



1. NAME AND TITLE

TALYS 1.2: Nuclear Model Code System for Analysis and Prediction of Nuclear Reactions and Generation of Nuclear Data.

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2. CONTRIBUTORS

NRG - Nuclear Research and Consultancy Group, Petten, The Netherlands, and CEA Service de Physique et Techniques Nucleaires, Bruyeres-le-Chatel, France, through the OECD NEA Data Bank, Issy-les-Moulineaux, France.

3. CODING LANGUAGE AND COMPUTER

Fortran 95; PC Linux (P00548PC58601).

NEADB package identifier is NEA-1737/03.

4. NATURE OF PROBLEM SOLVED

TALYS is software for the simulation of nuclear reactions. Many state-of-the-art nuclear models are included to cover all main reaction mechanisms encountered in light particle-induced nuclear reactions. TALYS provides a complete description of all reaction channels and observables. It is a versatile tool to analyze basic microscopic experiments and to generate nuclear data for applications. The official TALYS website is <http://www.talys.eu/home>.

Specific features of the TALYS package:

- an exact implementation of many of the latest nuclear models for direct, compound, pre-equilibrium and fission reactions.
- a continuous, smooth description of reaction mechanisms over a wide energy range (0.001- 200 MeV) and mass number range ($12 < A < 339$).

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- completely integrated optical model and coupled-channels calculations by ECIS-06
 - incorporation of recent optical model parameterizations for many nuclei, both phenomenological (optionally including dispersion relations) and microscopically.
 - total and partial cross sections, energy spectra, angular distributions, double-differential spectra and recoils.
 - discrete and continuum photon production cross sections.
 - excitation functions for residual nuclide production, including isomeric cross sections.
 - exact modeling of exclusive channel cross sections, e.g. (n; 2np), spectra, and recoils.
 - automatic reference to nuclear structure parameters as masses, discrete levels, resonances, level density parameters, deformation parameters, fission barrier and gamma-ray parameters, generally from the IAEA Reference Input Parameter Library
 - various width fluctuation models for binary compound reactions and, at higher energies, multiple Hauser-Feshbach emission until all reaction channels are closed.
 - various phenomenological and microscopic level density models.
 - various fission models to predict cross sections and fission fragment and product yields.
 - models for pre-equilibrium reactions, and multiple pre-equilibrium reactions up to any order.
 - astrophysical reaction rates using Maxwellian averaging.
 - option to start with an excitation energy distribution instead of a projectile-target combination.
 - use of systematics if an adequate theory for a particular reaction mechanism is not yet available or implemented, or simply as a predictive alternative for more physical nuclear models.

5. METHOD OF SOLUTION

The following model specificities are used:

- Optical Model (OM): Phenomenology local / global
- Direct reaction: Spherical OM, Distorted Wave Born Approximation (DWBA),

Rotational Coupled Channels (CC), Vibrational CC, Giant resonances, Weak-coupling

- Preequilibrium: Exciton model - 2-component, p-h LD phenomenology - surface effects, Kalbach systematics - angular distribution, - cluster emission, gamma-ray emission

- Compound: With fluctuation - Moldauer - GOE triple integral- HRTW, Hauser-Feshbach, fission competition - isotopic yields, gamma-ray emission, GC and Ignatyuk

- Multiple emission: Exciton (any order), Hauser-Feshbach, Fission competition - isotopic yields, gamma-ray cascade, all flux depleted, exclusive channels, recoils.

6. RESTRICTIONS OR LIMITATIONS

TALYS can be used to simulate nuclear reactions in the 1 keV-200 MeV energy range.

7. TYPICAL RUNNING TIME

Run times are very problem dependent. The sample problems provided with the code took about an hour to run on an AMD Opteron.

8. COMPUTER HARDWARE REQUIREMENTS

The authors tested TALYS only on PC's under Linux operating systems.

9. COMPUTER SOFTWARE REQUIREMENTS

A Fortran compiler is required; no executables are included in the package. At RSICC TALYS was tested under RedHat Enterprise Linux with GNU (gcc) 4.3, MacOS 10.5.8 with gfortran 4.3 and PGI 7.2 compilers and Windows 7 with Intel 11.1 compilers.

10. REFERENCES

10.a included in subdirectory fileadmin\talys\user\docs:

A.J. Koning, S. Hilaire and M. Duijvestijn, "TALYS 1.2, A Nuclear Reaction Program, USER MANUAL" (December 22, 2009).

10.b background reference

A.J. Koning, S. Hilaire, and S. Goriely, "Global and local level density models," Nuclear Physics A 810 (2008) 13-76.

11. CONTENTS OF CODE PACKAGE

The package is transmitted on one CD including the references listed above in Section 10.a. source code, scripts, nuclear structure database and sample problems.