COG11 – AVAILABLE NOW TO CRITICALITY SAFETY PRACTITIONERS

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ABSTRACT

This paper describes new features and capabilities of the COG11 code and future code development activities. COG11 is available from the Radiation Shielding Information Computer Center and Nuclear Energy Agency Data Bank.

Key Words: code, COG, criticality, Monte Carlo, transport

1 INTRODUCTION

COG is a modern, general purpose, high fidelity, multi-particle, Monte Carlo transport code developed at the Lawrence Livermore National Laboratory. A general description of the features and capabilities of the first external release of the COG code – COG version 10, or COG10 – was previously published for ICNC 2007 [1]. A recent paper describes specific COG10 features of interest to criticality safety practitioners [2]. This paper describes new features and capabilities included in the latest version of the COG code – COG version 11, or COG11 – available from the Radiation Shielding Information Computer Center[1] at Oak Ridge National Laboratory and the Organization for Economic Co-operation and Development Nuclear Energy Agency Data Bank[2].

1.1 Machine Requirements

COG11 is available from the Radiation Shielding Information Computer Center and the Nuclear Energy Data Bank for use on personal computers running Windows or Linux operating systems utilizing serial or parallel processing.

At the request of our internal photonics science users and external criticality safety users, additional special, limited distribution, versions have been provided for use on Apple Macintosh personal computers using Intel x86 processors running MAC OS 10.5; Hewlett-Packard machines

[1] http://www-rsicc.ornl.gov/codes/ccc/ccc7/ccc-777.html
[2] http://www.oecd-nea.org/tools/abstract/detail/CCC-0777

with Intel Itanium processors running Redhat Linux 5.5; and personal computers running SuSE 11.2.

COG11, and subsequent versions, may be developed for other hardware-software machine platforms upon request from our users.

1.2 New Code Features

Significant COG11 code features include new nuclear data libraries, interactive graphics, LATTICE geometry, a NOT operator, parallel processing, and user-specified detectors and sources, which were implemented in response to requests from our users.

1.2.1 New Nuclear Data Libraries

In addition to the data libraries previously distributed, COG11 includes the most recent Evaluated Nuclear Data Files, Version 7, Release 0 (ENDF/B-VII.0), from the United States National Nuclear Data Center (NNDC):

ENDFB7R0	point-wise continuous cross-sections
PT.ENDFB7R0.BNL	unresolved resonance region probability tables
T.ENDFB7R0	thermal scattering laws

Supplemental libraries distributed with COG11 include ENDFB6R8, ENDL99, ENDL2008, JEF2.2, JEFF3.1, JEFF3.1.1, and JENDL3.3; as well as MCNP.50c, MCNP.66c, and MCNP.70c originally developed at Los Alamos for use with the MCNP code[3].

1.2.2 Interactive graphics

Interactive graphics allow users to run interactive jobs (in the foreground) and easily modify the graphical display of the problem geometry using a simple command to launch a user-friendly graphical user interface. This feature is useful in developing problems with complex geometry or debugging user geometry errors.

1.2.3 LATTICE feature

The LATTICE feature allows the user to easily specify a regular array of identical units where the unit may have an arbitrarily complex structure. This feature is an extension of the UNIT feature.

1.2.4 NOT operator

The NOT (exclusion) operator may be used to describe a sector as a volume that excludes another specified volume (or volumes) and may be defined explicitly – in terms of its bounding surfaces – or implicitly – in terms of other previously defined sectors.

1.2.5 Parallel processing

To speed up calculations, a message passing interface (MPI) feature allows COG to run in parallel on a multiprocessor machine. Inter-process communications are designed to achieve performance increases that are nearly linear in the number of processors.

1.2.6 User-specified detectors and sources

COG offers the advanced user unusual flexibility in handling complex sources and detectors by providing for arbitrary user-specified detectors and sources. The user writes and compiles his user subroutines into a user library. At run time, COG links in the user routines and passes data to and from these routines via a formal interface. This feature has been used to simulate count distributions as a function of the detector time gate from multiplying systems with spontaneous fission sources with excellent comparison to experimental results [4].

[3] http://mcnp-green.lanl.gov/

1.3 Formal Training

A formal training course [5] has been developed to enable the new user to demonstrate a basic level of competency by completing a variety of hands-on criticality safety calculations. This training, and training in special topics, is available from the authors upon request.

1.4 Future Development

Development versions of the COG11 code have implemented the JENDL-4.0 nuclear data library as well as various "beta" test versions of the Evaluated Nuclear Data Files, Version 7, Release 1[4]. These libraries are currently undergoing testing.

New SOURCE features have been implemented in development versions of the COG11 code to allow the user to specify any number of parent isotopes and a time, or time interval, and COG will automatically calculate the photon source from alpha decay or fission product decay and then perform a standard transport calculation.

State-of-the-art photonuclear nuclear resonance fluorescence (NRF) cross-sections have also been implemented and tested in development versions of COG in support of the MEGa-ray and T-REX projects at Lawrence Livermore National Laboratory [6].

ENDF, Version 7, Release 1 (ENDF/B-VII.1); JENDL-4.0; and NRF libraries; together with the new SOURCE features to simplify specification of photon emission from alpha decay and fission product decay will be included in the next external release of the COG code scheduled for distribution in 2012.

2 CONCLUSIONS

The Nuclear Criticality Safety Division of the Lawrence Livermore National Laboratory maintains COG as "safety software" for use in criticality safety applications. Please visit our website at http://cog.llnl.gov for further details. As criticality safety practitioners, we particularly welcome comments from the criticality safety community. In addition to the authors' personal addresses, we can also be reached by email at cog@llnl.gov.

3 ACKNOWLEDGMENTS

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