St Petersburg University

LXX INTERNATIONAL CONFERENCE
NUCLEUS - 2020

Октябрь, 11-17, 2020

A POSSIBILITY OF DETERMINING CLUSTER STRUCTURE OF ^{6}Li EXCITED STATES IN INELASTIC SCATTERING OF ALPHA-PARTICLES

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Possible variants of the cluster structure of excited states of the ^{6}Li nucleus

Breakup energy:	**Cluster structure:**
-1.4743 MeV	**α + d**
-3.6989 MeV	**α + p + n**
-4.497 MeV	**^{5}He + p**
-5.39 MeV	**^{5}Li + n**
-15.7947 MeV	**t + ^{3}He**

Inelastic scattering reaction of alpha particles at E_α=30 MeV by ^{6}Li nuclei:

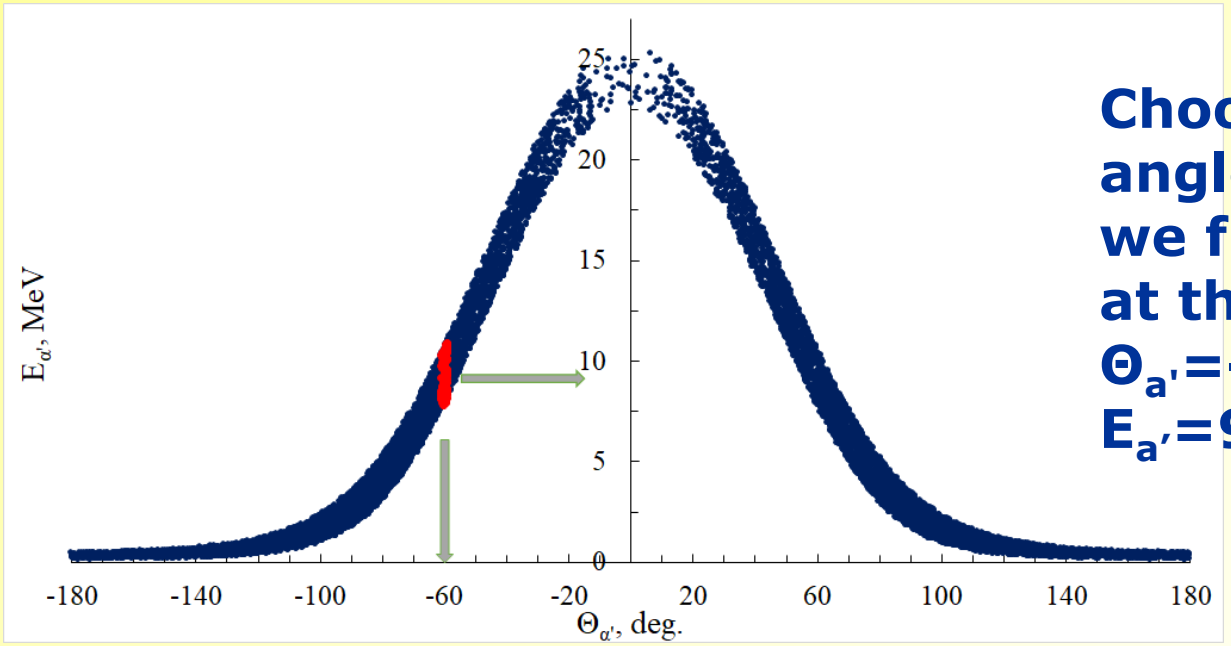
α + ^{6}Li → α′ + ^{6}Li* → α′ + α + d

α + ^{6}Li → α′ + ^{6}Li* → α′ + α + p + n

α + ^{6}Li → α′ + ^{6}Li* → α′ + ^{5}He + p → α′ + α + p + n

α + ^{6}Li → α′ + ^{6}Li* → α′ + ^{5}Li + n → α′ + α + p + n

The Simulation of $\alpha + {}^6Li \rightarrow \alpha' + {}^6Li^*$ (5.65 MeV) reaction. Parameters: E_α=30 MeV



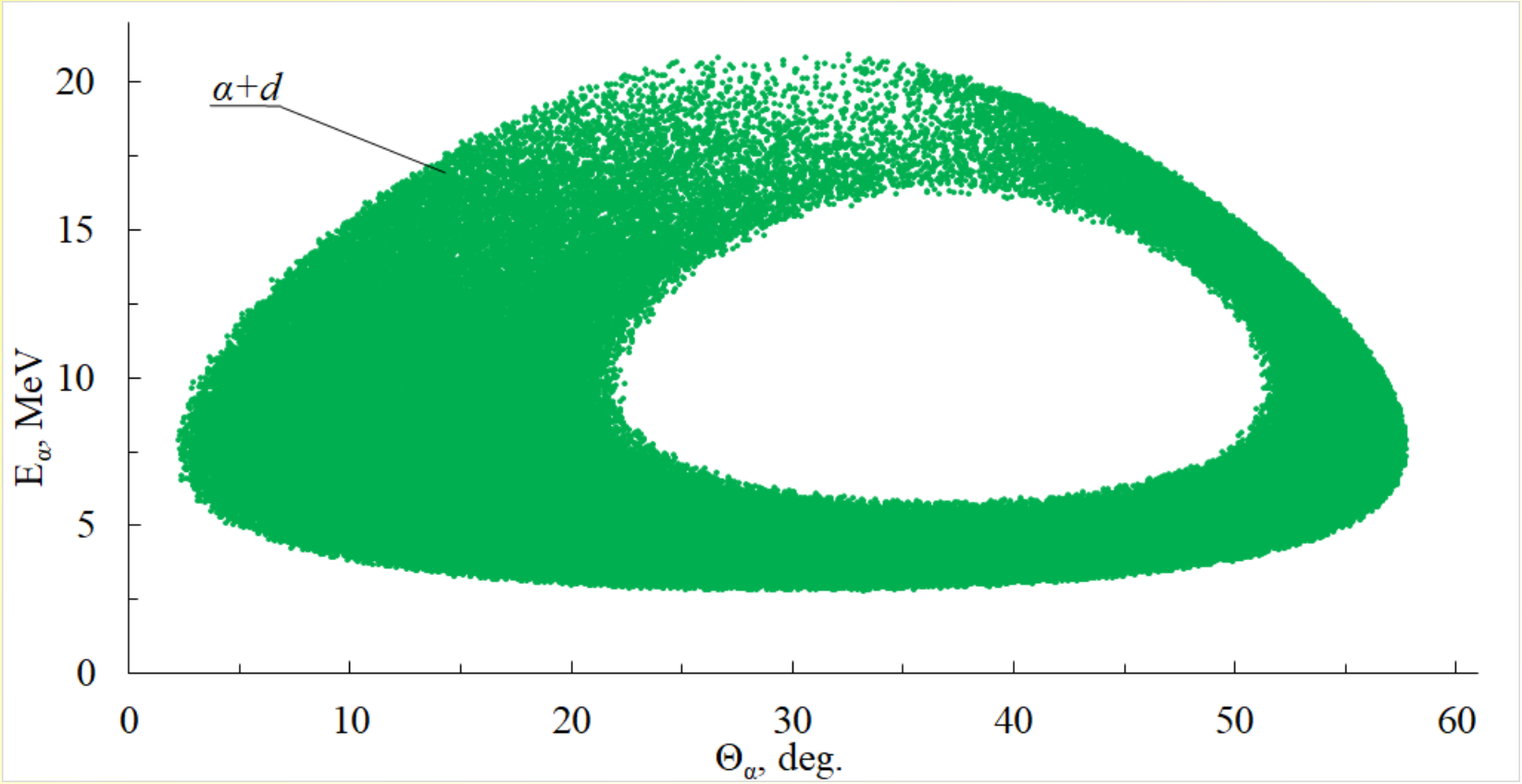
Choosing the detection angle of the alpha $\Theta_{a'}$, we fix alpha energy at this angle $E_{a'}$
$\Theta_{a'}$=-60°±1°
$E_{a'}$=9.25±1.75 MeV

E_x (MeV)	Γ (MeV)	$E_{\alpha'}$ (MeV)
g.s.		14.25±0.45
2.186	0.024	12.4±0.5
3.5629	~0	11.15±0.45
4.312	1.3	10.55±1.55
5.366	0.541	9.55±0.85
5.65	1.5	9.25±1.75

The energy of the scattered alpha particle, selected at an angle $\Theta_{\alpha'}$=-60°±1°, for various excited levels of the ^{6}Li nucleus

Diagram E_α–Θ_α for breakup alpha-particles.

Parameters: E_α=30 MeV, $\Theta_{\alpha'}$=-60°±1°, $E_x(^6Li)$=5.65 MeV



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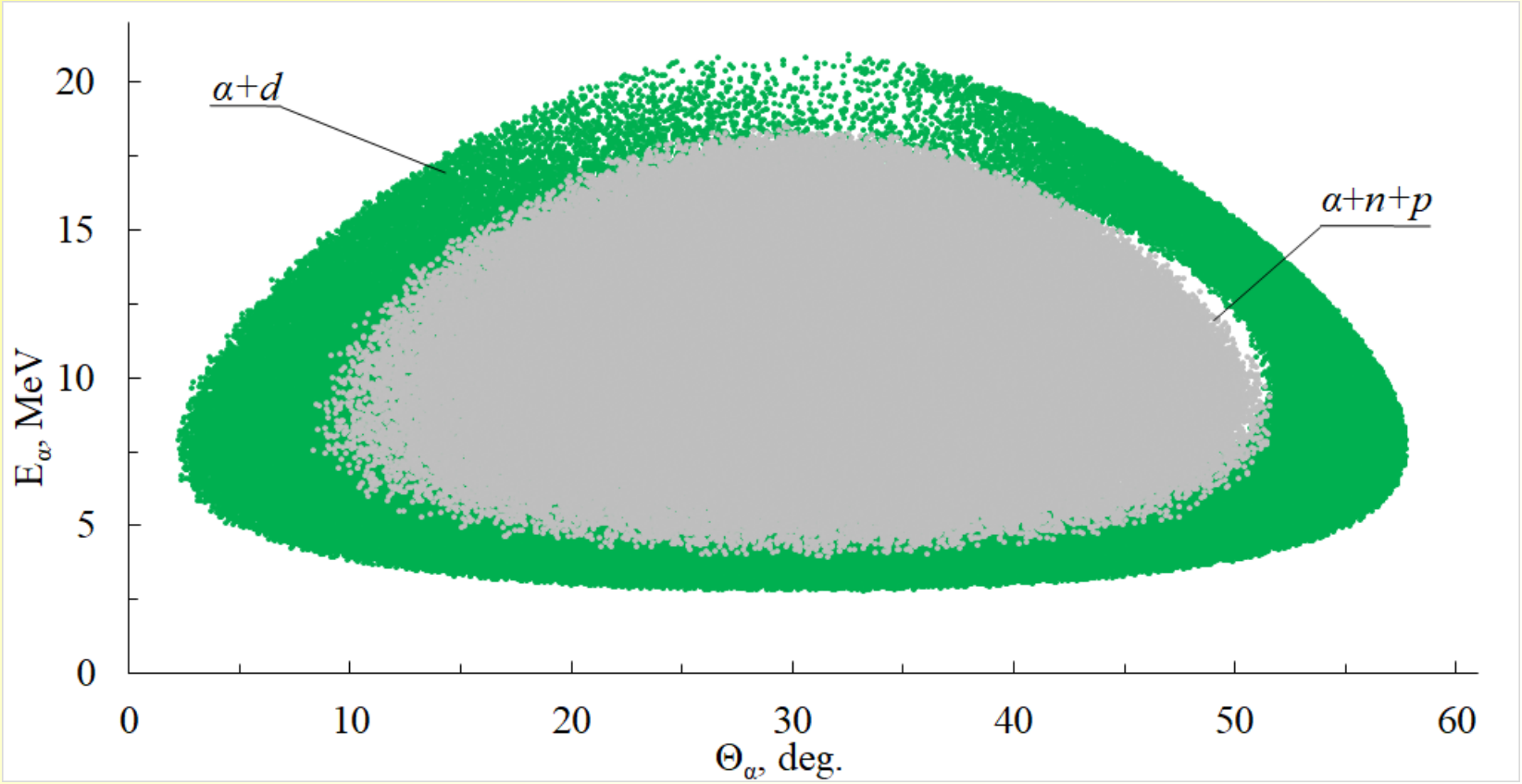

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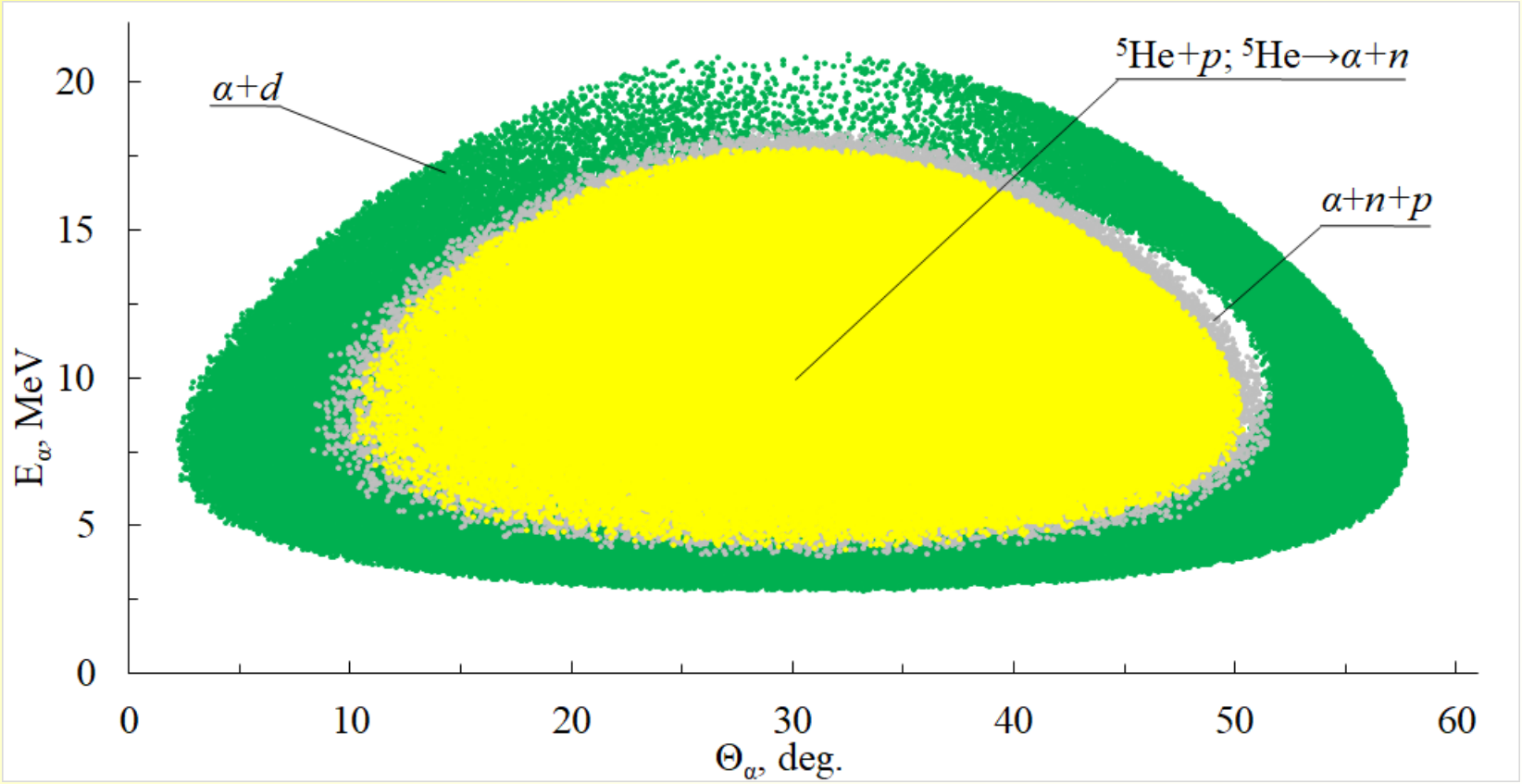

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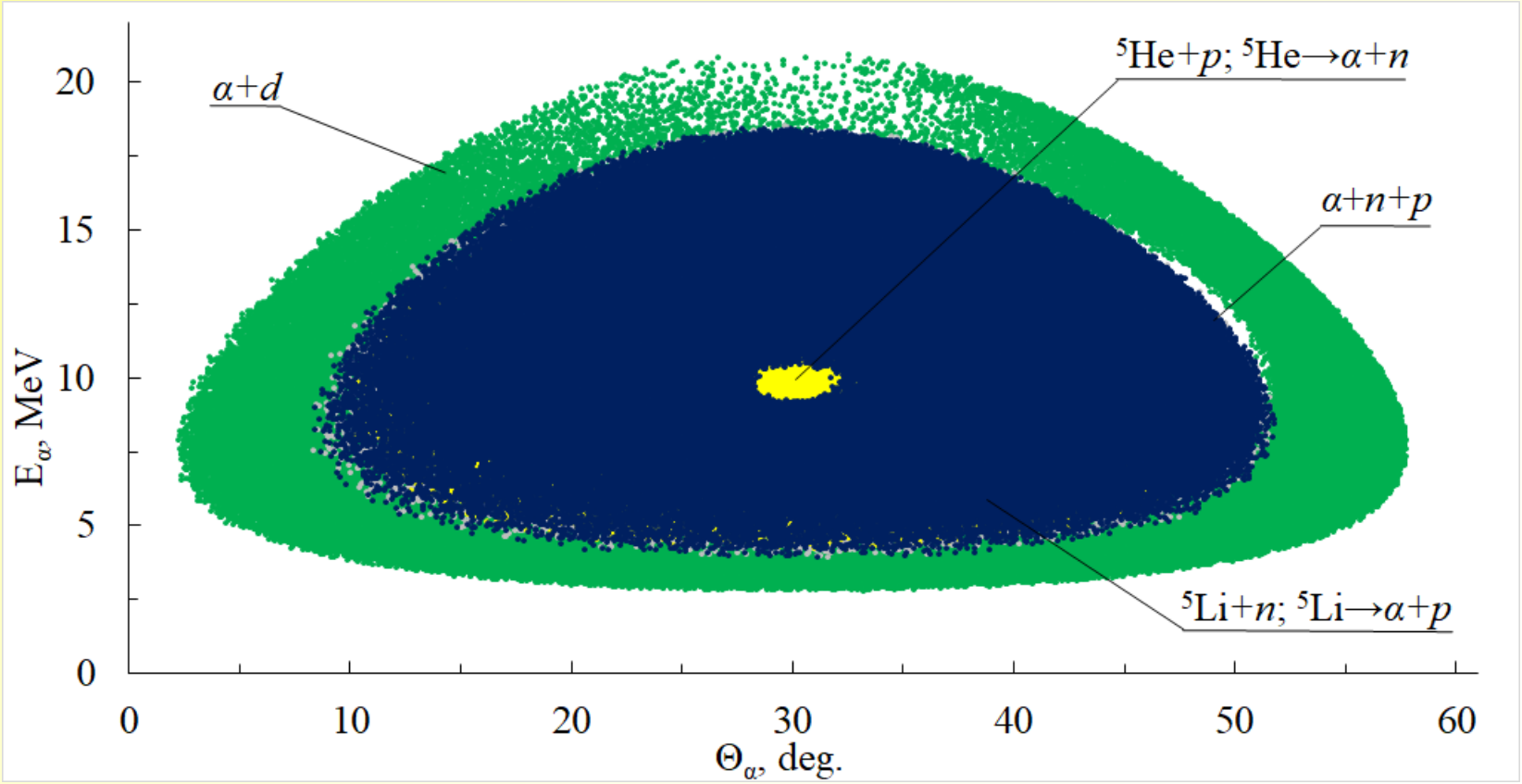
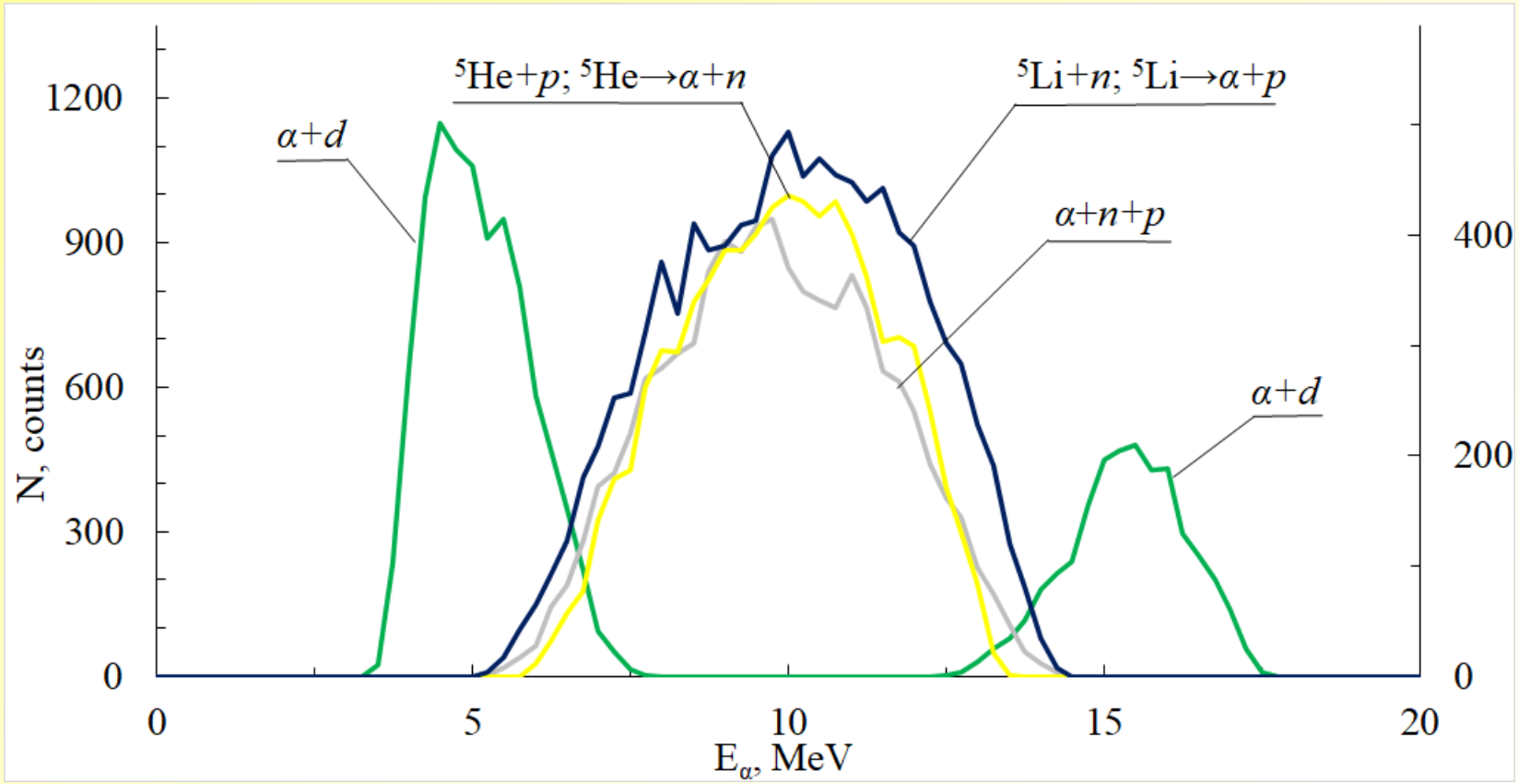


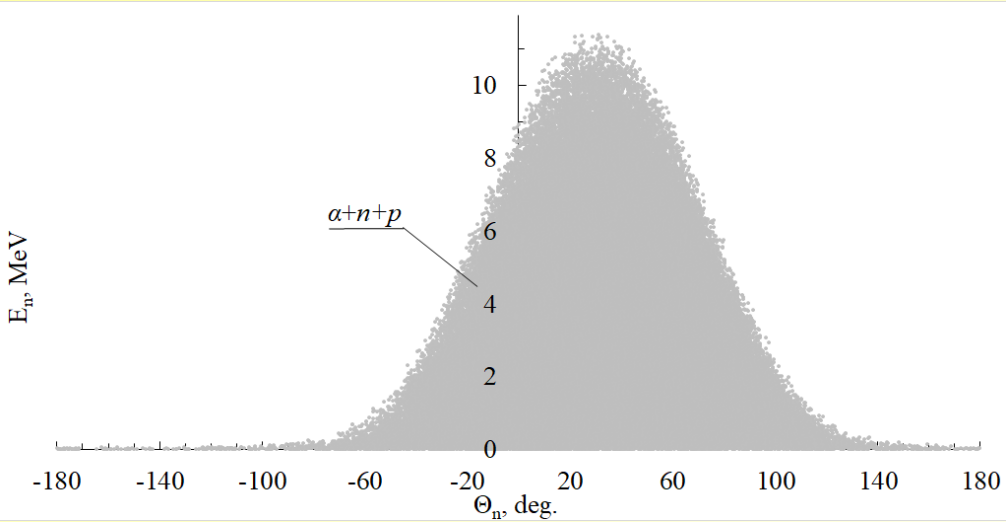
Energy spectra of breakup alpha-particles.

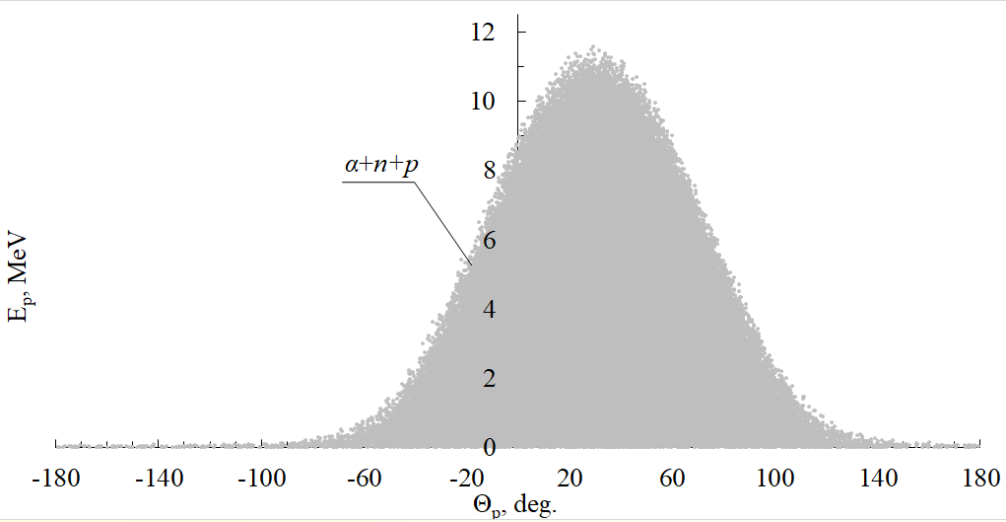
Parameters: E_α=30 MeV, $\Theta_{\alpha'}$=-60°±1°, Θ_α=48°±2°, $E_x(^6Li)$=5.65 MeV



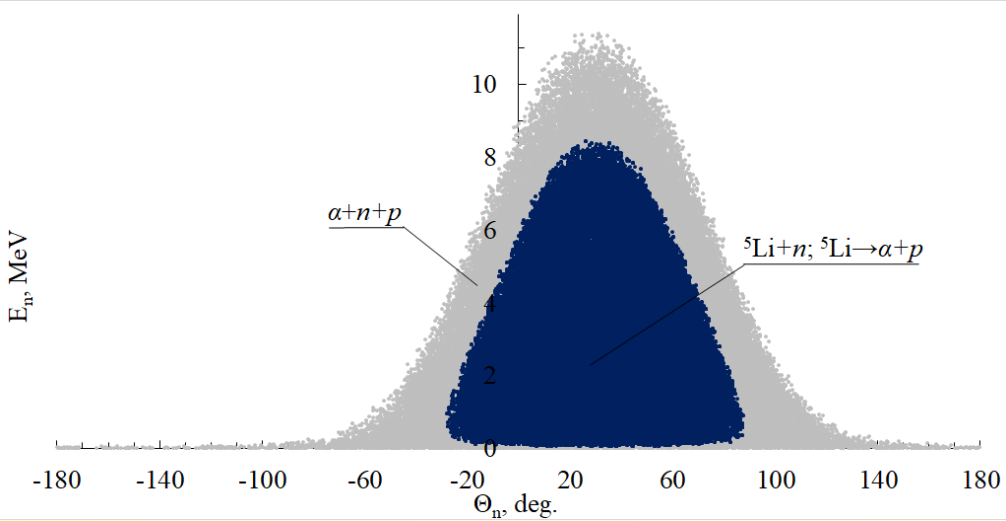
α+d breakup channel corresponds E_α < 5 MeV and E_α > 15 MeV

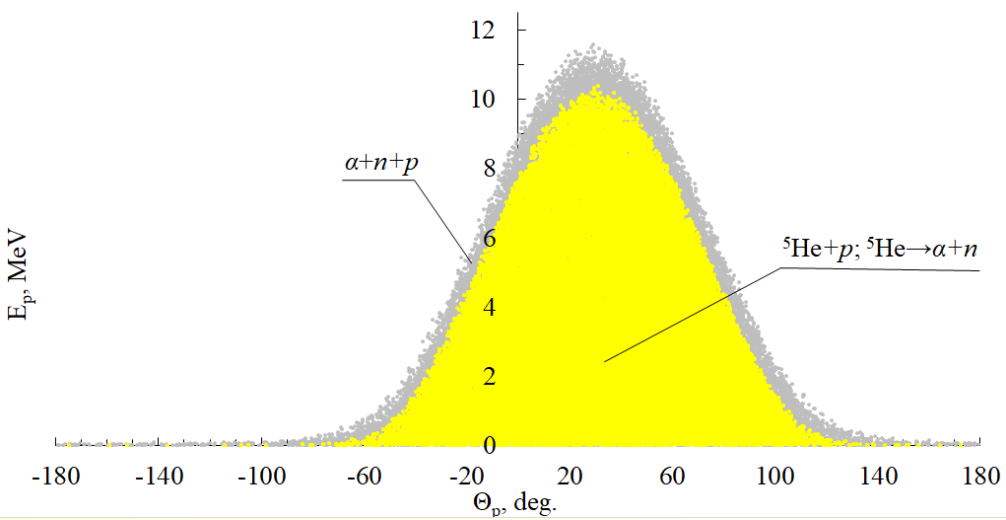
Diagrams E_n–Θ_n and E_p–Θ_p for breakup neutrons and protons. Parameters: E_α=30 MeV, $\Theta_{\alpha'}$=-60º±1º, $E_x(^6Li)$=5.65 MeV





Diagrams E_n–Θ_n and E_p–Θ_p for breakup neutrons and protons. Parameters: E_α=30 MeV, $\Theta_{\alpha'}$=-60º±1º, $E_x(^6Li)$=5.65 MeV





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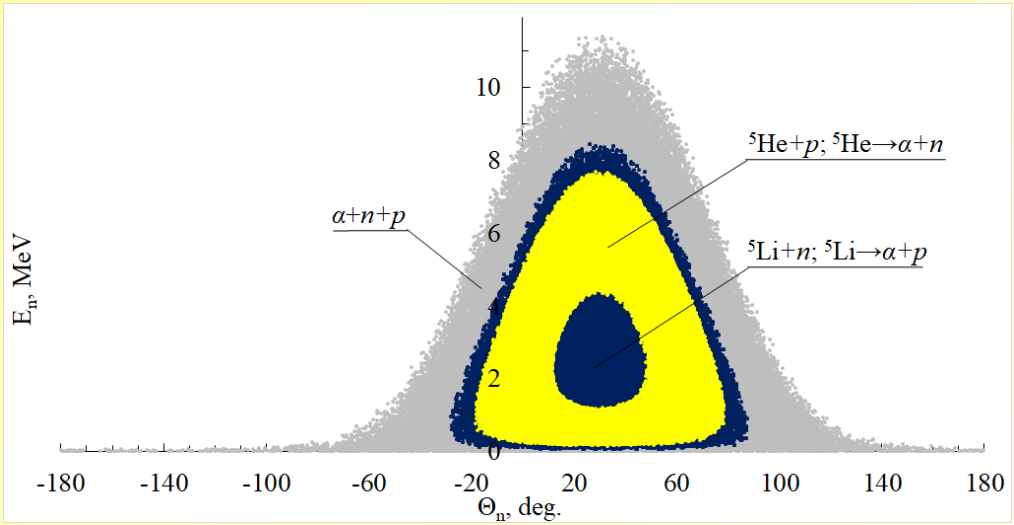
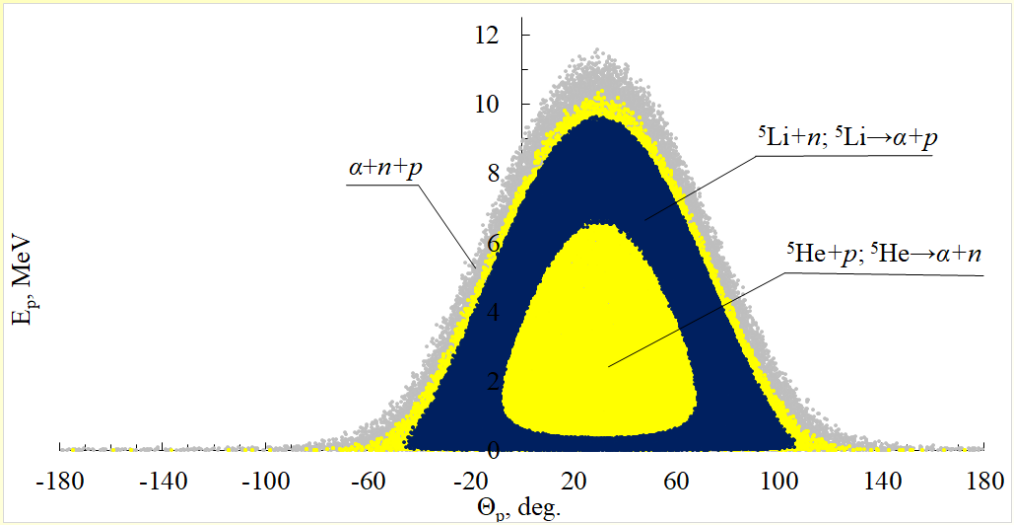
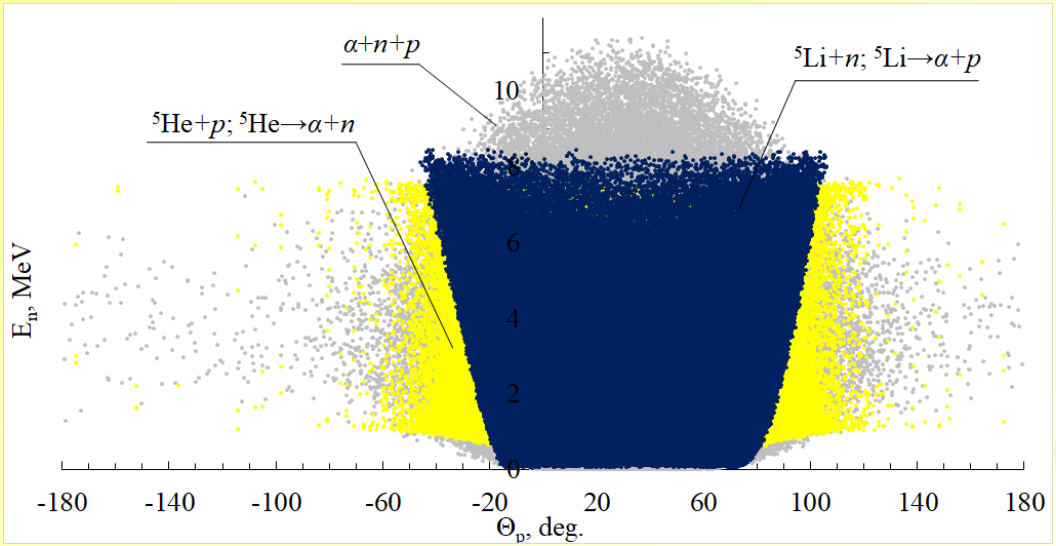


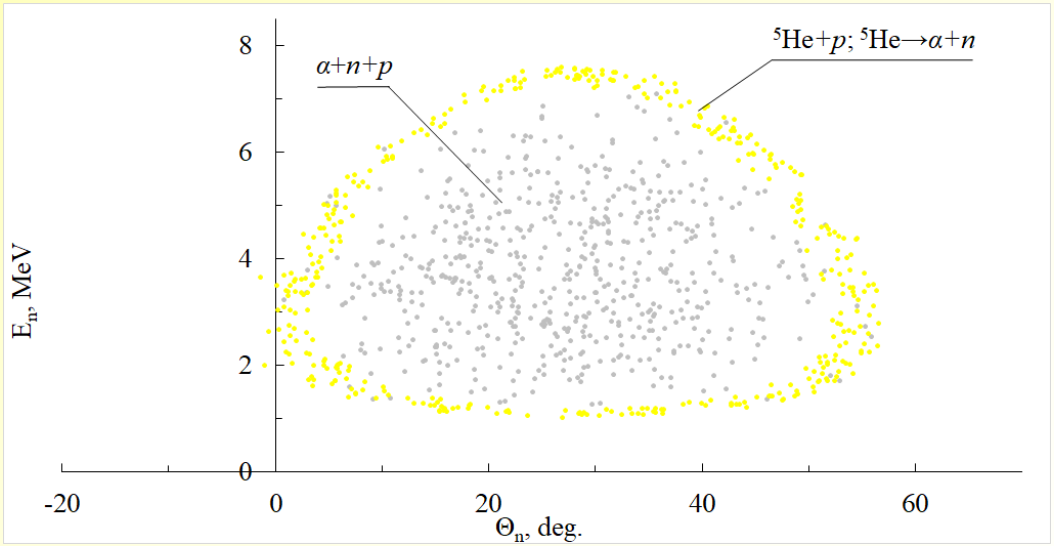


α+p+n breakup channel corresponds $\Theta_n < -25°$ and $\Theta_n > 90°$

Diagrams E_n–Θ_p; E_n–Θ_n for breakup particles.

Parameters: E_α=30 MeV, $\Theta_{\alpha'}$=-60°±1°, $E_x(^6Li)$=5.65 MeV



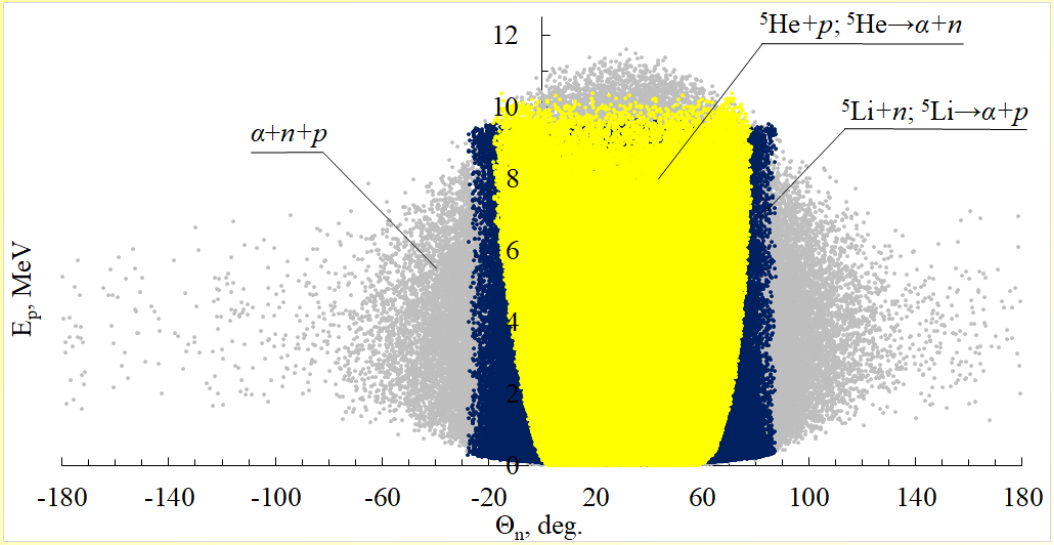


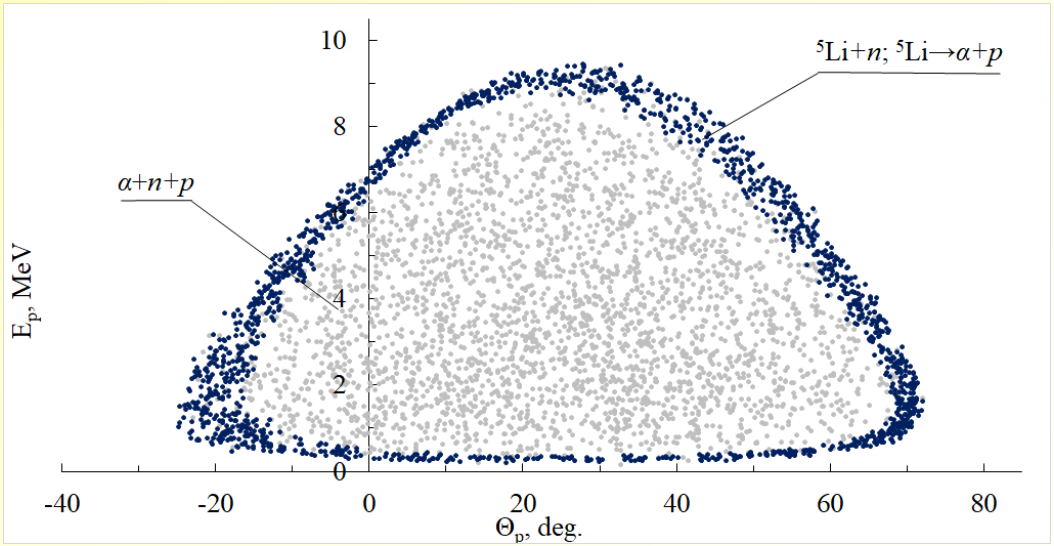
Θ_p=110°±2°

^{5}He+p breakup channel is grouped at the border of the locus

Diagrams E_p–Θ_n; E_p–Θ_p for breakup particles.

Parameters: E_α=30 MeV, $\Theta_{\alpha'}$=-60°±1°, $E_x(^6Li)$=5.65 MeV





Θ_n=80°±2°

^{5}Li+n breakup channel is grouped at the border of the locus

Simulation results for $^{6}Li^{*}$(5.65 MeV) and possible experiment

Kinematic simulation of ^{6}Li(α;α'n)X; ^{6}Li(α;α'α)X; ^{6}Li(α;α'pn)X reactions was carried out for different excited levels of the ^{6}Li nucleus and breakup channels.

An experiment on inelastic scattering of alpha particles by ^{6}Li nuclei can be carried out at the U-120 cyclotron of INP MSU at an energy of incident alpha particles of 30 MeV.

Possible cluster configurations of the $^{6}Li^{*}$(5.65 MeV) excited state

Registered particles	Cluster configurations
$\Theta_{\alpha'} = -60^{o}\pm1^{o}$; $\Theta_{\alpha} > 50^{o}$	α+d
$\Theta_{\alpha'} = -60^{o}\pm1^{o}$; $\Theta_{n} > 90^{o}$ or $\Theta_{\alpha'} = -60^{o}\pm1^{o}$; $\Theta_{n} < -25^{o}$	α+p+n
$\Theta_{\alpha'} = -60^{o}\pm1^{o}$; $\Theta_{p} = 110^{o}\pm2^{o}$; $\Theta_{n} = 0^{o}–55^{o}$	α+p+n; ^{5}He+p
$\Theta_{\alpha'} = -60^{o}\pm1^{o}$; $\Theta_{n} = 80^{o}\pm2^{o}$; $\Theta_{p} = -25^{o}–75^{o}$	α+p+n; ^{5}Li+n

Summary and conclusions

- **Kinematical simulation of inelastic scattering of α-particles on the ^{6}Li nucleus was performed at E_α = 30 MeV for various excited states of ^{6}Li nucleus**

- **It's clearly shown that there are kinematic areas of breakup particles corresponding to certain breakup channels of excited states ^{6}Li nucleus**

- **Analysis for the presence of events in the kinematic areas of breakup particles corresponding to the breakup of excited 6Li states through different channels will make it possible to estimate the contribution of various cluster configurations to the structure of excited ^{6}Li states**

- **Theoretical calculations for the distributions of breakup particles in comparison with experimental ones can give a more definite estimate of the contribution of various cluster configurations to the structure of excited states of the ^{6}Li nucleus**

Thank you!