DIGITAL LOW BACKGROUND SPECTROMETER FOR (n,α) REACTION CROSS-SECTION MEASUREMENT WITH SOLID TARGET

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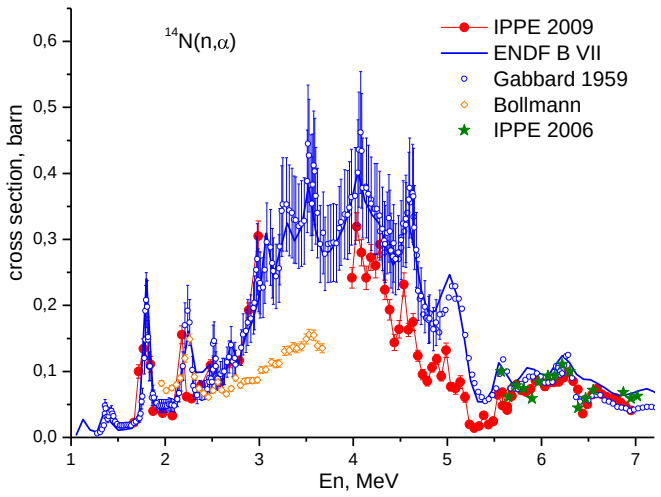
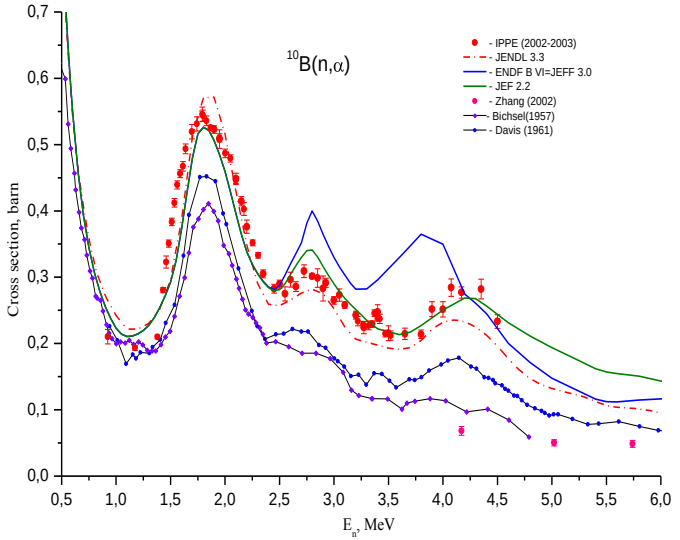
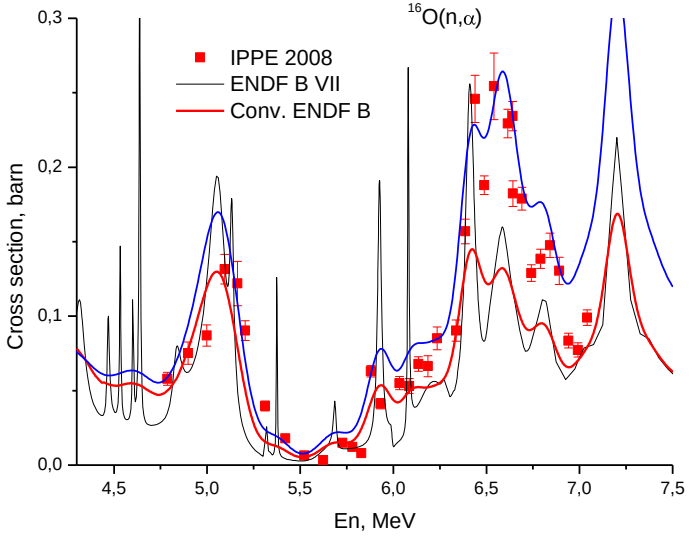
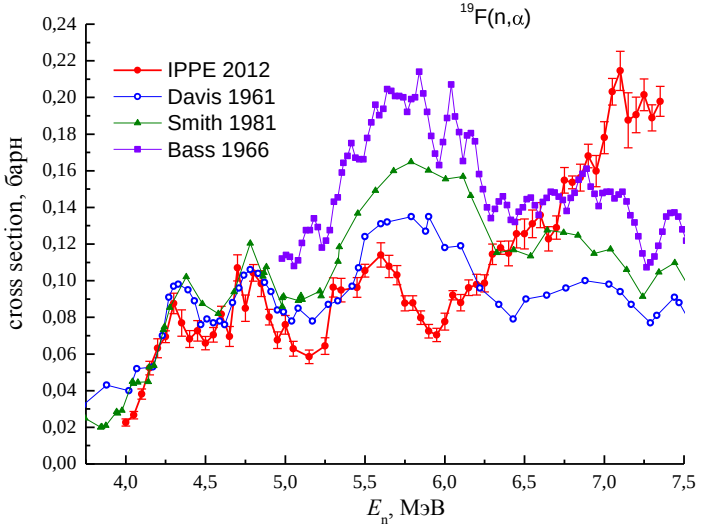
The measurements were carried out in IPPE

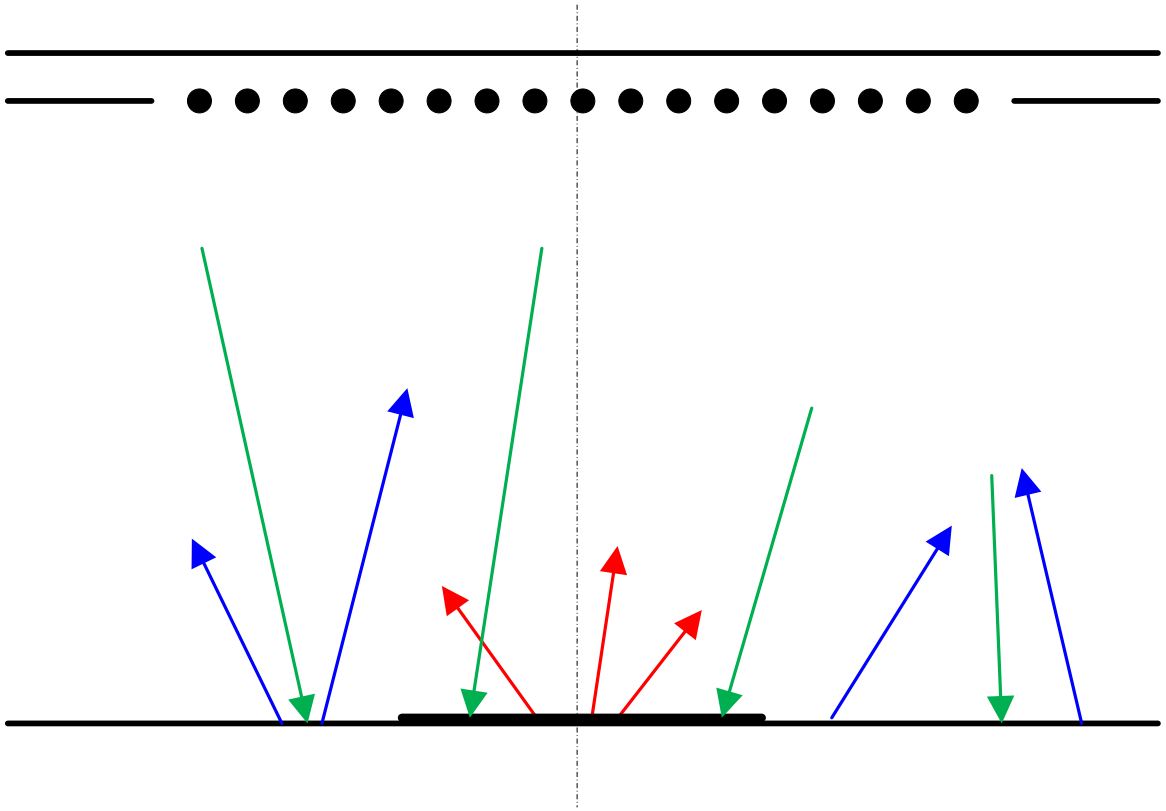




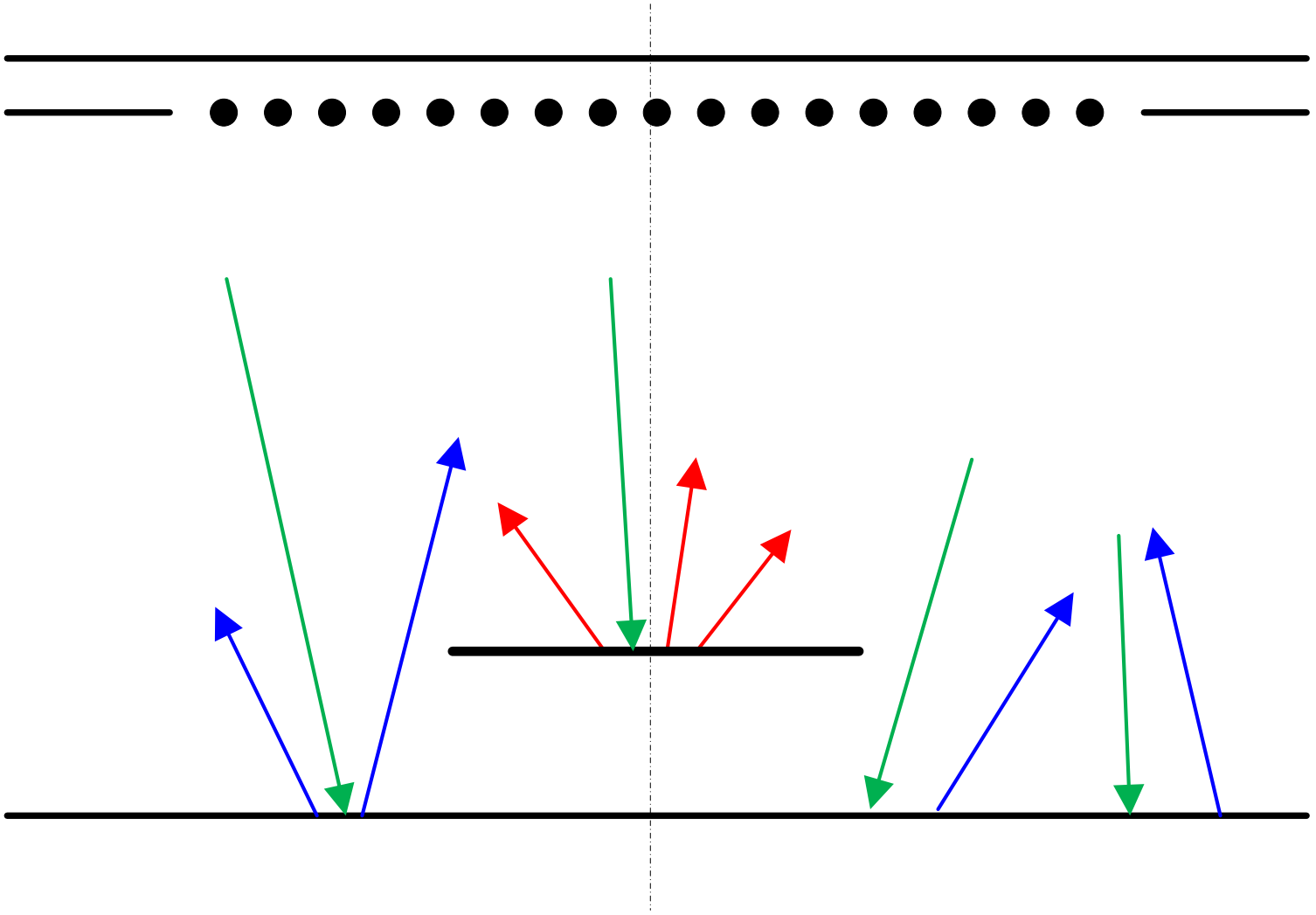




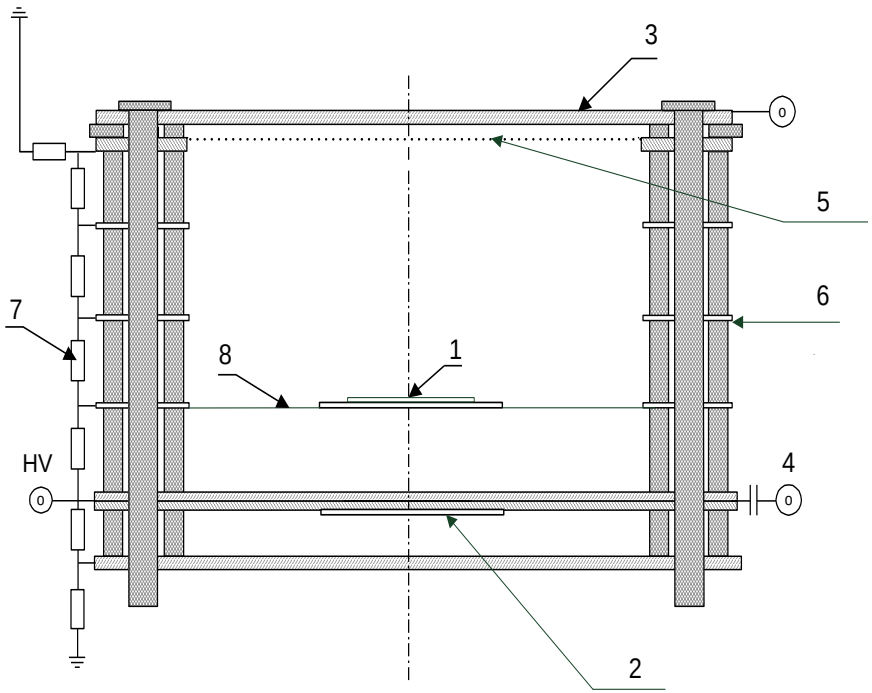
Background sources for solid target

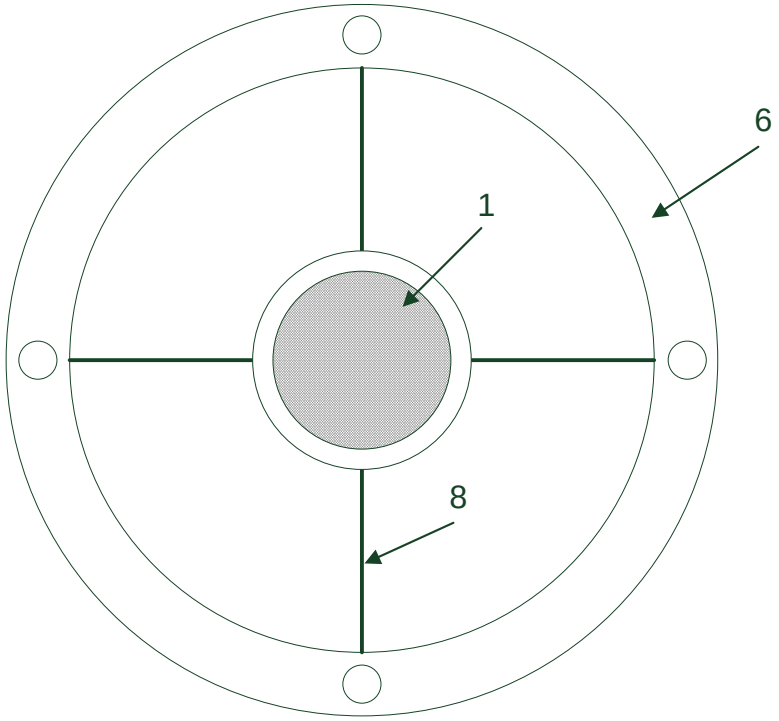


Advantages of the target place between cathode and Frisch greed



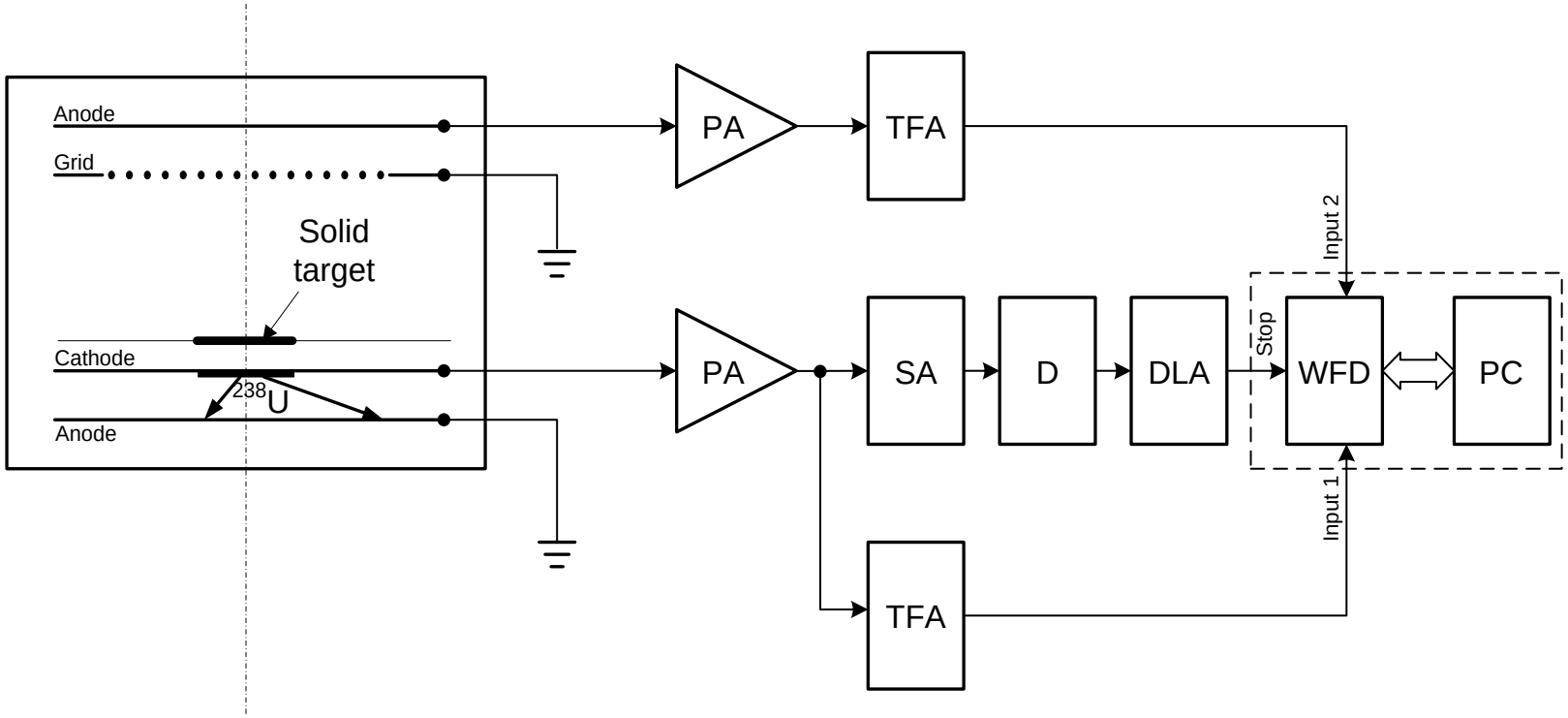
New chamber design.





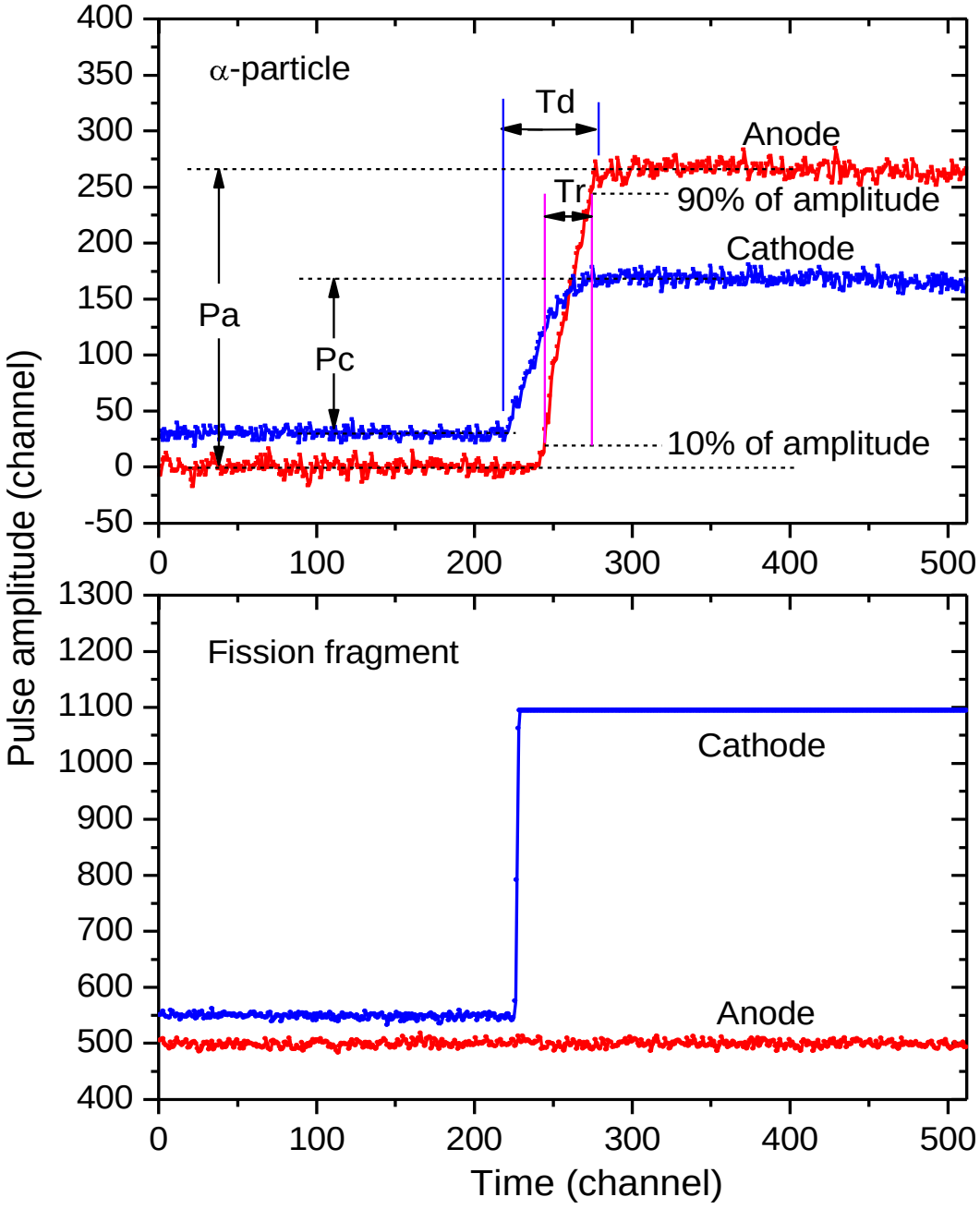
1) Solid target;
2) ^{238}U target;
3) Anode;
4) Anode signal connector;
5. Frisch greed;
6. Guard electrodes;
7. Resistor.
8. Golden threads

Experimental setup



PA – preamplifier, TFA – timing filter amplifier,
D – discriminator,
SA – spectroscopy amplifier, DLA – delay line amplifier,
WFD – waveform digitizer, PC – personal computer.

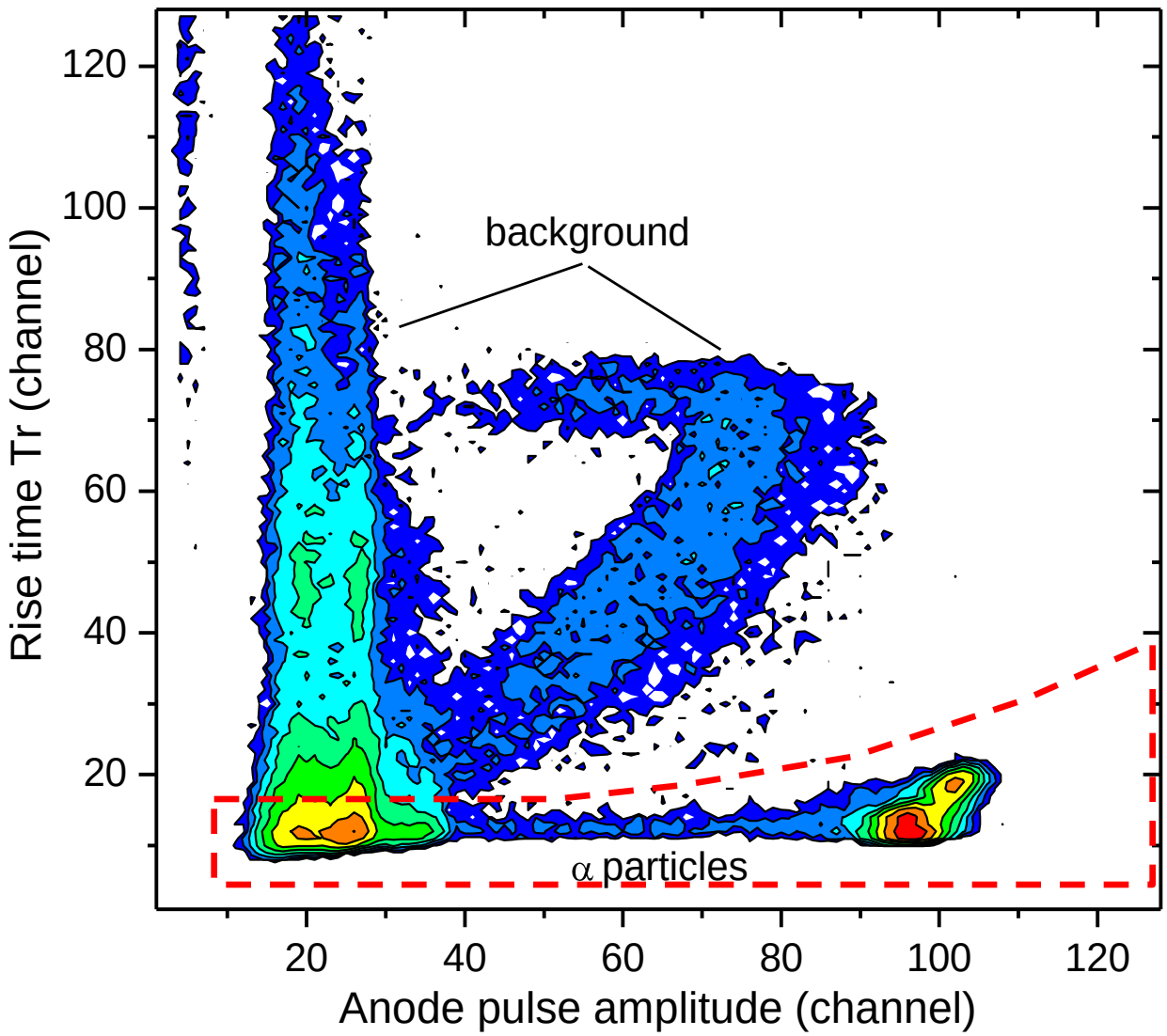
Examples of signals of the main chamber and monitor chamber



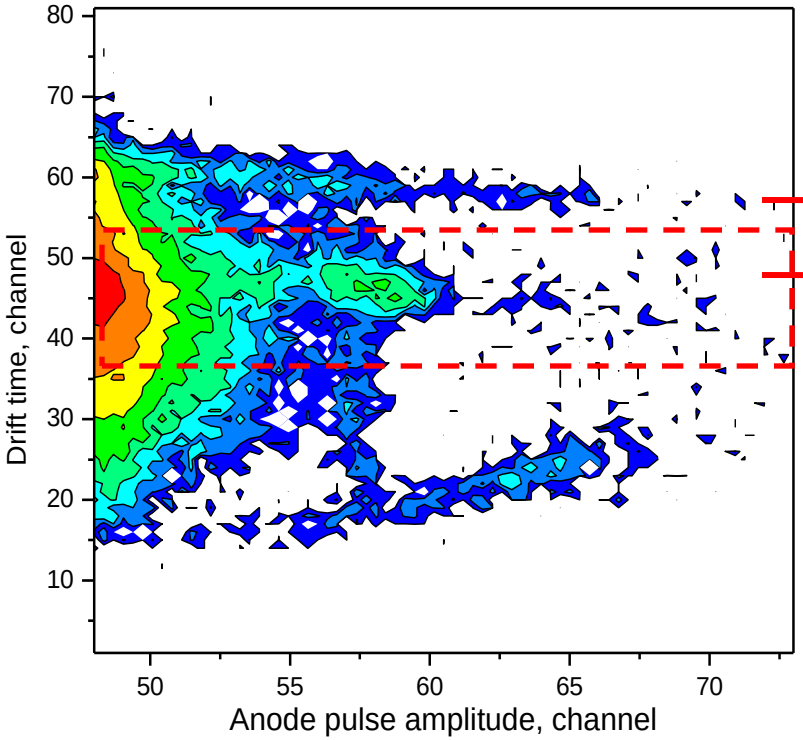
DSP allow you to analyse:

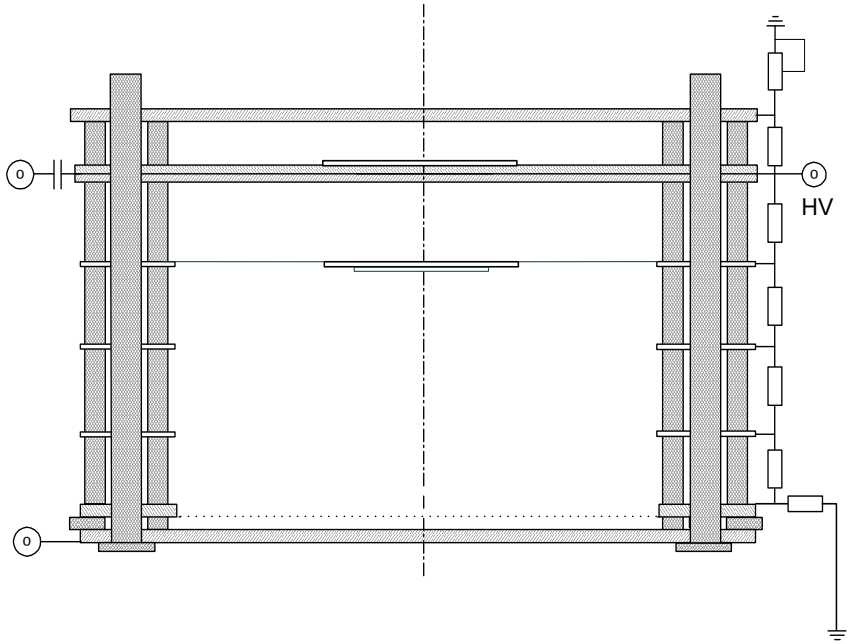
1) Amplitude of anode pulse (P_A);
2) Amplitude of anode pulse (P_C);
3) Time when cathode signal appear (T_{SC});
4) Time when anode signal appear (T_{SA});
5) Time when anode signal reach satiation (T_{EA});
6) Time of charges motion in ionizing chamber $T_d=(T_{EA}-T_{SC})$;
7) Time of anode signal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

Background suppression

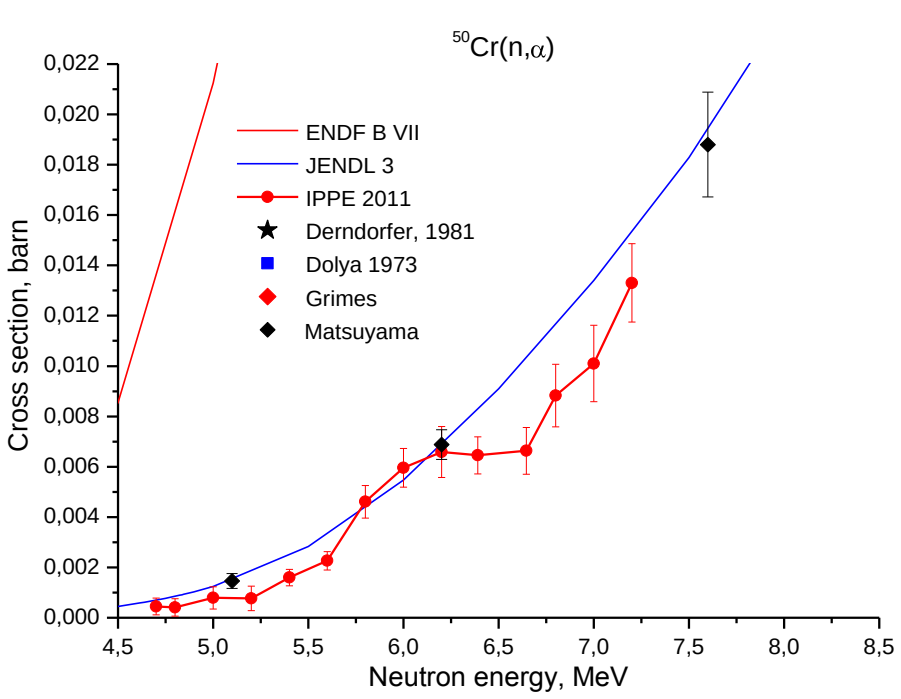


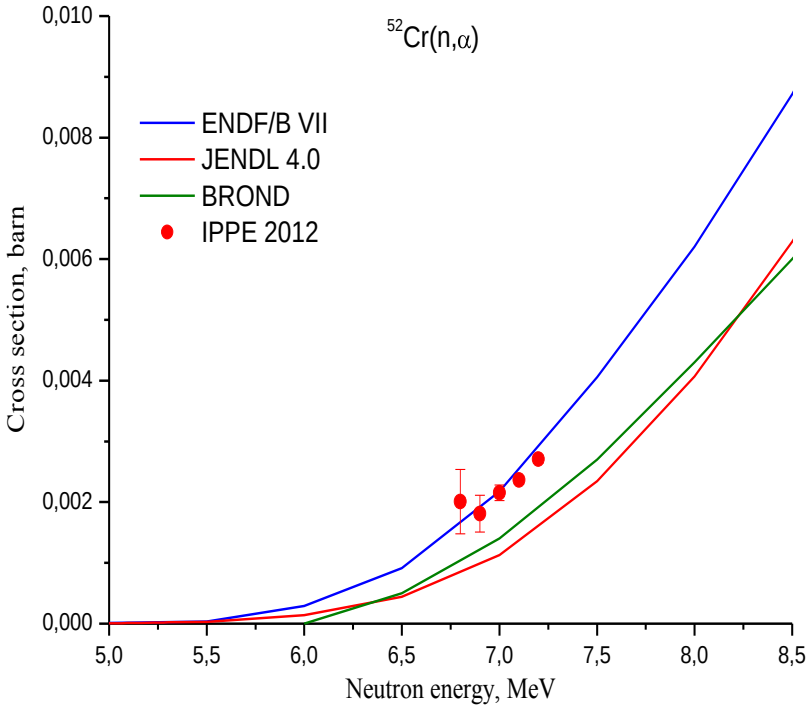
Drift time selection for α-particles only





OBTAINED RESULTS





Modification of spectrometer

- New accelerator
- Determination the number of nuclei of the self-supporting target
- Change the equipment
- Change the chamber design
- Change the working gas

New accelerator

The main parameters	Accelerator EG-1	New accelerator
Monoenergetical Neutrons	From 1,7 to 3,0 MeV From 4,0 to 7,2 MeV	From 0,1 to 9 MeV
Current	5 - 7 μA	~ 25 μA

Change the electrodes material

The advantages of gold electrodes:

- mono isotopic substance;
- the surface doesn’t oxidize
- high value of Z

500 grams of 99,99 % gold

Change the equipment

Change the waveform digitizer

Parameters	LeCroy 2262	Signatec PDA14
frequency	80 MHz	100 MHz
ADC	10 bit	14 bit
Bus	CAMAC	PCI

Using the High Speed Pressure Controller (CPC-3000):

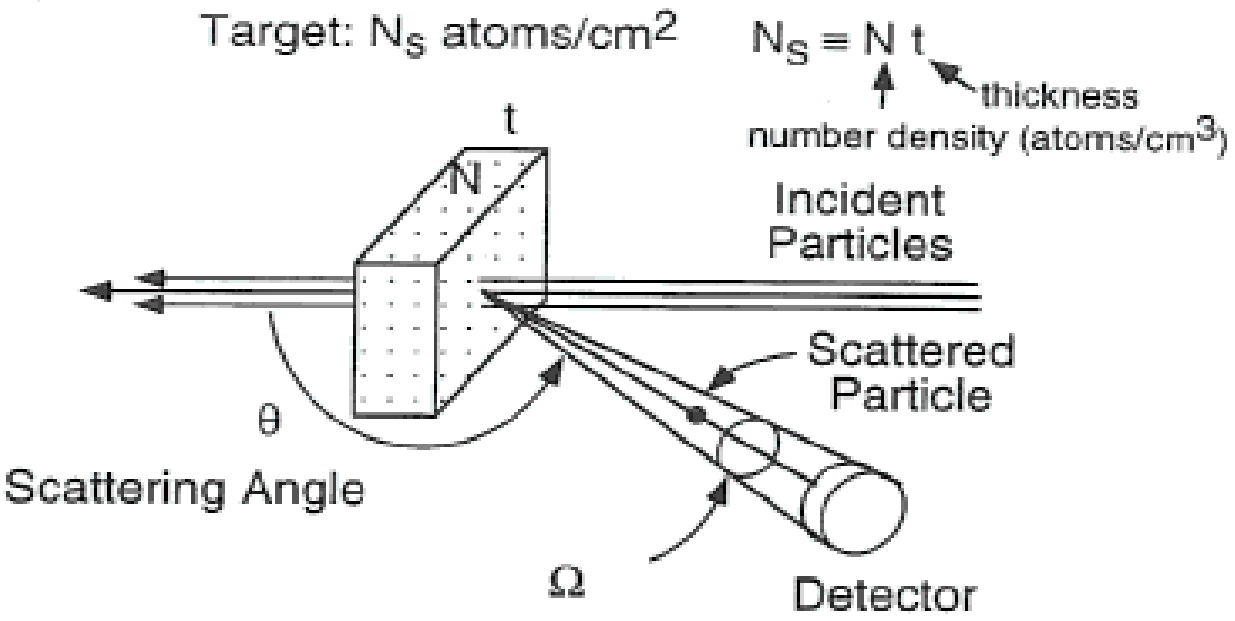
- absolute pressure 0,1 to 0,7 MPa
- uncertainty 0,025 %
- maintaining the stability of the set pressure 0,04%

Change the IC working gas

Isotope	**Natural abundance, %**	**(n,α) reaction Q-value, MeV**
^{78}Kr	0,35	+3,67
^{80}Kr	2,25	+2,352
^{82}Kr	11,6	+0,974
^{83}Kr	11,5	+ 3,426
^{84}Kr	57,0	-0,390
^{86}Kr	17,3	- 2,273

Xe + 3% CO2 (5%CH4)

Determination the number of nuclei



$$A = \sigma \Omega N_S Q$$

- number of particles detected
- cross section
- atoms/cm^2
- detector solid angle
- total number of incident particles

Conclusion

New generation of alpha-particle digital spectrometer will have

- Low background due to using gold electrodes and Xe as working gas
- Less dead time and digital signal evaluation accuracy due to new 14 bits 100 MHz PCI bus signal waveform digitizer
- New equipment for high precision working gas pressure measurements
- Using self-supporting target
- Using Ion Beam analyses for determine number of nuclear in the solid
- non radioactive target

Plans for future measurement

Structure materials:

^{53}Cr

^{56}Fe

^{58}Ni

Another nuclear:

$^{35,37}Cl$

Kr

^{12}C

Thank you for attention !