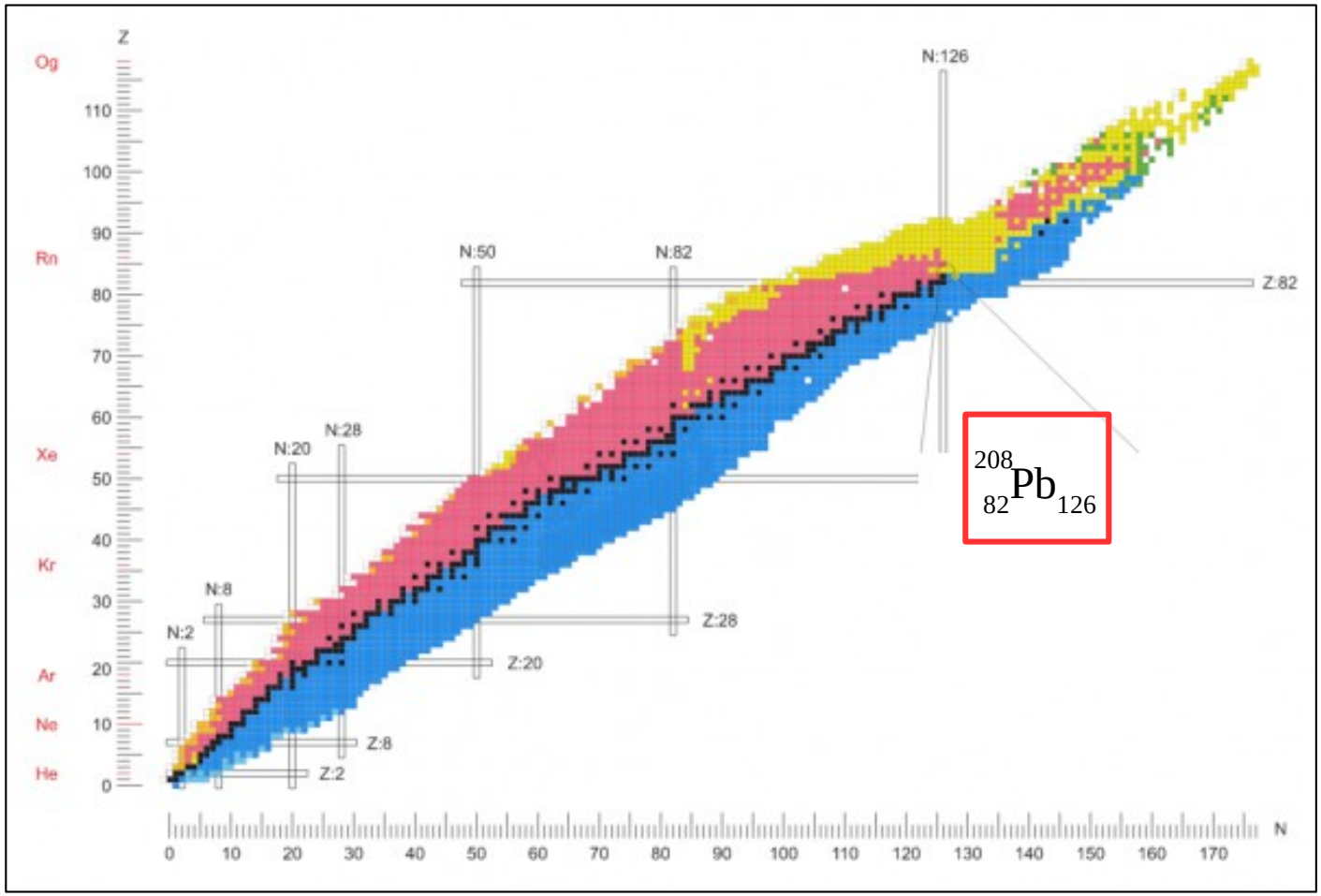
Измерване
на времена на живот в ядрата
^{208}Po и ^{209}Po

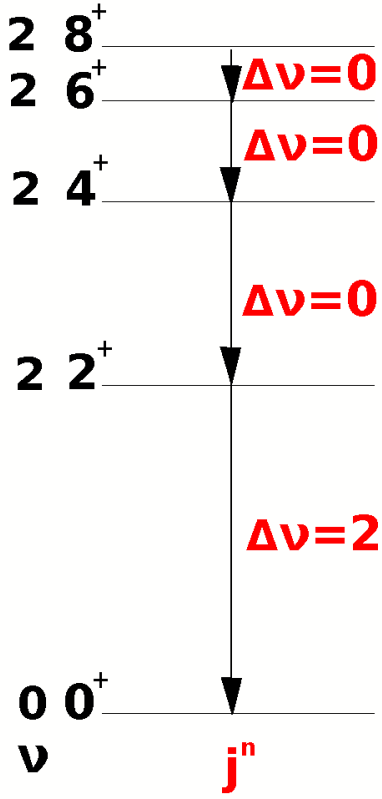
Атестационен семинар

Докторант : Милена Стоянова
Научен ръководител : проф. дфзн. Г. Райновски

Мотивация



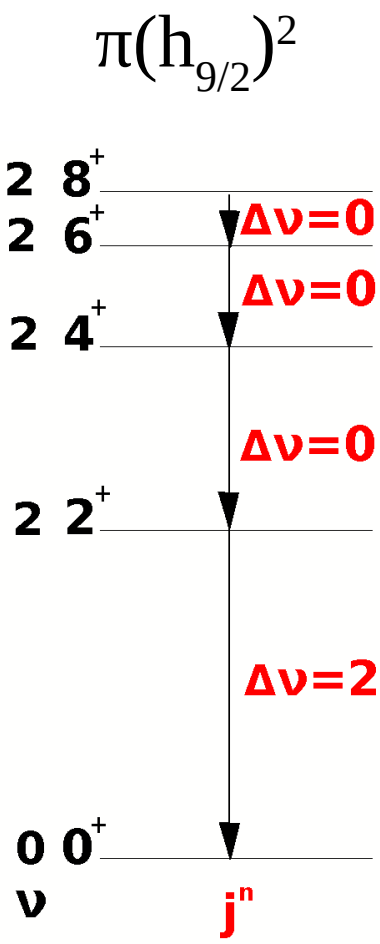
$\pi(h_{9/2})^2$



D. Kocheva *et all*, Eur.Phys.J. **A 53**, 175 (2017)

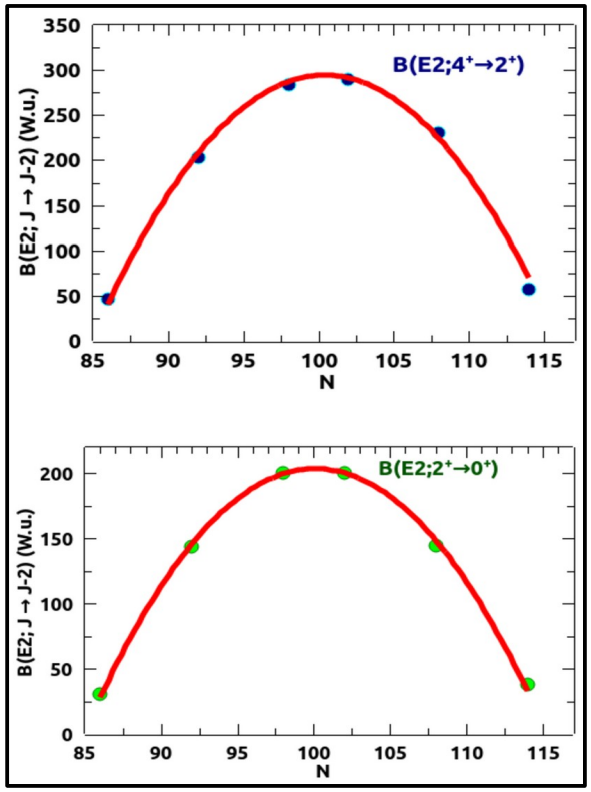
D. Kocheva *et all*, Phys.Rev. **C 96**, 044305 (2017)

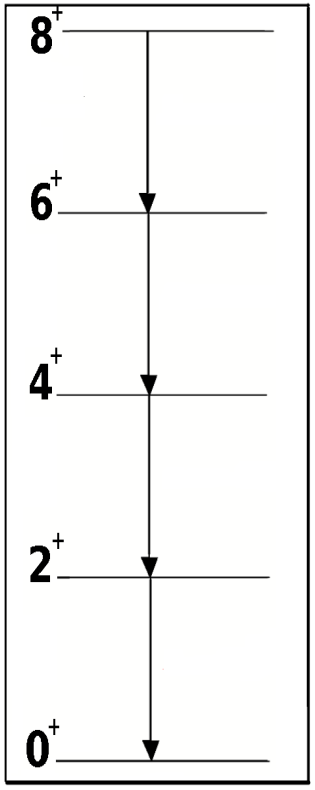
M. Stoyanova *et all*, Phys.Rev. **C 100**, 064304 (2019)

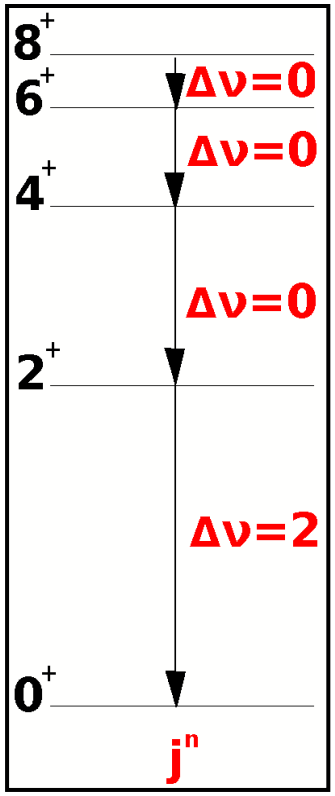


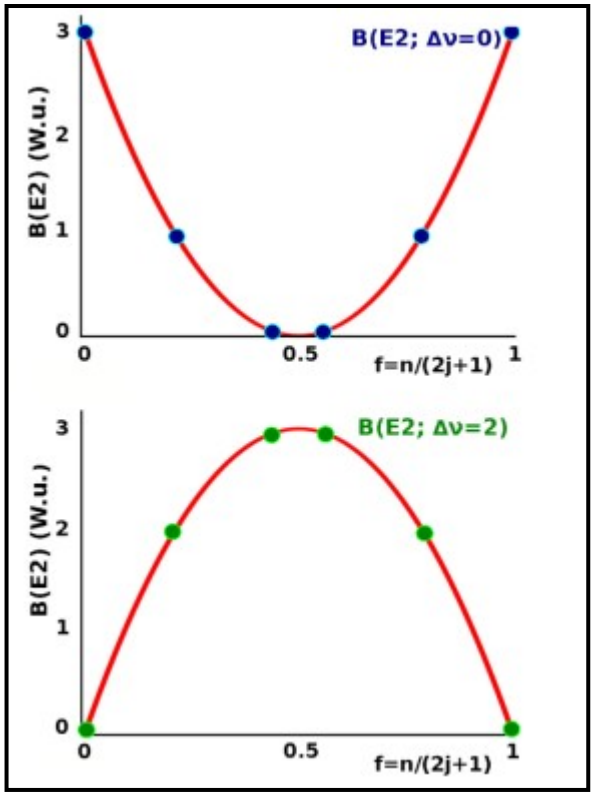
Мотивация

$\pi(h_{9/2})^2$

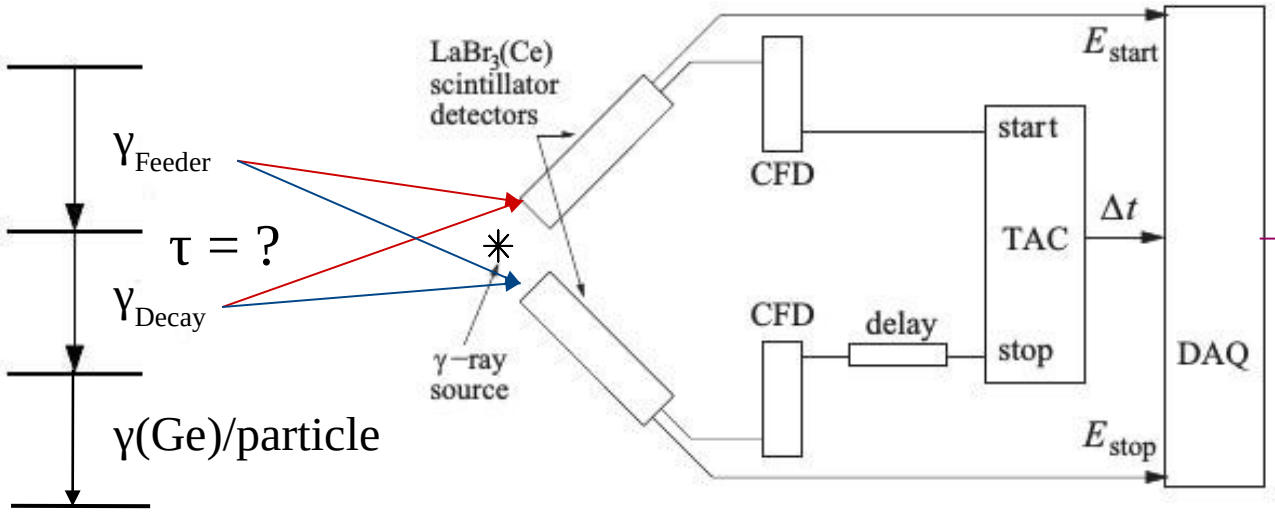








Generalyzed Centroid Difference Method



Sorting code

J.- M. Régis, NIM Phys. Res. **A 726,** 191 (2013)

J.-M. Régis, Phys. Rev. C **95**,054319 (2017)

$$C^D = \langle t \rangle = \frac{\int t\, D(t)\, dt}{\int D(t)\, dt}$$

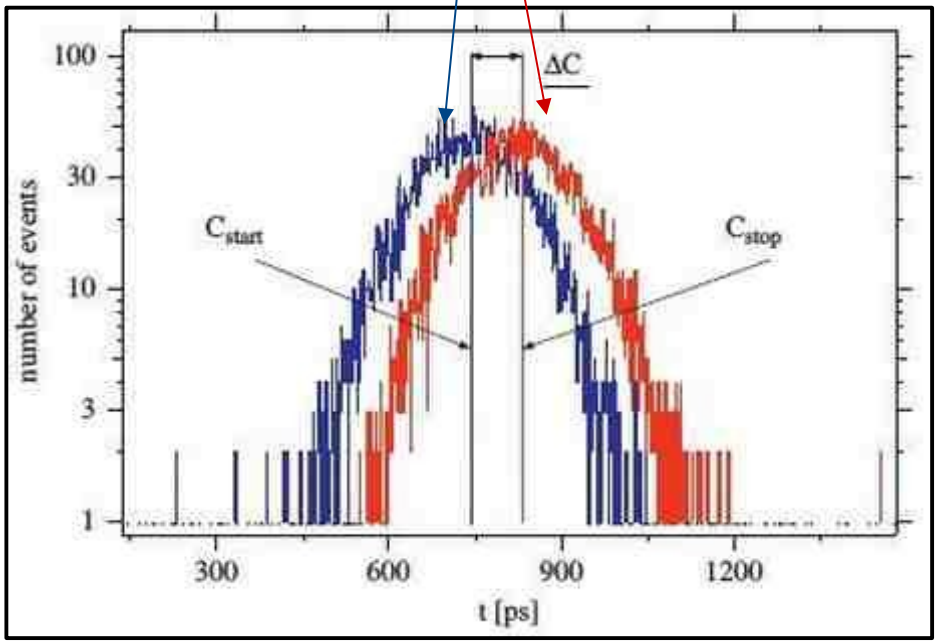
Experimental Centroid Difference :

$$\Delta C_{exp}(E_{Feeder},E_{Decay}) = C_{start} - C_{stop}$$

$$\Delta C_{FEP} = \Delta C_{exp} + \frac{1}{2}\left[\left(\frac{\Delta C_{exp}-\Delta C_{BG}}{p/b}\right)_{feeder} + \left(\frac{\Delta C_{exp}-\Delta C_{BG}}{p/b}\right)_{decay}\right]$$

$$\Delta C_{FEP}(E_{Feeder},E_{Decay}) = PRD(E_{Feeder},E_{Decay}) + 2\tau$$

$$\tau = \frac{1}{2}(\Delta C_{FEP} - PRD)$$

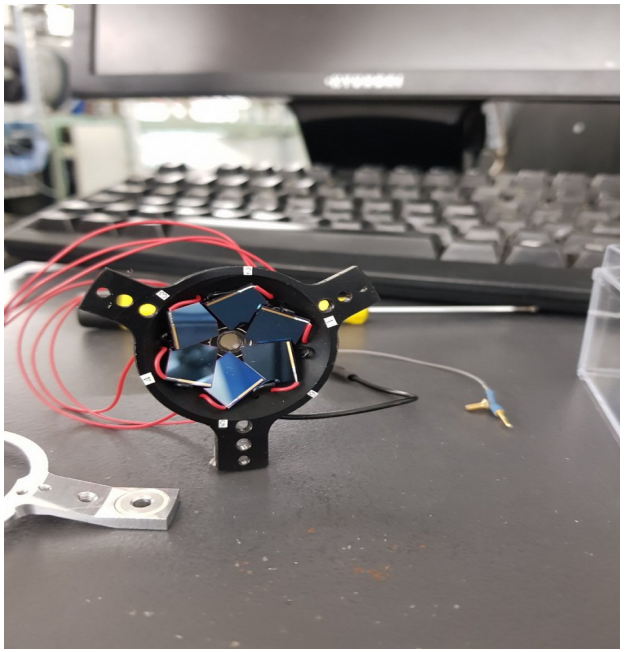


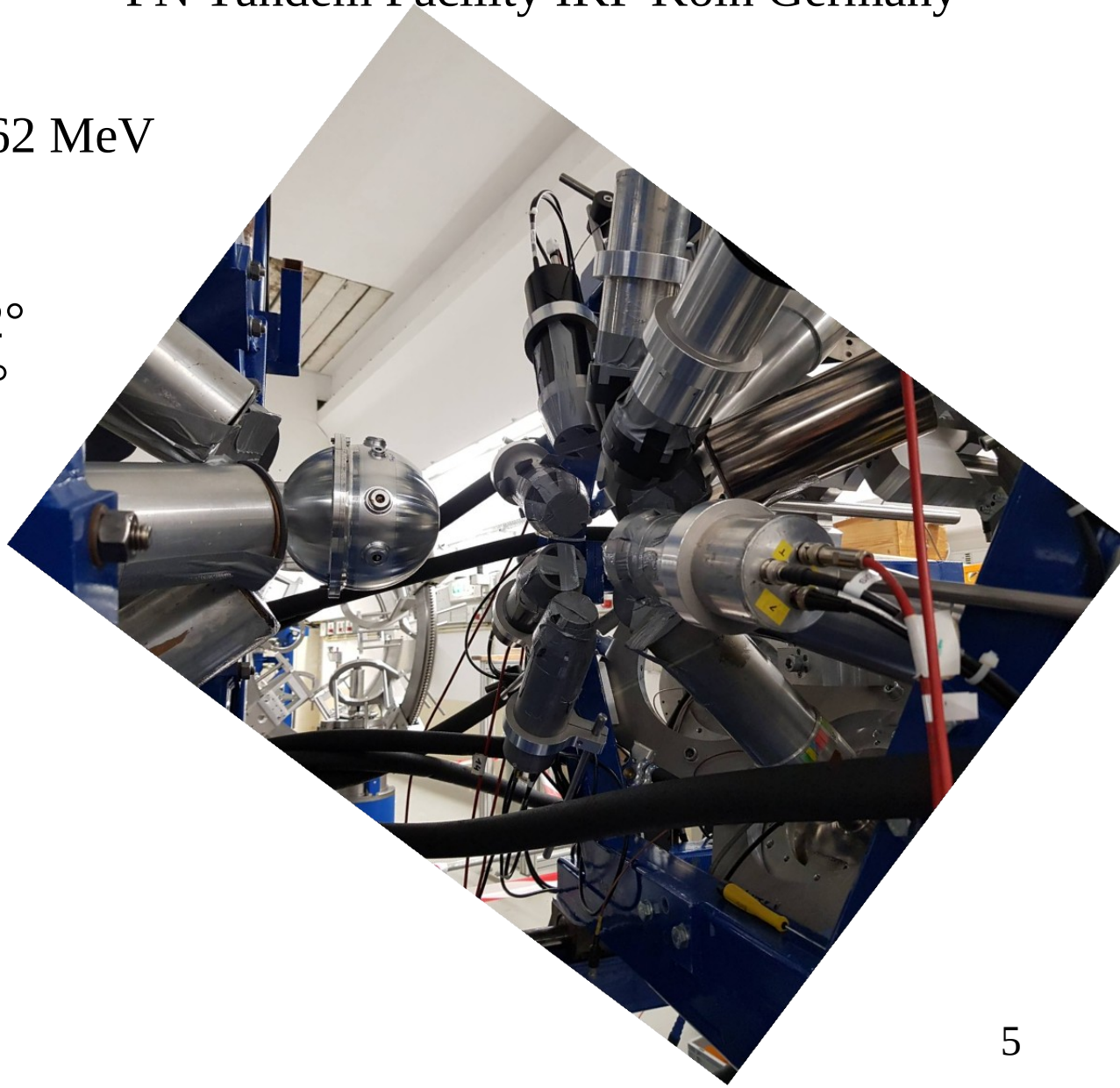
Експерименти

^{208}Po

FN Tandem Facility IKP Köln Germany

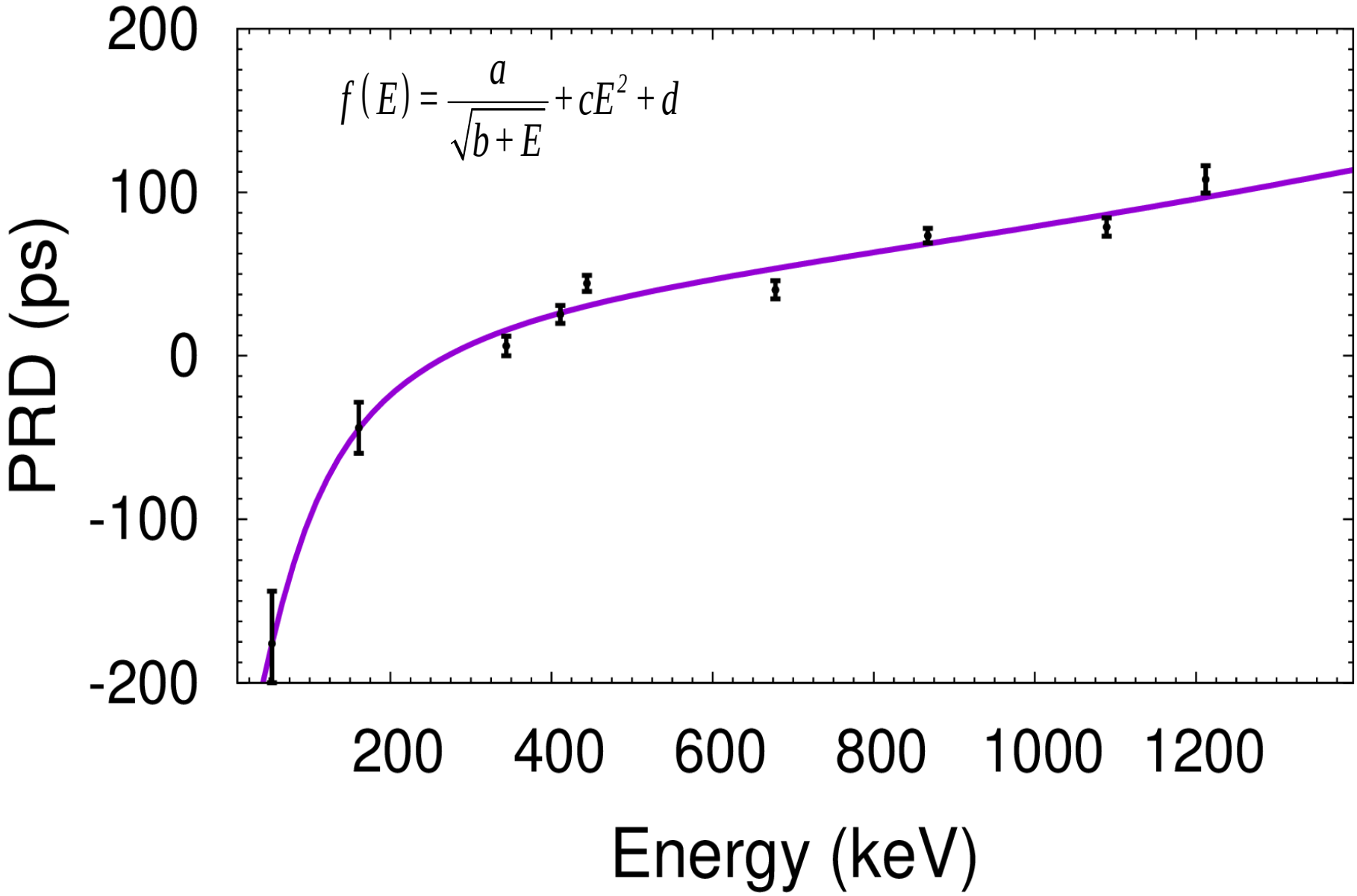
Reaction : $^{204}Pb(^{12}C,^{8}Be)^{208}Po$ at 62 MeV
Target : 23 mg/cm^2
Al foil 80 μm
- 6 HpGe at 45° и 5 HpGe at 142°
- 6 solar cells between 117°- 167°
- 7 $LaBr_3$(Ce) at 90°



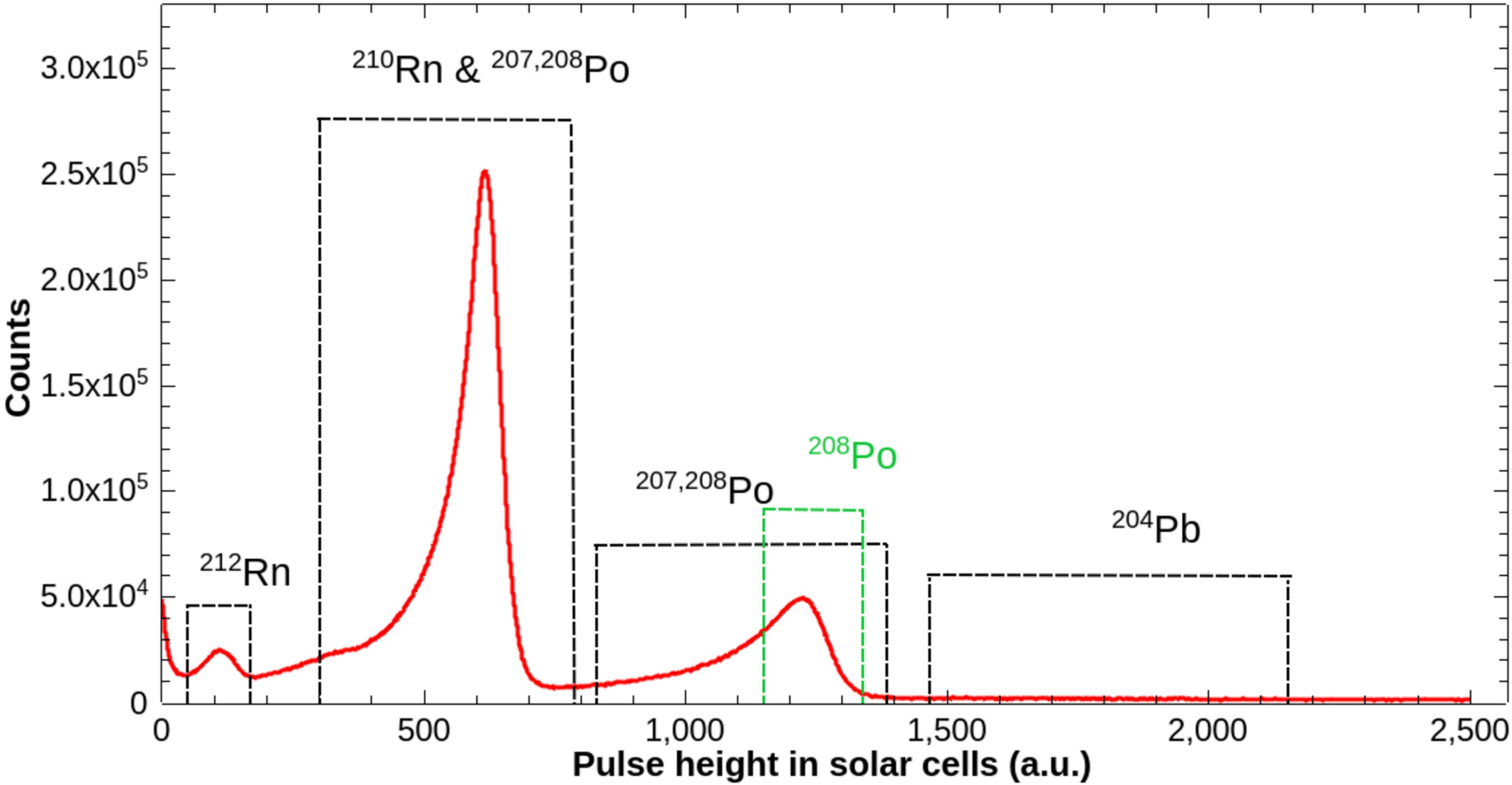


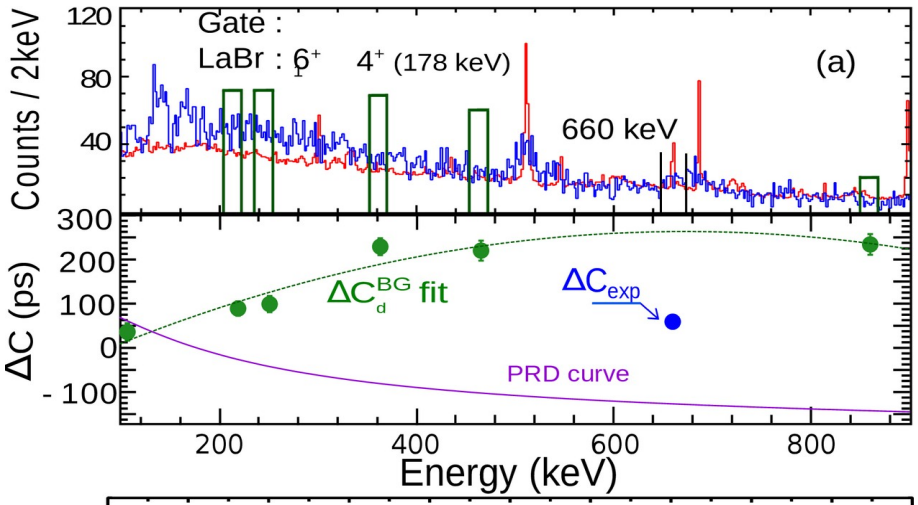
Резултати ^{208}Po

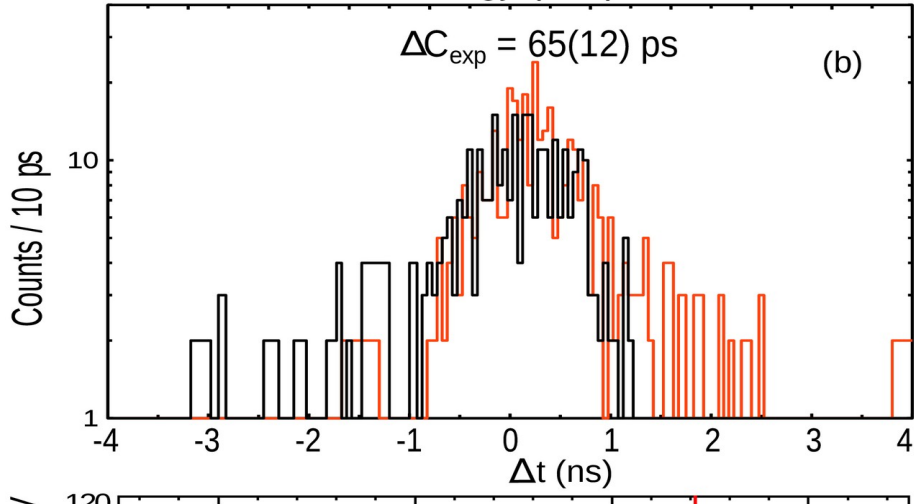
$$PRD(E_{Feeder},E_{Decay}) = \Delta C(E_{Feeder},E_{Decay}) - 2\tau$$

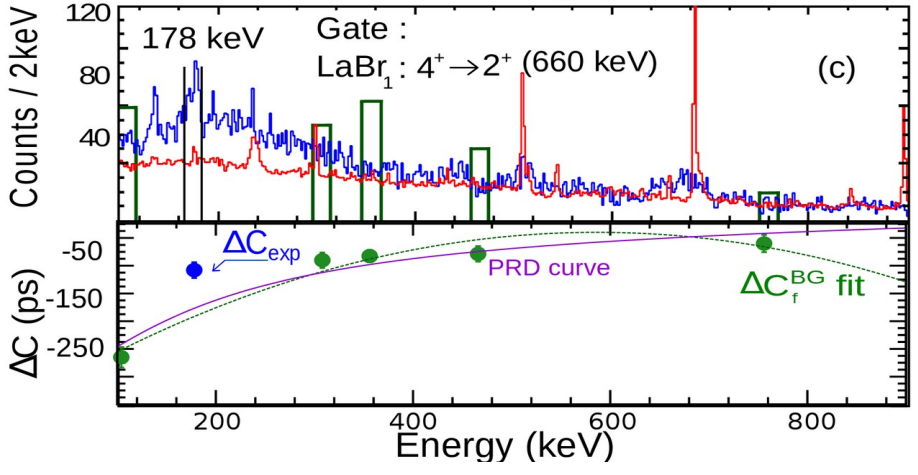


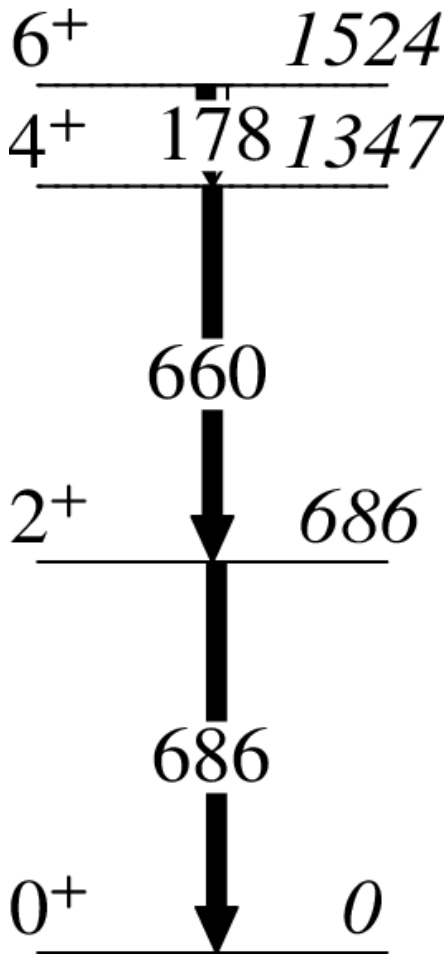
Резултати ^{208}Po











$\tau(4^+, {}^{208}\mathrm{Po}) = 125(31)$ ps

Нов резултат

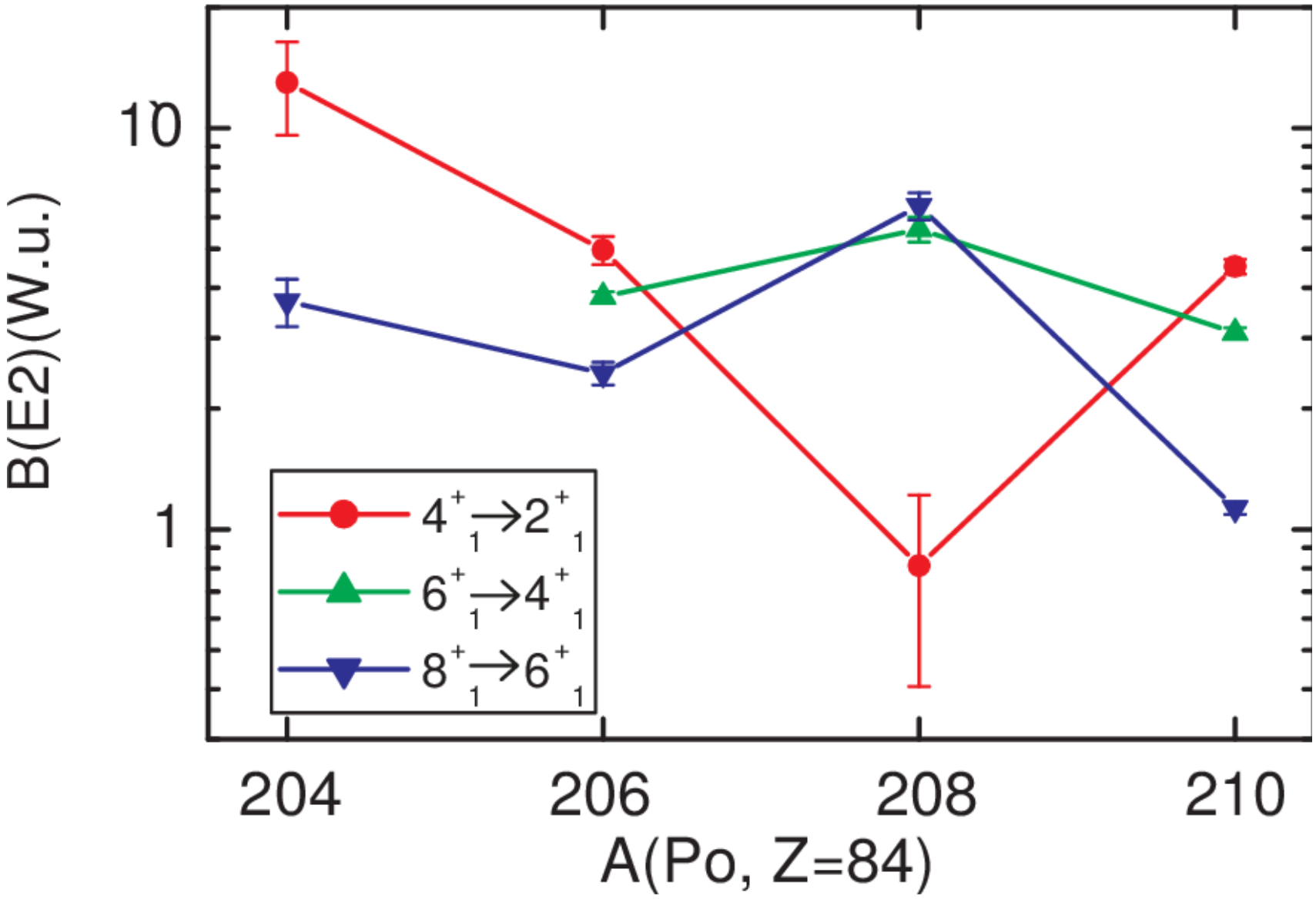
Резултати ^{208}Po

Nucleus	J^{π}_{i}	J^{π}_{f}	E_{γ} (kev)	α	I_{γ} %	τ (ps)	B(E2) (W.u.)
^{204}Po	4_1^+	2_1^+	516	0.0297	100	23(6)	13(3)
^{206}Po	4_1^+	2_1^+	477	0.0359	100	89(7)	5.0(4)
^{208}Po	4_1^+	2_1^+	660	0.0173	100	125(31)	0.7(2)

M. Stoyanova et al., Phys.Rev. C **100**, 064304 (2019)

M. Stoyanova et al., J. Phys.: Conf. Ser. **1555,** 012019 (2020)

Резултати ^{208}Po



Експерименти

^{209}Po

FN Tandem Facility IKP Köln Germany

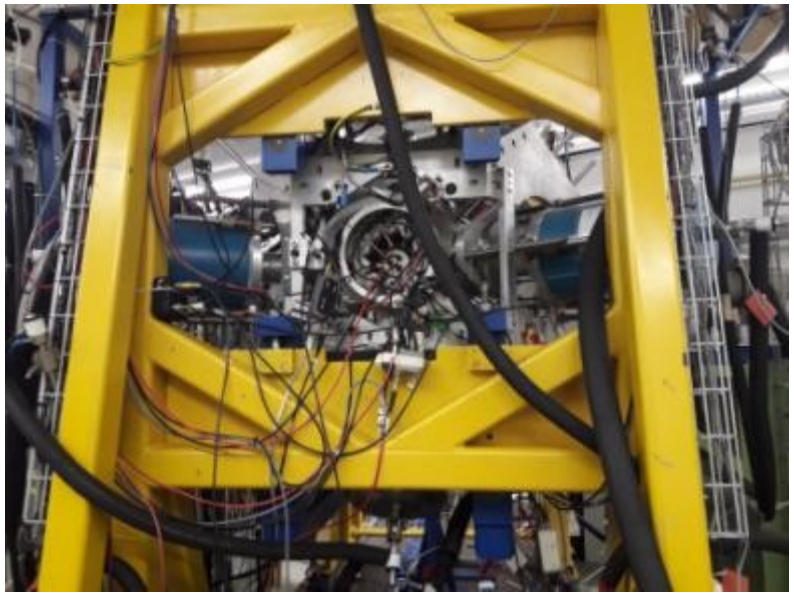
Reaction : $^{206}Pb(^{11}B,4n)^{213}Fr$ at 56 MeV

Target : 14.5 mg/cm^2

Backing : 130 mg/cm^2 Au

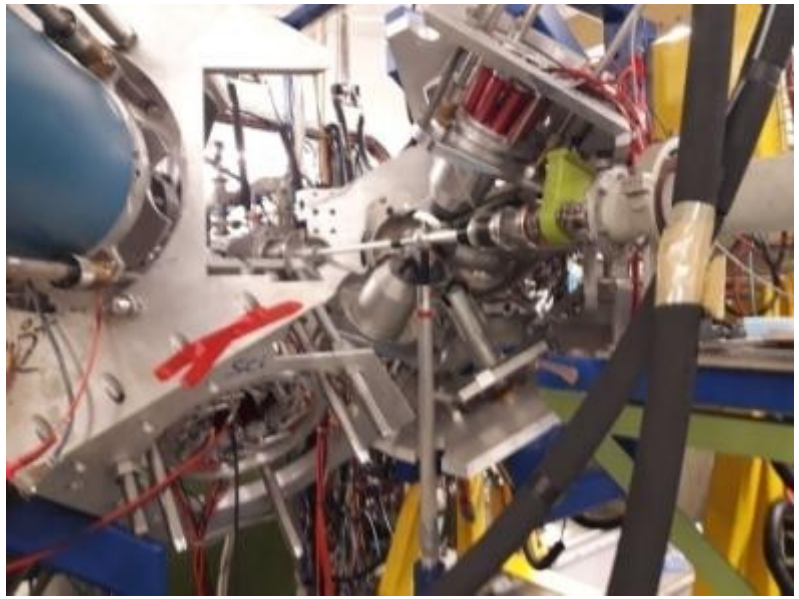
$$^{213}Fr \xrightarrow{T_{1/2} = 36.4\ s\ ,\ \alpha} {}^{209}At\ \ (J^{\pi} = 9/2^{-})$$

$$^{209}At \xrightarrow{T_{1/2} = 5.4\ h\ ,\ EC} {}^{209}Po$$



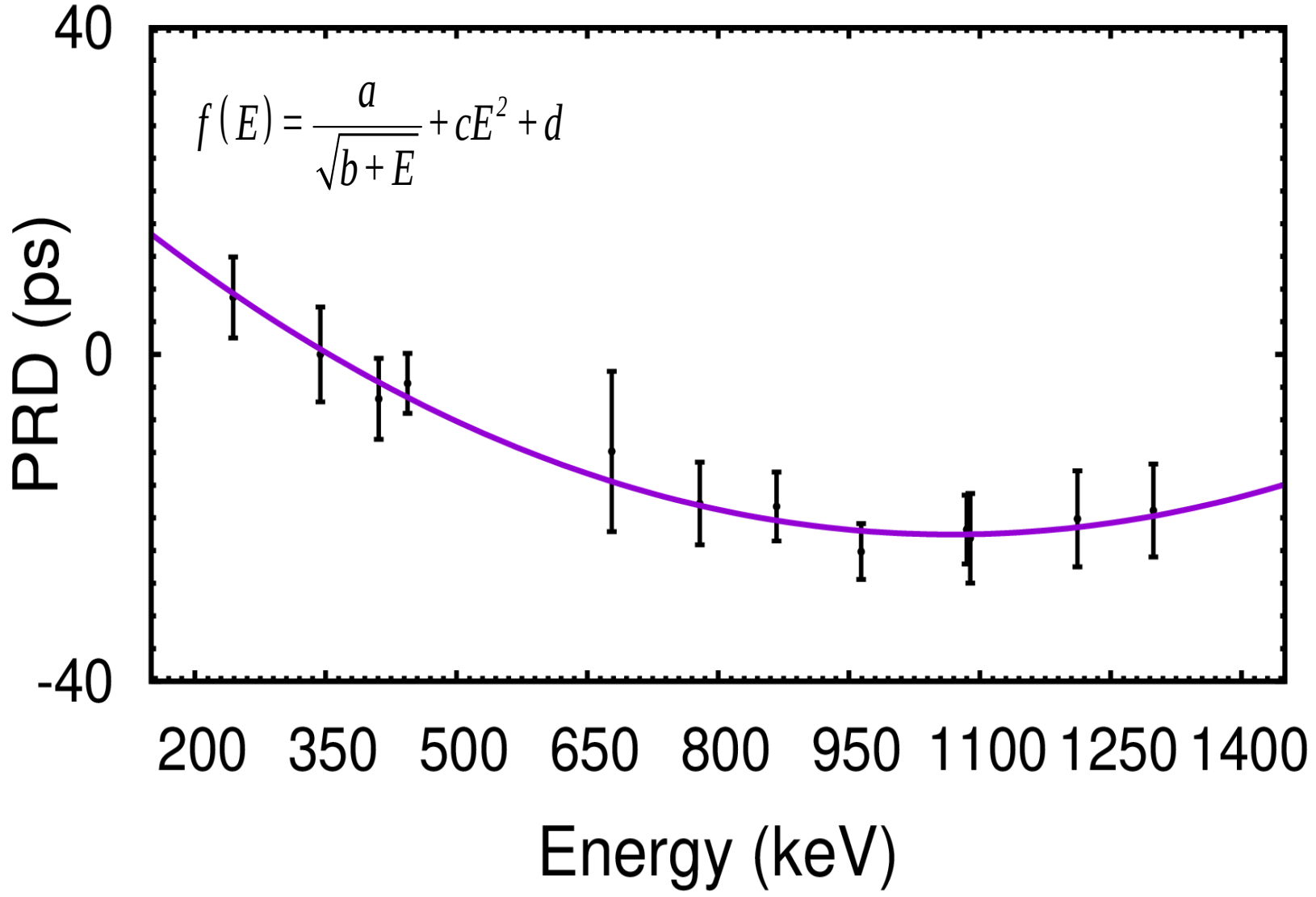
8 HpGe detectors

12 $LaBr_3(Ce)$

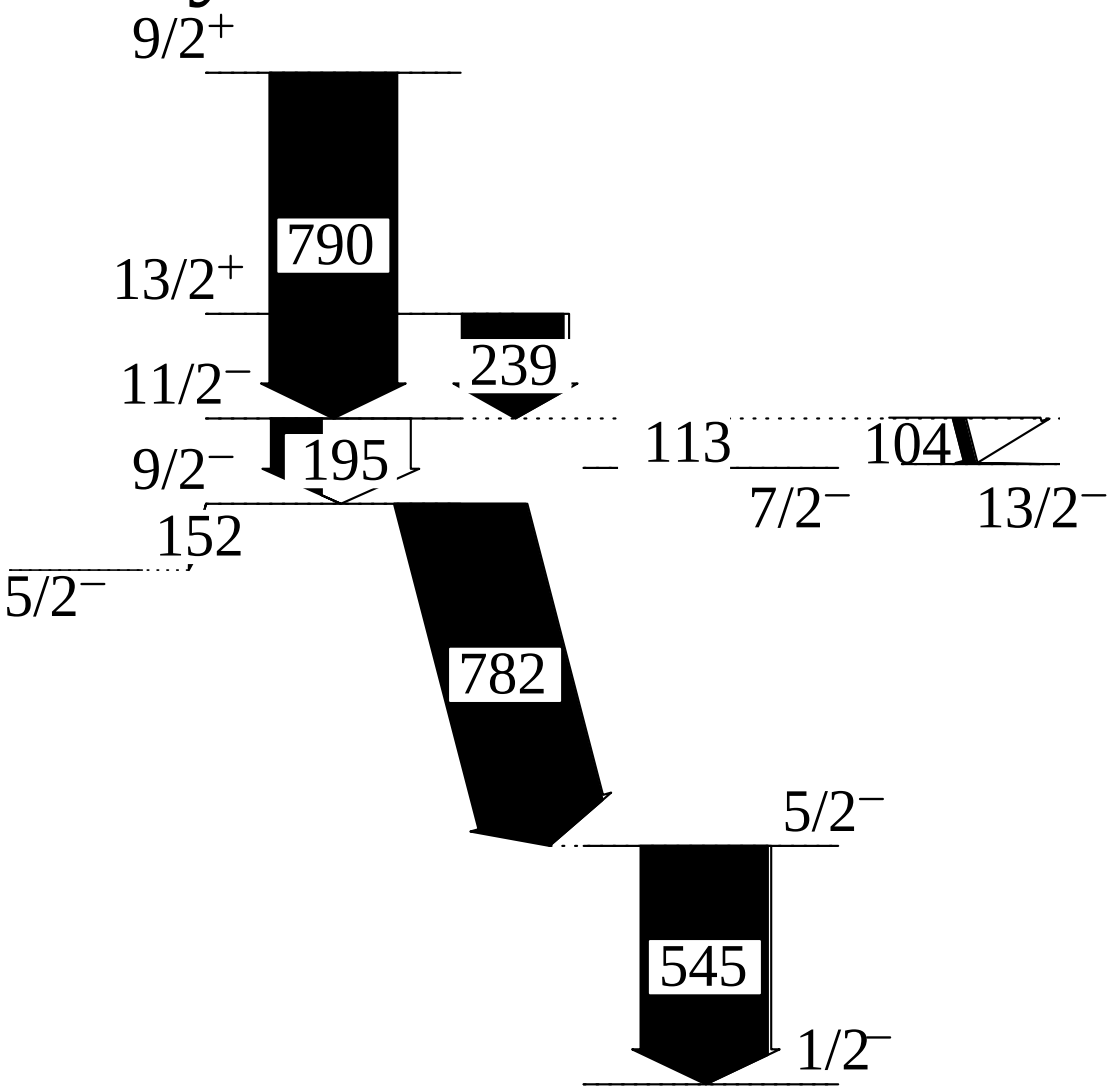


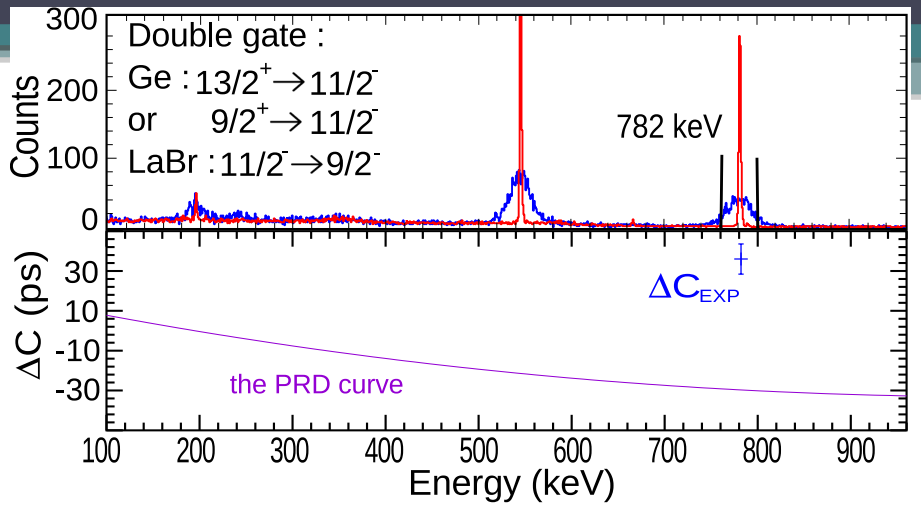
Резултати ^{209}Po

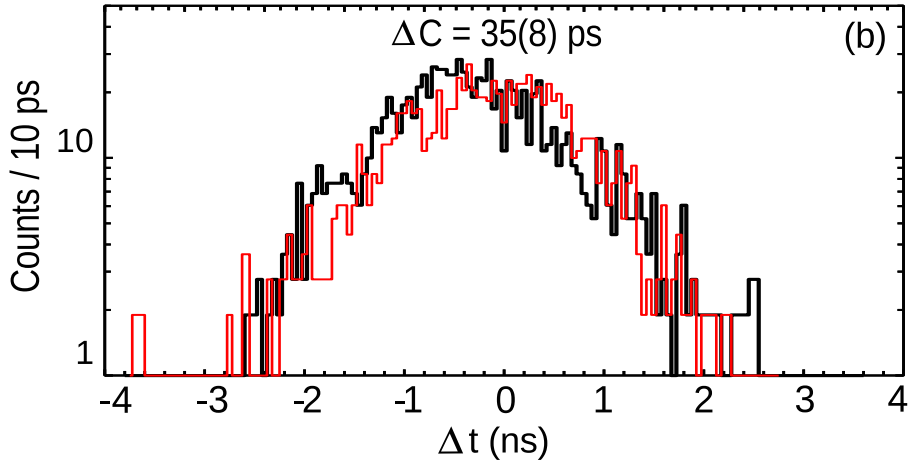
$$PRD(E_{Feeder},E_{Decay}) = \Delta C(E_{Feeder},E_{Decay}) - 2\tau$$

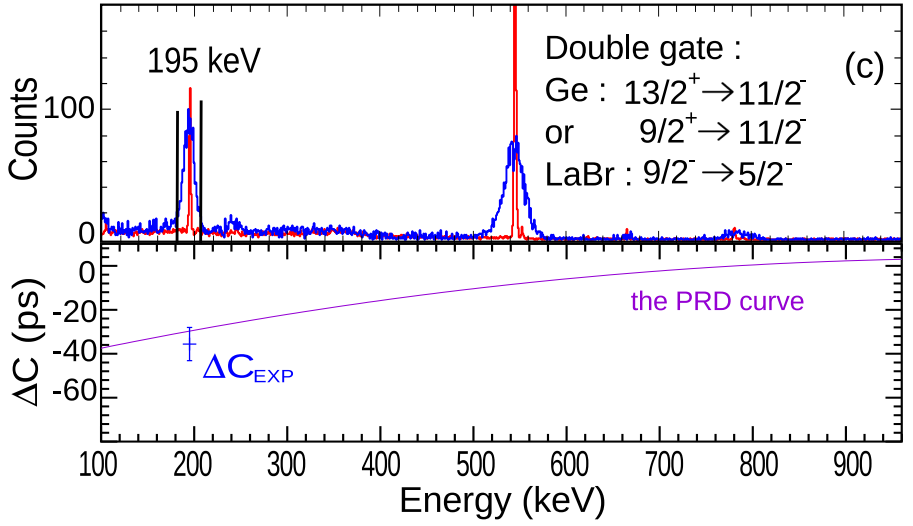


Резултати ^{209}Po









τ(9/2$^-$) = 30(6) ps

Нов резултат

Резултати ^{209}Po

1 W.u. = 73.67 e^2fm^4

E_{level} (kev)	J^{π}_i	J^{π}_f	E_γ (kev)	α	I_γ %	τ (ps)	B(E2) (e^2fm^4)
1327	$9/2^-_1$	$5/2^-_1$	782	0.0120	100(3)	30(6)	92(19)
		$5/2^-_2$	151.4	1.319	0.097(28)		327(89)

$$E_{2^+}(^{210}\mathrm{Po}) \simeq \mathrm{C.G.}(^{209}\mathrm{Po}) = \frac{\sum E_{level}(2J+1)}{\sum (2J+1)} \qquad J=(1/2,\ldots,9/2)$$

II II

1181 keV vs. 1258 keV

$$\pi(h_{9/2})^{+2} \otimes \nu(2f_{5/2})^{-1}$$

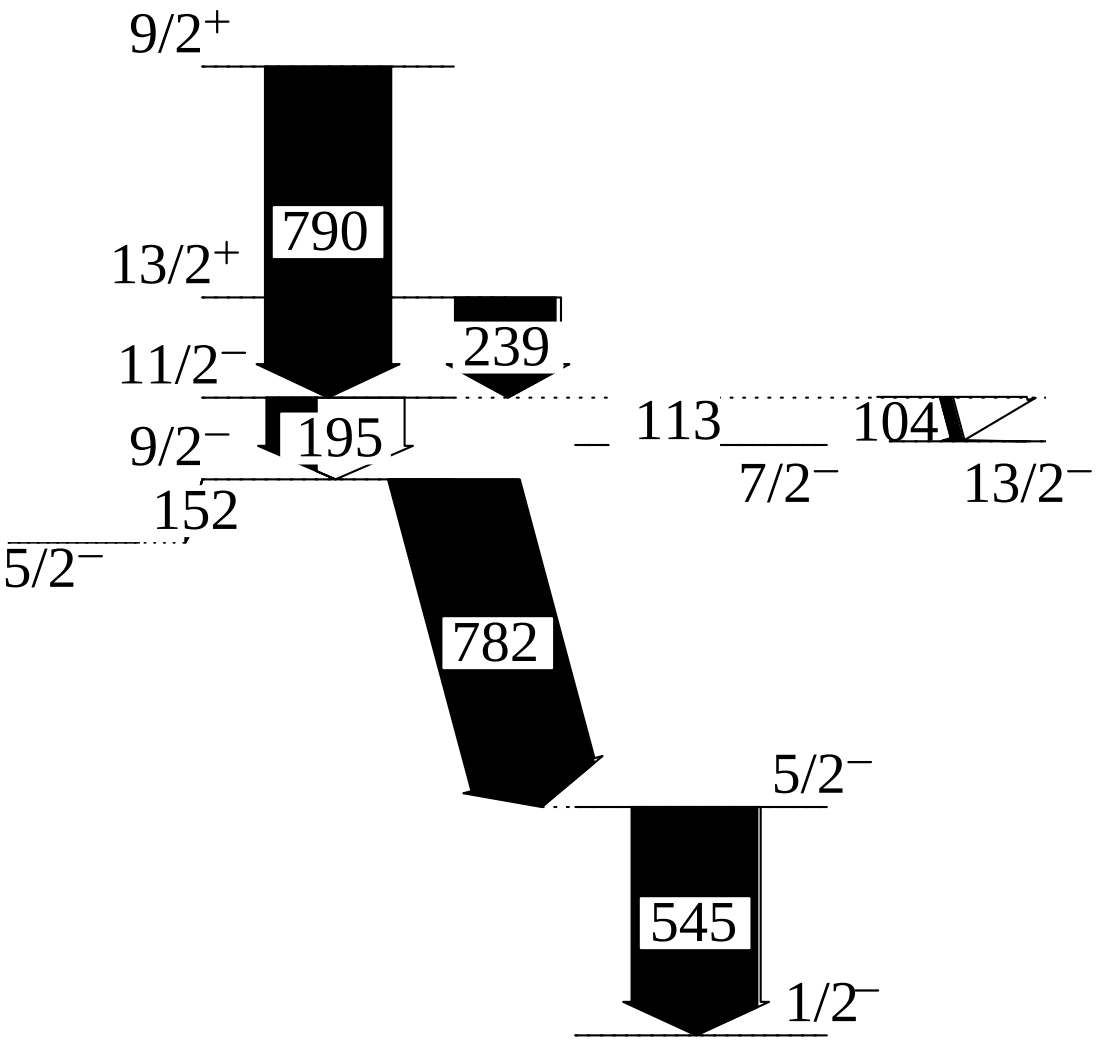
$$2^+ \otimes (2f^{-1}_{5/2})$$

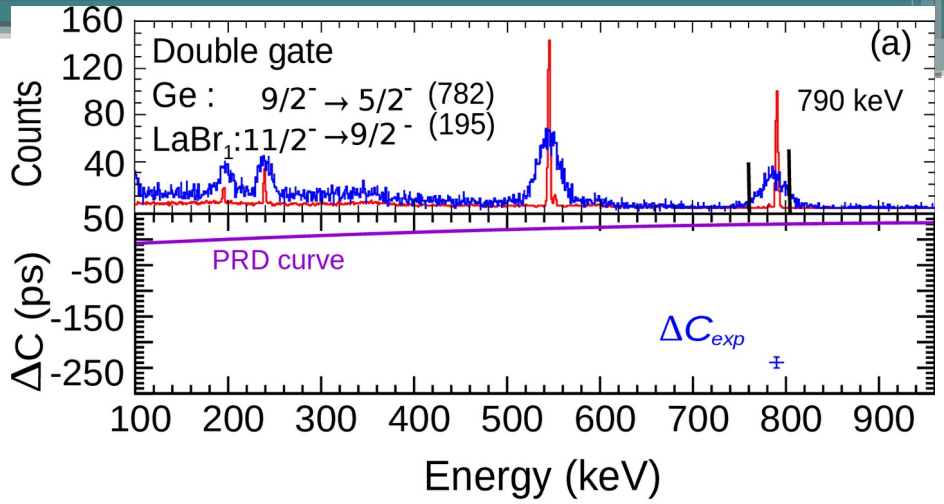
$$B(E2;2^+_1 \rightarrow 0^+_1)^{210}\mathrm{Po} \simeq B(E2;9/2^-_1 \rightarrow 5/2^-_1)\ ^{209}\mathrm{Po}$$

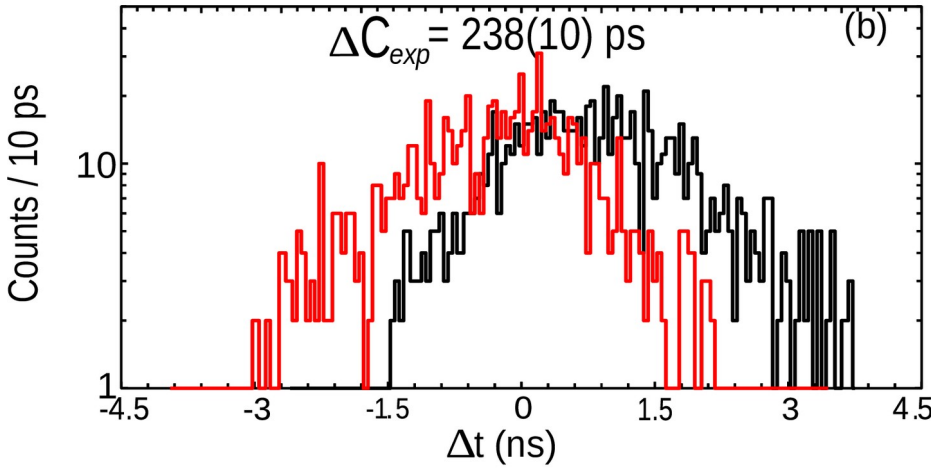
II II

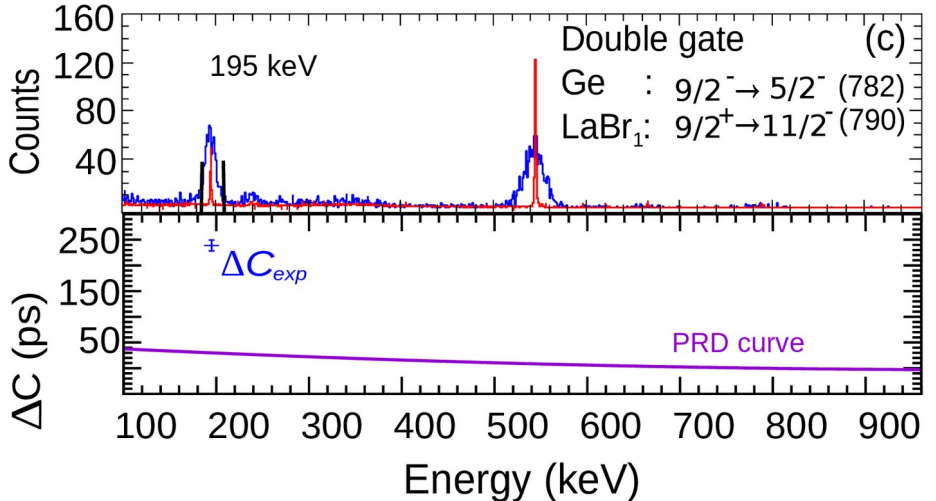
136(21) e^2fm^4 vs. 92(19) e^2fm^4

Резултати ^{209}Po





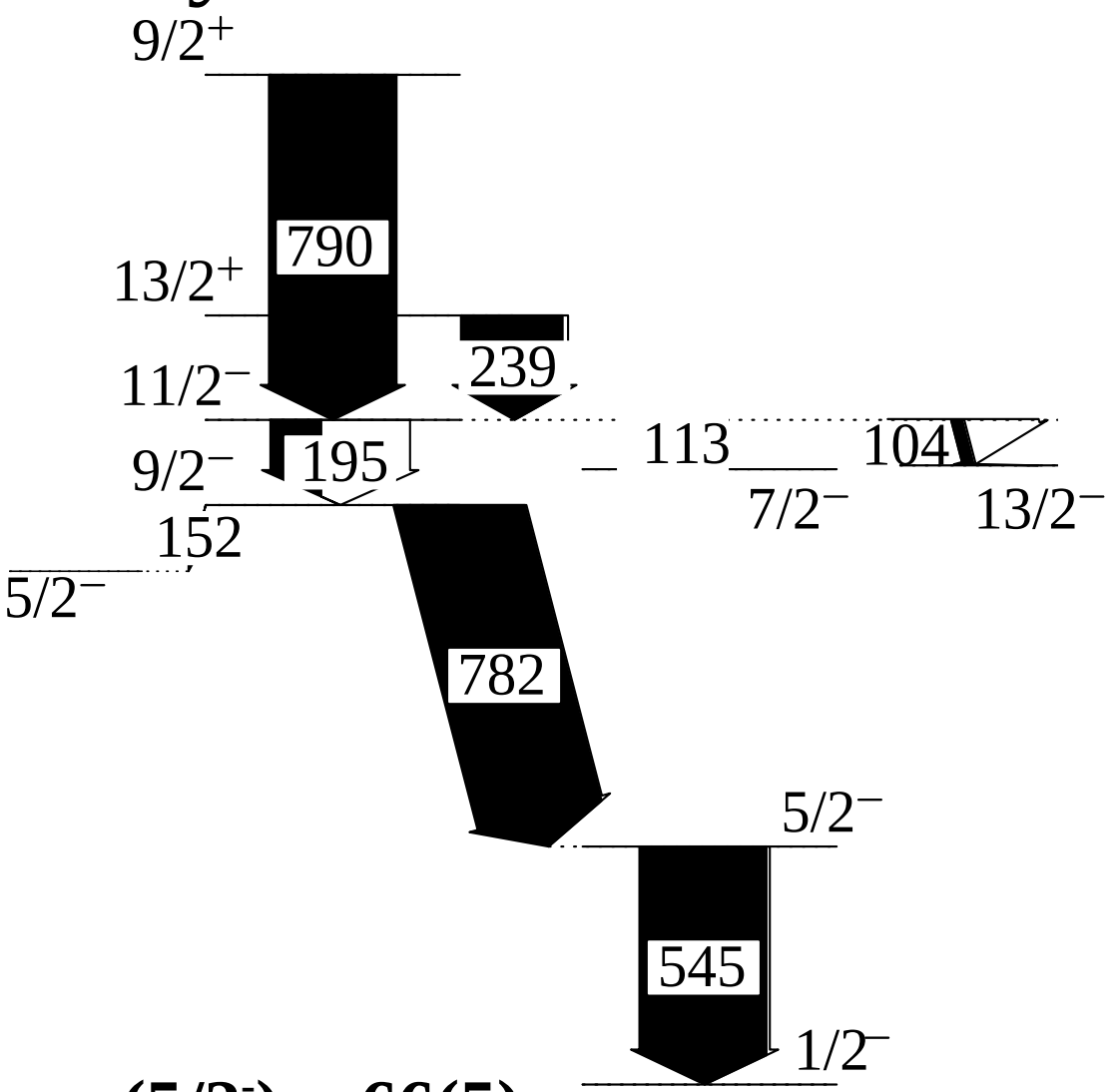




$\tau_{exp}(11/2^-) = 105(6)$ ps

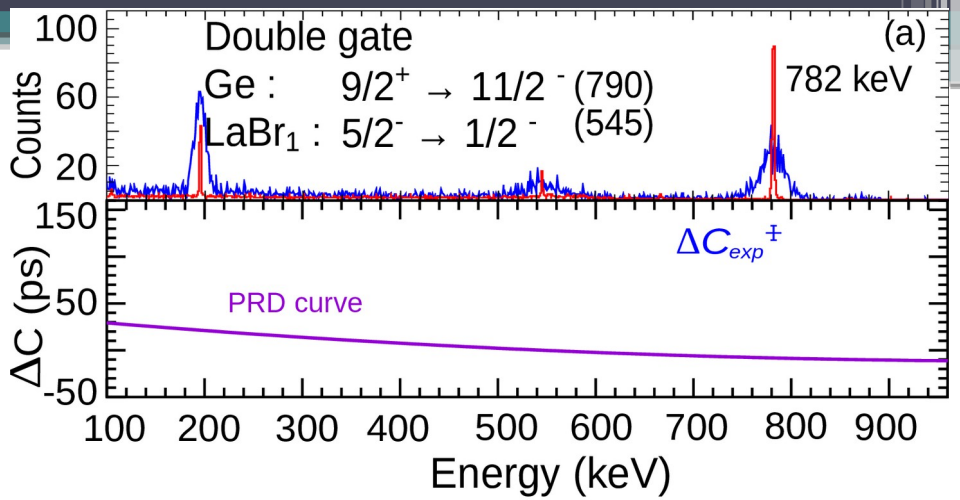
$\tau_{lit}(11/2^-) = 101(29)$ ps

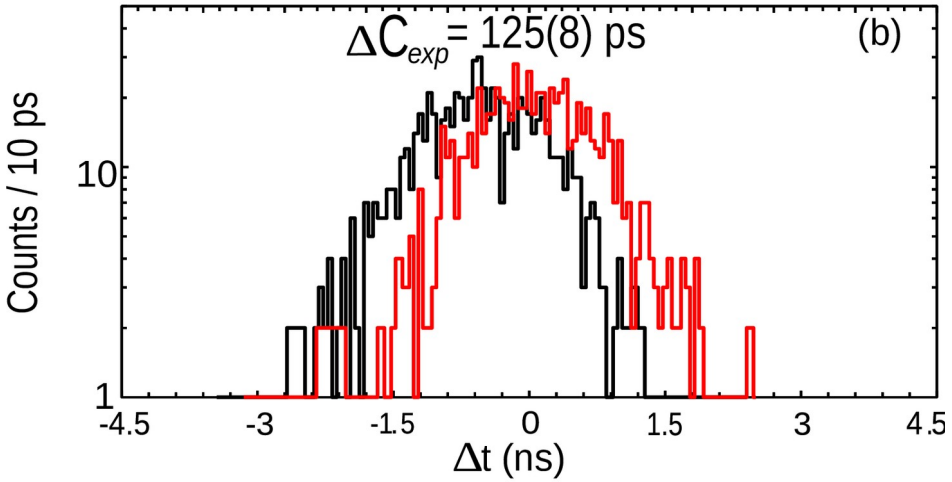
Резултати ^{209}Po

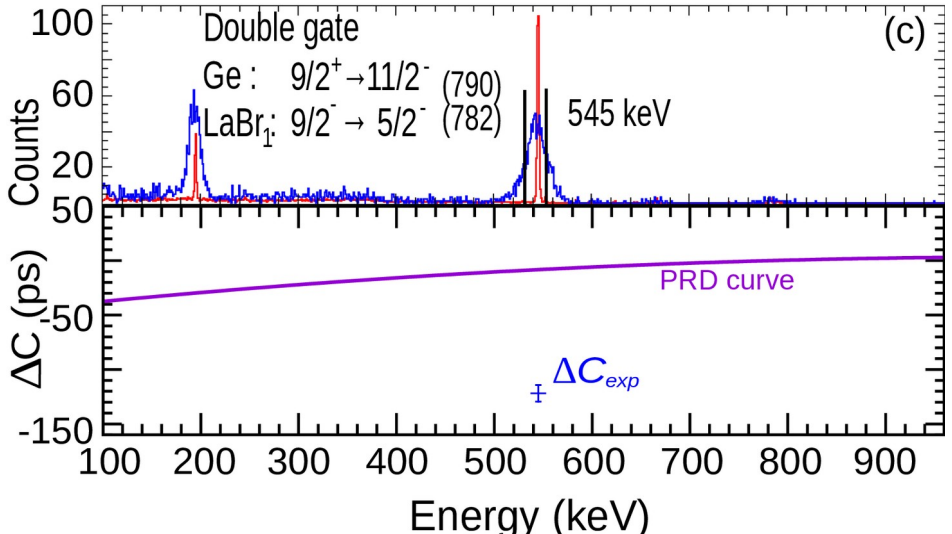


$\tau_{exp}(5/2^-) = 66(5)$ ps

$\tau_{lit}(5/2^-) = 101(29)$ ps







Заключение

За четно-четните полониеви изотопи :

1. 8^+_1 и 6^+_1 състоянията имат едночастичен характер
2. 4^+_1 състоянието има колективен характер
3. За 4^+_1 състоянието, преходът от едночастичен характер към колективен се осъществява между N = 122 и N = 120

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4. Теоретични сметки за ядрото ^{209}Po

Участие в конференции за целият период на докторантурата :

1. Nuclear Structure and related topics, 03-09.06.2018, Burgas, Bulgaria;

2. 10th Jubilee International Conference of the Balkan Physics Union, 26-30.08.2018 , Sofia, Bulgaria;

3. Euroschool on exotic beams, 25-31.08.2019, Aarhus, Denmark;

4. XXIII international school on nuclear physics, neutron physics and applications, 22-28.09.2019, Варна, България;

Публикации свързани с дисертацията за целият период на докторантурата:

1. M. Stoyanova et al, J. Phys.: Conf. Ser. **1555,** 012019 (2020)
2. M. Stoyanova et al., Phys. Rev. C **100**, 064304 (2019)
3. V. Karayonchev,..., M. Stoyanova et al., Phys. Rev. C **99**, 024326 (2019)
4. M. Stoyanova et al., EPJ Web of Conferences **194**, 03002 (2018)

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1. P. Petkov, M. Stoyanova, Bulg. J. Phys. **42**, 565–571,(2015)
2. D. Kocheva,..., M. Stoyanova,…,et al., Eur.Phys.J. A **53**, 175 (2017)
3. D. Kocheva,..., M. Stoyanova,…,et al., IOP Journal of Physics : Conf. Series **1023**, 012019 (2018)
4. R. Kern,..., M. Stoyanova,…,et al., EPJ Web of Conferences **194**, 03003 (2018)
5. D. Kocheva,..., M. Stoyanova,…,et al., J. Phys.: Conf. Ser. **1555** 012020 (2020)
6. R. Kern,..., M. Stoyanova,…,et al., J. Phys.: Conf. Ser. **1555** 012027 (2020)
7. D. Tonev,…, M. Stoyanova,…,et al., PLB-D-20-00725, submitted

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