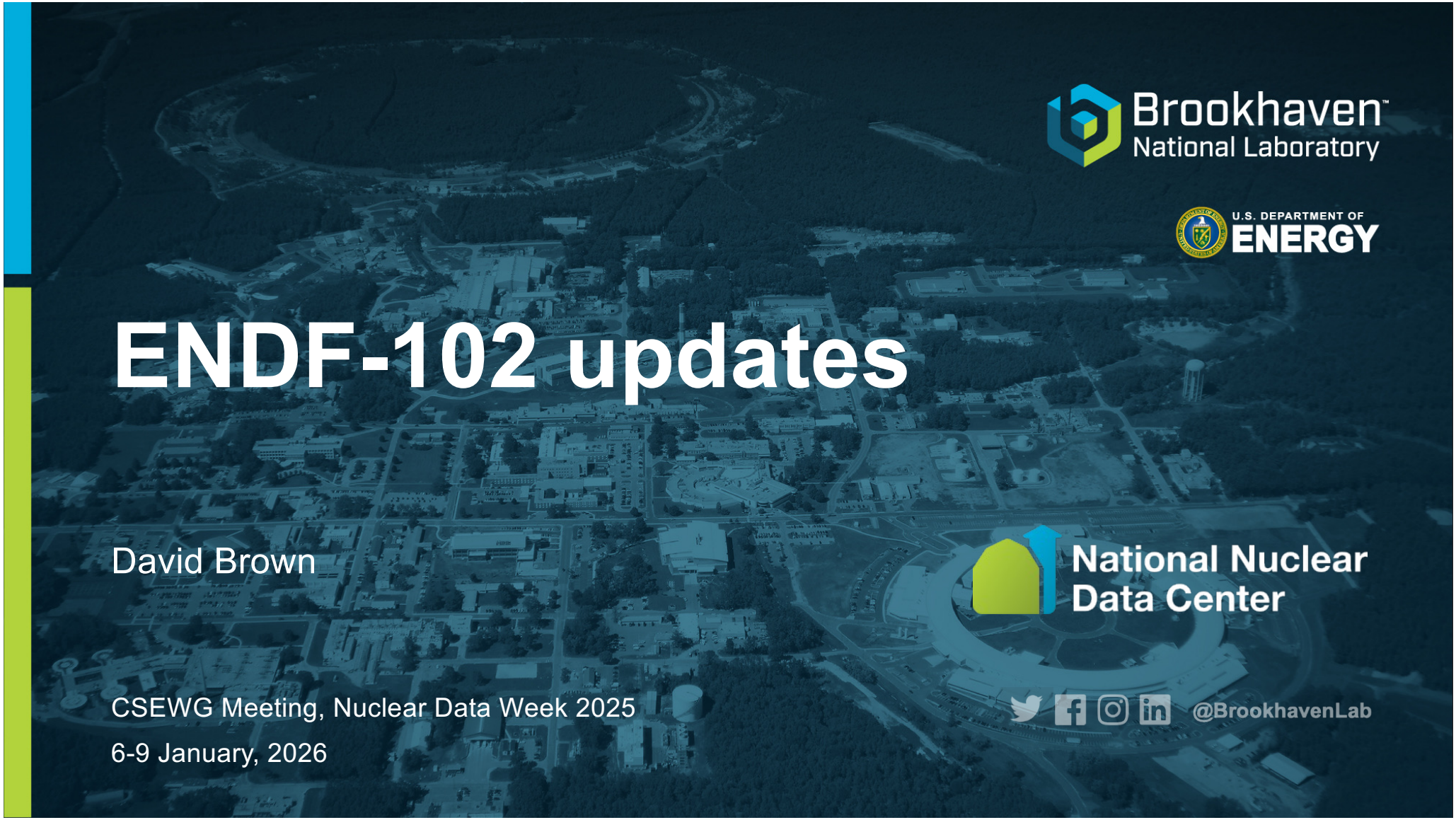
Brookhaven
National Laboratory
U.S. DEPARTMENT OF
ENERGY
ENDF-102 updates
David Brown
National Nuclear
Data Center
CSEWG Meeting, Nuclear Data Week 2025
6-9 January, 2026
@BrookhavenLab

Updates since November 2024

Tracker	Issue	Status
MR 42	Update URL for ENDF utility codes	Merged
Issue 161	Clean up IREV reference on page 41	Merged
Issue 162	Tabulated phase shift description incorrect	MR 44 (see next pages)
Issues 163 & 158	Sum rules needed some more clarification (the pictures are correct, but the text & table supporting it require care in interpretation)	Merged
Issue 155	Increase NE in MF=5	MR 45 (see next pages)
Issue 136	Charged-particle elastic scattering description improvements	MR 47 (see next pages)
Issue 135	Inconsistent use of the characteristic bound cross section for incoherent elastic scattering	No progress
Issue 134	Confusion regarding primary gamma description	No progress
Issue 129	For Rutherford cross section questions, need to clarify cross-section vs. distributions	No progress

Issue #162: Tabulated phase shifts (KPS=1) description

Option 0. Hard-sphere phase shifts (**LPS**=0)
No additional information is conveyed in this record, other than LPS=0.

```
[MAT,2,151/ 0.0, 0.0,   0,   0, LPS,   1/
            0.0, 0.0, 0.0, 0.0, 0.0, 0.0]LIST
```

Option 1. Phase shift is a tabulated complex function of energy (**LPS**=1)
Notation:

PSR Value of the real part of the tabulated phase shift

PSI Value of the imaginary part of the tabulated phase shift

```
[MAT,2,151/ 0.0, 0.0,   0,   0, LPS,   1/
            0.0, 0.0, 0.0, 0.0, 0.0, 0.0]LIST
[MAT,2,151/ 0.0, 0.0,   0,   0,  NR,  NP/E_int/ PSR(E) ]TAB1
            0.0, 0.0,   0,   0,  NR,  NP/E_int/ PSI(E) ]TAB1
```

(Recall that NR and NP are parameters, which define the interpolation scheme for TAB1 records, as defined in Secttion 0.6.4.7. Energy values given by Ei_{nt} are in units of eV.)

- LPS placed in spot reserved for length of a list
- LPS is used as a flag
- Next line is bogus list of 6 zeros that conflict with the “length”
- No one uses this format (according to Wim’s comment on issue tracker)

Issue #162: Tabulated phase shifts (KPS=1) description (cont.)

Option 0. Hard-sphere phase shifts (**LPS**=0)
No additional information is conveyed in this record, other than LPS=0.

```
[MAT,2,151/ 0.0, 0.0,   0,   0, LPS,   1]CONT
```

Option 1. Phase shift is a tabulated complex function of energy (**LPS**=1)
Notation:

PSR Value of the real part of the tabulated phase shift

PSI Value of the imaginary part of the tabulated phase shift

```
[MAT,2,151/ 0.0, 0.0,   0,   0, LPS,   1]CONT
[MAT,2,151/ 0.0, 0.0,   0,   0,  NR,  NP/E_int/ PSR(E) ]TAB1
            0.0, 0.0,   0,   0,  NR,  NP/E_int/ PSI(E) ]TAB1
```

(Recall that NR and NP are parameters, which define the interpolation scheme for TAB1 records, as defined in Secttion 0.6.4.7. Energy values given by Ei_{nt} are in units of eV.)

- Fix: make the LIST record a CONT record and delete the bogus zeros

MR 44 awaits approval:
https://git.nndc.bnl.gov/endf/format/endf6man/-/merge_requests/44

Issue 155: Increase NE in MF=5

File (MF)	Section (MT)	Variable	Max. value	Definition of the number represented by the variable
5	All	NE	200	Incident energy points
		NF	1,000	Secondary energy points

In Appendix G:

- For MF=5, values are too small
- Recommend increasing both values by (at least) a factor of 5

MR 46 awaits approval: https://git.nndc.bnl.gov/endf/format/endf6man/-/merge_requests/46

Issue 136: Remove LTP=15 from section 6.2.7

p_{NI} *is* the tabulated nuclear plus interference dist. LTP12 & 15 are the same. Recommend to remove LTP 15

(there is an additional tweak in this MR to make all the p_{NI}'s lowercase for consistency)

MR 47 awaits approval: https://git.nndc.bnl.gov/endf/format/endf6man/-/merge_requests/47

$$\sigma_{NI}(E) = \int_{\mu_{\min}}^{\mu_{\max}} [\sigma_e(\mu, E) - \sigma_c(\mu, E)]\, d\mu \qquad (6.19)$$

and

$$P_{NI}(\mu, E) = \begin{cases} \dfrac{\sigma_e(\mu, E) - \sigma_c(\mu, E)}{\sigma_{NI}(E)} & \mu_{\min} \le \mu \le \mu_{\max} \\ 0 & \text{otherwise,} \end{cases} \qquad (6.20)$$

where $\mu_{min} = -1$ for different particles and 0 for identical particles. The maximum cosine should be as close to 1.0 as possible, especially at high energies where Coulomb scattering is less important. The Coulomb cross section $\sigma_c(\mu, E)$ is to be computed using equations (6.9) or (6.10) for different or identical particles, respectively. The angular distribution p_{NI} is given in File 6 as a tabulated function of μ, and $\sigma_{NI}(E)$ in barns is given in File 3. The following quantities are defined for LAW=5:

SPI Spin of the particle. Used for identical particles (SPI=0, 1/2, 1, *etc.*).

LIDP Indicates that the particles are identical when LIDP=1; otherwise, LIDP=0.

LTP Indicates the representation:

LTP=1 nuclear amplitude expansion, equations (6.13) and (6.14);

LTP=2 residual cross section expansion as Legendre coefficients, equations (6.15) through (6.18);

LTP=12 nuclear plus interference distribution with p_{NI} linear in μ, equations (6.19) and (6.20);

146

6.2. FORMATS

LTP=14 tabulation with $\ln(P_{NI})$ linear in μ, equations (6.19) and (6.20).

LTP=15 tabulation with P_{NI} linear in μ, equations (6.19) and (6.20).