Correction of the $^{16}O(n,\alpha_0)$ cross section below 6 MeV for JEFF-3.2β

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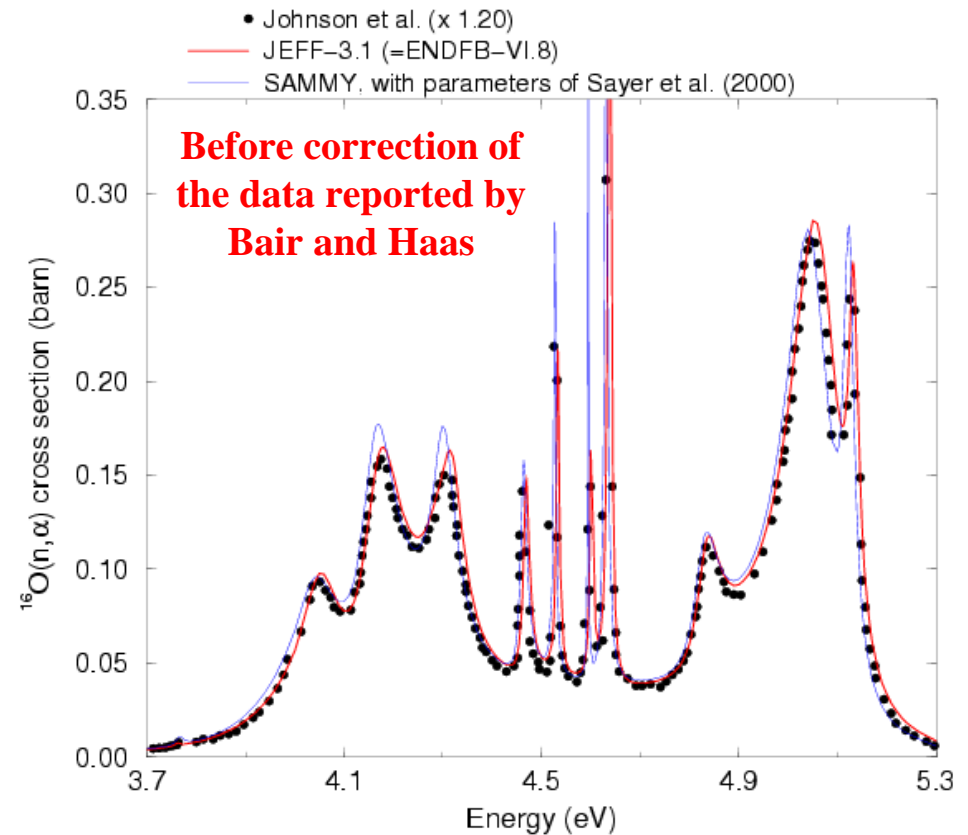
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Previous evaluations $\Rightarrow$ based on the $\sigma(n,\alpha)$ cross section obtained by reciprocity from data reported by Bair and Haas (1973)
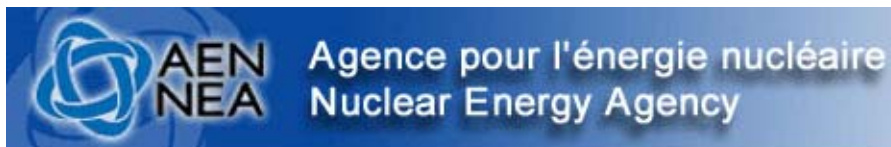
Bair and Haas $\Rightarrow$ absolute uncertainties are large ($\pm 20\%$)

Johnson et al. $\Rightarrow$ R-Matrix analysis of the (n,α) cross section with data reported by Blair, ORNL-4659, but reduced by 20 % due to new analysis.

Sayer et al. $\Rightarrow$ R-Matrix analysis with data from Blair without correction

Before correction of the data reported by Bair and Haas

- Johnson et al. (x 1.20)
- JEFF–3.1 (=ENDFB–VI.8)
- SAMMY. with parameters of Sayer et al. (2000)

$^{16}O(n,\alpha)$ cross section (barn)

Energy (eV)

Correction normalisation (20%) not included in JEFF-3.1 (=ENDF\B-VI.8)

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Request ID	2			Status of the request	High Priority request	
Target	Reaction and process	Incident Energy	Secondary energy or angle	Requested (1 sigma) Accuracy	Covariance
8-O-16	(n,a) SIG	2.5 MeV-10.0 MeV		5%	Y
Field	Subfield	Date Request created	Date Request accepted	Ongoing action	
Fission	LWR, Material recycling	21-SEP-05	11-MAY-06	Y	

✉ Send a comment on this request to NEA.

Requester: Mr. Arnaud COURCELLE at CADARACHE, FR
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☒ **S. Harrisopulos et al. Phys. Rev. C72, 062801 (2005)**

Absolute cross section of the $^{13}C(\alpha,n)^{16}O$ reaction has been measured at $E_\alpha = 0.8$ to 8.0 MeV with an overall **accuracy of 4%.**

☒ **G. Giorginis et al., Int. Conf. On Nuclear Data for Science and Technology, 2007**

Cross section values for $^{16}O(n,\alpha)$ reaction were measured at the VdG facility of the IRMM in the energy range 3.95 – 9.0 MeV with a novel spectrometer using signal digitisation technique. The overall **accuracy is close to 5%.**

☒ **Low energy range 4.0 – 4.5 MeV**

Energy resolution of the prelim. data reported by Giorginis-Khryachkov is about 2.5 time better

First approximation, data from Giorginis-Khryachkov can be used without taking into account the resolution broadening. Assuming that ENDF evaluation is free of energy resolution effects, JEFF-3.1 can be normalised to data presented at ND2007.

At 4.3 MeV σ (JEFF-3.1) = 163 mbarns and σ (IRMM) = 111 mbarns $\Rightarrow$ **N = 0.68**

⇒ No resonance parameters in the evaluated nuclear data file

⇒ Prior parameters reported by R.O. Sayer, L.C. Leal, N.M. Larson, R.R. Spencer and R.Q. Wright, "R-Matrix Evaluation of O-16 Neutron Cross Sections up to 6.3 meV", ORNL/TM-2000/212 (2000)
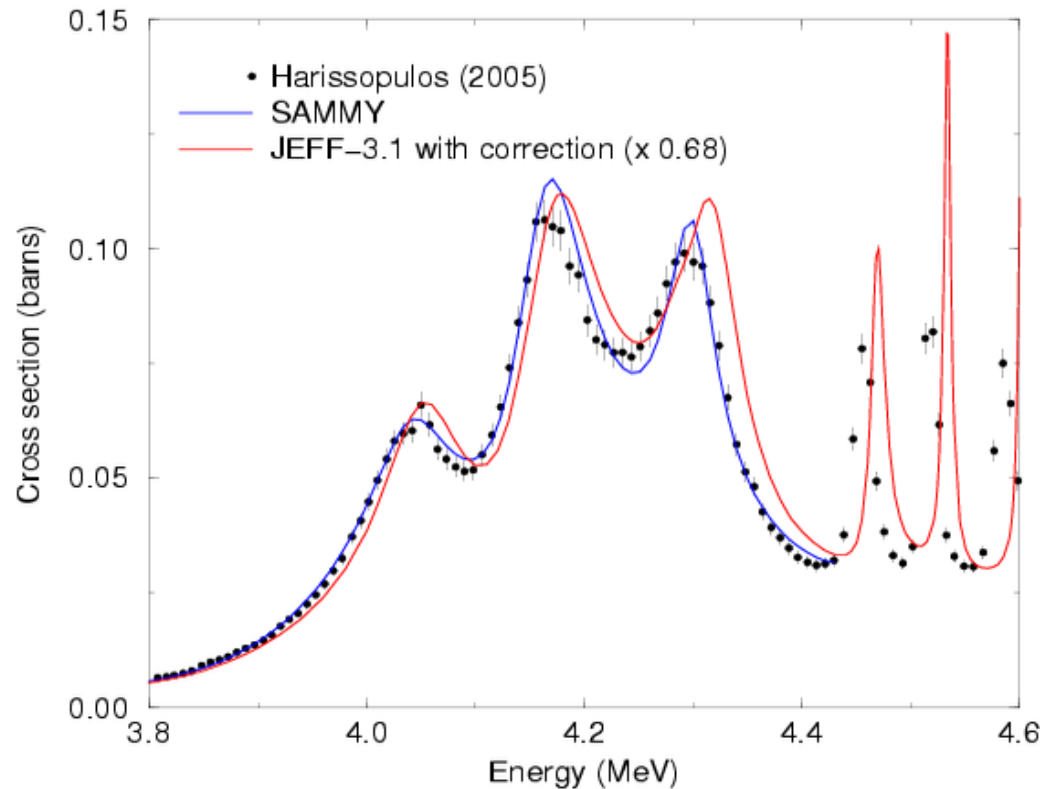
First approximation: prelim analysis of the data reported by Harissopulos (inverse reaction) give results consistent with the correction suggested by the preliminary data reported by Giorginis-Khryachkov

Had-hoc normalisation of previous evaluated cross section cannot be used over a wide energy range.

Above 4.4 MeV, accurate modelling of the energy resolution is needed to describe narrow resonances.
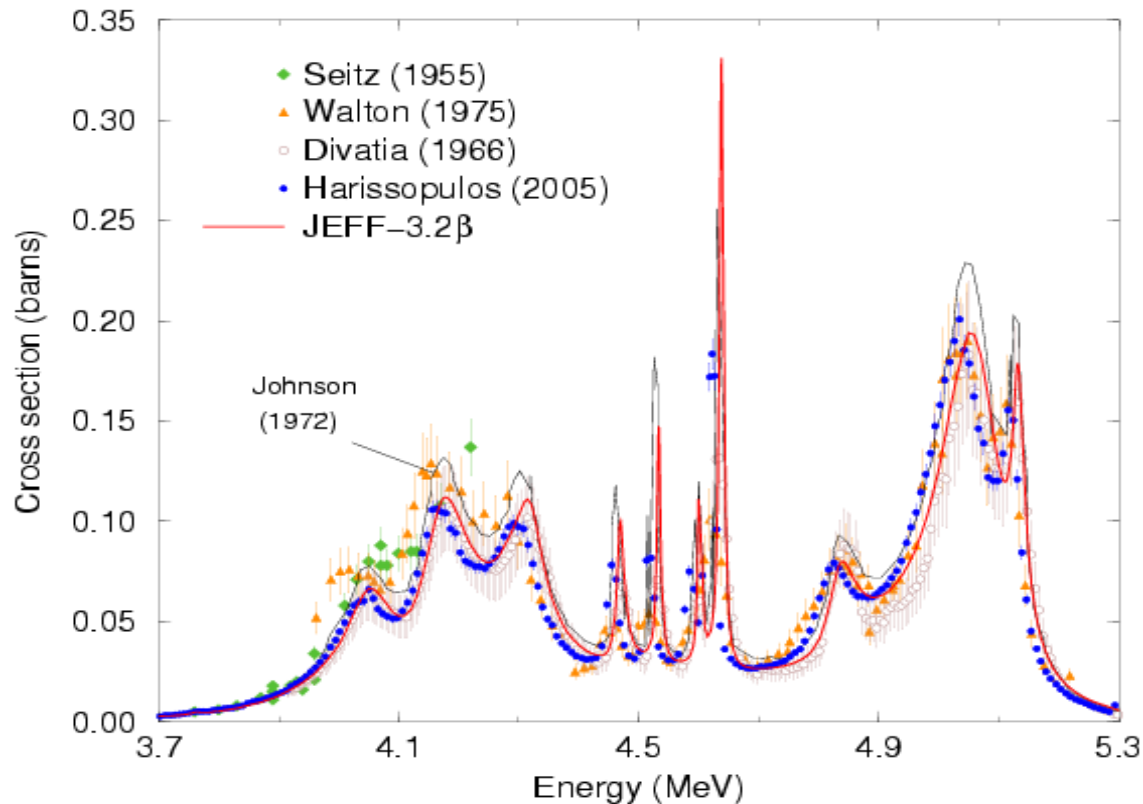
overall good agreement between JEFF-3.2beta and experimental data
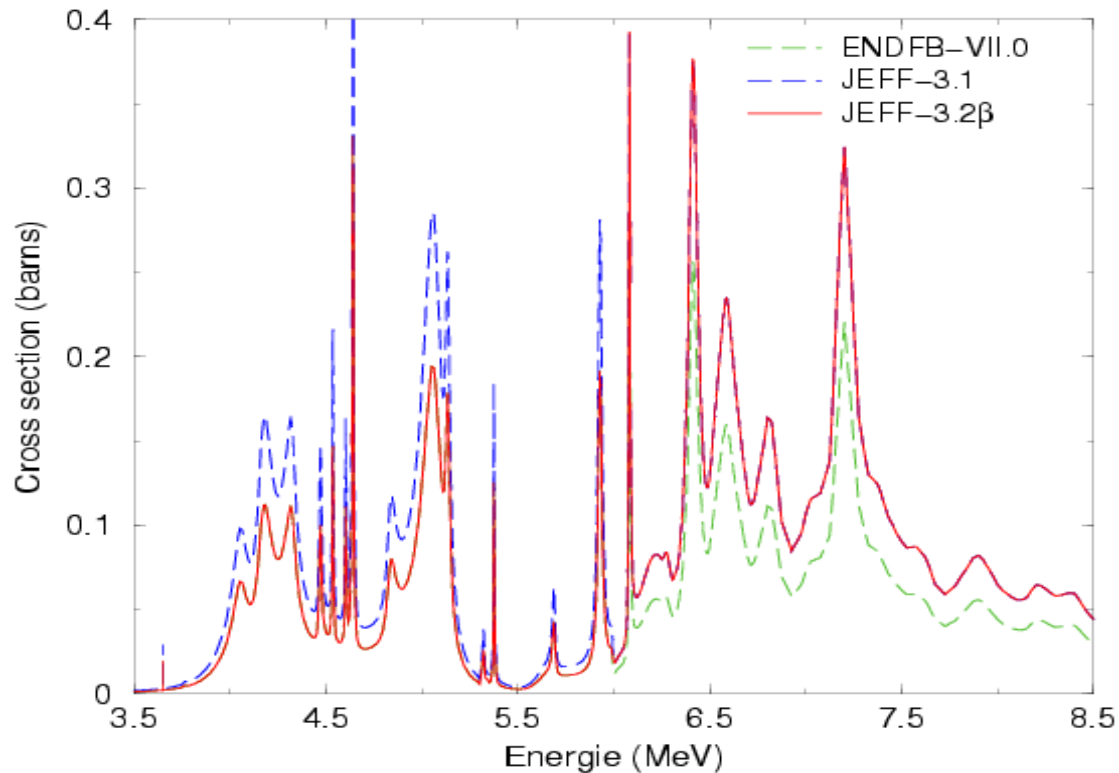⇒ however, old data sets characterized by large experimental uncertainties
evaluation from Johnson is still 10% higher
⇒ data reported by Bair and Haas are "definitely" wrong
only two data sets have to be used for new evaluation
⇒ inverse reaction from Harrisopulos + data reported by Giorginis-Khryachkov

Below 6 MeV :
- **JEFF-3.2beta = ENDF\B-VII.0** by using corrections suggested by G. Giorginis
- ENDF\B-VII.0 obtained from normalisation of ENDF\B-VI by **P.R. Page** using data reported by Harissopulos.
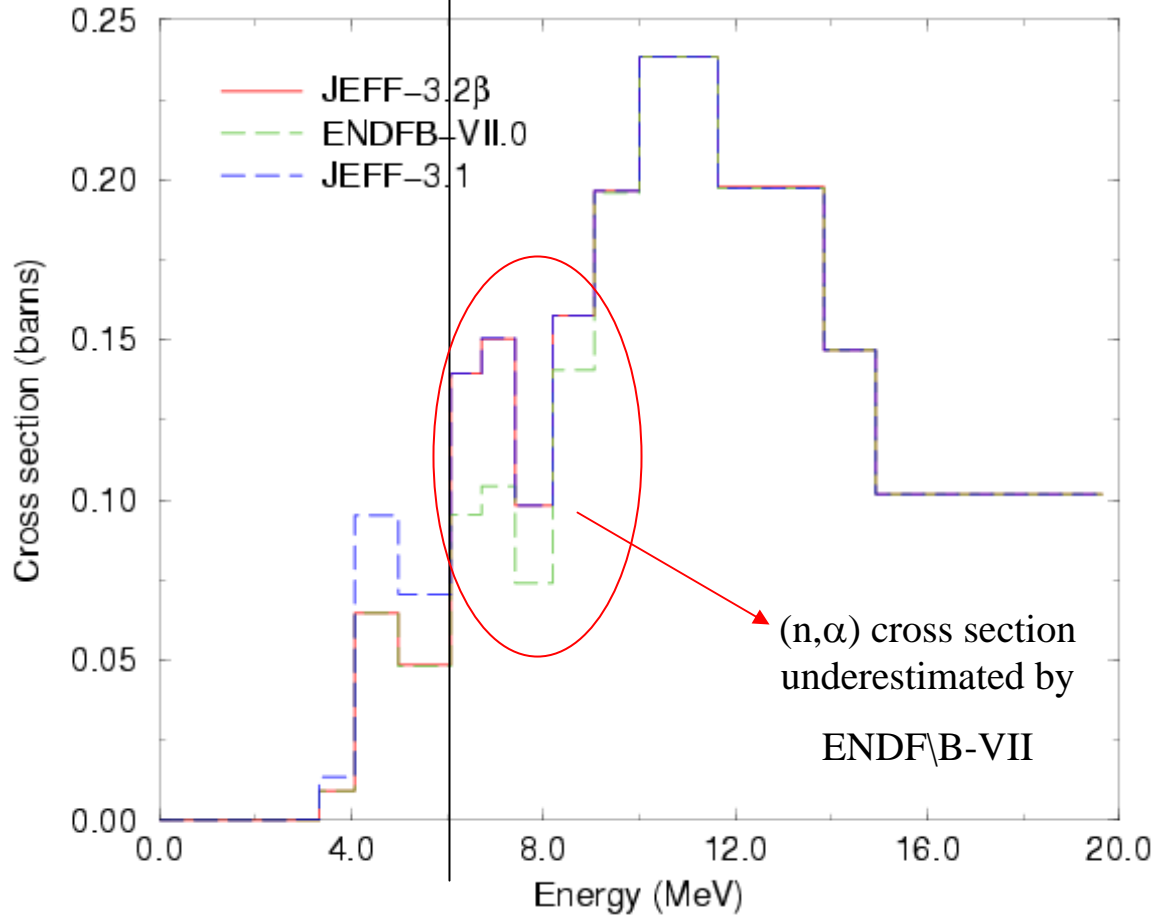
Above 6 MeV :
- ENDF\B-VII.0 normalized with old data reported by **Davis in 1963**
- **JEFF-3.1 (=ENDF\B-VI) provides a better compromise**

Normalisation of JEFF-3.1 (0.68)

JEFF-3.1 (=ENDF\B-VI)

Correction suggested by the preliminary data reported by Giorginis-Khryachkov

(n,α) cross section underestimated by ENDF\B-VII

Below 6 MeV

$\Rightarrow$ Excellent agreement between all the evaluation around 4.2 MeV

Above 6 MeV

$\Rightarrow$ Prelim IRMM results suggest to increase JEFF-3.1 (=ENDF\B-VI.8)

New evaluation

$\Rightarrow$ Owing to the large variation of the normalization coefficient, new R-matrix analysis is needed

IRMM data provide a consistent description of the (n,α) cross section up to 8.5 MeV.