# The National Transport Code Collaboration Module Library

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This paper reports on the progress in developing a library of code modules under the auspices of the National Transport Code Collaboration (NTCC). Code modules are documented software packages with a clearly defined interface. The modules provide a variety of functions, such as implementing numerical physics models; performing ancillary functions such as I/O or graphics; or providing tools for dealing with common issues in scientific programming such as portability of Fortran codes. Researchers in the plasma community submit code modules, and a review procedure is followed to insure adherence to programming and documentation standards. The review process is designed to provide added confidence with regard the use of the modules and to allow users and independent reviews validate the claims of the modules' authors. All modules include source code; clear instructions for compilation of binaries on a variety of target architectures; a driver program to illustrate how the module is used; and test cases with well-documented input and output. All the NTCC modules and ancillary information, such as current standards and documentation are available from the NTCC Module Library Website **http://w3.pppl.gov/NTCC.** The goal of the project is to develop a resource of value to builders of integrated modeling codes and to plasma physics researchers generally. A consequence of the NTCC Module Library is that researchers share their physics packages as modules and the modules can benefit by use in a variety of codes. As modules are extracted from legacy codes and documented, significant advances in the physics content often result. Examples of these advances will be discussed. Previously, because of the nature of fusion legacy codes, and particularly fusion integrated analysis and predictive codes, it has been very difficult to transfer the advances that were developed in one code to another community code. The modules available in the NTCC Module library are aiding in overcoming the difficulty in sharing advances in code development. For example, the Monte Carlo package for computing the neutral beam injection heating of tokamak plasmas, which is a major element in the TRANSP integrated modeling code, is now being installed in the CORSICA and ONE-TWO integrated modeling codes. Also anomalous transport modules such as Multi-Mode used in the BALDUR code and GLF23 developed at General Atomic have now been installed and used in a number of transport codes in the US and in Europe. Currently, there are more than 40 modules in the module library, written in a variety of computer languages. In addition to neutral beam injection and radio frequency heating modules, and anomalous transport modules, there are modules for atomic and nuclear reaction rate data, data analysis and visualization, divertor and edge physics, equilibrium and stability solvers, instabilities, neoclassical transport, neutral gas models, numerical tools and portability tools. In addition, modules that are currently under development will be described.