Adaptive Algorithm for Charged and Uncharged Particle Transport.

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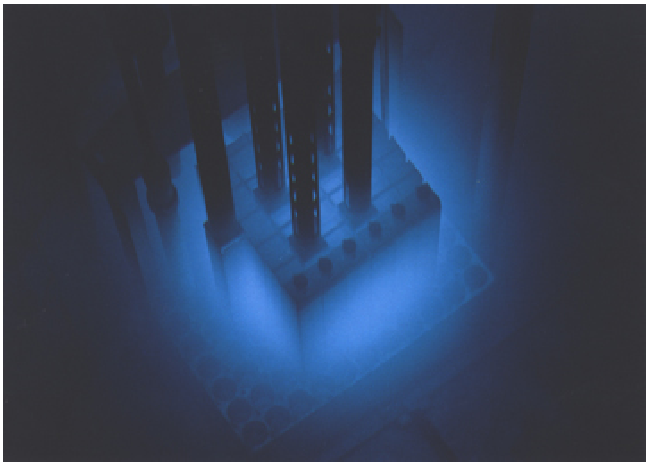
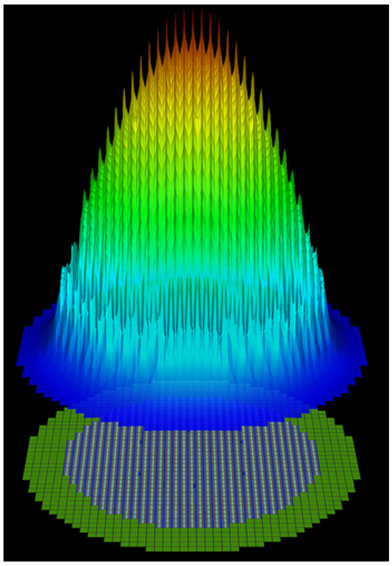
The first part of this project consists of solving the neutron transport equation. This equation tells us how neutrons behave in a absorbing and scattering medium. We can apply this equation in many fields, like in the design process of a nuclear power plant and in the research of materials with neutron beams. In a reactor core it is important to have a uniform burn up of fuel, without letting the temperature rise out of safe limits. The neutrons that are produced when a uranium atom is fissioned can induce such a fission reaction in other uranium atoms. This results in a cascade or chain reaction of fission reactions. The distribution of neutrons in a reactor therefore determines the distribution of heat production in that reactor.

An adaptive algorithm to solve the transport equation is already tested. In this algorithm constant functions were used as basis functions inthe discretization of the neutron flux. A better approximation would be to use linear basis functions, for we expect the convergence to be fourth order with these basis functions.



(a) *Reactor core with uranium that is being fissioned.*



(b) *Numerically computed flux profile of a reactor core.*

Charged particle transport is described by the Boltzmann Fokker Planck equation, which is the neutron transport equation with an extra term added. This term describes a diffusion process in the direction of the particles, or, in other words, the particles have an effect on the direction of travel of other particles. This coupling in the angular domain of the problem results in a system of equation that is more difficult to solve. A way of solving this system efficiently will have to be devised.

$$\mu \frac{d}{dz}\phi(z,\mu) + \sigma_t \phi(z,\mu) = \frac{\alpha}{2}\frac{d}{d\mu}\left[(1-\mu^2)\frac{d}{d\mu}\phi(z,\mu)\right] + \frac{\sigma_s}{2}\int_{-1}^{1}\phi(z,\mu)d\mu + s$$

Boltzmann Fokker Planck equation.