Monte Carlo Methods in Natural Sciences, in Engineering and in Economics

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Coupled CFD - Monte Carlo Transport Simulations for Magnetic Fusion Reactors

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With the first nuclear fusion reactor (ITER, Cadarche, France) currently being under construction, Monte Carlo particle transport simulations (radiation, atoms, molecules) in the plasma near high heat flux wall components of the burning chamber are challenged, because the interaction of these particles with the fusion plasma largely determine and control the macroscopic plasma flow and the response of exposed wall components of the reactor, and vice versa.

Linear multi-species Monte Carlo transport algorithms are integrated, iteratively, into specialised solvers for magnetised plasma flow equations (Navier Stokes type). Whereas each individual Monte Carlo part is fast and fully parallelised, the combined highly non-linear problem (plasma flow plus neutral particle transport) can be extremely CPU demanding, depending on convergence requirements. The current status of the numerical scheme as well as sample applications from the ongoing ITER design computations will be presented.

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