Angular measurements of the doubly charged projectile fragments of ^{9}Be at 1.2 A GeV

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Introduction

In the present report, preliminary results of angular measurements for the projectile fragments of relativistic ^{9}Be with the charge Z_f=2 are represented. Events type which the dissociation of relativistic nuclei ^{9}Be is accompanied by the ^{8}Be dissociation, and production of doubly charged fragments with opening angles smaller then half degree are studied.

The relativistic ^{9}Be nucleus fragmentation is an attractive source for ^{8}Be nucleus generation since the energy threshold of neutron separation of the ^{8}Be nucleus is only 1.6 MeV. The estimation of the ^{8}Be production probability will make it possible to clear up the role of this nuclear structure as a core in the ^{9}Be nucleus. In addition, the relation between ^{9}Be as composition from n+^{8}Be and three-body (n+^{4}He+^{4}He) excitation modes is expected to be established which is very important for the determination of the fragmentation scenario for heavier nuclei.

The secondary ^{9}Be nuclei have been formed on the Nuclotron in the 23.04.2004.

The secondary ^{9}Be nuclei were formed via fragmentation of the primary ^{10}B beam at 1.2 A GeV. The beam was enriched about 80% by these nuclei the background is lighter nuclei with a close charge-to-weight ratio.

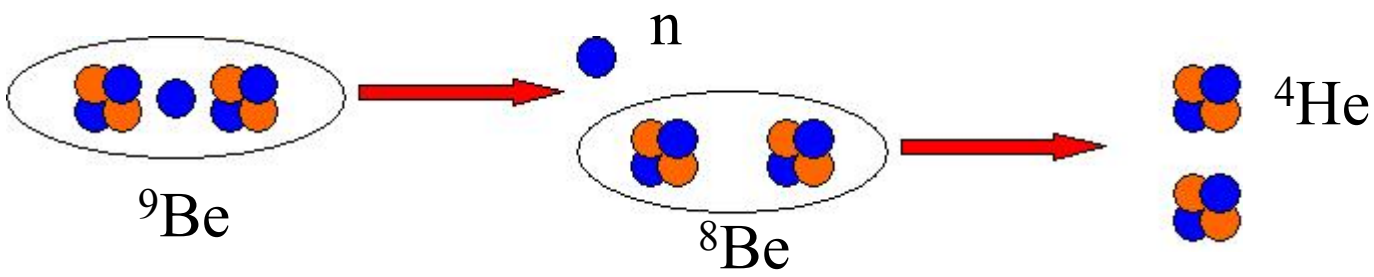
In the scanned emulsions exposed to ^{9}Be nuclei we have found at the present time 200 interactions in which the total charge of secondary fragments in the forward fragmentation cone is equal to the charge of a primary nucleus. The measurements were performed on statistics of 61 events.

Selection criteria for angular measurements:

- **number of fragments in narrow cone ($\theta<0.1$ rad) $N_f=2$;**
- **charge of each fragment $Z_f=2$;**
- **the events with several secondary tracks in broad cone ($\theta>0.1$rad)***

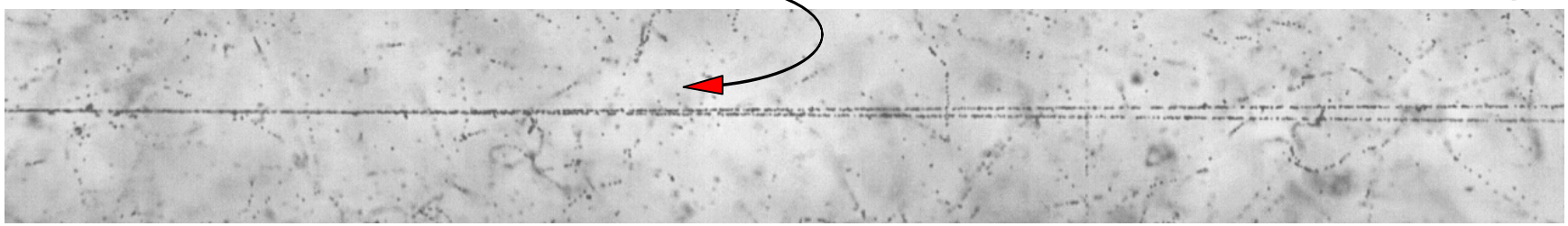
*for more statistics not only “white” stars

How the events in emulsion look like

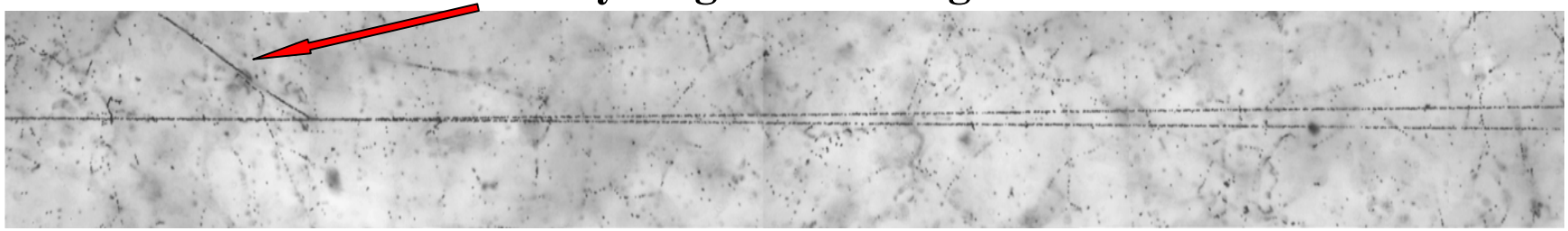


(PAVICOM image)

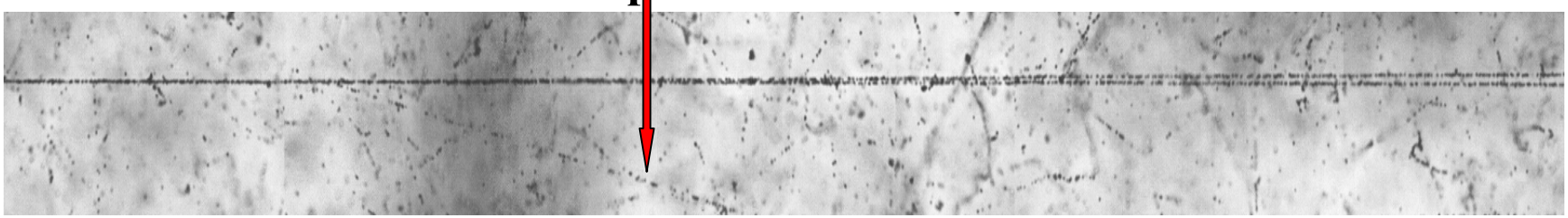
"white" star



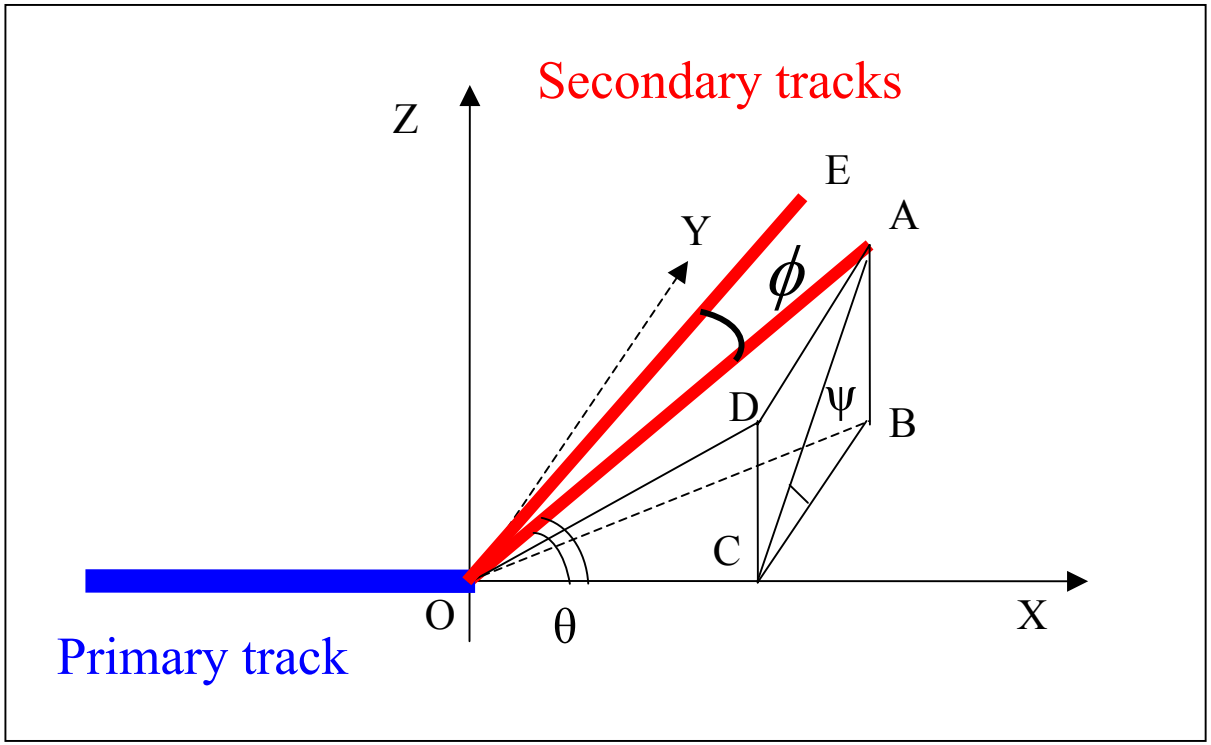
with heavy fragment of target nucleus



with recoil proton

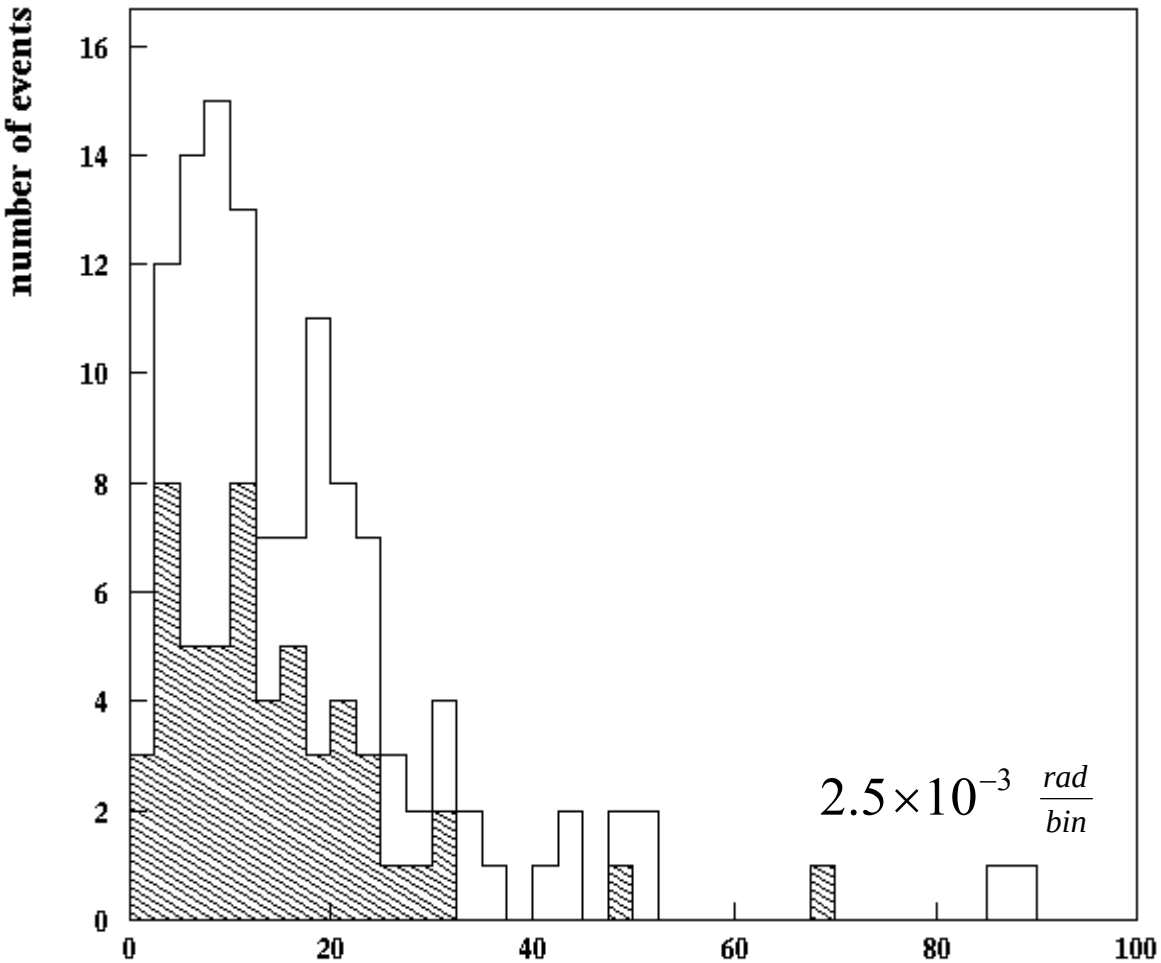


Angular scheme



(BOC)	**Emulsion plane**
OX	**Direction of primary track**
$\angle AOC$	**Polar angle** (θ)
$\angle ACB$	**Azimuthal angle** (ψ)
$\angle EOA$	**Opening angle** (ϕ)

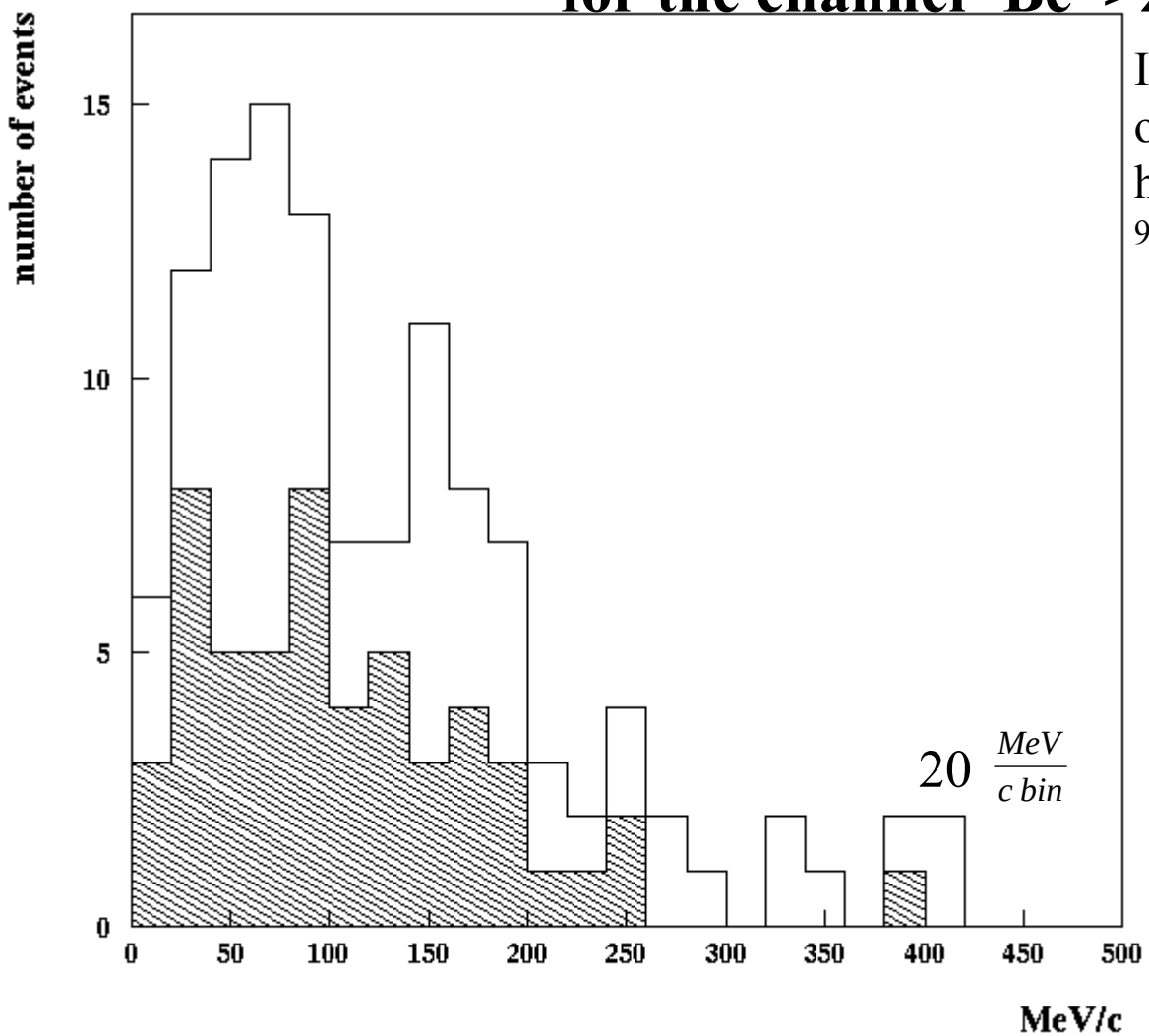
Polar angle of doubly charged fragments for the channel $^{9}Be \rightarrow 2^{4}He+n$



In figure is shown the distribution of polar angle for doubly charged fragments in channel $^{9}Be \rightarrow 2^{4}He$. The estimation of angular measurements accuracy is about $(1\text{-}2)\cdot10^{-3}$ rad.

total distribution "white" stars

Transverse momentum of doubly charged fragments for the channel $^{9}Be \rightarrow 2^{4}He+n$



In figure is shown the distribution of transverse momentum for the helium fragments in the channel $^{9}Be \rightarrow 2^{4}He$.

A=4 (in the supposition ^{4}He)

$p_0 = 1.9$ A GeV/c

$$P_t^A = p_0 \cdot A \cdot \sin(\theta)$$

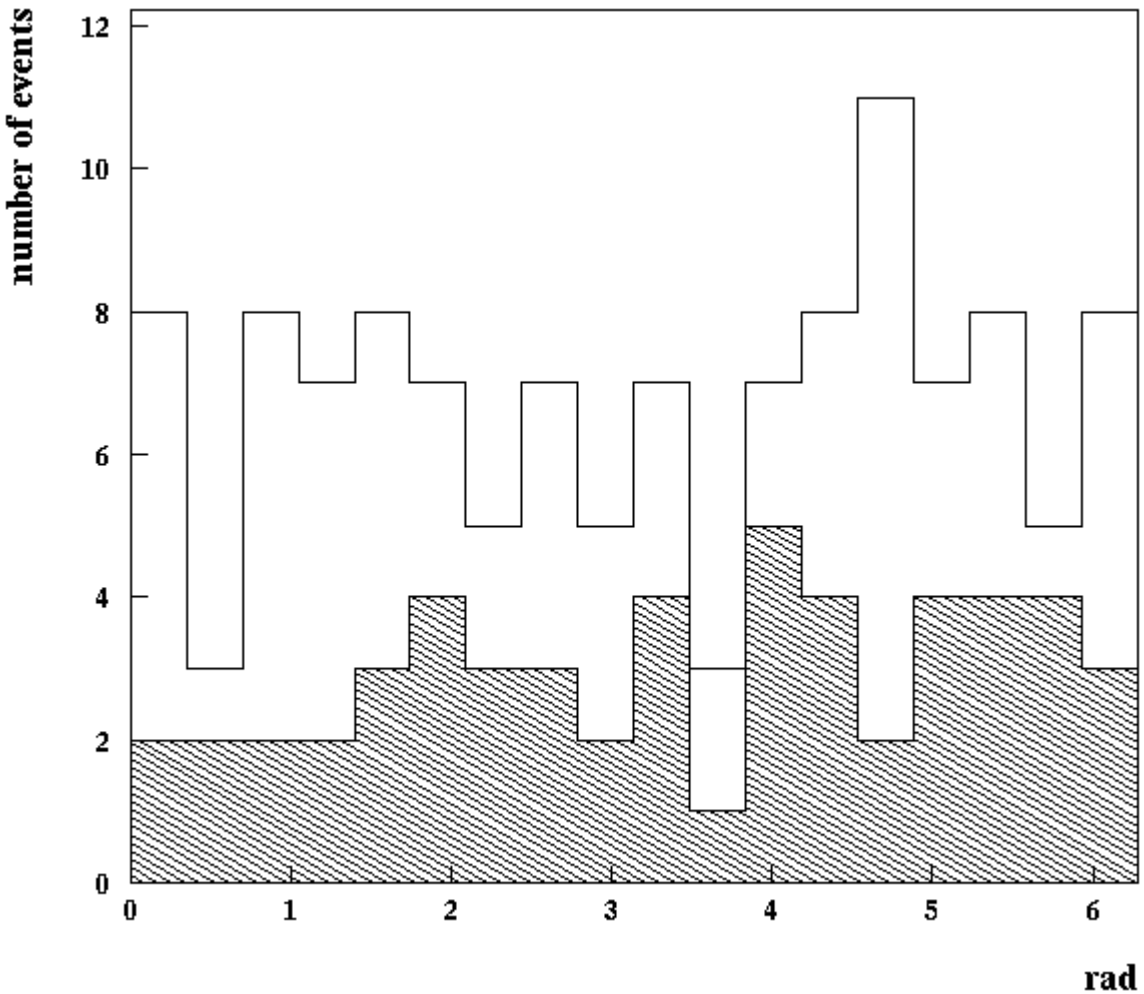
$\langle P_t^A \rangle = 125.3$ MeV/c**

$\sigma = 91.1$ MeV/c

total distribution

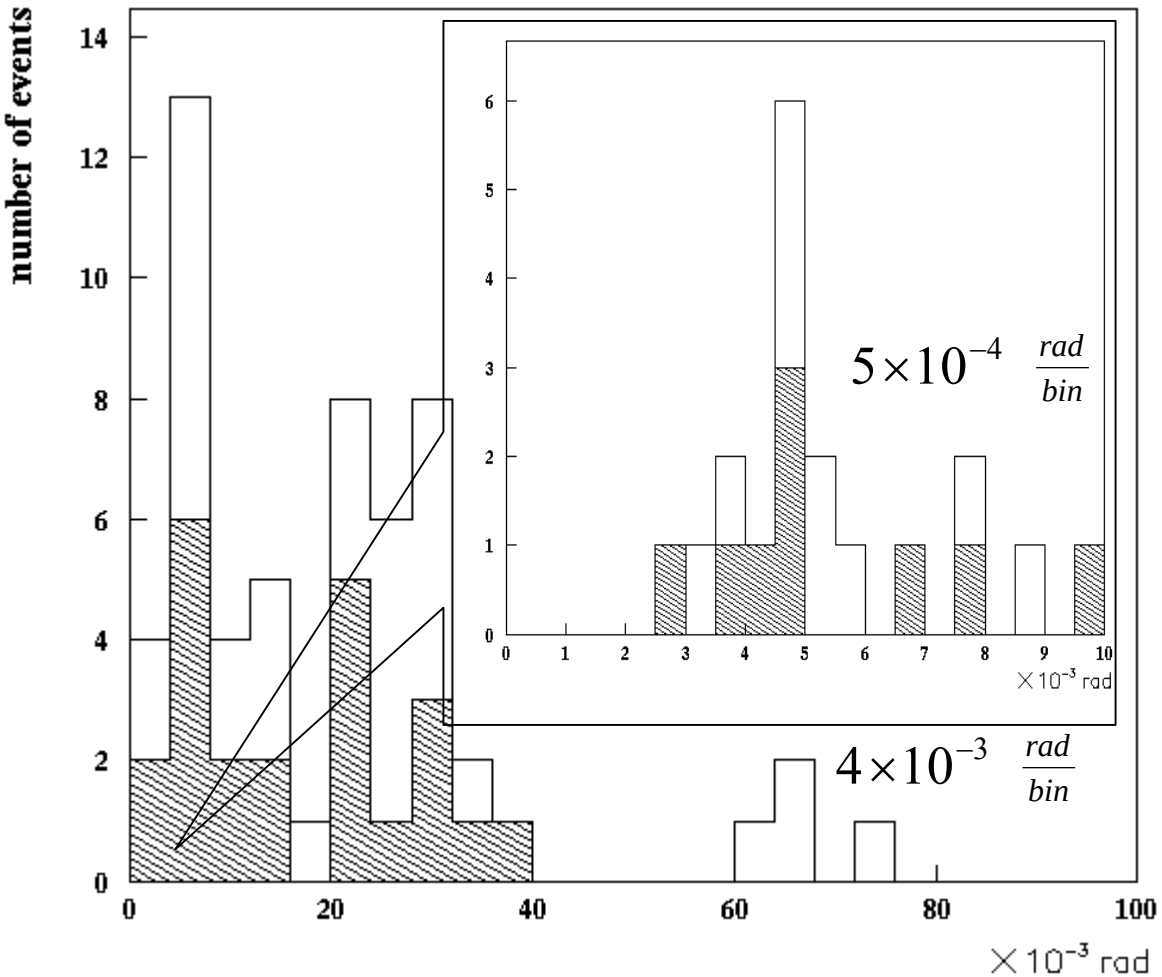
"white" stars

Azimuthal angle distribution of doubly charged fragments for the channel $^{9}Be \rightarrow 2^{4}He+n$



total distribution "white" stars

Opening angle between two doubly charged fragments for the $^{9}Be \rightarrow 2^{4}He+n$

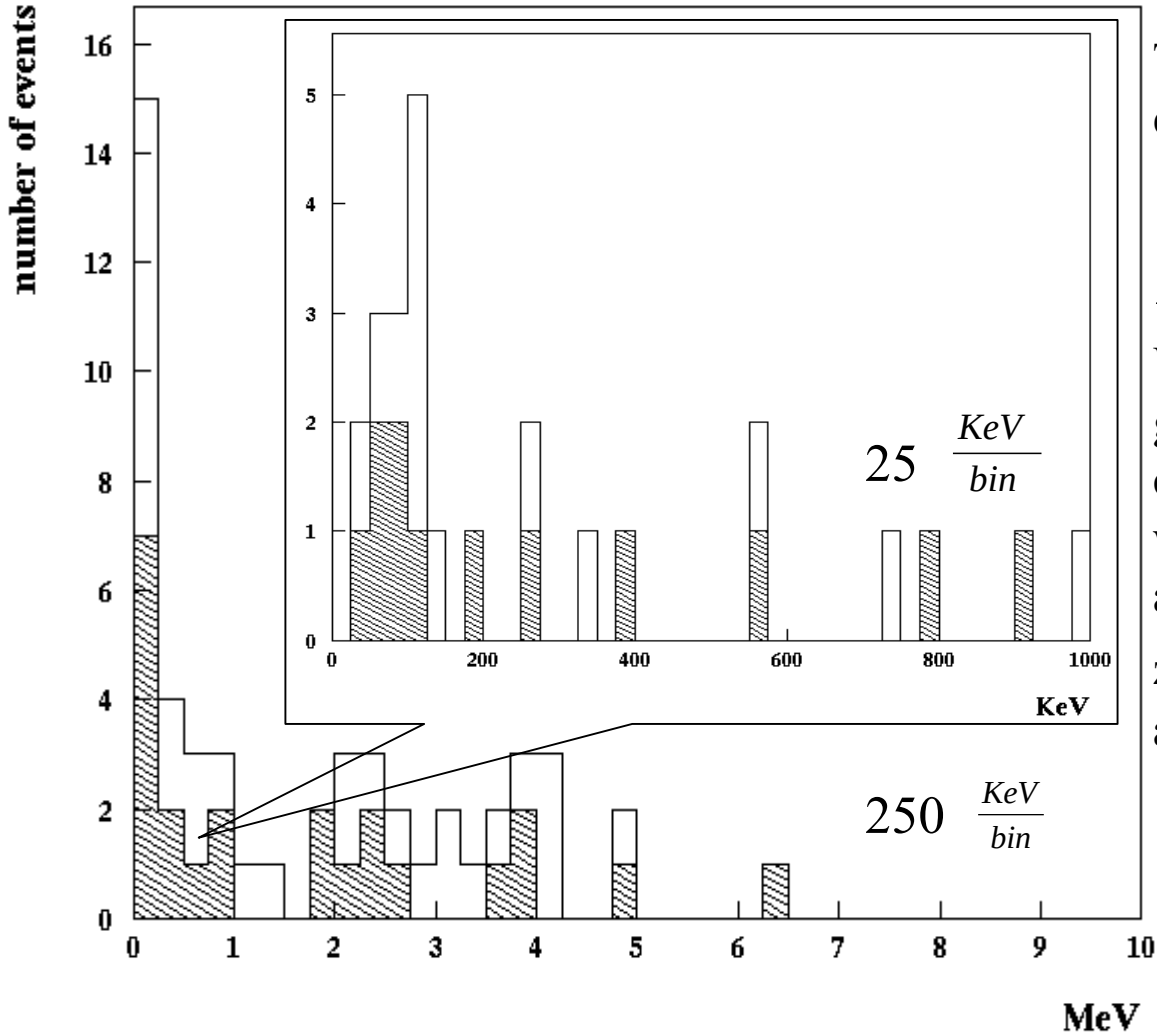


total distribution "white" stars

The opening angle distribution for the 56 measured events is shown in figure. The part of distribution in interval $(0\text{-}10^{-2})$ rad is zoomed separately.

One can see peak at $4 \cdot 10^{-3}$ rad corresponding to ^{8}Be decay from the ground state 0^{+}. The angle value $27 \cdot 10^{-3}$ rad approximately corresponds to decay from the first excited state 2^{+}.

Excitation energy for the channel $^{9}Be \rightarrow 2^{4}He$



The distribution for excitation energy is shown in figure.

$$Q = M^{*}_{2\alpha} - M_{2\alpha}$$

$$M^{*}_{2\alpha}{}^{2} = -\left(\sum P_{\alpha_i}\right)^{2},\ i = 1,2.$$

Where M is the total mass of the ground state of the nucleus corresponding to the charge and weight of the system being analyzed. The full distribution and zoomed part of this distribution in area up to 1 MeV is represented.

total distribution "white" stars

Total events - 56, with additional selection criteria for opening angle $\frac{\Delta\phi}{\phi} < 0.2$

Conclusion

- ✓ It is found about 200 events of ^{9}Be fragmentation with two helium fragments in a forward fragmentation cone.
- ✓ The analysis is based on statistics of 56 events, for which the angular measurements are conducted.
- ✓ The estimation of angular measurement accuracy is $(1\text{-}2)\cdot10^{-3}$ rad, that is enough for selection of ^{9}Be decays.
- ✓ The angular distributions of helium fragments in the reaction are obtained.
- ✓ The distributions of invariant excitation energy are obtained.
- ✓ With increasing of statistics it will be possible to establish the share of channel $^{9}\text{Be}\rightarrow{}^{8}\text{Be}+n$.
- ✓ The accumulation of statistics is carried out.