TRANSX-2005
New Structure and Features

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- TRANSX-2005 is a translation of TRANSX to Fortran-90/95 style with an extended code-management scheme.
- The new features are a capability to generate multigroup Monte Carlo data files for MCNP and changes to link with the Partisn SN code from Los Alamos

What is TRANSX?

- TRANSX is a code to prepare data for use by SN multigroup transport codes, including Partisn, and MCNP in multigroup mode.
- The data for TRANSX is prepared by the NJOY Nuclear Data Processing code in the MATXS format, which supports multiple input and output particles, detailed reaction cross sections and matrices, and self shielding.
- These data are converted to standard transport tables in several different formats with self-shielding, material mixtures, group collapse, transport corrections, coupled sets, special response function edits, thermal scattering, cell homogenization, and more.
- The MCNP multigroup option transforms the angular representation from the normal SN form to something Monte Carlo can use.

Why Fortran-90/95 Style?

- Using Fortran-90/95 type coding can improve portability, maintainability, and reliability.
- COMMON blocks are eliminated in favor of global variables encapsulated in modules, which provides for strong typing and protects against some of the side effects where changes in one location cause problems elsewhere.
- The complex system of pointers used to provide variable dimensioning in the F77 version is replaced by allocated arrays, which makes the logic much clearer.
- Variable typing using the KIND system is much more portable than the older methods, and the strong typing that can now be used helps to prevent inappropriate combinations of data types.

More on Fortran-90/95

- Using NO IMPLICIT helps to discipline the programmer and helps to catch problems introduced by changes before they can bite you.
- The CCCC-type files used in TRANSX depend heavily on records with mixed character, real, and integer data, which used to be handled by heavy use of “Hollerith” data types. Most of this problem can now be handled with more portable CHARACTER data types.
- The need to have many different system-dependent modifications is greatly reduced or completely eliminated.
- Free format lines, a reduction in the use of line numbers, and extensive use of indented block constructs make the code easier to read.

Portability

- TRANSX has been tested on a wide variety of systems including Sun, linux, Windows PC, and Mac OS X, with compilers from Sun, Absoft, Intel, IBM, Lahey, and GNU.
- Lately, we've been concentrating on g95, because it is free, available for all systems, and works well. The g95 compiler is very strict about Hollerith data and required changes in the codes that were not needed on the other systems. It also requires DEALLOCATE statements when leaving subroutines that other systems don't.

Code Maintenance

- Code maintenance is a very important part of modern QA procedures. The TRANSX system uses its own maintenance code, which is an evolution of the UPD code used in previous TRANSX and NJOY versions.
- UPD keeps a record of changes to TRANSX and its associated codes that enables the user to reconstruct various versions and also documents the changes made. The new UPD also keeps track of the changes to the report and allows them to be tightly coupled to the code changes. The report has to use a simple text format for this purpose, and we use LaTeX.
- This version of UPD allows for free format Fortran lines without update IDs at the ends of the lines.

Maintenance (continued)

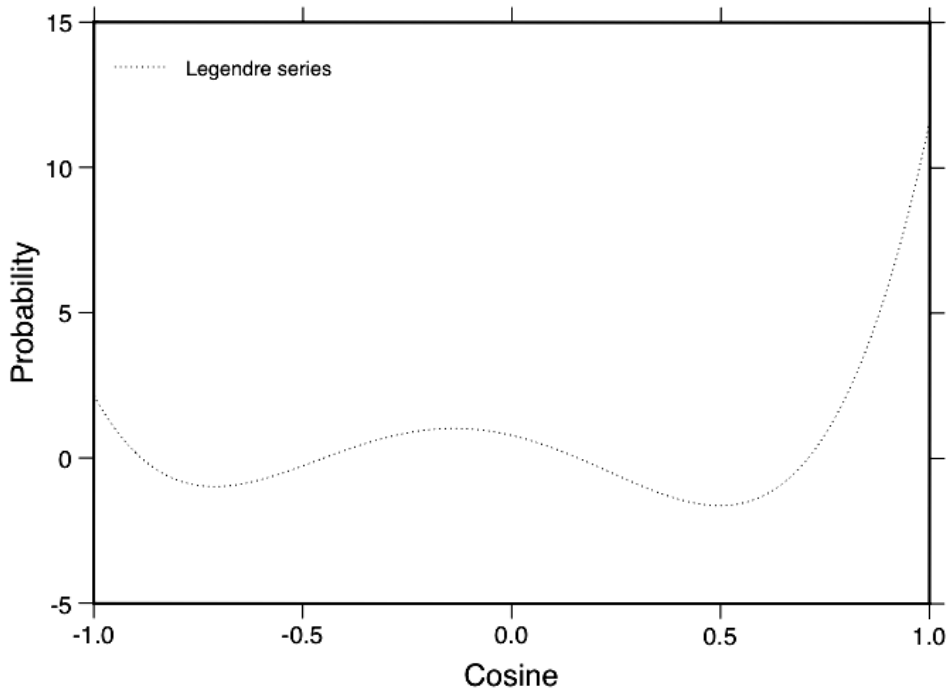
- The user can now make changes directly in the code with an editor and UPD will determine the differences between the new version and the previous one for the updates record.
- The code only touches the files that really change for the efficient use of make type systems.
- A standardized system for defining versions and providing corresponding comments is defined for good QA practices.

Multigroup MCNP

- MCNP is best known as a continuous energy Monte Carlo code with very detailed and faithful data and physics methods. However, it also has a multigroup mode for solving the Boltzmann equation rather than sampling histories stochastically.
- Why use multigroup Monte Carlo when CE Monte Carlo is more accurate? One possible reason is to validate SN calculations with a more detailed geometry without changing cross sections. Another reason is an adjoint capability for determining importance in more complex geometries than SN codes can normally handle.
- TRANSX capabilities such as coupled sets, self shielding, mixtures, and group collapse carry over to Monte Carlo directly. The exceptions are the Legendre representation of scattering, fission and nubar, and the MCNP definition of absorption.

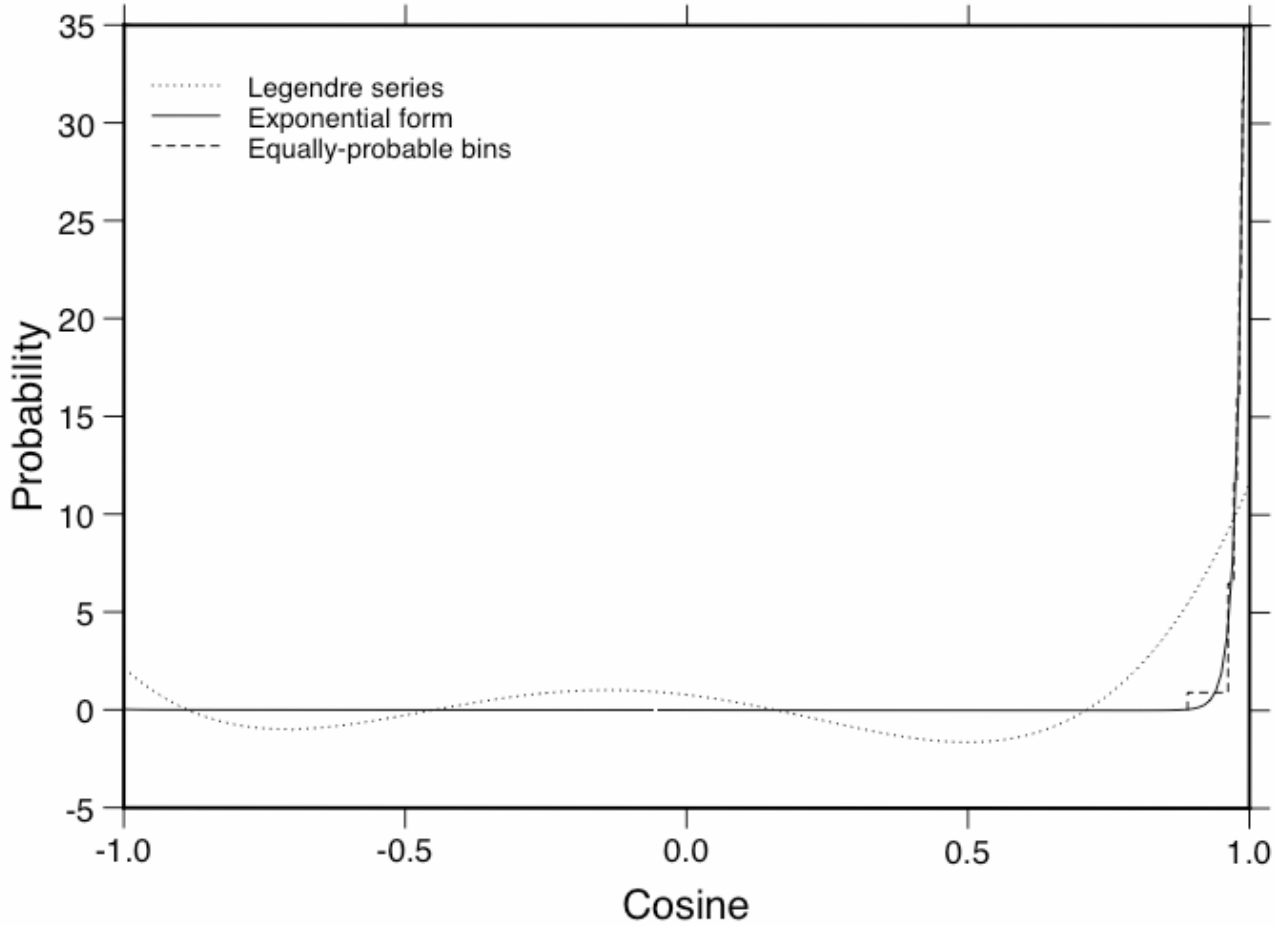
The Scattering Problem

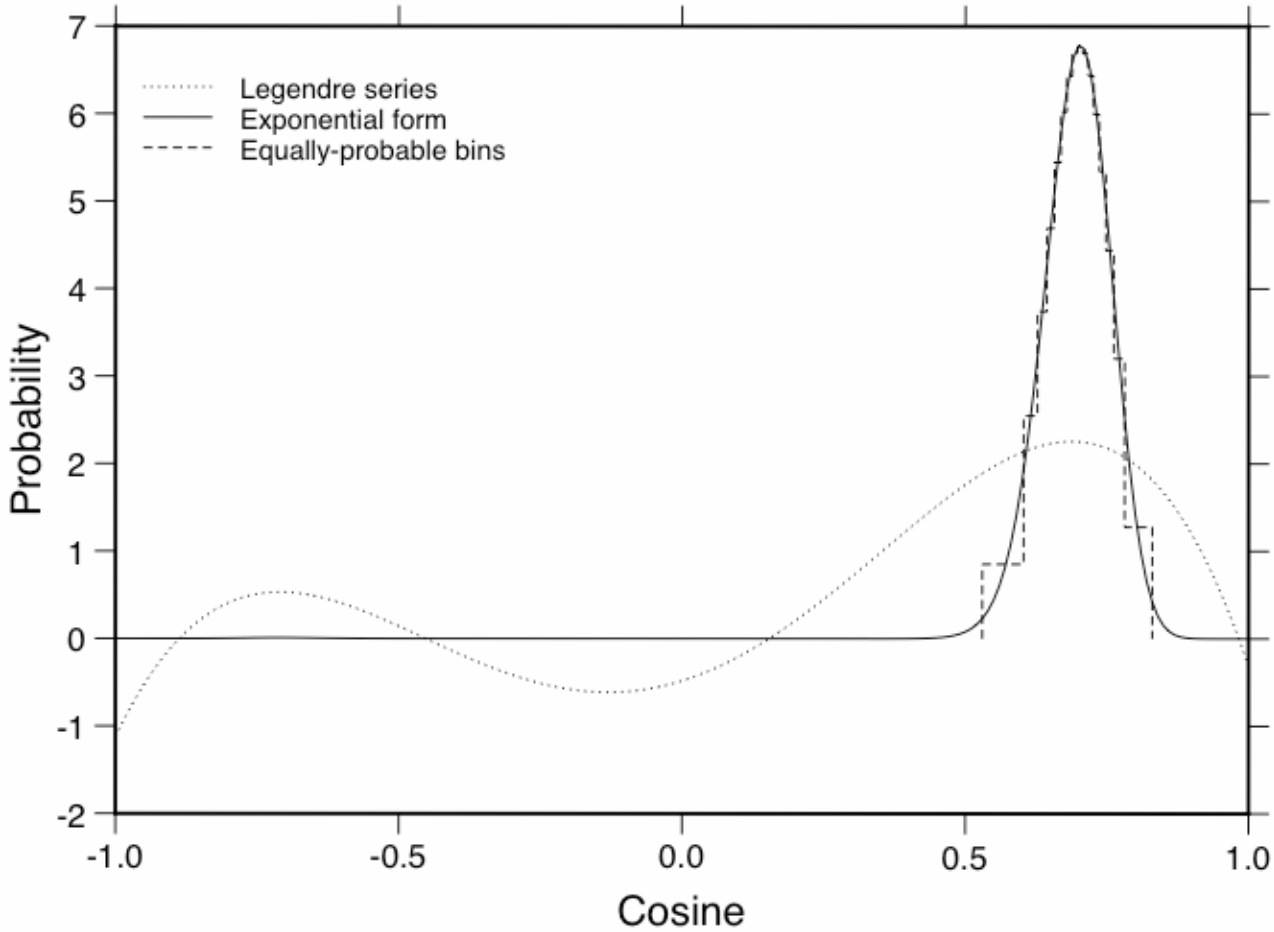
- Reconstructing the angular distribution from Legendre coefficients can lead to negative scattering probabilities.

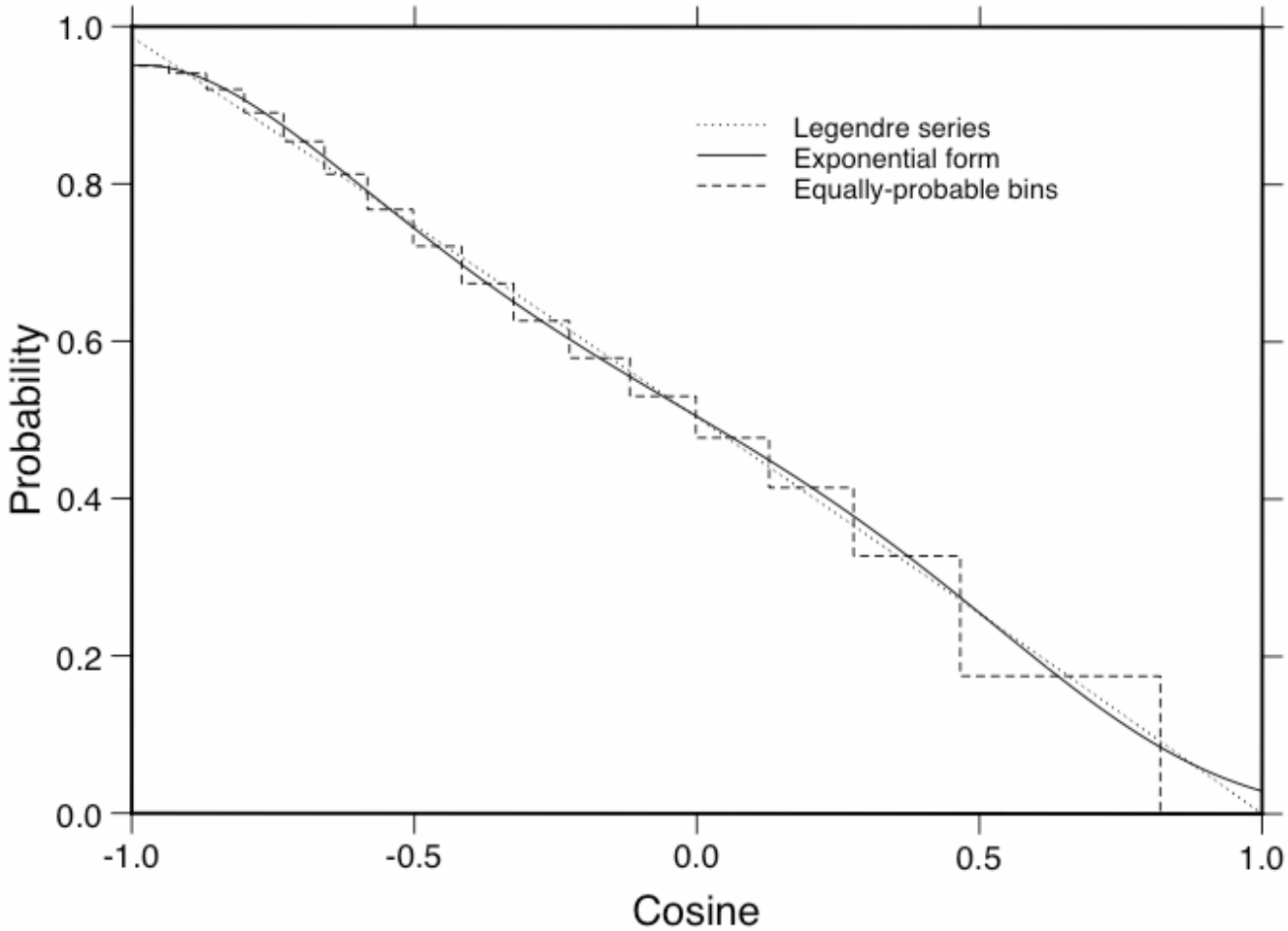


Modified Scattering Representation

- We use a method developed by Randy Baker based on a “maximum entropy” form to find a different angular distribution that is positive definite and has the same Legendre coefficients as the TRANSX table using a non-linear fitting process.
- This distribution is then converted into some number of equally probable cosine bins to satisfy the needs of MCNP.
- This method can handle sharply forward peaked distributions, distributions that scatter to a range of angles, and scattering from heavy targets as shown by the following figures. The heavy targets require a fairly large number of cosine bins for a good representation.

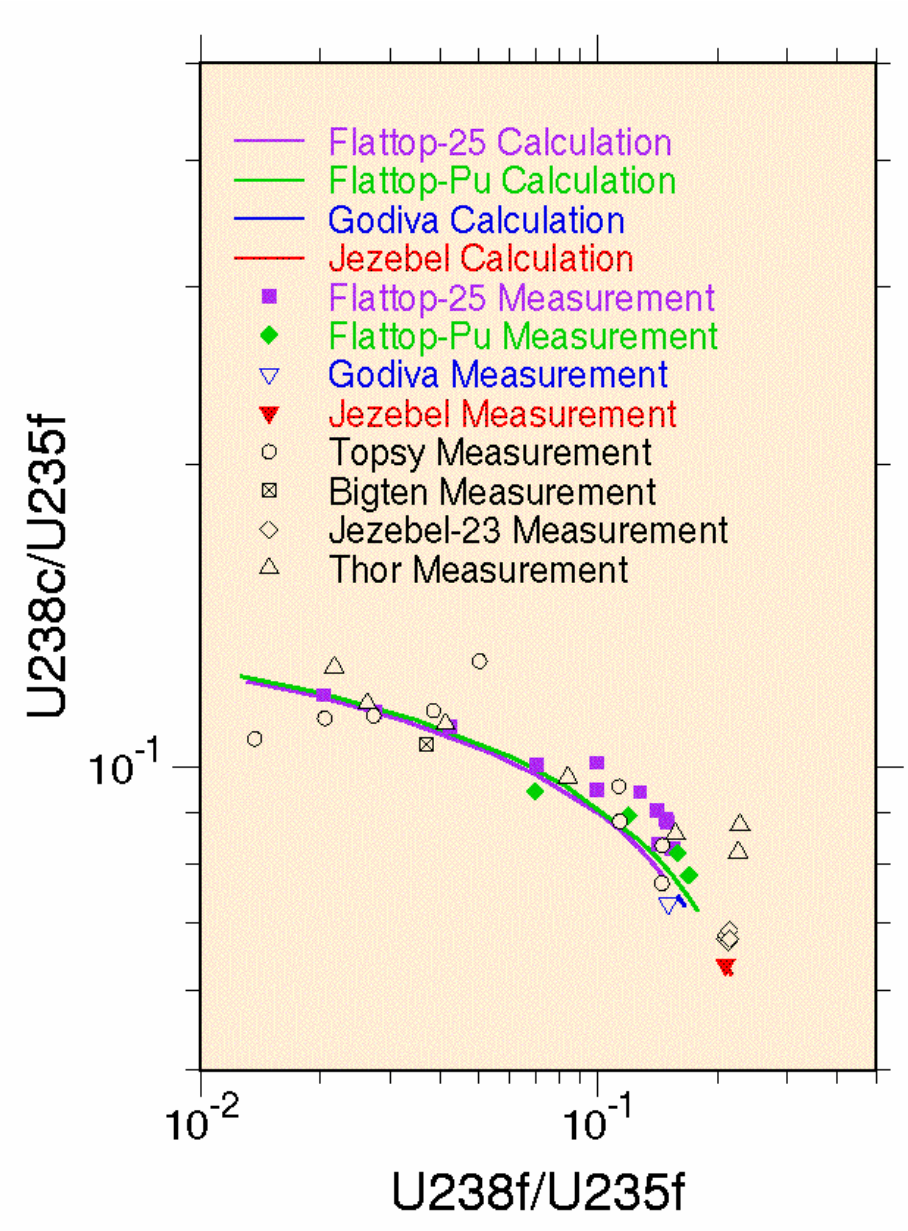

Legendre series
Exponential form
Equally-probable bins
Probability
35
30
25
20
15
10
5
0
-5
-1.0
-0.5
0.0
0.5
1.0
Cosine


Legendre series
Exponential form
Equally-probable bins
Probability
7
6
5
4
3
2
1
0
-1
-2
-1.0
-0.5
0.0
0.5
1.0
Cosine


Legendre series
Exponential form
Equally-probable bins
Probability
Cosine
1.0
0.8
0.6
0.4
0.2
0.0
-1.0
-0.5
0.0
0.5
1.0

Validation

- Another important part of a QA plan is validation. TRANSX has 15 test problems to verify its installation and to act as examples of its use. This new version of TRANSX adds tests problems using the multigroup MCNP method for Godiva and an ORNL solution critical.
- This new version has also been used in a careful study of how close multigroup SN results can be to Monte Carlo results, with the conclusion that the agreement can be good if the multigroup cross sections are prepared with a representative weighting function.
- Multigroup methods are useful when detailed contours are needed. As an example, we show a figure comparing radiological traverses in some fast critical assemblies.


Flattop-25 Calculation
Flattop-Pu Calculation
Godiva Calculation
Jezebel Calculation
Flattop-25 Measurement
Flattop-Pu Measurement
Godiva Measurement
Jezebel Measurement
Topsy Measurement
Bigten Measurement
Jezebel-23 Measurement
Thor Measurement
U238c/U235f
10^{-1}
10^{-2}
10^{-1}
U238f/U235f

Status

TRANSX-2005 is being packaged for release by June