**Nuclear Data Section**

**International Atomic Energy Agency**

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**Memo CP-D/1115**

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**To:** Distribution

**From:** N. Otsuka

**Subject:** Compilation of **“**(p,2n)” cross sections (EXFOR C0693)

G. Chodil et al., Nucl. Phys. A93 (1967) 648 detected outgoing neutrons from proton irradiation by using a large liquid scintillation tank and report

1. Neutron production cross section σyield
2. One neutron emission cross section σ(p,n)+σ(p,pn)
3. Two neutron emission cross section σ(p,2n)

in Table 1. The first and second ones were originally compiled in P0021 by conversion from a CPX file and transferred to C0693. However, the third one has been missing in this entry.

Table 2 of the article shows that the (p,pn) channel opens for all target nuclides in the investigated incident energy range (up to 15 MeV), and the second quantity is coded by a REACTION sum such as

(13-AL-27(P,N)14-SI-27,,SIG)+(13-AL-27(P,N+P)13-AL-26,,SIG)

(22-TI-0(P,N),,SIG)+(22-TI-0(P,N+P),,SIG)

For addition of the (p,2n) cross sections in this EXFOR entry by NNDC, I checked if it is only from the (p,2n) reaction, or contribution of (p,p2n) reaction is energetically possible.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 27Al | 46Ti | 47Ti | 48Ti | 49Ti | 50Ti | 50V | 51V | 59Co |  |  |
| p,2n | 19.6 | 21.6 | 17.1 | 15.7 | **13.2** | **12.6** | **13.0** | **11.0** | **11.0** |  |  |
| p,p2n | 25.3 | 23.2 | 22.5 | 20.9 | 20.2 | 19.5 | 21.3 | 20.8 | 19.4 |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 90Zr | 91Zr | 92Zr | 94Zr | 96Zr | 93Nb | 107Ag | 109Ag | 180Ta | 181Ta | 197Au |
| p,2n | 17.2 | **14.2** | **10.8** | **9.0** | **7.6** | **9.4** | **10.2** | **8.4** | **8.5** | **7.7** | **8.2** |
| p,p2n | 21.5 | 19.4 | 16.0 | 15.1 | ***14.5*** | 16.9 | 17.6 | 16.6 | ***14.6*** | ***14.3*** | ***14.8*** |

This tables shows we can ignore (p,p2n) contribution for all targets (except for one data point near 15.0 MeV for each of the Zr, Nb, Ta and Au target). If we treat V and Ta as monoisotopic, the “(p,2n)” cross sections in Table 1 may be compiled with the following REACTION string:

13-AL-27(P,2N)14-SI-26,,SIG

22-TI-0(P,2N),,SIG

23-V-51(P,2N)24-CR-50,,SIG

27-CO-59(P,2N)28-NI-58,,SIG

40-ZR-0(P,2N),,SIG

41-NB-93(P,2N)42-MO-92,,SIG

47-AG-0(P,2N),,SIG

73-TA-181(P,2N)74-W-180,,SIG

79-AU-197(P,2N)80-HG-196,,SIG

(All products in REACTION SF4 are not accessible by usual activation measurements.)

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