

Report from the group on experiments

October 14, 2006

This first operation of an 'ITER-like' fully superconducting Tokamak is an impressive achievement demonstrating the skills of the team in physics and engineering. The rapid development of the facility and team and the prompt completion are remarkable, despite a very tight budget. To strengthen this process further will need over the next 5 years an investment comparable to that in constructing the machine. The EAST team should be commended for an effective collaboration with the world fusion community in the initial operation of the EAST Tokamak. The first plasma in EAST is a milestone in fusion research.

The new machine has unique features which are well suited to answer a number of important issues for ITER operations and developments towards DEMO. The following issues are an integral part of the proposed EAST programme and are strongly supported by IAC:

1) New “physics engineering” aspects

Plasma initiation, ramp up and control with constraints of superconducting coils

Effect of AC losses and disruptions on the superconducting systems

Conditioning of the chamber with the toroidal field on

Profile control in steady-state conditions

2) Investigation of particle inventory with various divertor configurations, graphite walls and development of hydrogen removal techniques

3) Construction of a data base and modelling of transport phenomena in full steady state

4) Development of high performance operation in steady state

In the course of its experimental programme EAST will explore uncharted territory of steady state divertor Tokamak operation and is expected to discover new physics phenomena, as experienced with Tore Supra.

The IAC strongly supports the general focus on long pulse operation with the ultimate goal of steady-state high performance operation. Linking of supporting objectives to the development of auxiliary systems and diagnostics needs further work. To obtain high performance long pulse operation, additional heating and current drive systems are needed, which will require additional resources. In particular neutral beam injection is important for full high performance and diagnostics. With these upgrades, EAST will be a frontline device to develop steady-state high performance discharges in support of ITER and fusion energy. Stronger links among the laboratories focussed on steady-state technology and physics should be established.

IAC made specific remarks on:

Heating systems

The IAC agrees with the proposed phased approach with first priority on Lower Hybrid current drive as the most appropriate tool for steady-state operation followed by Ion Cyclotron and neutral beam heating and current drive. The IAC recommends implementing neutral beam injection as soon as practical. This is a challenging programme which will require adequate resources and extensive collaboration with laboratories experienced in these fields.

Diagnostics judged most important:

In the near term for reliable device operation

Improved magnetic diagnostics for plasma shape and position

control suitable for long pulse operation

Internal instability measurements

Characterisation of divertor operation

Impurity content measurements

For the longer term:

Specific diagnostics for hydrogen inventory/removal studies

Neutral beam based diagnostics, including current profile measurements

Specific measurements for transport studies

Diagnostics for fast particle physics

Closer collaboration on education

The EAST program has placed appropriate high priority on the education of junior staff for the future of both the Chinese fusion program and the support of ITER operation. The development of advanced diagnostics as well as theory and modelling are needed for the long term physics research program and are appropriate areas for student research and for collaboration with international laboratories. In addition, experimental time on EAST for student and post-doctoral research must be provided as part of their educational experience, and EAST management clearly recognizes this need.