# Uses of FUDGE and GND in the preparation of ENDF/B-VII.1

*(Tales of a beta tester)*

*David Brown*

BROOKHAVEN NATIONAL LABORATORY

*a passion for discovery*

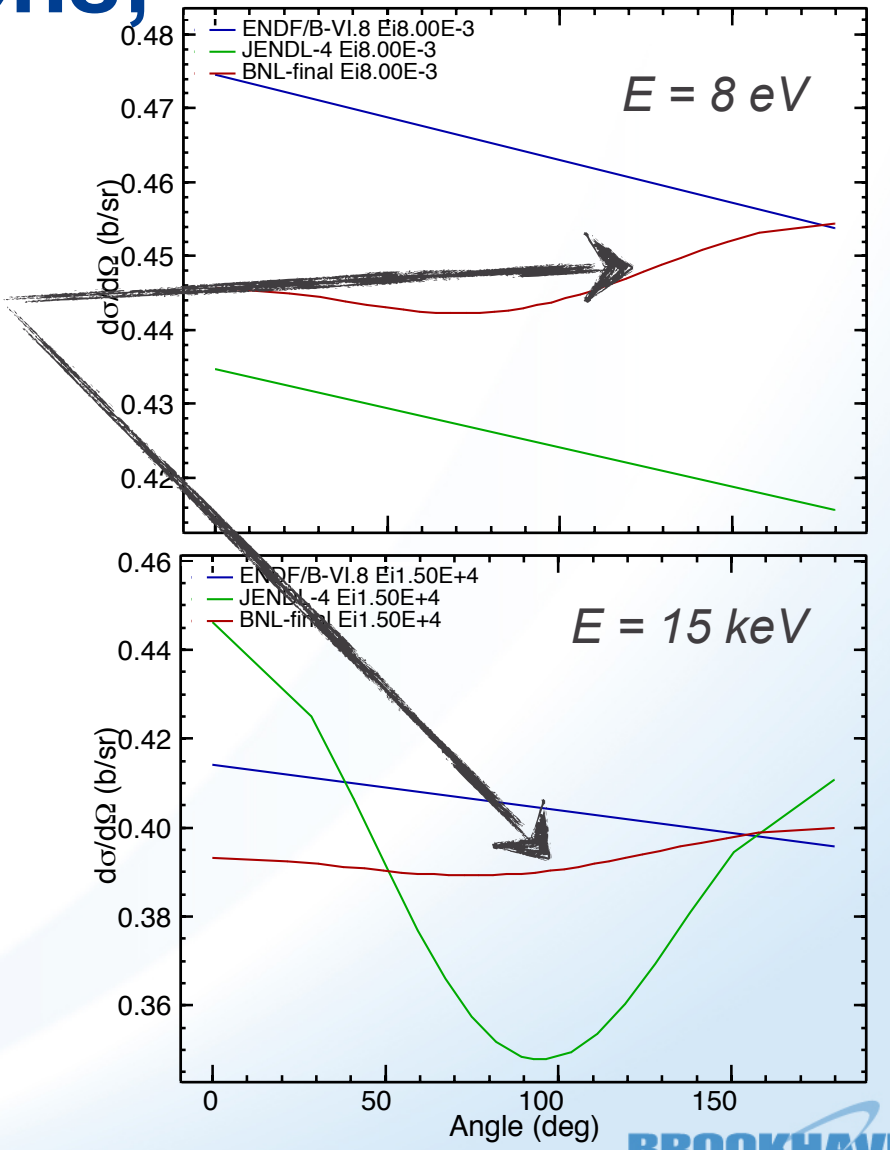
U.S. DEPARTMENT OF ENERGY | Office of Science

# Outline

- Zr modification
- Checking
- Plotting data & covariances
- Fixes
- My wish list

# All new Zr evals. had strange (n,el) angular distributions; changed leakage

Backward peaked at low energy?!?




Note: This keeps low energy neutrons from leaking out by scattering them back into the system, increasing $k_{eff}$

Reported by C. Lubitz, T. Trumbull

# Given the short time-scale before ENDF/B-VII.1 due, we looked to other libraries

- Since the double differential (n,el) cross section is

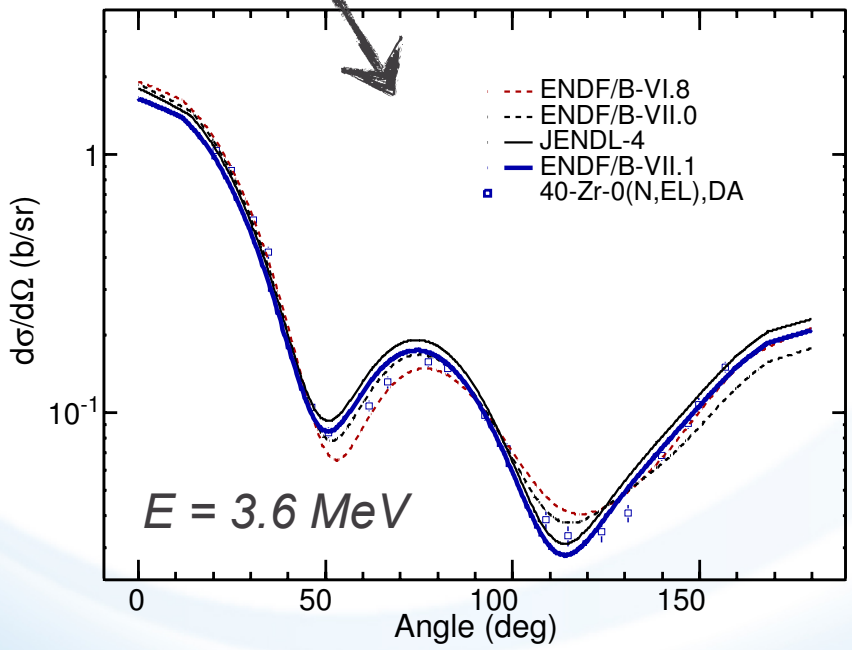
$$\frac{d\sigma(E)}{d\Omega} = (2\pi)^{-1}\sigma(E)P(E|\mu)$$

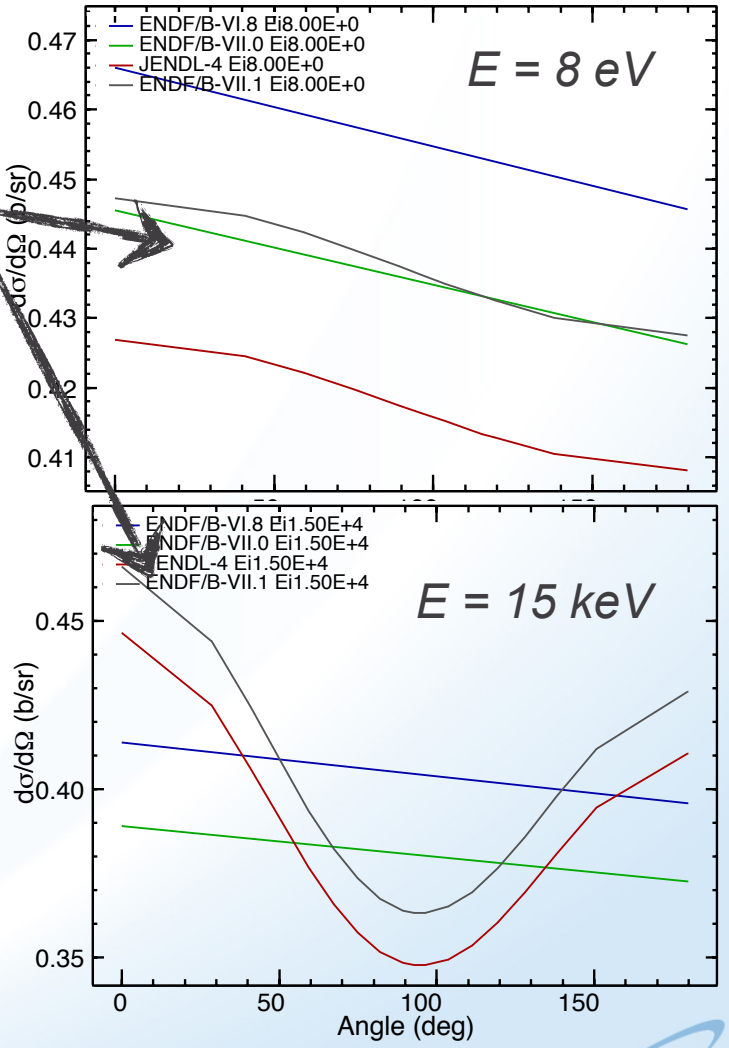
- We can preserve the excellent (n,el) total cross section by replacing only the $P(E|\mu)$ in file 4
- JENDL-4 used Koning-Deleroche OMP, a reasonable substitute given that we are at a closed shell

# FUDGE made this substitution simple

Agreement with data fantastic

Shape of distribution now makes sense



# Outline

- Zr modification
- Checking
- Plotting data & covariances
- Fixes
- My wish list

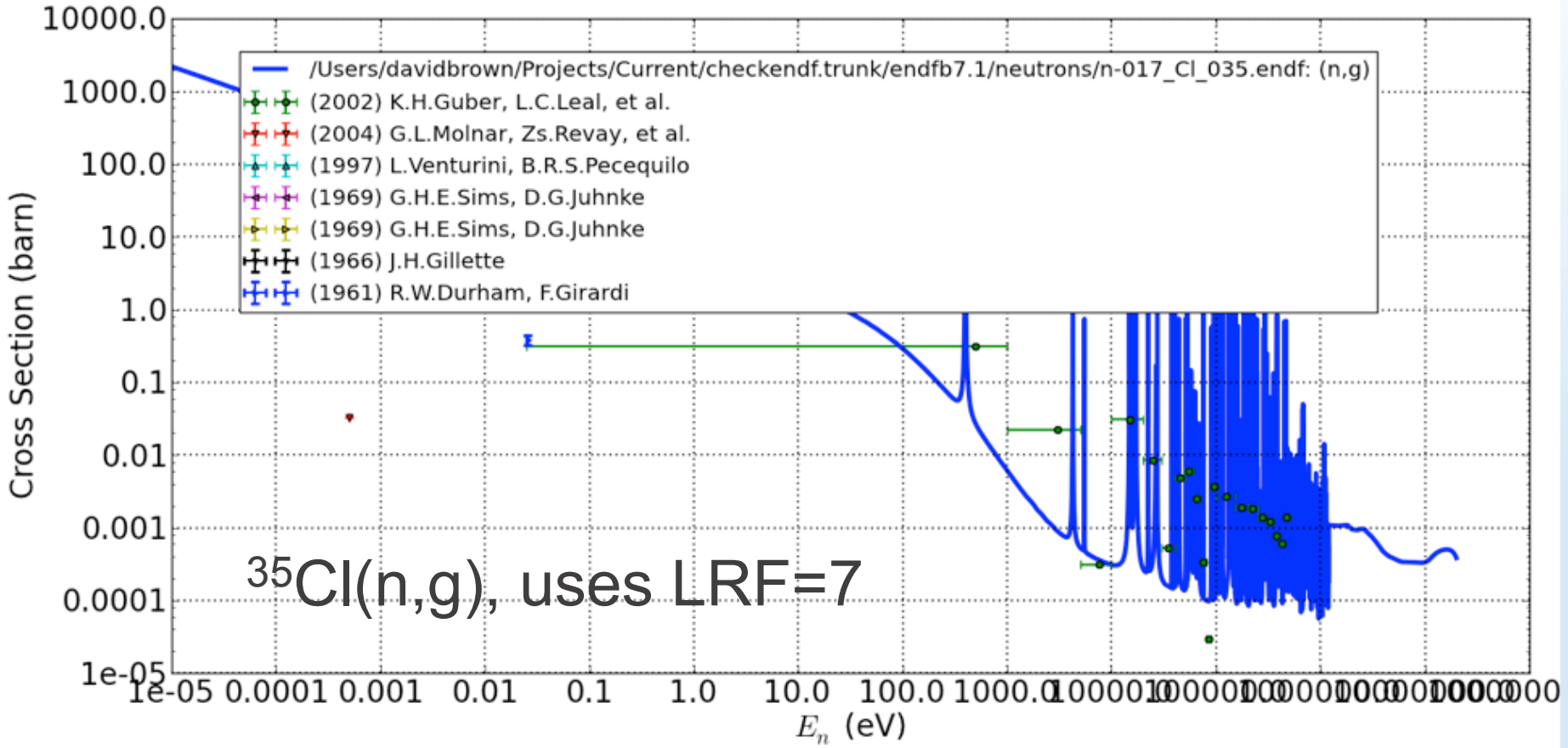
# FUDGE nicely complements other NNDC checking codes

- FUDGE can be used to translate ENDF formatted evaluations into GND format
- Along the way, it checks (& repairs!) many things, giving useful messages:
  - Interpolation corrections
  - Masses (FIZCON sorta does this)
  - Levels (FIZCON does it wrong IMHO)
  - Q values (FIZCON & PSYCHE do this too)
  - ENDF format compliance (CHECKR does this too)
  - Covariance positivity
- FUDGE is being integrated into the NNDC "continuous integration" on-line validation system [see R. Arcilla's talk Tues.]

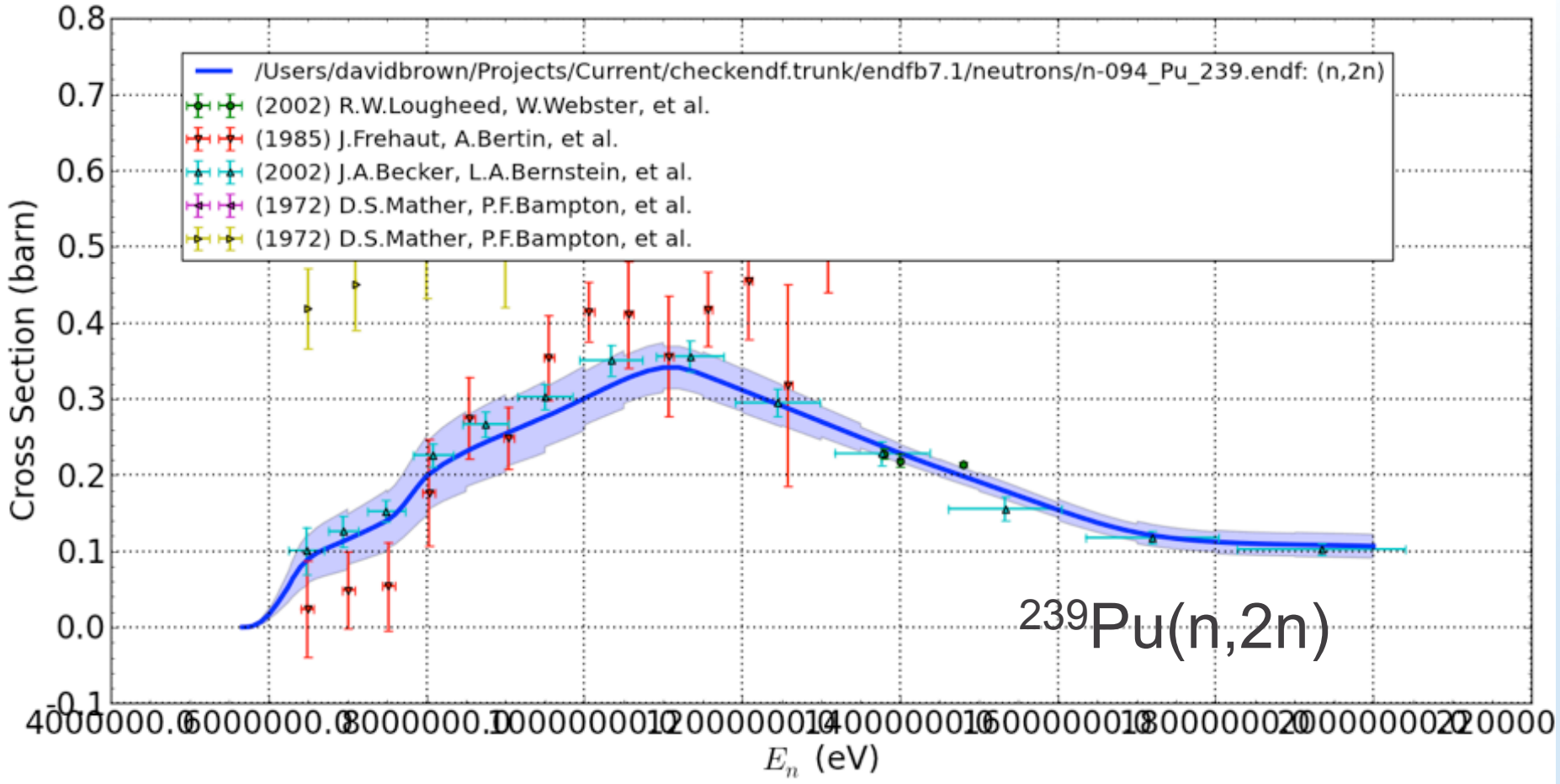
# Outline

- Zr modification
- Checking
- Plotting data & covariances
- Fixes
- My wish list

# FUDGE has matplotlib & gnuplot based plotting and can reconstruct resonances



# And it can handle covariances



# Outline

- Zr modification
- Checking
- Plotting data & covariances
- Fixes
- My wish list

# FUDGE is a handy tool and was used for many fixes to the library

- Since fudge can read/write ENDF evaluations, translating them into FUDGE/GND data structures, we used it for several fixes:
  - Synching fission Q values with fission energy release
  - Ensuring gamma BR's in the (n,n')'s sum to 1
  - Ensuring that covariances are positive definite (as much as possible anyway)
  - Fixing the threshold groups in covariances
- These scripts were back-ported to FUDGE and are now part of the main code base

# Outline

- Zr modification
- Checking
- Plotting data & covariances
- Fixes
- My wish list

# Features that would make library maintenance simpler

- Expressive exceptions:
  - “ValueError” better than generic “Exception”
  - Have fudge specific exceptions
  - Deep try/excepts so can keep going when hit error
- Better logging:
  - Not everything is a “WARNING”
  - Don’t try to guess indent levels
  - Mechanism to save messages beyond redirects
- By default, don’t change an evaluation
- (n,tot)
- Separate check() and fix() functionalities
- All of those fix() features from fudge-1.0