Advancing the theory of nuclear data evaluations[1*]

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Abstract: We present recent advances in the R-matrix formalism as well as the Bayesian evaluation framework for improved nuclear data evaluations. The advances in the R-matrix formalism include: 1) direct processes, 2) doorway, as well as multistep, processes, and 3) various forms of the Reich-Moore approximation for eliminated capture channels. Furthermore, to address unreasonably small posterior uncertainties often encountered in nuclear data evaluations of large data sets using the conventional form of the Bayes' theorem, we introduce *imperfections* (of the data or the model) as a formal evaluation tool for taming the evaluated uncertainties in harmony with Bayes' theorem. These theoretical advances were motivated by the nuclear data evaluations of differential resolved resonance cross section data using the code SAMMY, as well as the integral benchmark experiments using the SCALE code system, being performed at Oak Ridge National Laboratory for the Nuclear Criticality Safety Program. Some pedagogical applications of the new formalism, as well as a snapshot of the SAMMY modernization efforts, will be presented.

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