Progress Report of

NUCLEAR REACTION DATA GROUP at ATOMKI

2018

(S. Takács)

01-04 May, 2018, Bahadurgarh, India

Nuclear Data Group at ATOMKI

Main tasks

- **Measurements of new activation cross section data (p, d, ^{3}He, α,)**
- **Evaluation of reported experimental data**
- **EXFOR compilation**
- **Use the cross section data in different applications**

Staff

The research team consists of physicists, radio chemist and technical staff.

The number of the actual staff members is reduced to:

4 experimental physicists,

1 radiochemist

1 technical staff member

Experimental work

- Continue the systematic investigations of charged particle induced reactions
- Proton, deuteron, ^{3}He and/or alpha-particle induced reactions on Al, Ca, Ti, Ni, Cu, Pd, Ag, Cd, Tb, Tm, Yb, Hf, Ir targets. Determination of activation cross sections.

Applications

- **Thin Layer Activation** (TLA) technique with free handling activity level
- **Isotope production** for process development and industrial applications
- Other **tracer** experiments

Collaborations

- VUB, Cyclotron laboratory of Free University Brussels, Belgium,
- Nishina Center for Accelerator-Based Science, RIKEN, Wako, Saitama, Japan,
- Faculty of Science, Hokkaido University, Sapporo, Japan,
- Molecular Imaging Center, NIRS, Chiba, Japan
- Institute of Physics and Power Engineering (IPPE), Obninsk, Russia.
- Cyclotron Facility, Nuclear Research Centre, Atomic Energy Authority, Cairo, Egypt,
- Austrian Competence Center for Tribology, AC^2T Wiener Neustadt, Austria

EXFOR compilation

Our responsibility to compile experimental data of charged particle induced nuclear reactions reported from HUNGARY (Atomki) and VUB, Brussels.

All newly published data were compiled in EXFOR

Participations in CRPs

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production (2012–2017)

The main part of the work in this CRP is completed. The reactions are evaluated, new recommended datasets are determined. Results for monitor reactions were published (Nuclear Data Sheets 148 (2018) 338–382) and the web version was created.
(34 reactions)
https://www-nds.iaea.org/medical/monitor_reactions.html
For medical isotopes the manuscripts of the publications are under preparation. After the manuscripts are finalized the web version will be prepared.

CRP on

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production (2012–2017)

https://www-nds.iaea.org/medical/monitor_reactions.html

Monitor Reactions 2017

Protons	Deuterons	^{3}He-particles	Alpha-particles
^{27}Al(p,x)^{22}Na	^{27}Al(d,x)^{22}Na	^{27}Al(^{3}He,x)^{22}Na	^{27}Al(α,x)^{22}Na
^{27}Al(p,x)^{24}Na	^{27}Al(d,x)^{24}Na	^{27}Al(^{3}He,x)^{24}Na	^{27}Al(α,x)^{24}Na
^{nat}Ti(p,x)^{48}V	^{nat}Ti(d,x)^{48}V	^{nat}Ti(^{3}He,x)^{48}V	^{nat}Ti(α,x)^{51}Cr
^{nat}Ti(p,x)^{46}Sc	^{nat}Ti(d,x)^{46}Sc	^{nat}Cu(^{3}He,x)^{66}Ga	^{nat}Cu(α,x)^{66}Ga
^{nat}Ni(p,x)^{57}Ni	^{nat}Fe(d,x)^{56}Co	^{nat}Cu(^{3}He,x)^{63}Zn	^{nat}Cu(α,x)^{67}Ga
^{nat}Cu(p,x)^{62}Zn	^{nat}Ni(d,x)^{61}Cu	^{nat}Cu(^{3}He,x)^{65}Zn	^{nat}Cu(α,x)^{65}Zn
^{nat}Cu(p,x)^{63}Zn	^{nat}Ni(d,x)^{56}Co		
^{nat}Cu(p,x)^{65}Zn	^{nat}Ni(d,x)^{58}Co		
^{nat}Cu(p,x)^{56}Co	^{nat}Cu(d,x)^{62}Zn		
^{nat}Cu(p,x)^{58}Co	^{nat}Cu(d,x)^{63}Zn		
^{nat}Mo(p,x)$^{96m+g}$Tc	^{nat}Cu(d,x)^{65}Zn		

Main	Monitor Reactions 2007	Gamma Emitters	Positron Emitters	Therapeutic Isotopes

Updated by: S. Takacs: Aug. 2017.

CRP on

Therapeutic Radiopharmaceuticals Labeled with New Emerging Radionuclides (^{67}Cu, ^{186}Re, ^{47}Sc)

2016-2019

All possible accelerator production routes for the three selected radionuclides were collected and evaluated regarding the possible yields, radionuclidic purity, chemical purity, specific activity. Based on the reaction network analysis the "best" accelerator production routes were selected for the ^{67}Cu, ^{186}Re and ^{47}Sc medically important radioisotopes.

Comparison of production routes of ^{67}Cu

Irradiation time 72h Cooling time 72h
Beam intensity 1 μA Enrichment level 98%

	E_{in} (MeV)	E_{out} (MeV)	target isotope	target thickness (μm)	^{67}Cu activity at EOB (MBq)	^{67}Cu activity after cooling (MBq)	activity of other Cu isotopes (MBq)	ratio to ^{67}Cu (%)
$^{64}Ni(\alpha,p)^{67}Cu$	23	9	^{64}Ni	**72**	17	7	0.1	1.0
$^{70}Zn(p,\alpha)^{67}Cu$	25	5	^{70}Zn	1361	144	64	0.2	**0.3**
$^{68}Zn(p,2p)^{67}Cu$	50	38	^{68}Zn	1892	299	133	9.3	7.0
$^{70}Zn(d,\alpha n)^{67}Cu$	30	7	^{70}Zn	1099	193	86	0.3	0.3
$^{68}Zn(d,2pn)^{67}Cu$	57	45	^{68}Zn	486	372	**166**	4.4	2.7
$^{67}Zn(d,2p)^{67}Cu$	44	30	^{67}Zn	1127	55	25	7.8	31.7
$^{71}Ga(p,\alpha p)^{67}Cu$	40	15	^{71}Ga	3389	29	13	0.3	2.1

Publications in 2017-2018

Number of publications: 28+

All the EXFOR relevant data are compiled in EXFOR database.

Thank you