International Atomic Energy Agency

Neutron Quasi-Elastic Scattering Data

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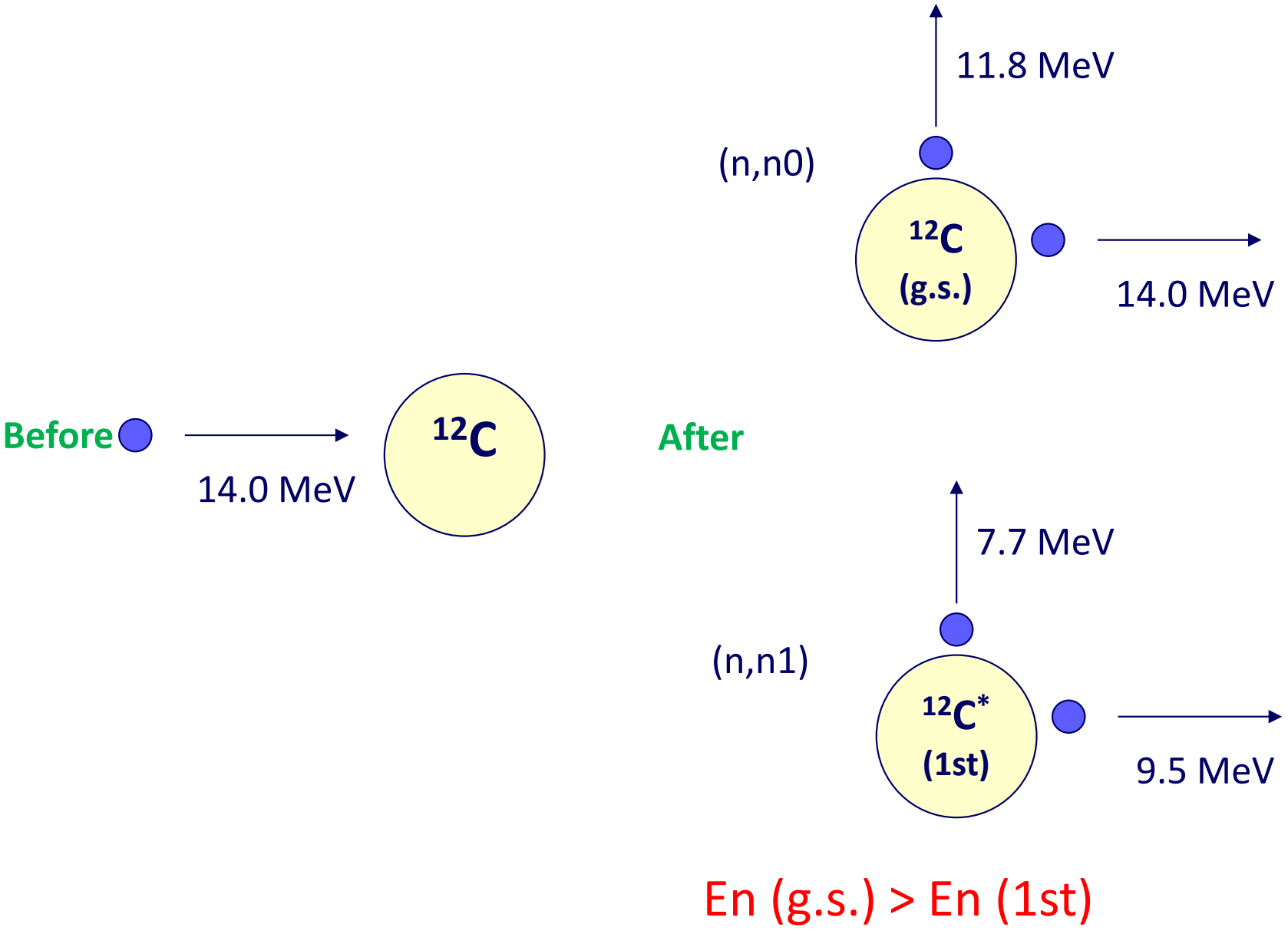
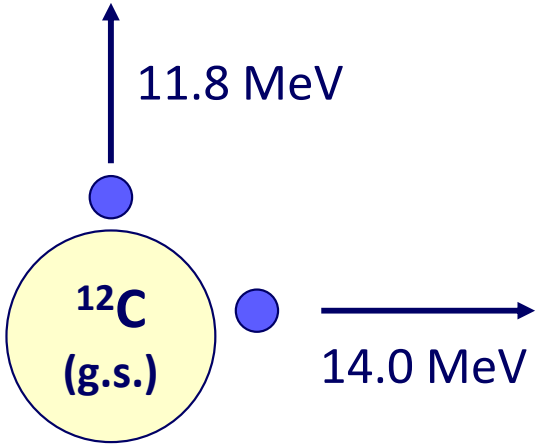
Outgoing neutron energy after scattering

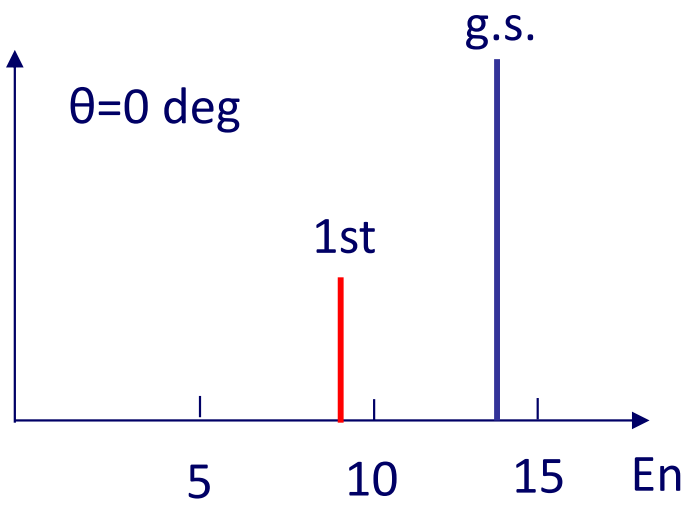


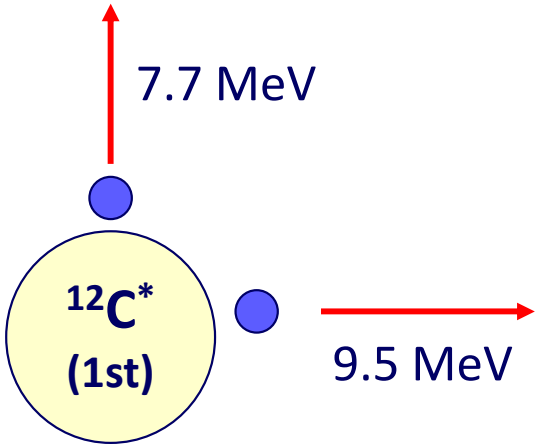
En (g.s.) > En (1st)

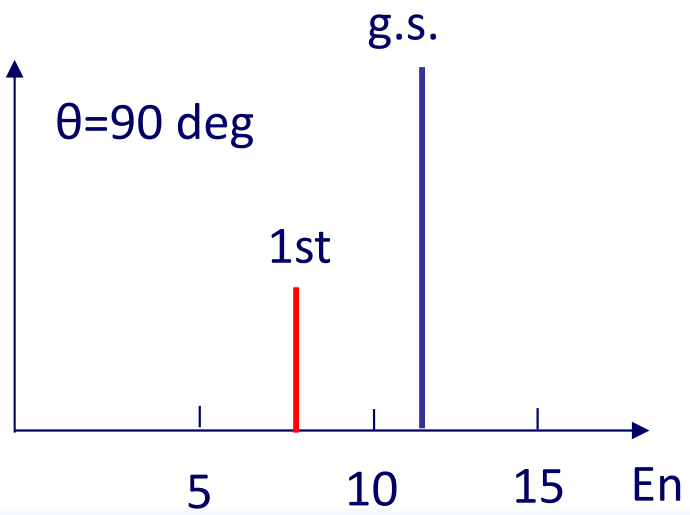
(n,n0) and (n,n1) neutron separation – ideal situation



Neutron spectrum (ideal case)



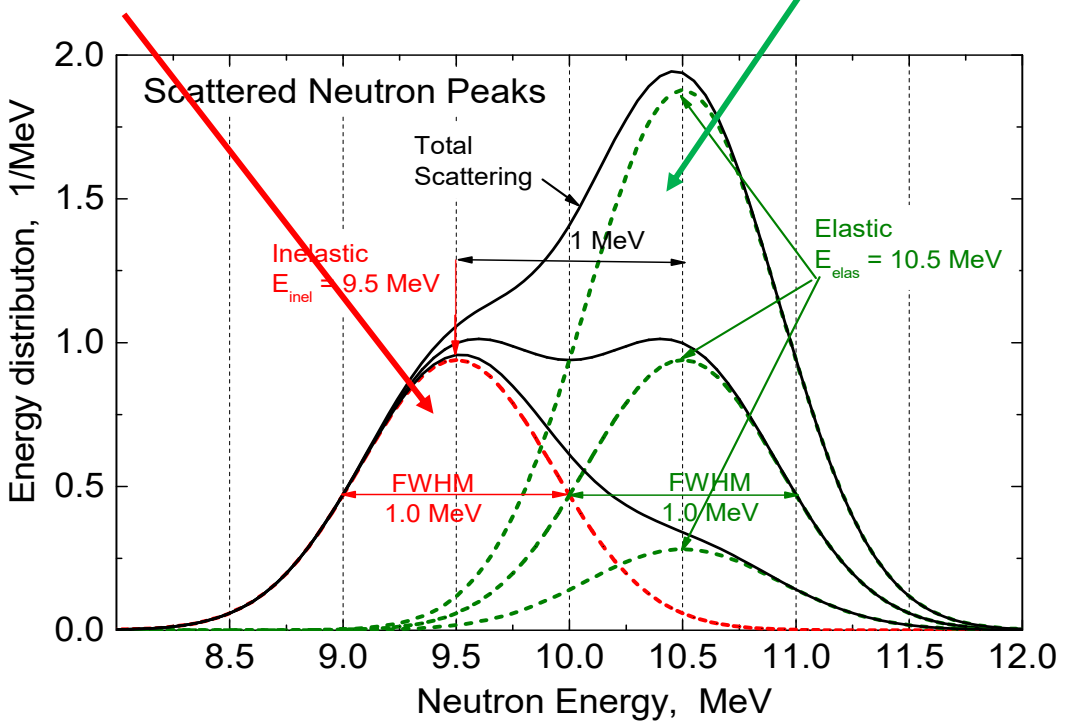




(n,n0) and (n,n1) separation – real situation

(n,n1) neutrons

(n,n0) neutrons



Courtesy of S.Simakov

Separation become difficult when level spacing < total energy resolution of experiment (incident energy spread + spectrometer/detector resolution + …)

Separation of (N,EL) is practically unrealistic for some nuclides (e.g, Ex(1^{st})=76 eV for ^{235}U, 6.2 keV for ^{181}Ta)

Review of (N,EL) datasets by Simakov

The following neutron elastic scattering (EL) angular differential (DA), several angular polarization (POL/DA) and integrated cross sections (SIG) were reviewed:

1. Einc > 1.5 MeV,
2. Ex(1^{st}) < 200 keV,
3. Atarg ≥ 40 (Ca).

(234 such datasets were in EXFOR Master 2021-10-01)

The full summary of the review was issued as Memo 4C-3/0410.

Information in article when EL is unresolved from inelastic

1. Unresolved level energy (E-LVL etc.) is given in the article

   Solution: SF3: EL → SCT. SF5: Add PAR. Add E-LVL.

2. Unresolved level energies are not given but detection energy resolution (~E-EXC-MAX) is specified in the article.

   Solution (proposal): Same as above, but compile the energy resolution instead of E-LVL. Use a new heading E-EXC-MX-A (approx. upper limit of E-EXC)?

3. No such usable values in the article.

   Solution (proposal): Keep SF3=EL but with SF5=EXL (excitation to low-lying excitation levels is not separated). Simakov's suggestion - in free text.

Example (^{93}Nb, Ex(1^{st})=30.8 keV)

Current

```
SUBENT         12892003      901102                          12892003     1
BIB                    2           2                          12892003     2
REACTION    (41-NB-93(N,EL)41-NB-93,,DA)                      12892003     3
...
ENDBIB                 2                                      12892003     5
NOCOMMON               0           0                          12892003     6
...
```

Source article (X.Wang et al., NPA465(1987)483)

Monitor normalized sample-in and sample-out t.o.f. spectra are shown in fig. 2 at $\theta_L = 30°$. The time resolution was about 2.0 ns which corresponds to an energy resolution of ~400 keV for 7 MeV neutrons.

Revision

```
SUBENT         12892003      901102                          12892003     1
BIB                    2           2                          12892003     2
REACTION    (41-NB-93(N,SCT)41-NB-93,PAR,DA)                  12892003     3
...
ENDBIB                 2                                      12892003     5
COMMON                 0           0                          12892003     6
E-EXC-MX-A
KEV
 400.
ENDCOMMON
...
```

Example (^{93}Nb, Ex(1^{st})=30.8 keV)

Current

```
SUBENT        12935008    20020220                          12935008     1
BIB                  1           1                          12935008     2
REACTION    (41-NB-93(N,EL)41-NB-93,,DA)                    12935008     3
ENDBIB               1                                      12935008     4
NOCOMMON             0           0                          12935008     5...
```

Simakov's report (Memo 4C-3/0420 Rev.)

Entries: 12935.008 (41-NB-93(N,EL)41-NB-93,,DA), 12935.011 (73-TA-181(N,EL)73-TA-181,,DA)
12935.012 (79-AU-197(N,EL)79-AU-197,,DA)

Ex of 1st level (MeV): 0.0308 (Nb-93), 0.0062 (Ta-181), 0.0774 (Au-197)

Author and Publication: L. Hansen et al., pr_c_31_111_1985_.pdf

Recommendation for SF3: **SCT**: (41-NB-93(N,SCT)41-NB-93,PAR,DA), (73-TA-181(N,SCT)73-TA-181,PAR,DA), (79-AU-197(N,SCT)79-AU-197,PAR,DA), with *E-LVL-MAX≈0.120 MeV*

Revision

```
SUBENT        12935008    20020220                          12935008     1
BIB                  1           1                          12935008     2
REACTION    (41-NB-93(N,EL)41-NB-93,EXL,DA)                 12935008     3
COMMENT     S.Simakov (Memo 4C-3/0420 Rev.): E-LVL-MAX~0.120 MeV
ENDBIB               1                                      12935008     4
NOCOMMON             0           0                          12935008     5...
```

Summary

- New heading to provide the energy resolution as the approximate upper boundary of excitation energy (e.g., E-EXC-MX-A)
- New branch code to indicate possible contribution of low-lying level excitation (e.g., EXL)
- If they are approved, I am going to check if these codes work well for corrections of entries based on Memo 4C-3/0420.
- Open questions: Natural sample (not reviewed this time), suspicious total scattering datasets (SF3=SCT without SF5=PAR).