Czech ISOLDE user community and perspective for membership of Czech republic in ISOLDE collaboration

M. Veselsky

(IEAP CTU Prague)

Brief history od experimental nuclear physics in Czech republic:

1950s – membership of Czechoslovakia in JINR Dubna, construction of cyclotron in INP CAS Rez

1960s – intense collaboration with JINR Dubna.
Notable example: Irradiation of Ta target at synchrocyclotron in JINR Dubna, Transport by passenger flight Moscow-Prague, spectroscopy in INP CAS Rez. First Ge(Li) detector produced outside of USA.

1968-1969 – emigration of many scientists to western countries

1970s-1980s – international collaboration restricted to JINR Dubna, contacts with western countries limited.

After 1989 – Membership in CERN, shift towards particle physics, participation In large collaborations such as ATLAS, ALICE, SuperNemo, collaboration with JINR Dubna influenced by deteriorating status of infrastructure and changed political climate.

User community

It is foreseen to involve not only nuclear physicists, but also material and solid state scientists and researchers in biological and medical sciences

Presently participating institutions from Czech republic:

IEAP CTU Prague, institute membership from 2019, M. Veselsky

INP CAS Rez (Dalibor Zakoucky)

Inaugural user community meeting took place in 2020

Possible further participants

University Olomouc (M. Maslan, J. Pechousek)

Technical University Brno (K. Katovsky)

University Opava (V. Chudoba)

Experiment IS581 (IEAP CTU Prague)

Direct measurement of fission barriers
Of heavy unstable nuclei

Such information does not exist

Important for the investigation of
Production of heaviest nuclei
In r-process nucleosynthesis

One of priorities list in NuPeCC
Long range plan

In collaboration with ACTAR TPC
Collaboration

To be performed after CERN-ISOLDE
Will be back on

CERN-INTC-2012-055 / INTC-P-356
04/10/2012

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Proposal to the ISOLDE and Neutron Time-of-Flight Committee
(Following HIE-ISOLDE Letter of Intent I-095)

(d,p)-transfer induced fission of heavy radioactive beams

October 3rd, 2012

M. Veselsky[1], R. Raabe[2], A.N. Andreyev[3], M. Huyse[2], P. Van Duppen[2], F. Renzi[2], K. Nishio[4], H. Makii[4], I. Nishinaka[4], S. Chiba[4], G. Souliotis[5], P. Fountas[5], N. Vonta[5], T. Grahn[6], P.T. Greenlees[6], J. Pakarinen[6], P. Rahkila[6], M. Venhart[1], J. Kliman[1], S. Hlavac[1], V. Matousek[1], L. Krupa[1], I. Sivacek[1], D. Klic[1], M. Sedlak[1], E. Rapisarda[7], and the ACTAR TPC Collaboration (GANIL, KU Leuven, IPN Orsay, CEA Saclay, CENBG, Univ. Santiago de Compostela)

1 Institute of Physics, Slovak Academy of Sciences, Bratislava, Slovakia
2 Instituut voor Kern- en Stralingsfysica, KU Leuven, Belgium
3 University of York, York, UK
4 Advanced Science Research Center, Japan Atomic Energy Agency, Tokai, Japan
5 University of Athens, Athens, Greece
6 University of Jyväskylä and Helsinki Institute of Physics, Finland
7 ISOLDE, CERN

Spokesperson(s): M. Veselsky (Martin.Veselsky@savba.sk), R. Raabe (riccardo.raabe@fys.kuleuven.be)
Local contact: E. Rapisarda (Elisa.Rapisarda@cern.ch)

Abstract

(d,p)-transfer induced fission is proposed as a tool to study low energy fission of exotic heavy nuclei. Primary goal is to directly determine the fission barrier height of proton-rich fissile nuclei, preferably using the radio-active beams of isotopes of odd elements, and thus confirm or exclude the low values of fission barrier heights, typically extracted using statistical calculations in the compound nucleus reactions at higher excitation energies. Calculated fission cross sections in transfer reactions of the radioactive beams show sufficient sensitivity to fission barrier height. In the probable case that fission rates will be high enough, mass asymmetry of fission fragments can be determined. Results will be relevant for nuclear astrophysics and for production of super-heavy nuclei. Transfer induced fission offers a possibility for systematic study the low energy fission of heavy exotic nuclei at the ISOLDE.

Requested shifts: 28 shifts on (split into 2 runs over 2 years)
Beamline: 2 nd REX beamline

IS521: Simultaneous spectroscopy of γ rays and conversion electrons: Systematic study of *E*0 transitions and intruder states in close vicinity of mid-shell point in odd-Au isotopes

S. Gmuca, J. Kliman, L. Krupa, K. Petrik, **M. Venhart** and M. Veselsky
Institute of Physics, Slovak Academy of Sciences, Bratislava
T. E. Cocolios and J. Pakarinen
CERN-ISOLDE
J. L. Wood
Georgia Institute of Technology, Atlanta, USA
S. Antalic and Z. Kalaninova
Comenius University, Bratislava
P. A. Butler, D. T. Joss and R. D. Page
University of Liverpool, UK

First phase successfully completed, now in upgrade

Nuclear Physics Institute of Academy of Sciences of CR
25068 Rez near Prague

Dalibor Zakoucky

participates in several experimental projects at ISOLDE – mainly probing the structure of weak interactions – planning to continue in future

- project **WISArD** (**W**eak-**I**nteraction **S**tudies with ^{32}**Ar D**ecay)
  INTC-I-172 , precision measurement of the Doppler energy shift of the β-delayed protons emitted in decay of ^{32}Ar used as a sensitive tool to search for the scalar component of weak interactions

- project **VITO** (**V**ersatile **I**on-polarized **T**echniques **O**n-line)

laser polarized ISOLDE beam used for various experiments

- IS601, Measurement of the β-asymmetry parameter in ^{35}Ar decay with a laser polarized beam , INTC-P-426
- involvement in some bio-physical experiments utilizing the VITO beamline
  IS645, Interaction of Na+ions with DNA G-quadruplex structures studied directly with Na beta-NMR spectroscopy, INTC-P-521
  IS666, Liquid β-NMR studies of the interaction of Na and K cations with DNA G-quadruplex structures , INTC-P-560

Drahoslav Venos

Possible implantation of radioactive source at ISOLDE for KATRIN (in case of failure of Bonn implantator).
KATRIN is accepted as recognised experiment in CERN

Department of Experimental Physics

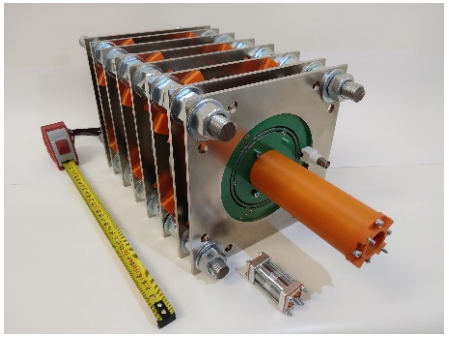
Faculty of Science, Palacký University in Olomouc

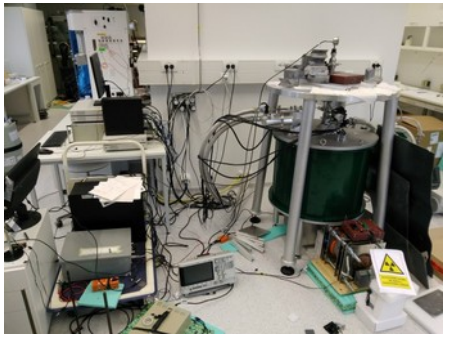
- Activities in Applied Physics:
  1. Nuclear spectroscopic methods - development of instrumentation for nuclear physics experiments (detectors, modules, measurement and testing systems), utilization of this technique in material research in the University and foreign laboratories, main focus on **Mössbauer spectroscopy of iron bearing materials**.
  2. Nanotechnology - preparation and characterization of nanosystems, nanomaterials, development of nanotechnology methodologies, material studies of basic and applied research.
- Cooperation with JINR Dubna:
  1. Flerov Laboratory of Nuclear Reactions
     - SHE factory, MASHA, SHI irradiation of materials
  2. Veksler and Baldin Laboratory of High Energy Physics
     - NICA / MPD – instrumentation, support

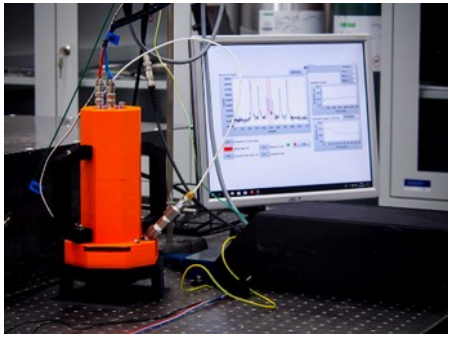
From the view of some possible common interests for Czech Republic and ISOLDE/CERN cooperation.

Mössbauer spectroscopy

- Mössbauer spectrometry has a long tradition at Palacký University.
- Mössbauer spectrometers in **various measuring arrangements** from low temp. (3 K) to high temp., bulk, surface analysis, external mag. field, reaction conditions, ex situ / in situ, transmission, emission…
- Various tasks regarding Mössbauer spectrometry, including **design, construction of the new components, data analysis and application** to the material research
- Department website: http://afnet.upol.cz/kef/en
- Mössbauer instruments website: http://mossbauer.upol.cz/en/about_us
- Mössbauer modular design: http://oltwins.upol.cz/
- Portable Mössbauer spectrometer: https://www.austenitemeter.com/







Nuclear Physics and Power Group
Department of Electrical Power Engineerint
Brno University of Technology, Bno, Czech Republic

Young group with about 10 members
Spallation reaction research
Physics and operation of ISOLDE
target; taget optimization and simulation
Cooperation with Dubna; IMP China; MSU Baroda; YerPhI Ye
Proton rich Gd isotopes
Neutron rich xenon, krypton (etc.) interactions
Responsible: Karel Katovsky (katovsky@vut.cz)

Road to ISOLDE membership

IEAP CTU Prague, institute membership from 2019

2020 – initiative to include full membership into central financing for 2023-2029,
Not accepted by the committee for collaboration with CERN, which is controlled by
Representatives of particle physics collaborations

2020 – initiative to form ISOLDE user community, inaugural meeting of representatives
of interested institutes

Possibility to form a consortium which would establish conditions for full membership earlier
than in 2029