PROGRESS OF HL-2A EXPERIMENT AND HL-2M PROGRAM
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ABSTRACT

During the recent two years after the last IAEA FEC conference, HL-2A has made significant progress in the high parameter related research areas, such as a high βn scenario with DT/E. Statistical analysis has shown that there is a critical velocity shear value for the L-H transition. The ELM control with RMP has been both achieved in HL-2A. Besides, the impurity seeding with different external actuators has been successfully used to modify the plasma confinement and instabilities as well as the plasma disruption with the aid of the disruption prediction on HL-2A. In addition, the turbulent transport result from a wide range of phenomenon such as the energetic particles and the magnetic island has been investigated. Finally, the status about the completion and the first plasma discharge of the new tokamak HL-2M with the plasma current of the megamperes level are presented.

EFFECT OF SMBI ON L-H TRANSITION

- Mechanism of SMBI on L-H transition is demonstrated.
  - Two dynamic processes:
    - GAM intensity increases with the turbulence intensity owing to SMBI.
    - Interaction between GAM and turbulence indicates that the turbulence is suppressed by GAM.
    - Neoviscous regulation dynamics between the turbulence and shear flow is externally enhanced by SMBI. The enhancement plays a key role in facilitating the L-H transition.

IMPURITY TRANSPORT & TEMPERATURE SCREENING EFFECT

- The evidence of impurity mode-induced transport such as impurity density peaking factor (FP) are observed in argon-ionization experiment for the first time.
- Theory predicted ITG screening effects on the transport are evidenced in the experiment.
- The increment of \( R_{\parallel} \) plays a key role in the decrement of FP and sustainment of slightly hollow profile of impurity ions.

INFLUENCE OF LARGE MAGNETIC ISLAND

- The influence of the rotating a > 0.5 magnetic islands on MHD stability is investigated.
- Both the QCM (105-175 kHz) and broadband turbulence (10-175 kHz and 175-390 kHz) inside the island are significantly enhanced by the Doppler effect in comparison with that of the stable configuration.
- The QCM magnitude increases with the island size.

EDGE VELOCITY SHEAR FOR L-H TRANSITION

- Velocity shear increases before the L and L-H transitions. Significant decrease of turbulence and increase of density gradient were observed at the L-H transition, mainly due to the pressure gradient term.
- L-H transition occurs only when the velocity shear exceeded some threshold, which is independent of the plasma density.

DISRUPTION MITIGATION & PREDICTION

- With LIO system, the avoidance of runaway current generation following disruptions has been successfully achieved.
- Disruption prediction algorithms developed based on deep learning.
- Accuracy: 98% by associated first principles neural network (FNN) and long short-term memory (LSTM) neural network.
- Disruption alarms: 30 ms before current quench.

OTHER FUSION RESEARCH ACTIVITIES AT SWIP

- Fusion reactor design
- Fusion technology relevant activities
- Fusion reactor materials
- R&D of key components (advanced divertor...)
- R&D of ITER Procurement Packages at SWIP
- Helium-cooled solid breeder and blanket module (TBM)
- First Wall & Discharging Blanket
- Gas Killer and Discharge Cleaning System
- Magnet Support
- Neutron Flux Monitoring
- Langmuir Probe

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