Development of tracer technology to characterize radial turbulent transport in stellarator geometry using the GENE gyrokinetic code

J. Alcusón[1], J. M. Reynolds-Barredo[1],, R. Sánchez[1] and P. Xantopoulos[2]

[1]Departamento de Física, Universidad Carlos III de Madrid, 28911 Leganés, Madrid, SPAIN

[2]Max-Planck-Institut für Plasmaphysik, Euratom-IPP Association, Greifswald, Germany

A possible way to characterize the nature of turbulent transport in plasmas is by means of tracer particles. Tracers are massless particles advected by the underlying turbulence. From the way tracers spread with time, much can be said about the nature of transport. In particular, one can tell whether transport bears a Fickian character, or if fractional features become important at some point or in some regimes. In the past, similar techniques has been used successfully to characterize transport in the presence of near-marginal conditions or in the presence of strong shear flows in tokamaks. Advecting tracer particles with modern Vlasov gyrokinetic codes is not as simple as it may sound. In order to properly capture the dynamics, tracers must be advected on a timescale of the order of the local turbulent decorrelation time. The most straightforward way would be to include the tracer evolution within the standard advance of the GK code. In most cases this is difficult to do, due to the complexity of the code and the careful internal balance that must be preserved in order to parallelize optimally. It is also highly impractical, since every time a new tracer initialization is required, the whole (very expensive) GK simulation should be done. For that reason, we have created an external parallel code that carries out this task using as input the information of the evolution of the fields read from file. In this contribution, we will present such a code, developed and tested to work with GENE, as well as with other gyrokinetic codes. It admits a general three-dimensional geometry, and allows to select different kind of advection schemes (mere ExB, magnetic drifts and so on). Therefore, it will be a very useful tool to study and characterize the nature of transport not only in regimes of interest for tokamaks, but also in stellarator-related problems. In fact, it is our intention to apply it in the near future to the investigation of the effect of the presence of quasi-symmetries of the confining field on the nature of the underlying transport.