Transport and confinement. What can Stellarators contribute to the new ITER physics basis report?

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The European fusion programme is organised by the EUROfusion Consortium of fusion research institutes, in which most of the work is under a range of mission oriented programmes working towards defined research goals for ITER, the design of a tokamak DEMO, and for stellarator research. The roadmap to a feasible magnetic fusion reactor based on the tokamak line is already established, however alternate concepts are highly desirable. In this scenario, stellarators offer a route to a fusion power plant with distinctive capabilities, such as steady state operation, absence of plasma disruptions and high density operation, for instance. At present, tokamaks can operate in a number of configurations that can be considered standard and are believed will be adopted in a tokamak reactor. Stellarators show greater diversity, but the successful start of the scientific exploitation of Wendelstein 7X is a key step towards bringing the stellarator to maturity as foreseen in the European Union roadmap.

From the perspective of the fusion physics community, the advent of Wendelstein $7X$ and the coming of ITER are a rather remarkable conjunction. With them, our knowledge of the physics of magnetically confined plasmas will be challenged in many different aspects, but it should also be fortified by the diversity of their confinement concepts. We are aware that a comparative approach between stellarators and tokamaks can be fruitful in the process of building our understanding of magnetically confined fusion plasmas. However, the need of highlighting some unique characteristics of one concept or the other often leads us to dwell upon their differences in an rhetorical exercise of exceptionalism. This, clearly, could make us lose the focus on the very reason that motivates our efforts as physicists.

Stellarators have both advantages (e.g. intrinsic steady-state operation and disruption-free operation) and disadvantages (technical complexity) compared with tokamaks. These are technical facts. However, from the perspective of plasma physics, synergies between stellarators and the main-line tokamak seem particularly meaningful, and their differences should be seen as a strength rather than a weakness in addressing fundamental open questions like: are there different paths to reach the L-H transition? Why is there decoupling between particle and energy transport channels at the transition to improved confinement regimes? Why does ion mass affect confinement? What is the role of 3-D effects on transport?

The International Tokamak Physics Activity is in the process of defining what are the key areas and questions that deserve to be considered to produce a new ITER physics basis document. It is perhaps time for the stellarator community to assess its possible contribution to such document, in the collaborative spirit just described above. We want to encourage the participants of the first JPP "Frontiers in Plasma Physics" conference to engage in this assessment for what regards transport and confinement. The time scale for the elaboration of the document will be presented. Some initial suggestions will be given.