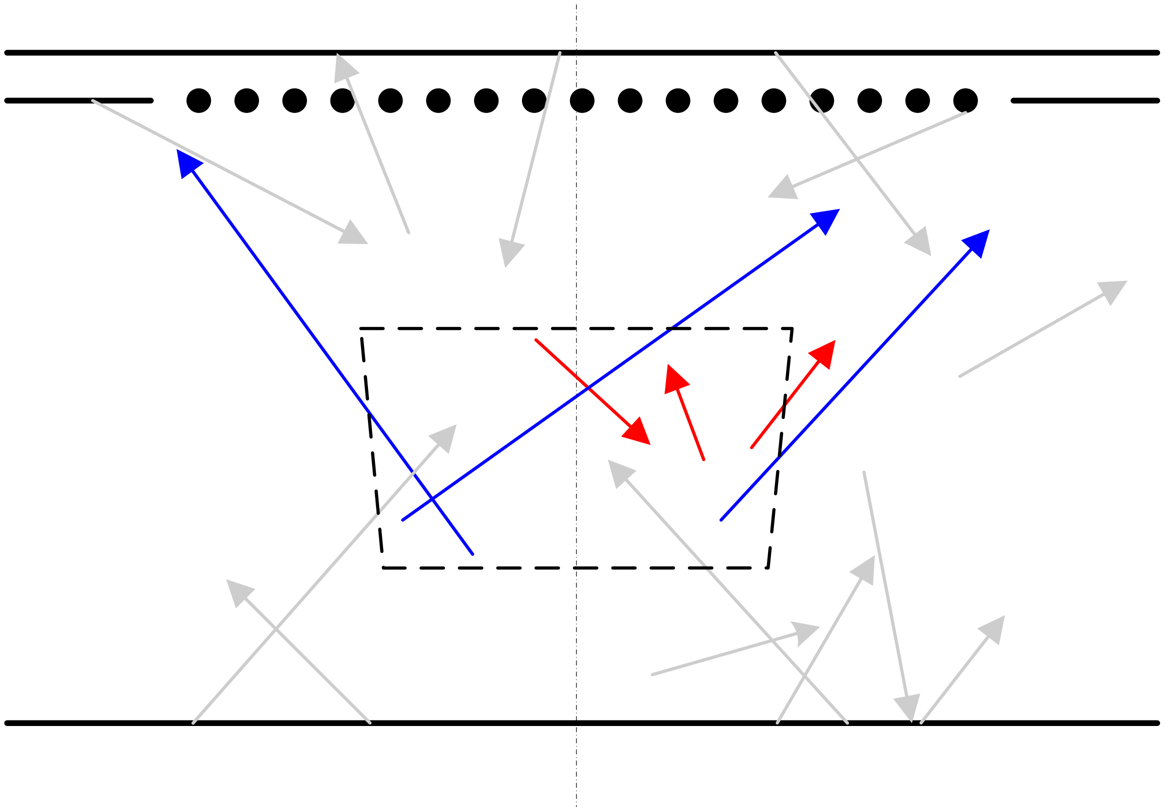


Classical spectrometer

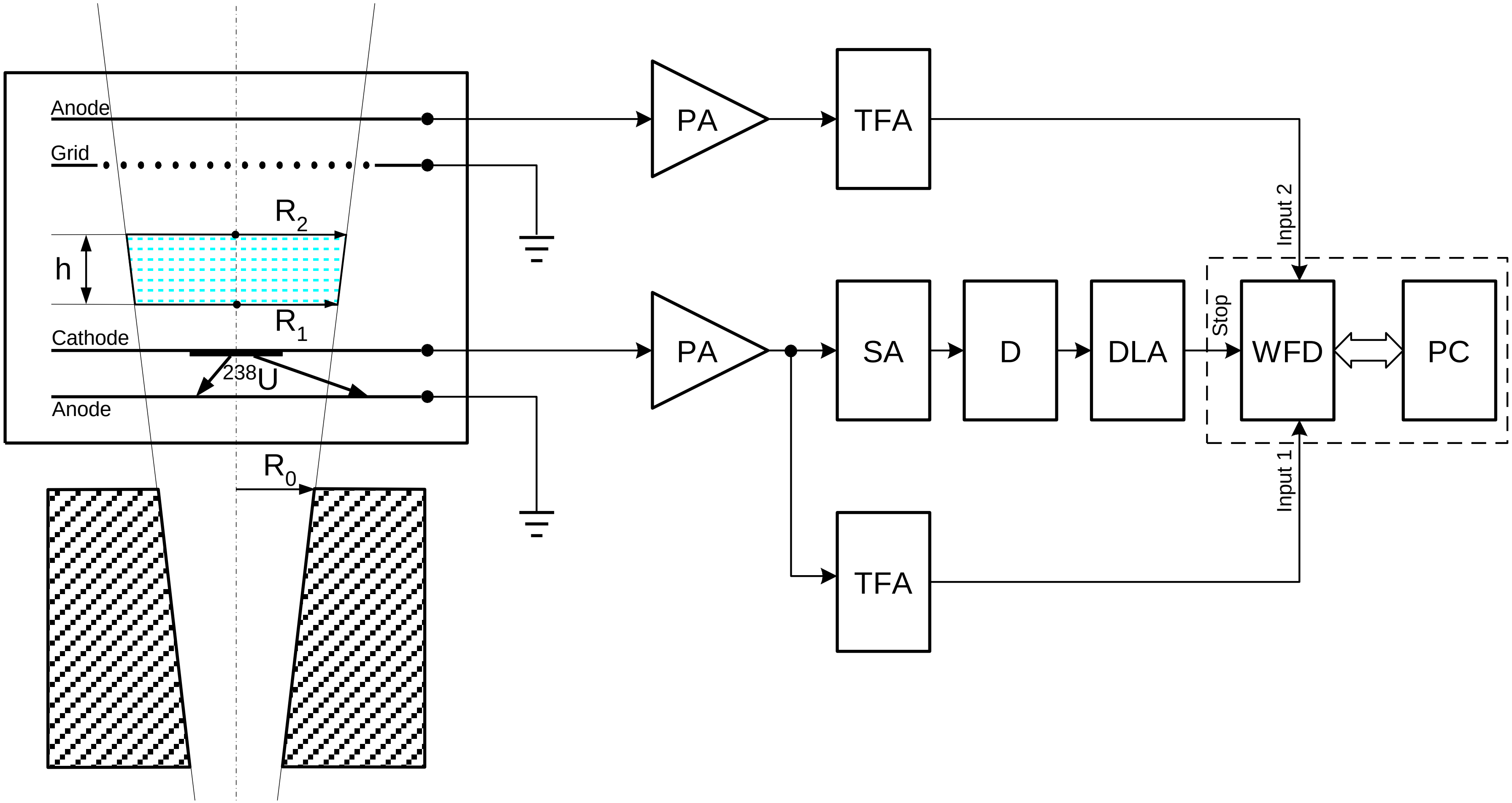
1. Target
2. Full absorption
3. Electrodes
4. Gas a-particles
5. Protons
6. Wall effect



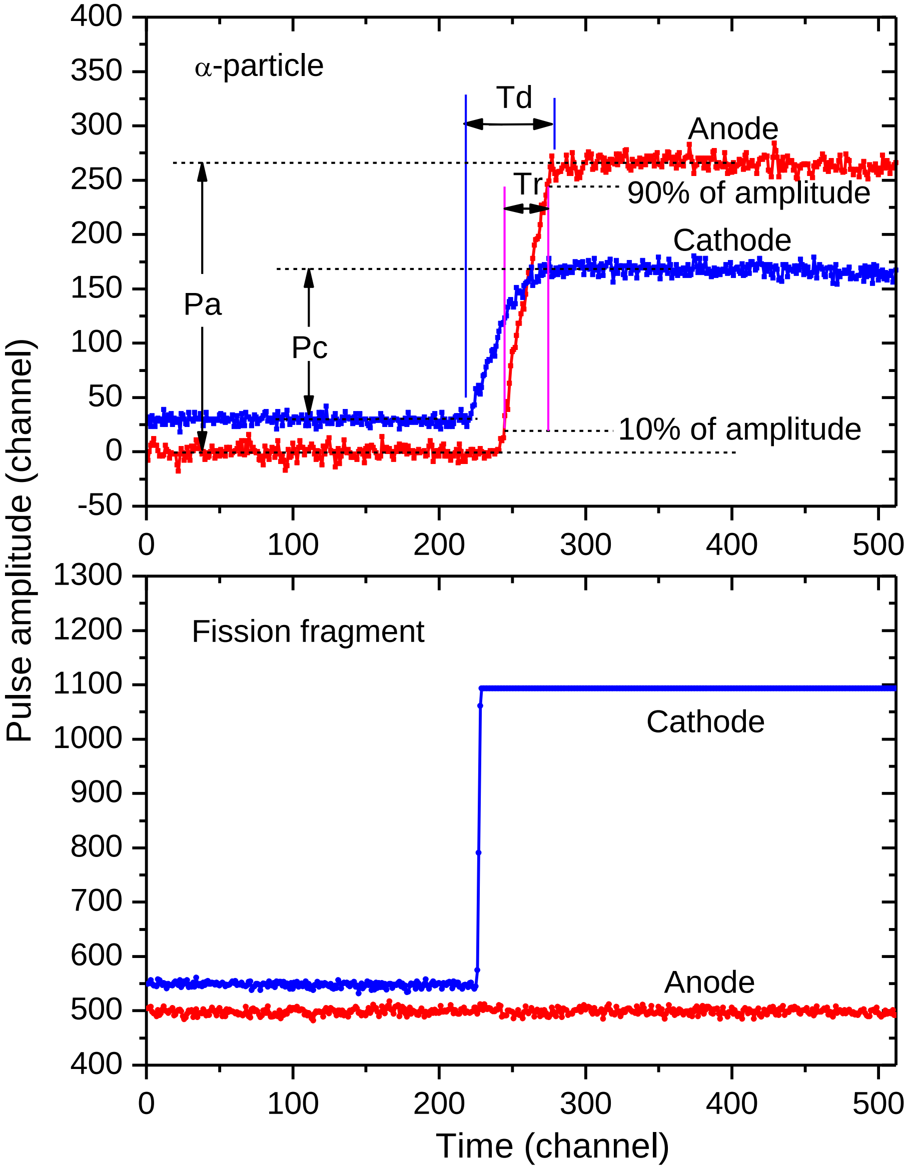
Gaseous target



Experimental set up



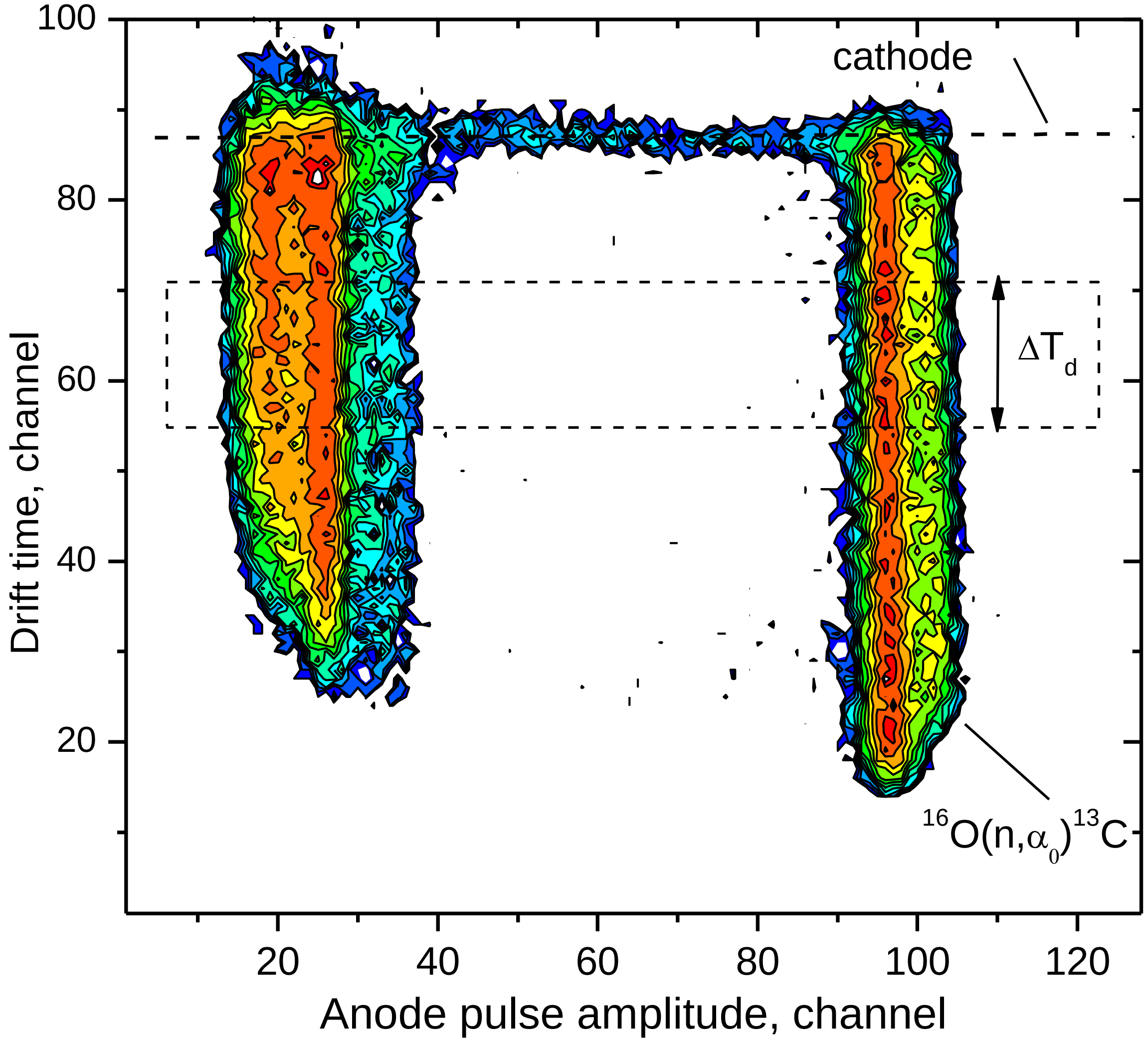
Signals example



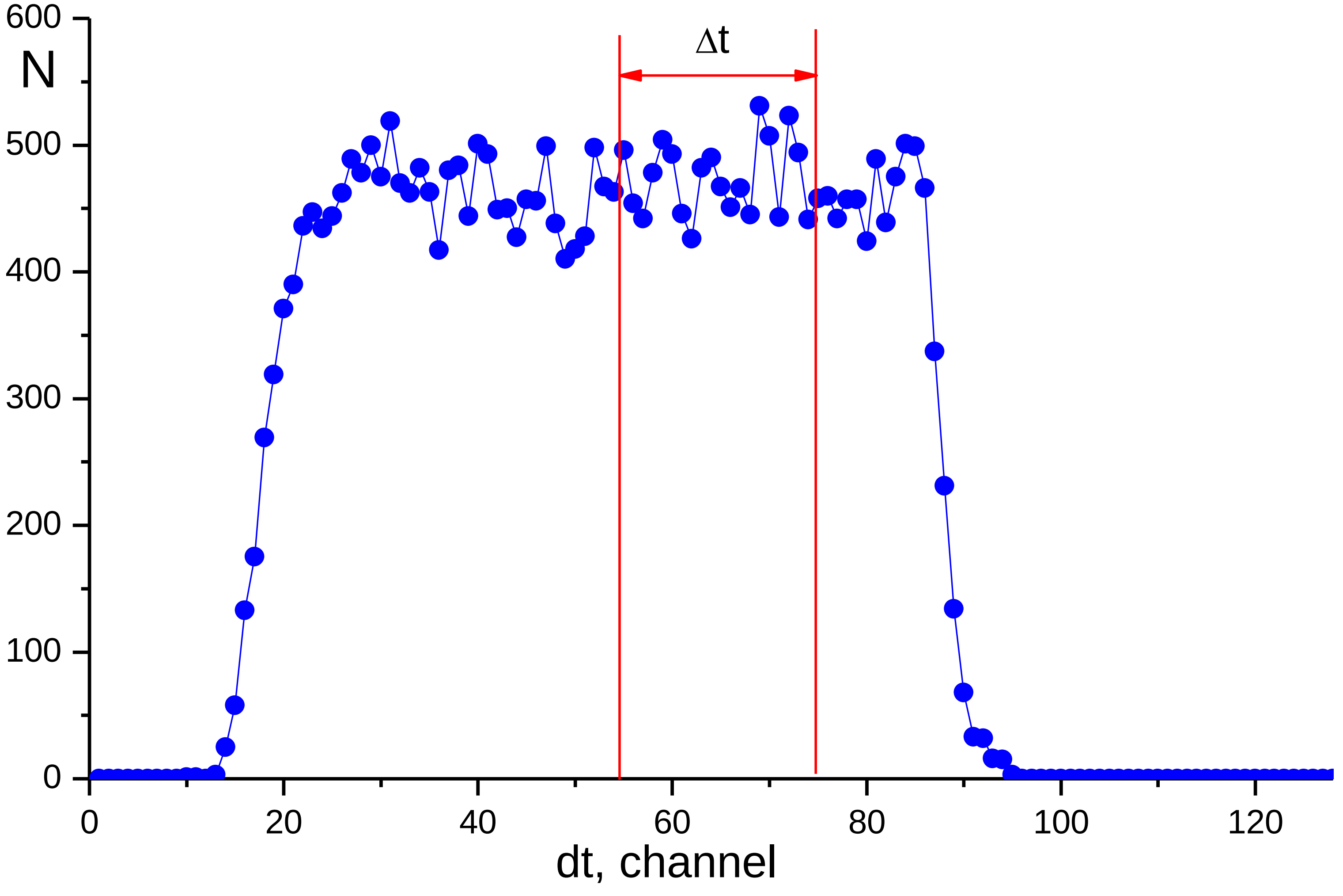
DSP allow you to analyse:

1) Amplitude of anode pulse (P_A);
2) Amplitude of cathode pulse (P_C);
3) Time when cathode signal appear (T_{SC});
4) Time when anode signal appear (T_{SA});
5) Time when anode signal reach satiation (T_{EA});
6) Time of charges motion in ionizing chamber $T_d=(T_{EA}-T_{SC})$;
7) Time of anode signal rise $T_r= (T_{EA}- T_{SA})$
8) Birth place $X=(D-T_d*v_e)$

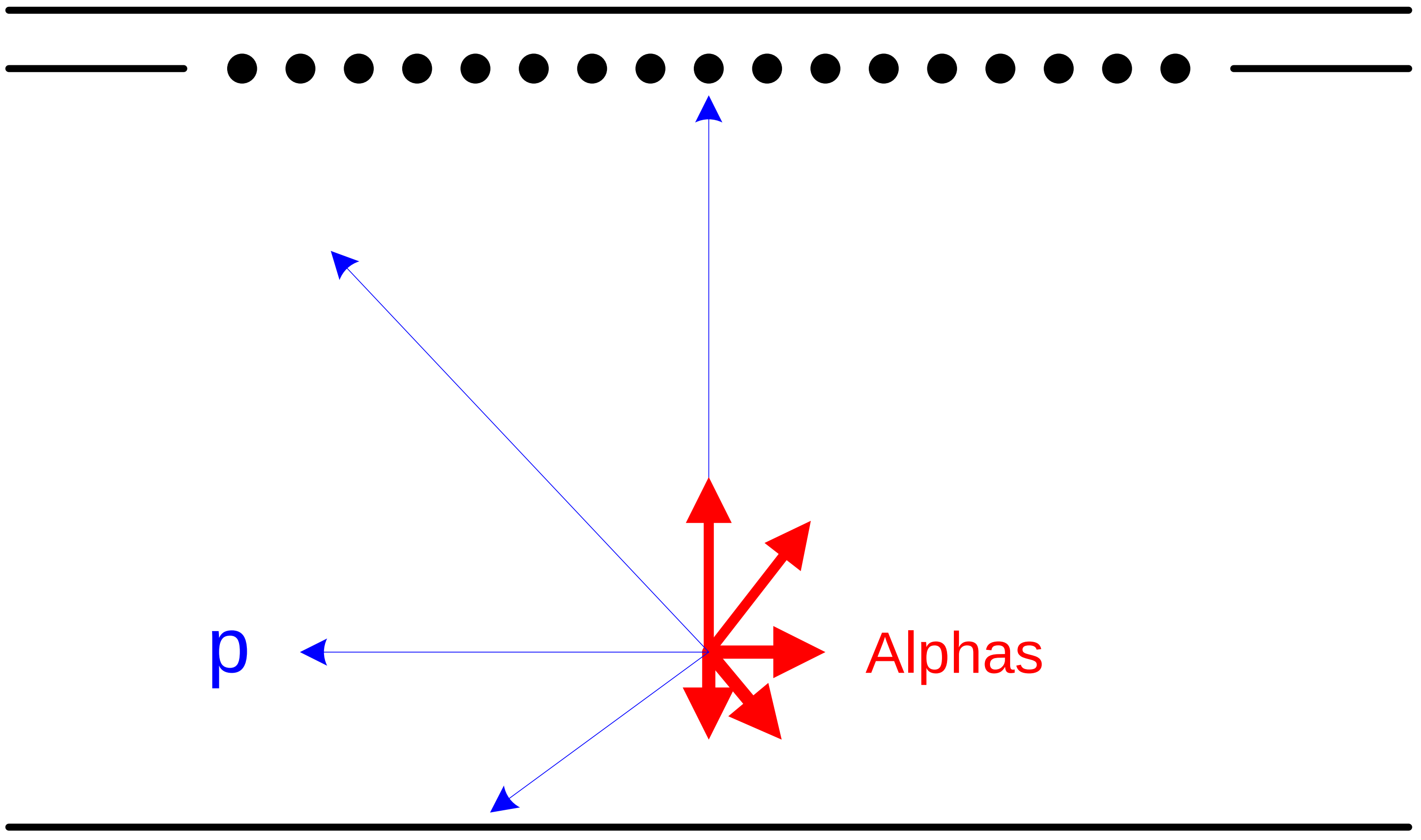
Track vertical position determination



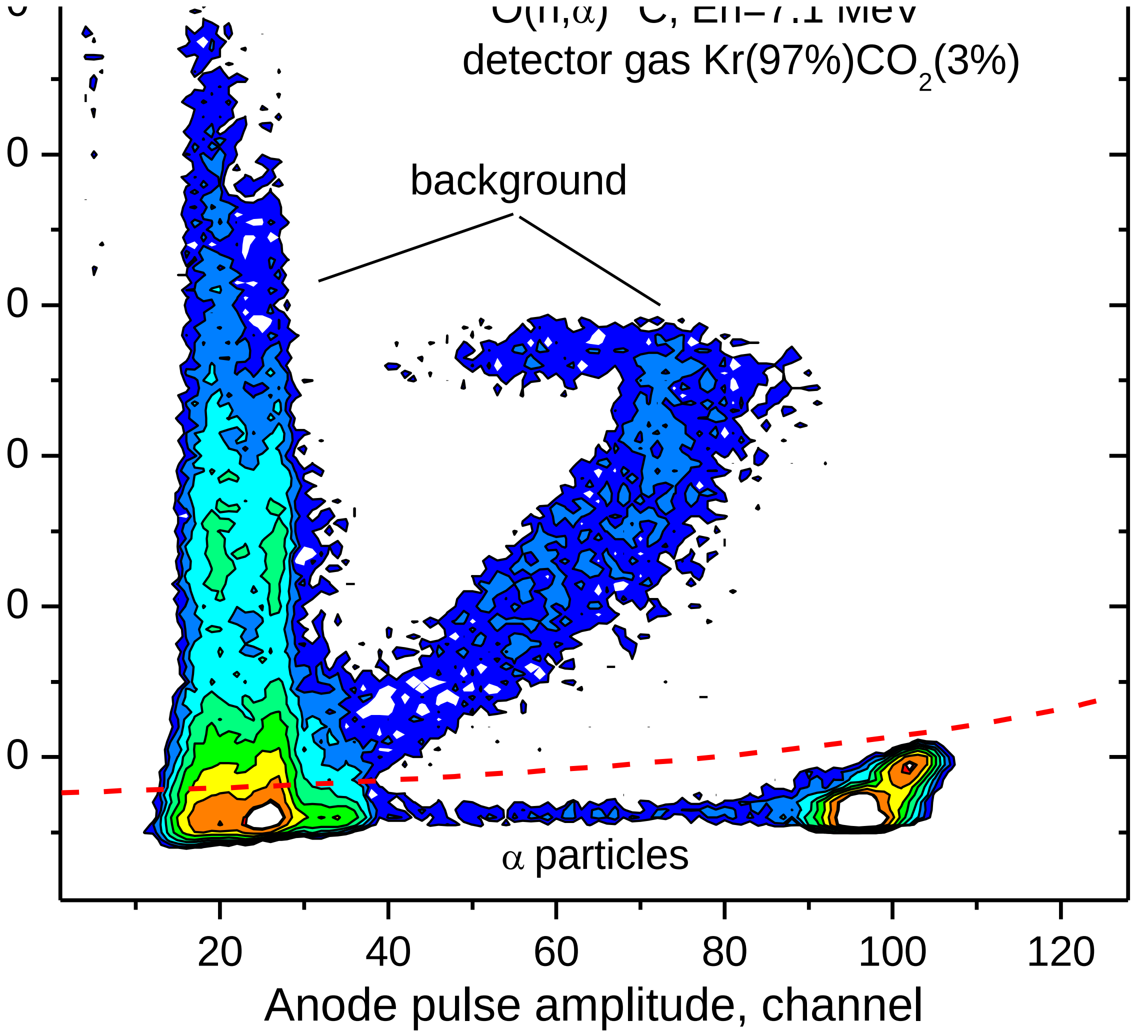
dt distribution for $^{16}O(n,\alpha)$ α-particles



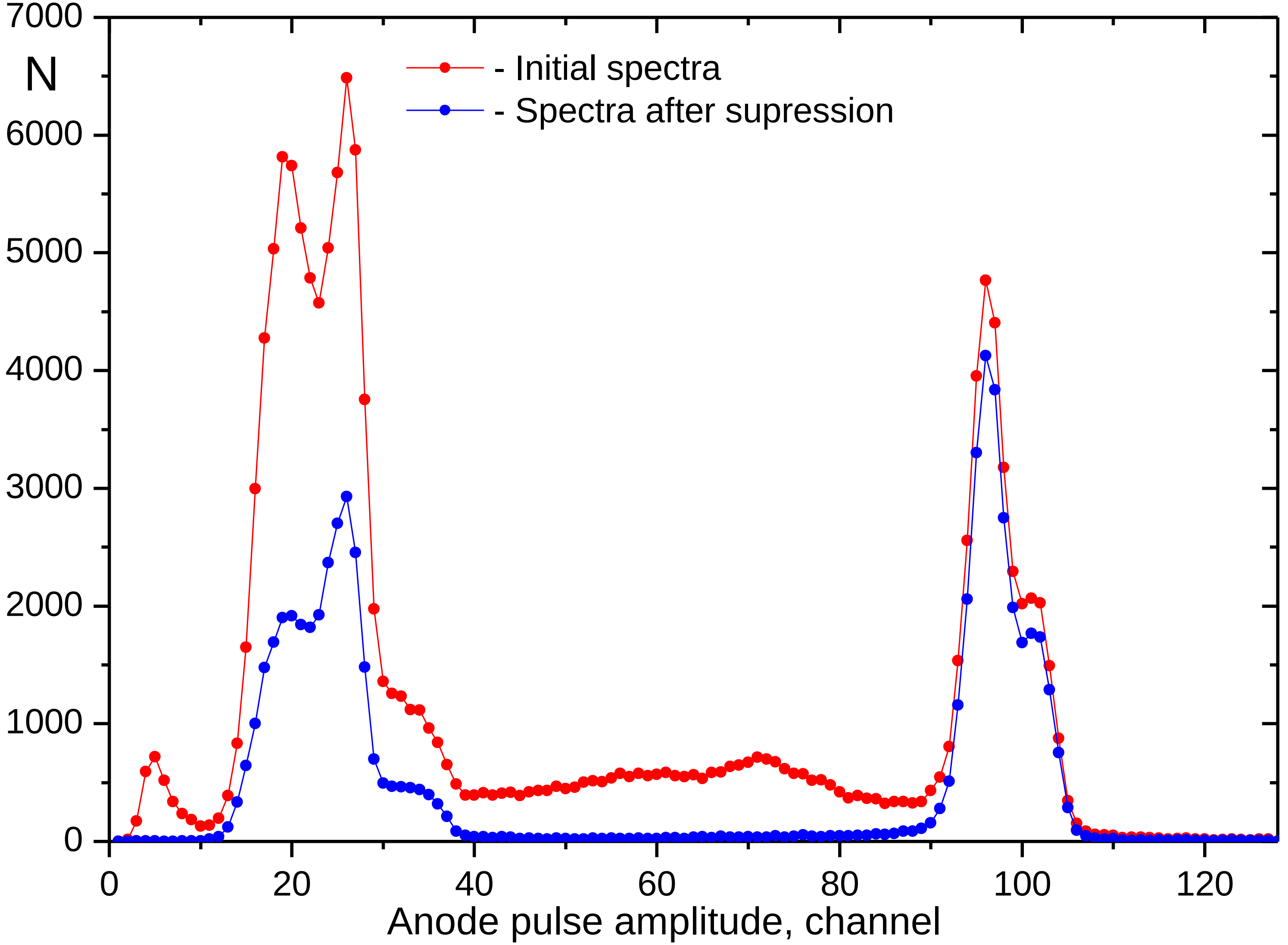
Type of particle determination



Pulse shape discrimination



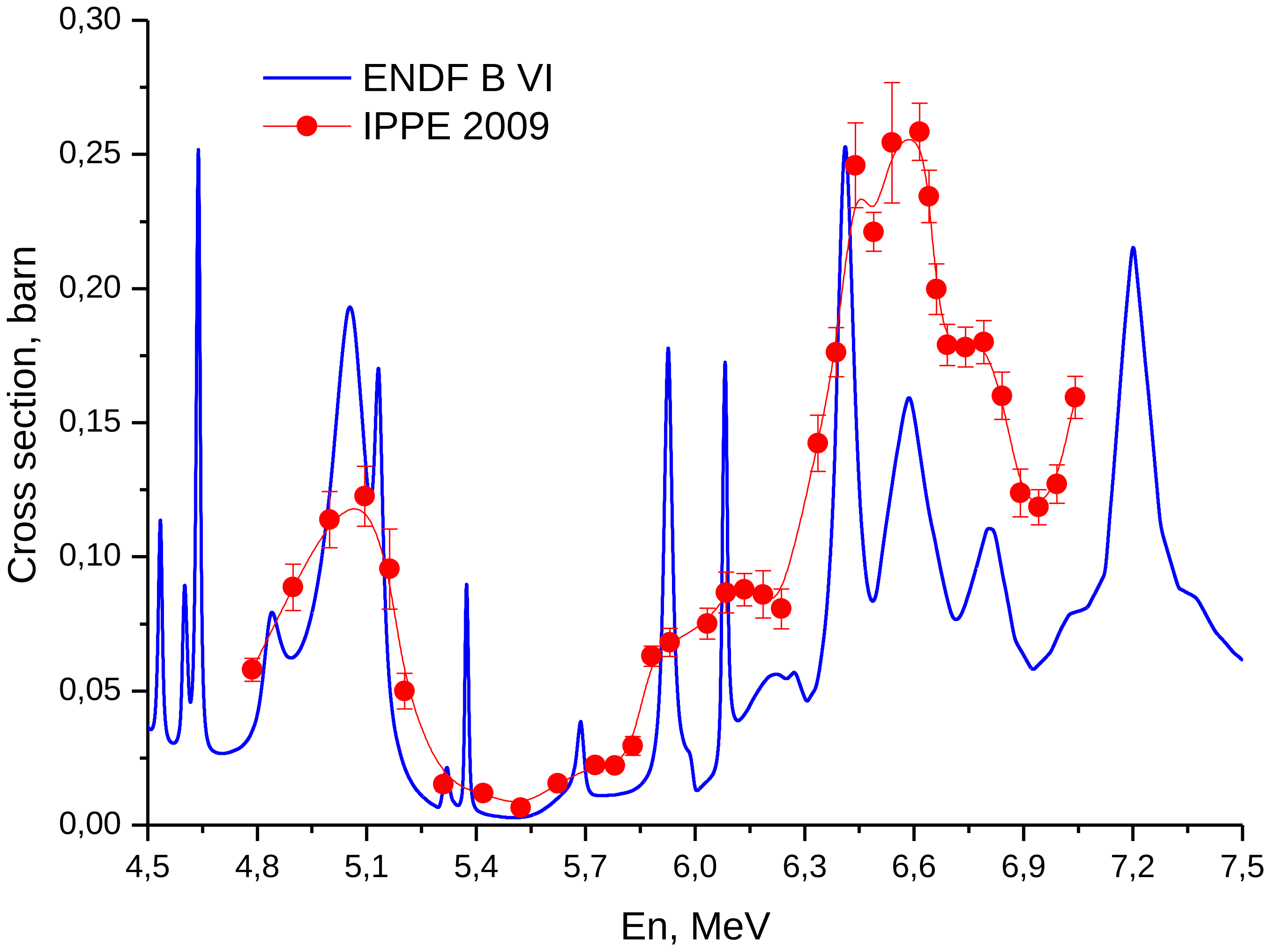
α-particles specter



Advantages of the method

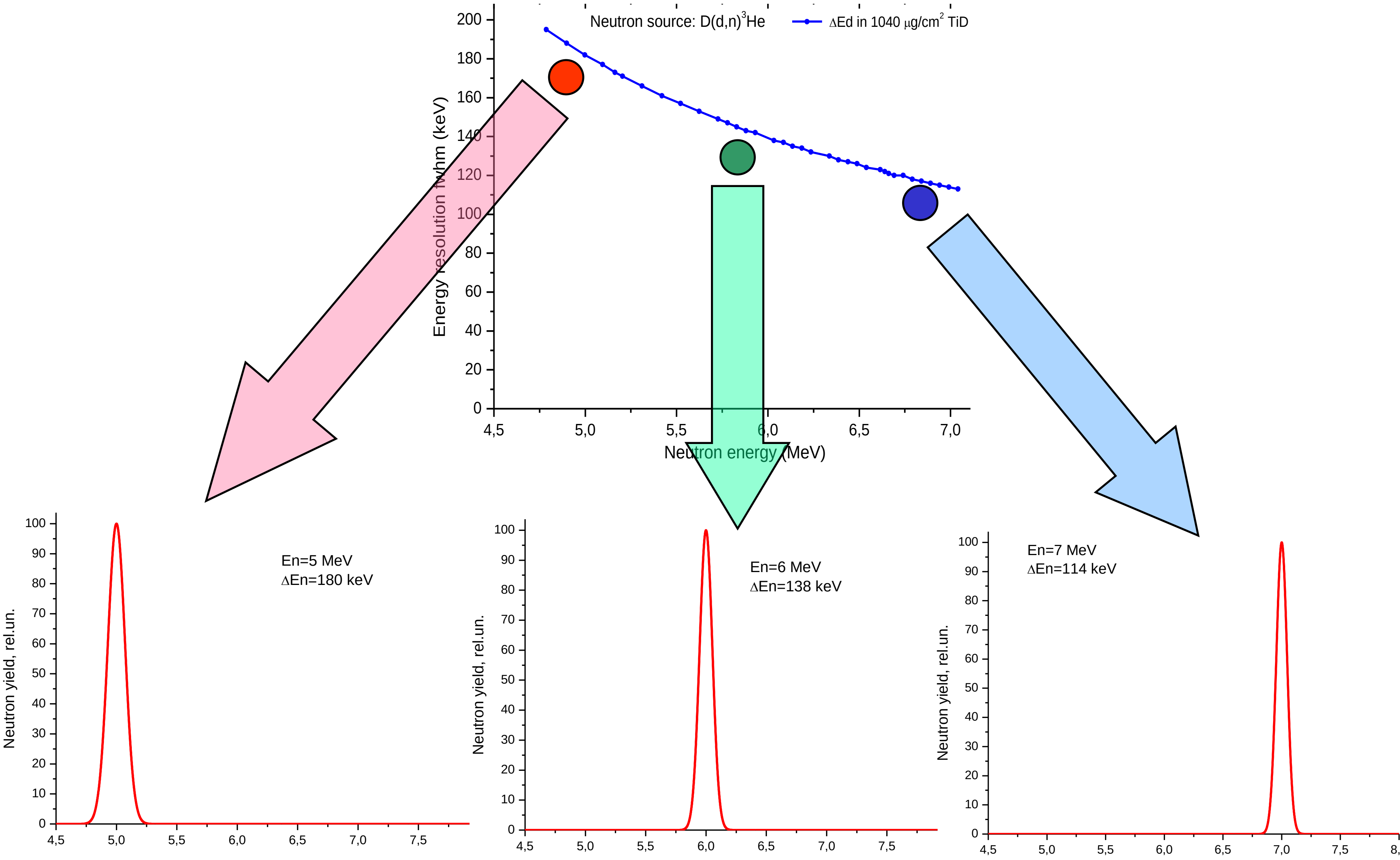
- Dead time for main and monitor channel is equally
- The simple response function of the spectrometer
- Achieved a big mass of the target
- A simple method for determining the mass of non-radioactive target
- Developed numerical methods to effectively suppress backgrounds
- Wall effect is absent

Result

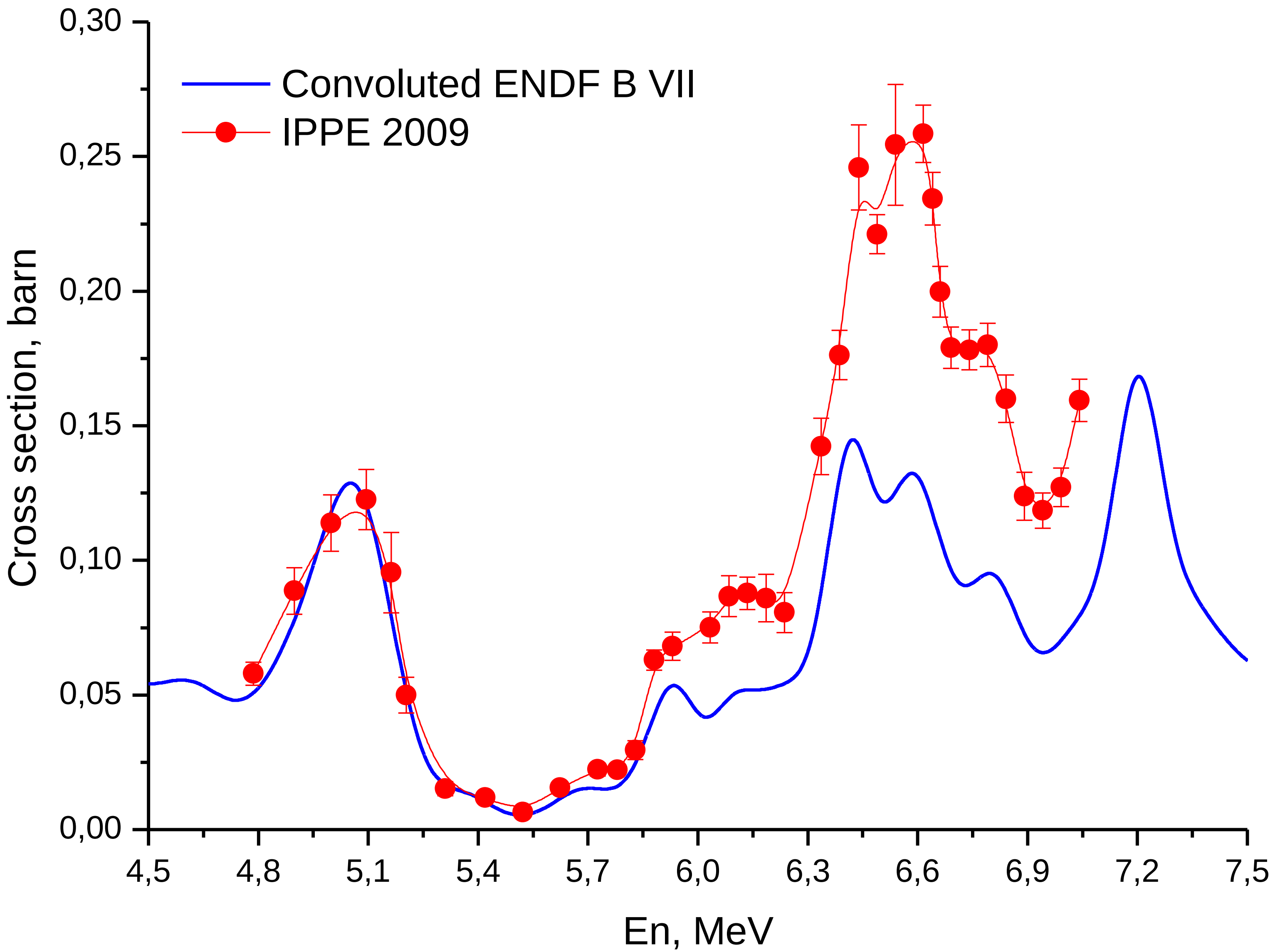


0,30
0,25
0,20
0,15
0,10
0,05
0,00
Cross section, barn
ENDF B VI
IPPE 2009
4,5
4,8
5,1
5,4
5,7
6,0
6,3
6,6
6,9
7,2
7,5
En, MeV

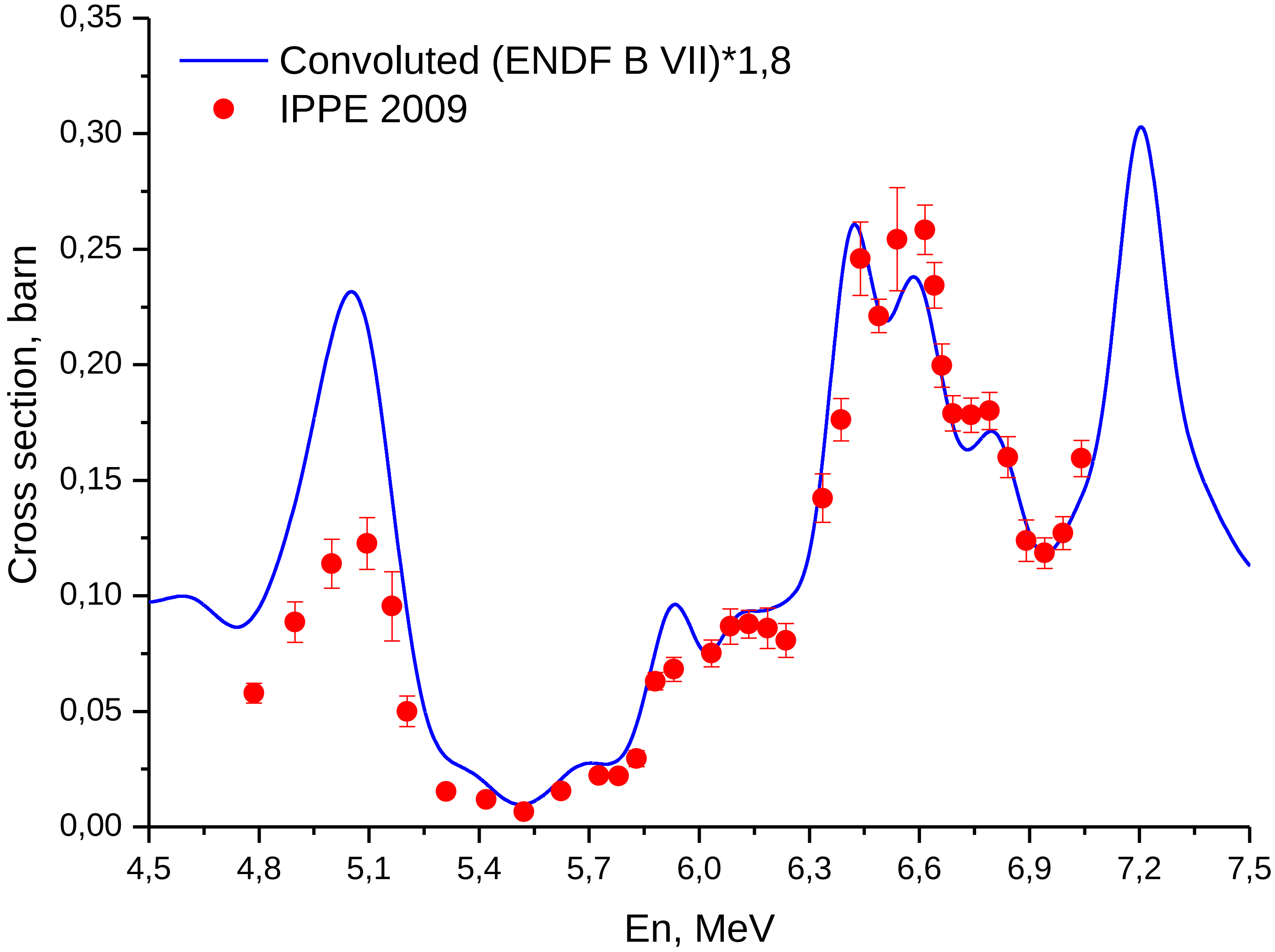
Neutron source - EG-1 accelerator (d,D) reaction En=4-7 MeV



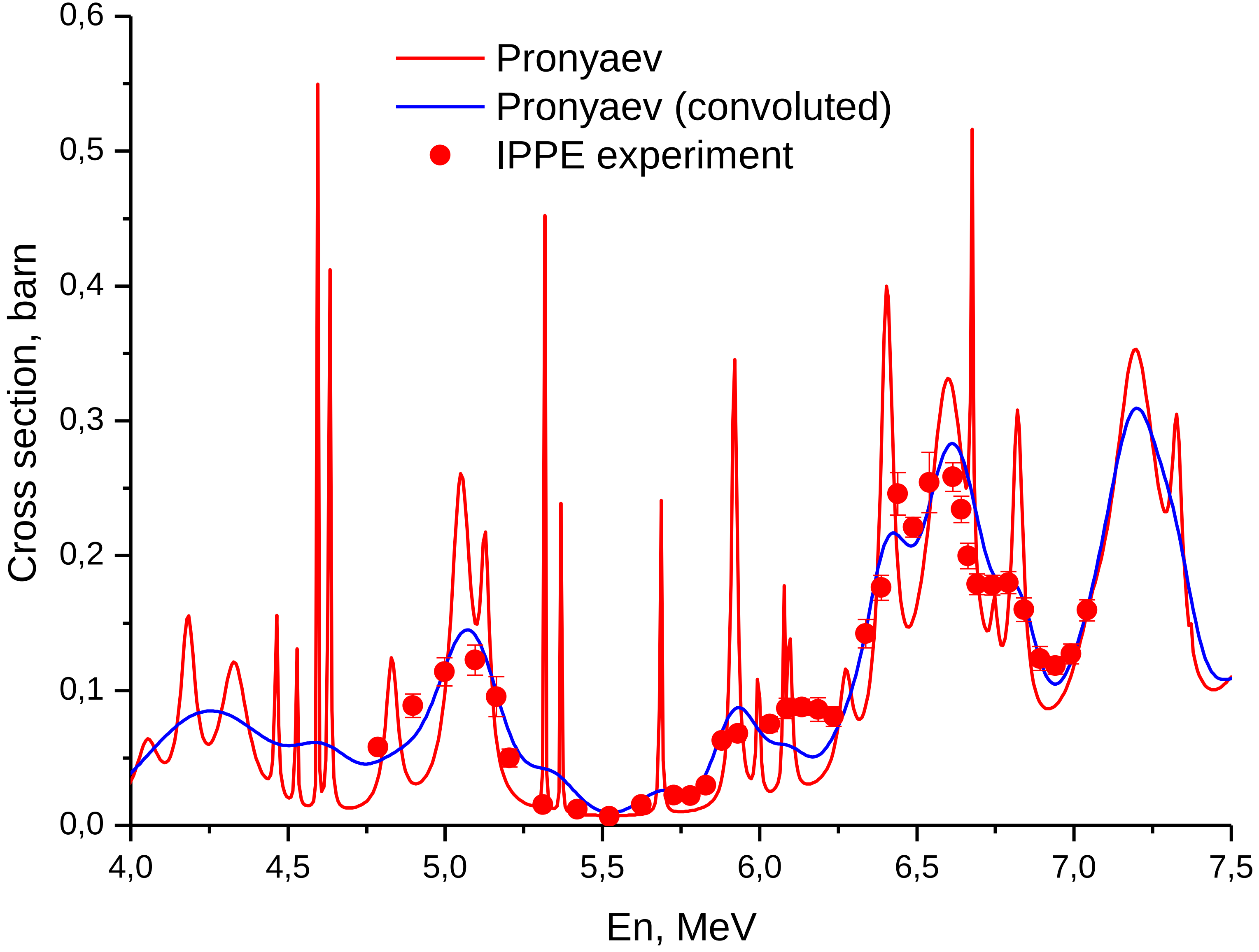
Convoluted ENDF vs IPPE experiment



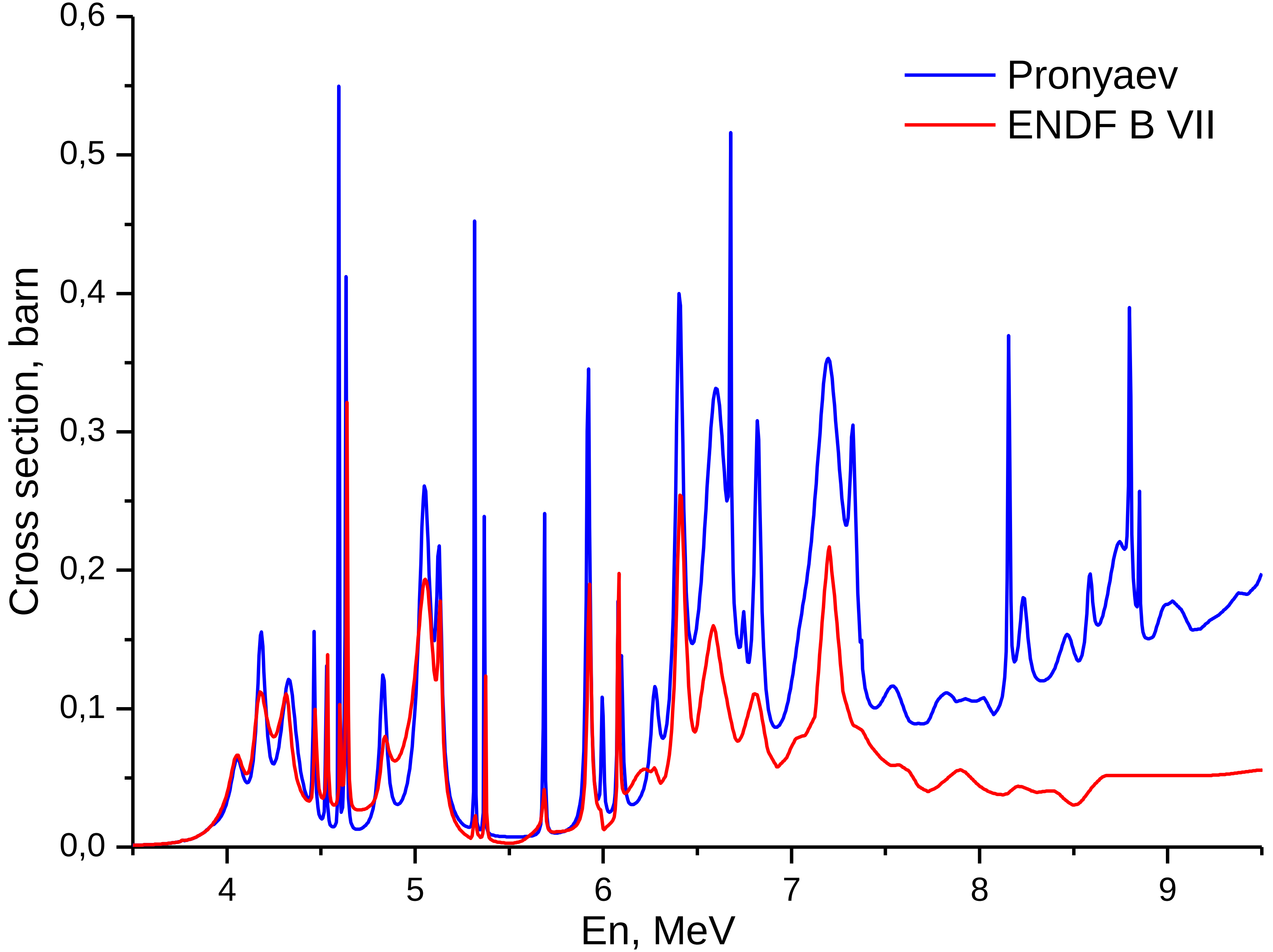
Convoluted ENDF*1,8 and IPPE experiment



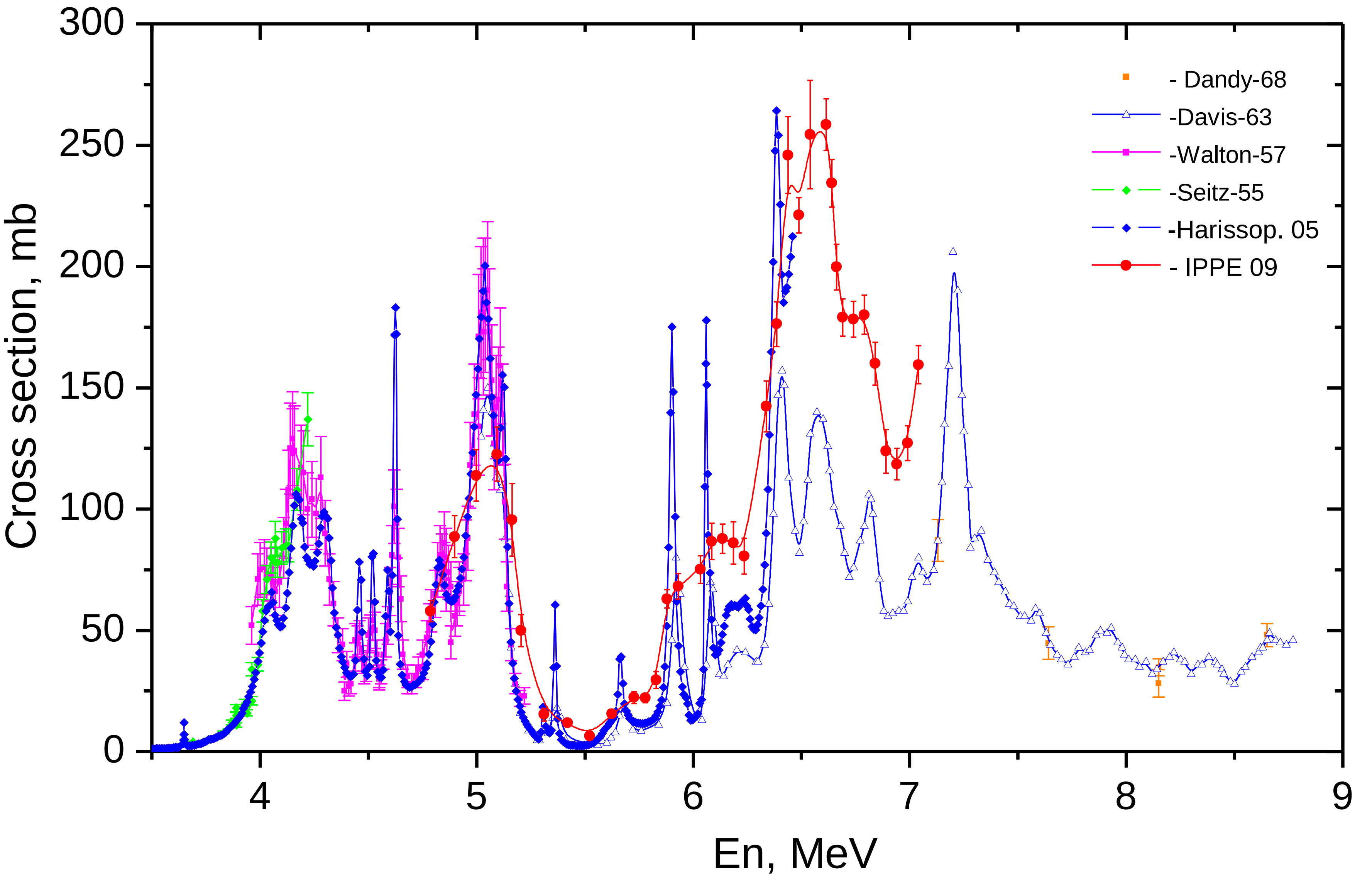
V.Pronyaev evaluation



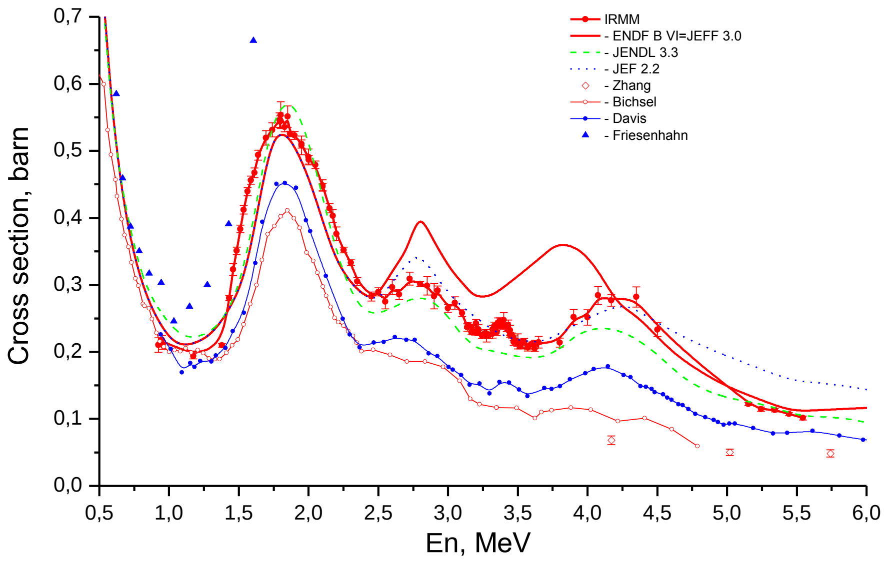
Pronyaev evaluation and ENDF B VII

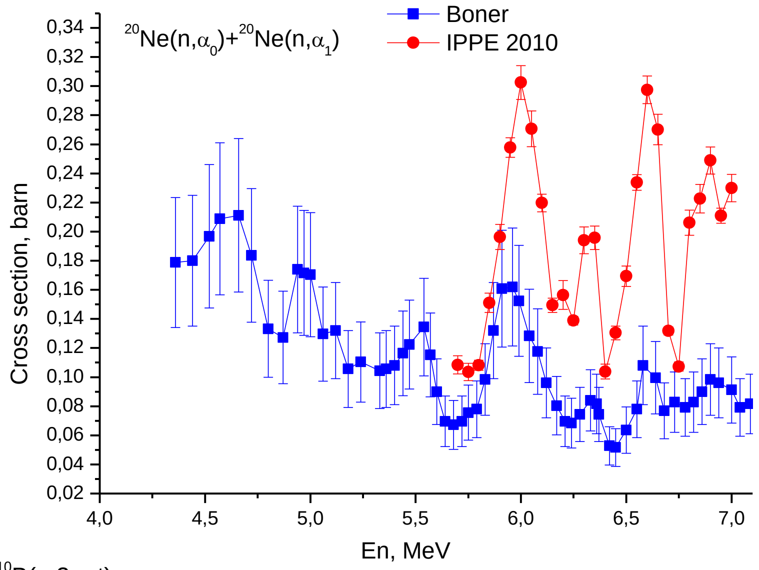


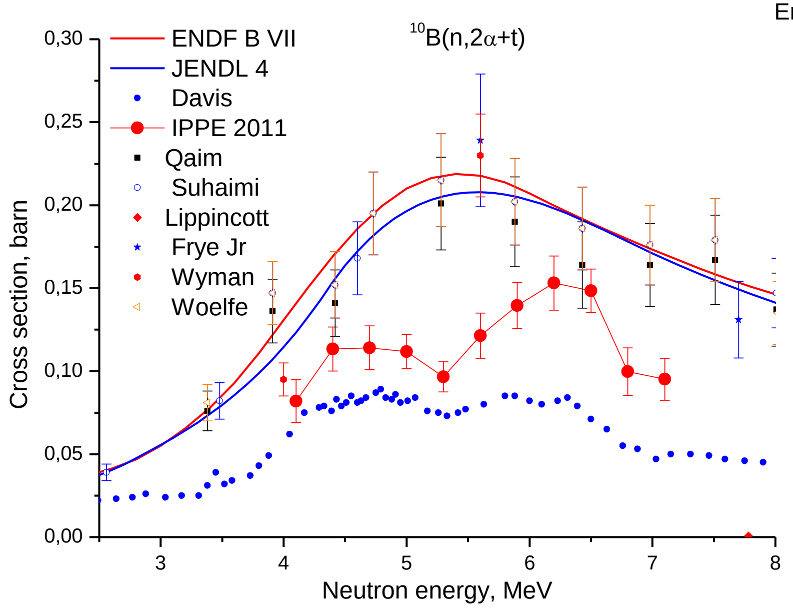
Comparison of IPPE data



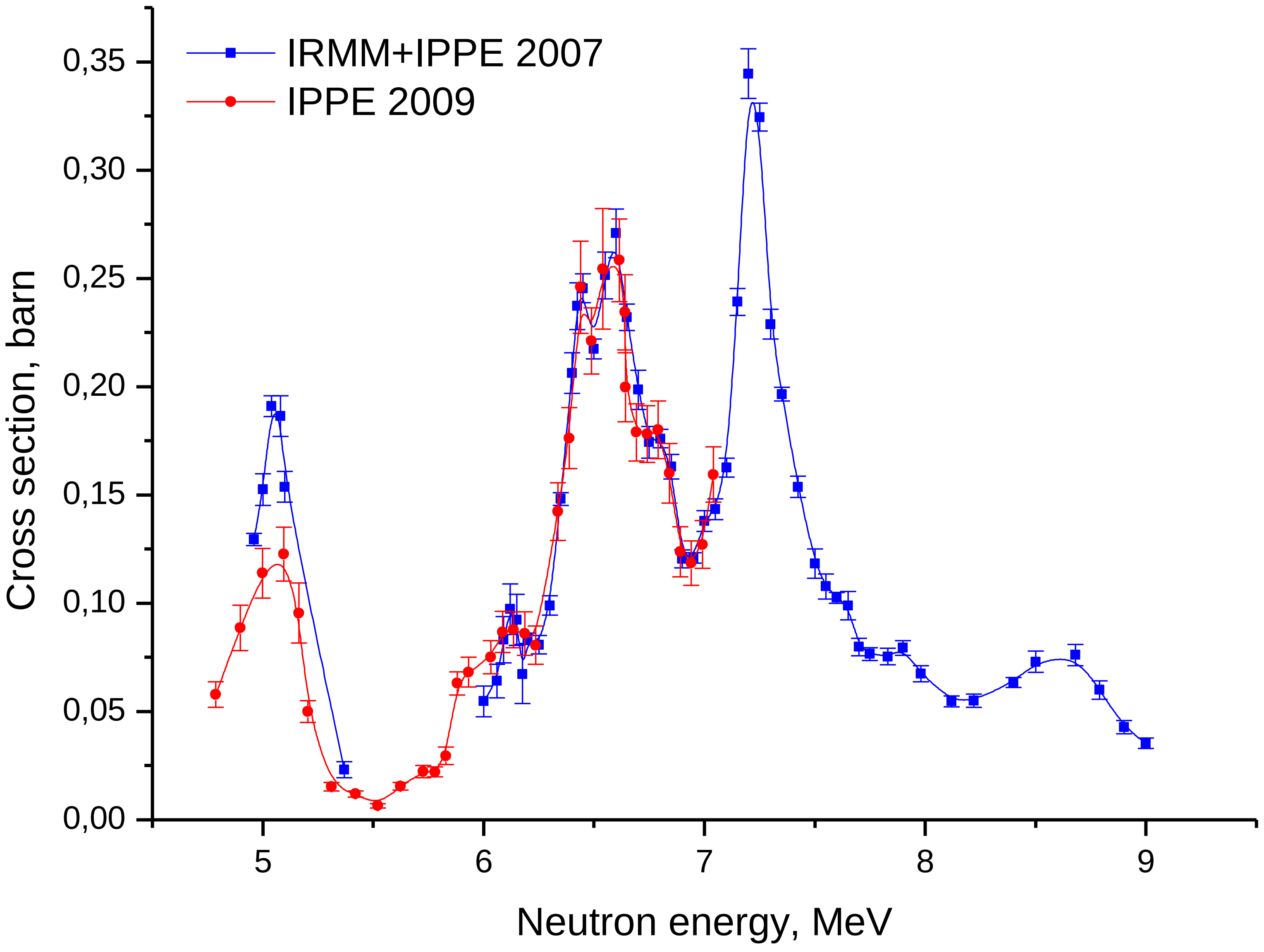
Davis data vs new experiments



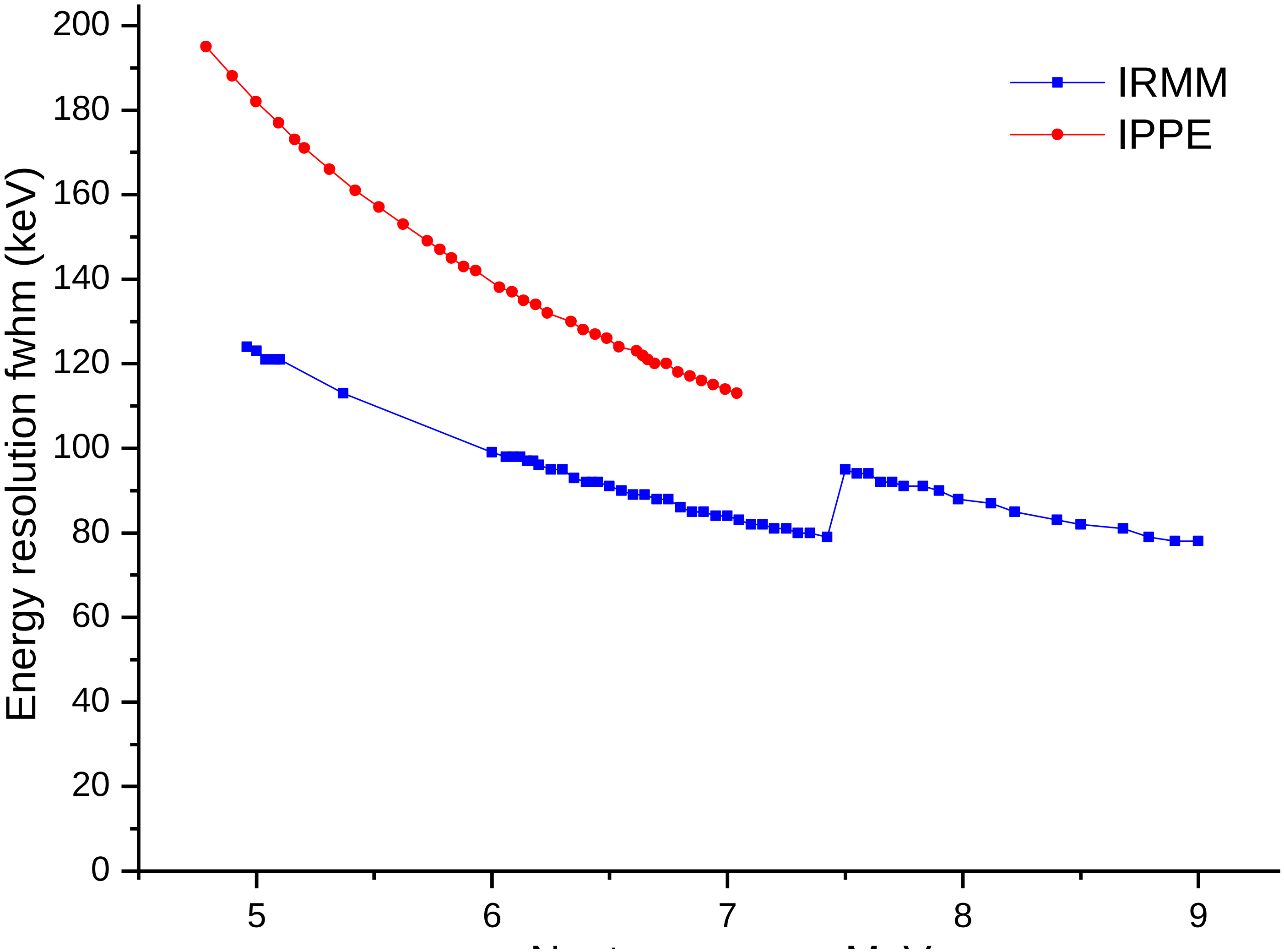




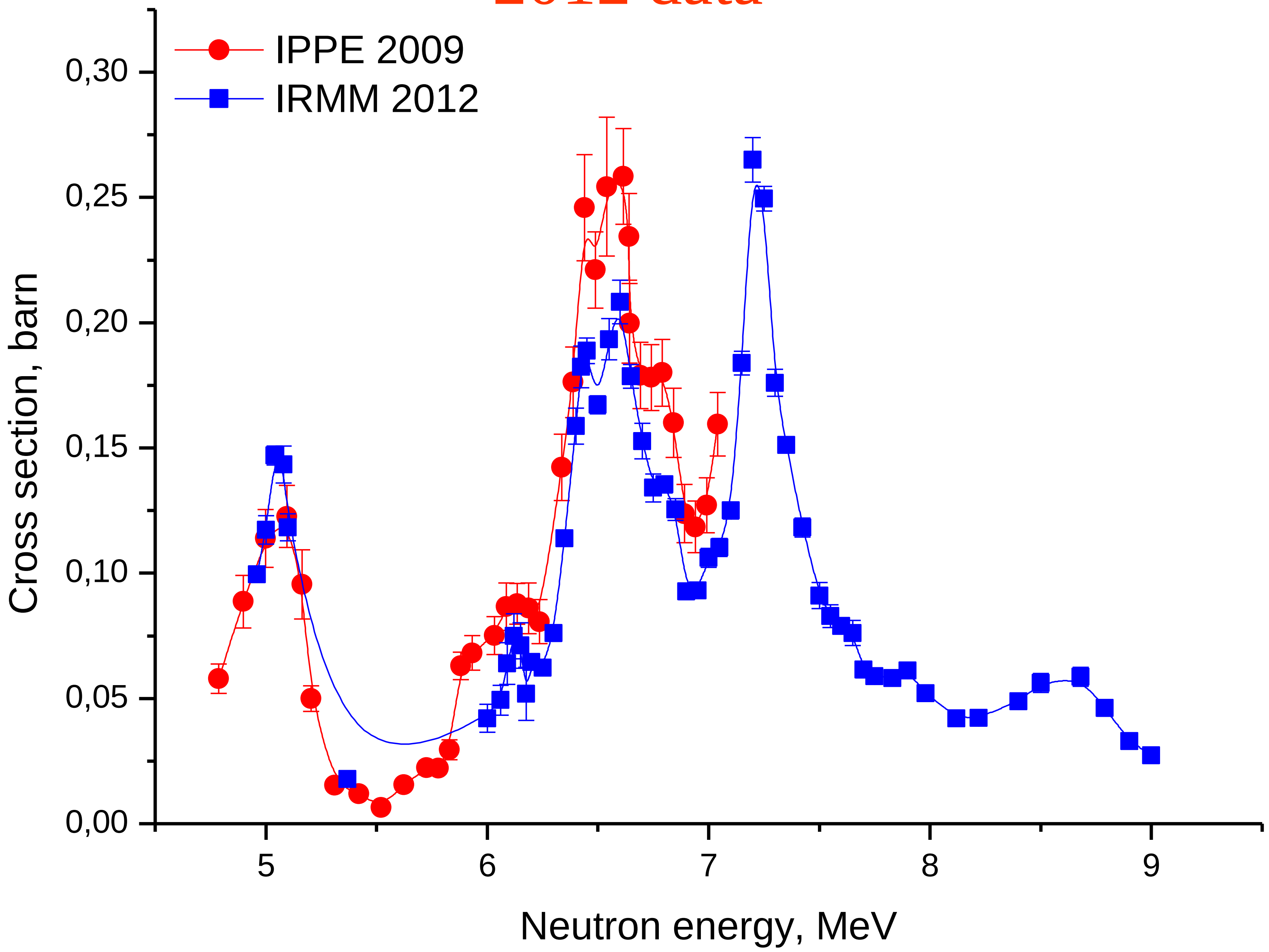
IRMM 2007 and IPPE 2009 data



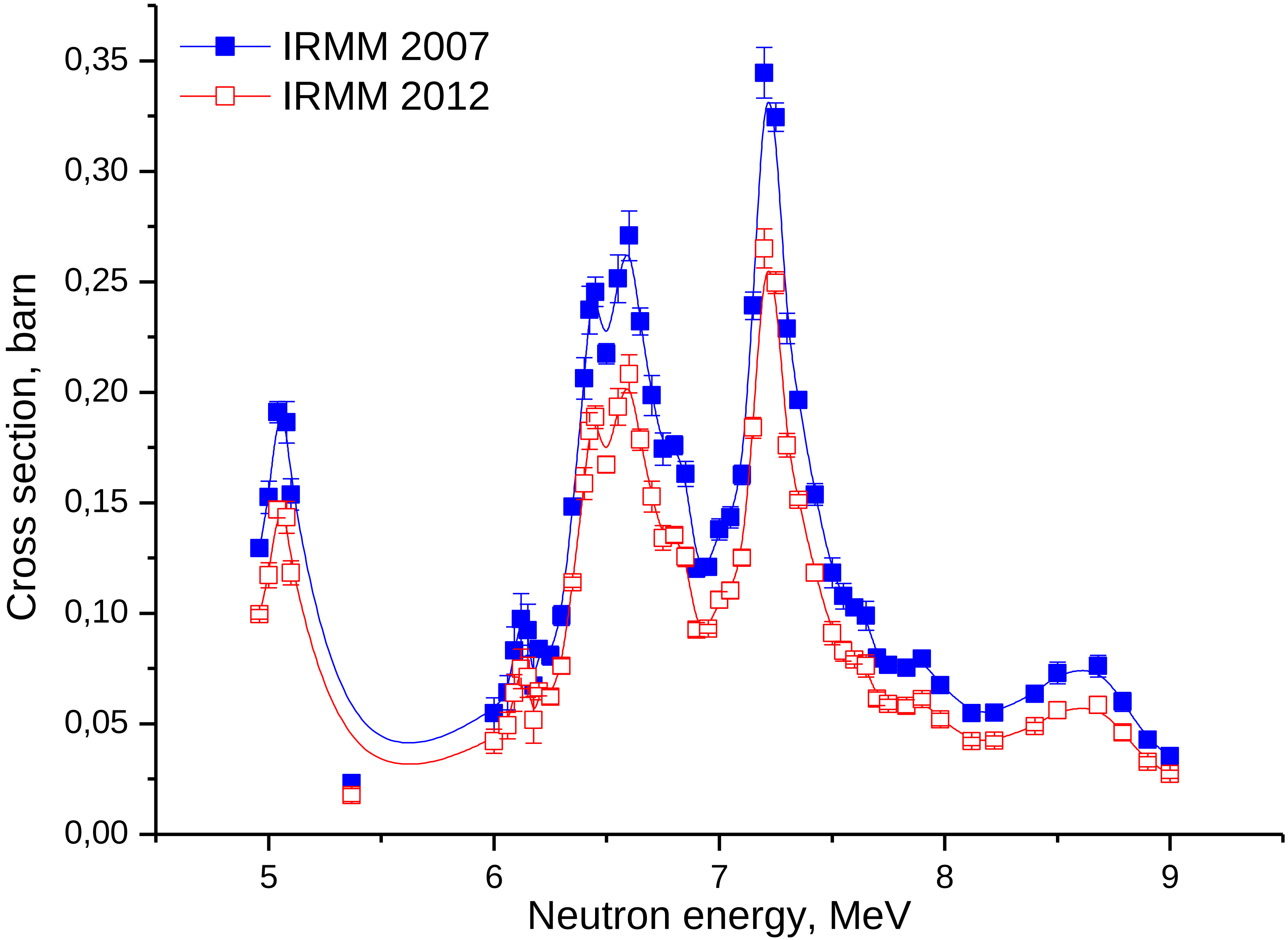
Neutron energy spread



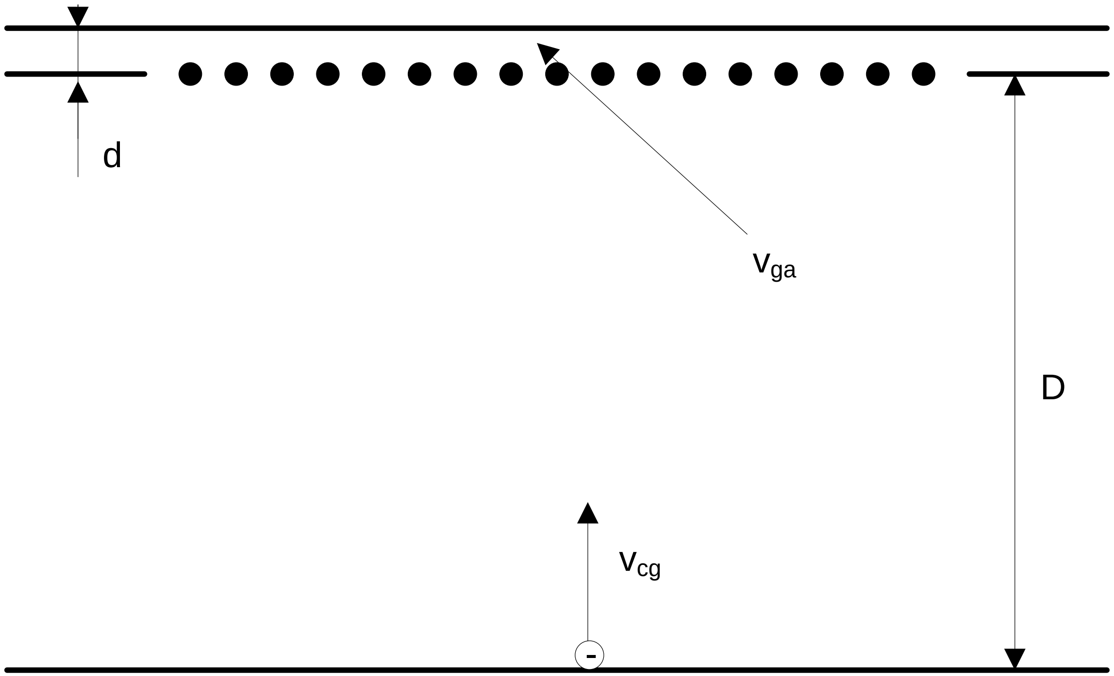
Comparison of the IPPE 2009 and IRMM 2012 data



$(\text{IRMM}_{2007})/(\text{IRMM}_{2012})=$ **1,17**

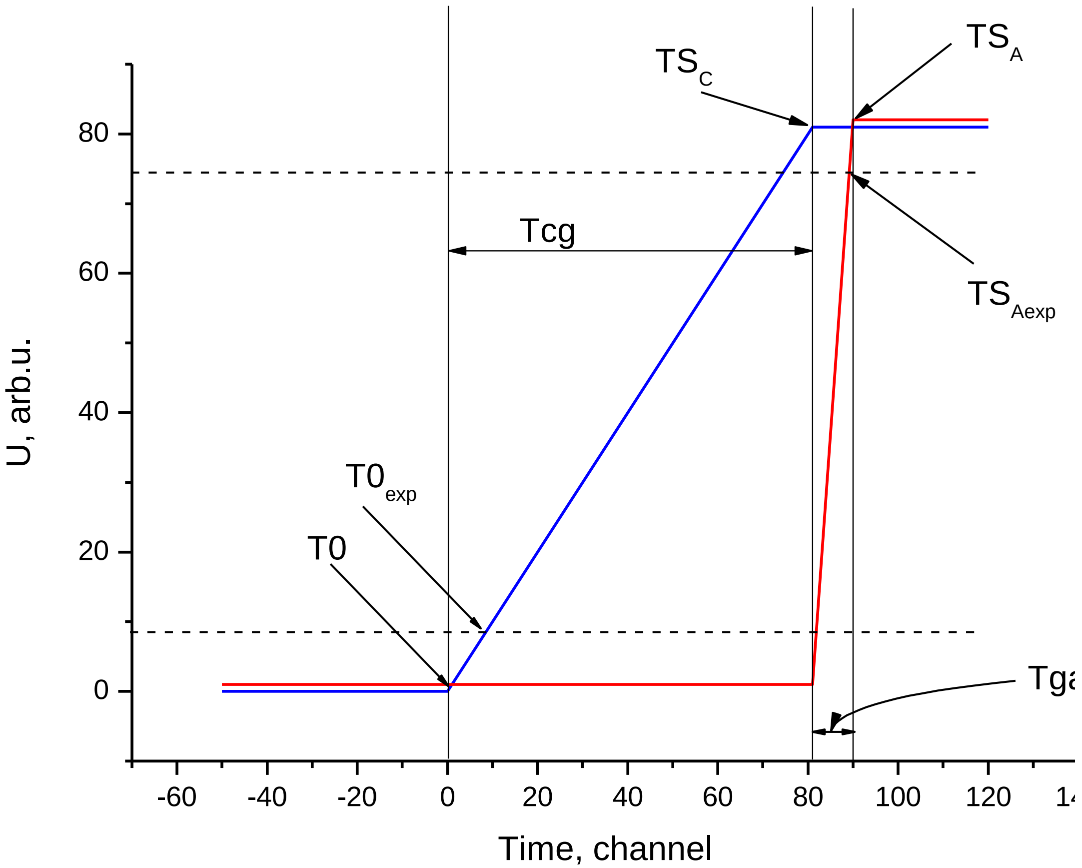


IRMM correction



$$v_{cg} = \left(1 + \frac{v_{cg}}{v_{ga}} * \frac{d}{D}\right) v_{cg\_Exp} \qquad v_{cg} > v_{cg\_Exp} \qquad \frac{\sigma'}{\sigma} = 1{,}105 \qquad \frac{\sigma'}{\sigma} = 1{,}17\,???$$

IPPE correction



$$v_{cg} < v_{cg\_Exp}$$

$$\frac{\sigma'}{\sigma} = 0{,}985$$ (IRMM correction is included!)

Conclusion

- New data was obtained for $^{16}O(n,\alpha)^{13}C$ reaction cross section.
- For neutron energy higher then 5,8 MeV there are big discrepancy of IPPE data and ENDF B VII.
- Shape of ENDF B VII excitation function is correct but normalization for high energy region is too low.
- Uncorrected IRMM data (before 2008) has the same level as IPPE data in all energy region.
- Correction which was done in IRMM is right but there are another correction the same scale with opposite sign.
- Davis's data is always has correct shape but absolute value at high energy can be significant shifted.

Plans

- Improvement of the experimental setup (golden electrodes, new gas pressure control system).
- New accelerator in 2015 (data up to 9 MeV).
- New digitizers.
- System for on line neutron specter measurement
- Using H(n,p) reaction as a monitor.
- Experiment at n-TOF facility (good energy resolution; low energy neutron background is absent; energy up to 20 MeV).

Thank you for attention !