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Memo CP-D/618

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To: Distribution
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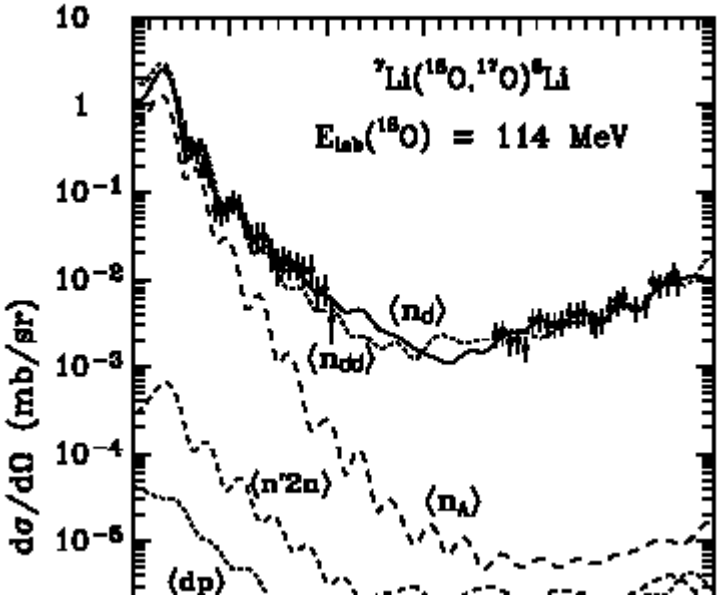
Subject: Two remarks on heavy-ion induced two-body reaction

We always define the heavier nuclide as the "reaction product" and code it in SF4 except for some processes (e.g. scattering, fission). We should be careful to REACTION coding when heavier nuclide is detected. Below I show two examples from heavy-ion induced reaction:

1. "Transfer reaction" measured by detection of heavier nuclide
Below A. T. Rudchik *et al*.[1] shows data sets measured for ^{7}Li(^{18}O,^{17}Og.s.) ^{8}Lig.s.



Because angular distribution of ^{17}O is given for, the REACTION code is

```
3-LI-7(8-O-18,3-LI-8)8-O-17,,DA,RSD
```

, namely we need RSD in SF7 even if the data set is given in the angle for the center of mass system. The data can be expressed by the tautology formalism

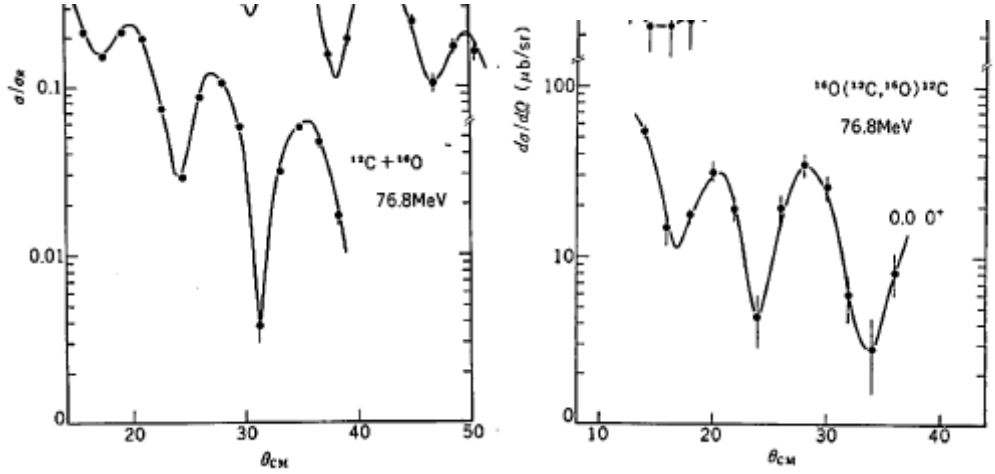
```
(3-LI-7(8-O-18,3-LI-8)8-O-17,,DA,RSD)=
(8-O-18(3-LI-7,3-LI-8)8-O-17,,DA)
```

if both incident energy and scattering angle are given in center-of-mass system.

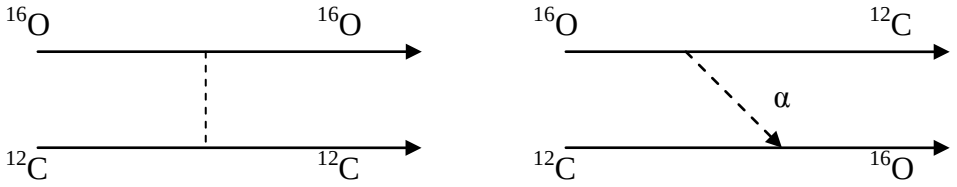
2. “Transfer reaction” regarded as elastic scattering in EXFOR

Below T. Motobayashi *et al*. [2] shows two data sets measured with ^{16}O beam and ^{12}C target:

Left: Angular distribution of ^{12}C detected measured for ^{16}O(^{12}C,^{12}Cg.s.)^{16}Og.s.
Right: Angular distribution of ^{16}O in ^{16}O(^{12}C,^{16}Og.s.)^{12}Cg.s.



These can be interpreted as “elastic scattering” and “α-transfer reaction”, respectively.



In EXFOR, however, these two data sets are regarded as elastic scattering because Q=0, and they have to be coded as

1. `8-O-16(6-C-12,EL)8-O-16,,DA,,RTH`
2. `8-O-16(6-C-12,`**`EL`**`)8-O-16,,DA,`**`RSD`**

, namely the second data set is regarded as elastic scattering data even if it is interpreted as data for transfer reaction.

On the assumption of parity invariance and momentum conservation, the data table for the REACTION code #2 can be also explained by

2a `6-C-12(8-O-16,EL)6-C-12,,DA`
2b `8-O-16(6-C-12,EL)8-O-16,,DA` (with $\theta_{cm} \rightarrow 180\text{-}\theta_{cm}$)

The expression 2a can be combined with 2. by the tautology formalism if both incident energy and scattering angle are given in center-of-mass system.

2c `(8-O-16(6-C-12,EL)8-O-16,,DA,RSD)=`
`(6-C-12(8-O-16,EL)6-C-12,,DA,RSD)`
(In this case, 2a should be used in the right hand side of the tautology formalism.)

References

[1] A. T. Rudchik *et al.*, Nucl. Phys. A831(2009)139
(EXFOR D5072, in compilation)
[2] T. Motobayashi *et al.*, Nucl. Phys. A331(1979)193
(EXFOR E0109, figure images are taken from his thesis.)

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