



## Research Highlight Summary

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# Research Highlights from 2002 Campaign

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- Transport Science
  - Nonlinear Gyrokinetic Analysis of critical gradients for ITG compared to C-Mod experimental results
  - Measurement of time evolution of rotation profiles indicating inward transport of momentum following L-H transition; changes in rotation in ITB discharges
  - Non-dimensional identity Pedestal experiments in collaboration with DIII-D and JET, AUG (also threshold comparison)
- Divertor and Plasma Boundary Science
  - Visualization of SOL turbulence and qualitative correlation with code simulations
  - Measurement of upper divertor pressures adequate for pumping in unbalanced DN equilibria with  $SSEP \leq 5 \text{ mm}$
  - Relation of density limit to cross-field transport and turbulence
  - New inner wall measurements show turbulence and transport suppressed on field lines not connected to outer SOL
  - Shown that gas leakage from the divertor is a *minor* contributor to neutral density in the main chamber

- RF (Wave Particle) Science
  - Observation and Identification of mode converted ICW
  - Successful modification of four-strap antenna to eliminate  $E \parallel B$  arcing, increasing voltage stand-off to 25kV at 78MHz
  - Implementation of efficient serial and parallel computational techniques in full-wave ICRF code TORIC
  
- Global Stability Science
  - Successful Installation and Initial Operation of Active MHD Spectroscopy Antenna
  - Observation and analysis (peeling-ballooning) of “grassy” ELM activity in high power H-mode pedestals
  - Modification of disruption halo current behavior by new divertor geometry, and confirmation of finite element model of wall distortion
  - Observation of locked mode phenomena and design of non-axisymmetric control coils

- Advanced Tokamak Research Thrust
  - Demonstration of control of ITB by on-axis ICRF heating, including those formed in ohmic H-modes
  - Integrated Modeling of AT Scenarios, including time-dependent evolution
  - Gyrokinetic modeling of transport in ITB discharges
  - Expanded field and current range of ITB's, scaling of barrier location
- Burning Plasma Support Thrust
  - Increase of operating current to 1.7 MA at 7.8 T
  - Extension of Edge Relaxation studies to higher (and lower) triangularity, and cross-machine investigations of pedestals and EDA-like phenomena
- Facilities
  - Installation and successful operation of new inner divertor
  - Modification to cryostat and cylinder to improve diagnostic access, maintainability, increase shot rate
  - Near completion of Lower Hybrid fabrication project
  - Successful implementation of DNB-based diagnostics (MSE, CXRS, BES)
  - Improvements to diagnostic systems (TS, high-speed cameras, HIREX, high resolution ECE . . . )

## Research Highlights over 1998-2001

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- Transport Science
  - Characterization of L/H threshold as critical  $T_e(B)$ .
  - Physics-based studies of H-mode threshold in terms of local quantities, semi-quantitative correlation with non-linear gyrofluid simulations
  - Observation of strong core rotation with no external torque
  - Identification of the role of the QC mode in EDA H-mode, and evolving theory/modeling to account for these observations
  - Characterization of pedestal parameters and mapping of the ELMfree-EDA boundary in terms of shaping and  $q$

- Divertor and Boundary Science
  - Importance of “Midplane Recycling”, cross-field transport in the SOL, and correlation with bursty transport events
  - Dissipative/radiative divertor operation compatible with  $Z_{eff} \leq 1.6$ , H-mode, reducing divertor heat loads at  $p_{\parallel} \sim 0.5 \text{ GW/m}^2$
  - Measurements of volume recombination and ion loss to divertor plates in detached divertor plasmas
  - Divertor bypass experiments on the effects of divertor neutral leakage on fuel and impurity compression
  - Detailed measurements of impurity sources, transport, and sinks (lifecycle) for high and low-Z impurities
  - Observation of edge turbulence modification as density limit is approached
- RF (Wave Particle) Science
  - Demonstration of efficient heating in D-He<sup>3</sup> plasmas at 8 tesla
  - Development and exploitation of Modeling and Simulation codes for ICRF (TORIC) and Lower Hybrid (ACCOMME)
  - Mode conversion heating experiments and analysis including observations of localized heating, direct observation of mode converted waves, and computational modeling consistent with observations

- Global Stability (MHD) Science
  - Observation and analysis of pedestal stability, including second-stable access to ballooning, observation of magnetic component of the QC mode, and transition to grassy ELM regime
  - Measurement and scaling of halo currents during VDE disruptions, and demonstration of neutral point effect to inhibit VDE and mitigation by use of killer pellets
  - Observation of  $\beta$ -limiting tearing mode activity
  - Observation and identification of Mercier mode in reversed shear plasma
  - Measurement of induced magnetic wall torque implicating static fields in mode breaking

- Advanced Tokamak Research Thrust
  - Discovery of ITB formation by off-axis (high and low-field side) ICRF, and spontaneous ITB generation in ohmic EDA H-mode discharges
  - Demonstration of long pulse operation  $t \gtrsim 2L/R$  at 5T
- Burning Plasma Support Thrust
  - Extension of H-mode threshold database to high B, n, P/A, resulting in significant modification of predicted power requirement for ITER, etc.
  - Constraints on H-mode Confinement Database, with significant impact on ITER scaling, projections
  - Demonstration of suitability of high-Z PFC's, vertical plate divertor geometry for high power operation
  - Identification of EDA H-mode as a benign edge relaxation mechanism