APOLLO2 : A PHYSICAL ANALYSIS TOOL

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ABSTRACT

The APOLLO2 code was presented for the first time at the M&C Paris meeting in 1987 [1]. Since then, a plethora of new models and computational methods has been added to the code. An updated description of today version has been done in the M&C Madrid conference in 1999 [2].

This first version of the APOLLO2 code had been developed by the Commissariat à l'Energie Atomique (CEA) on its own budget. Since then the French utility Electricité de France and the French reactor constructor Framatome have joined the CEA in the financial support for APOLLO2 software development. Today APOLLO2 is part of various dedicated packages used to analyze different problems in the nuclear industry:

- The Service for Reactor Studies and Applied Mathematics (SERMA) has developed the SAPHYR code system for reactor analysis. This package includes codes for neutronic and thermalhydraulics core calculation, CRONOS2 [3] and FLICA4 [4]. The SAPHYR system is used by the CEA to study all type of reactors, from PWRs to experimental reactors, from spatial power reactor concepts to VVERs, from RBMKs to naval propulsion reactors. Framatome has already integrated APOLLO2 as part of its reactor calculation package SCIENCE [5] and Electricité de France is intending to integrate it in its calculation scheme.
- For fuel-cycle and criticality studies APOLLO2 is also part of both DARWIN [6] and the new French criticality package CRISTAL [7] that has been developed by the CEA and will be used by all the French companies working in this area.

APOLLO2 is the result of an interactive and cooperative effort undertaken by the entire project team. This includes not only the group of developers of the code, but also the scientists that participate to library elaboration, code benchmarking, code analysis, validation, calculation scheme development and to the qualification of the industrial version of the code.

This poster is intended to present the capabilities offered by APOLLO2 as physical analysis tool : fuel physical behavior, absorber efficiency, power shape... All those capabilities are widely helped by the use of the GUI SILENE.

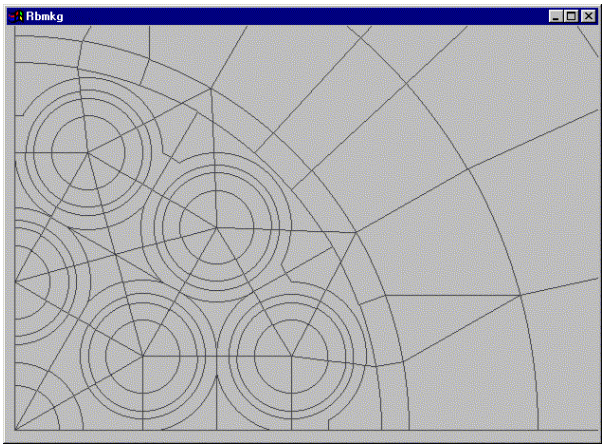
It has been developed to facilitate the description and treatment of more and more complex geometries, especially for those incorporating unstructured meshes [8]. The latest version of SILENE, written in the JAVA language, provides pre treatment for APOLLO2 and the Monte

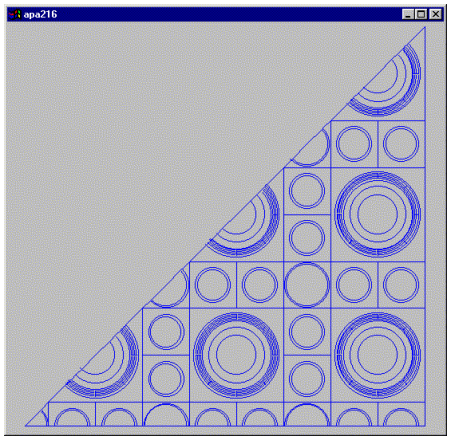
Carlo code TRIPOLI4 [9]. It allows the generation of all kind of APOLLO2 geometries, surfacic or limited combinatory TRIPOLI4 geometries.

To describe the motif a set of nodes are defined, using these nodes, one can define segments, circles, arcs or involutes of circle. Sets of equations forming closed figures define 2D meshes, each equation separating two neighboring meshes. Boundary conditions can be defined for all equations of the external perimeter.

The here following figures shows some samples of the geometries that has been studied with APOLLO2 thanks to SILENE (RBMK assembly and APA concept [10]).

In such reference calculations, the meshing is determined by the user ; for industrial cases, users used to take into account predetermined meshing.





The general purpose, parametrized output library SAPHYB is now be created by APOLLO2. This library contains not only macroscopic and microscopic cross section data resulting from homogenization and collapsing, but also fluxes, kinetic parameters and much more. The data are self-descriptive and have been structured for easy access. The SAPHYB library can be used for end-of-the-line applications such as whole-core CRONOS2 calculations within the SAPHYR package and for PEPIN2 depletion calculations within the DARWIN package.

SILENE already gives the user some limited post treatment functionalities but a new tool is under development to allow easier physical analysis of the lattice computation results stored in this structure.. The user is able to get all kinds of physical values available in the described lattice : concentrations, cross sections, currents, fluxes, spectrum... versus all sorts of parameters such as burn-up, temperatures... This tool will be presented during the conference.

A presentation of all the possibilities of APOLLO2 package (including the GUI SILENE and the post treatment tool), as physical analysis tool will be done during the poster session via pictures and real demonstration on a computer.

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