SUMMARY OF CAPABILITIES OF MONTE-CARLO HMSAlice CODE POST-1996

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1 SUMMARY- HMS-alice2008

The HMS-Alice codes began evolution from the Alice code in 1995 with the development of the Monte Carlo precompound model (1). The MC approach first maintained the two-body collision idea of precompound decay in a rigorous way; it allowed multiple precompound decay limited only by excitation energy, and it permitted a history file of emitted particle type, energy, angle, multiplicity, for each event. Having a history file (or such an event sequence calculation) permits kinematic corrections (c.m.-lab conversions) to be made rigorously, rather than using the usual two body approximation. It means that correlations of energy/angle/ejectile/recoil may be made if desired. It gives the advantages of the intranuclear cascade calculation, probably with a saving of computation time.

A manual exists describing how to execute the HMS nuclear reactions code (2), which has also been designed to be useable without a manual byusing a prompting screen input option. The old output has largely been replaced by multiple output files, such as a product yield file, SDCS and DDCS files for lab and for CM coordinates, fission neutron files, total neutron files, isomer yield files, and if one likes huge files, the recoil nuclei spectra may be printed vs. Z,A, angle,energy.

The history file has made possible the output of ENDV files, but only implemented thus far for all channels of up to 3 n,p,4He per incident energy. The logic used may easily be applied to increasing the number of emitted particles in the ENDV output, or to include 2H,3H,3He and 7Be in the exit channels. Warning: there will be a large increase in number of arrays to print if/when this is done.

Many other capabilities exist in the present code version over pre-HMS and even early HMS versions. Light excited nuclei may be given the Fermi breakup option in decay, (3). Precompound+compound emission of 2H, 3H, 3He, 4He, and 7Be may be requested (4). Isomer ratios may be calculated for product yields (2). Isomer targets may be used, as well as naturally occuring isotopic targets. For fission, the mass and charge yields of the fission products are calculated along with their excitations (3). These excited fragments are de-excited to ground state, and the emitted n,p,4He spectra are added to the total spectra in both c.m. and laboratory frames. For nucleon induced reactions, DDCS are calculated using the model of Chadwick and Oblozinsky (5)

Options for treating heavy ions in the entrance channel exist, using either a fast algorithm or random angle coupling of beam and Fermi momenta to get both SDCS and DDCS (5). This physics will be used for any projectile of A¿1; a better treatment should be programmed in for 2H, 3H, and 3He projectiles which would divide the reaction cross section into pick-up/stripping and composite capture channels. Perhaps this will be a future addition.

Projectiles used may be photons or nuclei (or neutrons). Pion physics is not yet programmed into the de-excitation phase, so users should be aware when per nucleon incident energies start to exceed 200 MeV. The model assumption for photon induced reactions is found in (6), and the photonuclear reaction cross sections are based on a giant dipole model with parameters provided by Giacri (7).

Notes on compilation are in the comments cards at the beginning of the HMS listing, and it is suggested that these be read. Any error messages in compilation are requested to be forwarded to blann@gte.net or blann@verizon.net.

This code is designed to find nuclear structure-reactions data needed for execution in library files which should be present in the user directory at time of execution. The necessary files are:
phtlib
tmadland
gdrparms
MASS.TBL
SHELL.TBL
pmtable
abund
tapesf

Level densities are discussed in the Manual. Fermi gas densities, and those of Kataria and Ramamurthy(9) existed as options in earlier code versions.

To these, the Obninsk model(10) has been added. Also a set designed for relatively light nuclei by Chadwick (11)may be selected, and the old Gilbert-Cameron model(12) is available.The present default result is that HMS looks to see if the composite nucleus is within two neutrons or protons of the "magic numbers", and if so, self selects Kataria- Ramamurthy level densities, else defaults to Fermi gas densities. If one selects not the grand default (777) at execution, but the options path (333), the user may require any of the level density models to be used as desired independent of proximity to magic numbers.

2 REFERENCES

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