NUCLEAR ASTROPHYSICS DATA EVALUATIONS AND DISSEMINATIONS

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We have a new program of evaluating and disseminating nuclear data of vital importance for studies in nuclear astrophysics. Research programs in nuclear astrophysics address some of the most fundamental questions in nature about the origins of the elements, formation and evolution of the solar system, the sun, the stars, and the galaxy. Measurements in the nuclear laboratory form the empirical foundation for the sophisticated theoretical models of these astrophysical systems. In many cases, however, new nuclear physics measurements are not rapidly disseminated to the research community nor rapidly incorporated into astrophysical models. For this reason, progress in many fundamental problems in nuclear astrophysics can be significantly aided by more effectively utilizing nuclear data. The ORNL effort addresses this problem by providing new evaluations of important reactions and disseminating them to the research community in user-friendly formats that are easily incorporated into astrophysics models. Our evaluation work is initially focused on capture reactions on radioactive isotopes on the proton-rich side of stability - reactions that are important for understanding the element synthesis and energy generation in stellar explosions. Our work utilizes the latest advances in Internet- and WWW-based information services to disseminate evaluated data to the astrophysics research community. A number of projects in nuclear astrophysics data have recently been completed or initiated at ORNL.

a) We have generated analytic expressions as a function of temperature for the stellar rates of the important explosive nucleosynthesis reactions $^{14}O(\alpha,p)^{17}F$ and $^{17}F(p,\gamma)^{18}Ne$ using the most recent indirect experimental measurements of relevant reaction parameters[3]. This is the first complete expression for the $^{14}O(\alpha,p)^{17}F$ rate incorporating recent experimental information, and corrects an error (as large as 13% at high temperatures) in the previously-published $^{17}F(p,\gamma)^{18}Ne$ rate.

b) We have disseminated the Caughlan and Fowler Reaction Rate Compilation[4] on the World Wide Web[5], including analytical rate expressions, tabular values, downloadable FORTRAN subroutines, GIF and Postscript plots, analytical expressions for temperature derivatives of rates, and search capabilities. Other nuclear astrophysics data - such as Big Bang Nucleosynthesis rates and a Nuclear Astrophysics Bibliography - has also been disseminated on the WWW.

c) We are currently evaluating the $^{17}O(p,\alpha)^{14}N$ reaction rate, important for determining the relative abundance of oxygen isotopes (tracers of convection processes) in the envelopes of red giant stars, and for interpreting oxygen

isotope anomalies in meteorites. More details on each of these ORNL projects are given in subsequent progress report articles.

Additionally, we have been active in organizing U.S. efforts in nuclear data for nuclear astrophysics, and M. S. Smith chairs an Astrophysics Task Force which recently submitted a six-laboratory proposal to the Department of Energy to fund a cooperative U.S. nuclear astrophysics data program.

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[4]G. R. Caughlan, W. A. Fowler, At. Data Nuc. Data Tables 20, 283 (1988).
[5]http://www.phy.ornl.gov/astrophysics/data/data.html.