

**Nuclear Data Section
International Atomic Energy Agency
P.O.Box 100, A-1400 Vienna, Austria**

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To: Distribution
From: N. Otsuka, S. Dunaeva, O.Schwerer, V.McLane

Subject: REACTION for heavy-ion scattering by light element target

To provide reaction rate table to nuclear synthesis study in the light mass region, resonance structures of light unstable nuclei have been investigated by using compound elastic scattering reaction where resonance structure of the compound nucleus is measured with unstable nucleus beam on light nucleus target (e.g. ^1H). The R-matrix analysis can be performed to the excitation function of the angular differential cross section at a fixed angle.

Example (EXFOR C1724.002 [1] in compilation, similar data are in E2107.006 [2])
Resonance structure of ^{22}Mg is studied by detection of protons in $^1\text{H}(^{21}\text{Na},\text{p})^{21}\text{Na}_{\text{g.s.}}$

LEXFOR defines elastic and inelastic scattering as follows:

Scattering:

Two-body interaction with only one particle, which is the same as the incident particle, in the exit channel;

Elastic scattering:

Scattering without excitation of the scattering nucleus ($Q = 0$).

Inelastic scattering:

Two-body interaction in which the incident projectile re-emerges with an energy less than its' initial energy by the amount of energy deposited in the target nucleus ($Q < 0$). The residual nucleus is left in an excited state which then decays, primarily, by γ -ray emission.

Therefore the data set C1724.002 is classified to elastic scattering data in EXFOR, too.
What is the right REACTION code?

1. 1-H-1 (11-NA-21 , P) 11-NA-21 , , DA
2. 1-H-1 (11-NA-21 , EL) 1-H-1 , , DA , P

1. Because of LEXFOR ask compilers to use EL in SF3, the 1st option should be excluded. We may add the underlined part to the EXFOR Formats Manual Chapter 7 as an item of "Notes on SF3" to clarify this rule as follows:

- 3) For coding of SF3 in the case of scattering, an appropriate process code (e.g., EL, INL, SCT) is used. See **LEXFOR, Scattering**.

2.-To clarify the coding rule for scattering data measured by inverse kinematics, addition of an item of the exceptional case in the EXFOR Formats Manual Chapter 7 is proposed:

- f) For scattering, nuclide code in SF1 is also coded in SF4 except for the isomer

code, which can be different for (de-)excitation of the isomeric state.

Note that P should be coded in SF7 of E2107.002-003 and 005-006 if data are for proton angle.

Definition of elastic and inelastic scattering

Revision of definition is proposed below for elastic and inelastic scattering.

1. Elastic scattering

Because projectile nucleus also can be excited in heavy-ion induced reaction, the following new definition is proposed:

“Scattering without excitation of both the projectile and target nucleus ($Q = 0$).”

2. Inelastic scattering

Some EXFOR data give de-excitation of the metastable states (“inelastic neutron acceleration”, see EXFOR 10465, 20295, 41381).

Example (EXFOR 22950.008):

(71-LU-177-M(N, INL) 71-LU-177-G, , SIG, , MXW)

In order to allow use of INL for $Q > 0$ scattering case, revision of the current definition (See the 1st page of this memo) is proposed:

“Scattering with (de-)excitation of the projectile and/or target nucleus ($Q \neq 0$).”

References

- [1] J. J. He *et al.*, Phys. Rev. C **80**(2009)015801
(EXFOR C1724, in compilation)
- [2] J. J. He *et al.*, Euro. Phys. J. A **36**(2008)1
(EXFOR E2107)

Distribution:

blokhin@ippe.ru
chiba@earth.sgu.ac.jp
claes.nordborg@oecd.org
emmeric.dupont@oecd.org
ganesan@barc.gov.in
gezg@ciae.ac.cn
hongwei@ciae.ac.cn
jhchang@kaeri.re.kr
j.roberts@iaea.org
kaltchenko@kinr.kiev.ua
katakura.junichi@jaea.go.jp
kato@nucl.sci.hokudai.ac.jp
kiralyb@atomki.hu

l.vrapcenjak@iaea.org
manuel.bossant@oecd.org
manokhin@ippe.ru
mmarina@ippe.ru
mwherman@bnl.gov
nicolas.soppera@oecd.org
nklimova@kinr.kiev.ua
n.otsuka@iaea.org
nrhc@jcprg.org
oblozinsky@bnl.gov
ogritzay@kinr.kiev.ua
otto.schwerer@aon.at
pronyaev@ippe.ru

r.forrest@iaea.org
samaev@obninsk.ru
s.babykina@polyn.kiae.su
scyang@kaeri.re.kr
s.dunaeva@iaea.org
stakacs@atomki.hu
stanislav.hlavac@savba.sk

taova@expd.vniief.ru
tarkanyi@atomki.hu
varlamov@depni.sinp.msu.ru
vlasov@kinr.kiev.ua
vmclane@optonline.net
v.zerkin@iaea.org
yolee@kaeri.re.kr