

Thermal Diffusivities in DIII-D Show Evidence of Critical Gradients

**by
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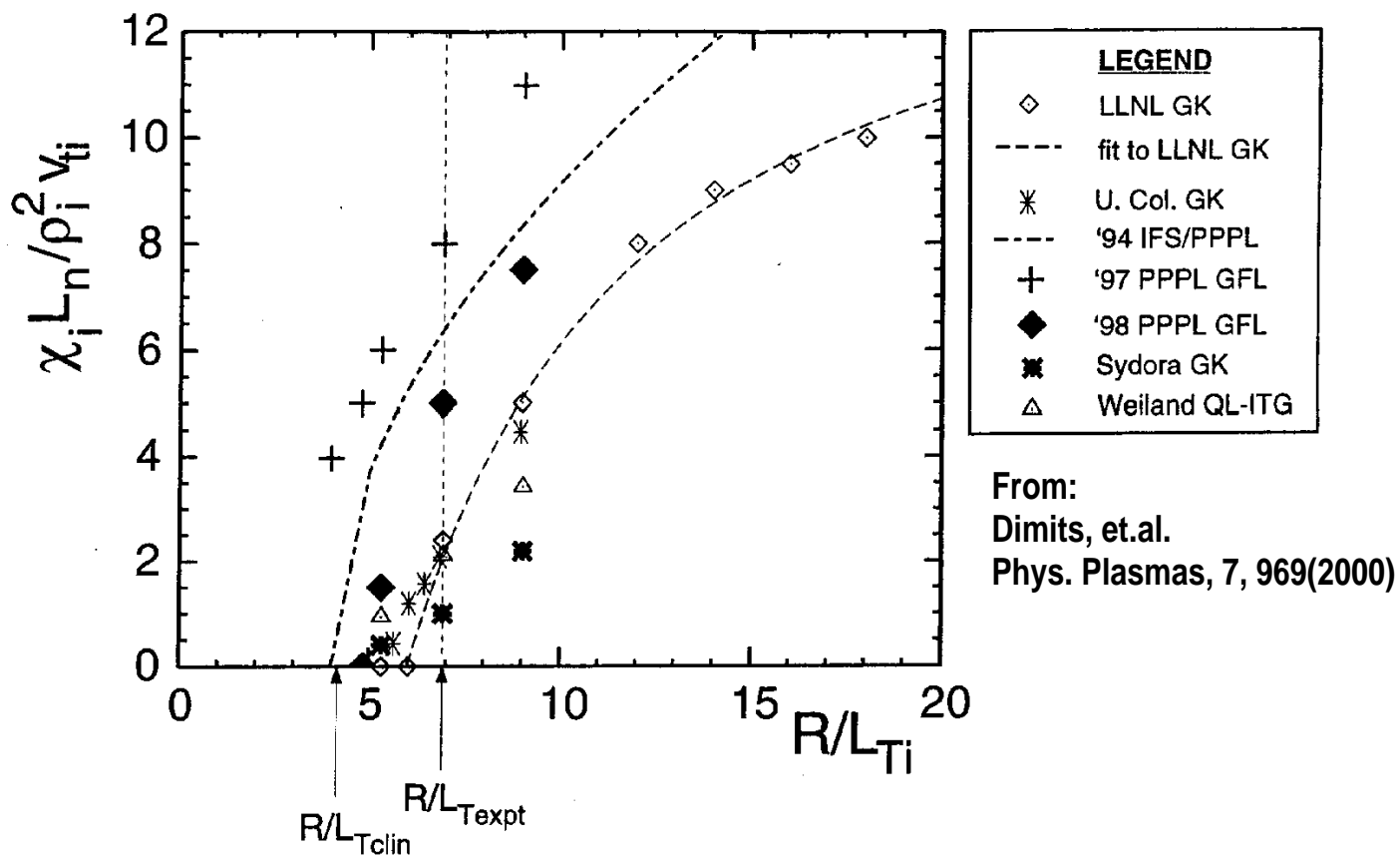
***Lawrence Livermore National Laboratory**

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TRANSPORT MODELING PREDICTS A DISCONTINUITY IN χ_i AT R/L_{Ti} OF ABOUT 6



● $R/L_{Ti} \equiv R \frac{\nabla T_i}{T_i}$

SIMPLE RELATIONS FOR TURBULENT TRANSPORT COEFFICIENTS

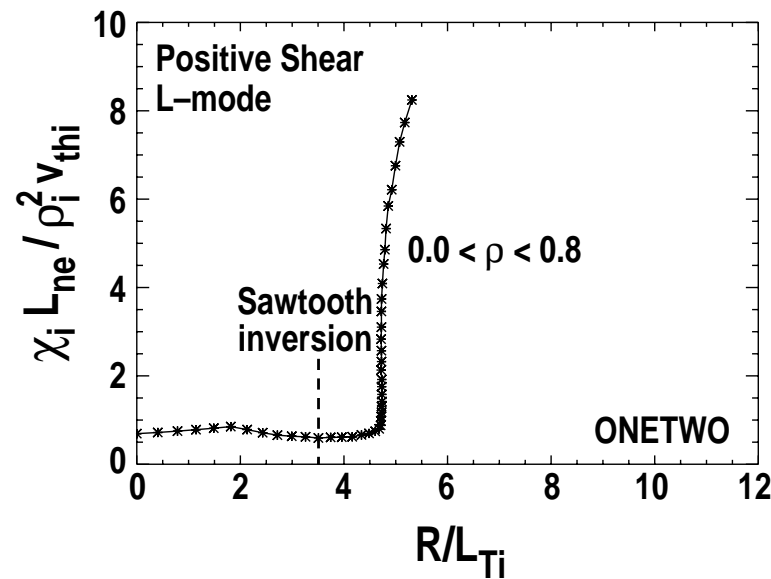
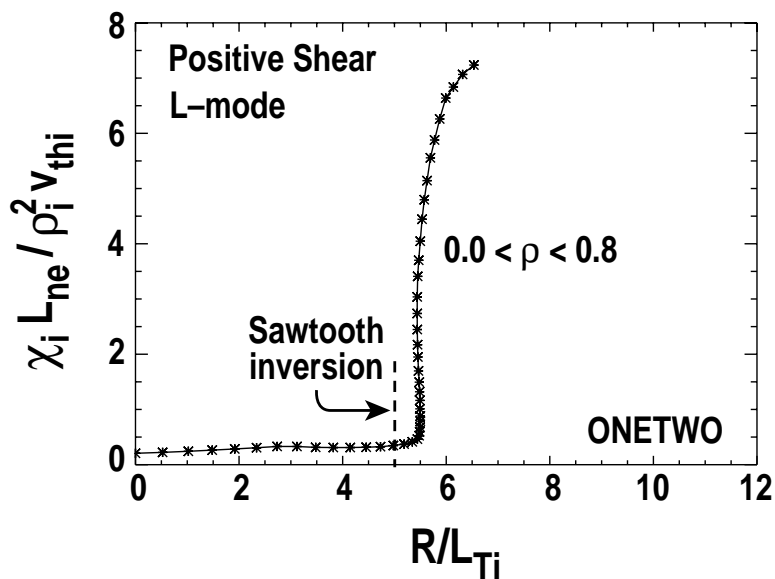
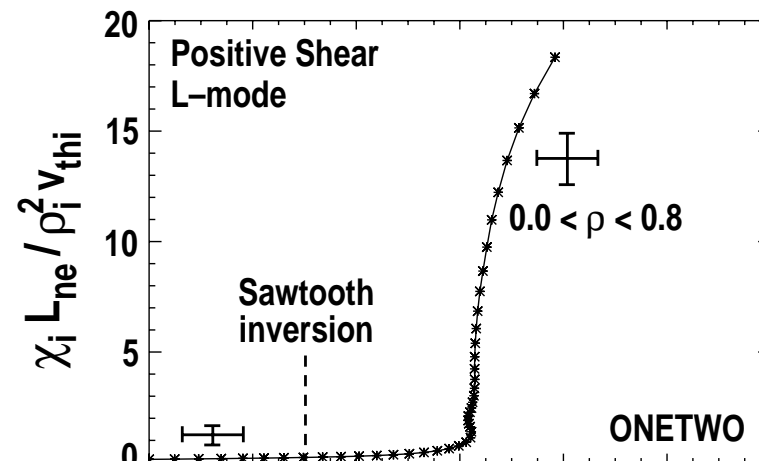
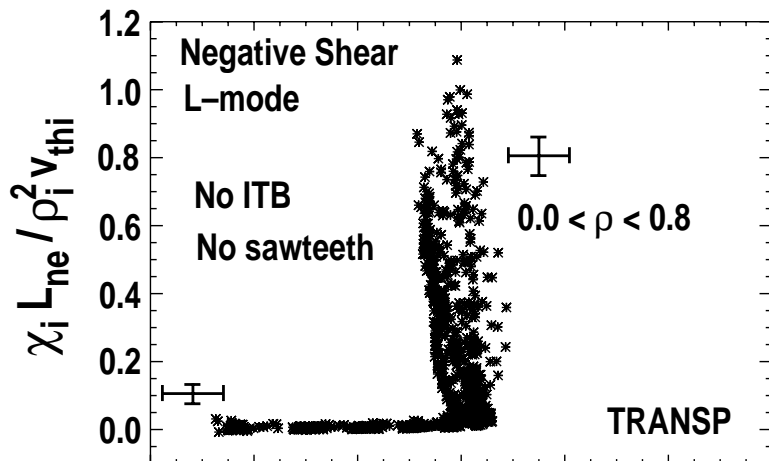
- $\chi_{i,e}^{ITG} \propto H(R/L_{T_i} - R/L_{T_i \text{ crit}})$

A.M. Dimits, G. Bateman, M.A. Beer, B.I. Cohen, W. Dorland, G.W. Hammett, C. Kim, J.E. Kinsey, M. Kotchenreuther, A.H. Kritz, L.L. Lao, J. Mandrekas, W.M. Nevins, S.E. Parker, A.J. Redd, D.E. Shumaker, R. Sydora, J. Weiland, Phys. Plasmas 7, 969 (2000)

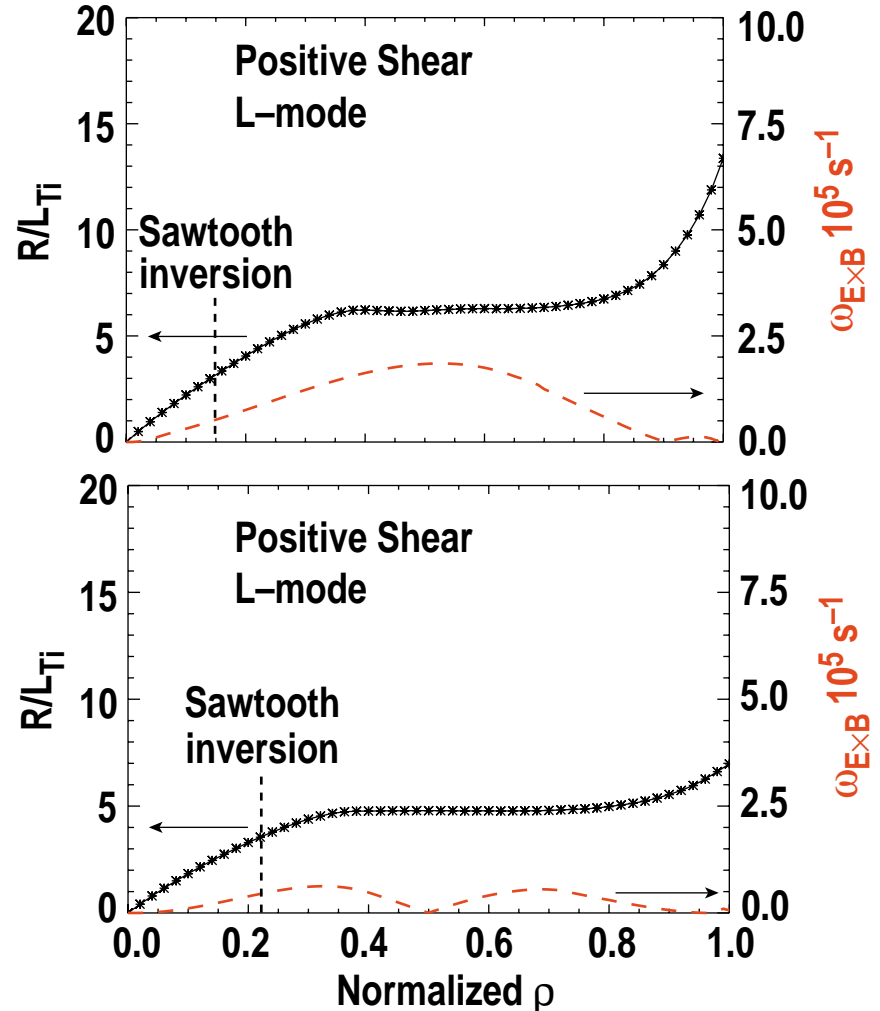
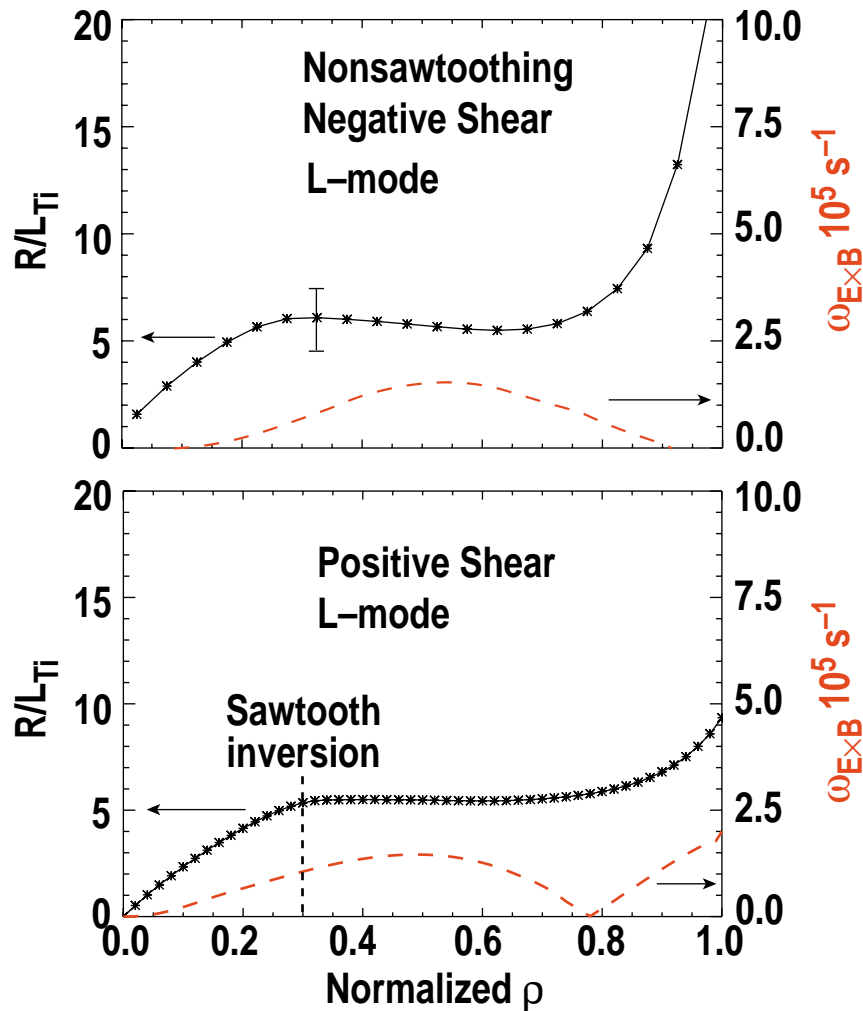
- $\chi_e^{ETG} \propto (a/L_{T_e} - 2/3 a/L_{n_e} - 1.6) H(a/L_{T_e} - 2/3 a/L_{n_e} - 1.6)$

G.M. Staebler, Nucl. Fusion 39, 815 (1999)

DIII-D χ_i SHOWS CRITICAL GRADIENT BEHAVIOR

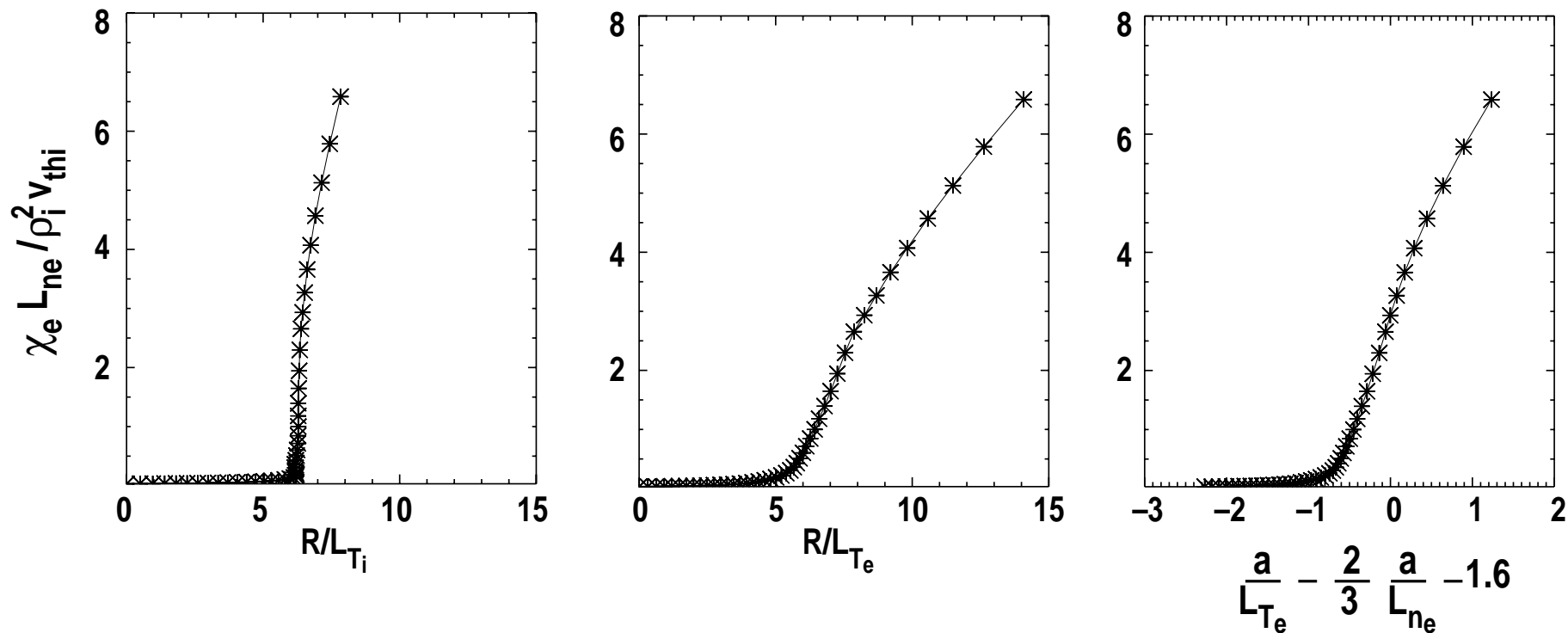


R/L_{Ti} IS APPROXIMATELY CONSTANT OVER A LARGE REGION OF THE PLASMA



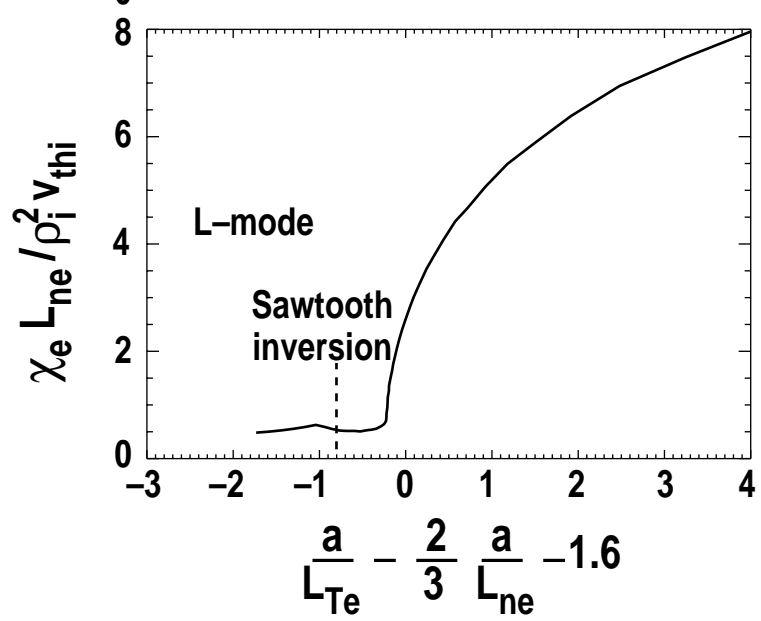
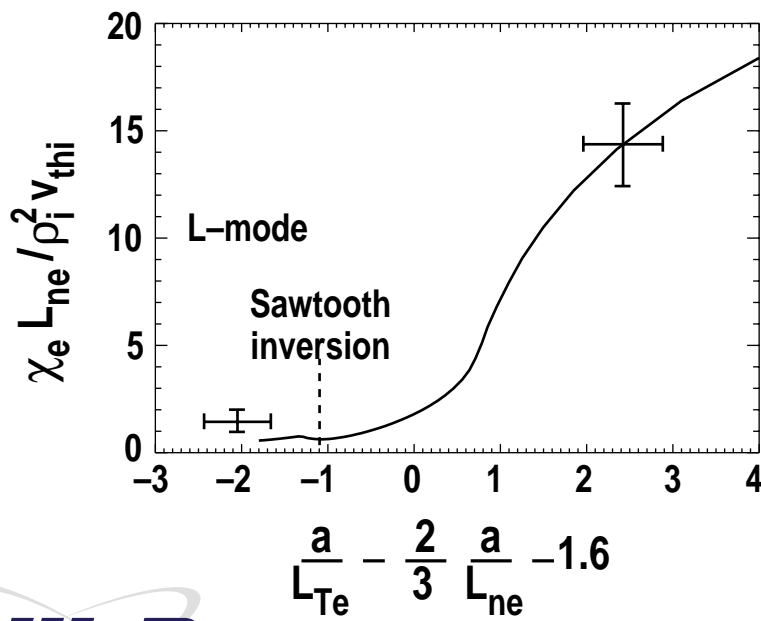
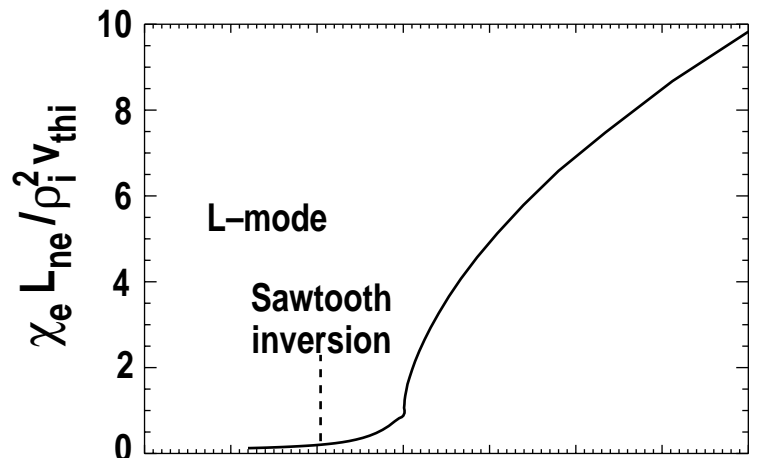
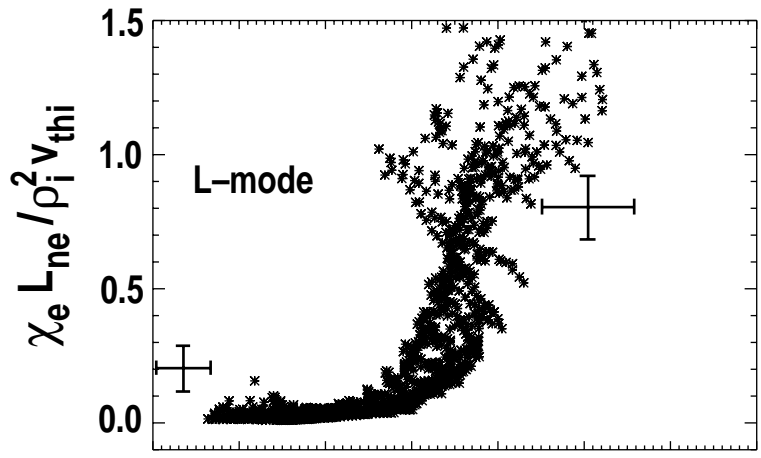
FIRST CONSIDER L-MODE PLASMAS

DIII-D χ_e SHOWS CRITICAL GRADIENT



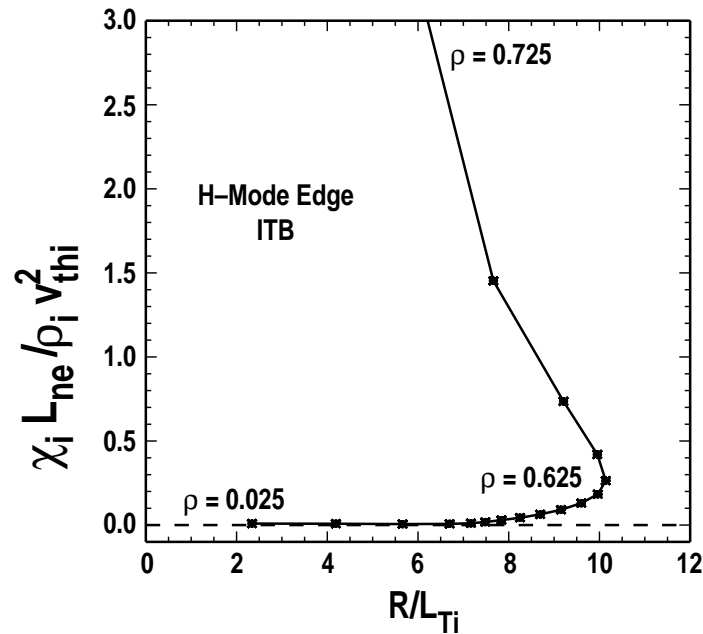
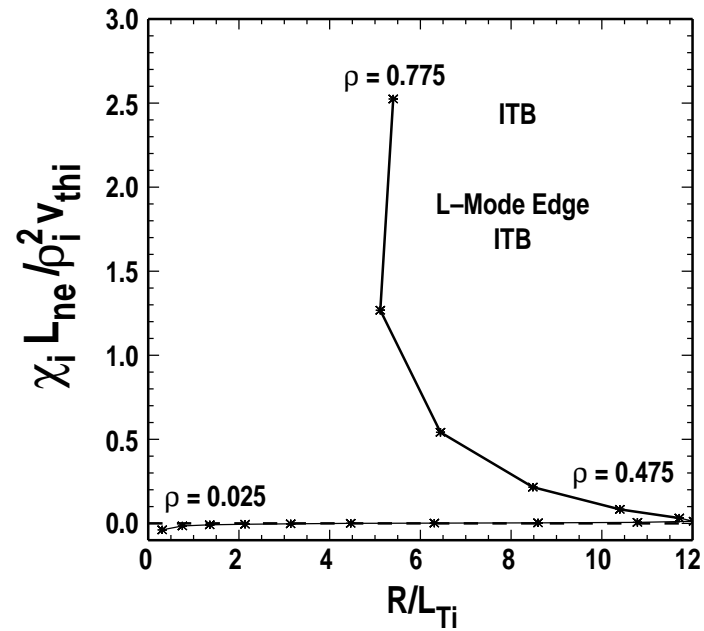
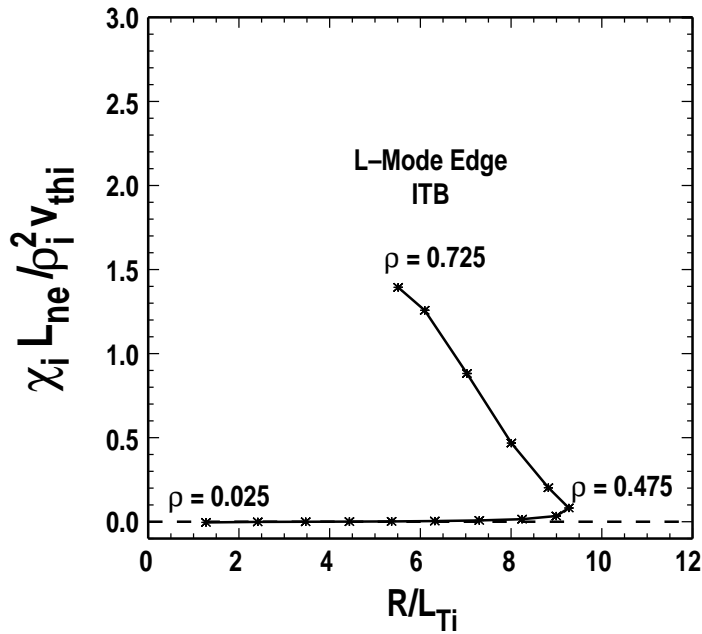
- L-mode, no ITB, $0.0 < \rho < 0.9$
- It is not possible to distinguish if critical gradient is related to ITG or ETG turbulence
- Similar results reported on ASDEX Upgrade and Tore Supra

ONETWO AND TRANSP TRANSPORT ANALYSIS — χ_e PLOTTED VERSUS $(a/L_{Te} - 2/3 a/L_{Te} - 1.6)$



NOW CONSIDER PLASMAS WITH INTERNAL TRANSPORT BARRIERS

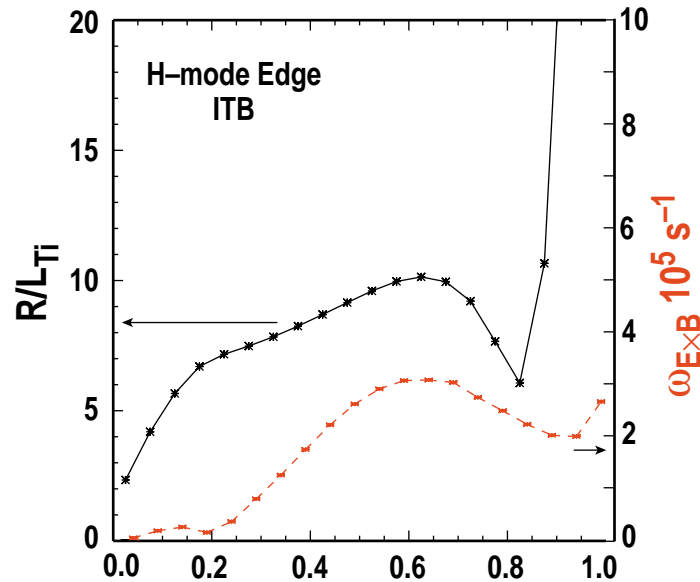
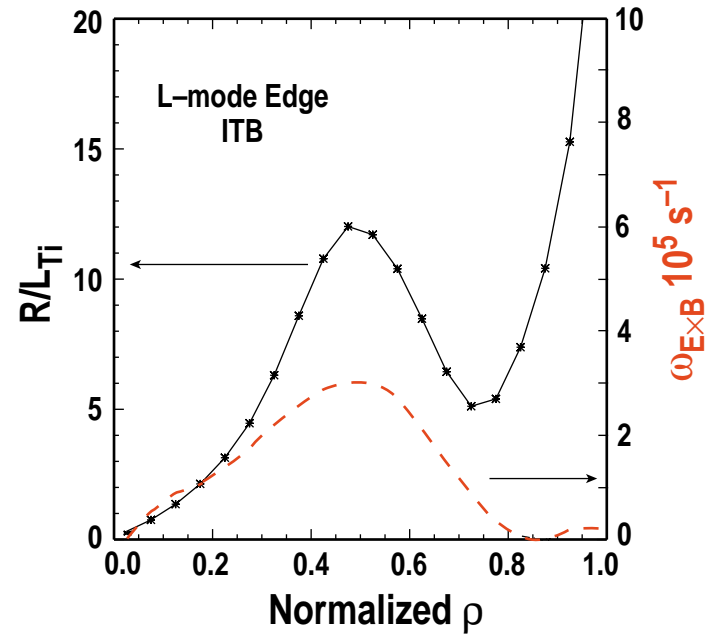
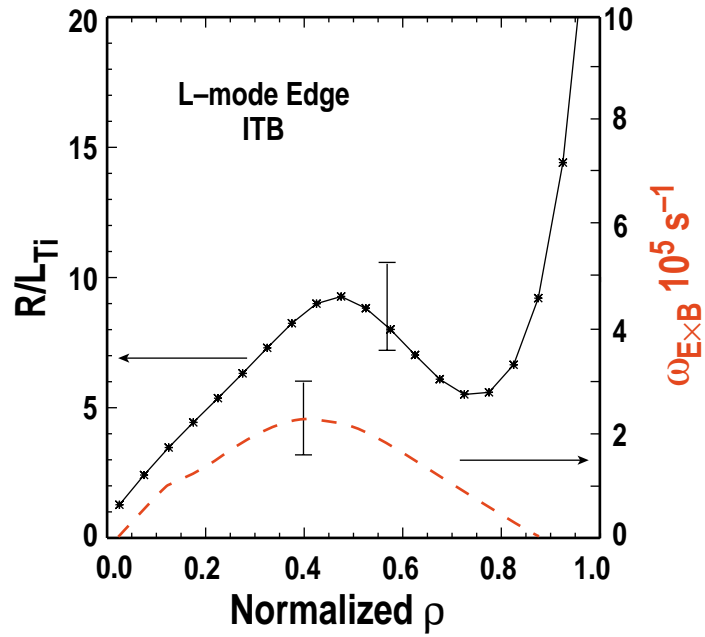
WITH ITB, $R/L_{Ti} > R/L_{Ti} \text{ CRIT}$



- Quantitative measure of ITB existence

If $R/L_{Ti} > 6$
then there is an ITB

WITH ITB, $\omega_{E \times B}$ IS RELATED TO R/L_{Ti}



SUMMARY

- DIII-D L-mode plasmas show clear evidence of critical gradient in ion and electron temperatures
- DIII-D plasmas with ITBs show relation between R/L_{T_i} and $\omega_{E \times B}$
- Quantitatively identify existence of ITB by $R/L_{T_i} > R/L_{T_i \text{ L-mode}} \equiv R/L_{T_i \text{ crit}}$
(G. Tresset, X. Litaudon, D. Moreau, EUR-CEA-FC-17000)
- Similar results are reported on ASDEX Upgrade and Tore Supra

[Hoang, et al., and Ryter, et al., Proc. of 18th IAEA Fusion Energy Conf., Sorrento, Italy, 2000 (International Atomic Energy Agency, Vienna) to be published.]