Fission product yield compilation

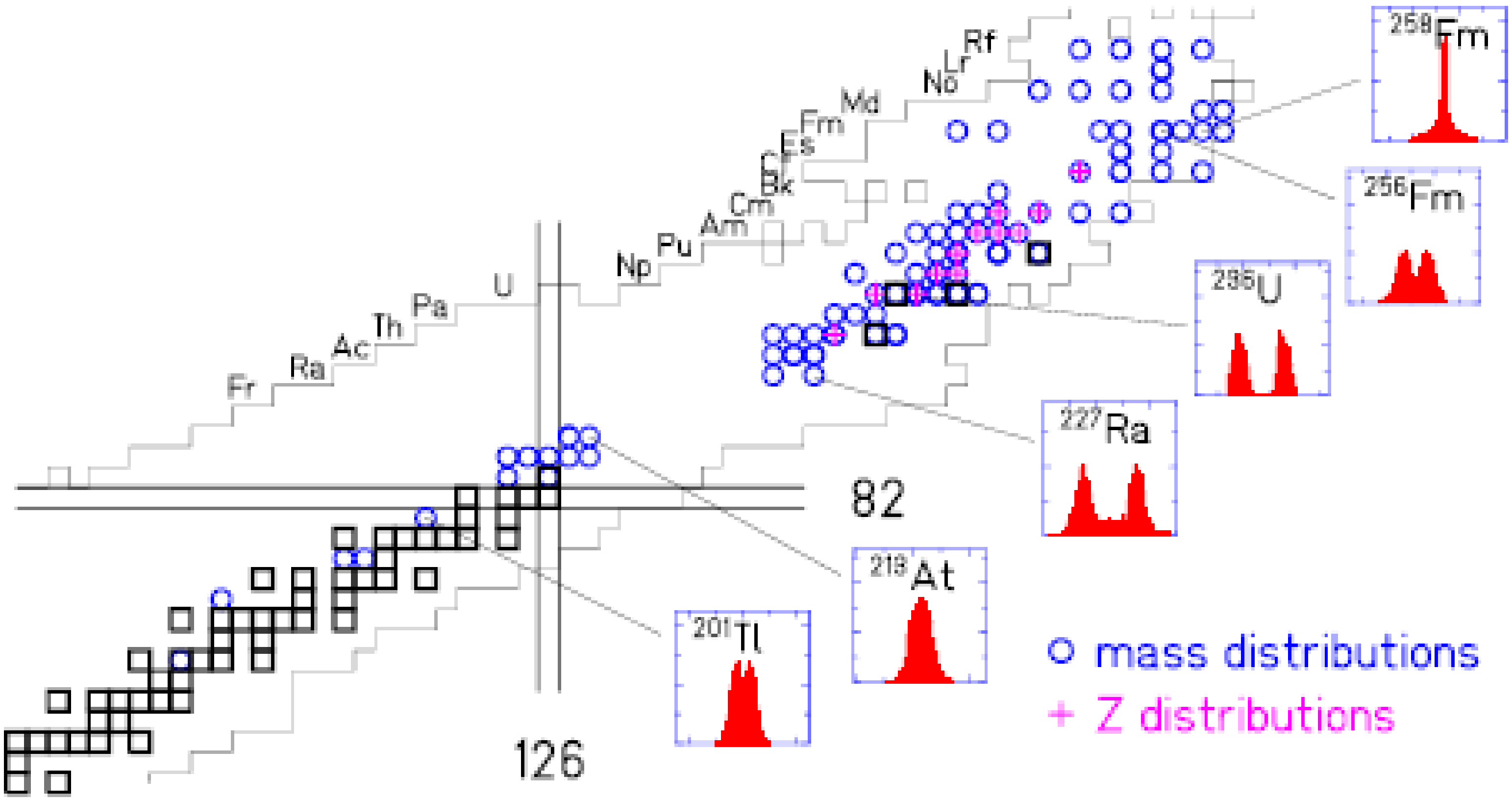
V. Semkova

Institute for Nuclear Research and Nuclear Energy,
Bulgarian Academy of Sciences
Sofia, Bulgaria

Nuclei investigated in low-energy fission (up to 10 MeV above the fission barrier).

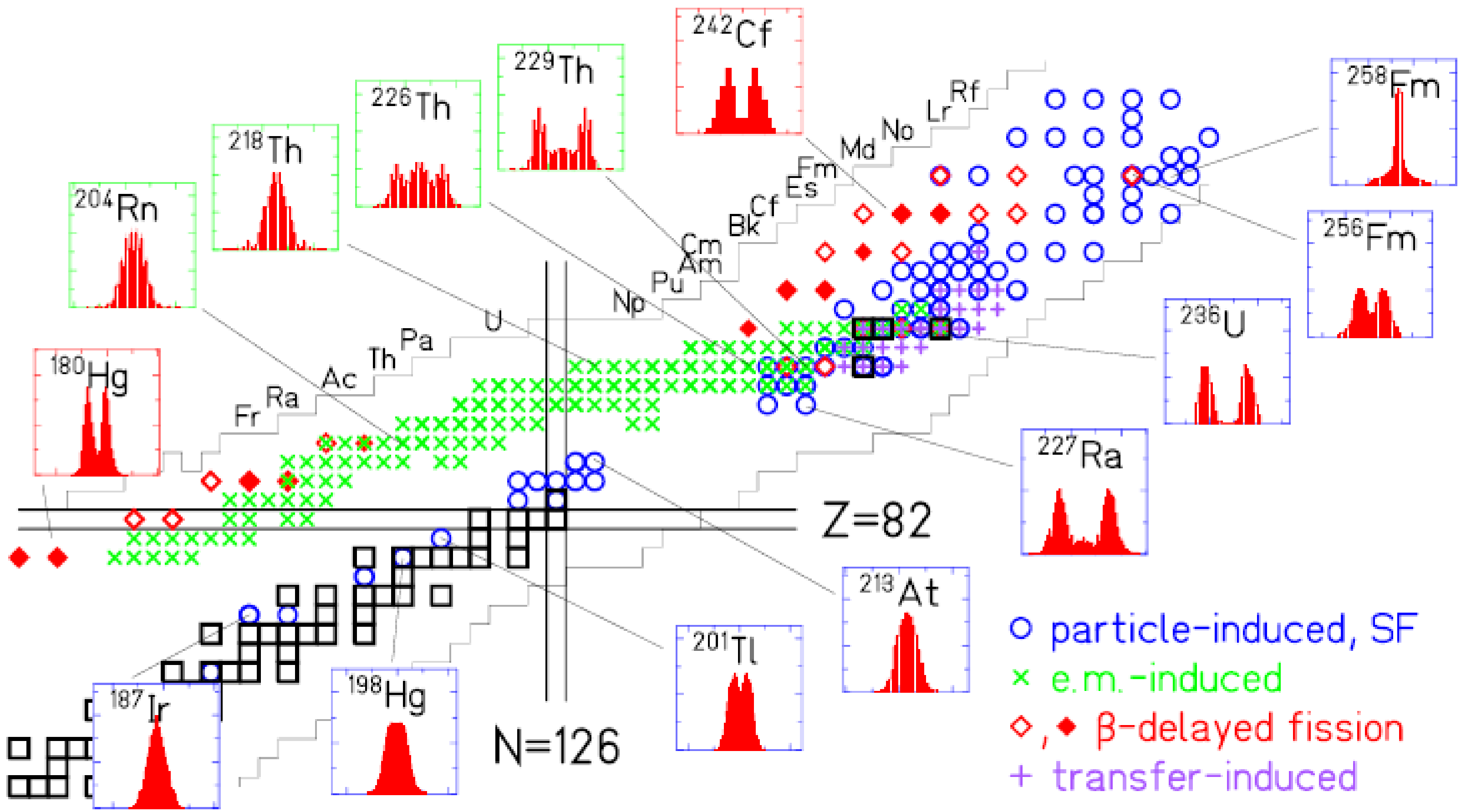
Neutron-induced fission, low-energy charged-particle-induced

prompt fusion/transfer-fission reactions.



K.-H. Schmidt et al. NP/A 665 (2000) 221

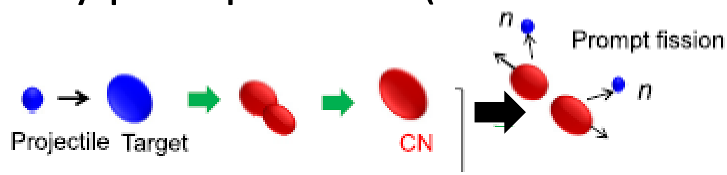
Low-energy fission studded nuclei + the nuclei for which FF Z distribution was studied after electromagnetic excitation in inverse kinematics at FRS@GSI; fissioning nucleus obtain from βDF; multinuclear transfer-induced fission



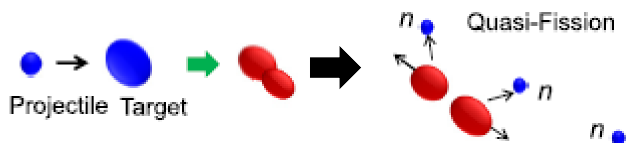
K.-H. Schmidt et al. NP/A 665 (2000) 221

Reaction mechanism of light/heavy-ion-induced reactions in direct kinematics in the vicinity of the coulomb barrier.

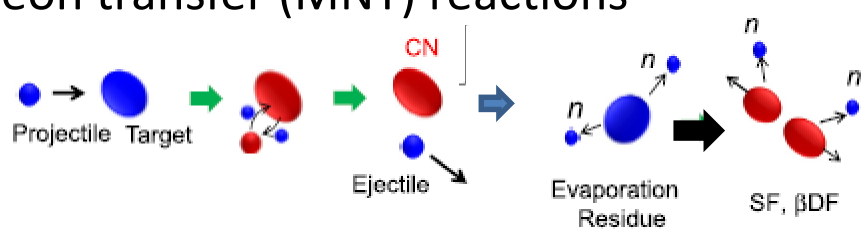
- Complete fusion which proceeds via the formation of excited compound nucleus followed by prompt fission(fusion-fission)



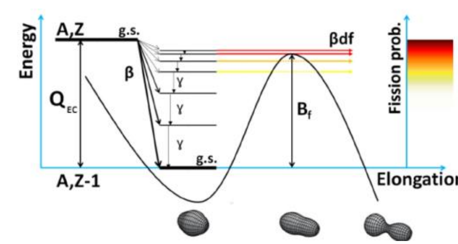
- Quasfission is prompt fission from not fully equilibrium system



- Multi-nucleon transfer (MNT) reactions



Beta-delayed fission

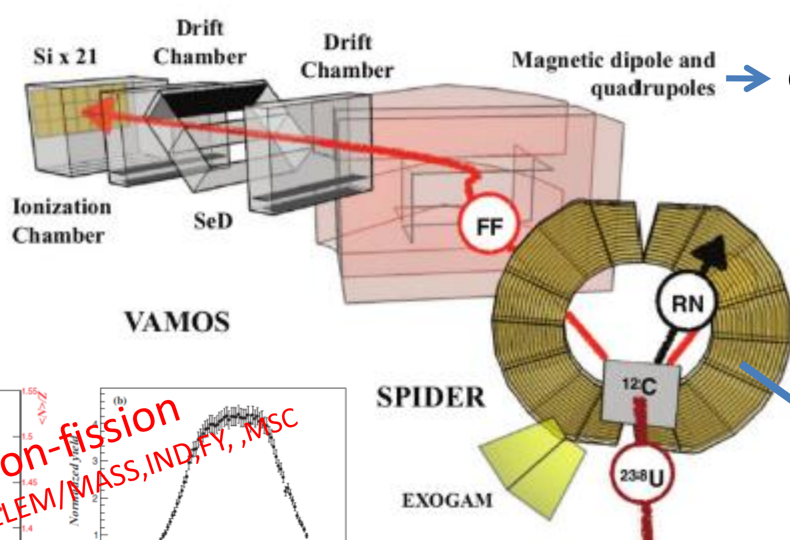


VAMOS @ GANIL
fusion-fission & transfer induced

^{238}U on ^{12}C

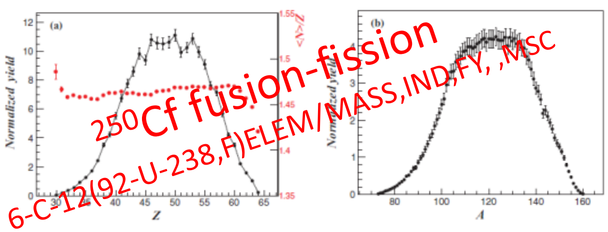
Coulomb energies (6.1 MeV A) inverse kinematics U to Cm produced and FF emitted in a cone of about 25 degree recoils from transfer reaction reach greater angles

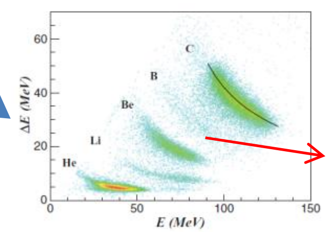
^{238}U+^{64}Ni; ^{238}U+^{48}Ca, ^{106}Cd+^{56}Ni, … - multi-nucleon transfer reactions



Magnetic-rigidity distribution of FF: convolution of A distr. & q distr. & v distr.

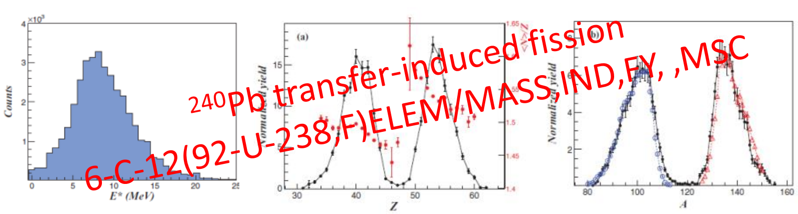
$$Y(Z,A) = f_\theta \sum_q \int_{\theta_{\text{fiss, max}}}^{\theta_{\text{fiss, min}}} \frac{dN(Z,A,q)}{d\cos(\theta_{\text{fiss}})} d\cos(\theta_{\text{fiss}}),$$

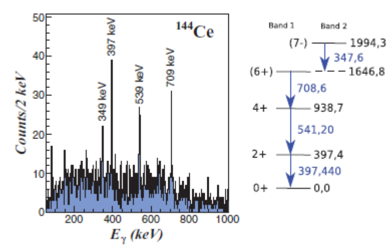




^{250}Cf fusion-fission

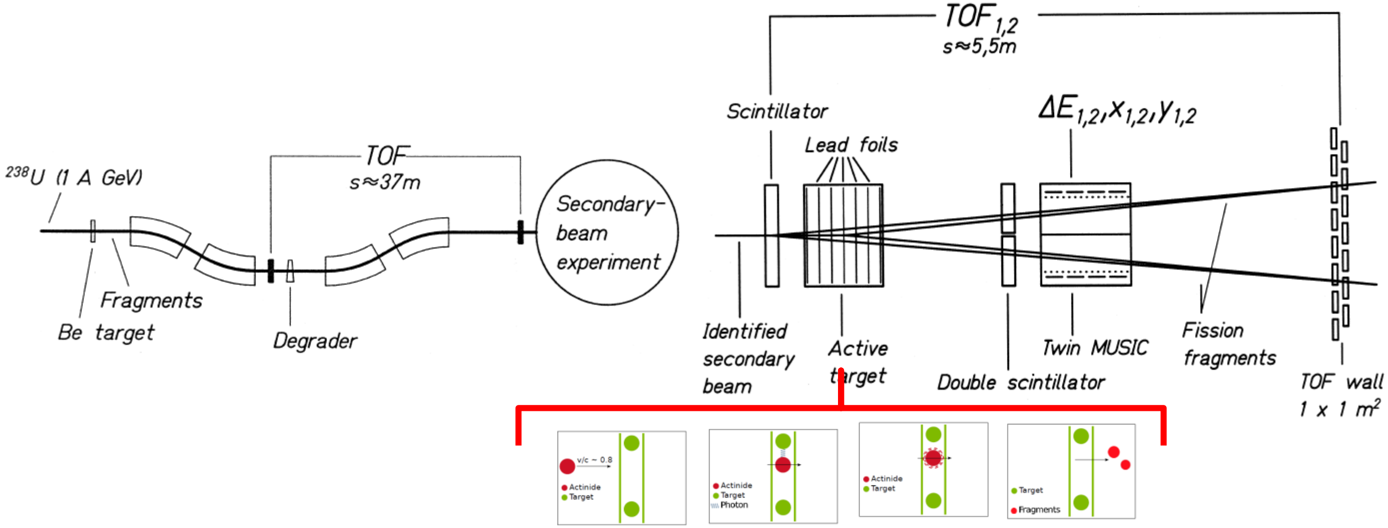
2 proton transfer
80%^{240}Pu+ 20%^{241}Pu





In-flight
g-ray
spectrometry
in coins. with FF

Measurements in inverse kinematics K.-H. Schmidt et al. NP/A 665 (2000) 221 & SOFIA experiment high FF kinematical boost in forward direction & better mass/charge resolution



The electromagnetic excitation in-flight of the radioactive-beam particles in the secondary target is one of the most important ingredients of the experiment, ideally adapted to the high beam energy. Although the excitation energy acquired is not precisely known for a single event, the excitation-energy distribution that is determined by the equivalent photon spectrum seen by the projectile and by the photo-absorption cross section of the projectile nucleus can be estimated on the basis of theoretical considerations and empirical systematics. The detailed knowledge of the excitation-energy distribution is important for the interpretation of the results.

End of part III

EPJ Web of Conferences **146**, 04009 (2017) DOI: 10.1051/epjconf/201714604009
ND2016

Experimental fission study using multi-nucleon transfer reactions

Katsuhisa Nishio[1a], Kentaro Hirose[1], Romain Léguillon[1], Hiroyuki Makii[1], Riccardo Orlandi[1], Kazuaki Tsukada[1], James Smallcombe[1,2], Satoshi Chiba[3], Yoshihiro Aritomo[4], Shouya Tanaka[4], Tsutomu Ohtsuki[5], Igor Tsekhanovich[6], Costel M. Petrache[7], and Andrei Andreyev[8,1]

[1] Advanced Science Research Center, Japan Atomic Energy Agency, 2-4 Shirakata, Tokai, Naka-gun, Ibaraki 319-1195, Japan
[2] TRIUMF, Vancouver, British Columbia V6T 2A3, Canada
[3] Laboratory for Advanced Nuclear Energy, Tokyo Institute of Technology, 2-12-1, Ookayama, Meguro-ku, Tokyo 152-8550, Japan
[4] Faculty of Science and Engineering, Kindai University, Higashi-Osaka 577-8502, Japan
[5] Research Reactor Institute, Kyoto University, Kumatori-cho, Sennangun, Osaka 590-0494, Japan
[6] Université de Bordeaux, 351 Cours de la Libération, 33405 Talence Cedex, France
[7] Centre des Sciences Nucléaire et des Sciences de la Matière, Université Paris-Saclay, CNRS/IN2P3, 91406 Orsay, France
[8] Department of Physics, University of York, Heslington, York, YO10 5DD, UK

Abstract. It is shown that the multi-nucleon transfer reactions is a powerful tool to study fission of exotic neutron-rich actinide nuclei, which cannot be accessed by particle-capture or heavy-ion fusion reactions. In this work, multi-nucleon transfer channels of the reactions of $^{18}O+^{232}Th$, $^{18}O+^{238}U$ and $^{18}O+^{248}Cm$ are used to study fission for various nuclei from many excited states. Identification of fissioning nuclei and of their excitation energy is performed on an event-by-event basis, through the measurement of outgoing ejectile particle in coincidence with fission fragments. Fission fragment mass distributions are measured for each transfer channel. Predominantly asymmetric fission is observed at low excitation energies for all studied cases, with a gradual increase of the symmetric mode towards higher excitation energy. The experimental distributions are found to be in general agreement with predictions of the fluctuation-dissipation model. Role of multi-chance fission in fission fragment mass distributions is discussed, where it is shown that mass-asymmetric structure remaining at high excitation energies originates from low-excited nuclei by evaporation of neutrons.