



BECQUEREL  
PROJECT

Проект  
БЕККЕРЕЛЬ

Beryllium (Boron)

Clustering

Quest in

Relativistic Multifragmentation

<http://becquerel.jinr.ru>

# Fragmentation of Relativistic Nuclei in Images

**I. G. Zarubina (JINR)**

**<http://becquerel.jinr.ru>**

**<http://becquerel.lhe.jinr.ru>**

"The universe is not to be narrowed down to the limits of the understanding, which has been man's practice up to now, but the understanding must be stretched and enlarged to take in the image of the universe as it is discovered."

FRANCIS BACON  
*Passages, Aphorism 4.*

TO THE UNIVERSITY OF BRISTOL  
DURING THE YEAR OF THE FIFTIETH ANNIVERSARY  
OF ITS FOUNDATION

"Those who are altogether unaccustomed to research are at the first exercise of their intelligence befogged and blinded, and quickly desist owing to fatigue and failure of intellectual power, like those who without training attempt a race. But one who is accustomed to without, training attempt a race. But one who is accustomed to investigation, worming his way through and turning in all directions, does not give up the search, I will not say day or night, but his whole life long. He will not rest, but will turn his attention to one thing after another which he considers relevant to the subject under investigation until he arrives at the solution of his problem."

ERASISTRATUS  
(from a translation by J. B. FARINGTON)

6820 NEW BRISTOL  
c 344.1  
p - 89

# The Study of Elementary Particles by the Photographic Method

An account of  
The Principal Techniques and Discoveries  
illustrated by  
An Atlas of Photomicrographs

BY

C. F. POWELL

P. H. FOWLER and D. H. PERKINS

H. H. WILLS PHYSICAL LABORATORY  
UNIVERSITY OF BRISTOL

Объектный исторический  
исследовательский  
библиотека



PERGAMON PRESS

LONDON · NEW YORK · PARIS · LOS ANGELES

1959

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1959

ОБЩ. ЧИТ. ЗАЛ

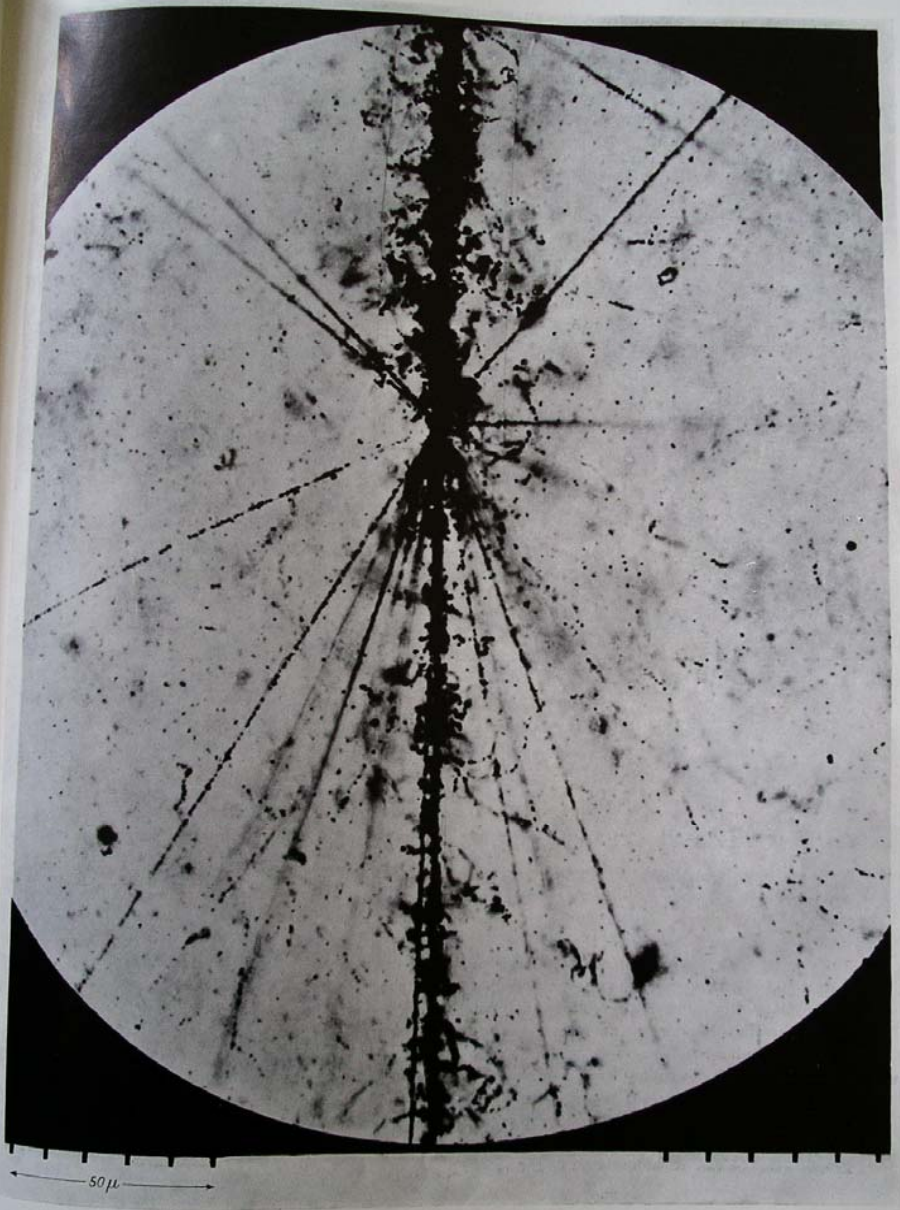


с 344.1

р - 89

Лит. 4803

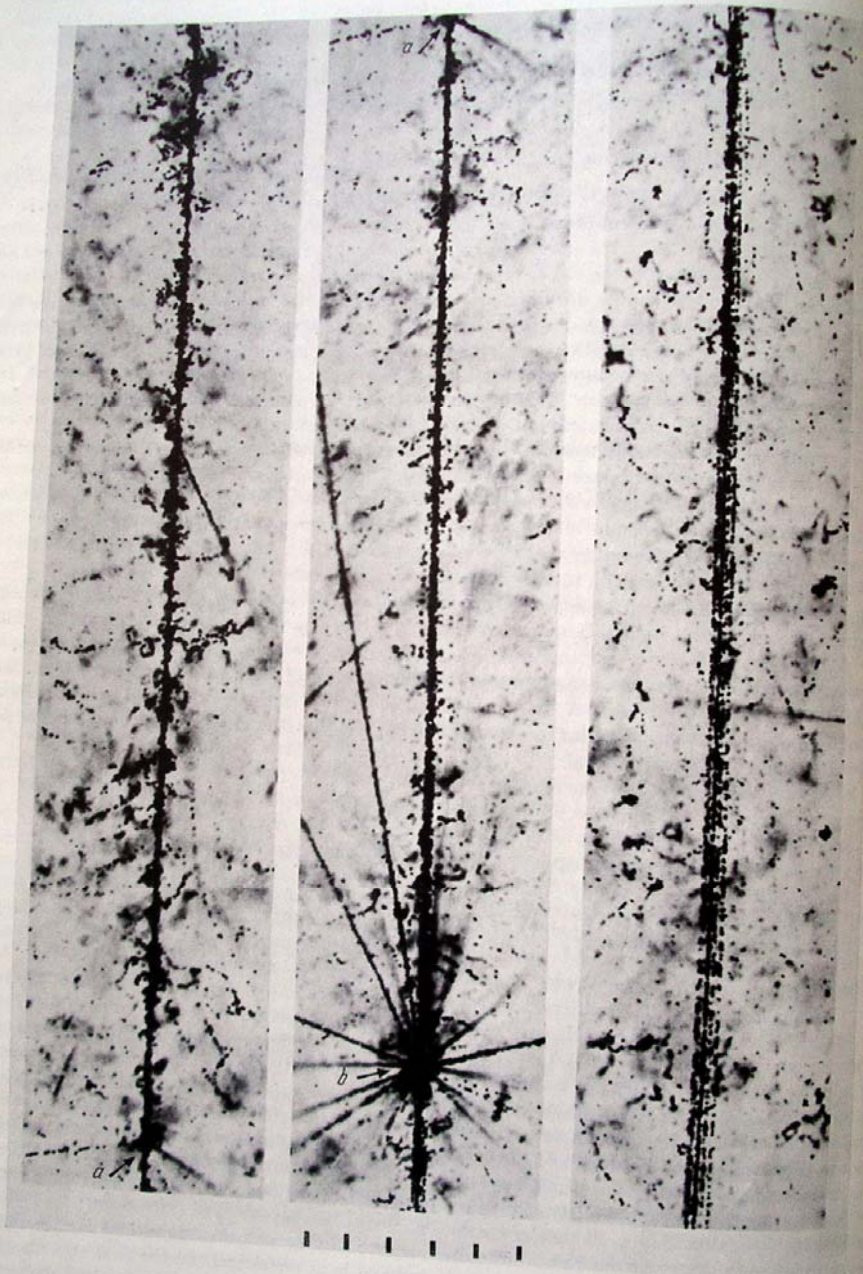
Collision of a nucleus of iron  
↓



Iford G 5 Emulsion

PLATE 3-1

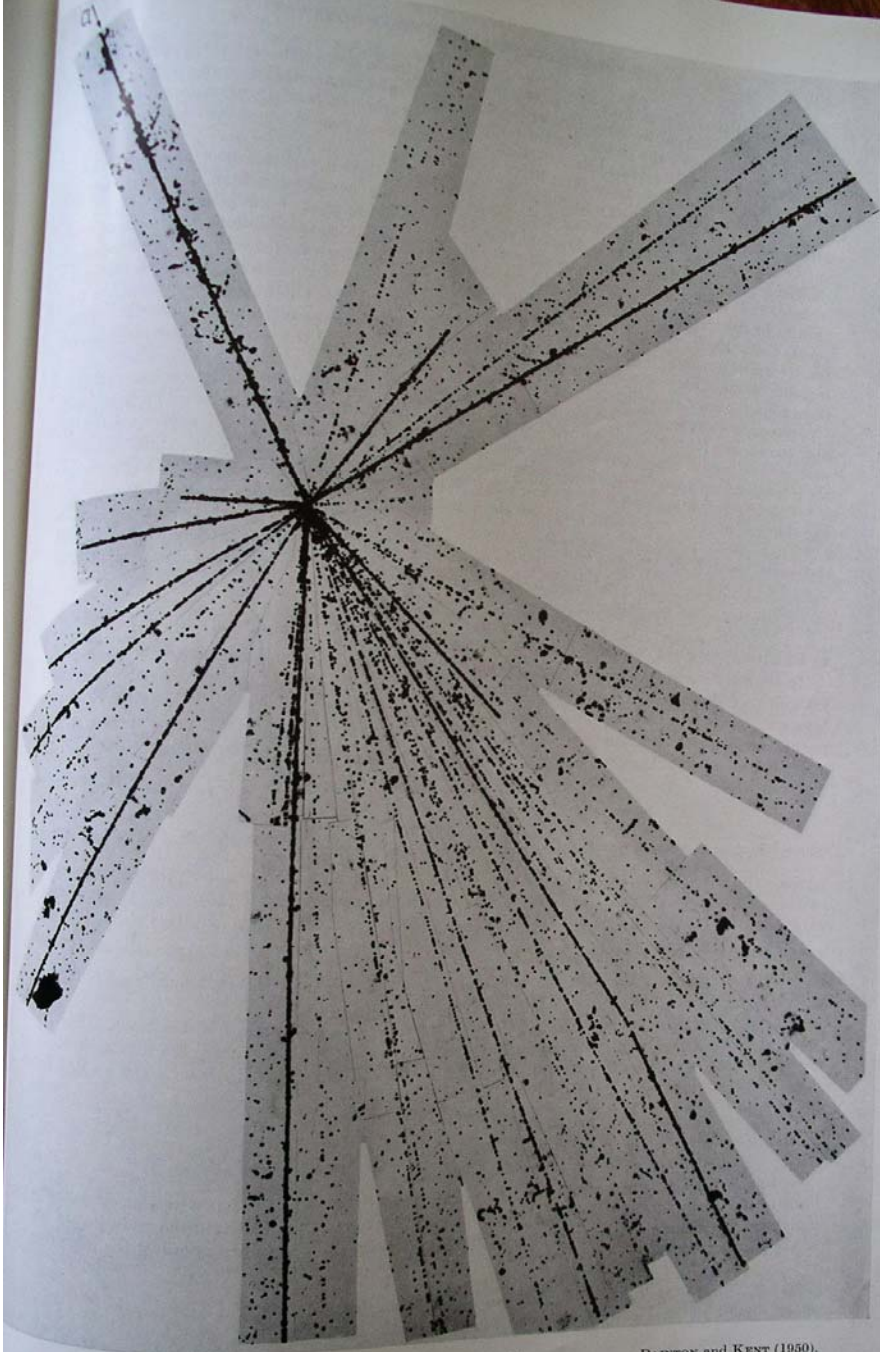
DAINTON and FOWLER (unpublished)



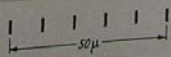
Iford G 5 emulsion.

PLATE 4-3

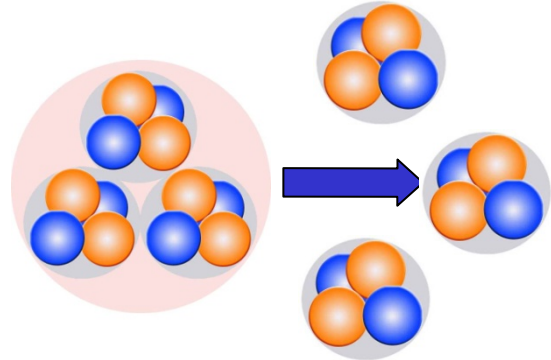
DAINTON and FOWLER (unpublished).



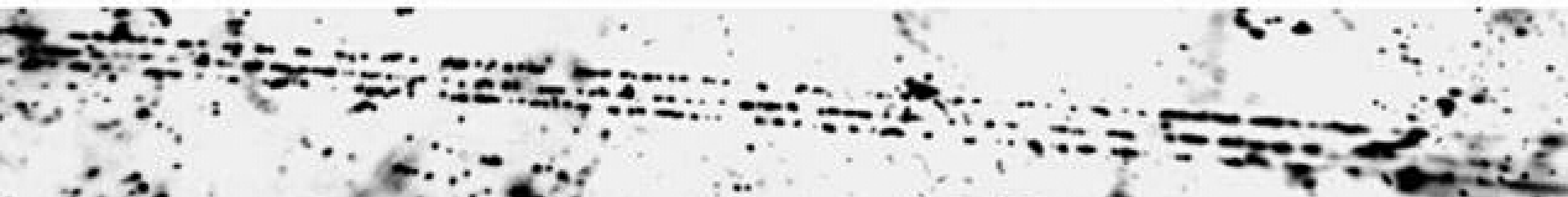
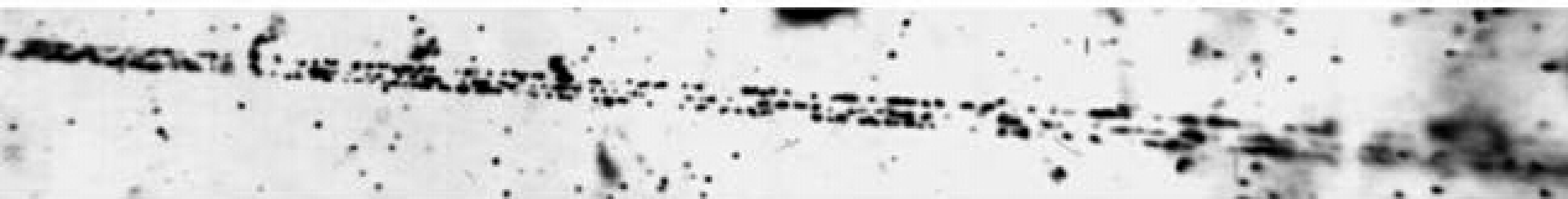
Ilford G5 emulsion.



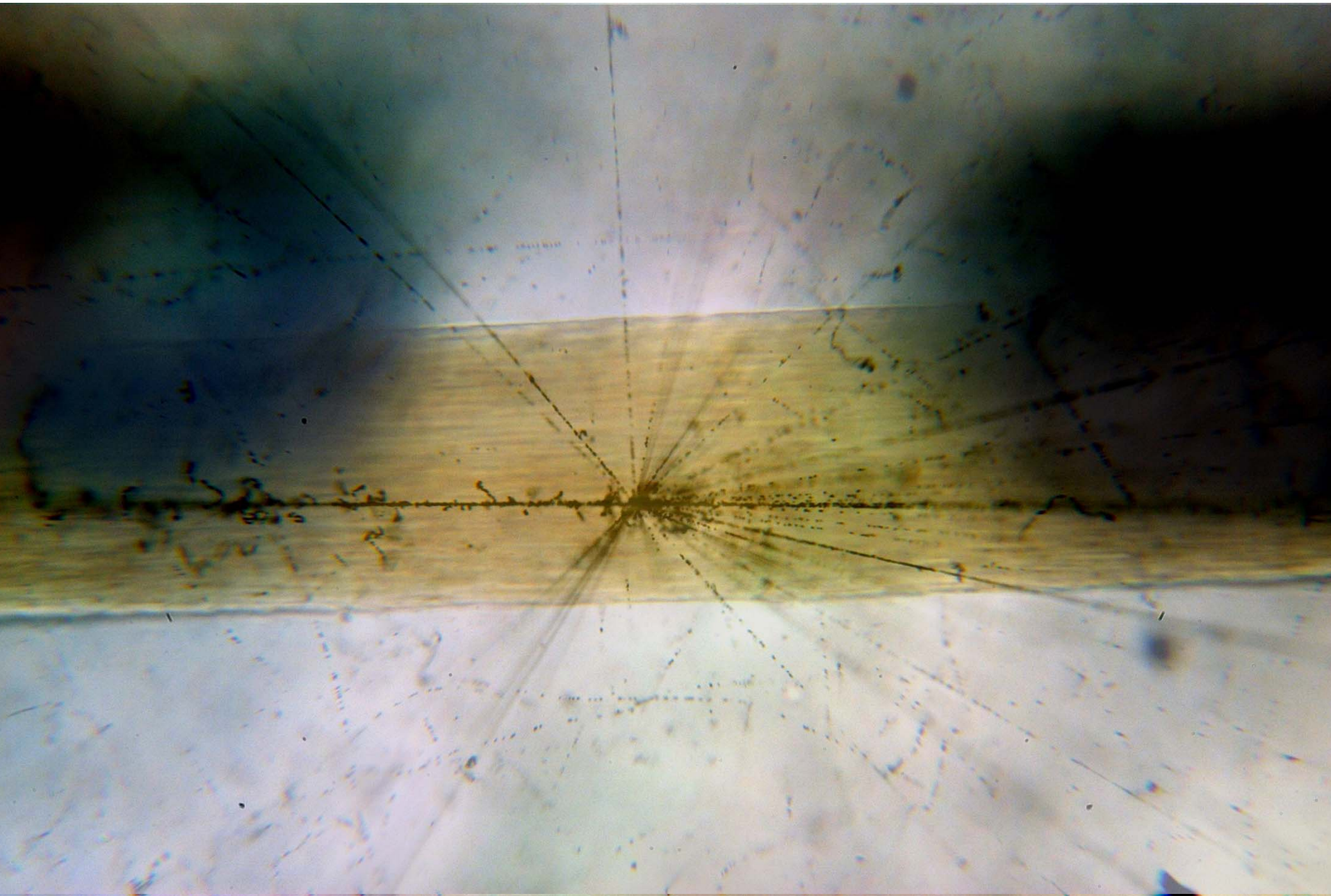
DAINTON and KENT (1950).



**4.5A GeV/c  $^{12}\text{C} \rightarrow 3\alpha$**   
**(Dubna SPhT, early 70-ies)**



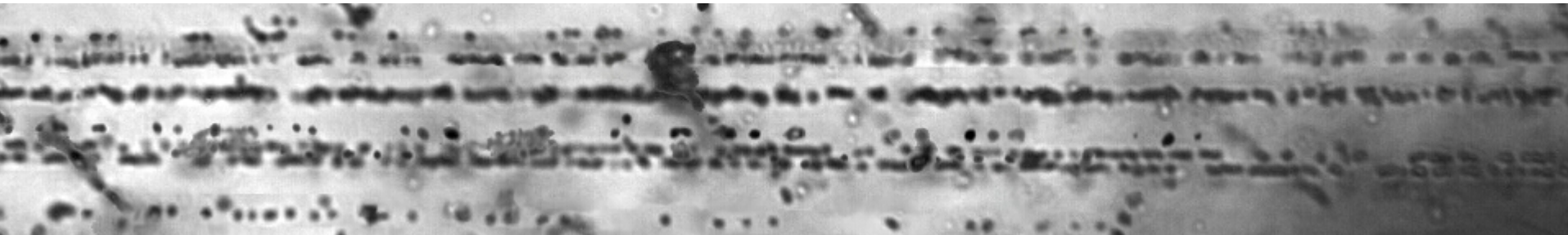
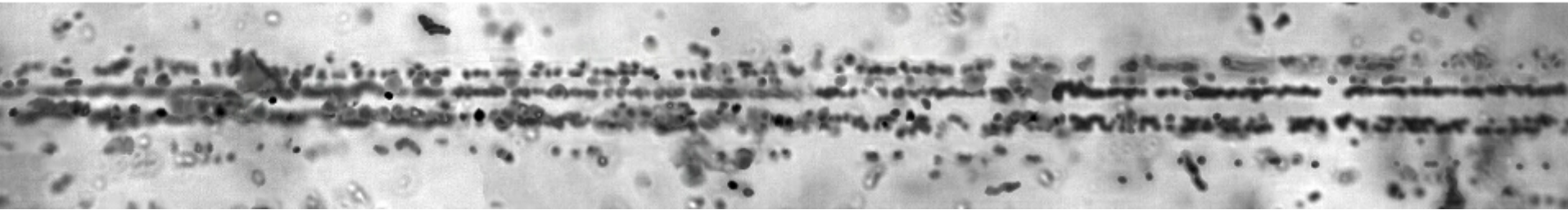
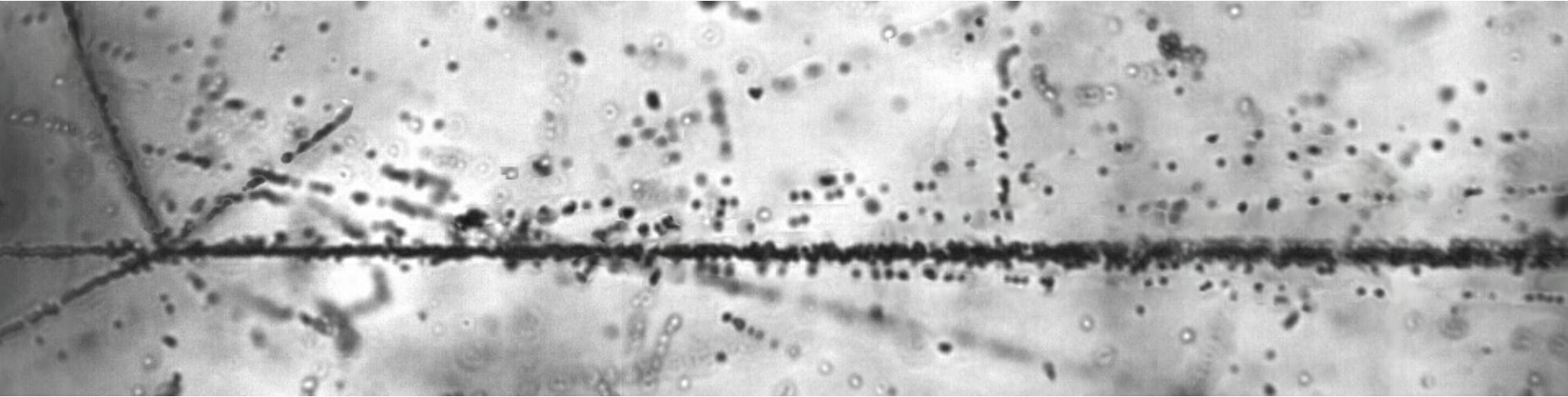


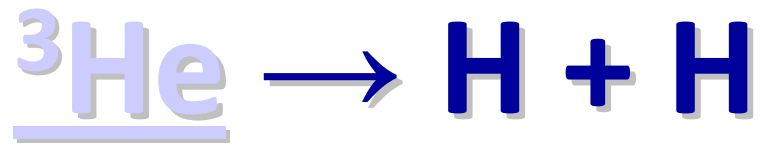
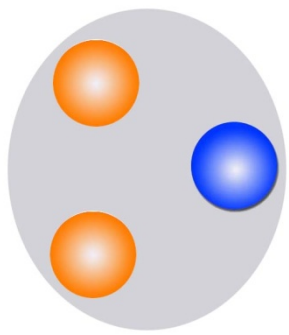




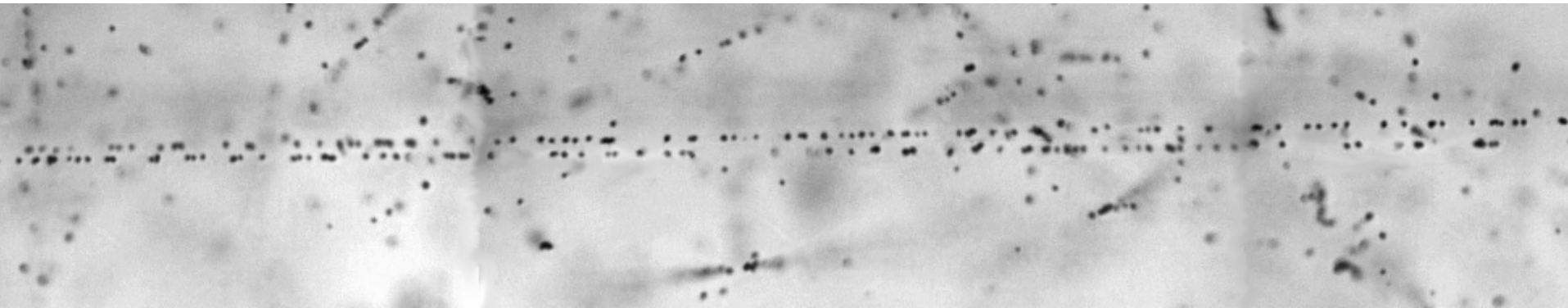
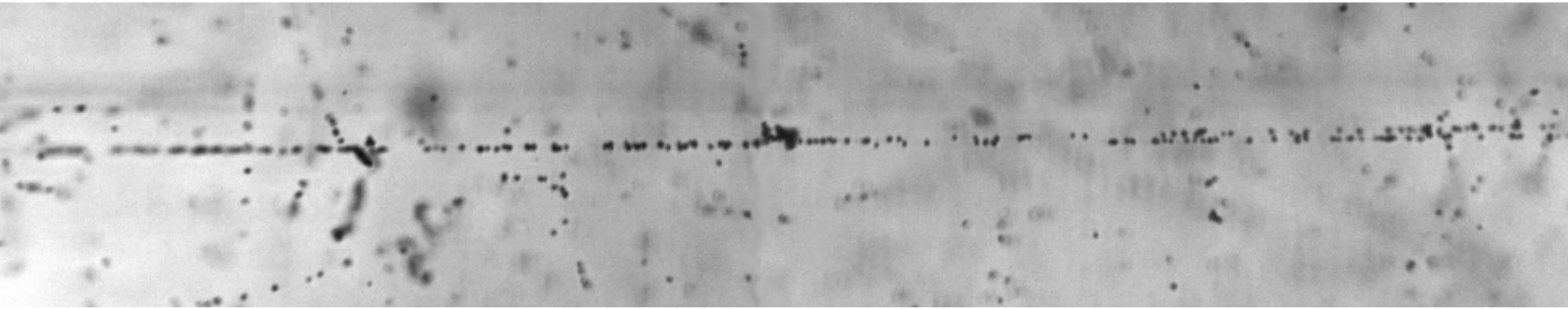
# 3.65A GeV $^{28}\text{Si}$

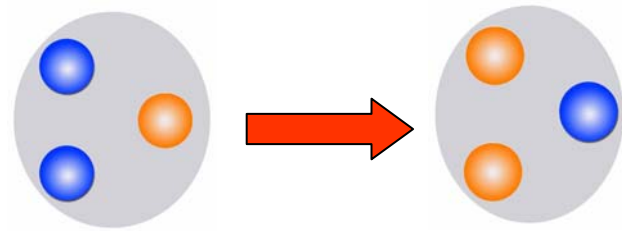
(Dubna SPbT, mid 80-ies)





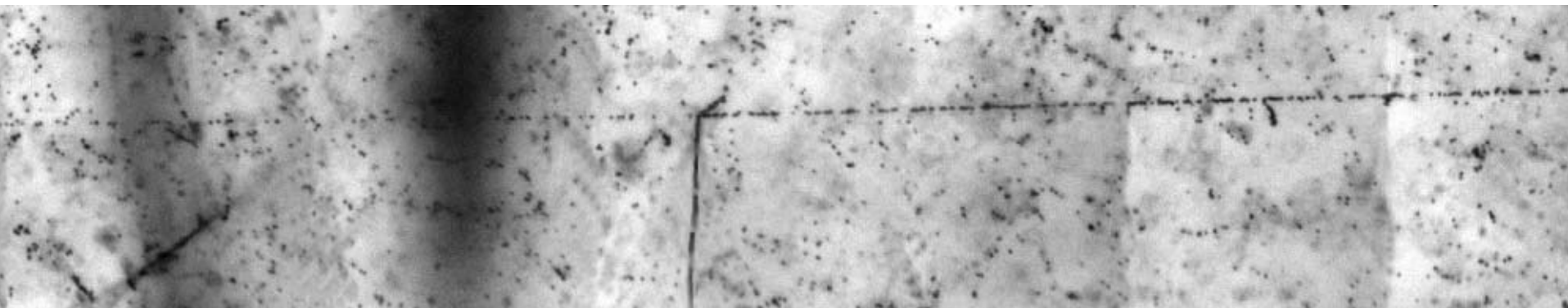
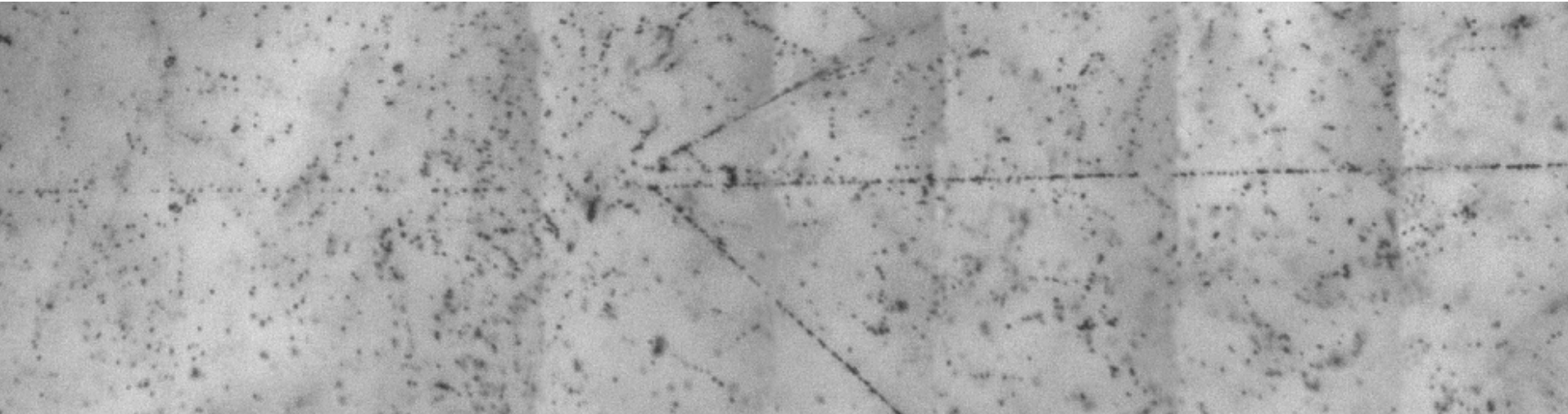
(Dubna SPhT, 80-ies)





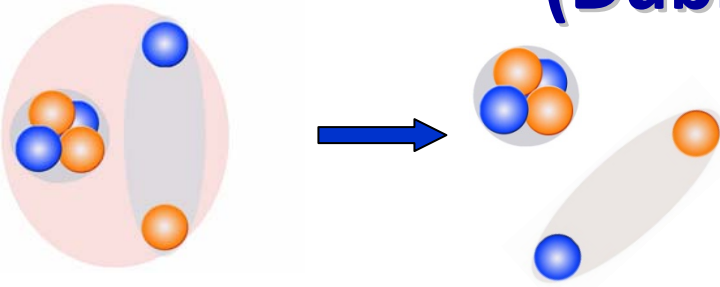
**$2.76\text{A GeV } {}^3\text{H} \rightarrow {}^3\text{He}$**

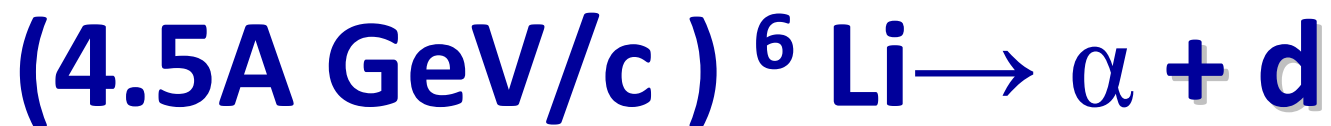
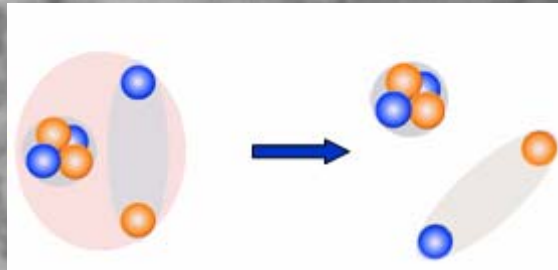
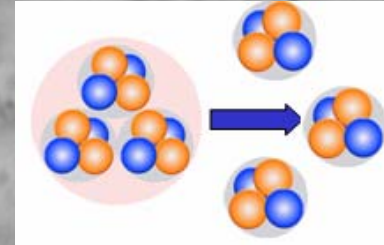
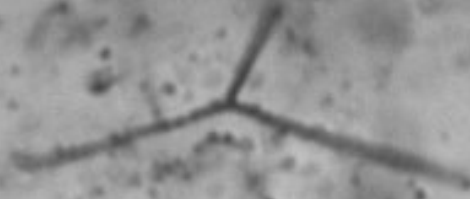
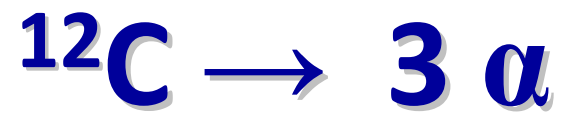
**(Dubna SPhT, late 90-ies)**



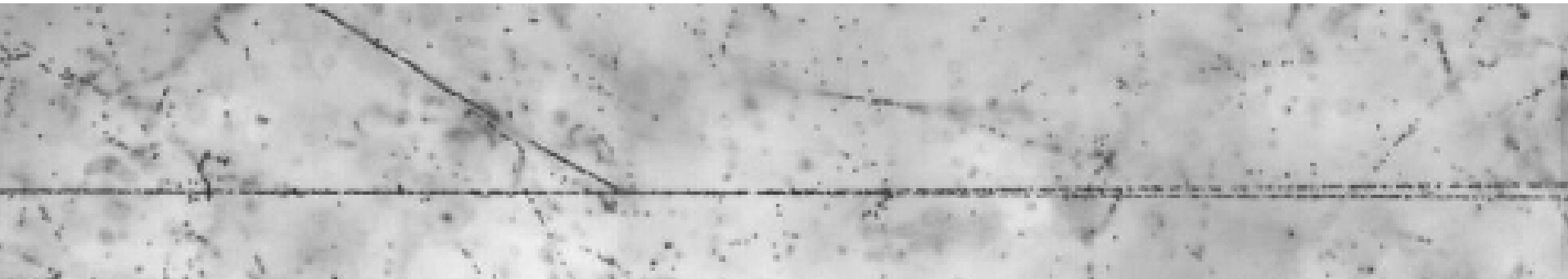
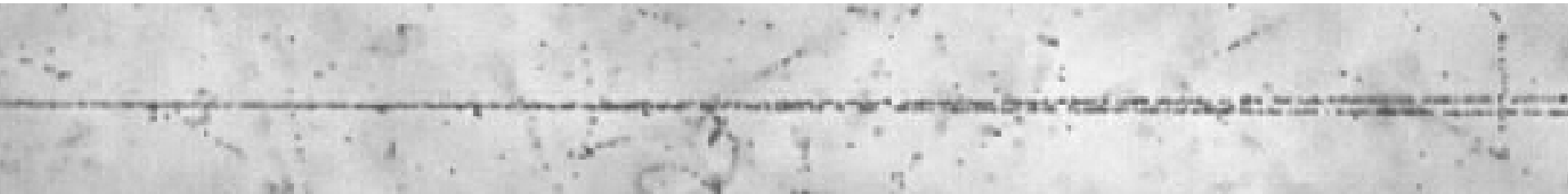
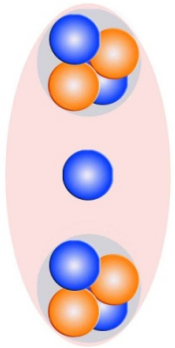
# 4.5A GeV/c ${}^6\text{Li} \rightarrow \alpha + \text{d}$

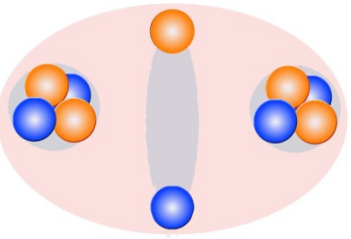
(Dubna SPhT, 80-ies)



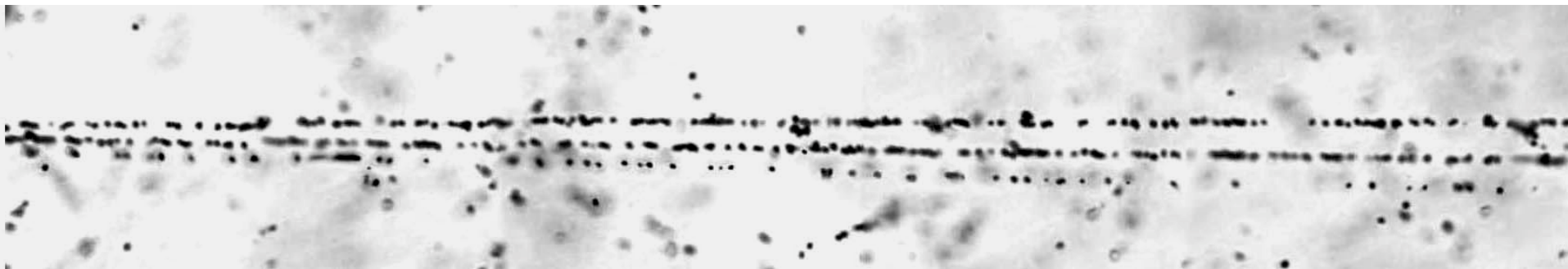


# 1.2 A GeV ${}^9\text{Be} \rightarrow \text{He} + \text{He}$ (Dubna Nuclotron, 2004)



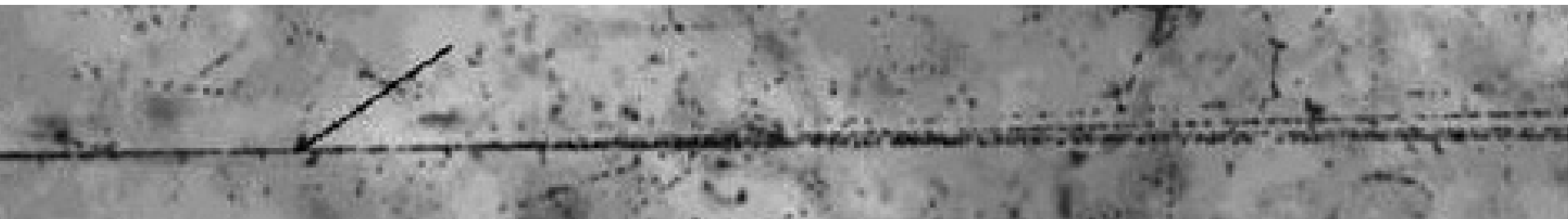
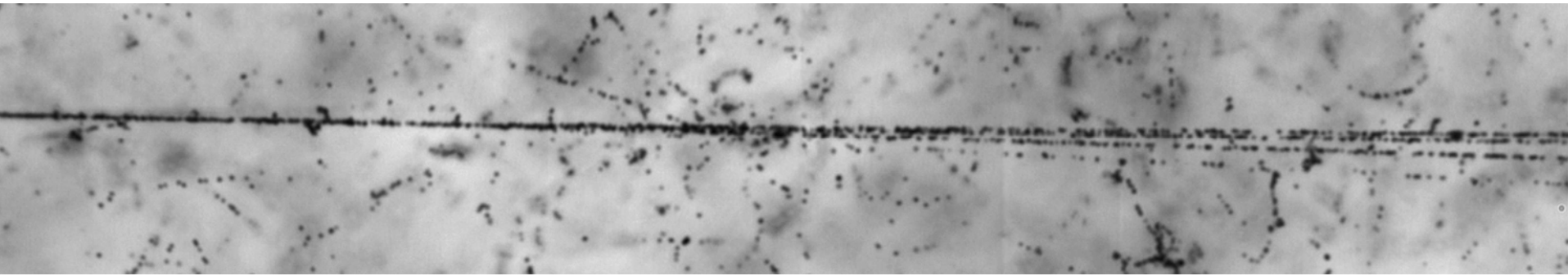


1.0A GeV  $^{10}\text{B} \rightarrow \text{He} + \text{He} + \text{H} -$   
75% (Dubna Nuclotron, 2002)

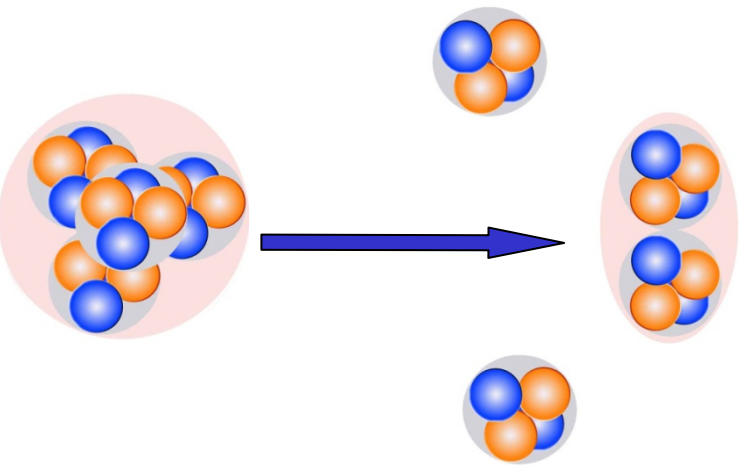


Li + He (4.5 MeV) - 12%

**2.1A GeV  $^{14}\text{N} \rightarrow \text{He} + \text{He} + \text{He} + \text{H}$**   
**(Dubna Nuclotron, 2005)**

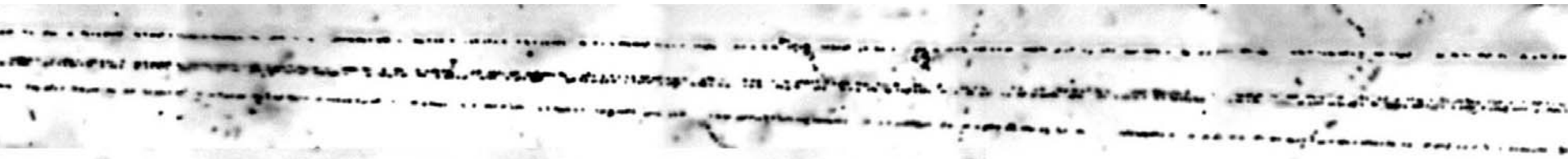
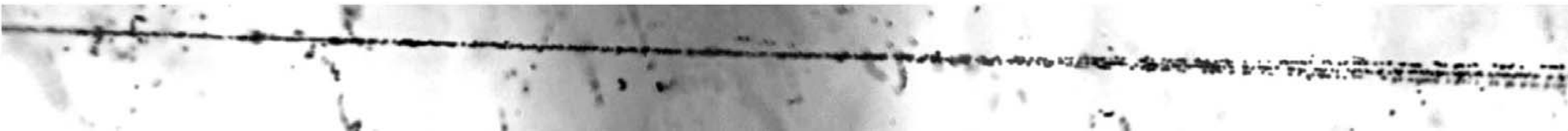


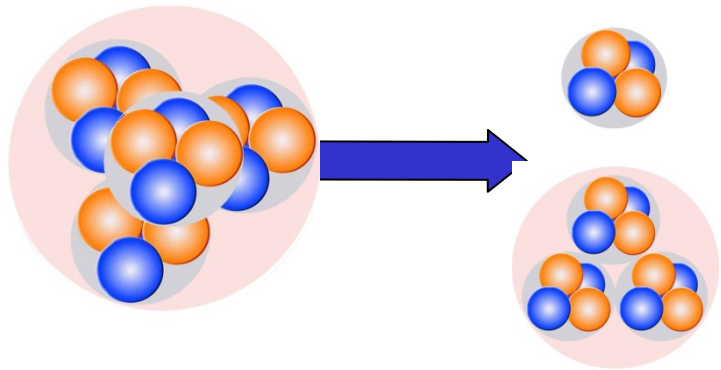




4.5A GeV/c  $^{16}\text{O}$

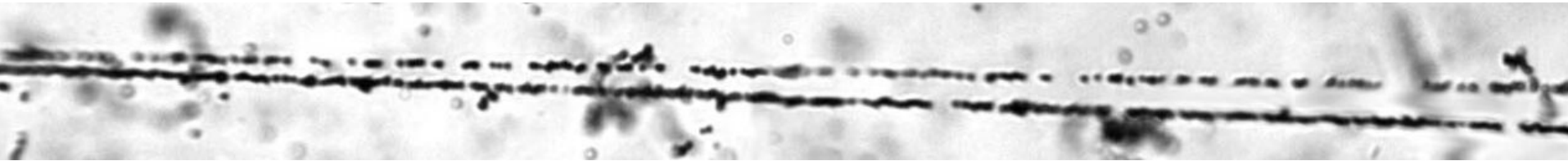
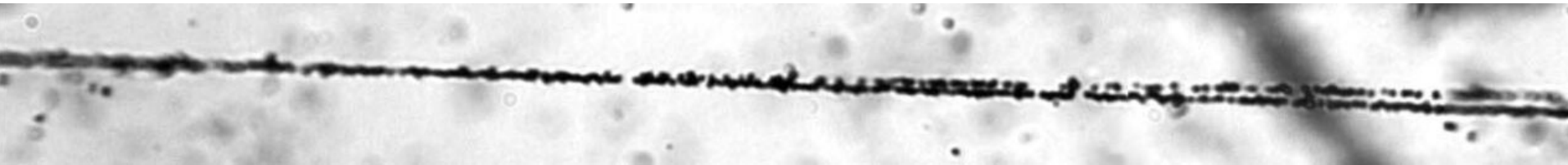
(Dubna SPhT, 70-ies)





4.5 A GeV/c  $^{16}\text{O}$

(Dubna SPhT, 70-ies)



He

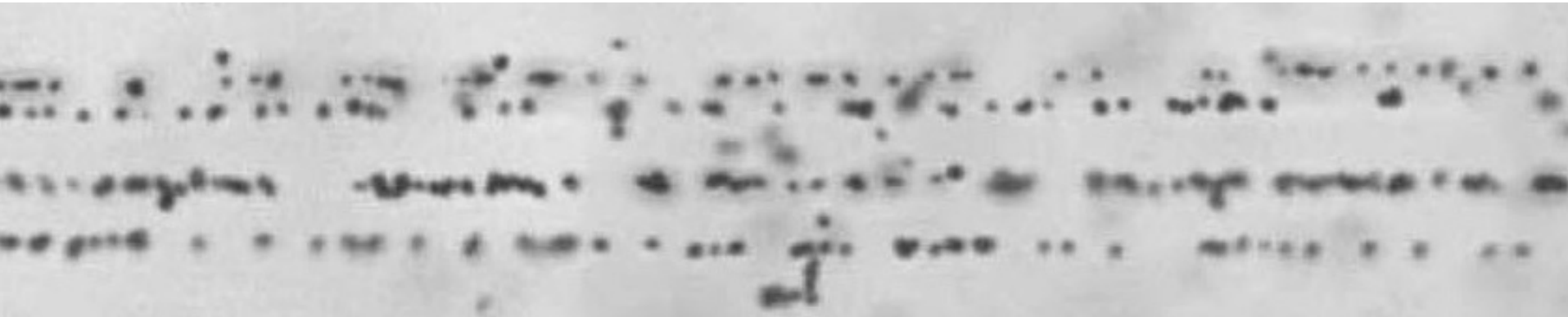
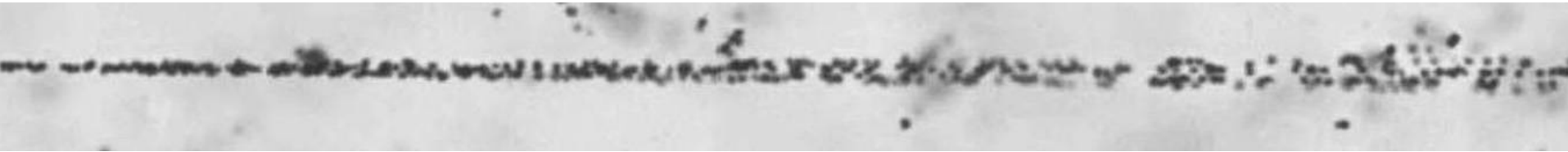
C

3.65A GeV  $^{20}\text{Ne} \rightarrow 5\text{He}$

**(Dubna SPhT, 80-ies)**

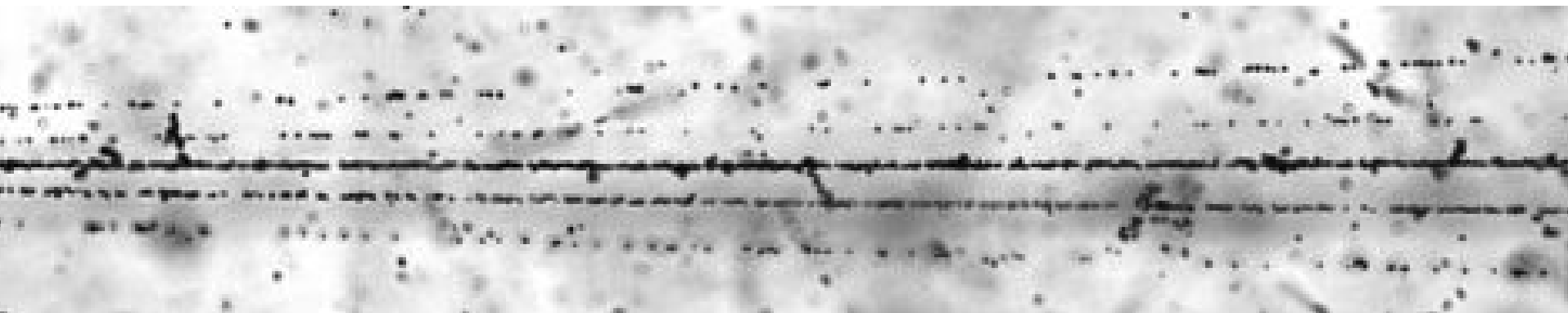
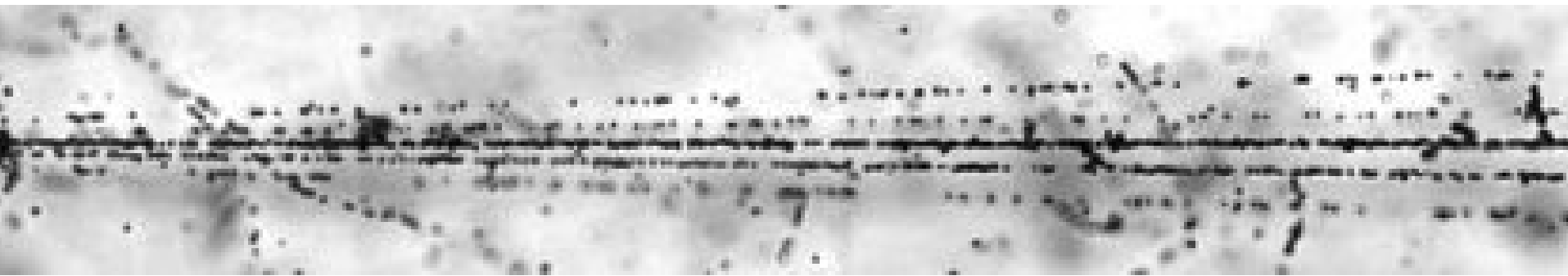
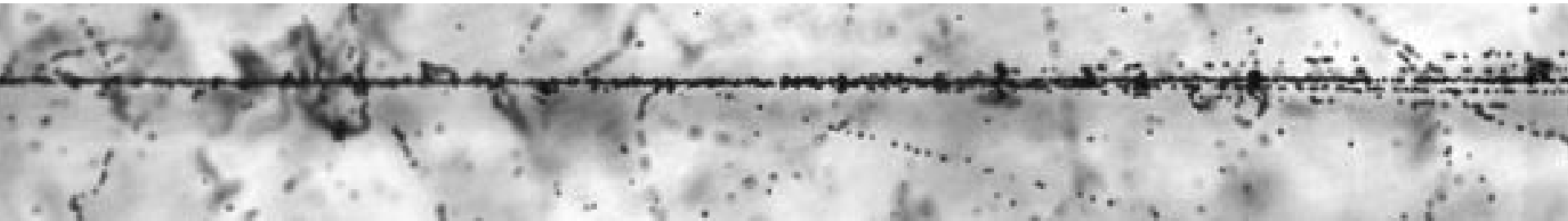


# 3.65A GeV $^{20}\text{Ne} \rightarrow 5\text{He}$



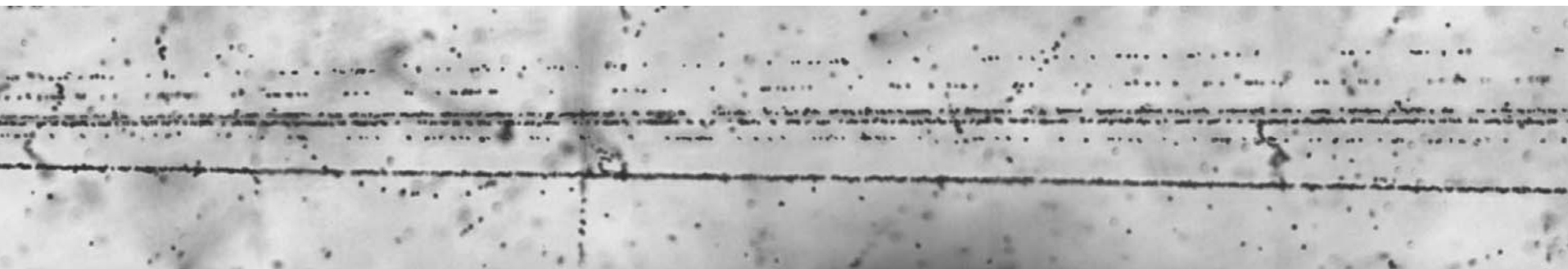
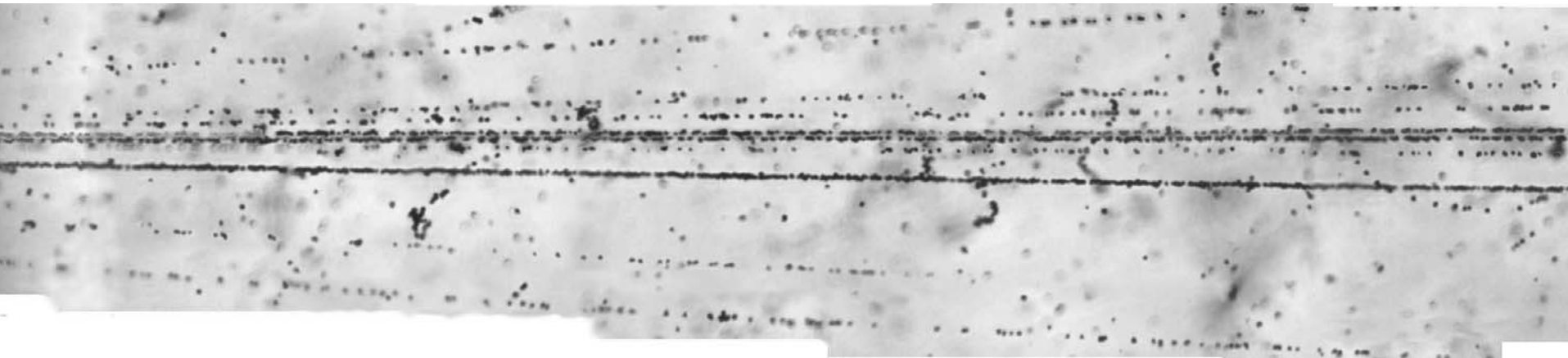
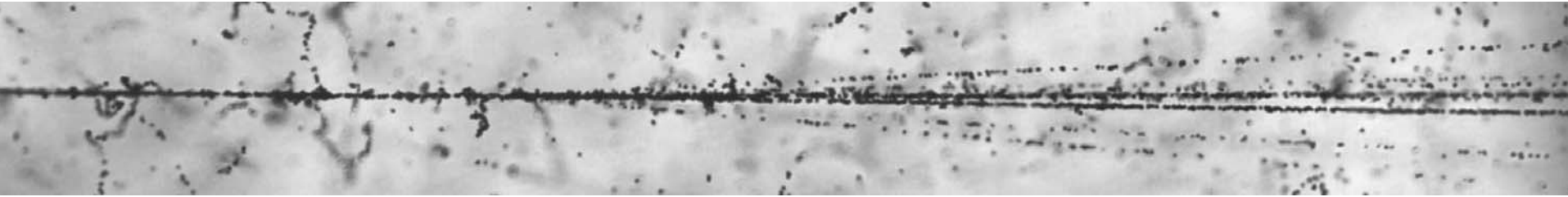
**4.5A GeV/c  $^{24}\text{Mg} \rightarrow \text{N} + \text{He} + 3\text{H}$**

**(Dubna SPhT, 80-ies)**



**4.5A GeV/c  $^{24}\text{Mg} \rightarrow \text{B} + {}^8\text{Be} + 3\text{H}$**

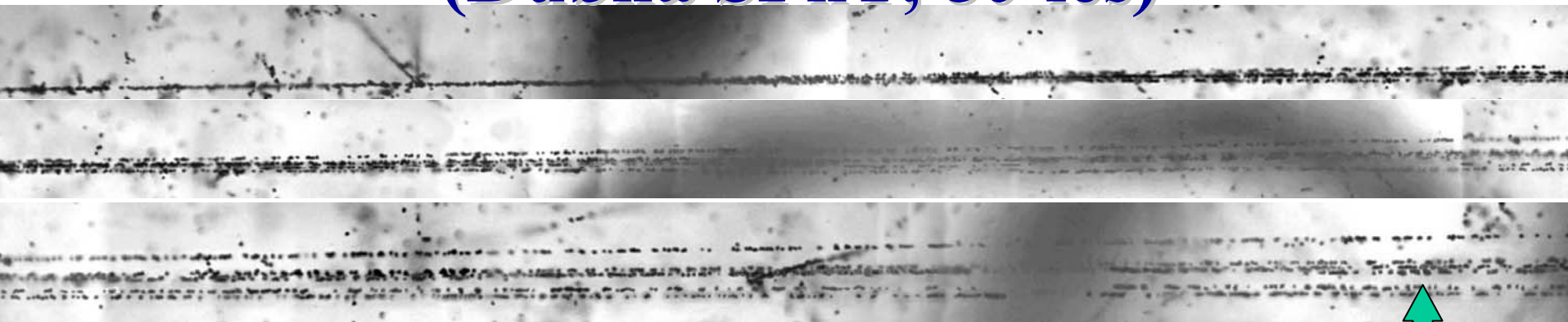
**(Dubna SPhT, 80-ies)**



3.65A GeV  $^{24}\text{Mg} \rightarrow 6\text{He}$

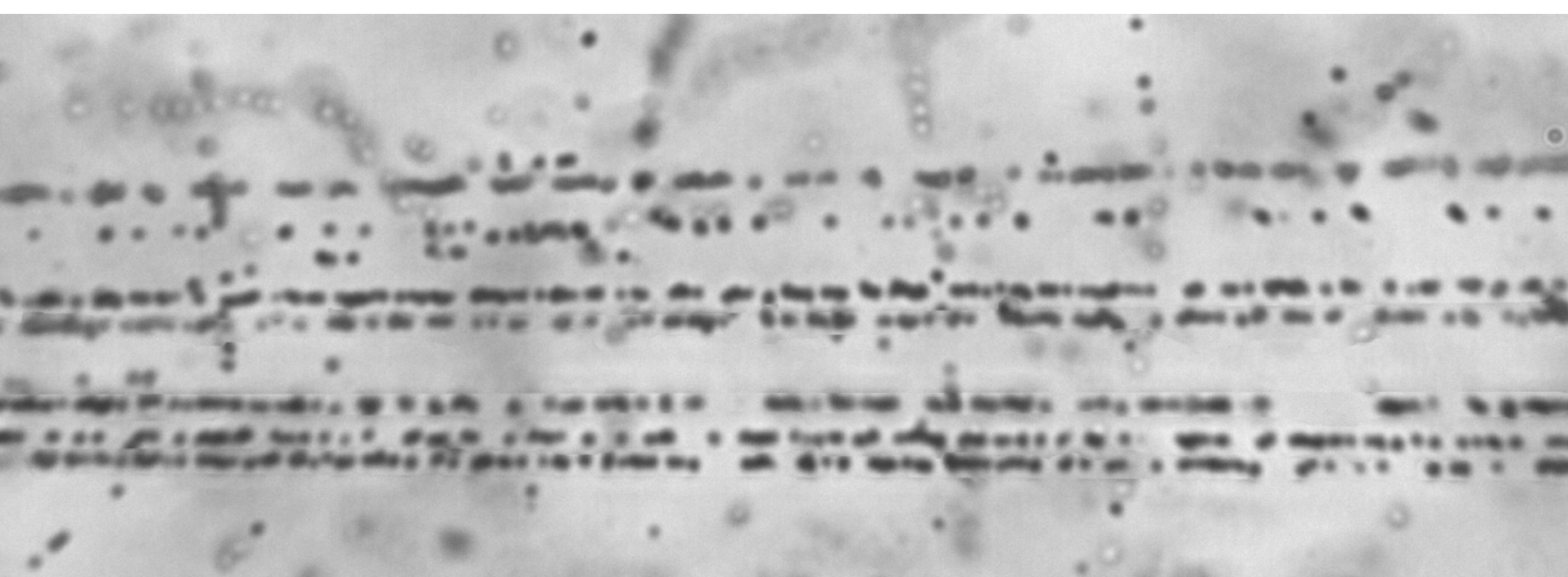
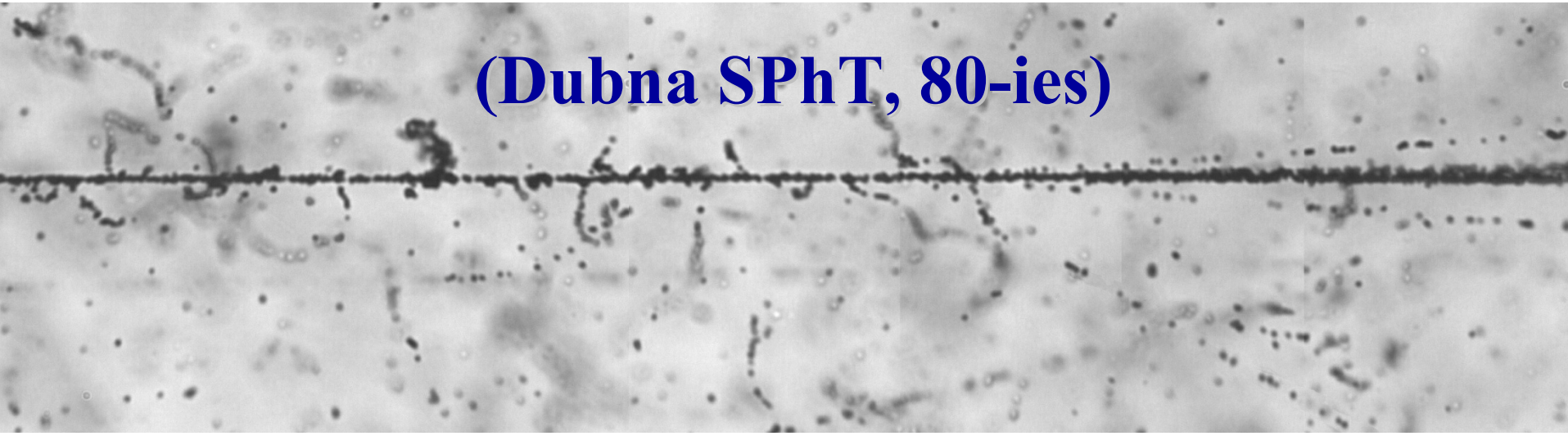


**(Dubna SPhT, 80-ies)**



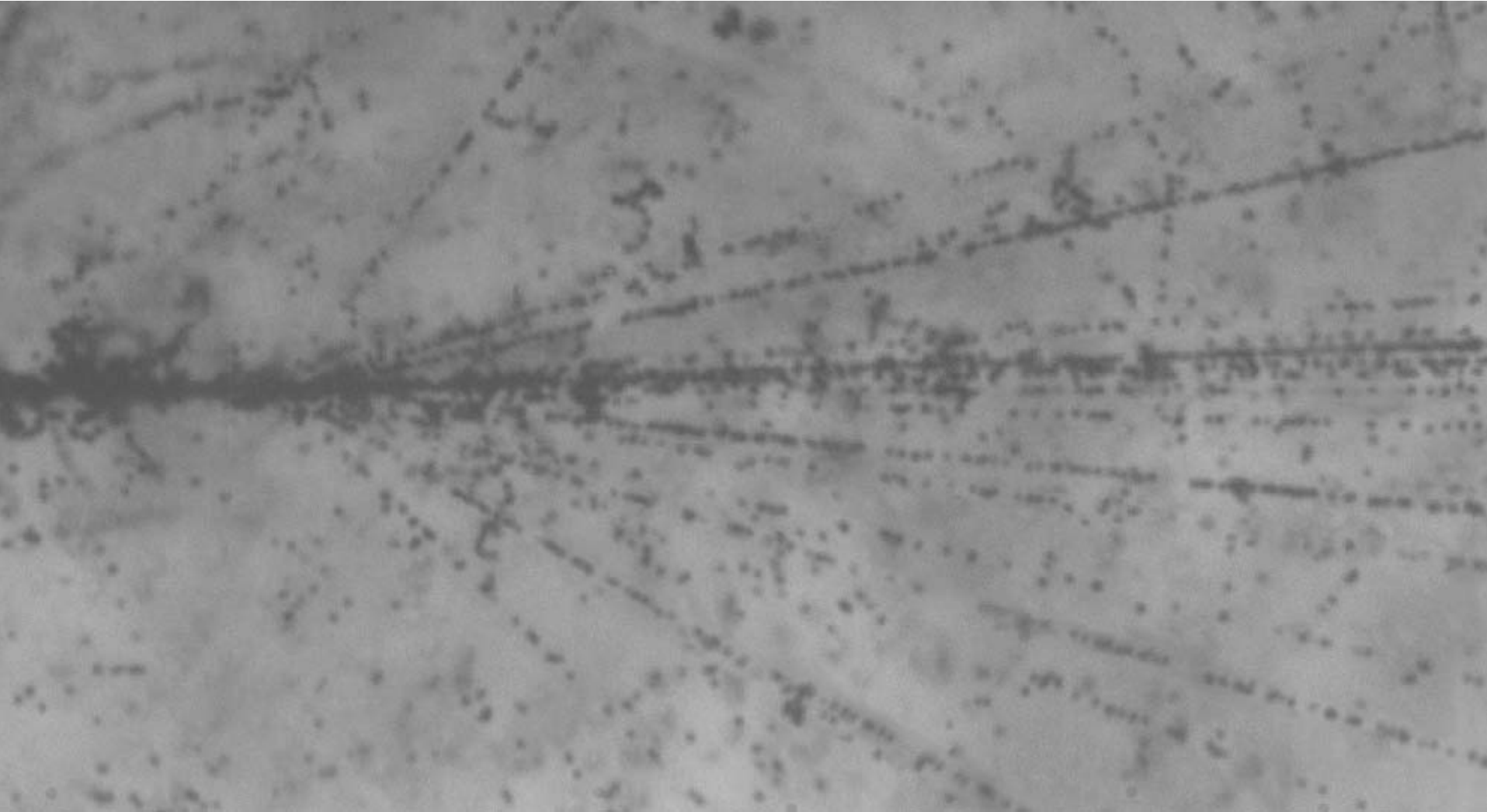
# 3.65A GeV $^{28}\text{Si} \rightarrow 6\text{He} + \text{H}$

(Dubna SPhT, 80-ies)





1A GeV  $^{56}\text{Fe}$   
(Dubna Nuclotron, 2005)



Central

Binary Fission

Very Peripheral with Multifragmentation





# BECQUEREL PROJECT Проект БЕККЕРЕЛЬ

# Beryllium (Boron) Clustering Quest in Relativistic Multifragmentation <http://becquerel.jinr.ru>

slides | papers | contacts | friends | movies | photos | presentations | miscellanea | backup

**Relativistic Multifragmentation**  
Savenko 1970

A.M. Buzin

**Light nucleus formation in relativistic heavy ion collisions**

**Beryllium (Boron) Clustering Quest in Relativistic Multifragmentation**

The BECQUEREL project is devoted to...  
The expected results could make it possible to answer some open questions concerning the cluster structure of light nuclei...

# http://becquerel.jinr.ru

**Clustering leading to the formation of light nuclei**

**Properties of nuclear matter...**

**Clustering in Light Nuclei**

**Optimal Phenomena in Light Nuclei**

**A=6**

**Light Nuclei Dissociation into charge state**

**<sup>12</sup>C dissociation**

**Isotopic composition spectra**

**Cluster states**

**Advantages of relativistic fragmentation in emulsions**

**4.5 GeV <sup>10</sup>B**

**4.5 GeV <sup>10</sup>B Cluster Dissociation**

**PAVICOM**

**Cluster states**

**Clustering in Light Nuclei**

**4.5 GeV <sup>10</sup>B Cluster Dissociation**

...	...	...	...
...	...	...	...

...	...	...	...
...	...	...	...

**2.76A GeV <sup>10</sup>B Cluster Dissociation**

**Dissociation Alpha Clustering in Light Nuclei**