

Clustering of light nuclei and electron screening in astrophysical environments



How to start a physics collaboration overseas?

How to start a physics collaboration overseas?

e-mail

-----Original Message-----

From: <spitaleri@lns.infn.it>

Date: Mon, 5 Jan 2015 15:19:08 +0100

To: "Carlos.Bertulani" <carlos.bertulani@tamuc.edu>

Subject: Re: alignment

Dear Carlota,
AUGURI BUON ANNO.

I regret not having been able to say goodbye before you left.

I apologize but but when I got to the lab I found you.

. . .

I send you the draft of the paper. There are the total idea.
You can operate your cuts and changes.
I send for this reason the copy of the tex.

There are many observation about the disagreement between the
Theoretical limit (adiabatic) and the U_e from the experiment.

. . .

Desejos para um feliz ano novo para você e sua esposa

Ciao

Claudio

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Be clear



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ask for input

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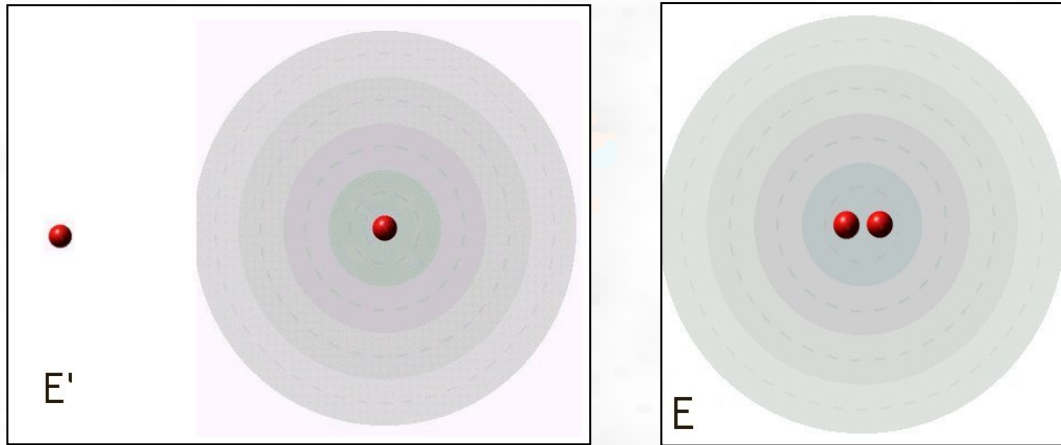
Claudio

Be clear

Tell your idea,
ask for input

Use Google Translate

Electron screening (in the laboratory)

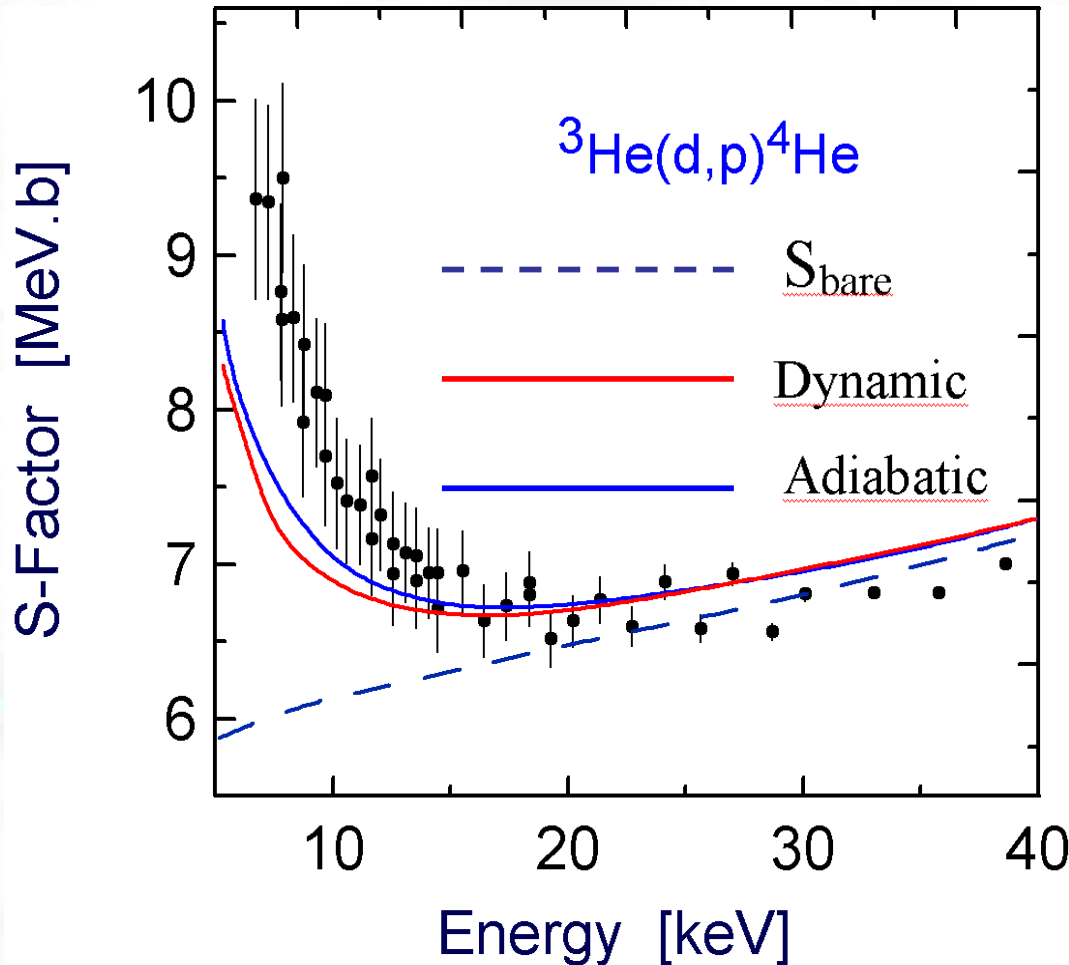


UNOTICED TILL 1989!

Adiabatic model: $\Delta E = E' - E$

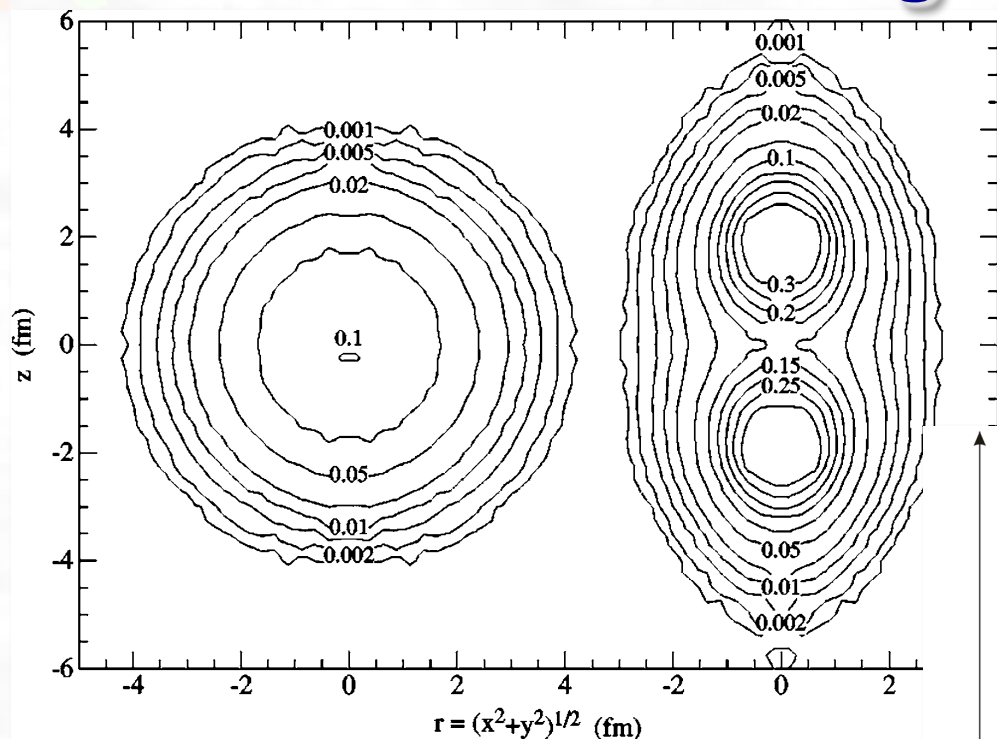
$$\sigma_{\text{lab}}^{\text{fusion}} \sim \sigma_{\text{bare}}(E + \Delta E)$$

$$\sim \exp\left[\pi\eta(E)\frac{\Delta E}{E}\right] \sigma_{\text{bare}}(E)$$



Reaction	U_e^{adlim} (eV)	U_e^{exp} (eV)
${}^2\text{H}(d, t){}^1\text{H}$	14	19.1 ± 3.4
${}^3\text{He}(d, p){}^4\text{He}$	65	109 ± 9
${}^3\text{He}(d, p){}^4\text{He}$	120	219 ± 7
${}^3\text{He}({}^3\text{He}, 2p){}^4\text{He}$	240	305 ± 90
${}^6\text{Li}(d, \alpha){}^4\text{He}$	175	330 ± 120
${}^6\text{Li}(d, \alpha){}^4\text{He}$	175	330 ± 49
${}^6\text{Li}(p, \alpha){}^3\text{He}$	175	440 ± 150
${}^6\text{Li}(p, \alpha){}^3\text{He}$	175	355 ± 67
${}^7\text{Li}(p, \alpha){}^4\text{He}$	175	300 ± 160
${}^7\text{Li}(p, \alpha){}^4\text{He}$	175	363 ± 52
${}^9\text{Be}(p, \alpha_0){}^6\text{Li}$	240	788 ± 70
${}^{10}\text{B}(p, \alpha_0){}^7\text{Li}$	340	376 ± 75
${}^{11}\text{B}(p, \alpha_0){}^8\text{Be}$	340	447 ± 67

Clustering in light nuclei



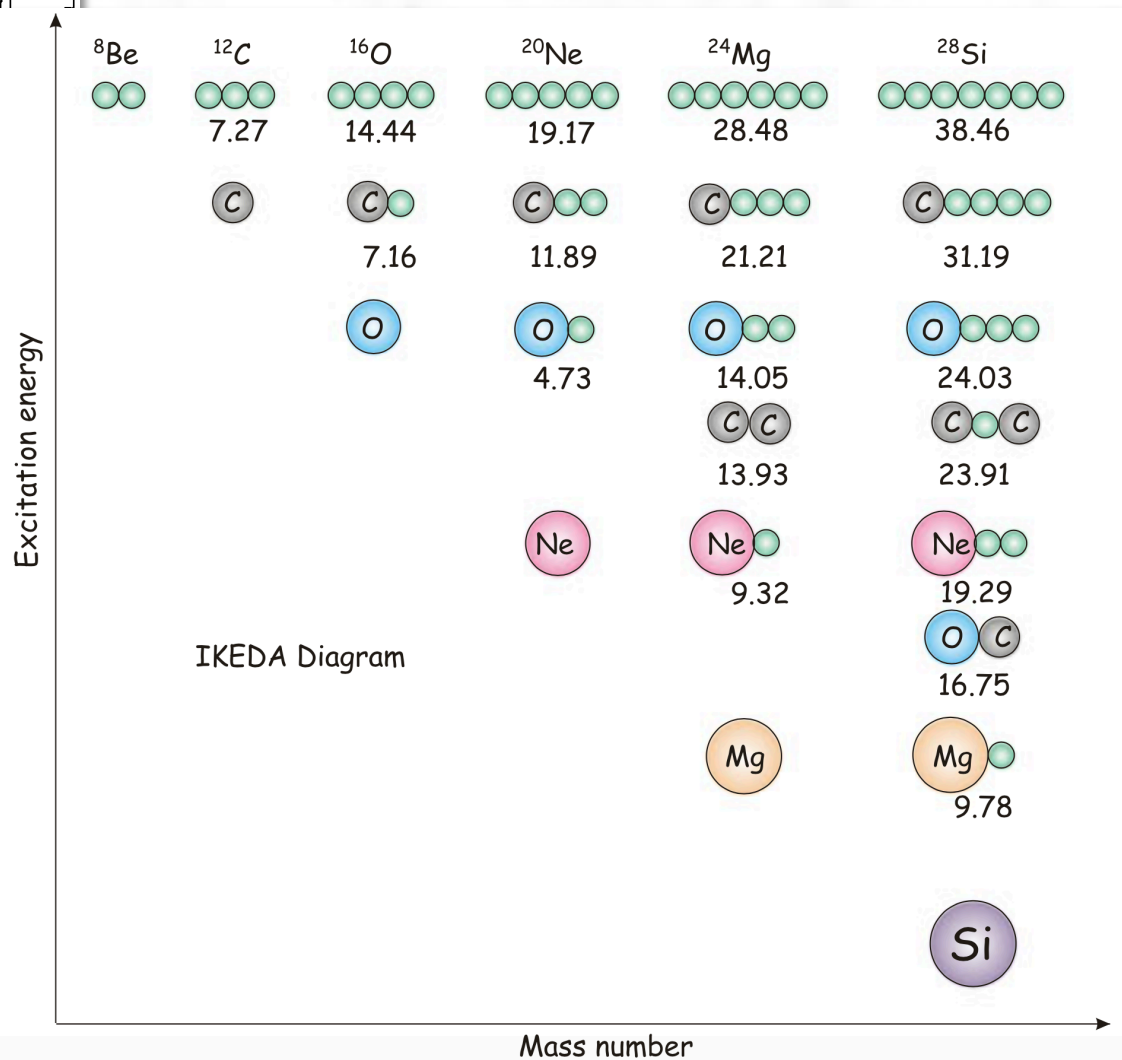
Density of ^8Be :

(a) laboratory, (b) intrinsic frame

Wiringa, Pieper, Carlson, Pandharipande,
PRC 62, 014001 (2000)

Ikeda diagram

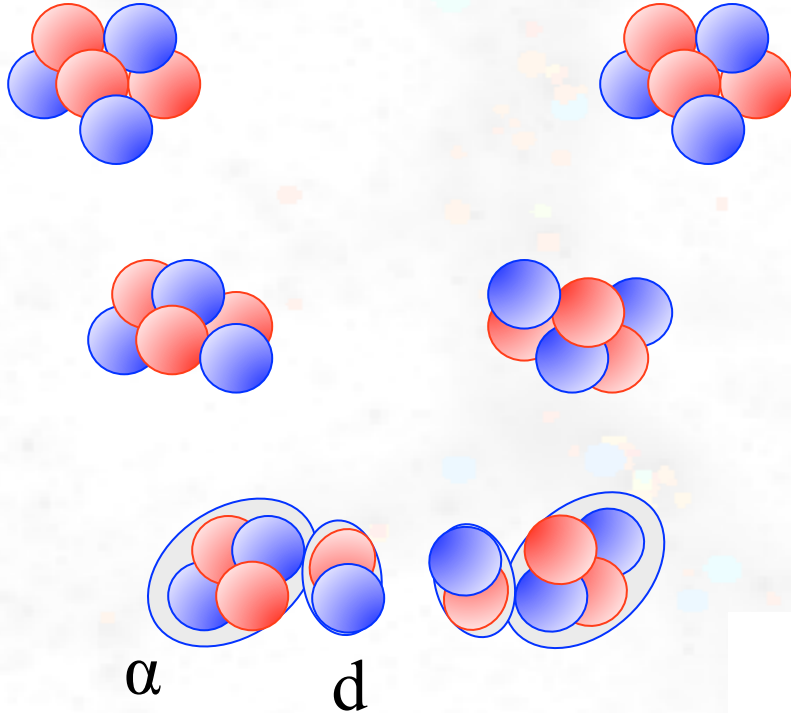
Cluster degree of freedom as
the excitation energy increases



M. Freer

IV Euroschool on Exotic Beams

Nuclear clustering in reactions



$$|\psi\rangle = \alpha|\psi_A\rangle + \beta|\psi_a\psi_B\rangle + \gamma|\psi_c\psi_D\rangle + \dots$$

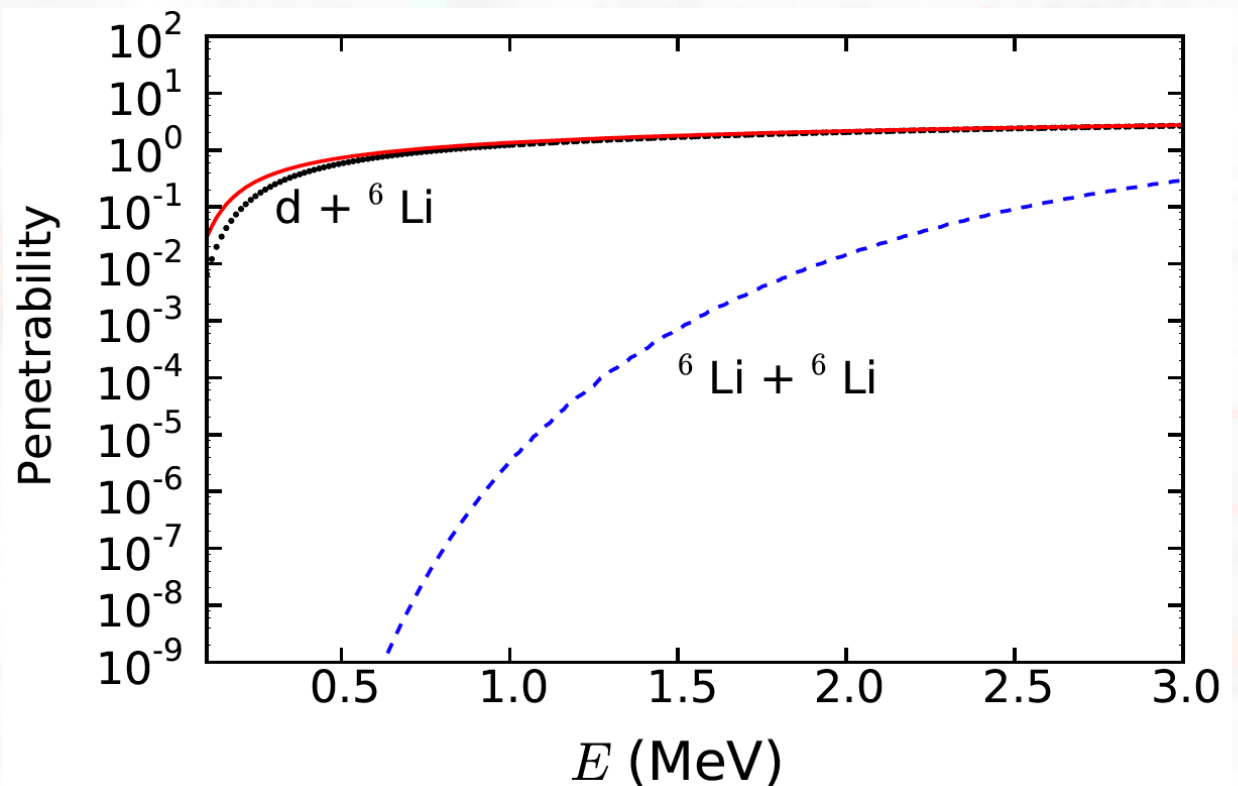
$$\sigma_L = C_{66}P_{6_{\text{Li}+6_{\text{Li}}}} + C_{26}P_{d+6_{\text{Li}}} + \dots$$

$$\frac{P_{6_{\text{Li}+6_{\text{Li}}}}}{P_{d+6_{\text{Li}}}} \xrightarrow{k \rightarrow 0} 0$$

But ${}^6\text{Li} + {}^6\text{Li}$ puzzle:

$$\sigma({}^6\text{Li} + {}^6\text{Li} \rightarrow 3\alpha) \neq 0$$

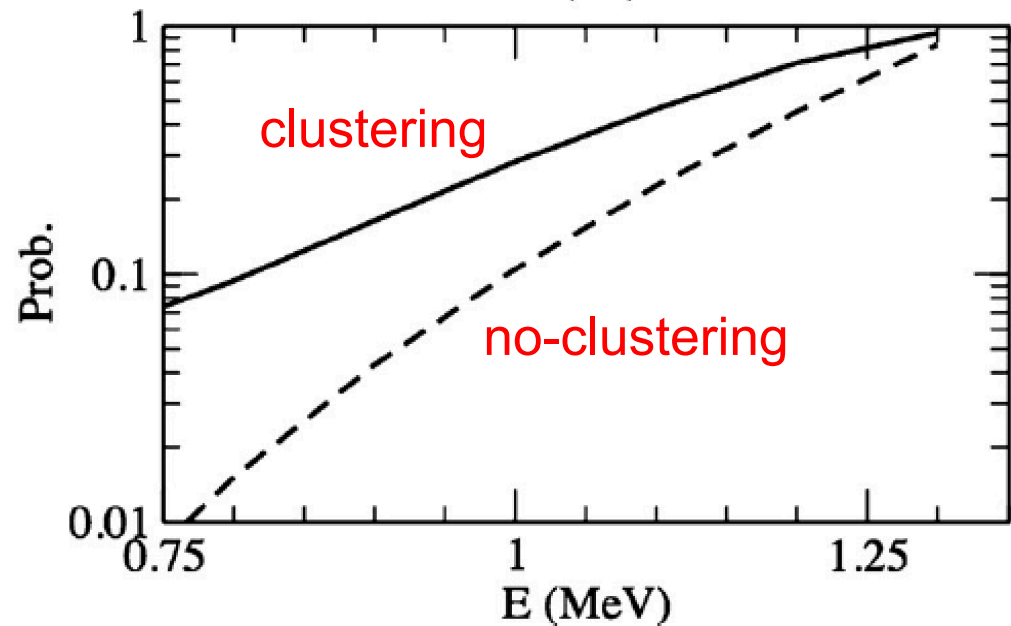
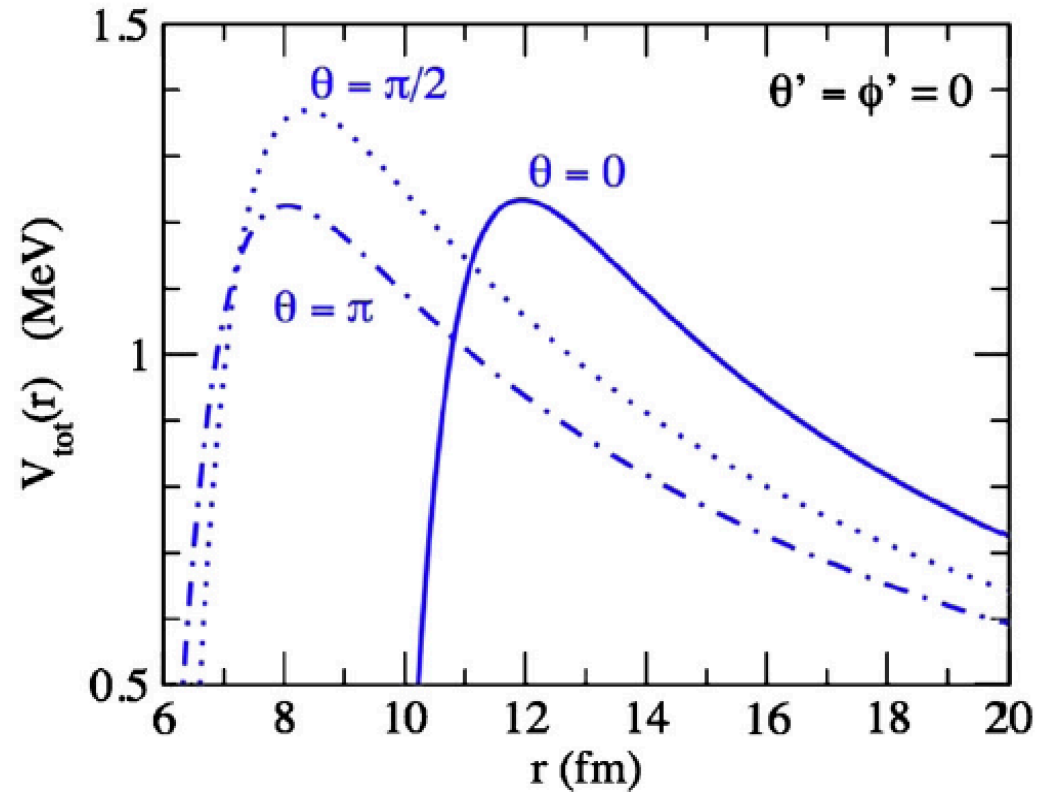
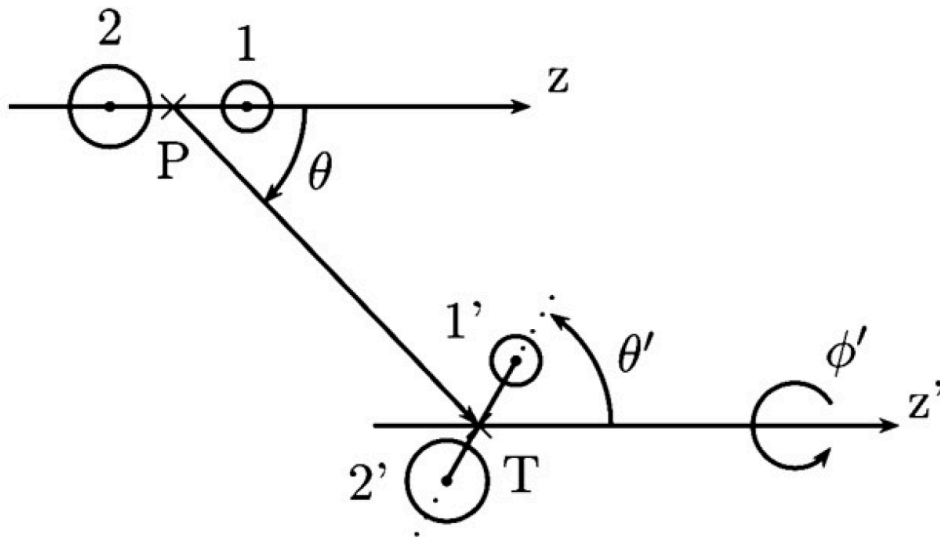
Lattuada, et al.,
Z. Phys. A 330, 183 (1988)



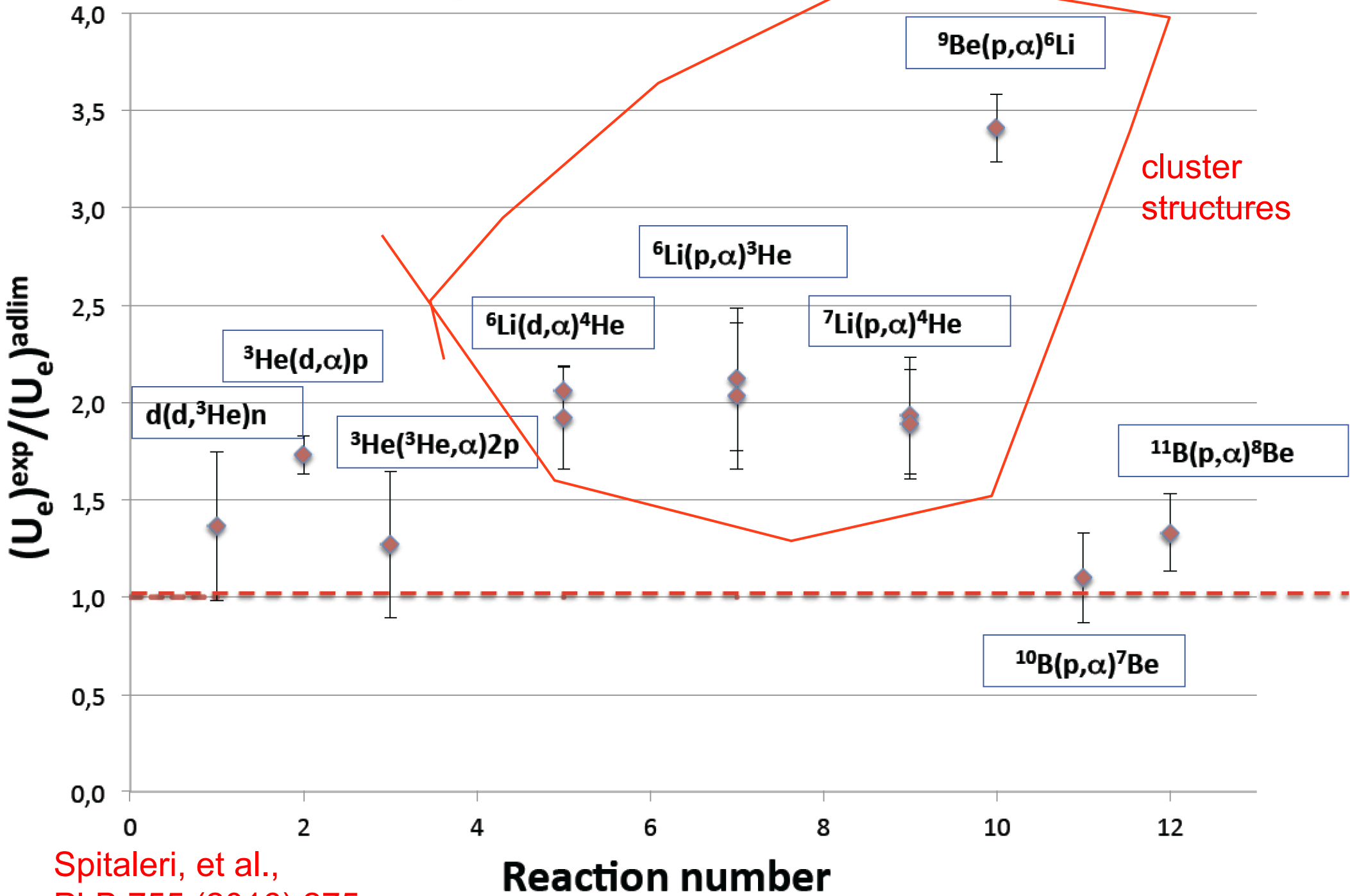
Electron screening puzzle & nuclear clustering

${}^6\text{Li} + {}^6\text{Li} \rightarrow 3\alpha$ experimentally
 much larger than penetrability
 estimates \rightarrow suggests clustering
 + alignment

Spitaleri, CB, Fortunato, Vitturi
 PLB 755 (2016) 275



Electron screening puzzle & nuclear clustering



Spitaleri, et al.,
PLB 755 (2016) 275

A very clear and perfect e-mail

From: "spitaleri@lns.infn.it"
Date: Thursday, February 11, 2016 at 6:13 PM
To: Carlos Bertulani
Cc: "spitaleri@lns.infn.it"
Subject: Files

Dear Carlos,
CE L'ABBIAMO FATTA!!
Thanks for everything.
Ciao

Claudio

Subject: Your Submission PLB-D-15-00499R2
From: "W. Haxton" <physlb@u.washington.edu>
Date: Wed, February 10, 2016 10:28 pm
To: spitaleri@lns.infn.it

Ms. Ref. No.: PLB-D-15-00499R2
Title: The electron screening puzzle and nuclear clustering
Physics Letters B PLB-D-15-00499R2

Dear Prof. SPITALERI,

I am pleased to confirm that your paper "The electron screening puzzle and nuclear clustering" has been accepted for publication in Physics Letters B.

