Quasielastic scattering and halo nuclei

S174 collaboration

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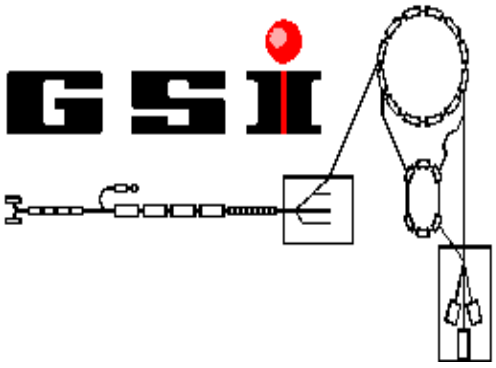
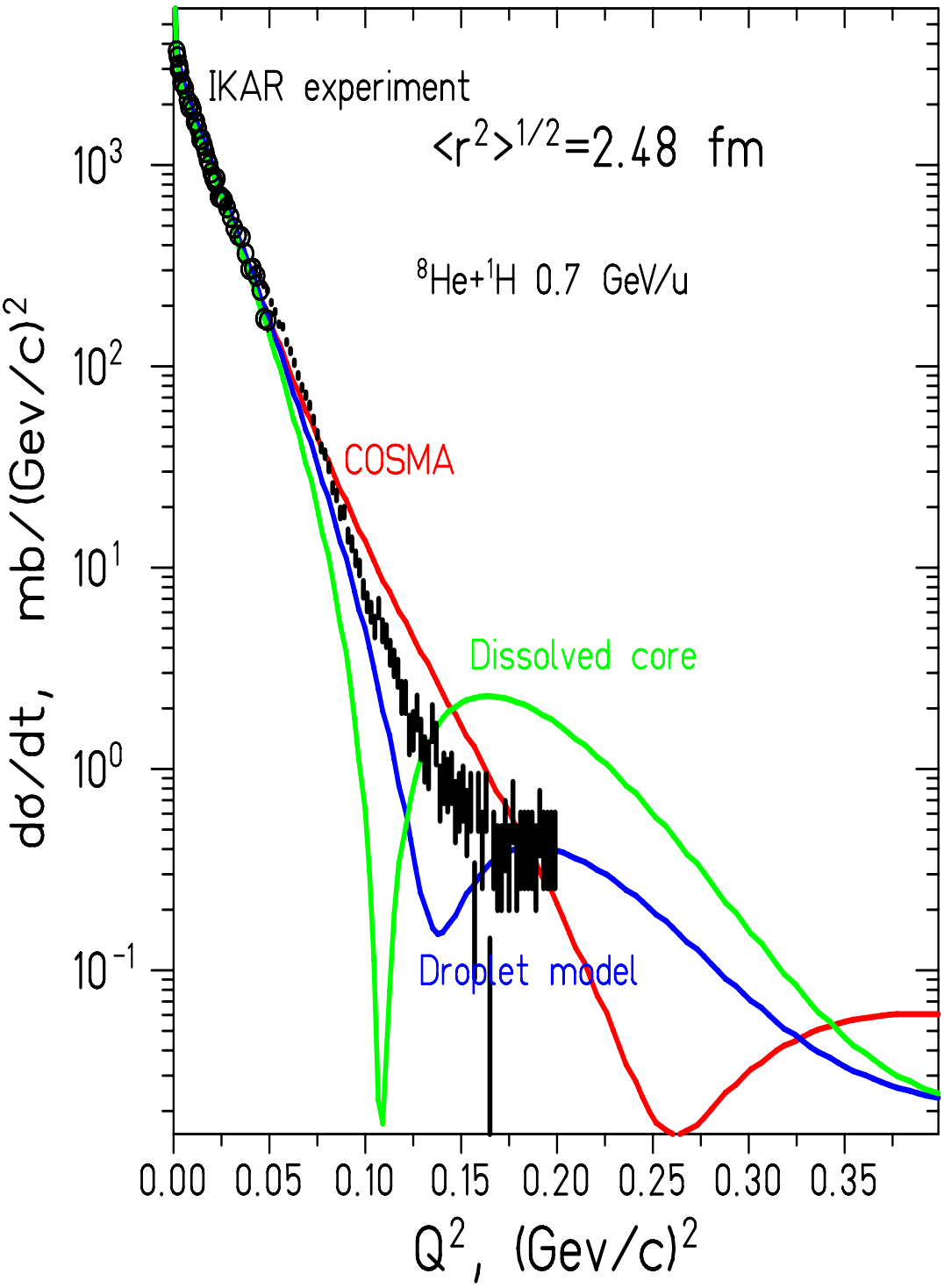


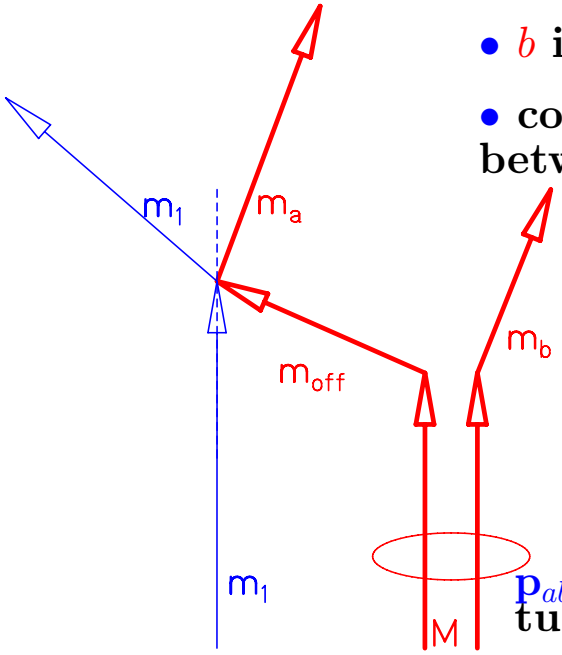
S174 experiment



Inelastic and quasielastic scattering

Quasielastic scattering

$$\frac{d\sigma}{d\Omega_p d\Omega_c dE_p} = S_c \left(\frac{d\sigma}{dQ^2}\right)_{p-c} |\psi(q)|^2$$



- b is a spectator.
- correlations are expected only between 1 and a

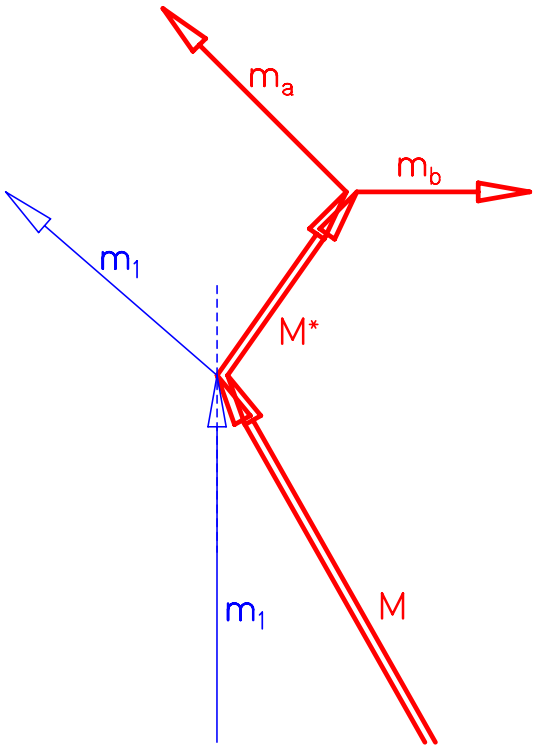
Problem with a heavy cluster:

$$\mathbf{p}_{ab} = \frac{m_a m_b}{m_a + m_b}\left(\frac{\mathbf{p}_a}{m_a} - \frac{\mathbf{p}_b}{m_b}\right)$$

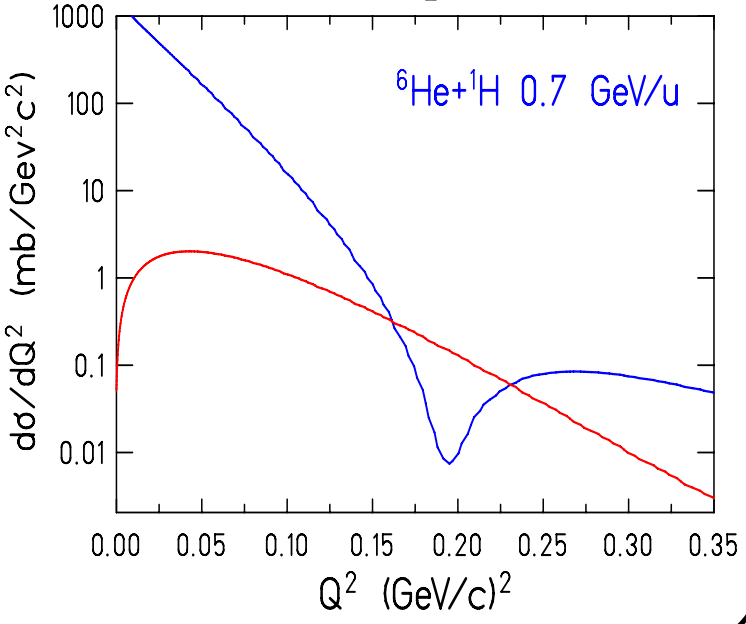
$\mathbf{p}_{ab}$ is small even for a large momentum transfer when a is heavy

$\longrightarrow$ Final state interactions

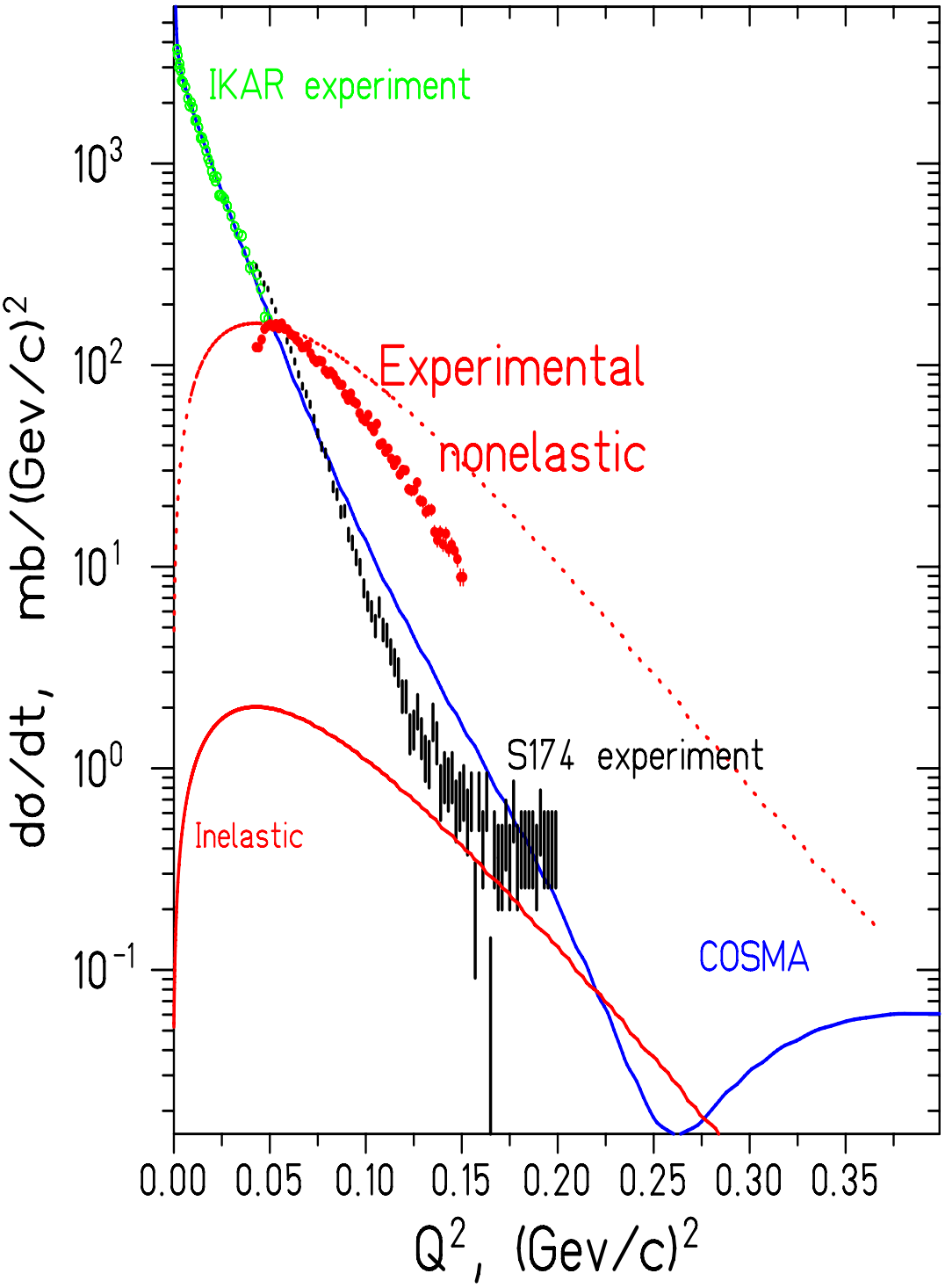
Inelastic scattering



- spectators are absent
- correlations are expected between all the particles



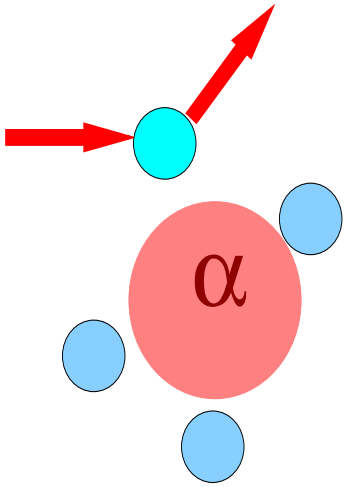
Huge nonelastic contribution

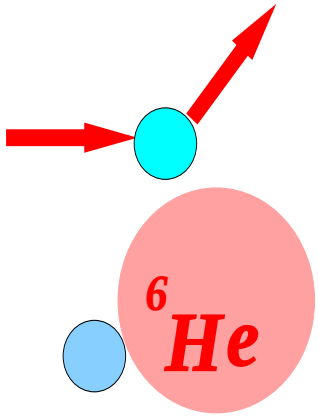


^{8}He structure and quasielastic scattering

$$\frac{d\sigma}{d\Omega_p d\Omega_c dE_p} = S_c \left(\frac{d\sigma}{dQ^2}\right)_{p-c} |\psi(q)|^2$$

Neutron knockout





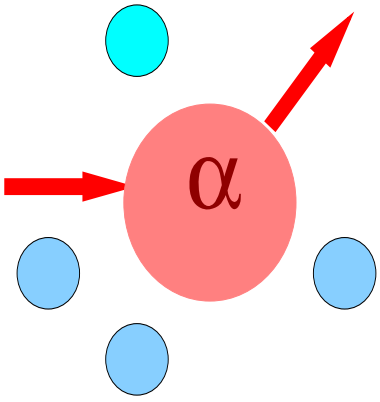
$$\mathbf{p}_{ab} = \frac{m_a m_b}{m_a + m_b}\left(\frac{\mathbf{p}_a}{m_a} - \frac{\mathbf{p}_b}{m_b}\right)$$

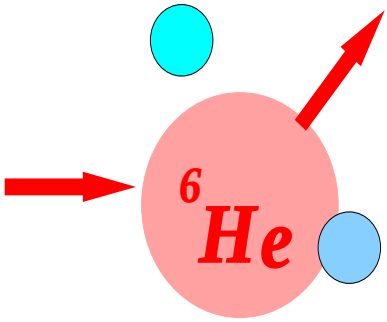
$\mathbf{p}_{ab}$ is small even for a large momentum transfer when a is heavy

$\longrightarrow$ Final state interactions

Quasielastic scattering (shake off)

S.Karataglidis et al., PRL79(1997)1447
R.Crespo et al., NPA689(2001)559c

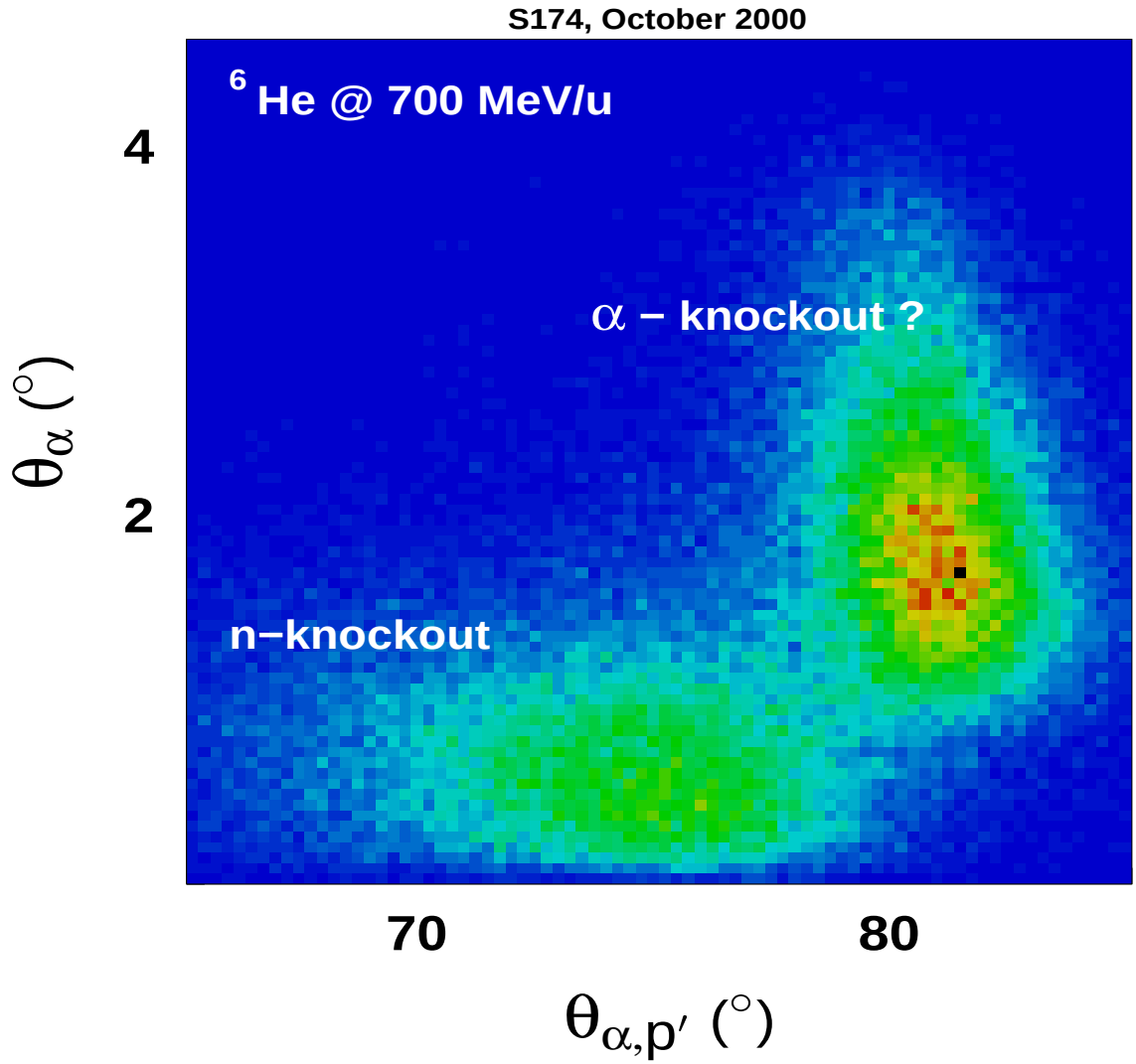




Butterfly

Butterfly is any of attractive objects with broad

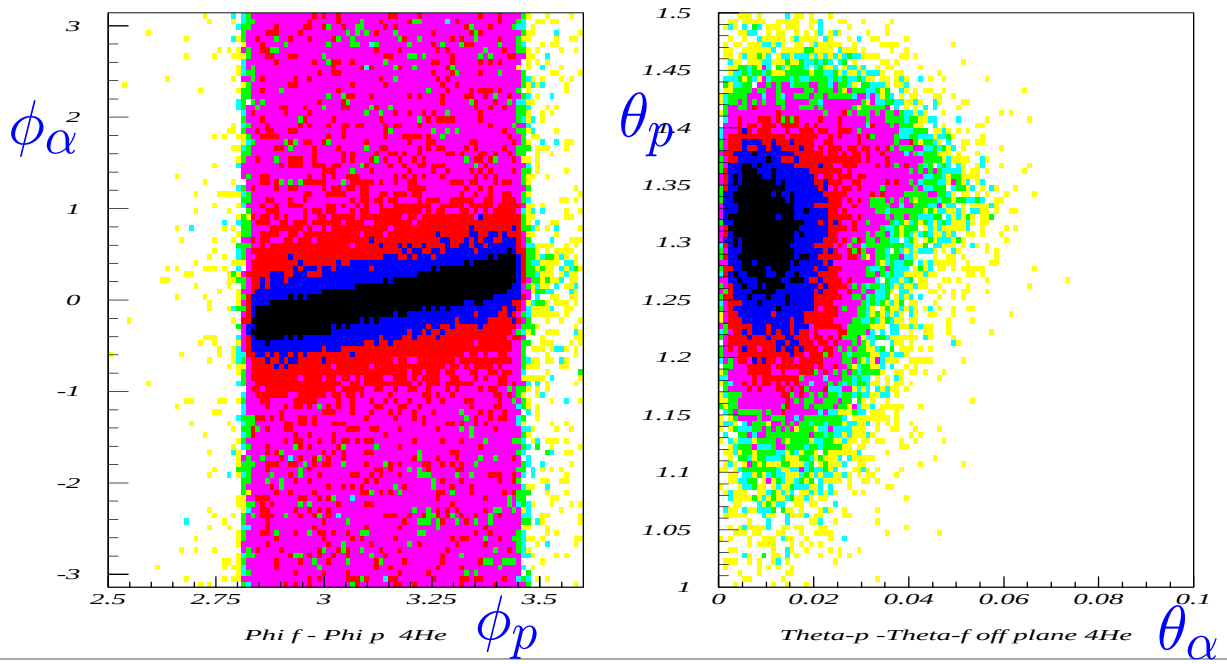
often brightly colored wings



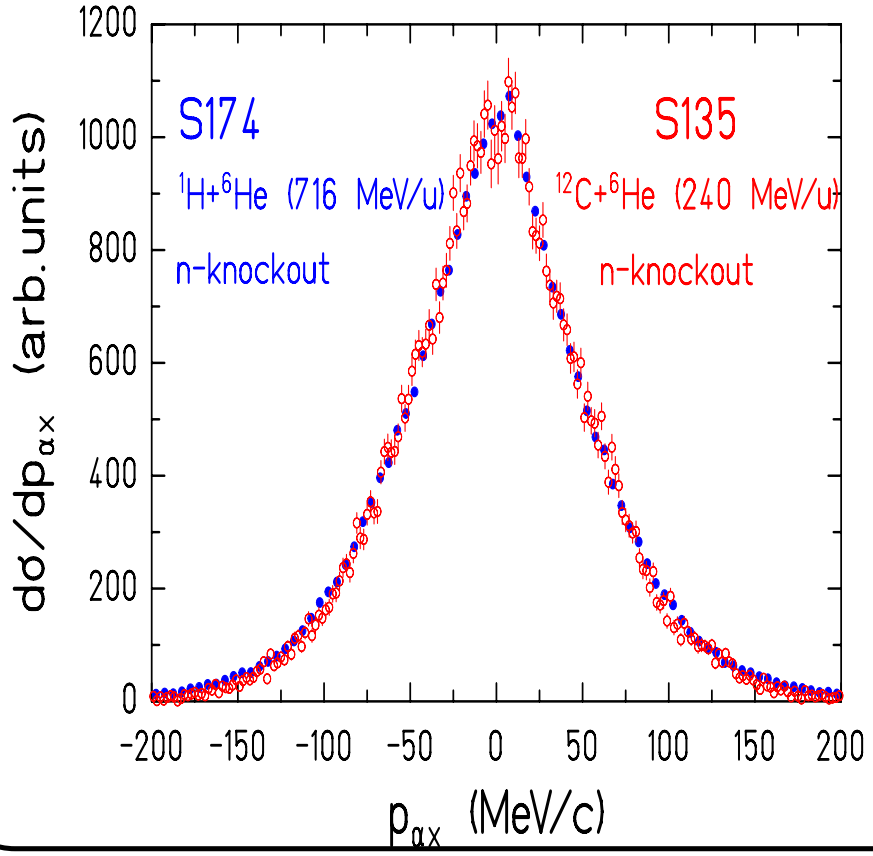
- Right wing - α does not show any correlations with proton -could be neutron knockout
- Left wing - correlations between α and proton are well pronounced - straightforward conclusion can not be made

One neutron knockout

Mainly off-plane events



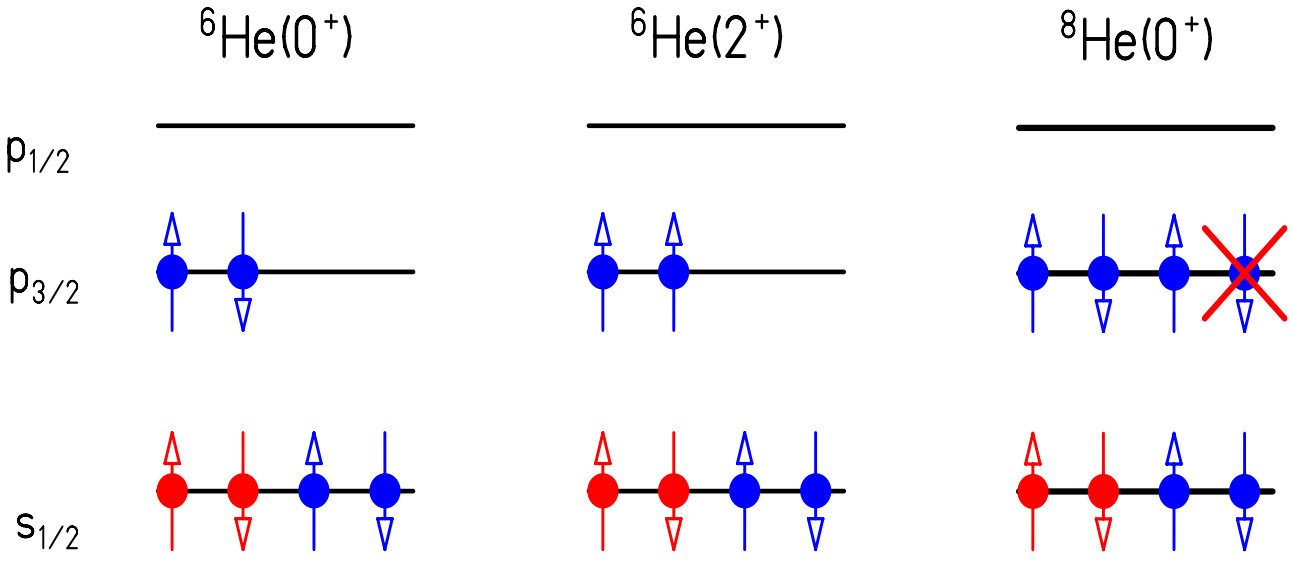
$$p_x = p_0 Sin(\theta_\alpha) Cos(\phi_\alpha)$$



One neutron knockout

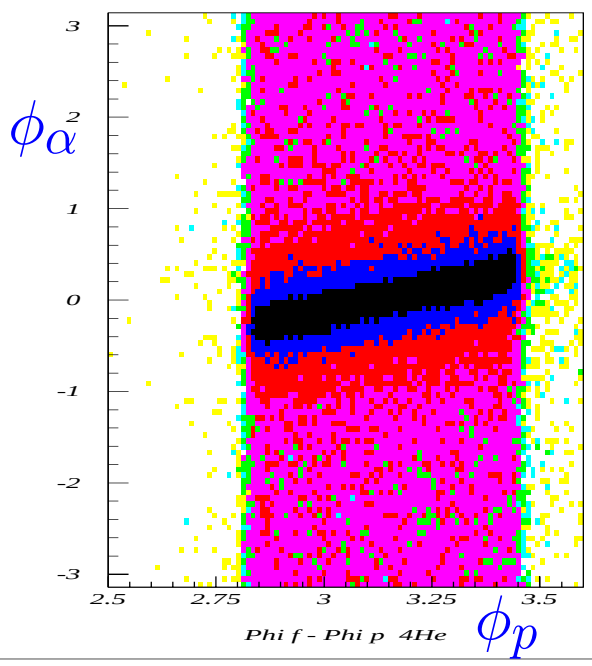
Fragment	Beam particles: ^{8}He	^{6}He
	PRELIMINARY DATA	
^{4}He	4.4 mb	12.0 mb
	PRELIMINARY DATA	
^{6}He	14.3 mb	
	PRELIMINARY DATA	

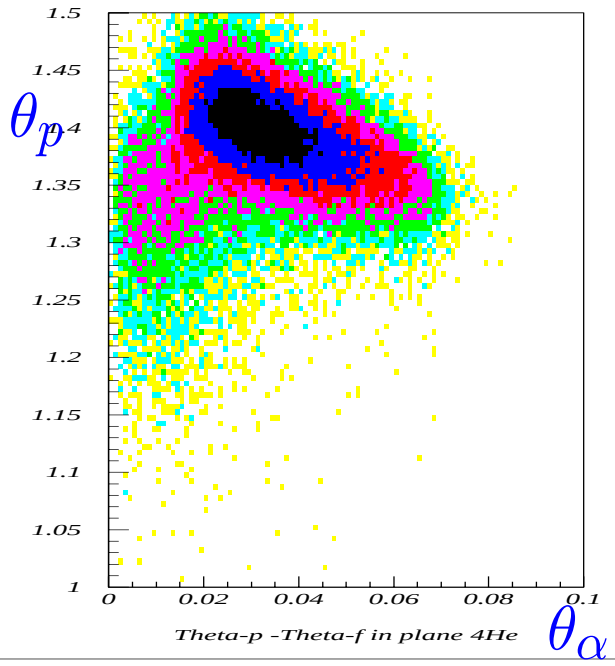
^{8}He $\longrightarrow \approx 75$ % of ^{6}He+2n configuration!



Heavy cluster knockout

Mainly in-plane events





Beam particles

Fragment	^{8}He	^{6}He	^{4}He
	PRELIMINARY DATA		
^{4}He	3.0 mb	9.2 mb	13.9 mb
	PRELIMINARY DATA		
^{6}He	8.2 mb	7.1 mb	
	PRELIMINARY DATA		
^{8}He	9.2 mb		

^{8}He $\longrightarrow \approx 75$ % of ^{6}He+2n configuration!

Perspectives

The easiest way to exotic nuclei

$$^{8}He \longrightarrow \alpha +^{4} n$$

$$^{9}Li \longrightarrow \alpha +^{5} H$$

$$^{11}Li \longrightarrow \alpha +^{7} H$$

$$^{14}Be \longrightarrow \alpha +^{10} He$$

^{6}He as a neutron target for (p,n) scattering at relativistic energies and large momentum transfer