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US Nuclear Data Reaction Working Group discussion topics

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Nuclear Reaction Theory, Modelling, and Evaluation for ENDF

- Primary users of nuclear data are:
  - National security and nuclear safety
  - Nuclear energy production and applications
    - fission and fusion
  - Other applications or fundamental science
    - medical, astrophysical, space, ...
    - analysis of experimental data, understanding of physical phenomena
  - ...
- Nuclear reaction theories, which are essential for producing reliable nuclear data, include:
  - Direct reactions
  - Compound reactions
    - R-matrix for resonances, and statistical theories
  - Pre-equilibrium reactions
  - Modelling of them also includes other ingredients (optical potential, level density, strength function, etc)
- Other tools to reinforce evaluations
  - statistical analysis of experimental data

Current Status? Significant Deficiencies?

- Hauser-Feshbach model codes play the central role
  - Are they good enough?
    - TALYS, CoH_3, EMPIRE, YAHFC, CCONE, …
  - What are the weaknesses?
    - predictive fission calculation still unsatisfactory
    - transitional mass and energy ranges from resolved to unresolved region
    - composite particle (e.g. deuteron) induced reactions
    - energies above 20 MeV
    - …
- Production of evaluated data files
  - Extract all relevant information from the codes and store in the ENDF files
    - these tools are often private, not so generalized
    - evaluated files are often not reproducible by others
    - technology transfer to the next generation
  - Demands for nuclear data other than neutron-induced reactions
    - Fission products, photonuclear reaction, beta-delayed neutron and photons, and so on
    - Charged particle induced reactions for medical isotope production applications and space applications

Experimental efforts in improving reaction data

- Most organized efforts are in neutron-induced reaction measurements
  -neutron facilities: LANSCE, RPI, Ohio U., UC-Berkeley, TUNL, U Notre Dame, U. Kentucky, NTOF, Gelina, ILL, etc.
  -charged particle facilities: UC-Berkeley, ATLAS, FRIB, TAMU, Ohio U, U Notre Dame, FSU, etc.

- Direct measurements to deduce cross sections and outgoing particle information
  – absolute, ratio to standards
- Indirect measurements to provide nuclear inputs for calculating cross sections
  – level density, photon strength function, nuclear mass, ...
- Measured nuclear structure information
  -- level energies & spin/parities, branching ratios, decay schemes, …

- Coverage to improve reaction data quality becomes large

- Uncertainties required by application govern experiment plans, to set cost, timeline, facility, detection choice, analysis methods, …
  -- Encourage more collaborations among facilities to share capabilities and resources
  -- Direct and Indirect measurements are complementary