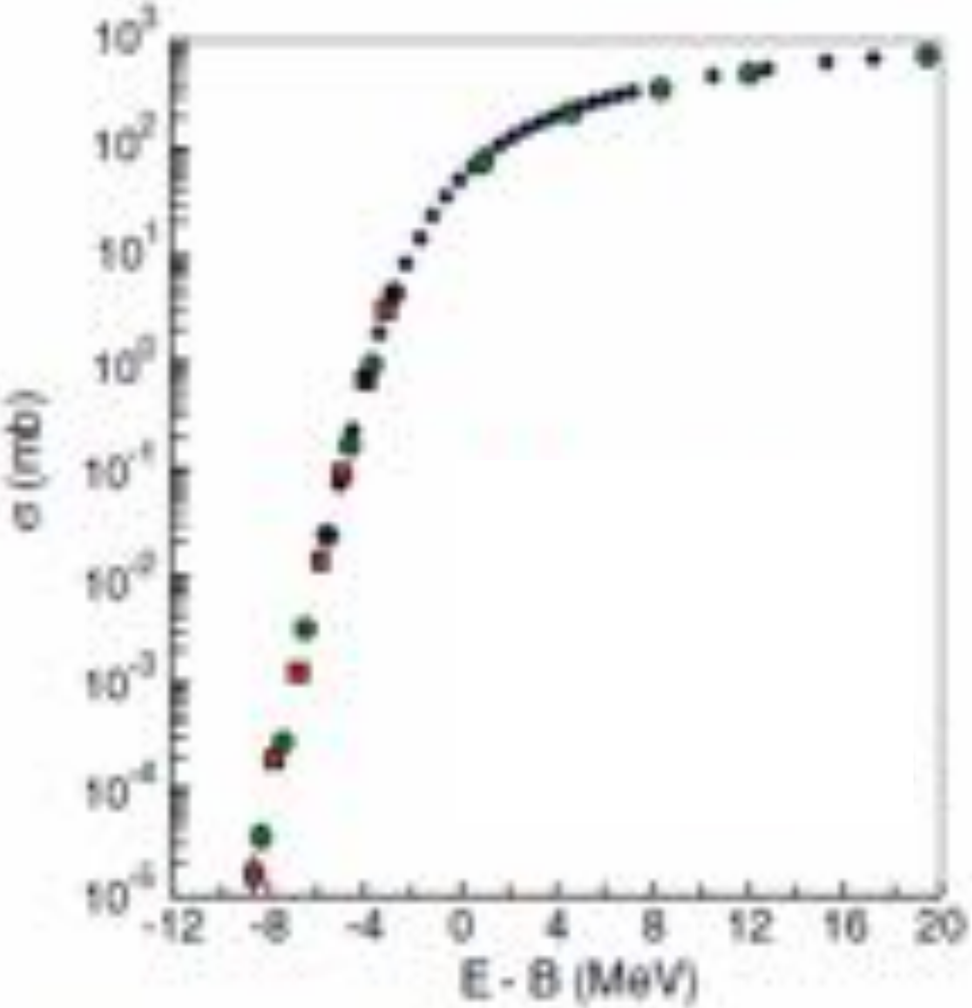
Conference Summary

Carlos Bertulani
Texas A&M University-Commerce
Commerce, Texas, USA

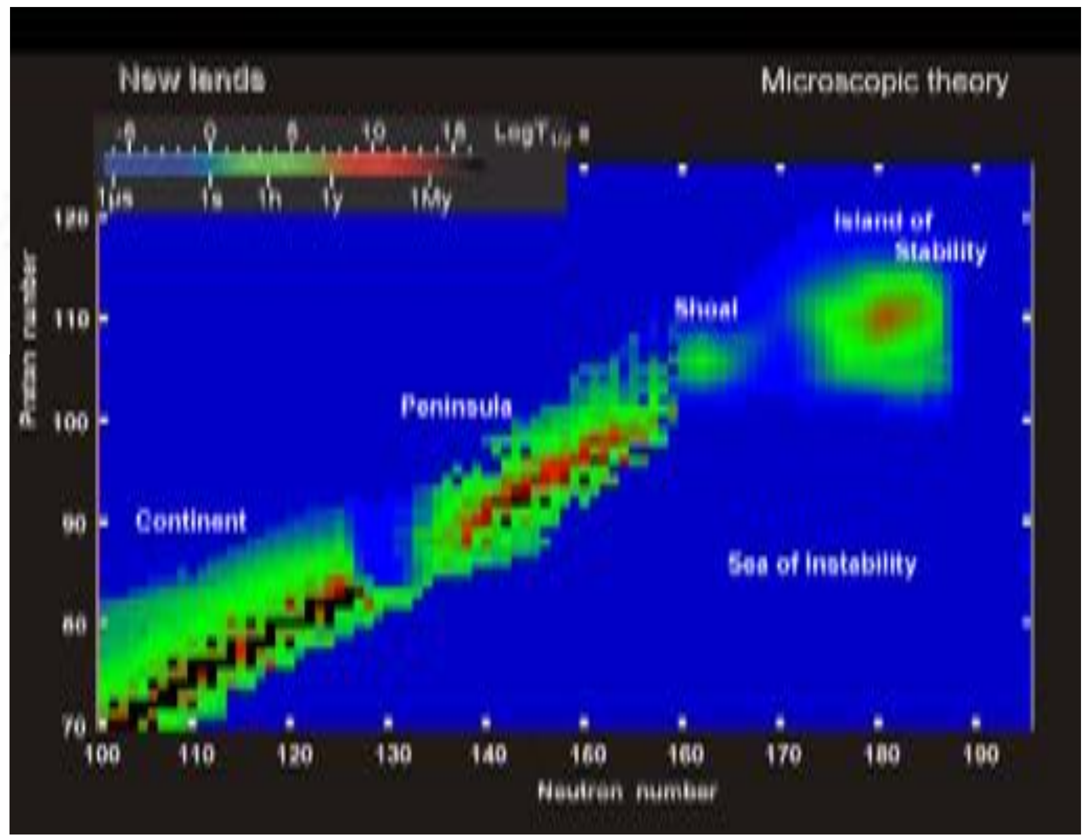
TEXAS A&M UNIVERSITY COMMERCE

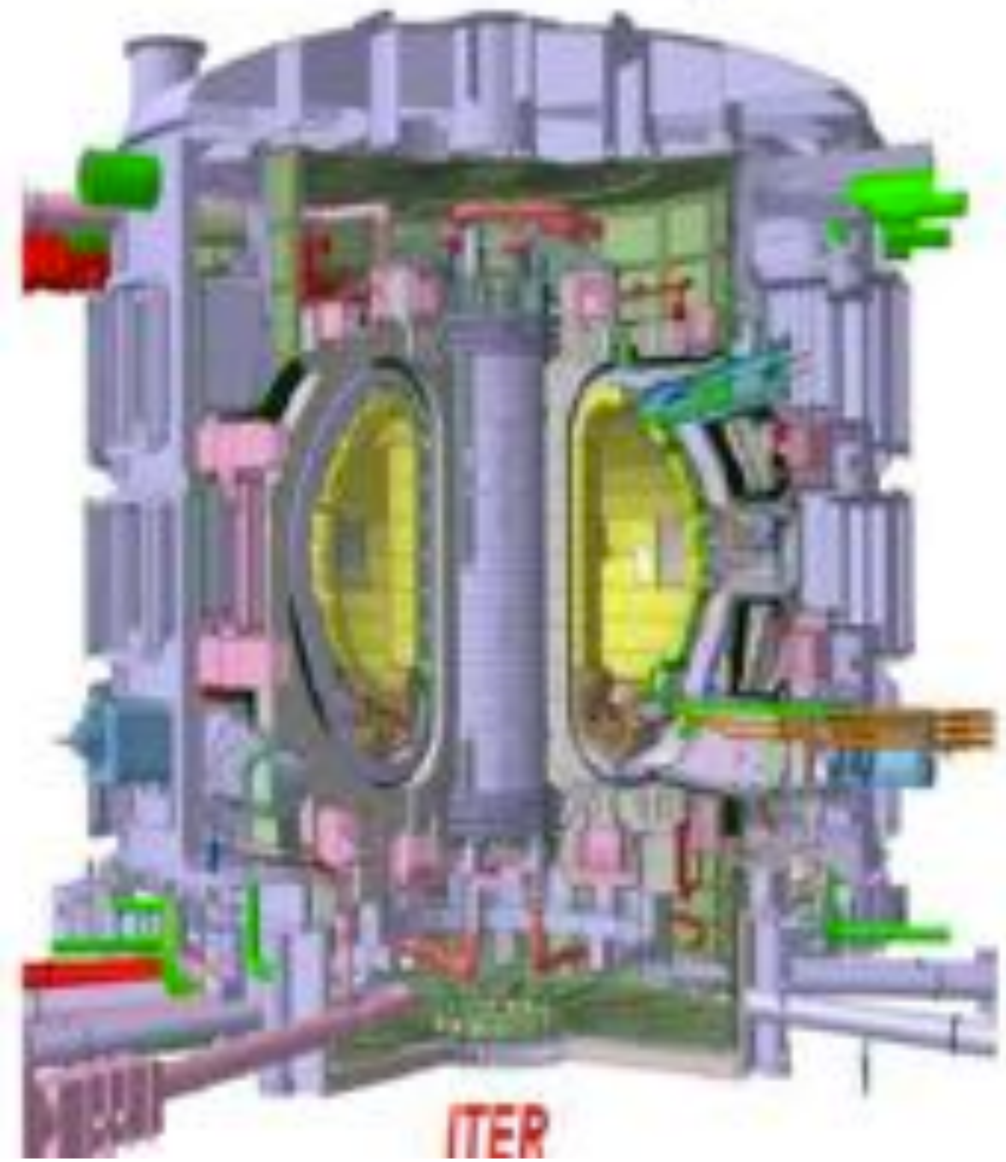
Scientific Goals



1 - Studying fusion and the nature of nuclear processes

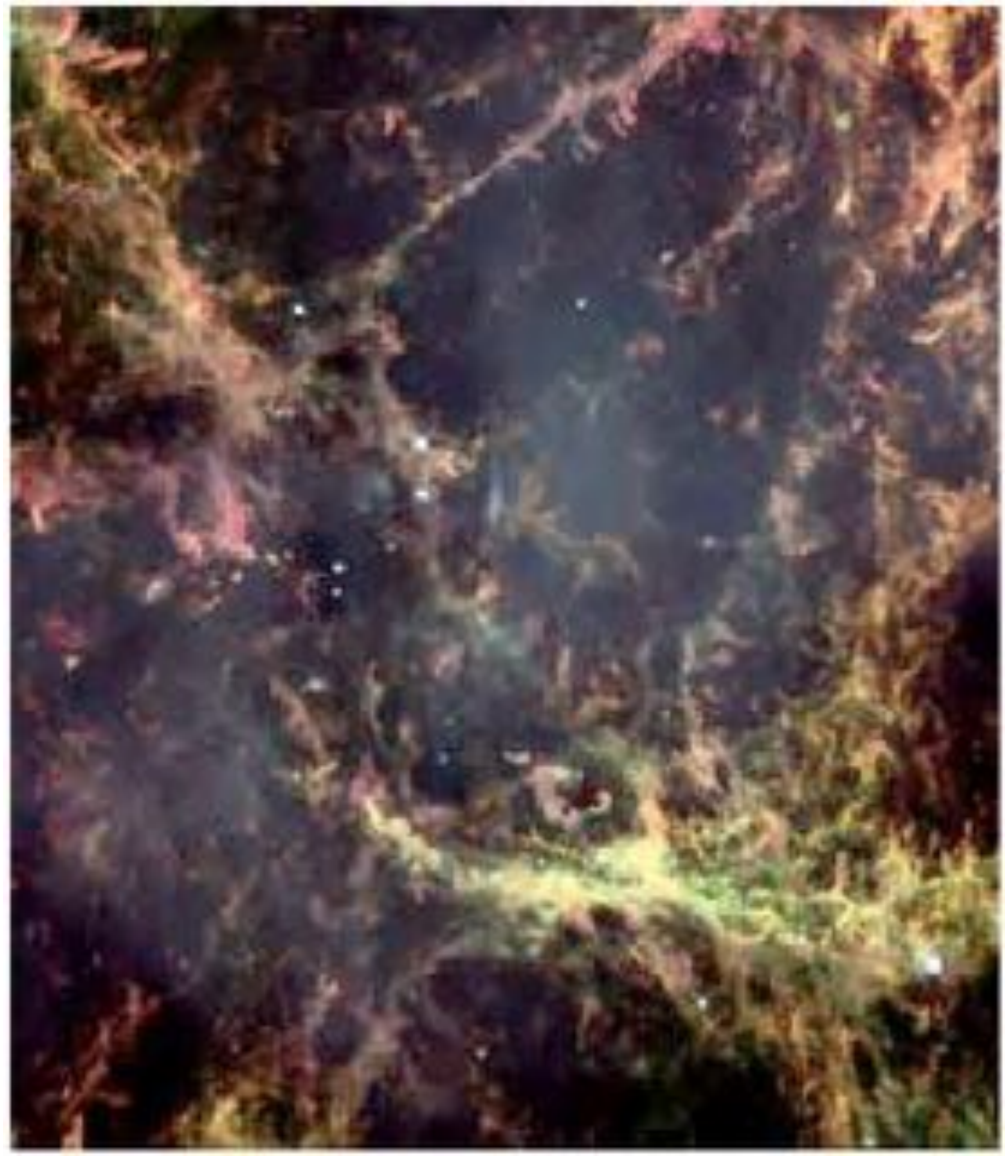
2 - Discovering new elements





3 - Seeking abundant energy

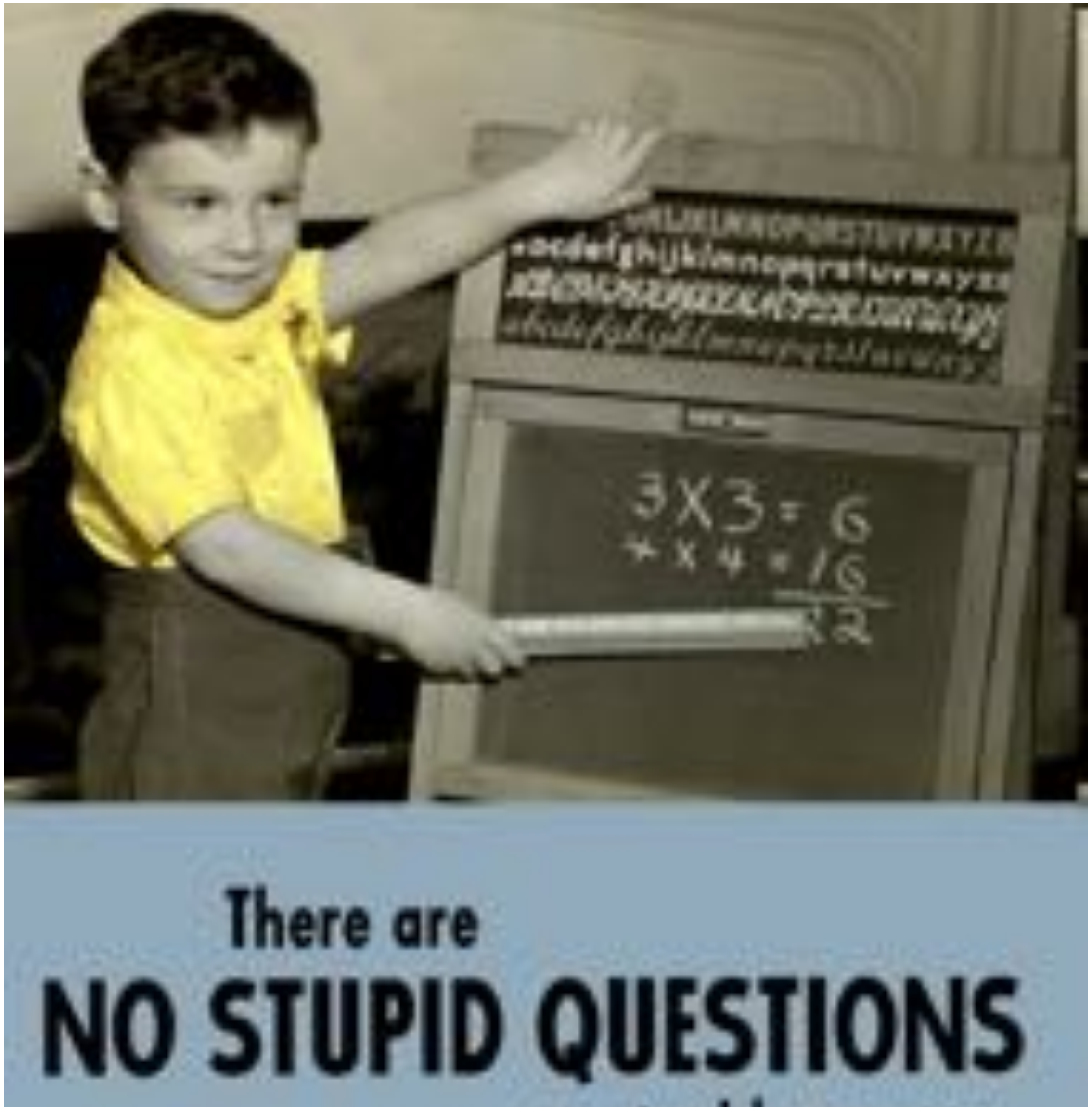
4 - Understanding the cosmos



Talk by **A. Navin (GANIL)**

For example:

What the duck is that?



Thank you Christian Beck.

Building the future

SPIRAL2 Construction in 2 Phases

2006-2014

Talk by **S. Gales (GANIL)**

Collaborations

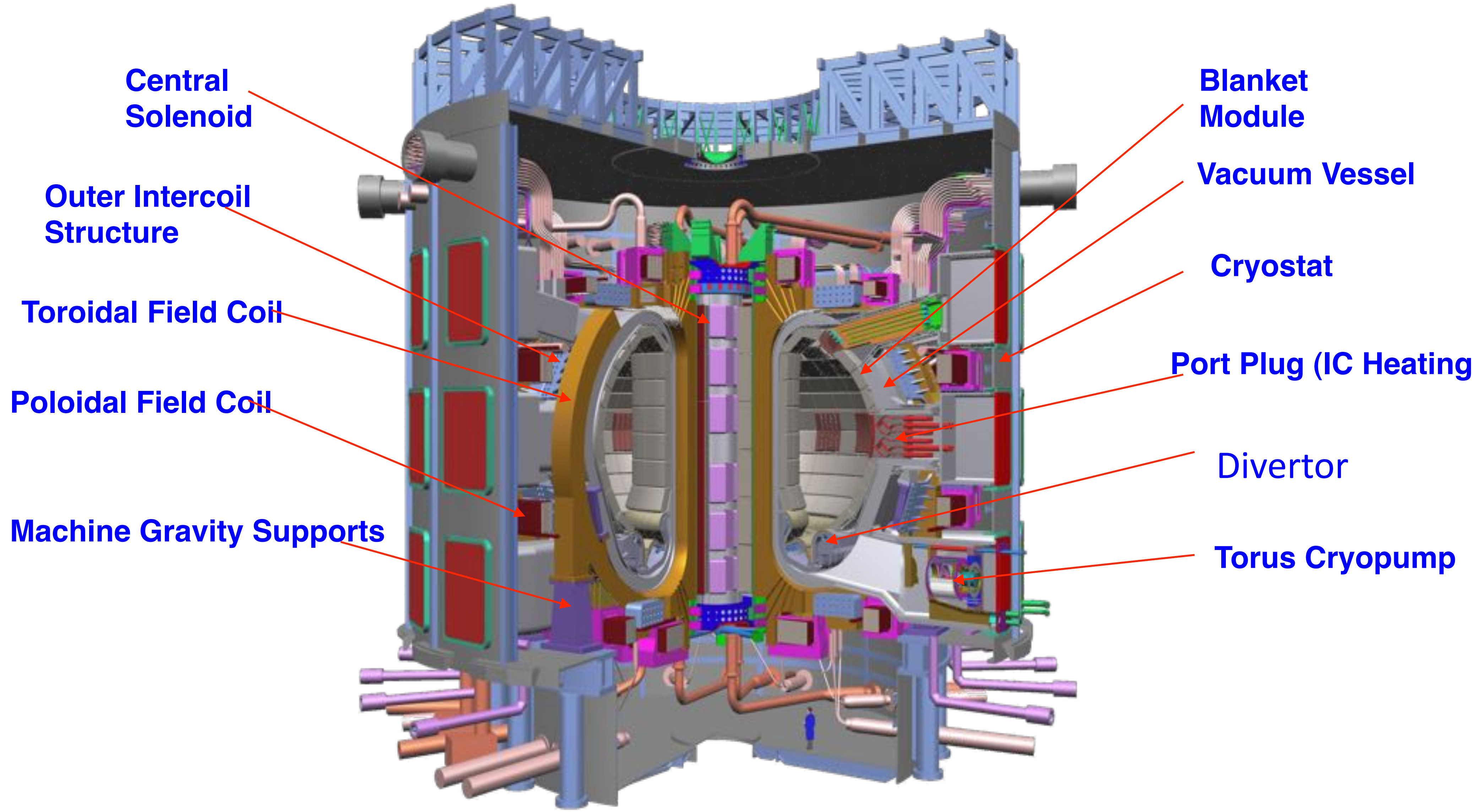
15 signed (LEA*, LIA**, MoU***) agreements
3 agreements under preparation:
•MoU with GSI (FAIR)
•MoU with Bilbao (RIB production module)

21-22/09/10 LIA Workshop with India
22/09/10 Meeting with Sweden
8-9/11/10 Workshop with Dubna
15-19/11/10 LEA Workshop with SPES
3-8 Jan 2011 LIA RIKEN FR-JP Tokyo

Lesson: for a French official, world without South America looks better.

ITER Design - Main Features

Talk by P. Monier-Garbet



ITER Objectives

Programmatic

- Demonstrate the scientific and technological feasibility of fusion energy for peaceful purposes.

Practical

- No nuclear physics research
- Lots of atomic physics research
- Lots of material science research
- Lots of money (15,000 million = 15 billion, as of 2011)
- If works, need additional ITERS in 2050 (maybe 2100)

ELI-Nuclear Physics @ Bucharest

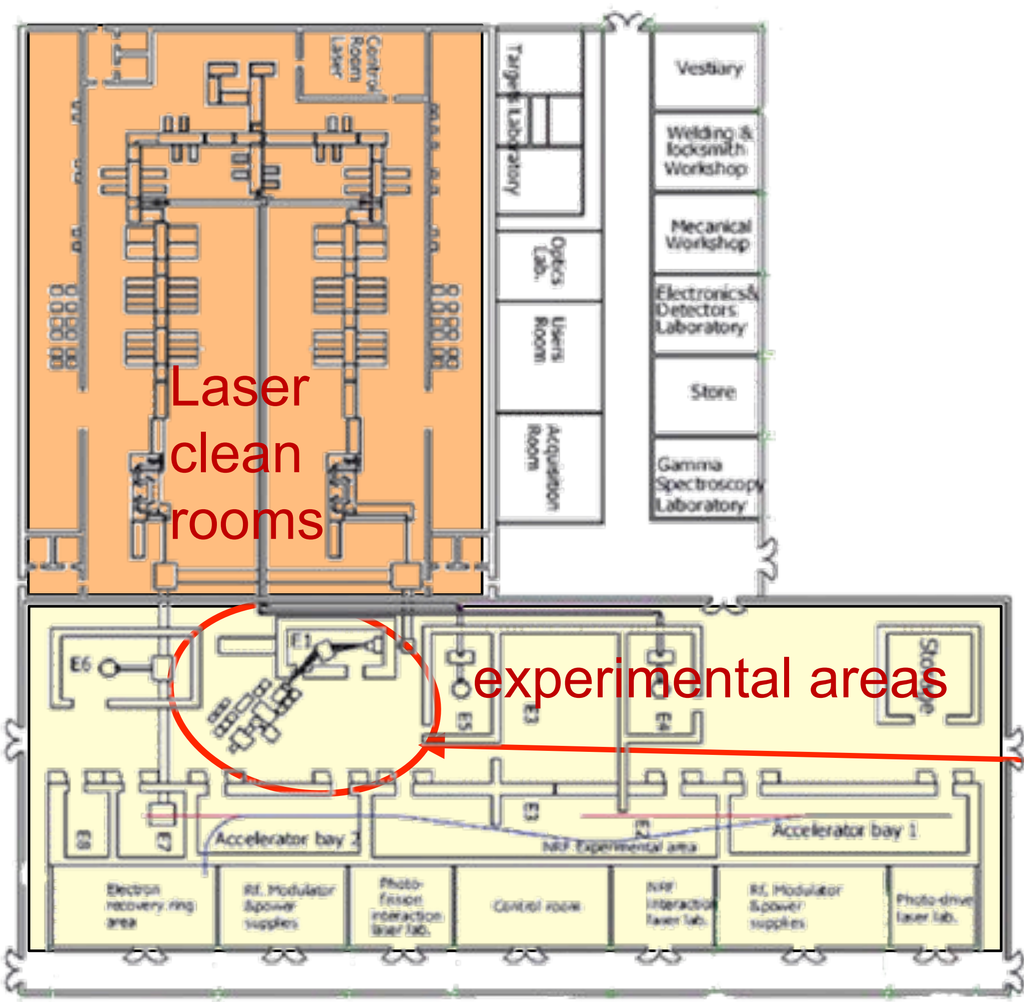
high-power laser (20 PW):

- laser acceleration,
- high field physics

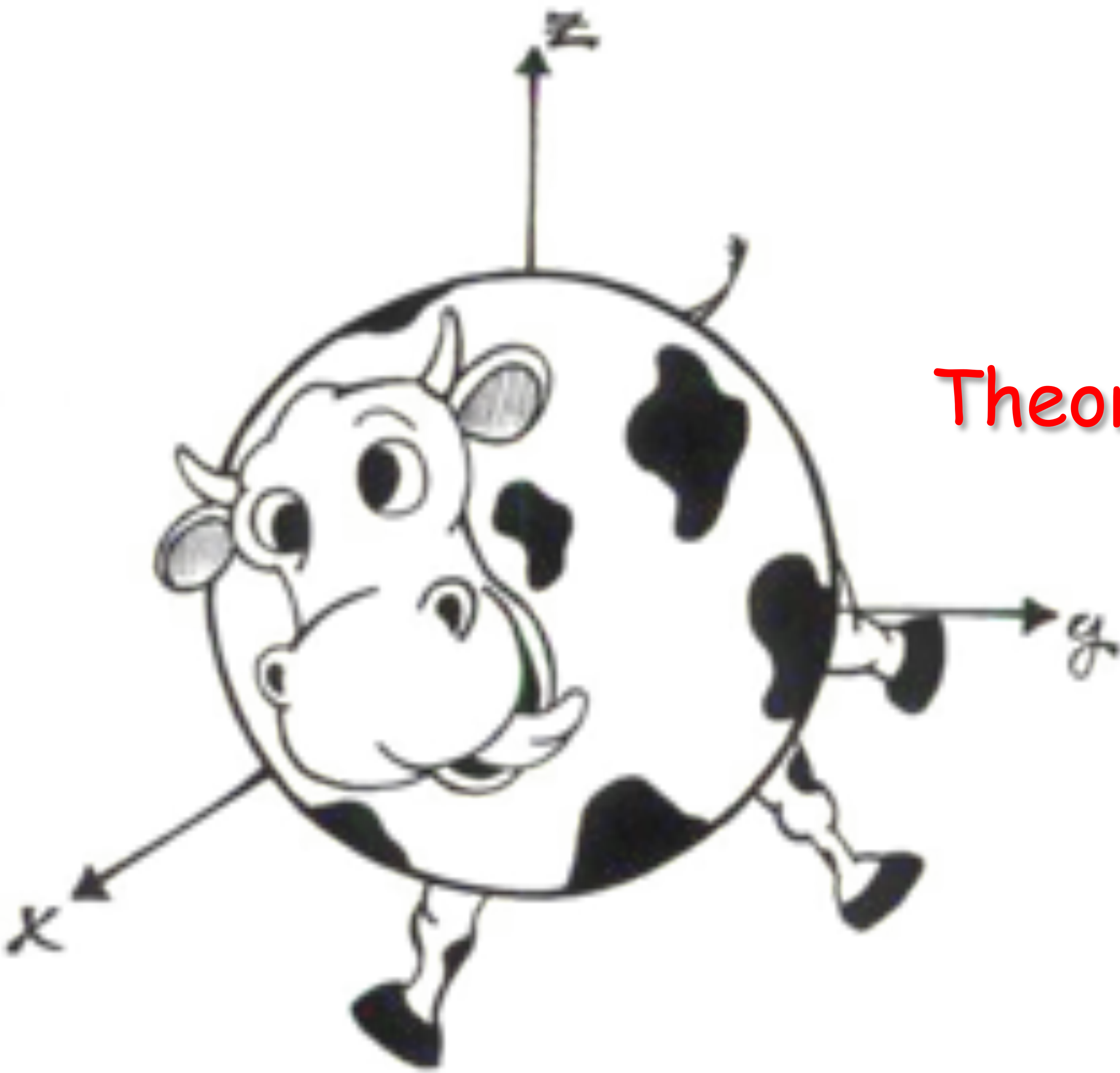
electron linac (600 MeV) : → γ beam

- E < 19 MeV, DE/E < 10^{-3}, > 10^{13} g/s

Talk by Peter G. Thirolf (Munich)



laser-induced nuclear reactions
→ "fission-fusion"



Theory

Figure credit: SPS @ Berkeley

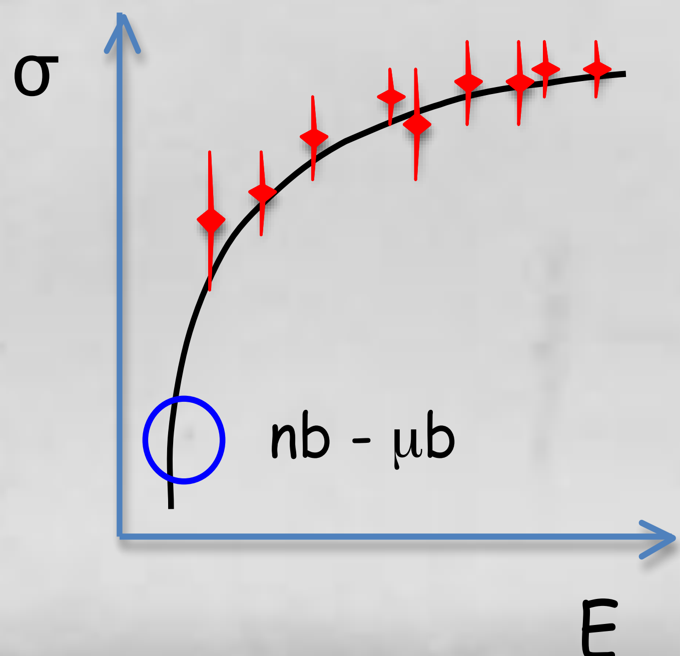
back of the envelope

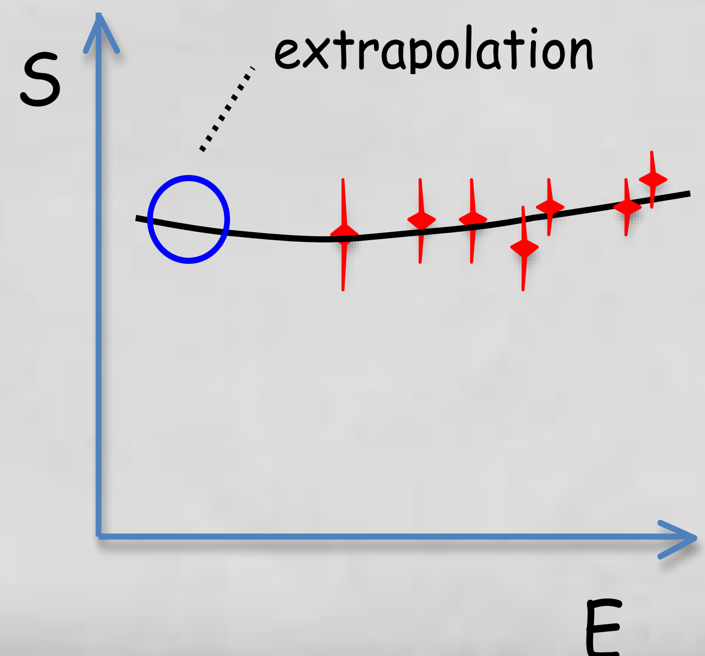
Fusion equation

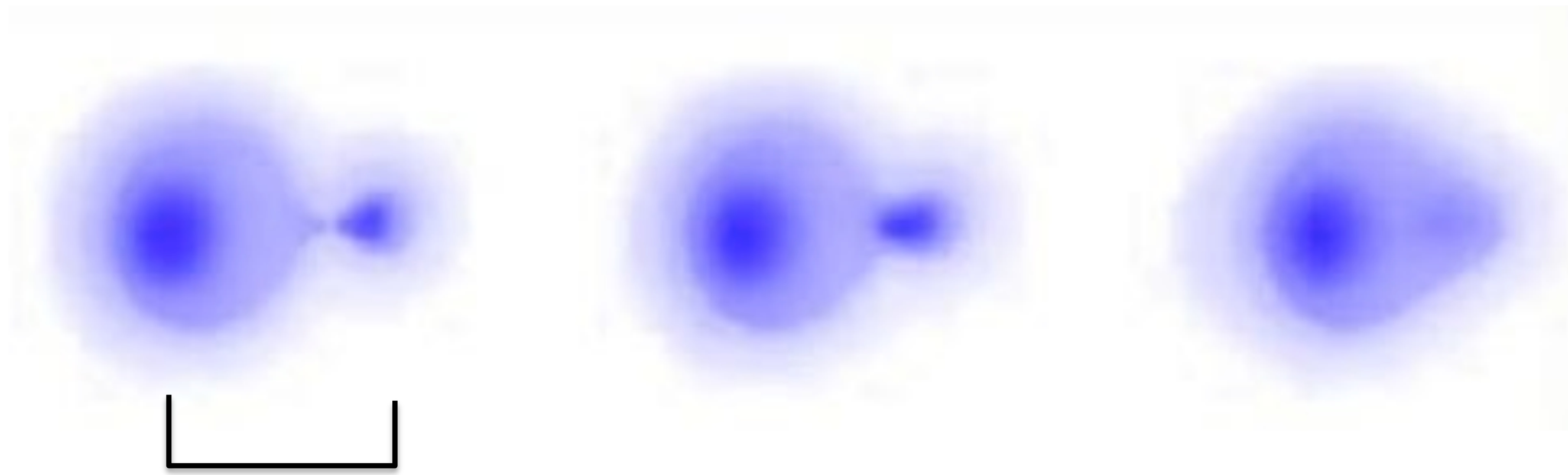
$$\sigma(\mathrm{E}) = \frac{\pi\hbar^2}{2\mu\mathrm{E}} \sum_l (2l+1) P_l(E)$$

Redefinition

$$\sigma(\mathrm{E}) = \frac{1}{\mathrm{E}} S(E) \mathrm{e}^{-2\pi\eta(E)} \quad \text{or} \quad \ln\left[E\sigma(E)\right]$$







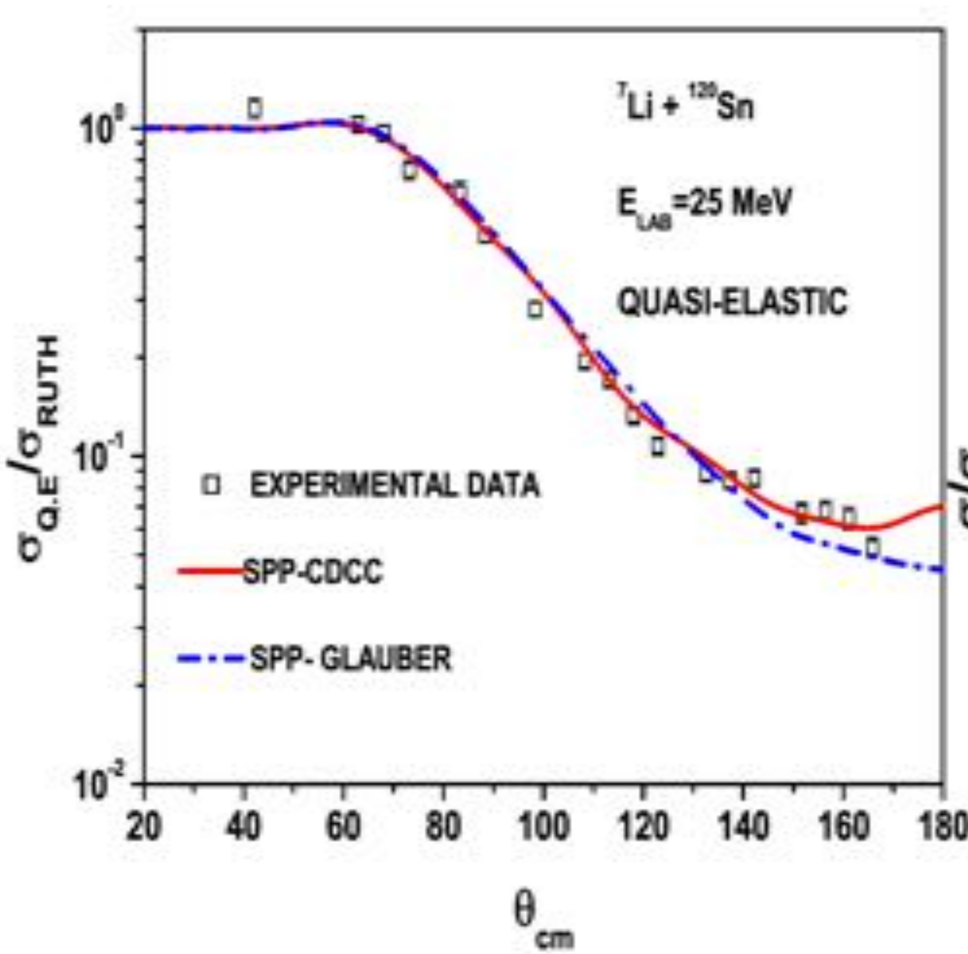
U_{opt}

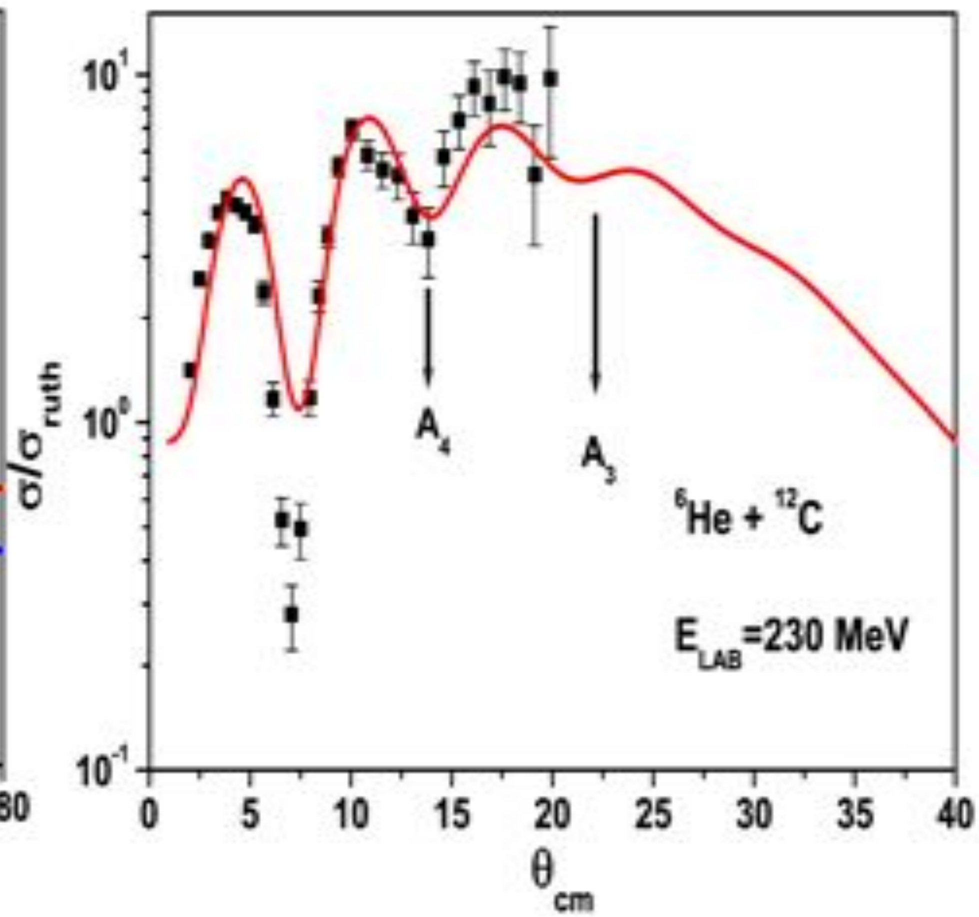
$P_l(E)$ + absorption

Horribly phenomenological

Talk by **D. Pereira (São Paulo)**

A new approach for the imaginary potential to account surface dissipative processes in H.I. reactions



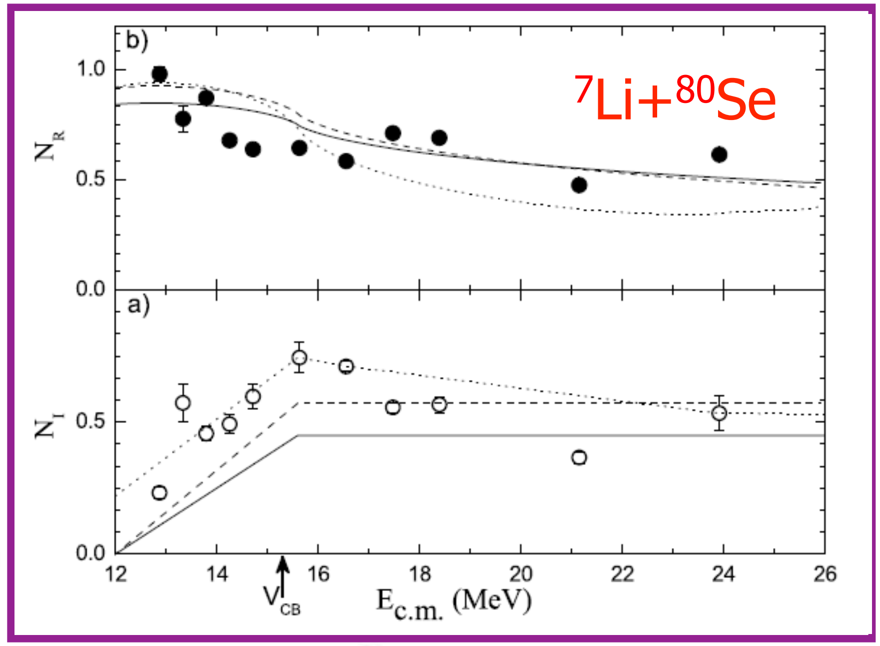


Threshold anomaly???!!!

Talk by **G. Marti (Buenos Aires)**

For the elastic scattering of ^{7}Li the behavior of both types of potentials as a function of energy, is compatible with the presence of the threshold anomaly.

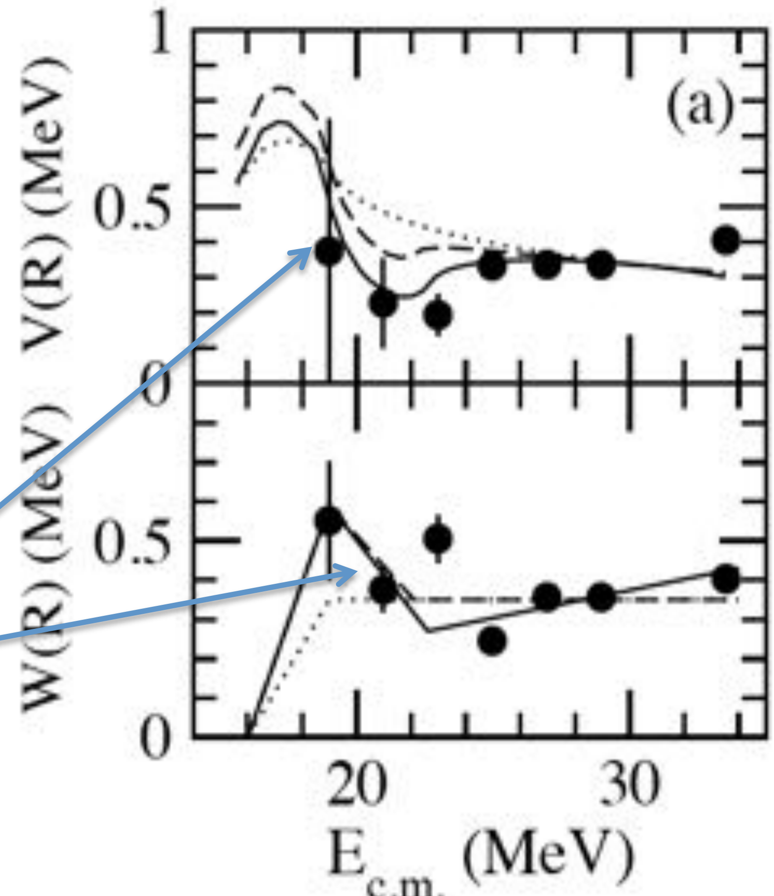
See also, *Talk by* **M. Sinha (Saha)**



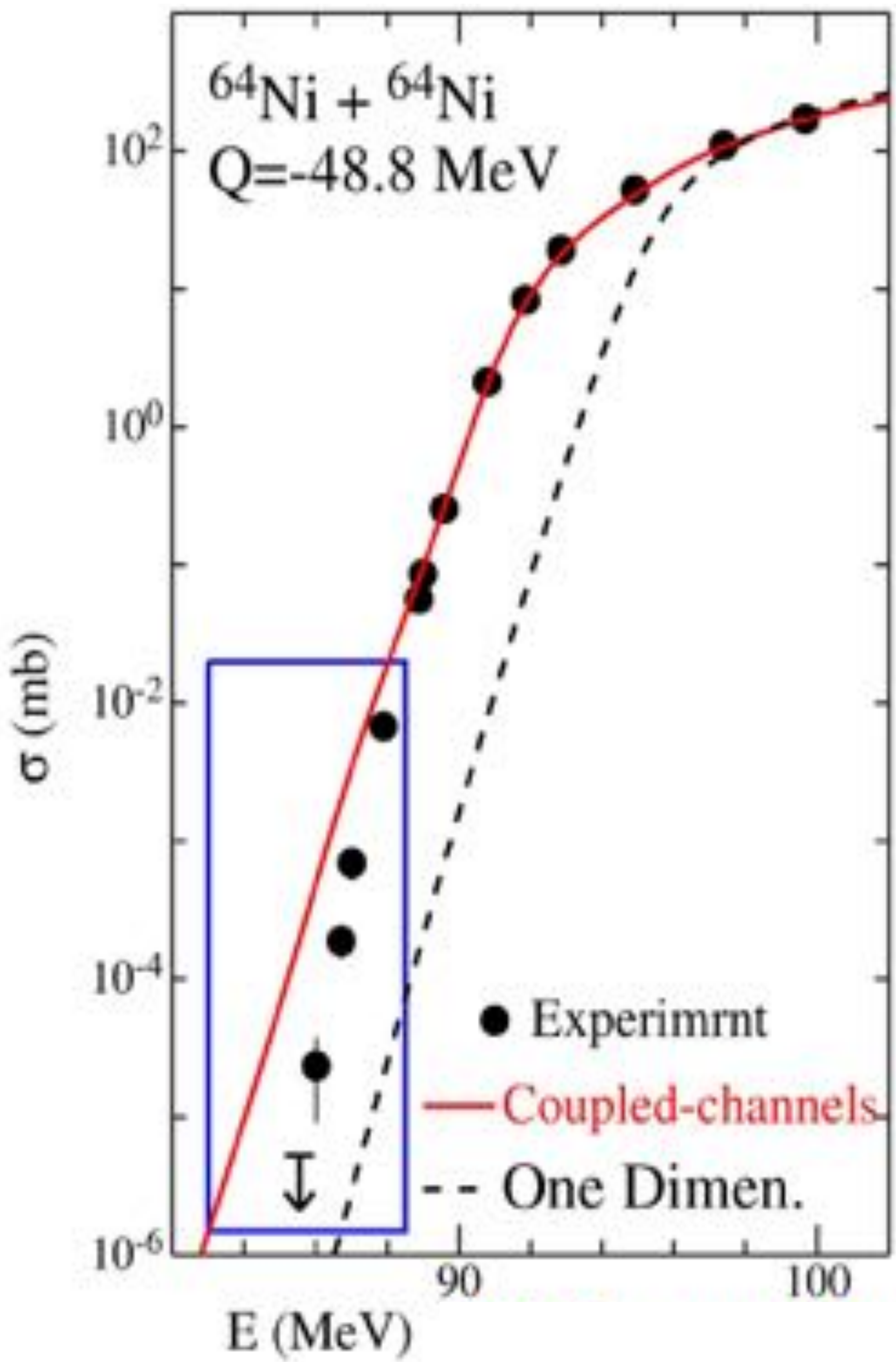
Talk by **C.S. Palshetkar (Bhabha)**

- Dispersion relation is satisfied by the ^{9}Be+^{89}Y system
- Threshold anomaly is absent for the system

Breakup threshold anomaly



C.L. Jiang et al,
PRL 93, 012701 (2004)



Does the BPM work?

No!

(as loud as Jiang sounds)

Coupled-channels and microsocpic models are often necessary.

coupled channels

$$\Psi = \sum_{i,k} a_i(\alpha, q_k)\phi(\alpha, q_k)$$

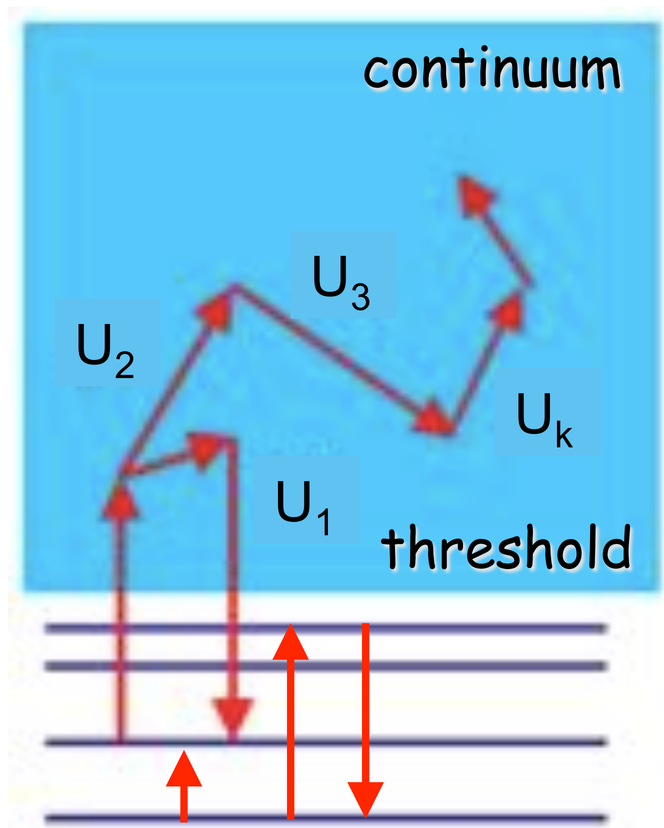
$$\frac{da_i}{d\alpha} = \sum_j a_j(\alpha)\langle\phi_k|U(\alpha)|\phi_j\rangle e^{iE_\alpha \alpha/\hbar}$$

α = dynamical variable

q_k = intrinsic coordinates
ϕ_k = single particle channels, vibration, deformation transfer.

+ discretize continuum

$$|\varphi_j\rangle = e^{-iE_\alpha \alpha/\hbar} \int_E^{E+\Delta} |E', q_j\rangle dE'$$

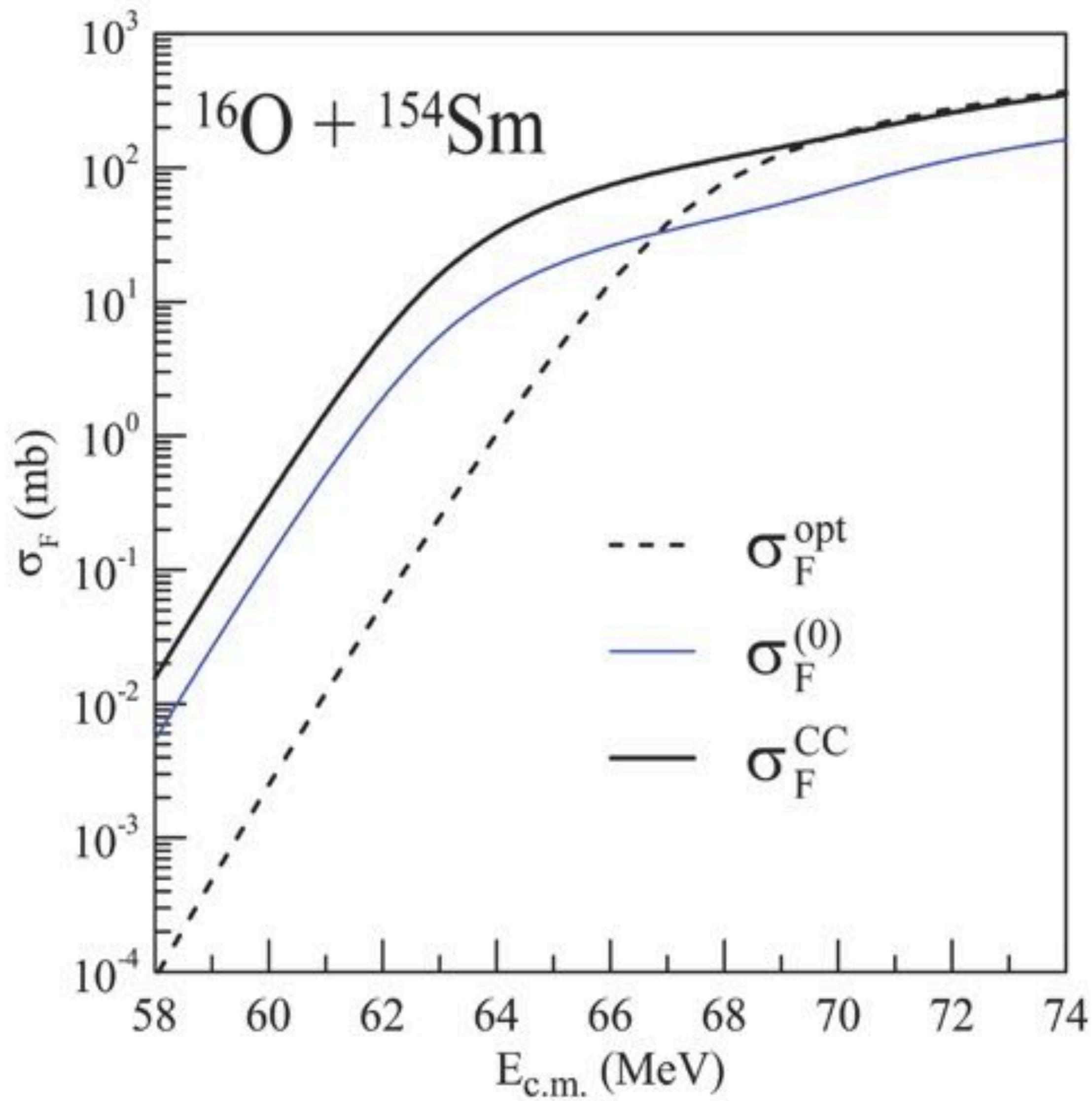


P. Chau Huu-Tai (CEA)

CDCC for d+A with rotational and vibrational channels

A. Moro (Seville)

Simultaneous analysis of elastic, breakup, and fusion channels for the $^{6}He+^{208}Pb$ reaction at energies near the Coulomb barrier



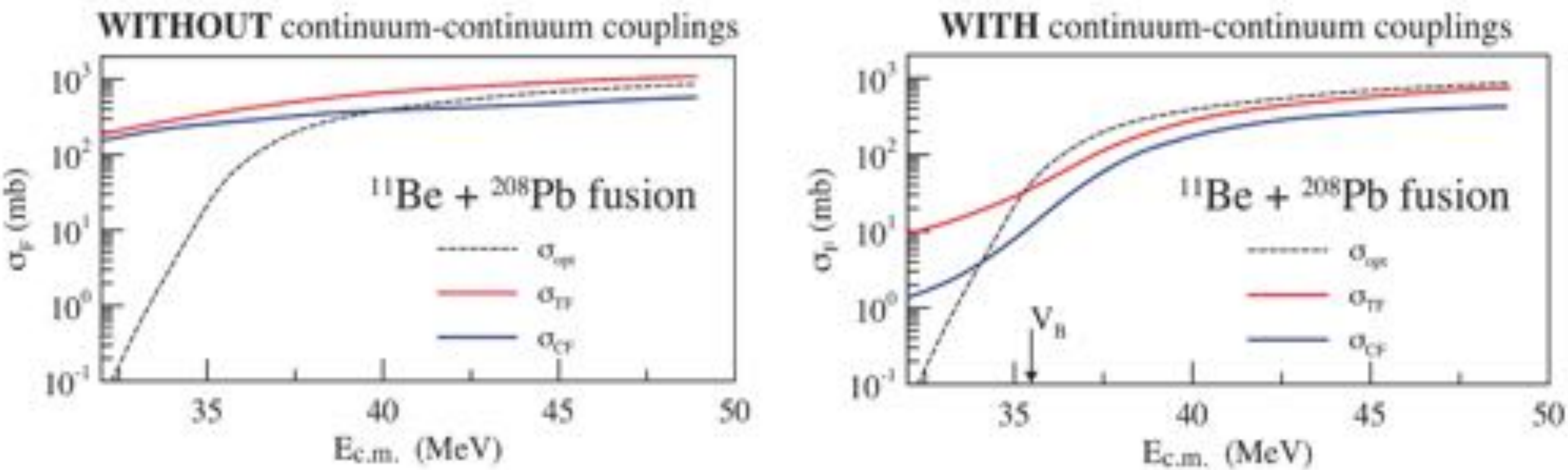
Coupling enhances σ_F strongly

Why? Barrier decreases

Still many open questions.

Talk by L.F. Canto (Rio de Janeiro)

Talk by L.F. Canto (Rio de Janeiro)

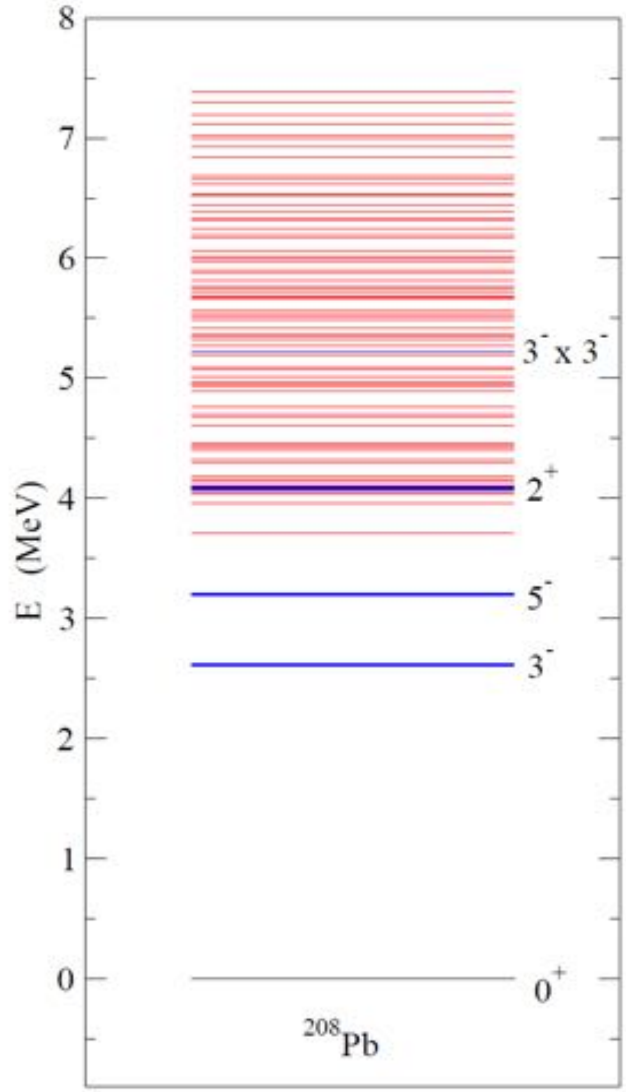


From: Diaz-Torres and Thompson (2002)

Continuum-continuum couplings hinders fusion …. but what is the mechanism?

Coupled channels one of the least controllable calculations: couplings can add as +-+--++-+ or as +++-+++ or ----+----, depending on the system

→ Suppression or enhancements are difficult to understand. DISGUSTING.



Talk by K. Hagino (Sendai)

Non-collective states:
weakly coupled, but many levels

64 non-collective levels up to 7 MeV
nearly "complete" level scheme
both E^* and β_λ

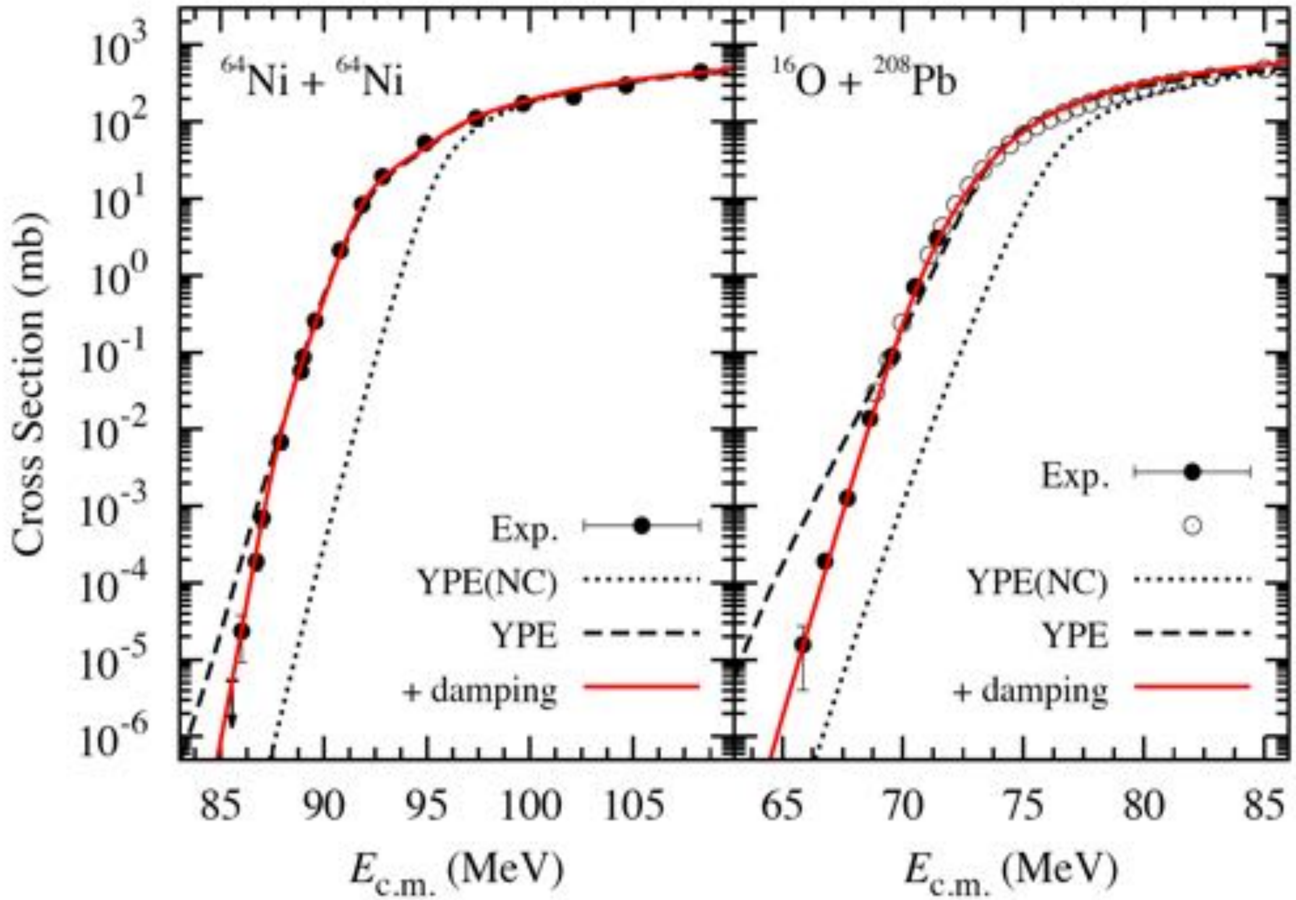
Solve C.C. equations including also these non-collective levels

⇒ Energy dependence of fusion cross section: is not altered much

Will the future be solving CC with 1,000,000 or more states?
What happened to the statistical theory of nuclear reactions (Feshbach, Kerman, etc)?

- Talk by **T. Ichikawa (Kyoto)**

Smooth transition from sudden to adiabatic states in heavy-ion fusion reactions at deep-subbarrier incident energies

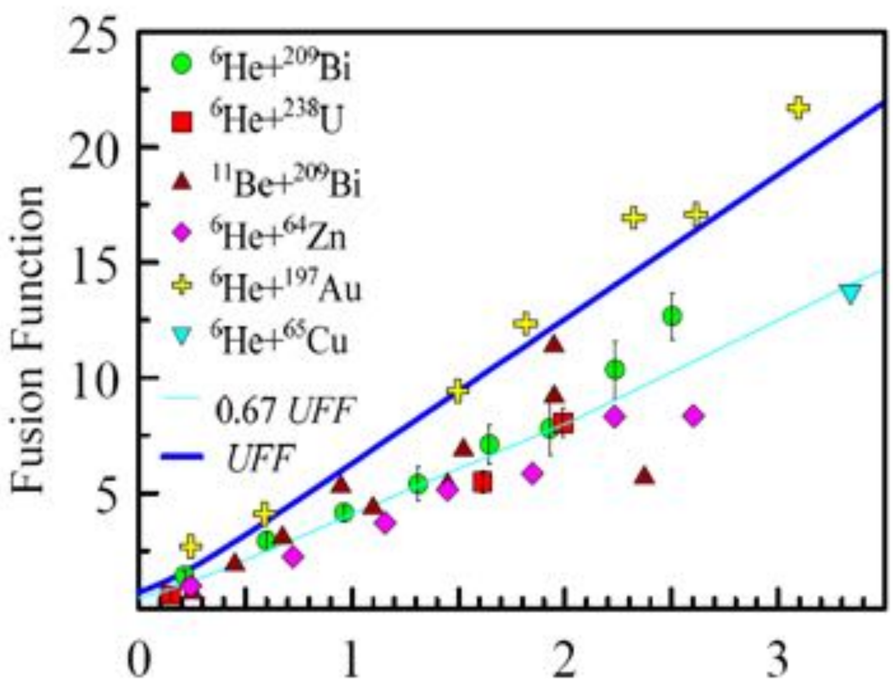


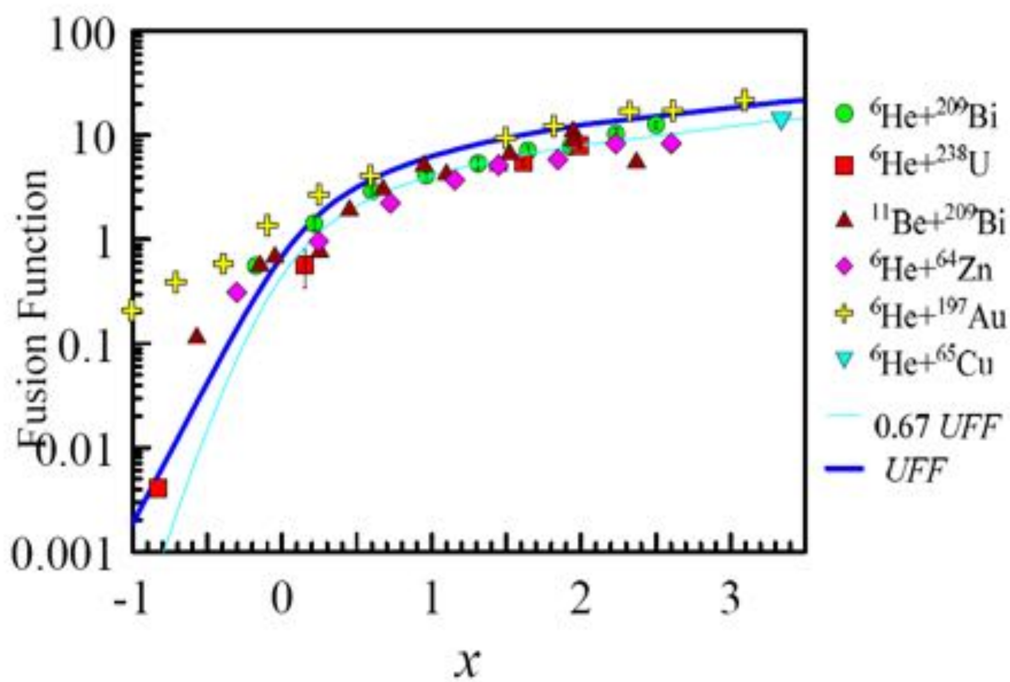
Talk by **P. Gomes (Rio de Janeiro)**

fusion function

A GUT for fusion reactions?
Dream of af a Final Theory?

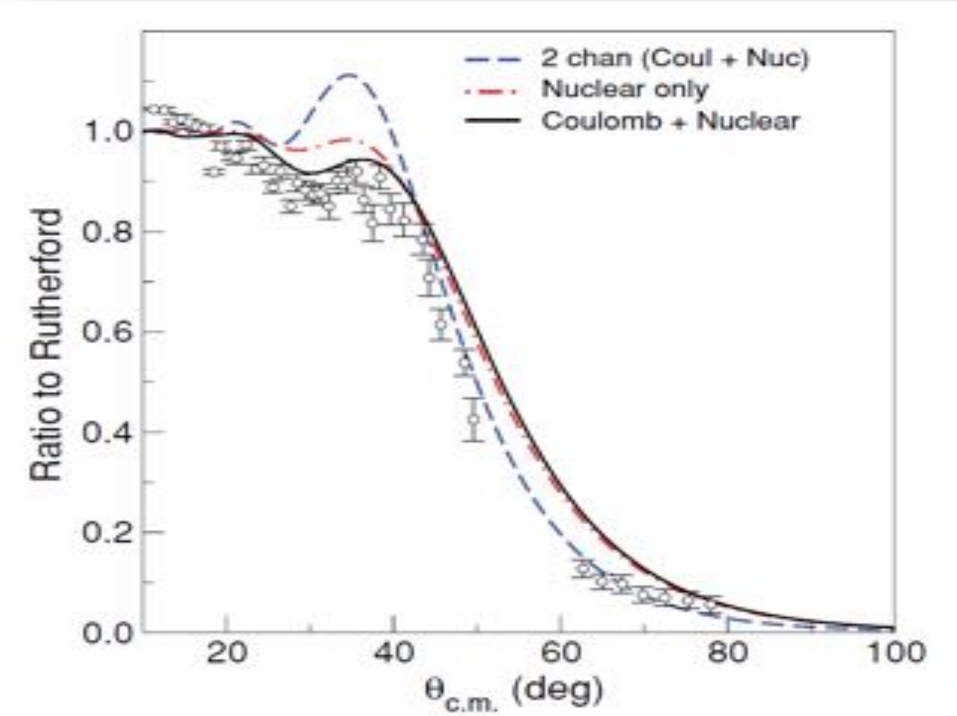
Use of UFF for investigating the role of BU dynamical effects on fusion of neutron halo ^{6}He weakly bound systems





Suppression above the barrier- enhancement below the barrier

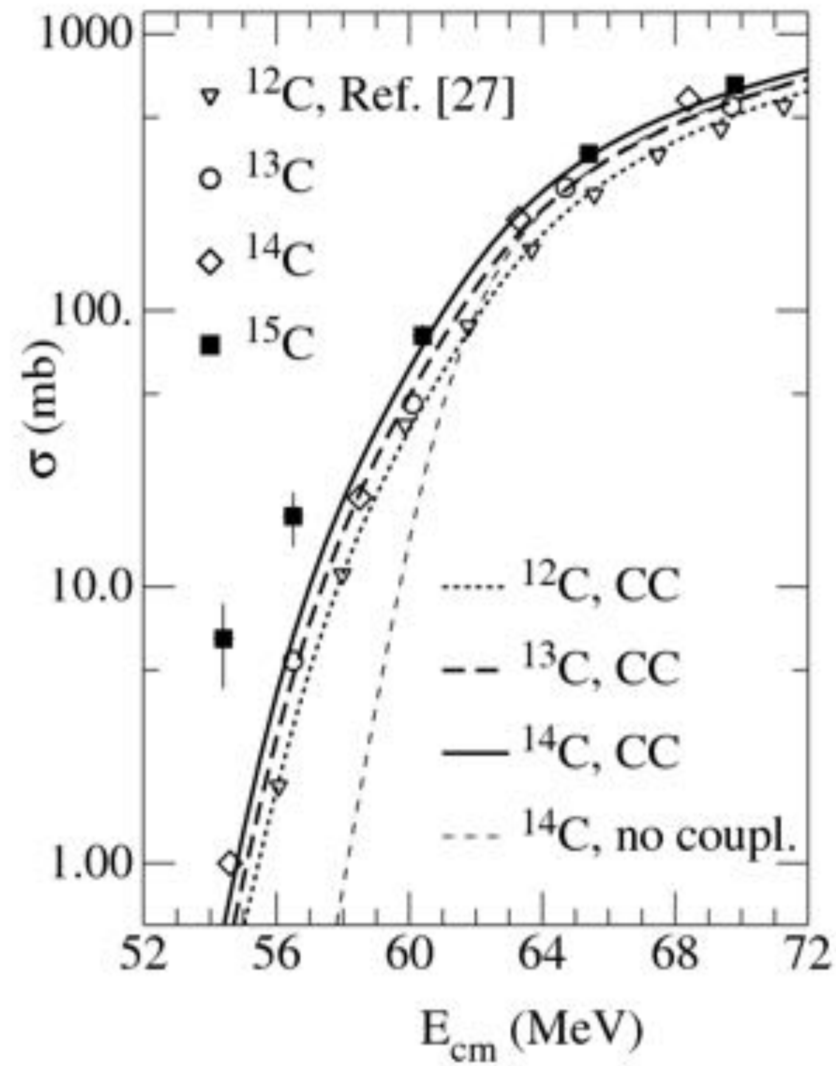
$^{11}Be+^{64}Zn$ coupling to nuclear and/or Coulomb



N. KEELEY et al. PRC 82, 034606 (2010)

Talk by **A. Di Pietro (LNS)**

Damping of elastic cross-section for the reaction induced by the ^{11}Be nucleus when compared with both ^{9}Be (S_n=1.67 MeV) and ^{10}Be (S_n=6.8MeV)

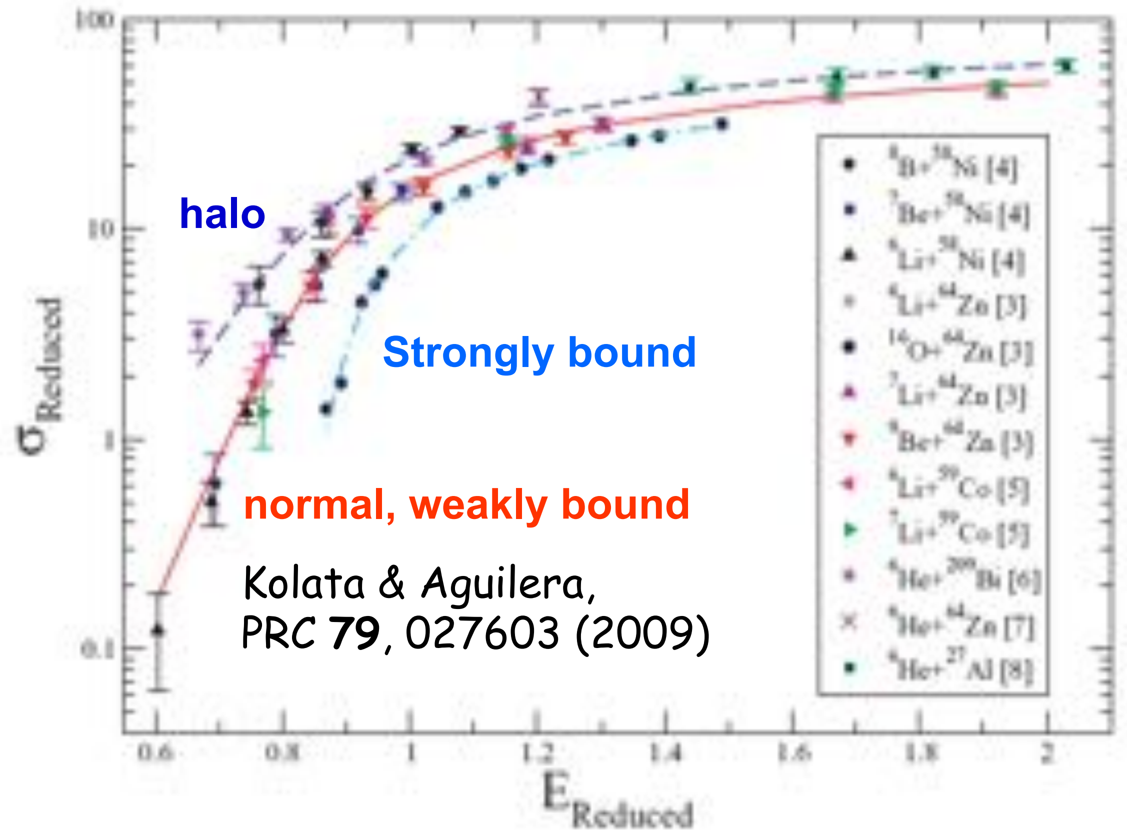


Talk by **M. Alcorta (Argonn**
and **E. Rehm (Argonne)**

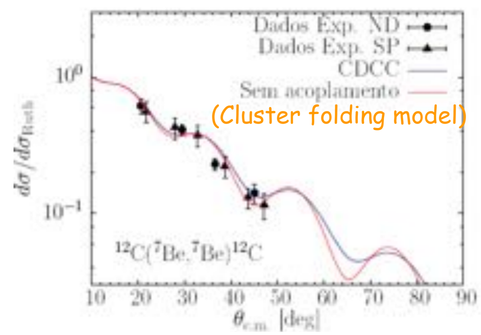
- Measured fusion-fission cross sections for the systems $^{13,14,15}C$ + ^{232}Th
- ^{14}C + ^{232}Th similar to $^{12,13}C$ + ^{232}Th
- ^{15}C + ^{232}Th shows a fusion enhancement by a factor of 5-6 at E/V_c~ 0.85

Talk by **E. F. Aguilera (ININ)**
and **J. Kolata (Notre Dame)**

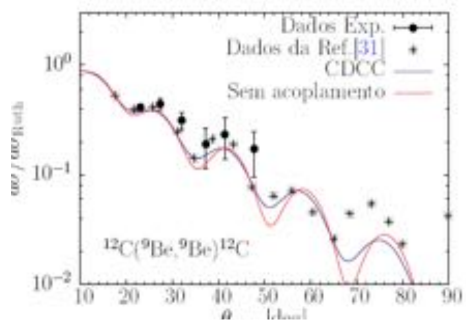
Measured evaporation protons from $^{8}B + ^{58}Ni$ @ 8 energies.



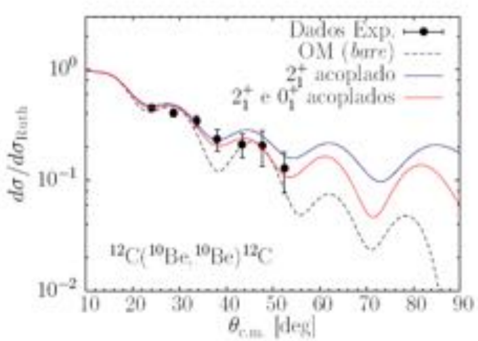
$^{7}Be + ^{12}C$



$^{9}Be + ^{12}C$



$^{10}Be + ^{12}C$



Talk by **V. Guimaraes (Sao Paulo)**

Experiment with RIBRAS – São Paulo – Brazil

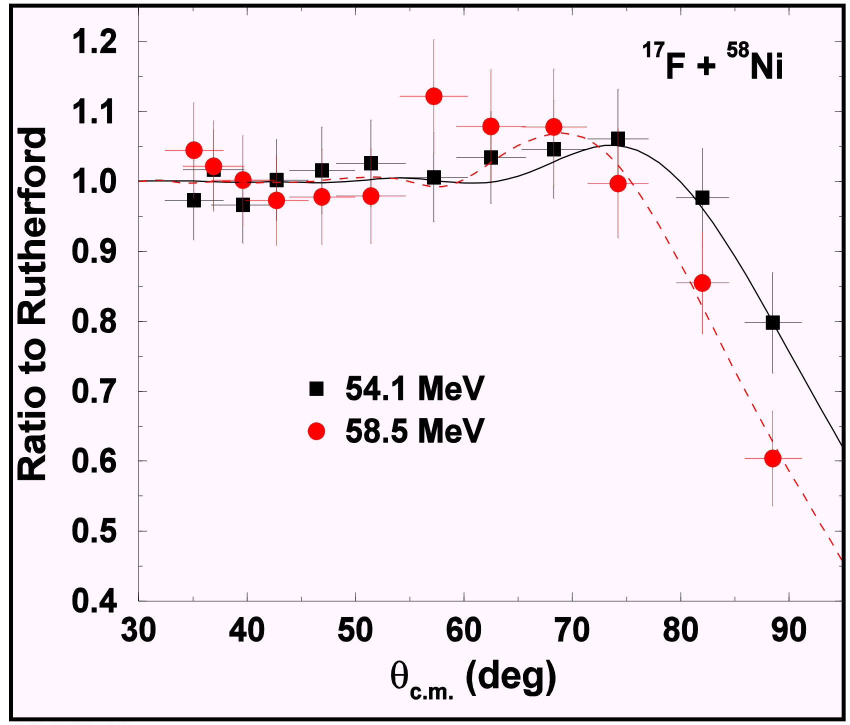
Optical model analyses with double-folding
São Paulo Potential

Talk by M. Mazzocco (Padova)

Quasi-Elastic Angular Distributions

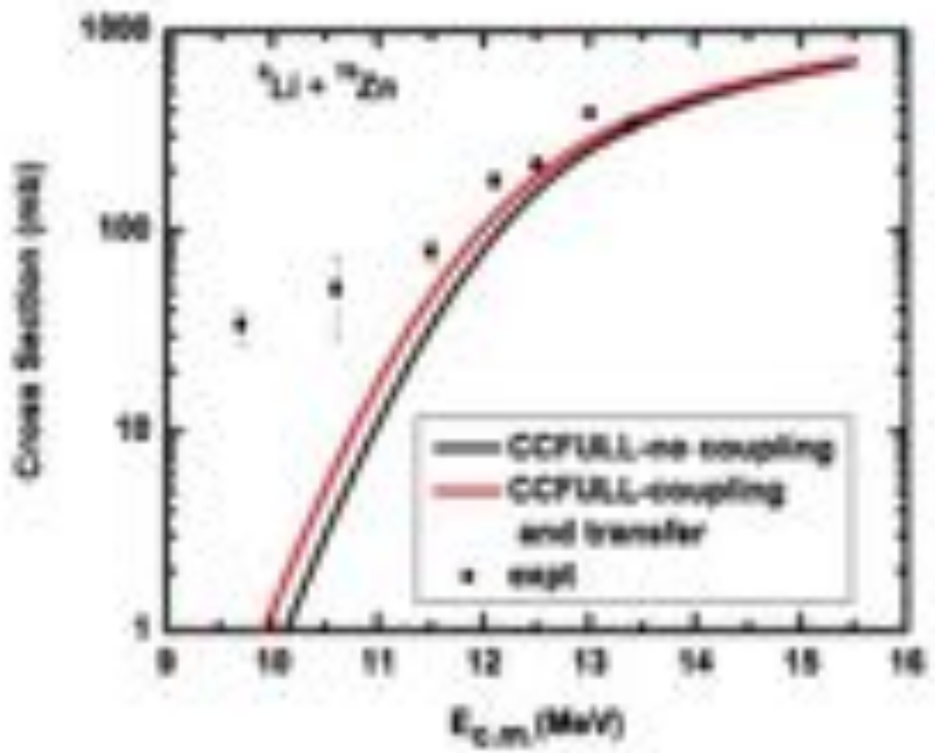
The collected data were analyzed within the framework of the optical model with the coupled-channel code FRESCO to extract the **reaction cross sections** and to investigate the relevance of **direct reaction mechanisms**.

Small influence of the ^{17}F low binding energy on the reaction dynamics?



Talk by W. Loveland (Oregon)

But, e.g., ^{9}Li fusion excitation functions show sub-barrier fusion enhancement not easily accounted for by current models of fusion.



Barrier distribution

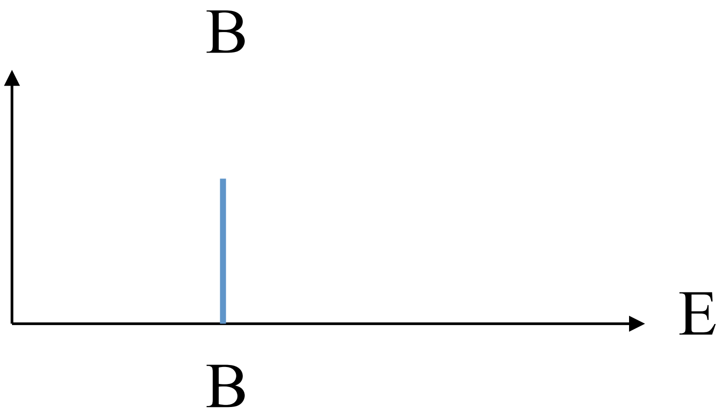
Barrier Distribution

Rowley, Satchler, Stelson, PLB 254, 25 (91)

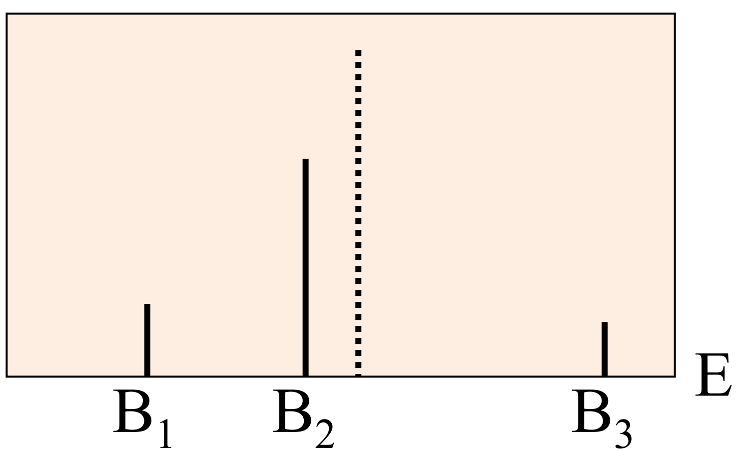
$$\sigma(E) \sim (1 - V_B / E)\Theta(E - V_B) \quad \Rightarrow \quad \frac{d[E\sigma]}{dE} \sim \Theta(E - V_B)$$

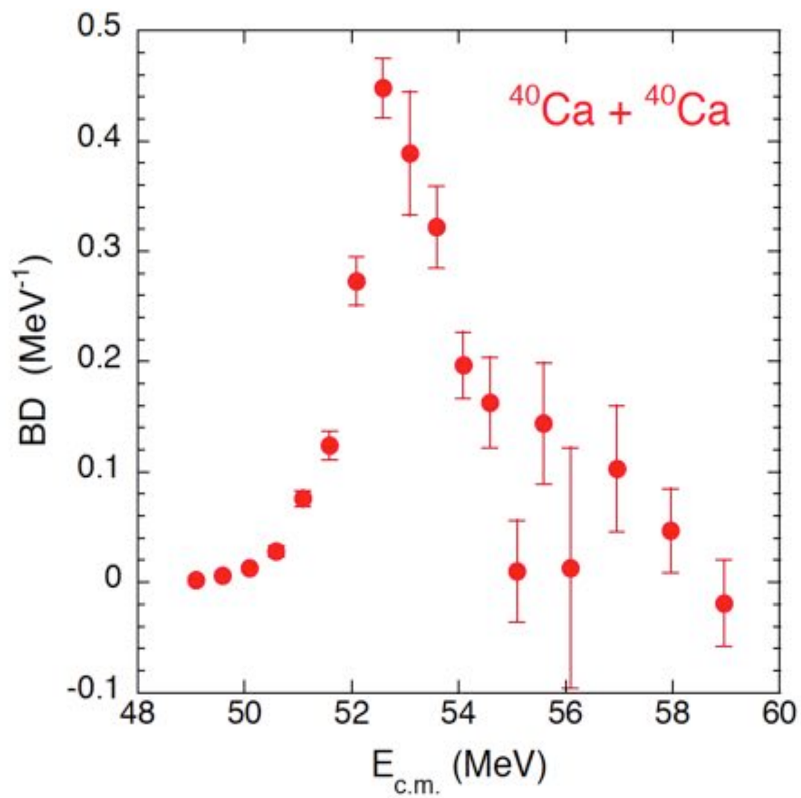
$$\Rightarrow \quad \frac{d^2[E\sigma]}{dE^2} \sim \delta(E - V_B)$$

$$\frac{d^2[E\sigma]}{dE^2}$$



$$\frac{d^2[E\sigma]}{dE^2}$$





Talk by **G. Montagnoli (Padova)**

Quasi-elastic scattering

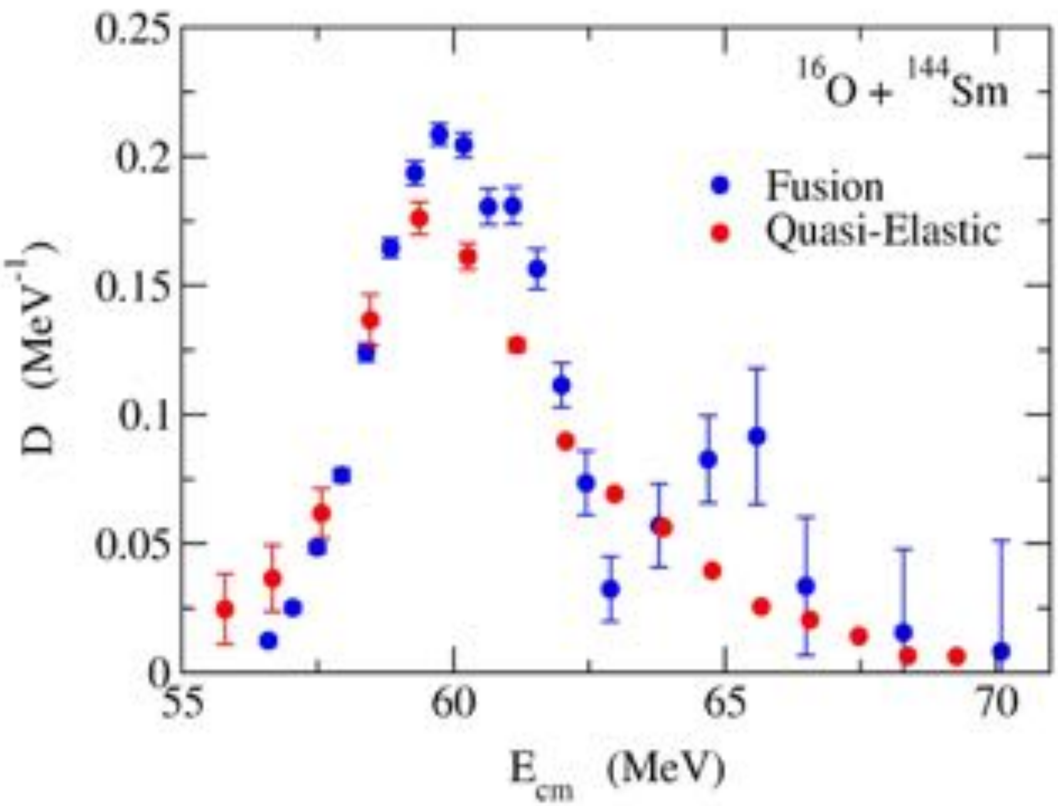
A sum of all the reaction processes other than fusion (elastic + inelastic + transfer + breakup……)

Quasi-elastic barrier distribution:

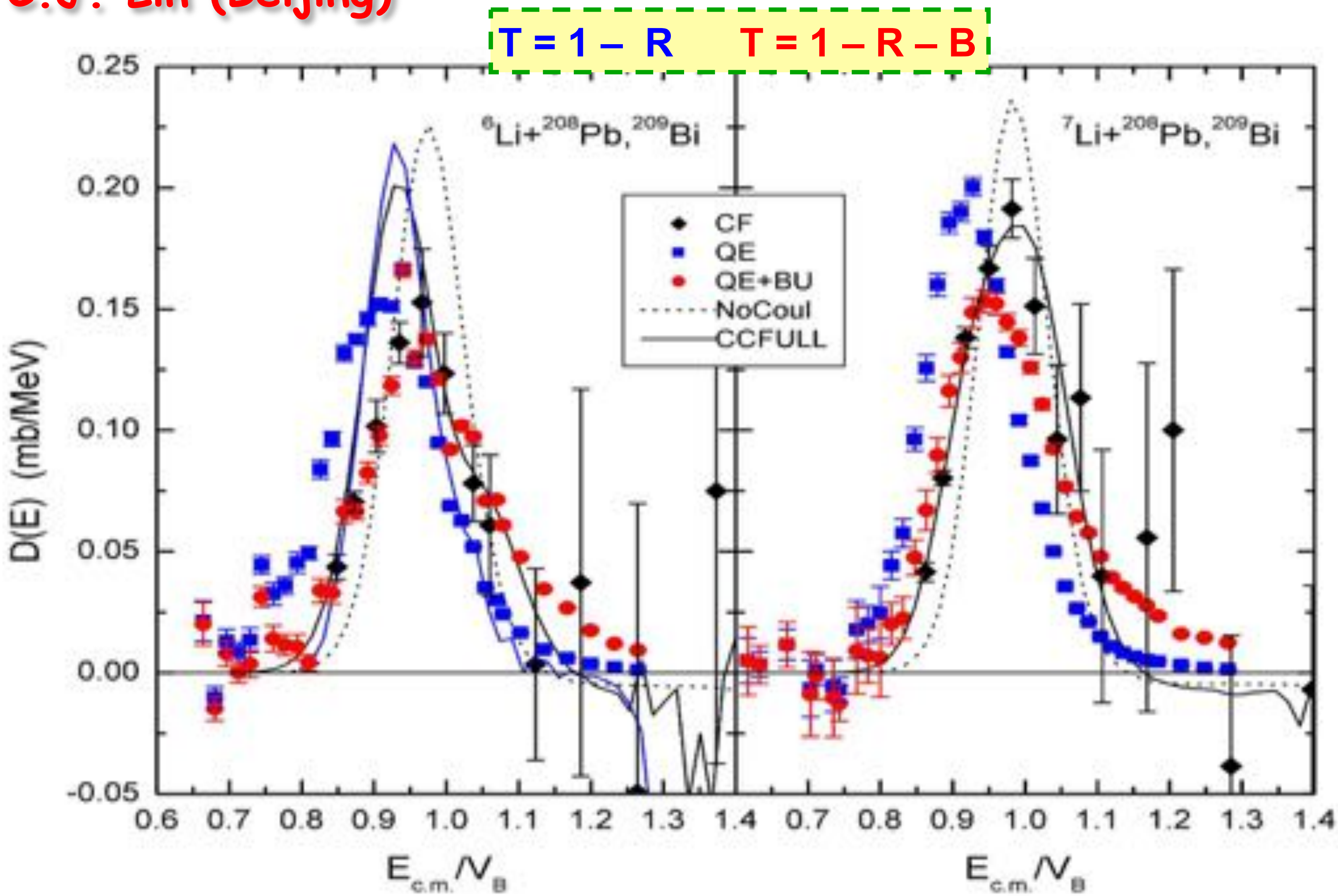
Fusion and Qel: inclusive ⟷ complementary to each other

$$D(E) = -\frac{d}{dE}\left[\frac{\sigma_{qe}(E)}{\sigma_R(E)}\right] \sim \delta(E - V_B)$$

Timmers et al., NPA584, 190



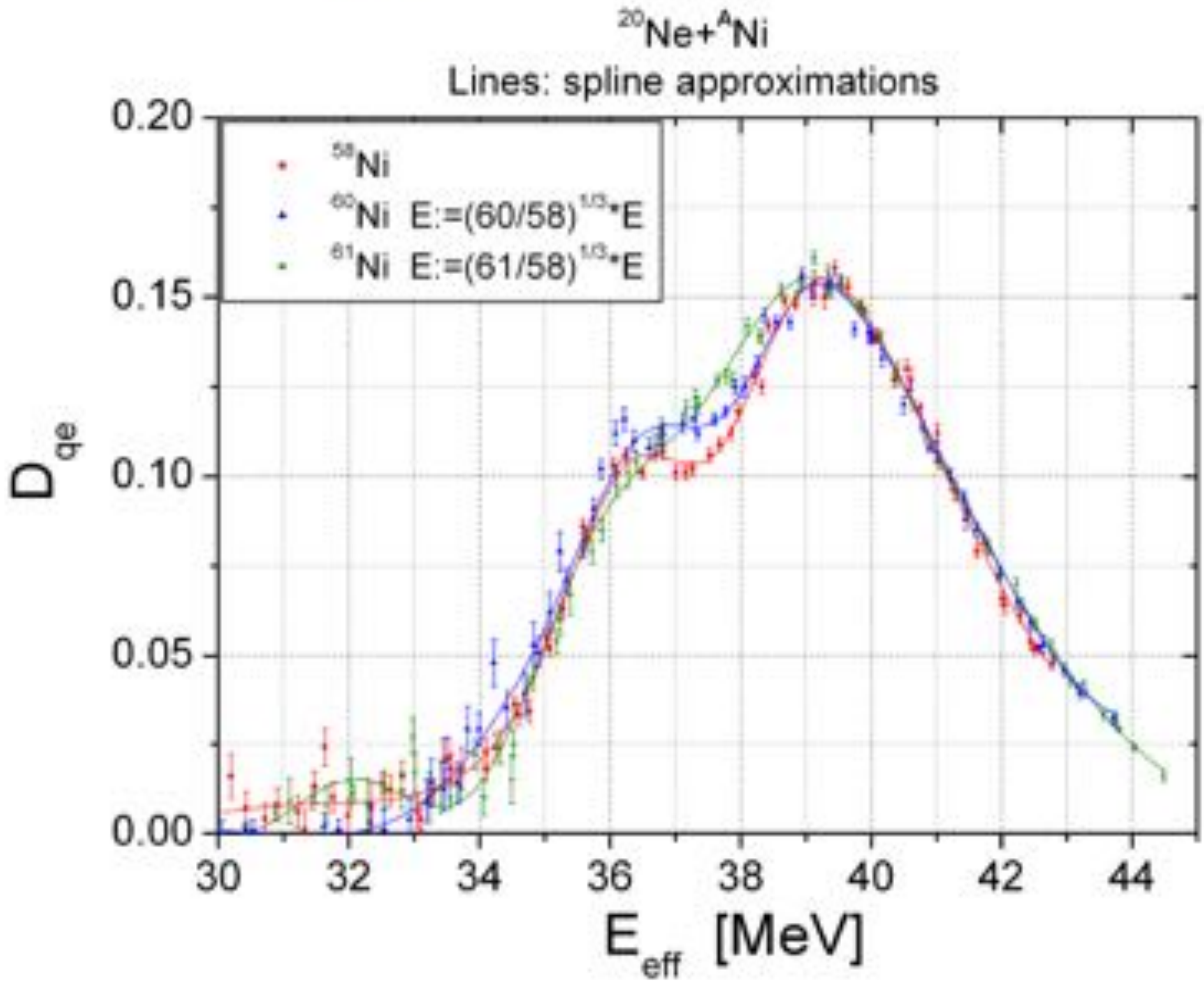
Talk by **C.J. Lin (Beijing)**



- ♠ T = 1 – R barriers are lower than T = 1 – R – B barriers
- ♠ Quasi-elastic barrier distributions extracted by T=1-R-B are in good agreement with those extracted by complete fusion.
- ♠ Barrier distribution is a sensitive probe to study the structure effects and also the dynamics effects.

Talk by **A. Trzcińska (Warsaw)**

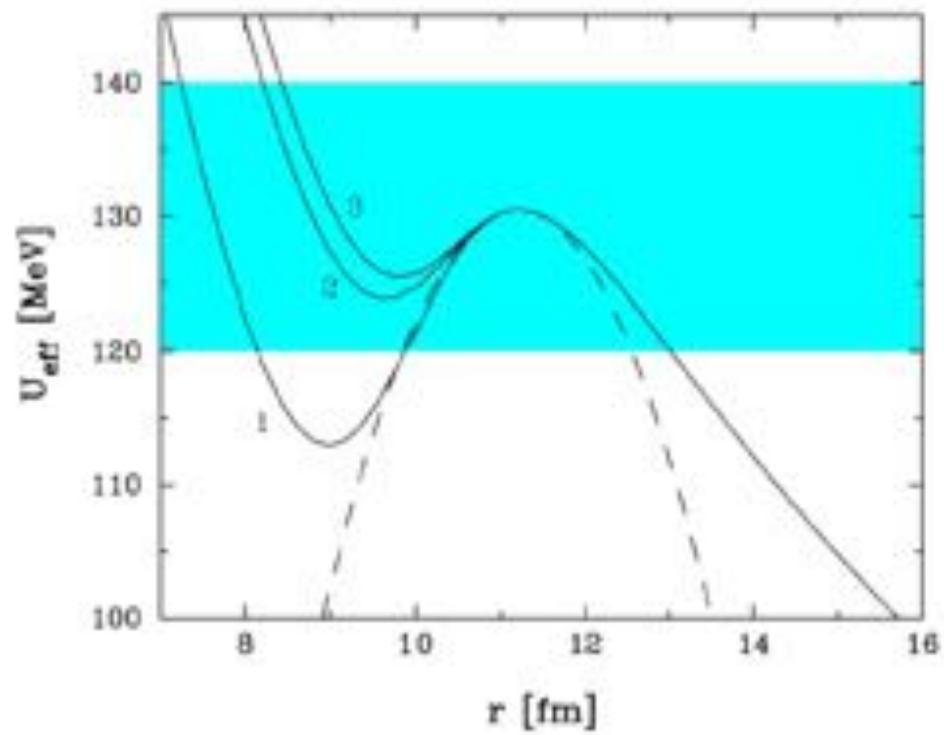
D_{QE} for $^{20}Ne+^{58,60,61}Ni$



Hindrance

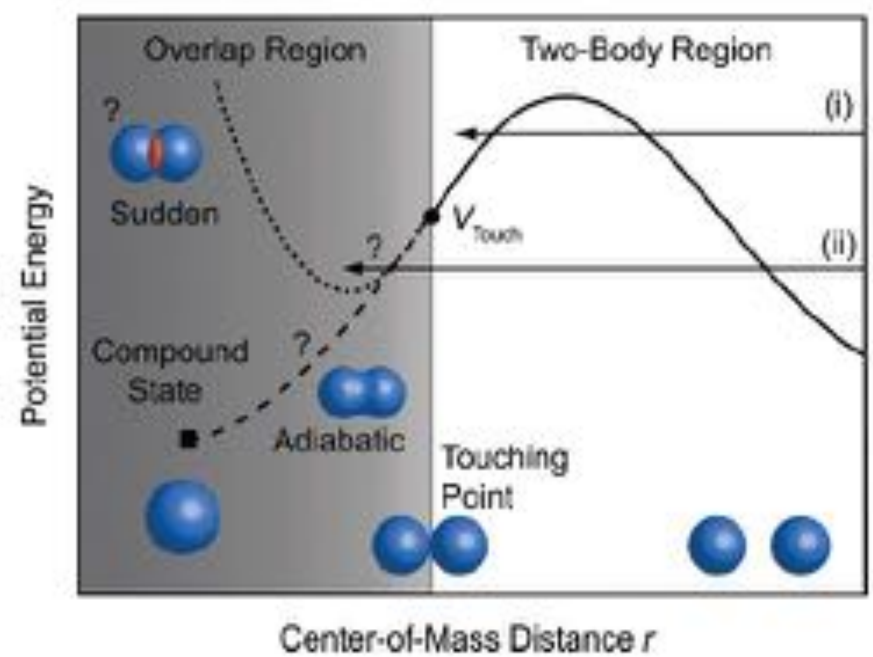
Talk by **A. Shrivastava (Bhabha)**

Deep sub-barrier fusion – probe to study inner part of inter-nuclear potential



Fusion hindrance explained by

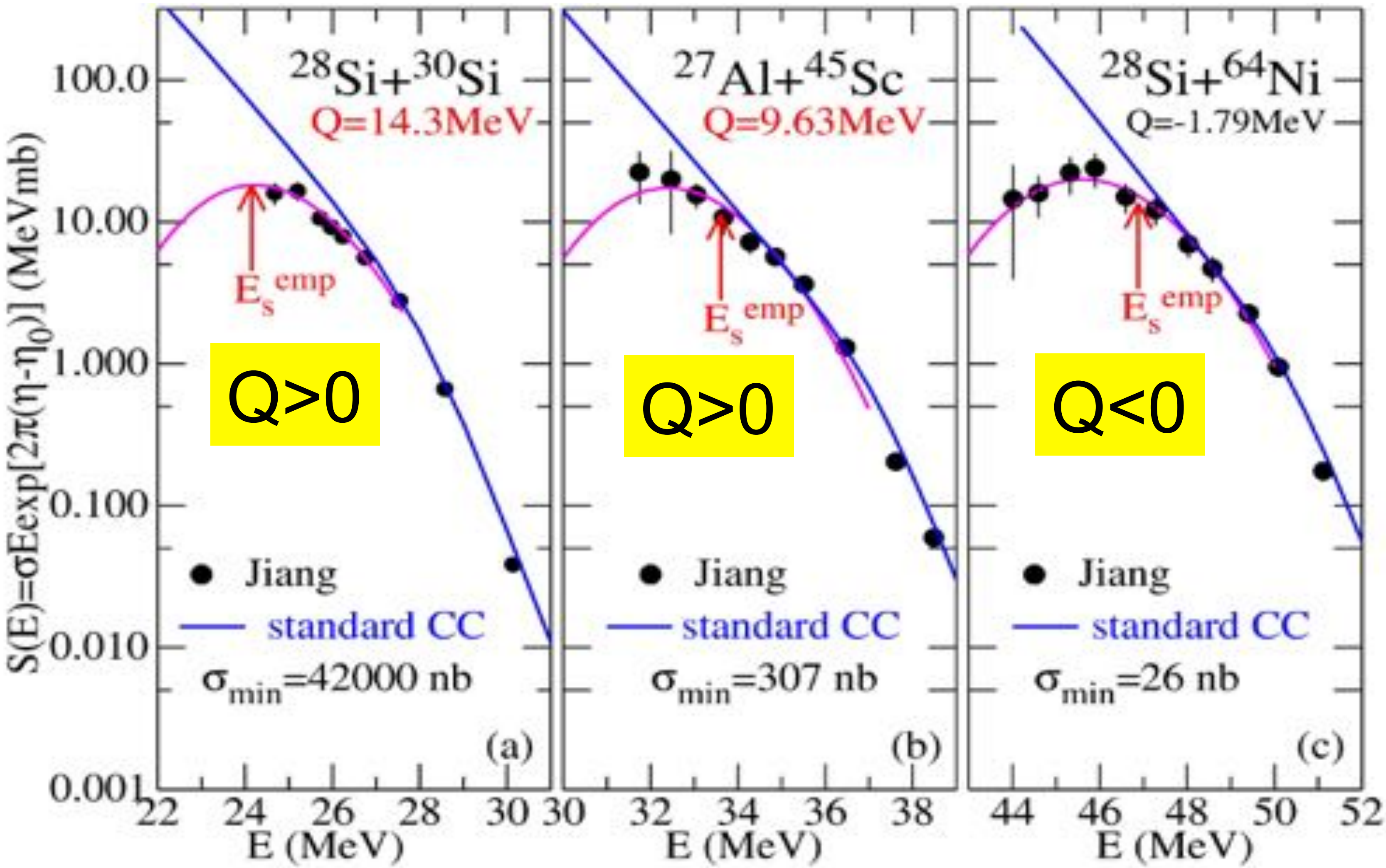
Sudden model: Potential with shallow pocket: M3Y double folding+repulsive core (Pauli Blocking) reproduces nuclear incompressibility - Esbensen & Misicu



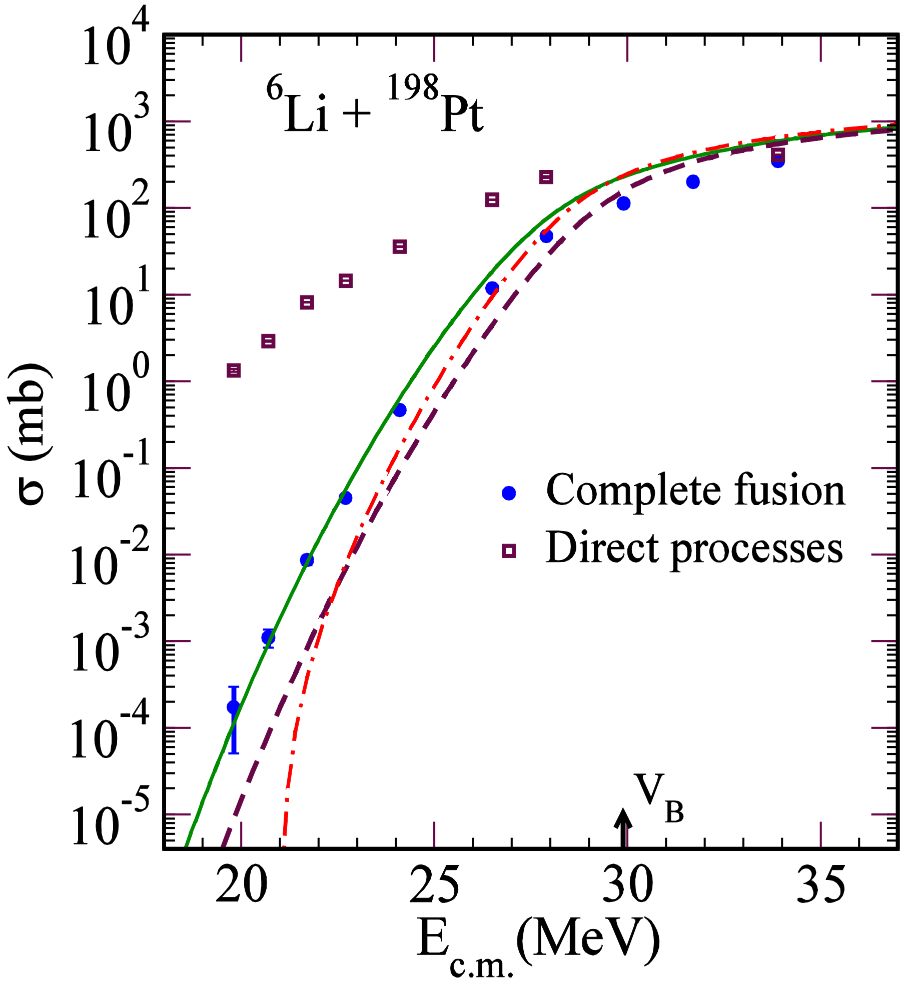
Adiabatic model: two step via neck formation – Ichikawa & Hagino

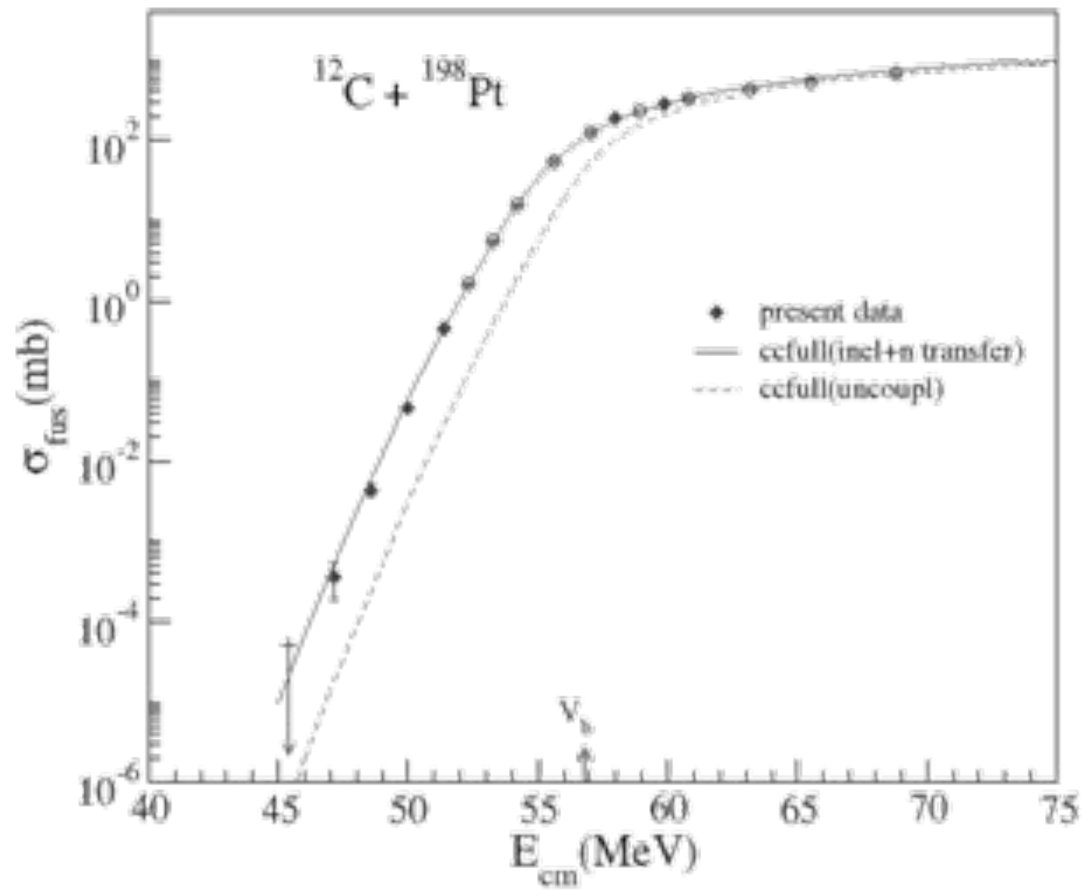
Talk by **C.L. Jiang (Argonne)**

Hindrance observed also in two systems with Q > 0 !



Talk by **A. Shrivastava (Bhabha)**

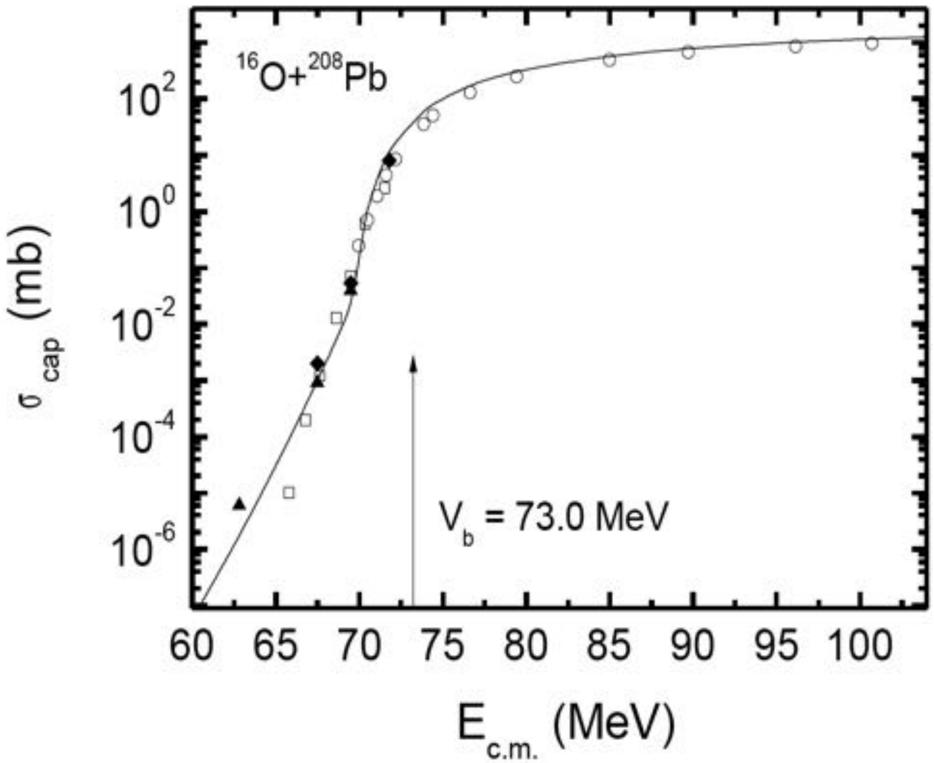




No fusion hindrance observed

Talk by G.G.Adamian (JINR)

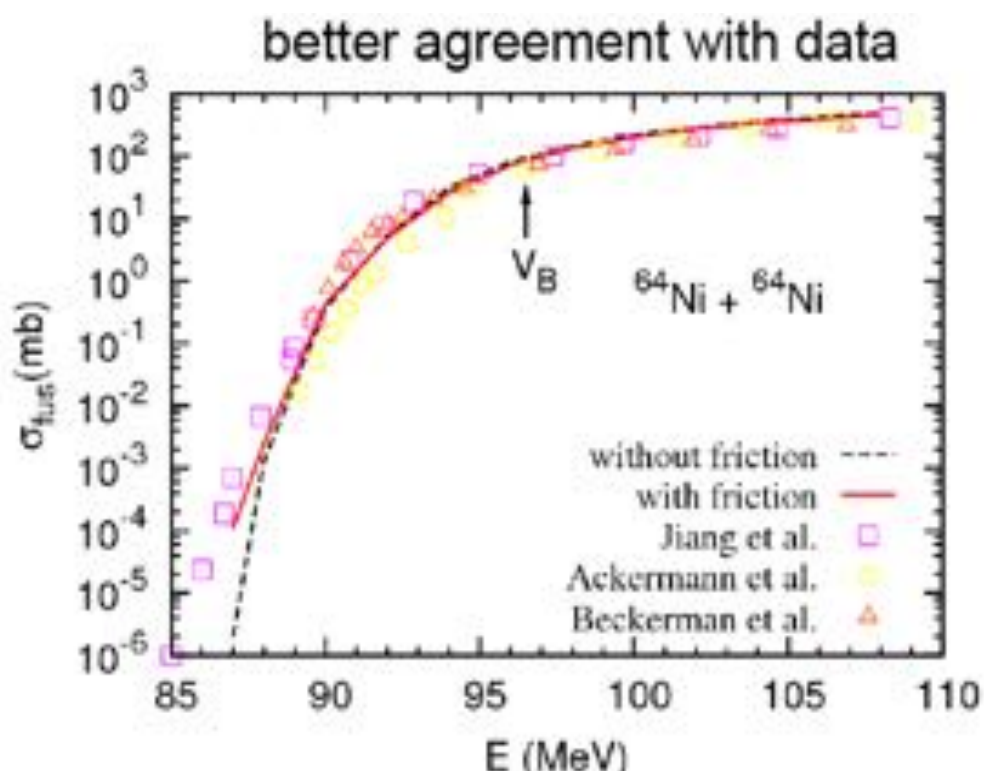
Sub-barrier capture with the quantum diffusion approach



Talk by B. Yılmaz (Ankara)

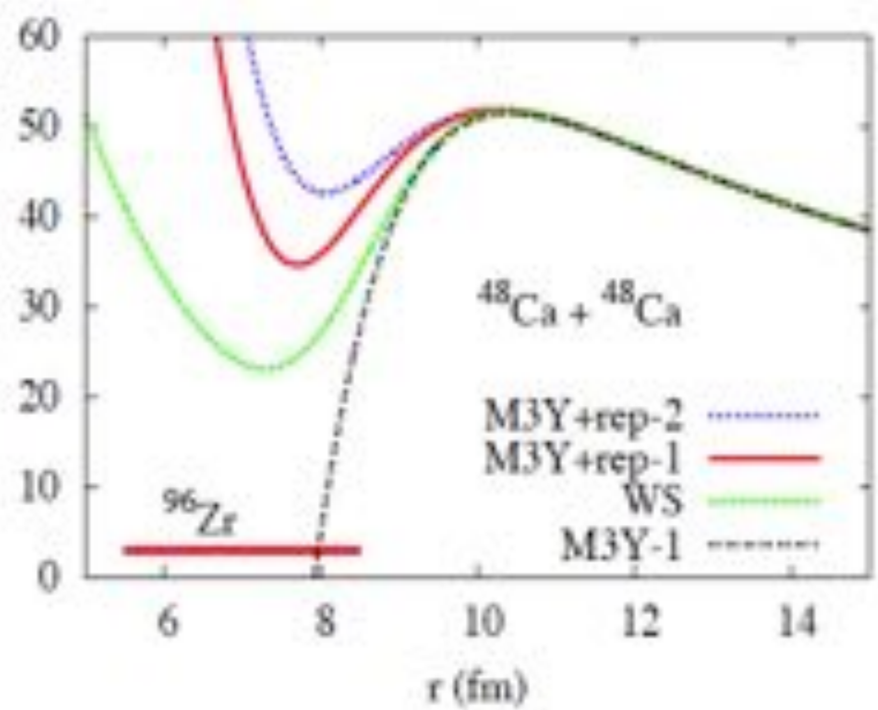
Stochastic semi-classical description of sub-barrier fusion

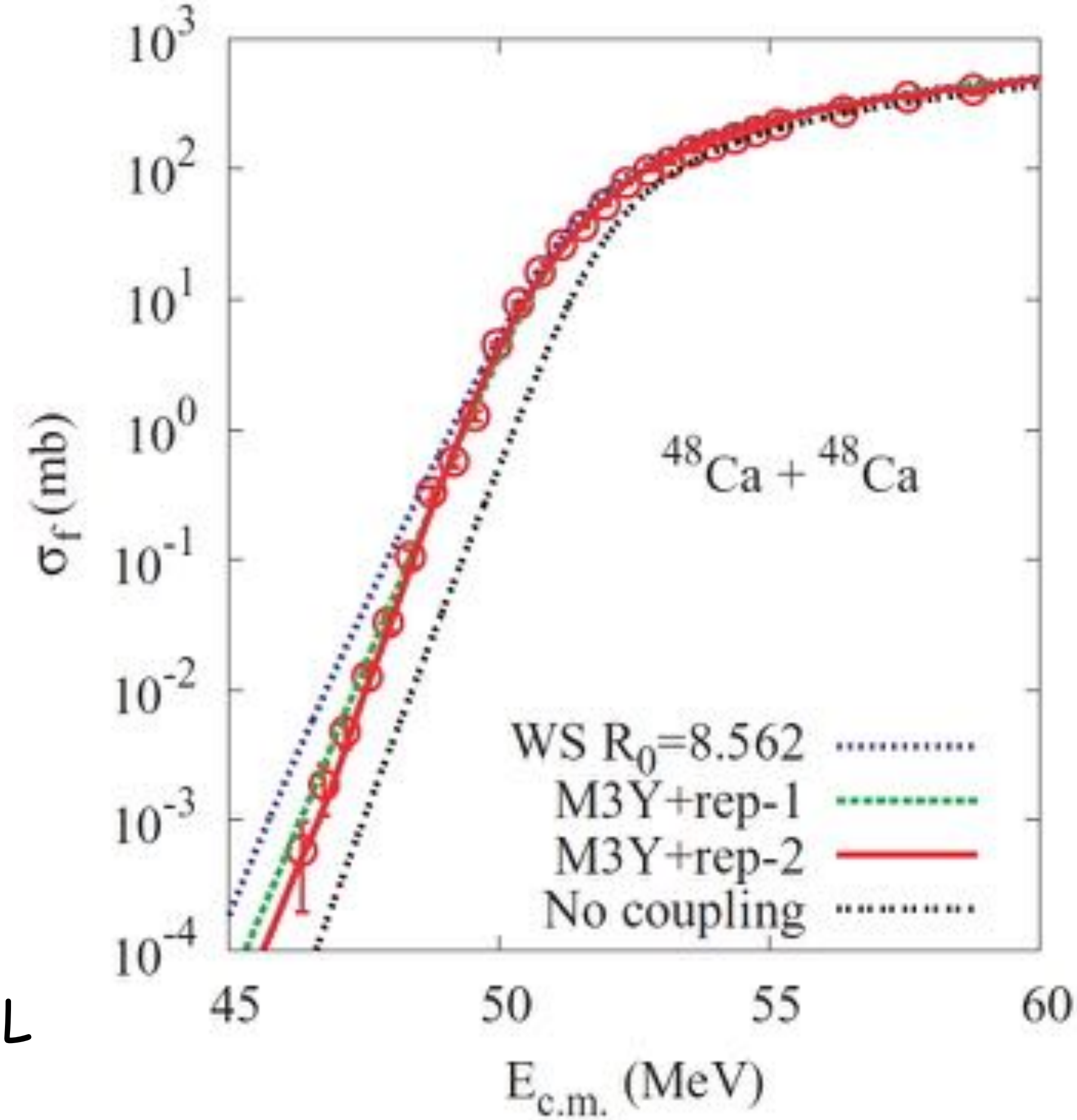
No hindrance



Talk by G.Montagnoli (Padova)

Data are nicely reproduced with CC calculations using a shallow ion-ion potential





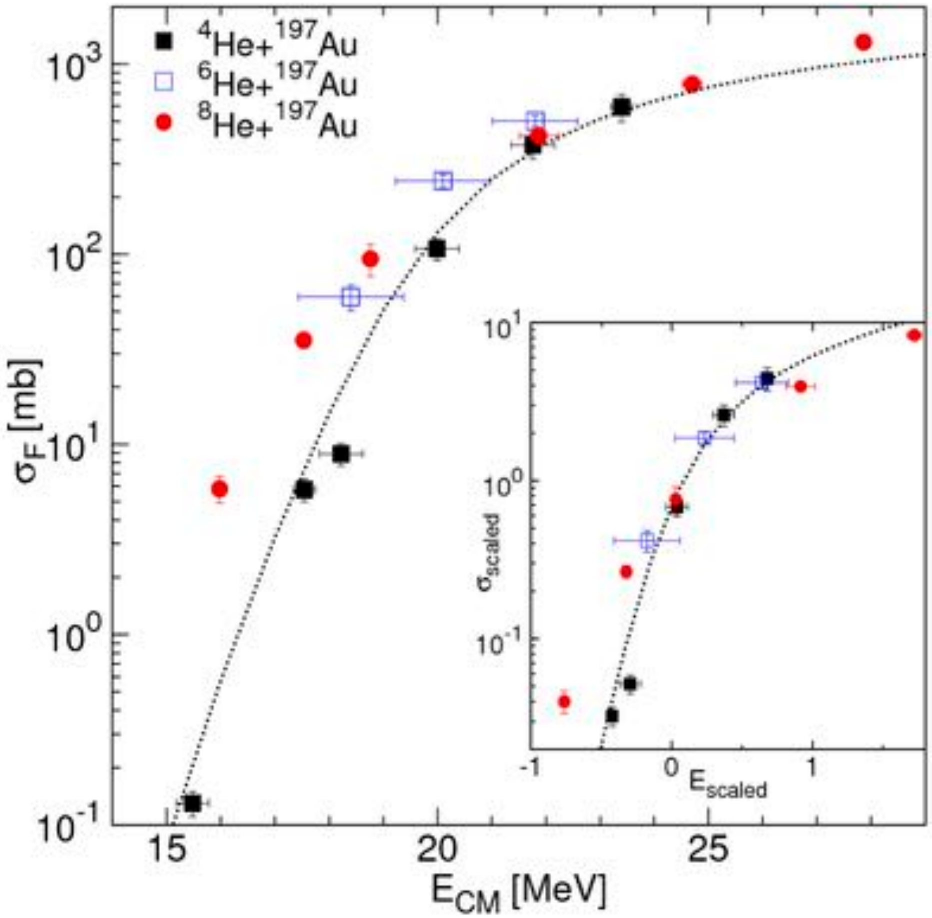
Talk by F. Scarlassara (Padova)

First results of the analysis of $^{60}Ni+^{100}Mo$ fusion measured at ANL with the FMA and a multiparametric FPD


Transfer

Talk by A. Lemasson (MSU/GANIL)

Unexpected similar behavior of ^{6}He and ^{8}He



Additional two neutrons do not modify the tunneling probability

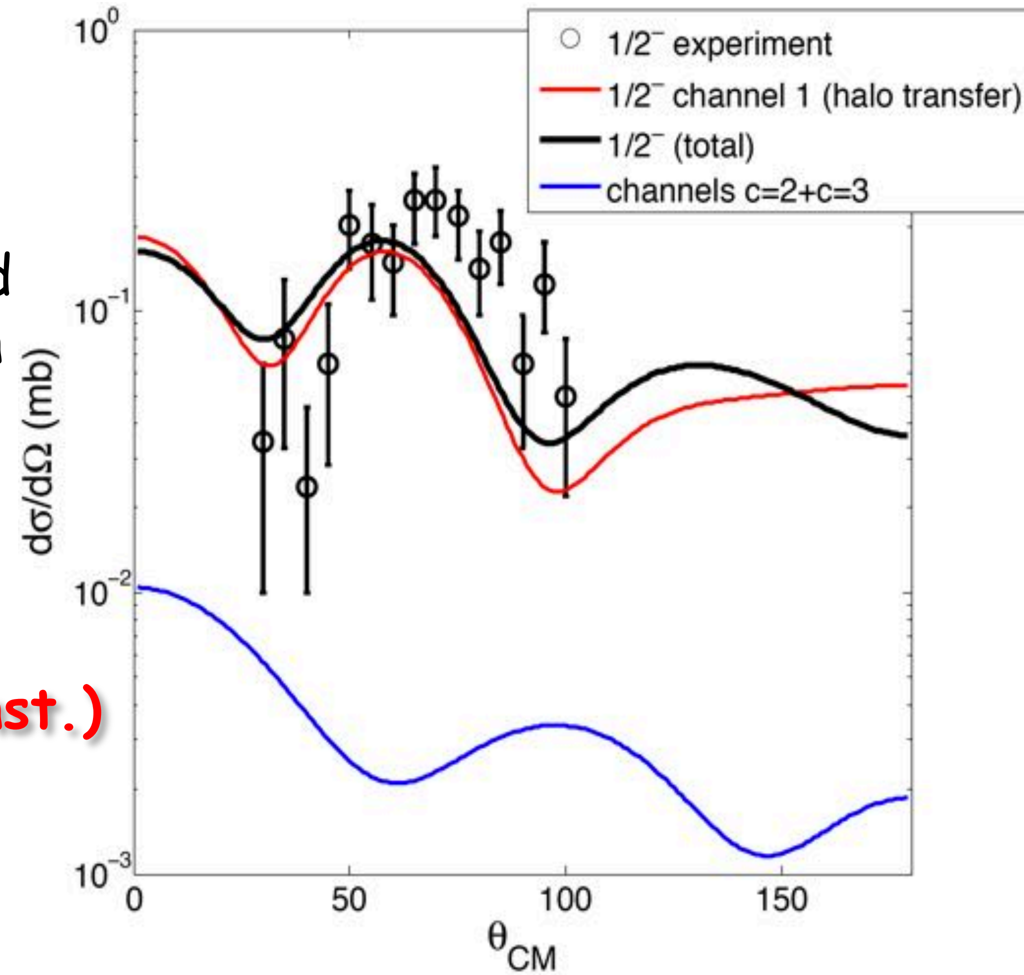
Showcase for general problem of the tunneling of composite objects
Bertulani, Flambaum and Zelevinsky, J. Phys. G 34 (2007) 2289

Talk by **F. Liang (Oak Ridge)**

- A large sub-barrier fusion enhancement has been observed in reactions with ^{40}Ca.
- Comparing to the fusion with ^{48}Ca, the enhancement in ^{40}Ca can be attributed to neutron transfer.

Talk by **G. Potel (Sevilla)**

The absolute cross section associated with the first excited state of 9Li in the p(11Li,9Li*(1=2⁻; 2:69MeV))t reaction: **direct evidence of phonon mediated pairing in nuclei.**



Talk by **S. Szilner (Ruđer Bošković Inst.)**

Multinucleon transfer reactions have been investigated in ^{40}Ar+^{208}Pb with the Prisma+Clara set-up.

Support HRIBF

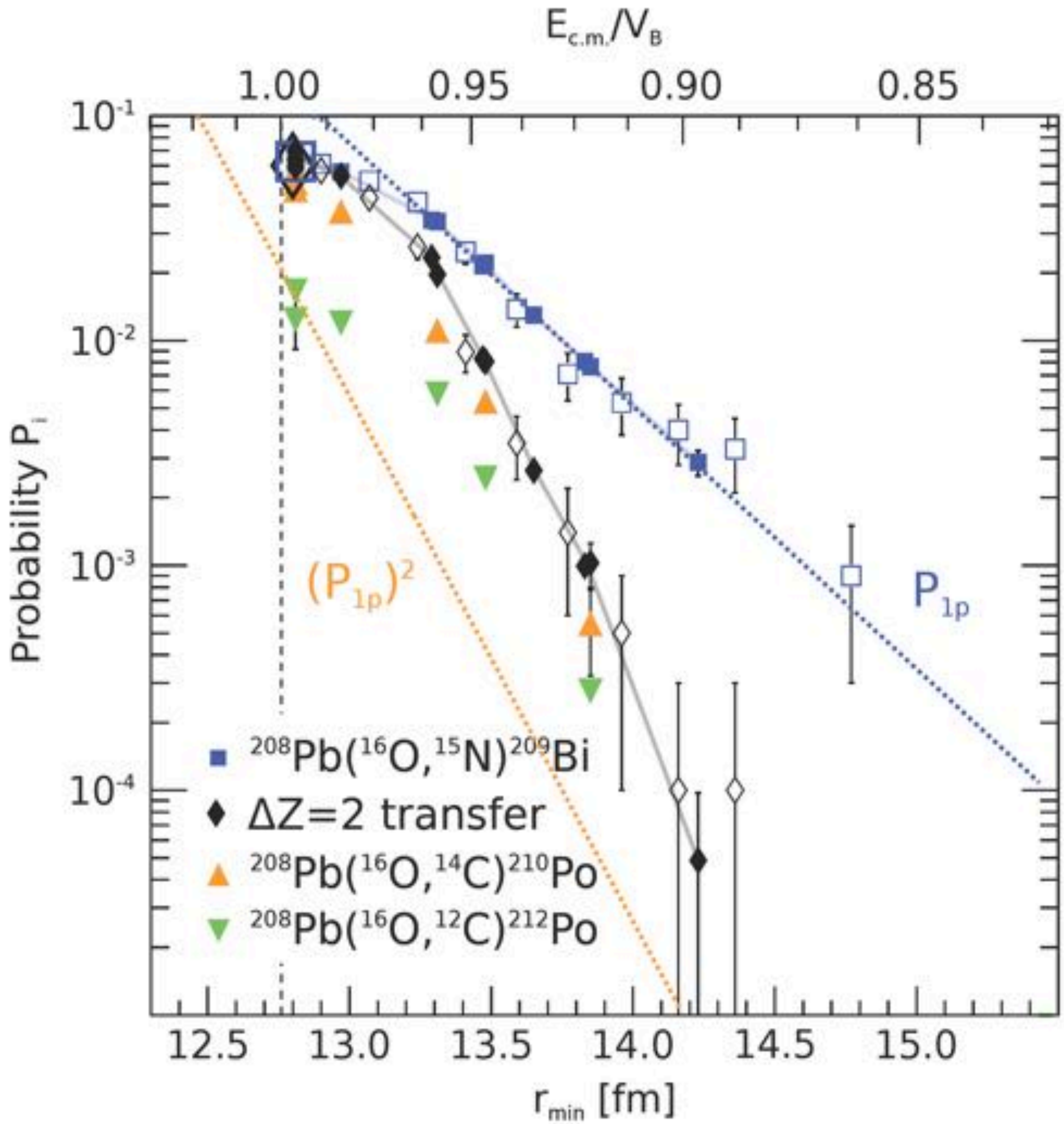
Dear HRIBF Users,

In the submitted FY2012 U.S. Department of Energy Office of Science budget it is proposed to terminate the user program at the Holifield Radioactive Ion Beam Facility (HRIBF) saving $10.3 million.

http://www.supporthribf.org/

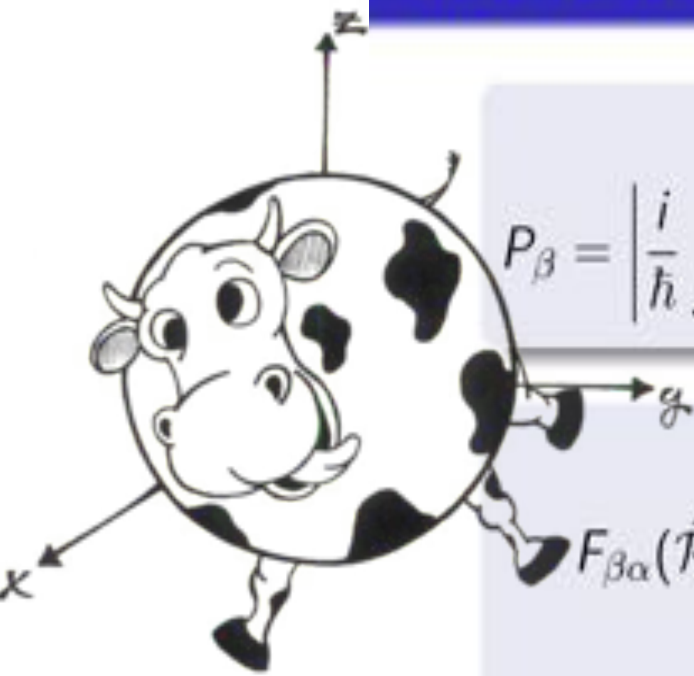
Talk by M. Evers (ANU)

(Multi-)nucleon transfer processes already play an important role at energies well below the fusion barrier



Talk by G. Polarollo (Torino)

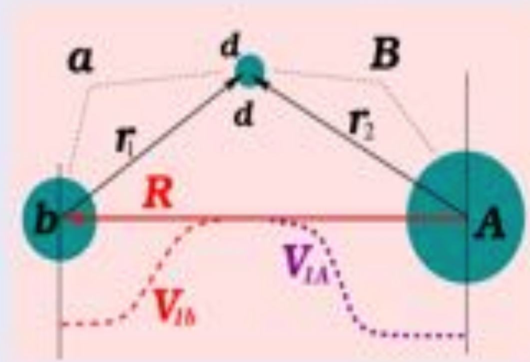
One-Particle transfer (Born approximation)



$$P_\beta = \left| \frac{i}{\hbar} \int_{-\infty}^{+\infty} dt\, F_{\beta\alpha}(\vec{\mathcal{R}}) e^{i(E_\beta - E_\alpha)t + (\ldots)} \right|^2 = \tau_{coll} \left| F_{\beta\alpha}(\mathcal{D}) \right|^2 g(Q_{\beta\alpha})$$

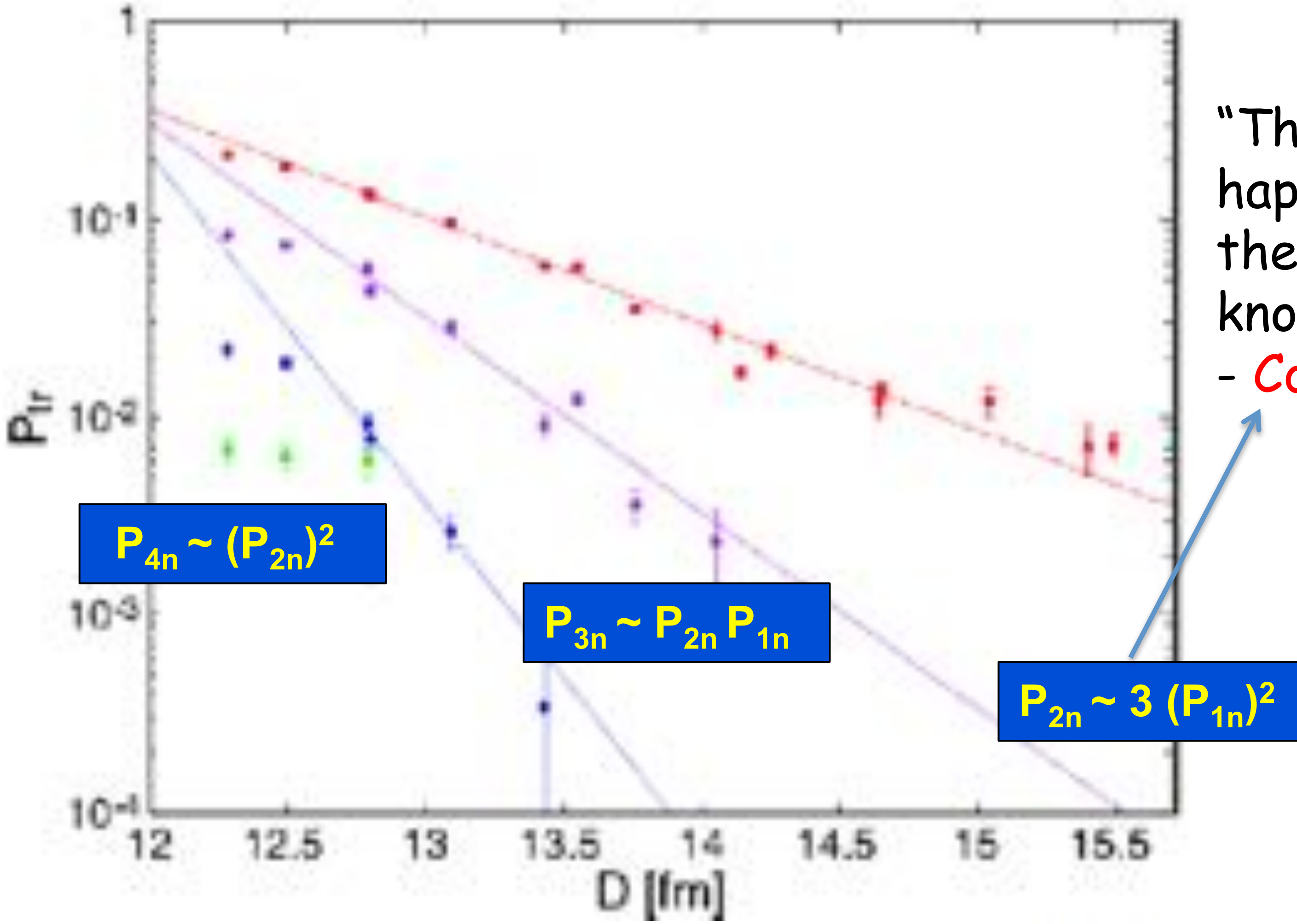
$$F_{\beta\alpha}(\vec{\mathcal{R}}) = \int d^3\vec{r}_1 e^{i\vec{Q}\cdot\vec{r}_1} \phi_{a_n}^{(A)}(\vec{\mathcal{R}} + \vec{r}_1)(V_{1A} - < U >)\phi_{a'_n}^{(b)}(\vec{r}_1)$$

- $\vec{Q}$ RECOIL momentum
- V_{1A} transfer interaction.
  Why not V_{1b} ??
  POST-PRIOR representation



Talk by L. Corradi (Legnaro)

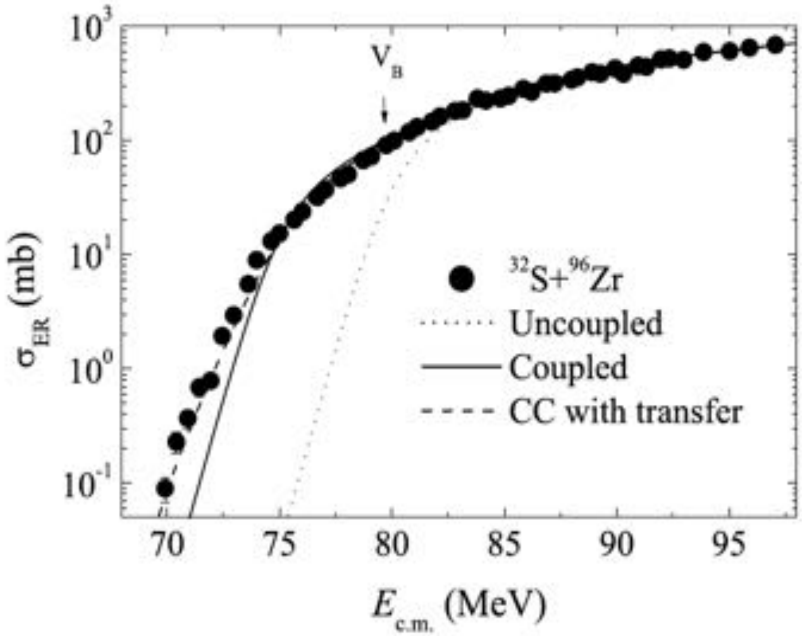
$$\frac{P_{tr}}{\sin(\theta_{c.m.}/2)} \propto \exp(-2\alpha D)$$



"That is what happens when theorists do not know what to do"
- Corradi

$$D = \frac{Z_1 Z_2 e^2}{2E_{c.m.}}\left(1 + \frac{1}{\sin(\theta_{c.m.}/2)}\right)$$

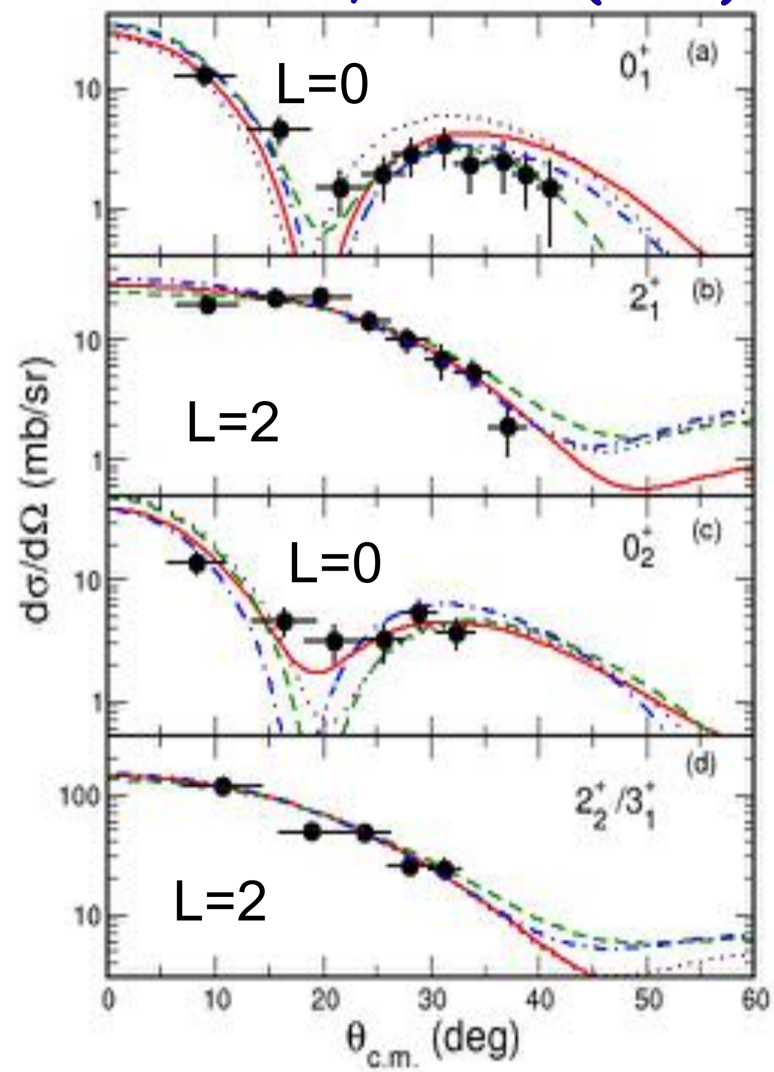
Talk by C. Beck (Strasbourg)



--- : includes de multi-neutron channel couplings

Talk by B. B. Back (Argonne)

PRL 105, 132501 (2010)



$^{15}C(d,p)$

Curves are DWBA calculations with various optical-model potentials.

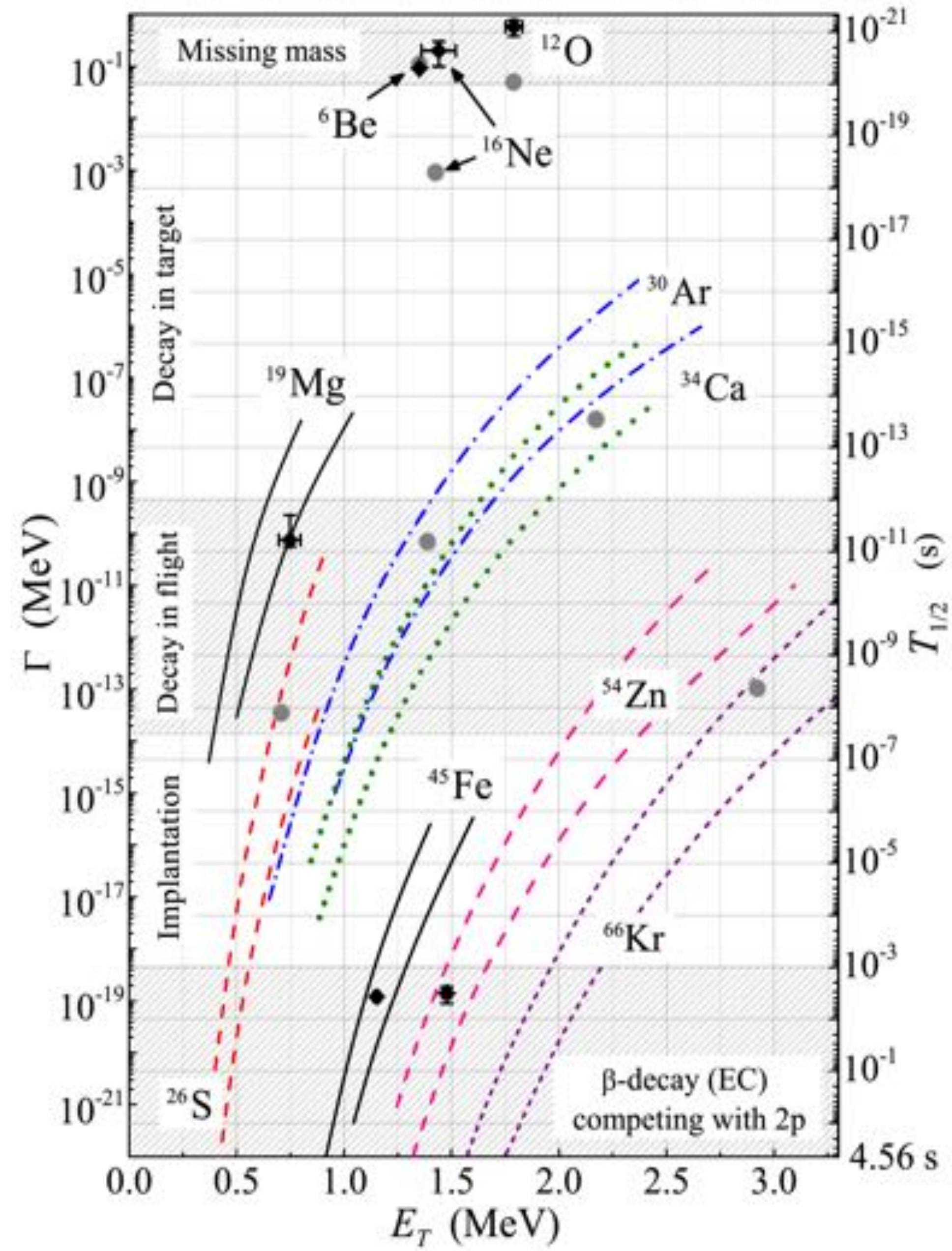
Talk of **L.V. Grigorenko (Dubna)**

Advances in the studies of 2p radioactivity and three-body decays

Lifetime vs. decay energy systematics for several known and prospective true 2*p* emitters calculated in three body model.

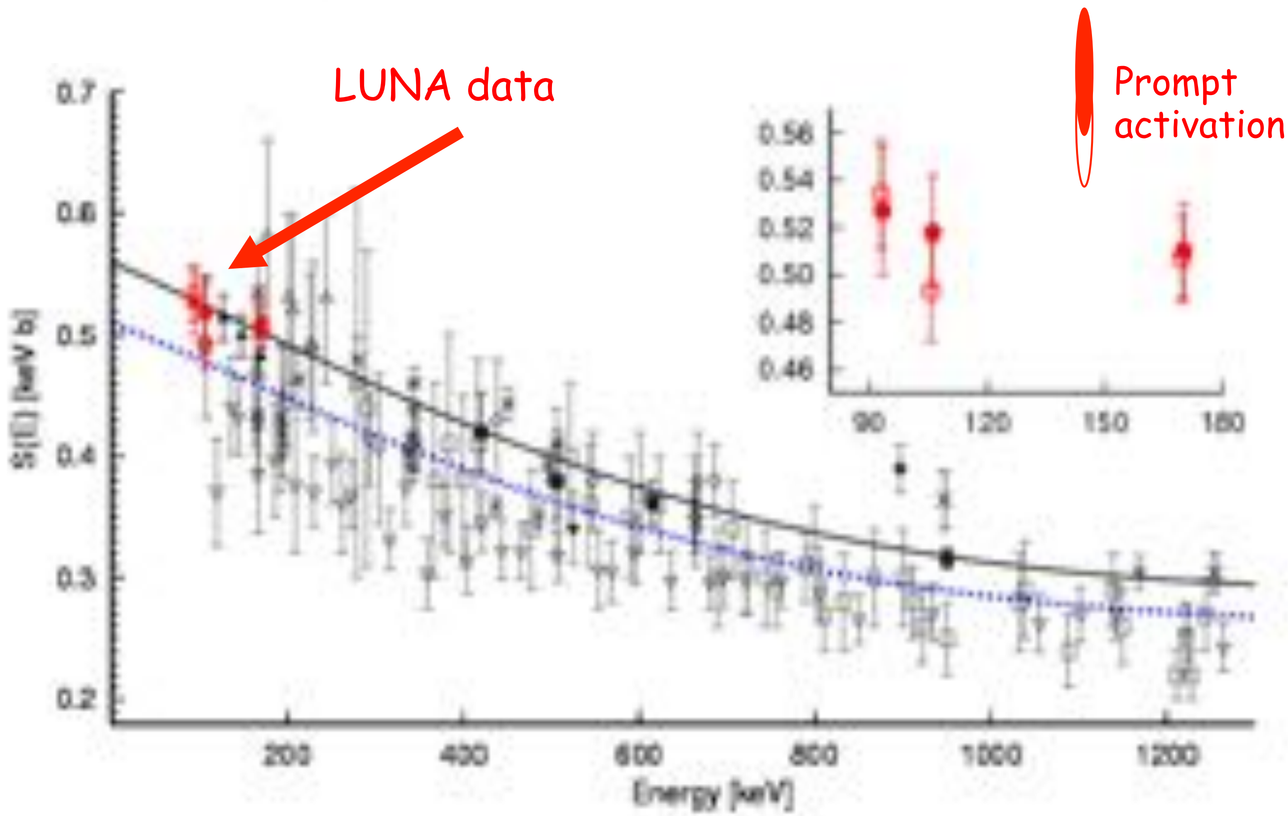
Hatching separate lifetime ranges accessible to different experimental techniques.

Experimental results are shown by diamonds. Gray circles shows specific predictions, where available.




Nuclear
Astrophysics

Talk by **A. Guglielmetti (Milano)**



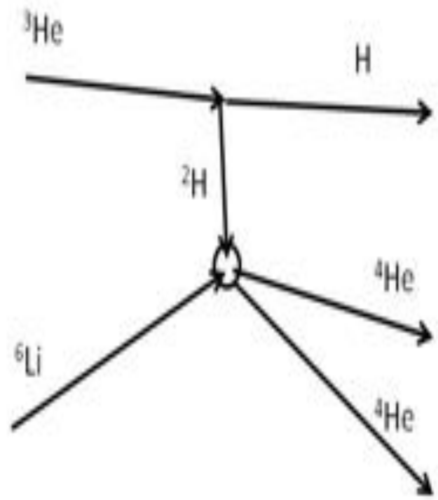
S_{34} (LUNA) =0.567±0.018±0.004 keV b

Uncertainty due to S_{34} on neutrinos flux:
$\Phi(^{8}B)$ 7.5% → 4.3%
$\Phi(^{7}Be)$ 8% → 4.5%

F. de Oliveira Santos (GANIL) - New results for $^{18}F(p,\alpha)^{15}O$, $H(^{17}Ne,p)^{17}Ne$, $H(^{14}O,p)^{14}O$.

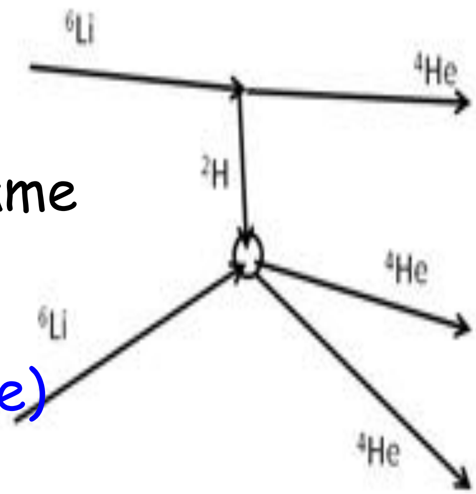
R.G. Pizzone (Catania)

Trojan horse method for $^{6}Li(d,\alpha)^{4}He$

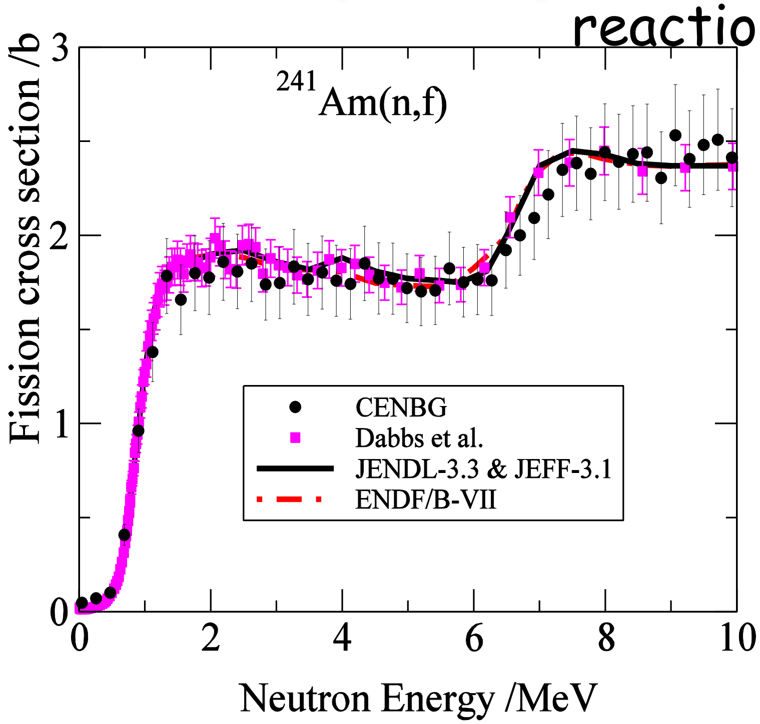


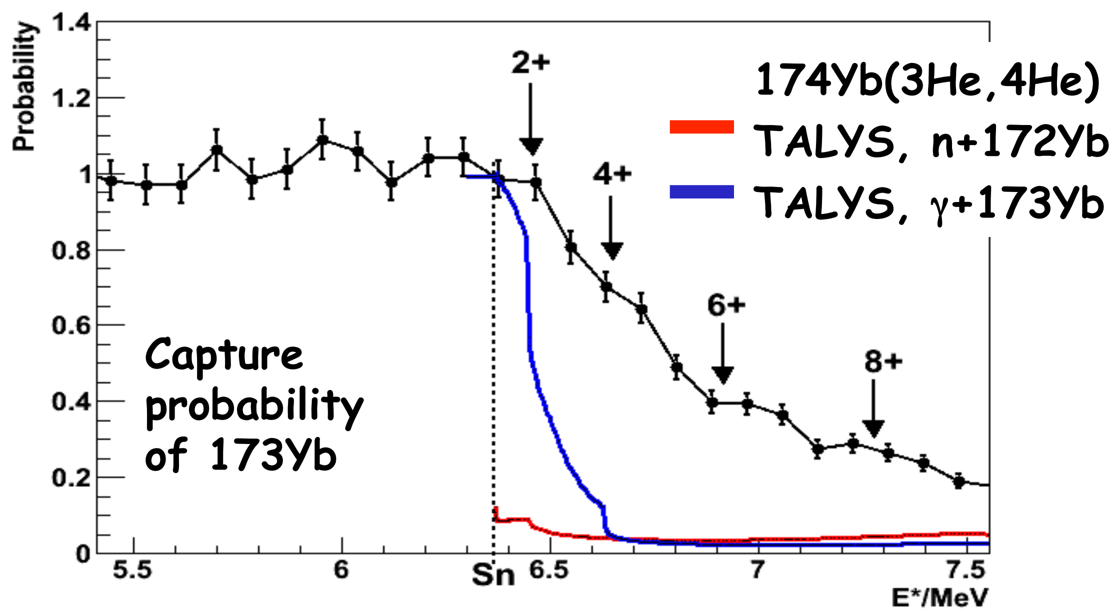
← gives the same result as →

(pole invariance)



B. Jurado (CENBG) - Surrogate reactions: e.g., (n,f) from transfer reactions

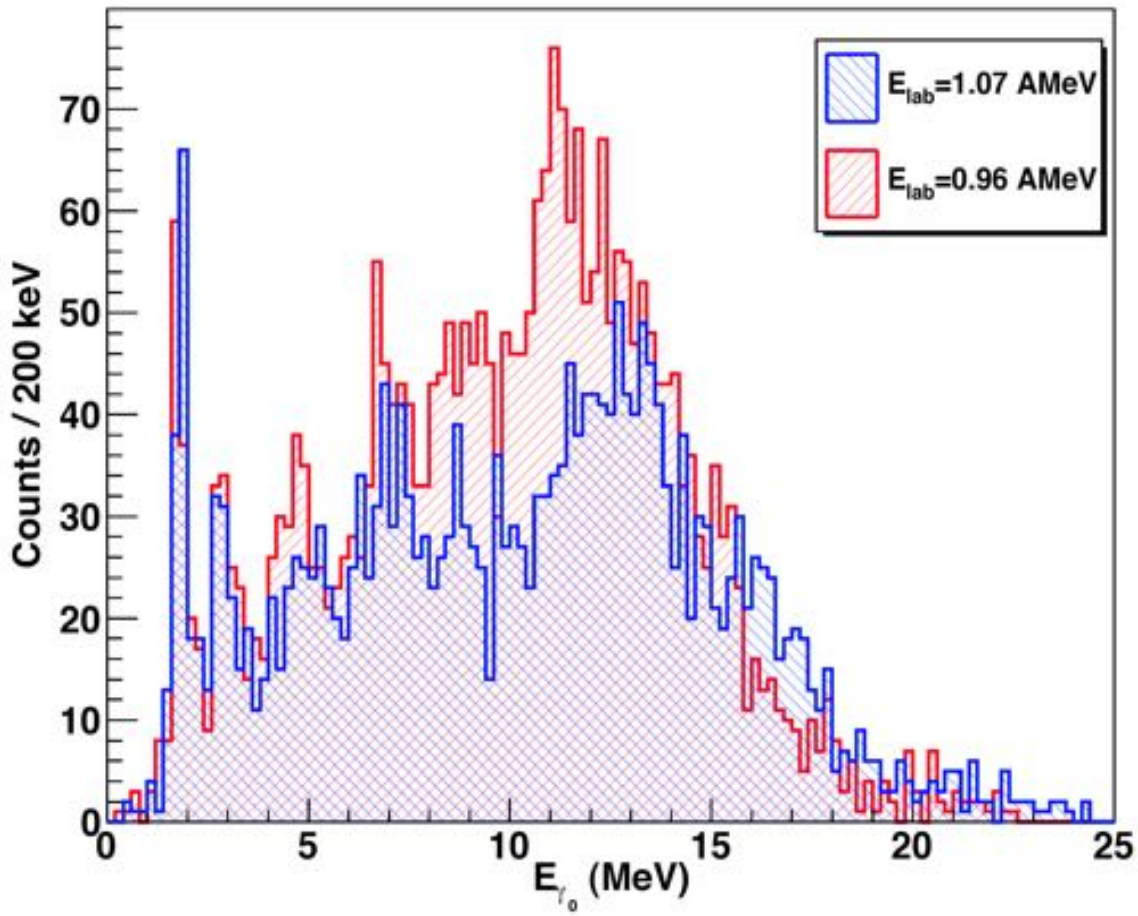




- Excellent agreement for (n,f)
- BUT, J^{π} dependence for capture reactions

A. Goasduff (IPHC)

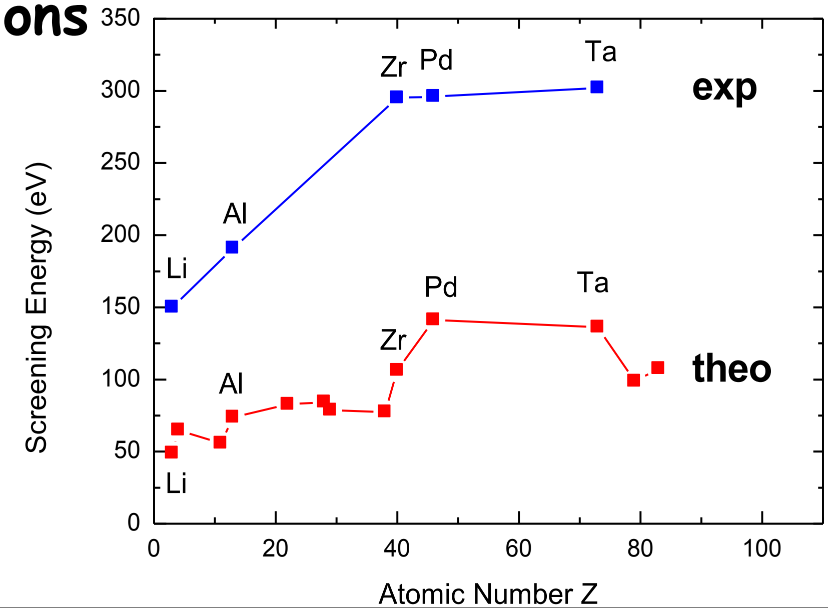
$^{12}C+^{16}O$ sub-barrier radiative capture cross section measurements

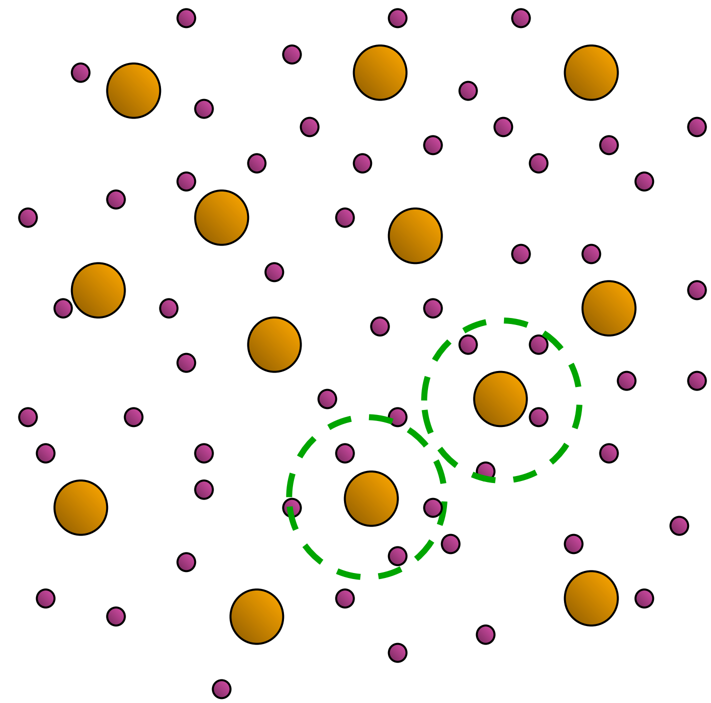


Highest γ-ray spectrum in coincidence with 28Si for Elab=1.07 AMeV (blue) Elab=0.96 AMeV (red).

Talks by K. Czerski (Szczeci)
J. Kasagi (Tohoku)

Enhanced Electron Screening in Nuclear Reactions



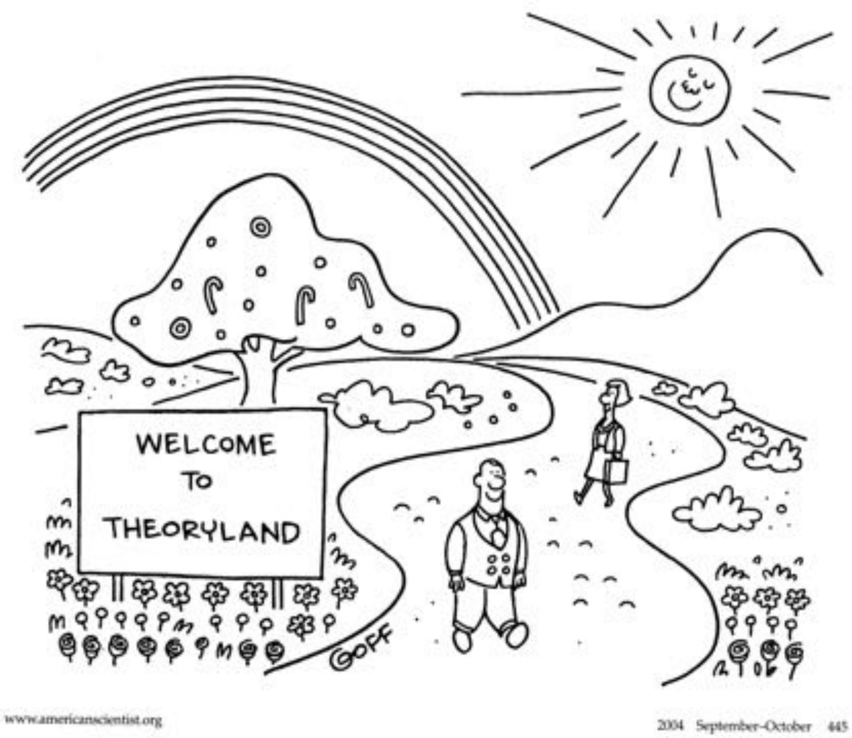


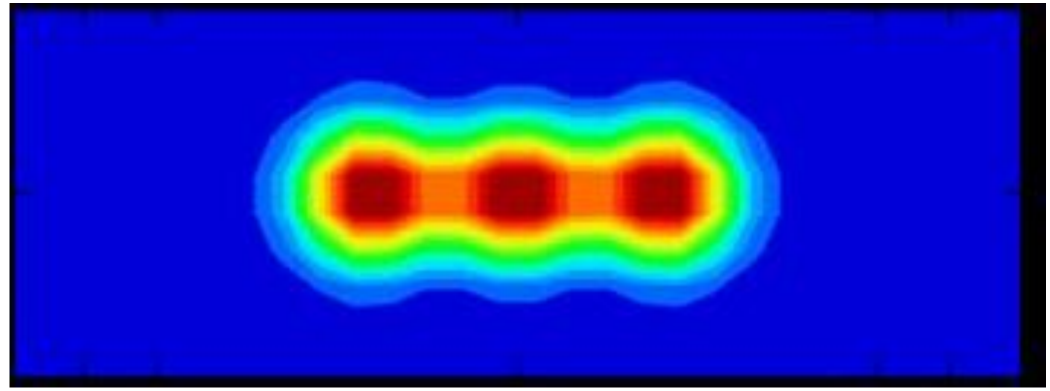
Cold fusion is back!

	atom/ molecule (Rolf's group)	in metals (ours, Rolf's, Czerski's)	in solid Li	in liquid Li	liquid Li + ultrasonic cavitation
D+D	~25 eV (20 eV)	30 - 300 eV 800 eV 600 eV; (50~70 eV)	~150 eV (Czerski)	~ 360 eV (preliminary)	U ~ 2000 eV or T ~ 6.8 x 10^6 K 1.5 x 10^5 K
Li+D or Li+p	~290 eV (186 eV)	1200 eV (Pd)? 3800 eV (Pd)?	~400 eV (250 eV)	~490 eV (670 eV)	no effect, so far


BRITISH CHANNEL
Fort Royal
Clusters
PLAN
of the
CITY and CASTLES
of
ST MALO.

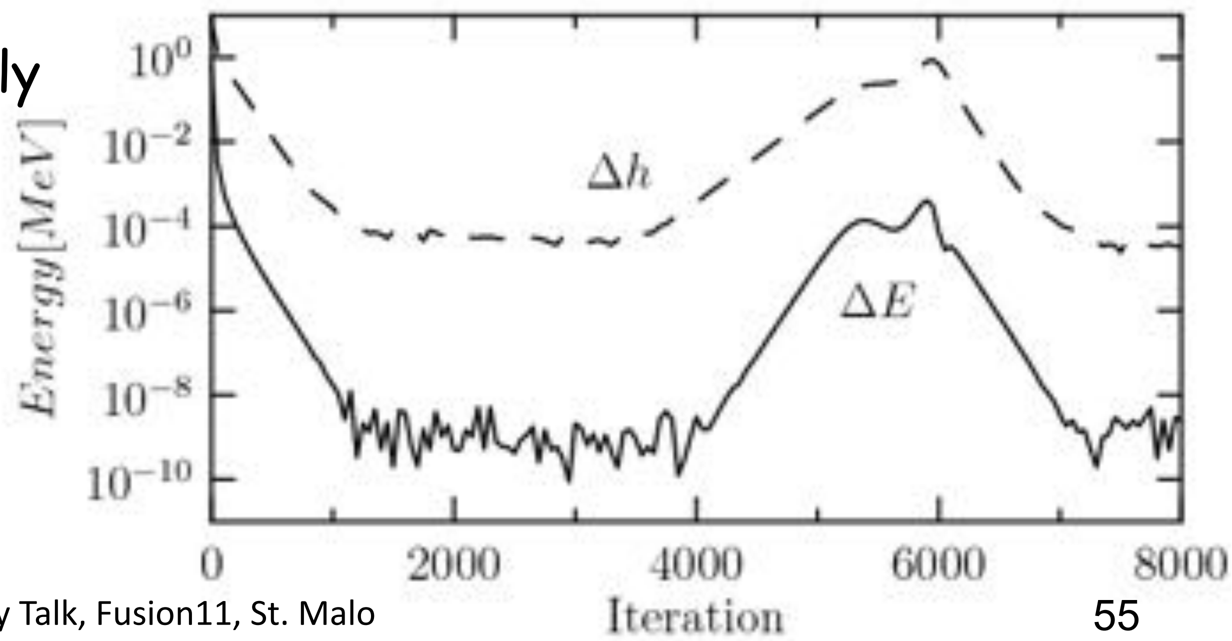
Talk by **J. Maruhn (Frankfurt)**



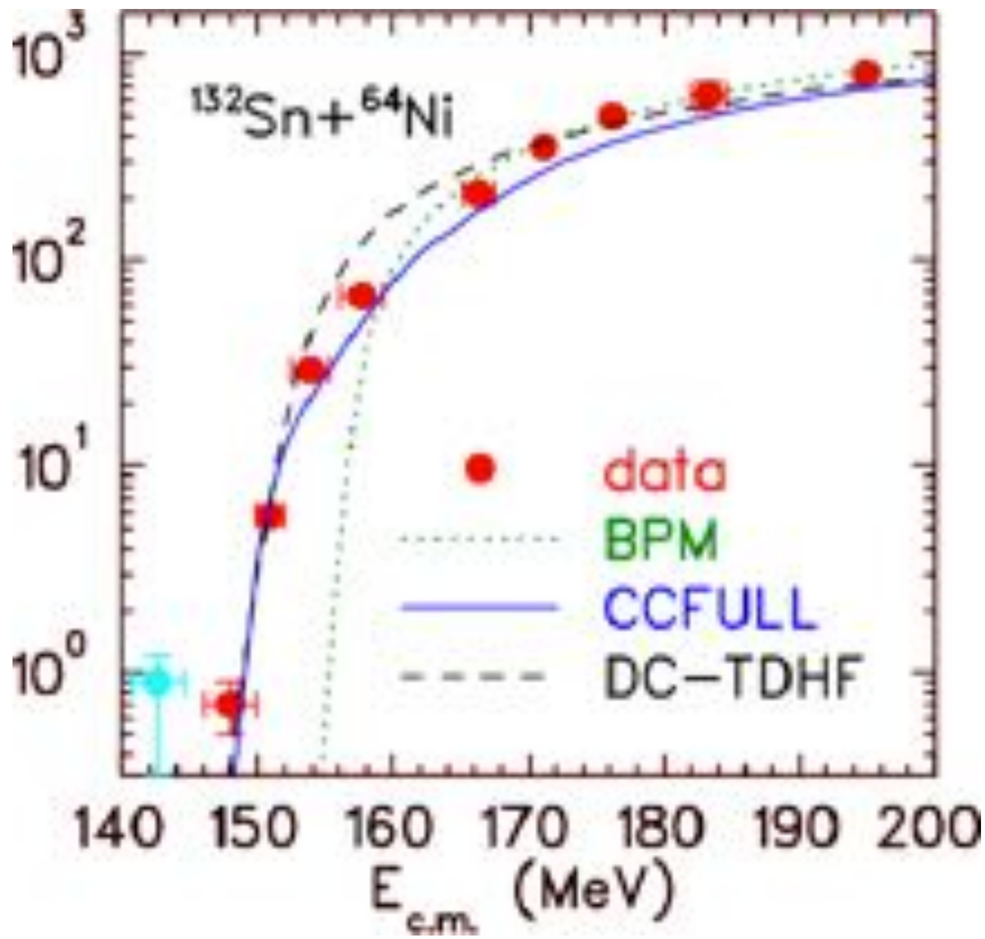


- **TDHF**
- Chain state in ^{12}C , ^{16}C, ^{20}C
- Chain state in ^{16}O : rotational stabilization

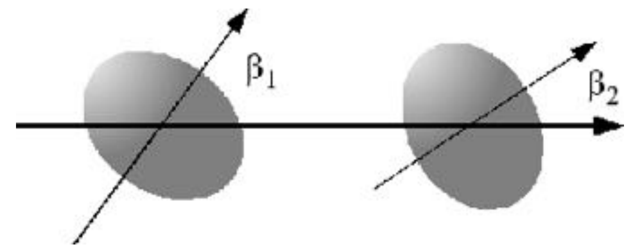
Discovery of numerical tunneling!



- An excited quasistable (?) state appears as an apparently converged configuration for 1000 's of iterations.
- OOPS! Subsequently, there is rapid conversion to the ground state via triaxial shapes.

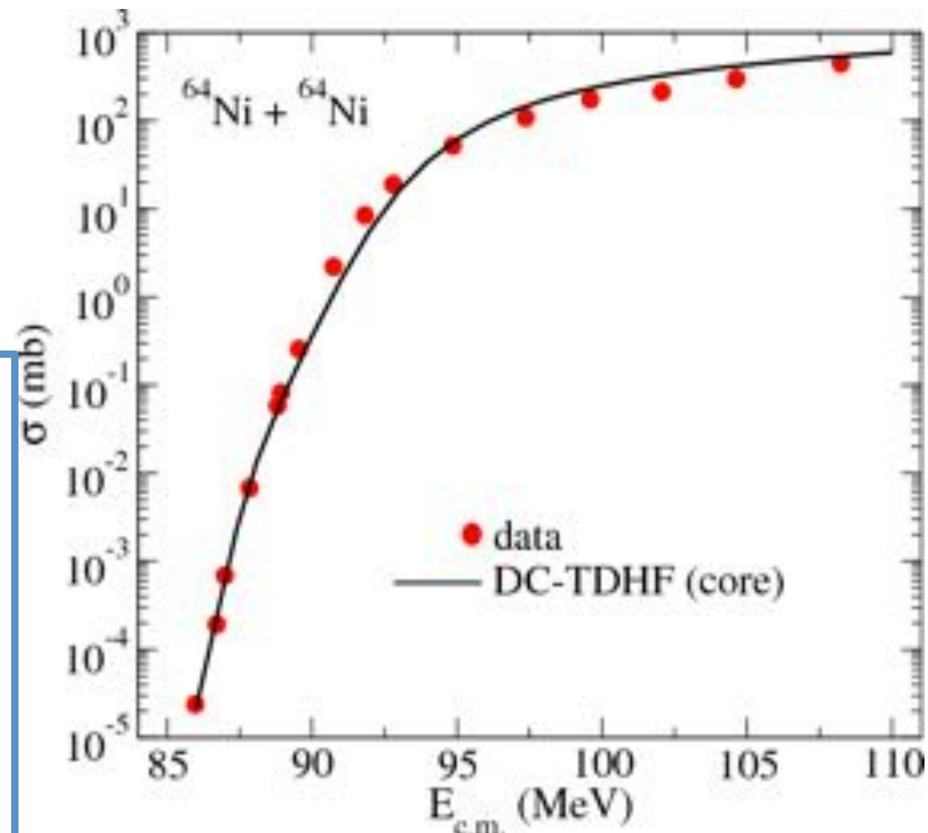


Talk by S. Umar (Vanderbilt)

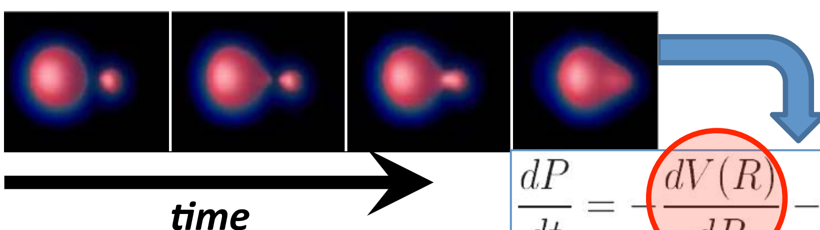


Average over orientations

$$\sigma_f(E) = \int_0^{\pi} d\cos(\beta) P(\beta) \sigma(E,\beta)$$



Talk by K. Washiyama (Bruxelles)



Mapping

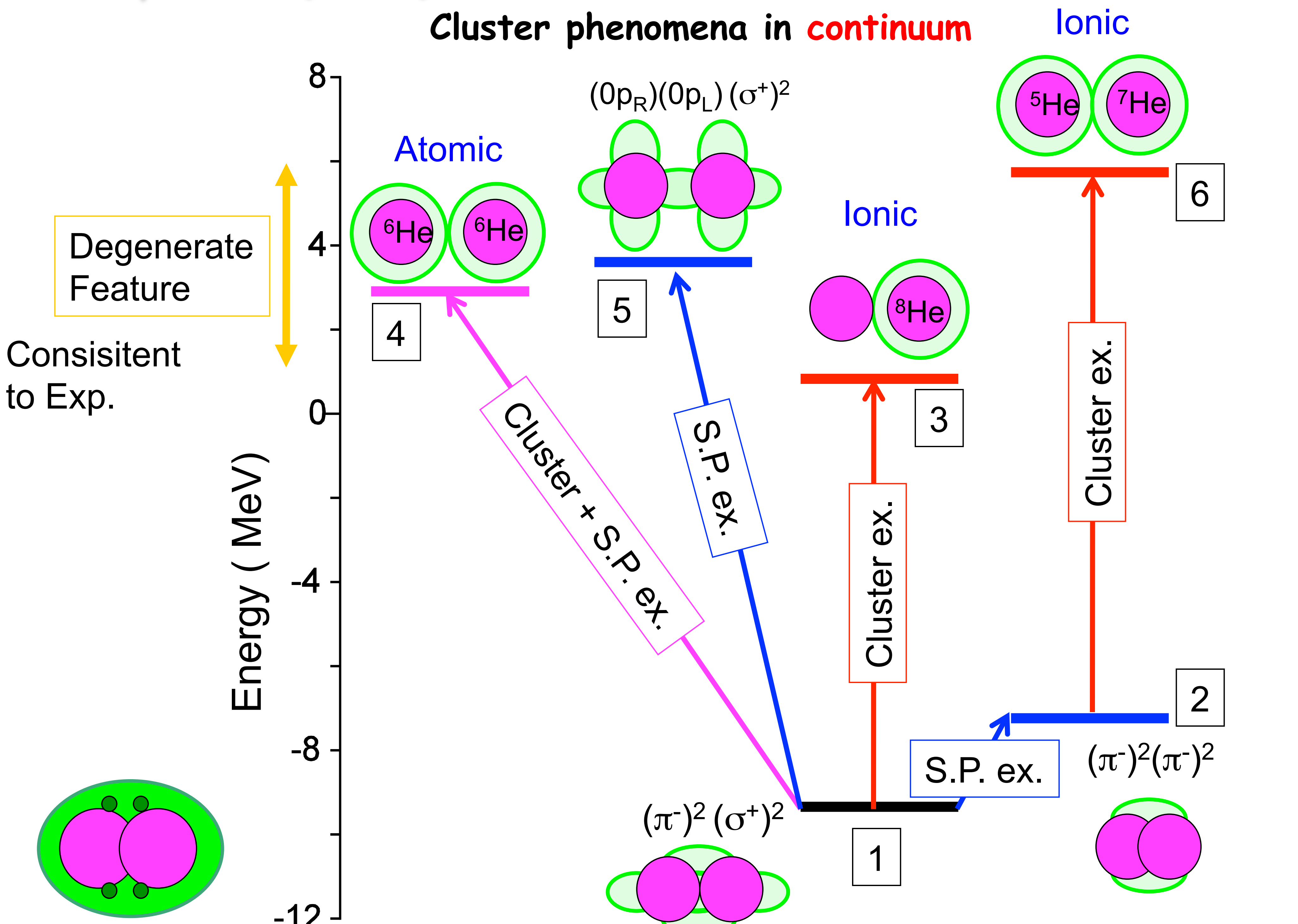
$$\frac{dP}{dt} = -\frac{dV(R)}{dR} - \gamma(R)\frac{dR}{dt}$$

Beyond mean-field approach to heavy-ion reactions around the Coulomb barrier

Talk by **M. Ito (Kansai)**

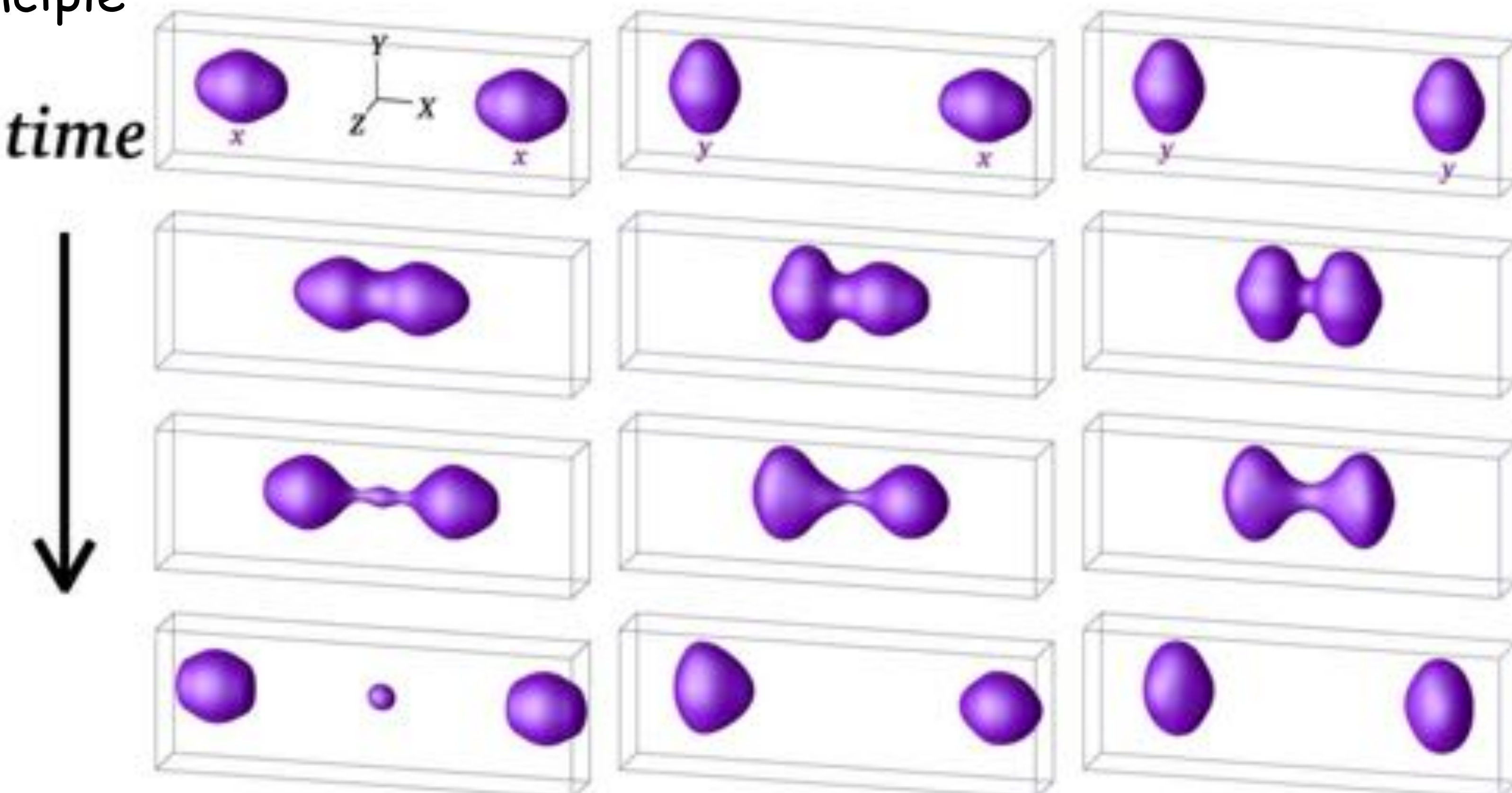
Femto-Molecules : $^{12}Be=\alpha+\alpha+4N\ J^{\pi}=0^{+}$

Cluster phenomena in continuum



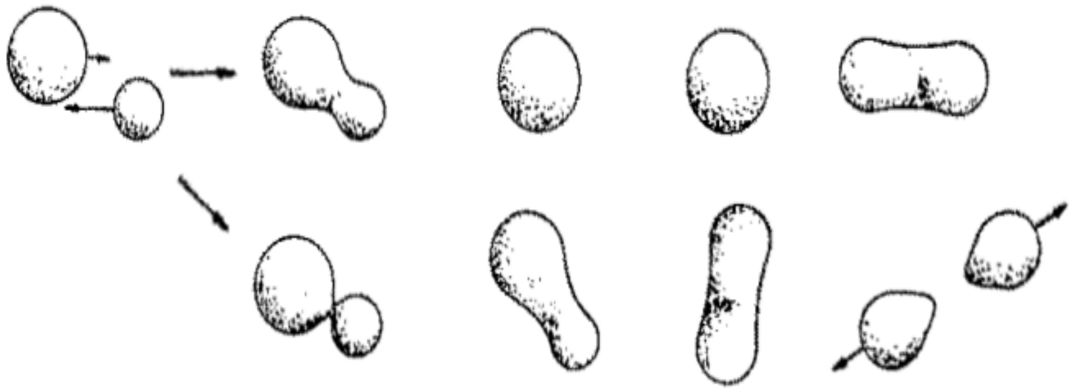
Talk by **A.C. Simenel (Saclay)**

Actinide collisions for QED and superheavy elements with the time-dependent Hartree-Fock theory and the Balian-Veneroni variational principle



Isodensities at half the saturation density, i.e., $r_0/2 = 0.08\ fm^{-3}$, in $^{238}U+^{238}U$ central collision at a center of mass energy E = 900 MeV. Snapshots are given at times t = 0, 15, 27, and 42 × 10^{-22} s from top to bottom.

Incomplete fusion, etc.



~10^{-18} s Fusion-fission

~10^{-20} - 10^{-21} s Quasi-fission

$$\sigma_{EVR}(E) = \sigma_{capture}(E) P_{CN}(E) W_{sur}(E)$$

HIVAP, PACE, TSALYS

Talk by P.P. Singh (Mumbai)

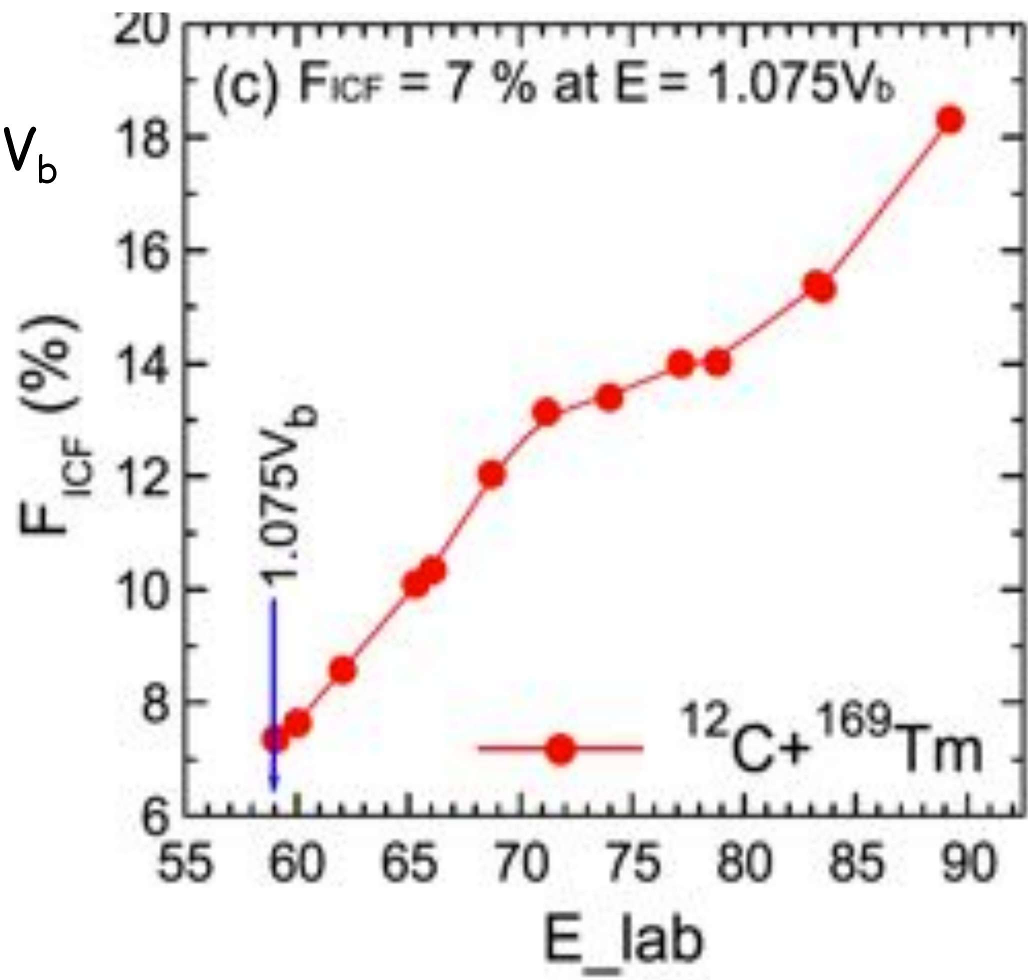
Unexpected increase of ICF above V_b

Talk by D.J Hinde (ANU)

Improved modeling of ICF

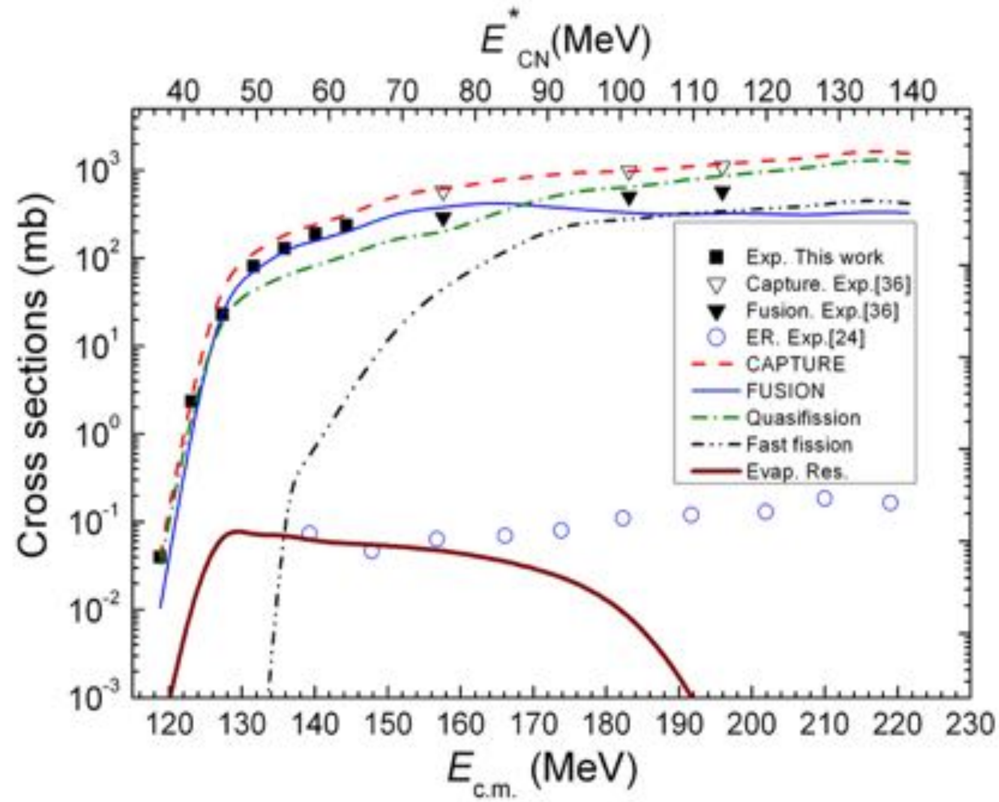
Talk by A. Wakhle (ANU)

Shell effects around ^{208}Pb strongly affect reaction dynamics.



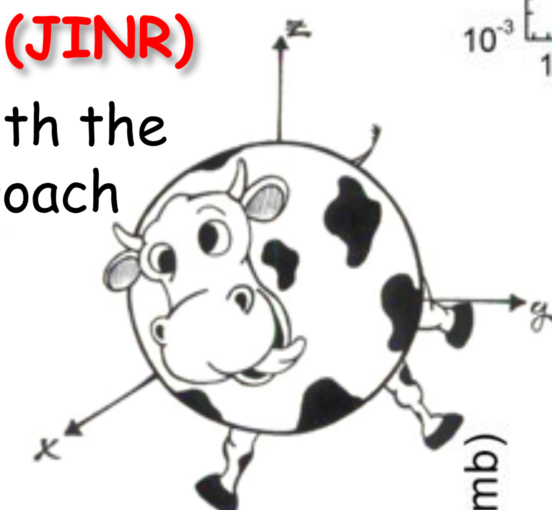
Talk by H. Zhang (Beijing)

Competition between fusion-fission and quasifission in $^{32}S+^{184}W$ reaction.



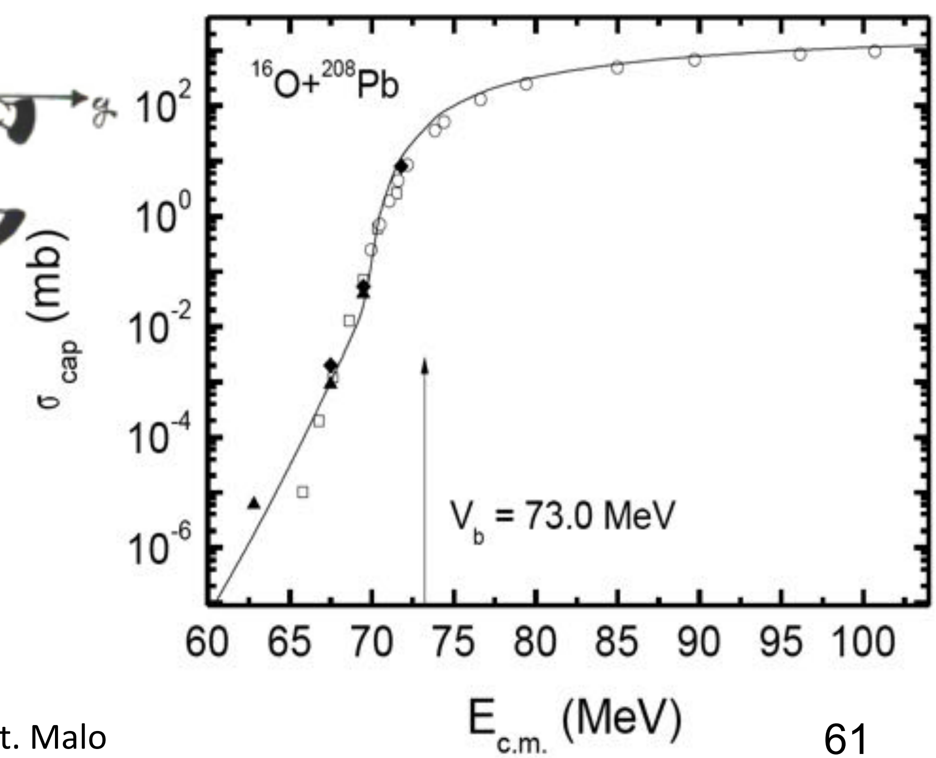
Talk by G.G.Adamian (JINR)

Sub-barrier capture with the quantum diffusion approach



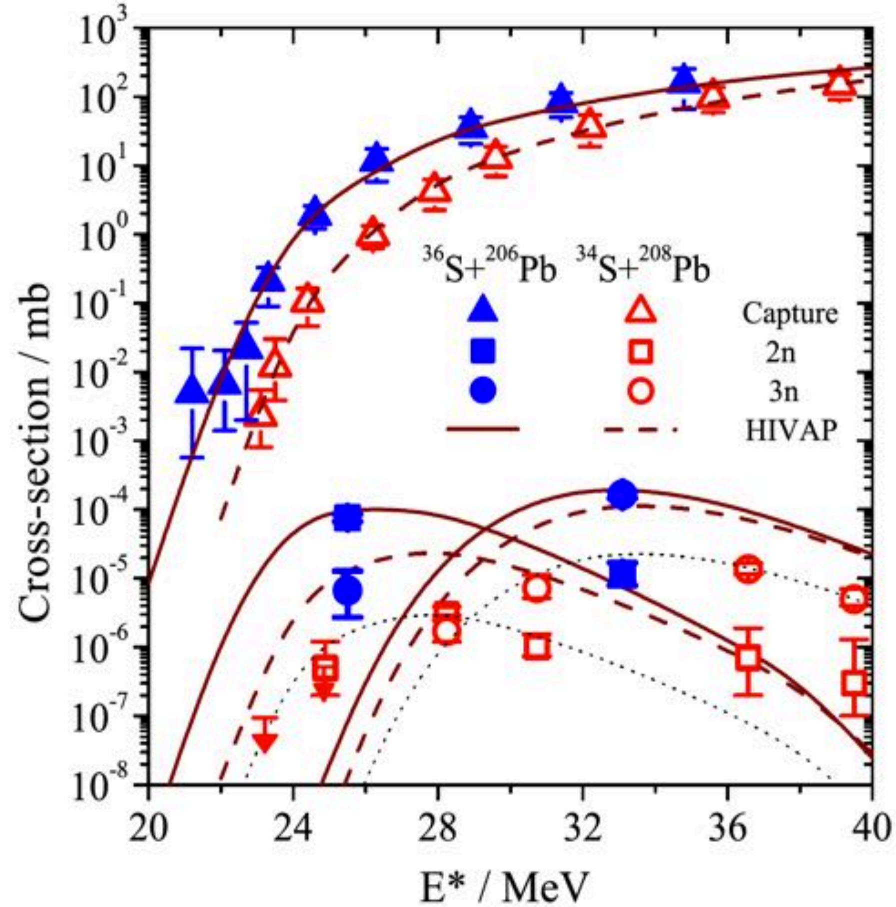
Talk by B. Yılmaz (Ankara)

Stochastic semi-classical description of sub-barrier fusion



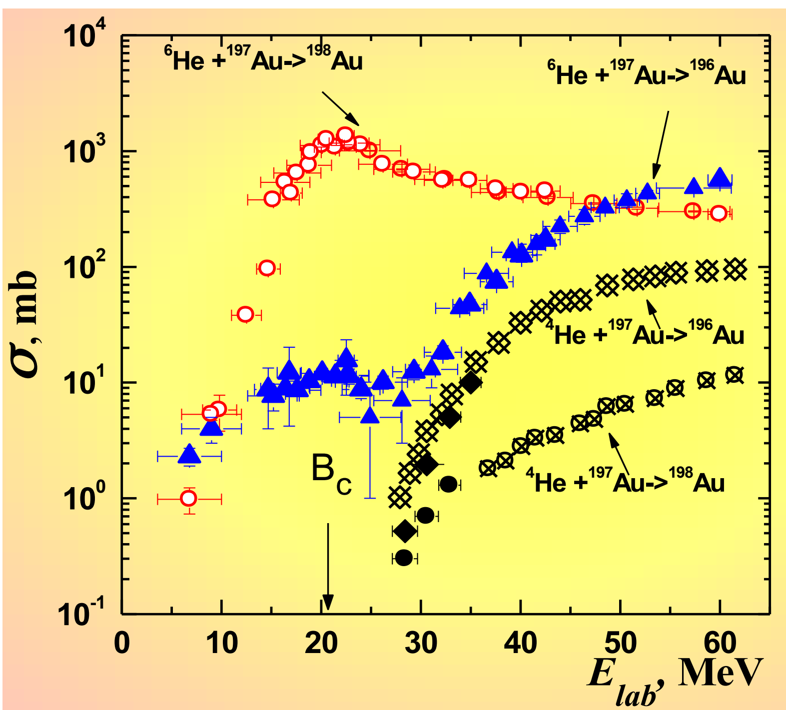
Talk by J. Khutagbaatar (GSI)

A larger enhancement of the capture cross-sections below the interaction barriers was observed for ^{34}S compared to ^{36}S with $^{204,206,208}Pb$ targets .



Talk by S.M. Lukyanov (JINR)

The effect of multi-neutron transfers leads to enhancement in sub-barrier fusion reactions



Talk by N. Rowley (Orsay)

Evaporation-residue cross sections:
role of the entrance channel

In the case where the probability of QF depends purely on the entrance-channel configuration (for a given target-projectile combination) we have

$$\sigma_{\rm ER} \approx \; < P_{\rm fus} > \sigma_{\rm max}$$
$$\equiv \; < PT > \sigma_{\rm max}$$

where all of these quantities are *well defined*.

This is somewhat different from the schematic form:

$$\sigma_{\rm ER} \approx \sigma_{\rm cap} P_{\rm fus} W_{\rm ER}$$

where the survival probability $W_{\rm ER}$ and the fusion probability $P_{\rm fus}$ are ill-defined averages, and the formula is structurally incorrect.

Talk by D. Pierroutsakou (Naples)

Dynamical Dipole Mode in heavy-ion fusion reactions by using stable and radioactive beams

Talk by K. Nishio (JAEA)

Investigation of fission properties and evaporation residue measurement in reactions using ^{238}U target nucleus

Talk by D. Boilley (GANIL)

Dynamicals effects in the fusion hindrance

- The neck is a key parameter:
  Change the inner barrier
  Change the initial condition of
  the radial coordinate
- Appearance of the fusion hindrance gives some constraints on the fusion barriers

Talk by D. Mancusi (Liege)

Constraining statistical-model parameters using fusion and spallation reactions

- Fusion and spallation help to constrain fission
- IMF emission Sierk's IMF barriers require a 7 MeV shift
- **Can this be attributed to Wigner energy?**

Talk by Sh. A. Kalandarov (JINR)

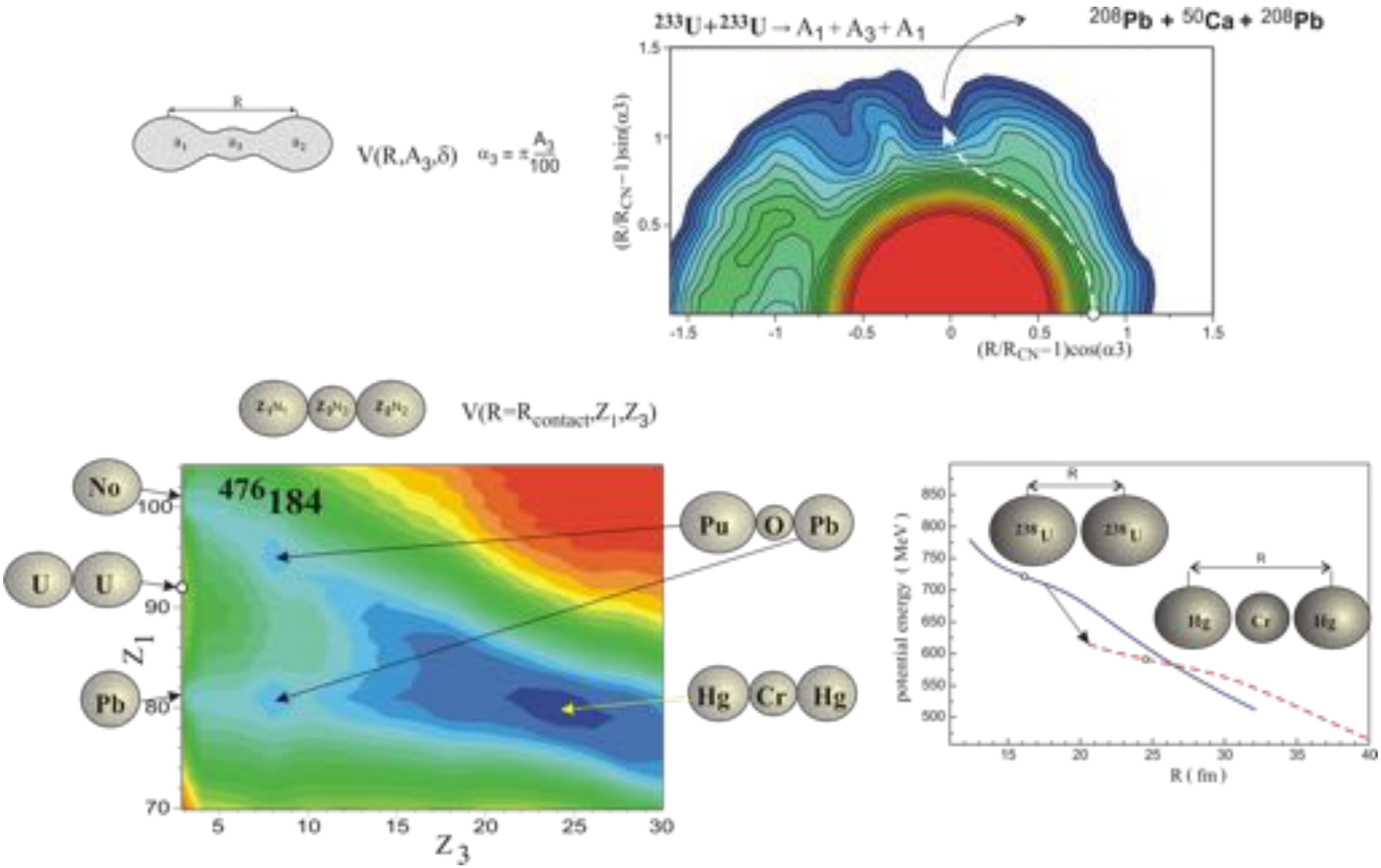
Production of doubly magic nucleus ^{100}Sn in $^{72,74,76}Kr+^{40}Ca$, $^{72,74,76}Kr+^{40}Ar$ and $^{72,74,76}Kr+^{32}S$ reactions at 4-6 MeV/nucleon

Talk by G. Ademard (GANIL)

Decay of excited nuclei produced in the $^{78;82}Kr+^{40}Ca$ reactions
at 5.5 MeV/nucleon

Talk by A. Karpov (JINR)

Ternary Quasifission of giant nuclear systems

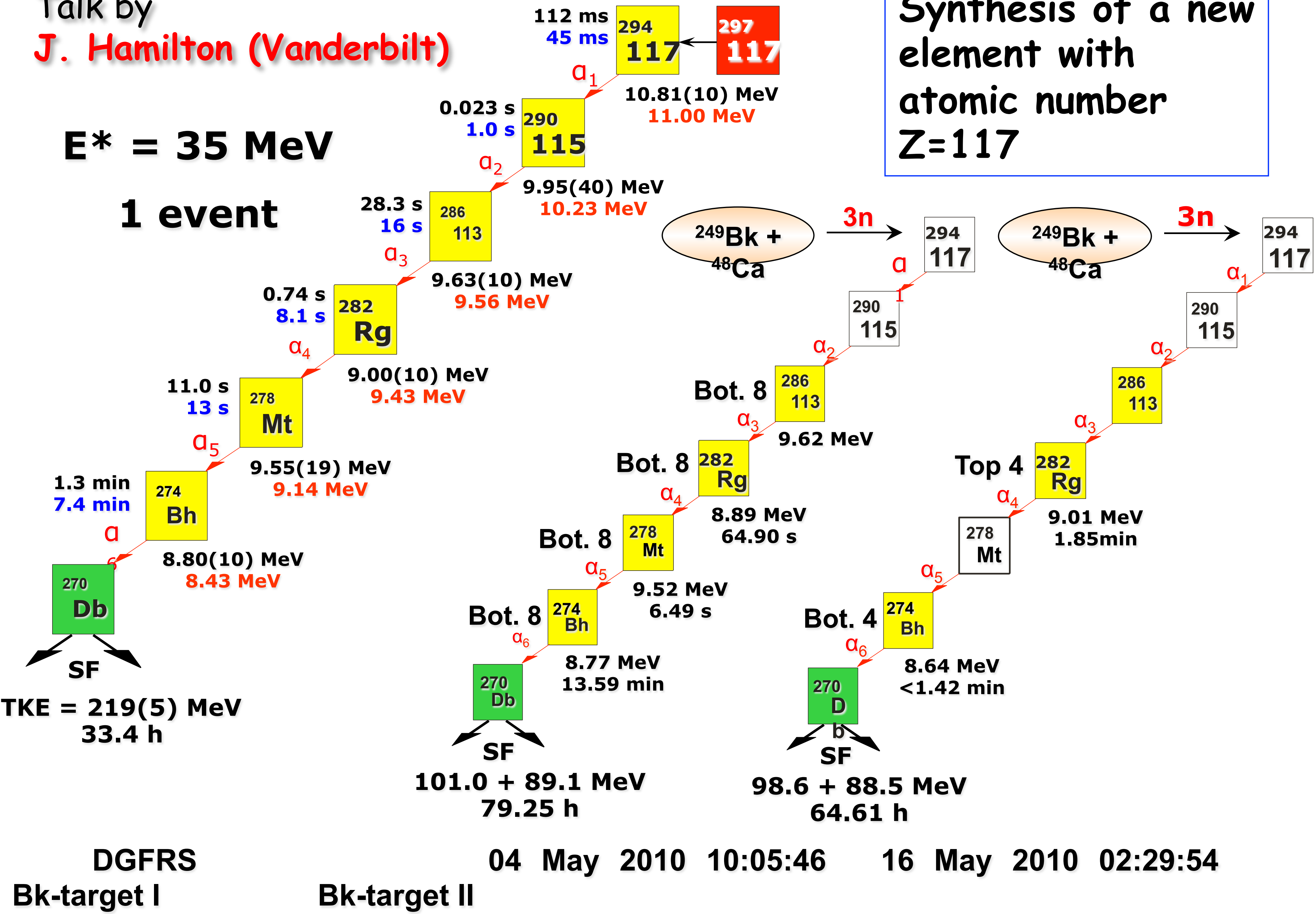


- True ternary fission is impossible for actinides (insufficient mass).
- Superheavy nuclei have a real chance to split onto tin + something + tin.
- Giant nuclear molecules may decay onto lead + something + lead.


Superheavies

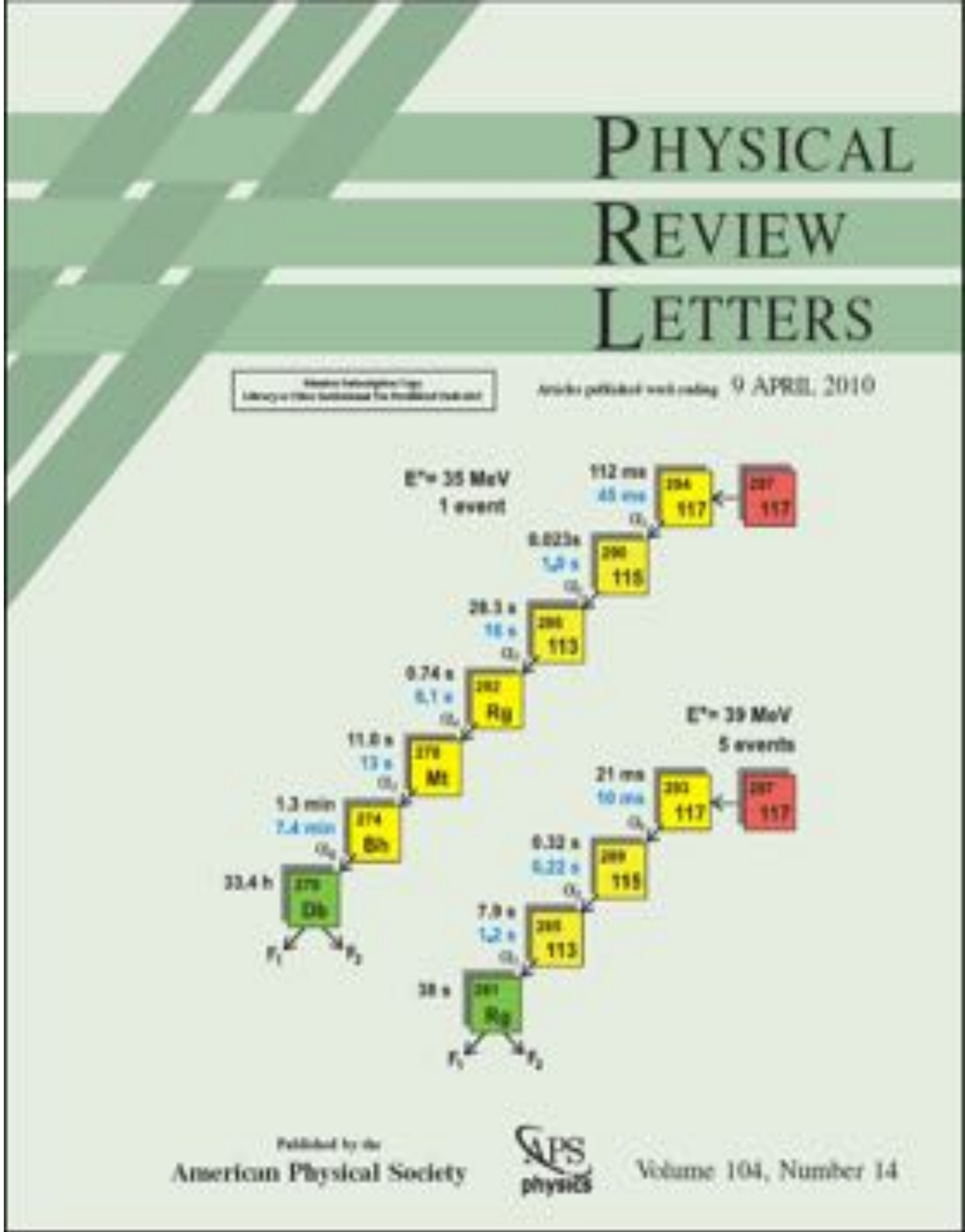
Synthesis of a new element with atomic number Z=117

Talk by
J. Hamilton (Vanderbilt)



Lesson:

Find the right people to buy Berkelium ($$$) and ship it to Russia



Talk by **K. Morita (RIKEN)**

(a) ^{209}Bi(^{70}Zn, *n*)^{278}113

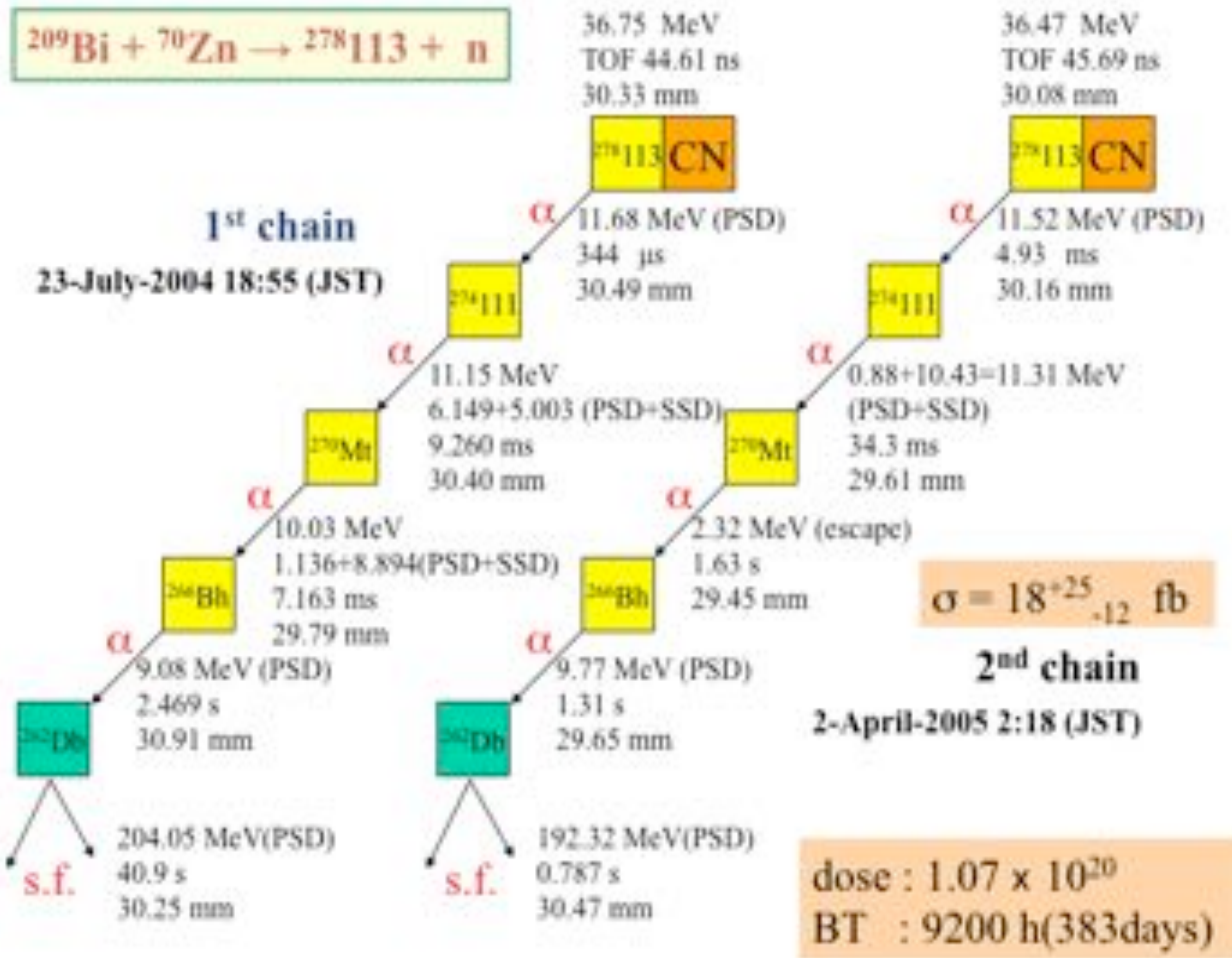
- *Cross-section* $\quad 18^{+25}_{-13}$ *fb*

(b) New Spectroscopic Data

- *^{266}Bh, ^{262}Db – further confirmation of ^{278}113*
- *^{265}Sg$^{a/b}$, ^{261}Rf$^{a/b}$ – further confirmation of ^{277}Cn*
- *^{264}Hs, ^{263}Hs*

(c) New Instruments

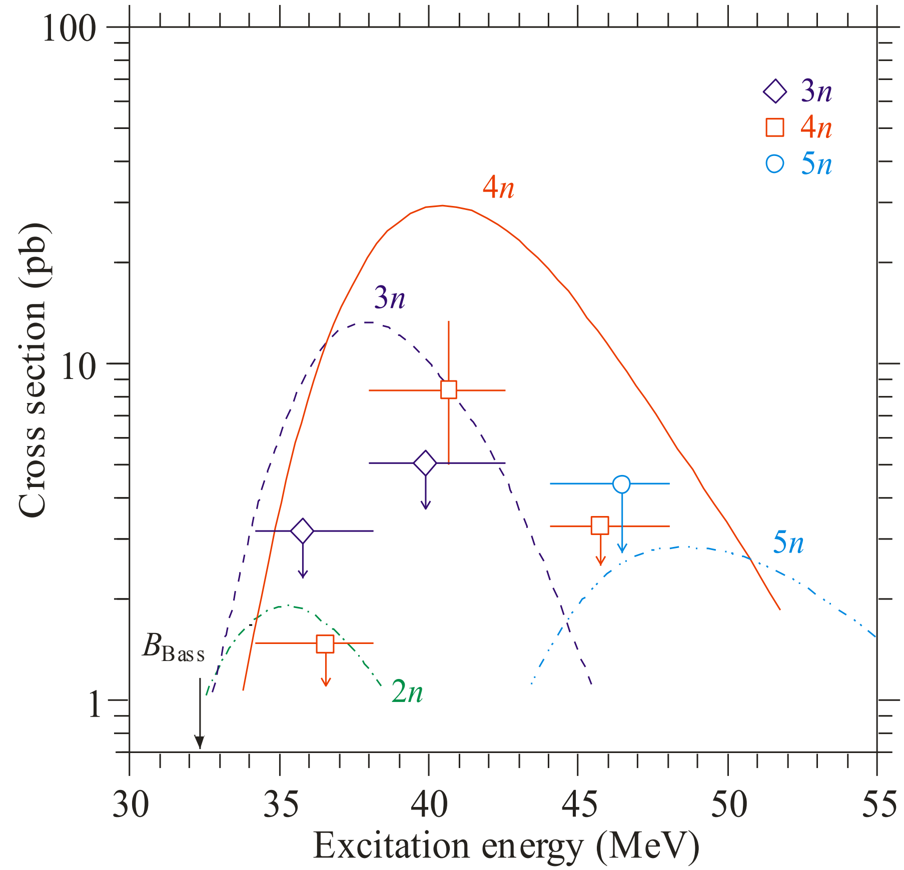
- *GARIS-II –*

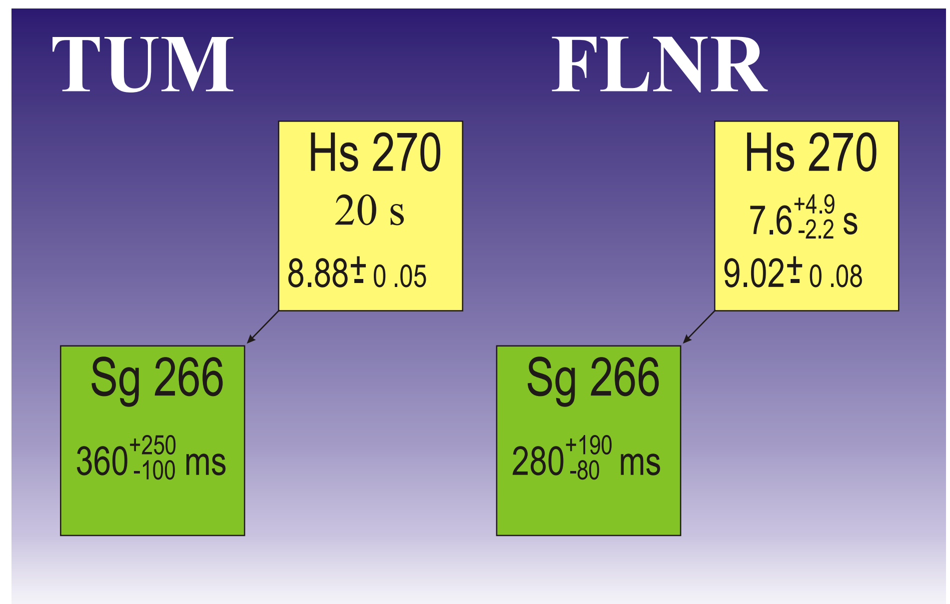


Talk by **A. A. Voronov (JINR)**

$^{226}Ra + ^{48}Ca = ^{269-271}Hs + 3\text{-}5n$

- Six decay chains of ^{270}Hs were observed at 233 MeV beam energy
- Cross section σ_{4n}= 8.3 pb was measured to be lower than predicted
- No decay chains of $^{269-271}Hs$ isotopes were observed at two other bombarding energies of 228.5 MeV and 240.5 MeV
- The upper cross section limits are σ_{3n} < 4.2 pb and σ_{5n} < 5.0 pb for the low and high ^{48}Ca beam energy, respectively



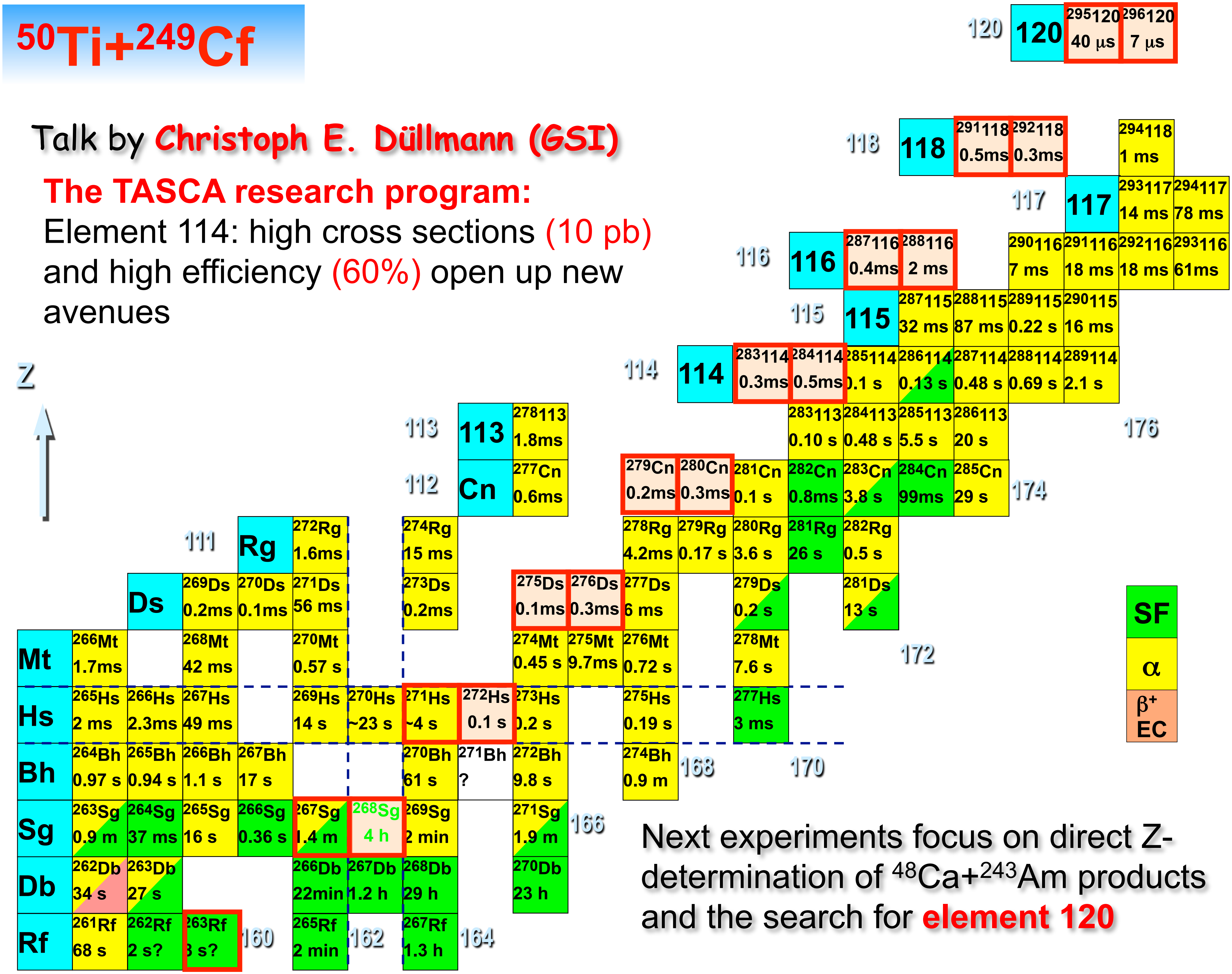


$^{50}Ti+^{249}Cf$

Talk by **Christoph E. Düllmann (GSI)**

The TASCA research program:

Element 114: high cross sections (10 pb) and high efficiency (60%) open up new avenues



Next experiments focus on direct Z-determination of $^{48}Ca+^{243}Am$ products and the search for **element 120**

Talk by **P. Armsbruster (GSI)**

What should be done next (in superheavy research)?

- Experiments to determine the atomic numbers of the elements Z=114-118, either by chemistry or by characteristic K and L x-ray energies.
- How to enter the region of spherical SHE, and to understand production cross sections for reactions induced by beams beyond ^{48}Ca.
- Fission of oblate nuclei has never been observed. Their fission probabilities should be measured.
- γ-spectroscopy in the region of SHE should reveal first excited states. Search for isomers.
- Measurements of ground-state binding energies of SHE.

Talk by **M. Itkis (JINR)**

Reactions with ^{48}Ca ion

- Double-magic nucleus ^{48}Ca allows one to obtain the low excitation energy of compound nucleus ($E^* \approx 30\text{-}36$ MeV) at the Coulomb barrier

- Neutron excess leads to N_{CN}=170-180 in the reaction with actinide targets in differ from cold fusion reaction, where $N_{CN} \approx 150\text{-}160$

- The heaviest element, which can be obtained with the reactions with ^{48}Ca-projectiles, is 118 nucleus.

- A possible alternative pathway for SHE synthesis is represented by the complete fusion of actinide nuclei with heavier projectiles such as ^{58}Fe or ^{64}Ni leading to the formation of CN with Z=118-124 and N=178-188.

Talk by **V. Zagrebaev (JINR)**

What is behavior of valence nucleons at near-barrier collisions of HI ?

Time-dependent Schrödinger equation shows that at low-energy collisions nucleons do not "jump" from one nucleus to another ~~($\langle y_i(\mathbf{r}_i)|y_k(\mathbf{r}_k)\rangle$)~~.

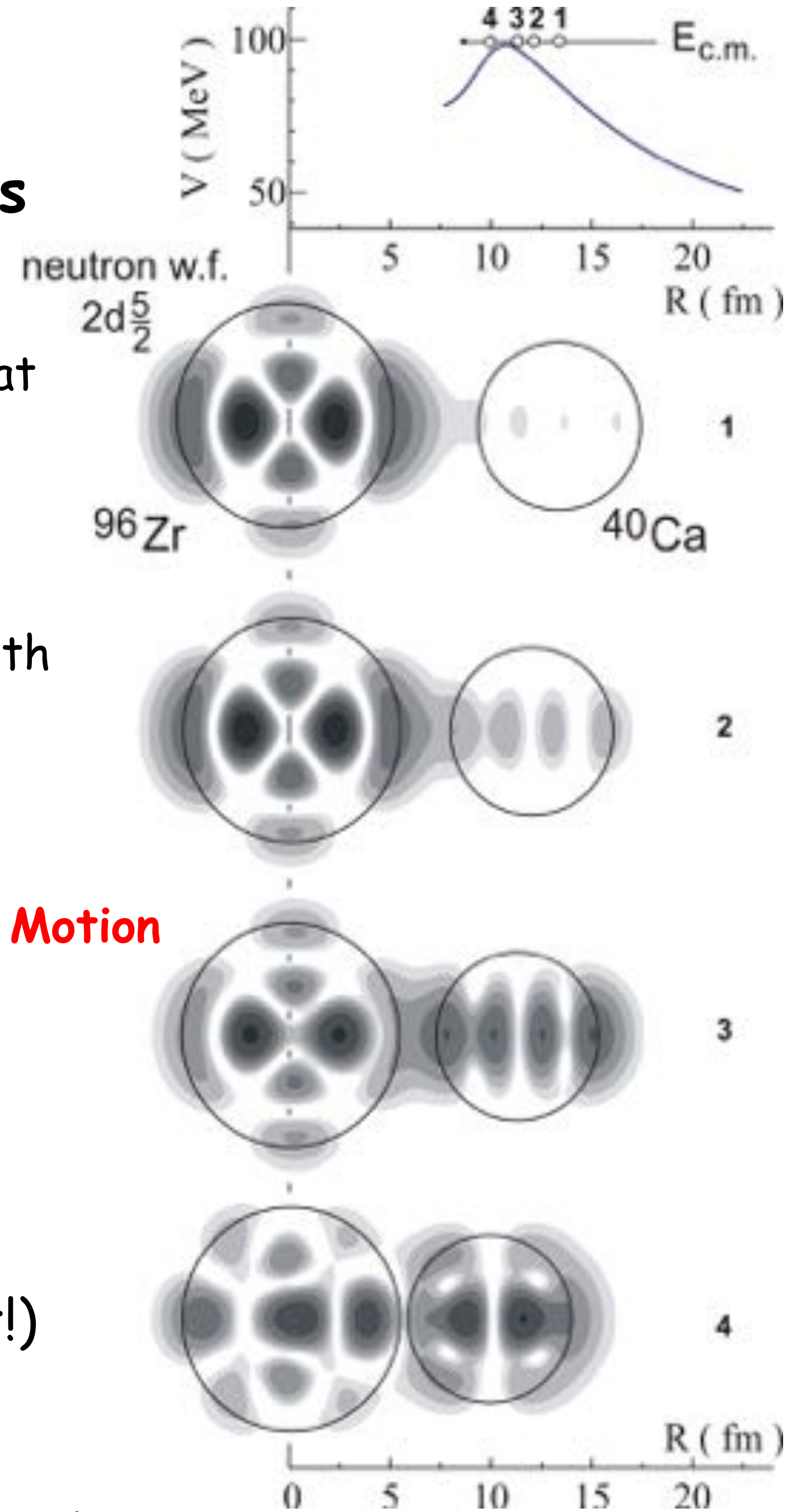
Wave functions of valence nucleons follow the **two-center molecular states** spreading over both nuclei.

Two-Center Shell Model +
Adiabatic Potential Energy Surface +
Transport (Langevin type) Equations of Motion
are appropriate for description of low-energy multi-nucleon transfer

Proposals:

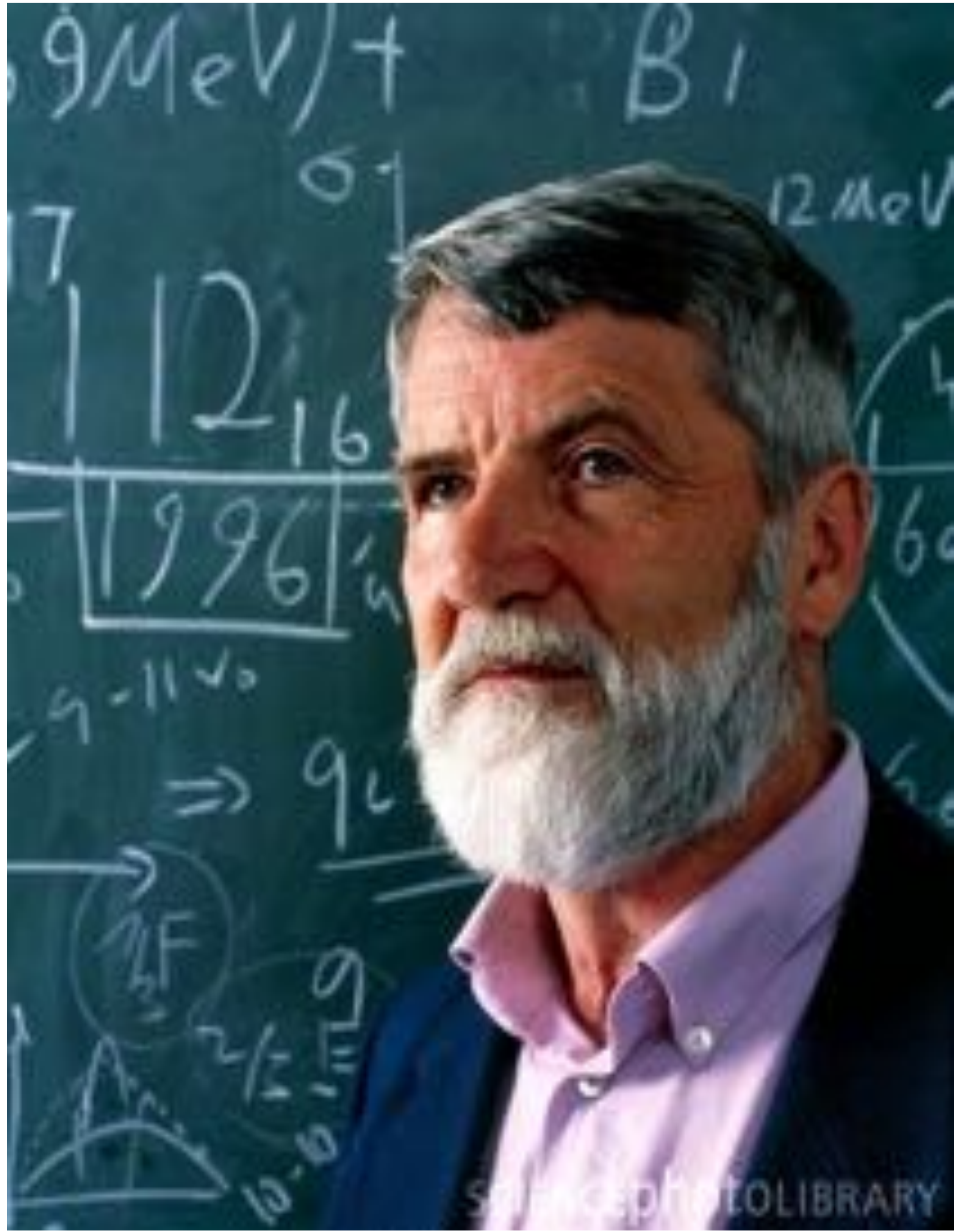
1- Produce SHE with pulsed nuclear reactors

2- Produce SHE in multiple (rather soft!) **nuclear explosions.**



Thanks to St. Malo

Happy 80th birthday



Peter Armbruster

Organizers:

Navin Alahari *(Chair)*
Héloïse Goutte
Denis Lacroix
Christine Lemaître
Maurycy Rejmund
Christelle Schmitt






FUSION11 – SAINT –MALO, France – 2nd to 6th May 2011

I prefer this picture

FUSION11 – Saint Malo, France – 2nd to 6th May 2011