IAEA FEC 2014

Contribution ID: **173** Type: **Poster**

Real-Time Control of ELM and Sawtooth Frequencies: Similarities and Differences

Thursday, 16 October 2014 08:30 (4 hours)

ELMs and Sawteeth, located in different parts of the plasma, are similar from a control engineering point of view. Both manifest themselves through quiescent periods interrupted by periodic collapses. For both, large collapses, following long quiescent periods, have detrimental effects while short periods are associated with decreased confinement. It is of interest to implement control systems to maintain the collapse frequency in the desired range. Two control strategies can be considered. In pacing control, exemplified by pellet ELM triggering, the plasma is perturbed periodically at the desired frequency. Continuous control schemes, exemplified by ECRH or ICRH control of sawteeth, modify the underlying plasma parameters which determine the collapse frequency. Both pacing and continuous control techniques have been developed on JET, using pellet and gas injection for ELM frequency control and ICRH for sawtooth control. Avoidance of tungsten accumulation has become a major challenge following the installation of the all metal 'ITER like wall' on JET and sawteeth and ELMs play an important role by expelling tungsten from the core and edge of the plasma respectively. Control of tungsten has therefore been added to divertor heat load reduction, NTM avoidance and helium ash removal as reasons for requiring ELM and sawtooth control. JET experiments have, for the first time, established feedback control of the ELM frequency, via real time variation of the injected gas flow. Using this controller in conjunction with pellet injection allows the ELM frequency to be kept as required despite variations in pellet ELM triggering efficiency. JET Sawtooth control experiments have, for the first time, demonstrated that low field side ICRH, as foreseen for ITER, can shorten sawteeth lengthened by central fast ions. The development of ELM and sawtooth control could be key to achieve stable high performance JET discharges with minimal tungsten content. Integrated control of a range of mutually coupled plasma instabilities and properties, including ELMs and sawteeth will be required in future tokamaks and gaining such experience on current tokamaks is essential.
This work, supported by EURATOM, was carried out in the framework of the European Fusion Development Agreement. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

Paper Number

EX/P5-30

Country or International Organisation

European Commission

Primary author: Mr LENNHOLM, Morten (European Commission)

Co-authors: Dr SIPS, Adrianus (European Commission); Mr GOODYEAR, Alex (CCFE); Dr SOZZI, Carlo (Istituto di Fisica del Plasma CNR, Associazione EURATOM-ENEA); Mr GRIST, David (CCFE); Dr FRIGIONE, Domenico (ENEA); Dr DE LA LUNA, Elena (CIEMAT); Dr LERCHE, Ernesto (KMS/ERM Belgium); Dr RIMINI,

Fernanda G. (CCFE); Mr SHEIKH, Haroon (CCFE); Dr CHAPMAN, Ian (CCFE); Mr MONAKHOV, Igor (CCFE); Mr CARVALHO, Ivo S. (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico); EFDA CONTRIBUTORS, JET (JET); Mr MORRIS, James (CCFE); Dr GRAVES, Jonathan (CRPP - EPFL); Dr GARZOTTI, Luca (CCFE); Dr GONICHE, Marc (CEA, IRFM, F-13108 St-Paul-Lez-Durance, France); Dr NAVE, Maria Filomena (Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico); Dr REICH, Matthias (Max-Planck-Institut fűr Plasmaphysik); Dr TSALAS, Maximos (FOM DIFFER); Mr BEAUMONT, Perry S. (CCFE); Dr LANG, Peter (Max-Planck-Institut fűr Plasmaphysik); Dr DUMONT, Remi (CEA, IRFM, F-13108 St-Paul-Lez-Durance, France); Mr FELTON, Robert (CCFE); Mr MOONEY, Robin (CCFE); Mr JACHMICH, Stefan (KMS/ERM Belgium); Dr JOHNSON, Thomas (KTH Kungliga Tekniska Högskolan); Mr BLACKMAN, Trevor (CCFE)

Presenter: Mr LENNHOLM, Morten (European Commission)

Session Classification: Poster 5