# Modelling of negative ion sources' extraction region

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Negative ion sources have since long been proposed as suitable production means of fast particle beams to be used in ITER as additional heating mechanisms. The numerical simulation of the particle production and extraction mechanisms within these sources is a valuable tool towards their optimisation. A challenging aspect of the problem of producing a realistic consistent model of the external applied fields, extracted particles and plasma boundary has been the large difference between the microscopic characteristic Debye Length and the macroscopic size of the actual geometry. Therefore most of the work has been focussed on describing the extraction region over distances of the order of Debye sheath length, leading to such a small values that any macroscopical description-aimed at describing details over spatial scales of order of $10^{-2}$ m and larger-cannot be grasped using realistic computer resources. A numerical code has been developed ex-novo for this problem. The model has been reduced to one of electrostatics coupled self-consistently to plasma dynamics, in which electric fields are both applied from the outside as well as partly generated by the motion of the charged particles. Non-trivial boundary conditions are supplemented, due to the complicated geometry of sources. The electrostatic problem is solved using a given plasma background. A Monte-Carlo module, using the potential computed in the previous step, produces a map of particle density, which is fed into Poisson equation for a re-evaluation of potential. The whole process may be repeated as long as convergence is reached. The code works well in cases where the plasma density acts as a perturbation over the potential profiles or, equivalently, in the approximation of very strong applied extracting potentials compared to the plasma potential. The geometry used includes values of electrical and magnetic fields similar to those used for the RF Negative Ion Source, under development for the ITER injector. First results include: 1) an assessment of the relative effectiveness of surface production versus volume production for extracting negative ions; 2) a study of the effectiveness of a magnetic filter in confining electrons away from the extraction region.