Increased ECCD Efficiency with Higher Beta in DIII–D

by
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CompX

GENERAL ATOMICS

244–01/CCP/wj

FEATURES OF ECH PROGRAM ON DIII–D TOKAMAK

- Electron cyclotron current drive (ECCD) experiments seek to validate a predictive model of ECCD

- Experimental program uses electron cyclotron waves to
  - Probe transport properties (e.g., heat pulse propagation)
  - Control instabilities (e.g., neoclassical tearing modes)
  - Modify current profile (e.g., advanced tokamaks)

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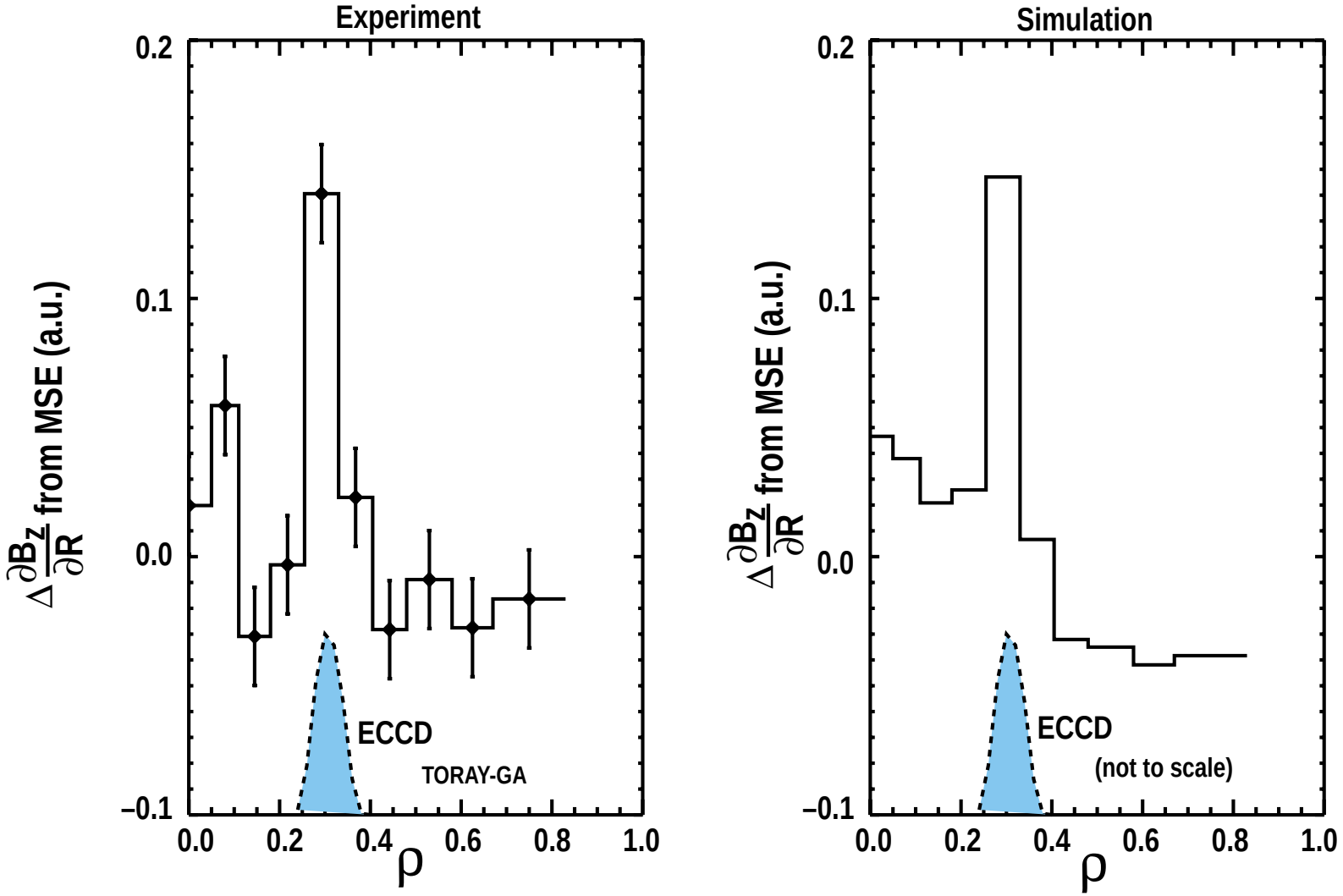
ECCD LOCATION AND MAGNITUDE DETERMINED BY COMPARING MEASURED CHANGES IN MSE SIGNALS WITH ECCD SIMULATIONS



- MSE measures radial profile of B_z

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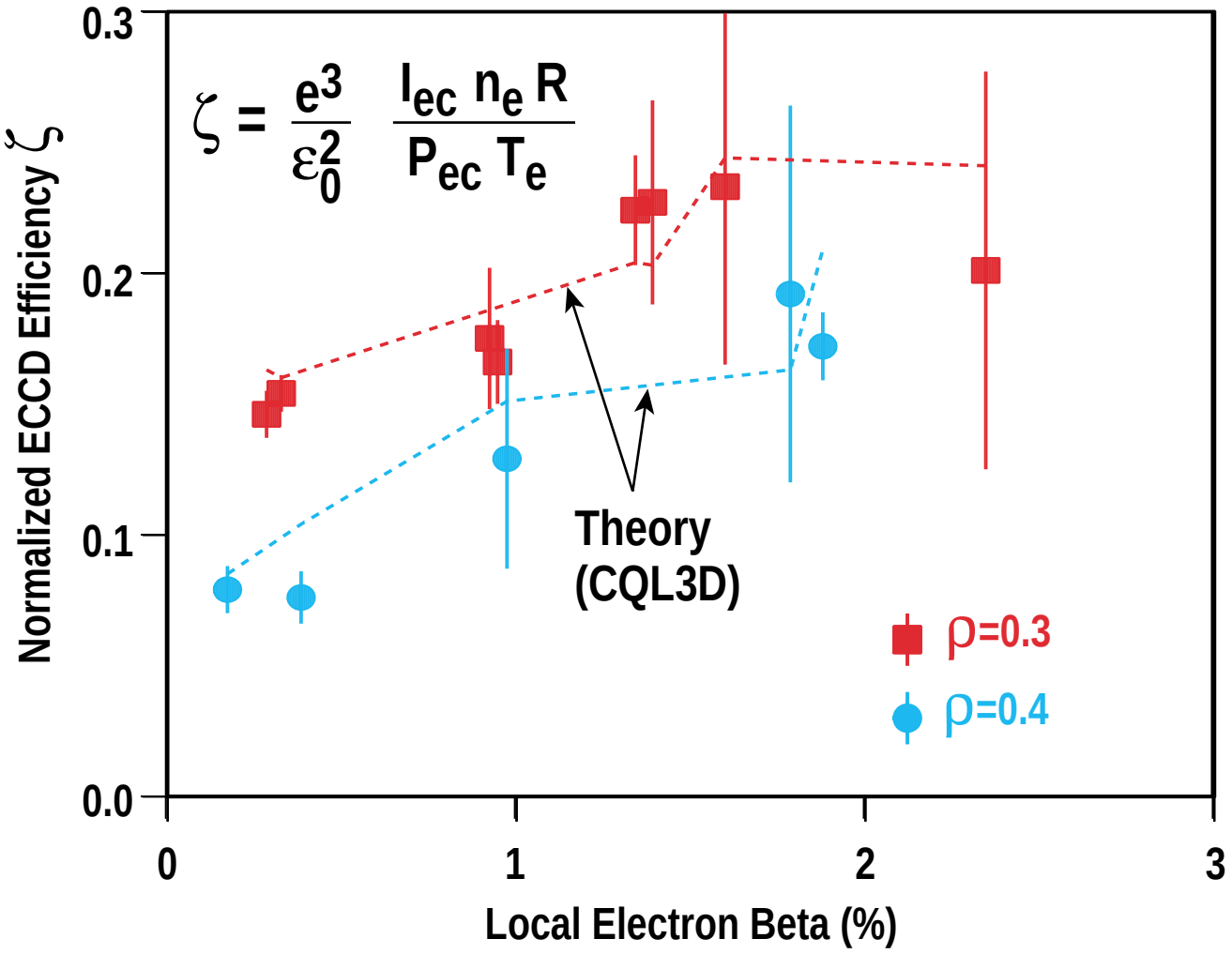
MEASURED OFF-AXIS ECCD EFFICIENCY INCREASES WITH ELECTRON BETA, INDICATING REDUCED TRAPPING EFFECTS



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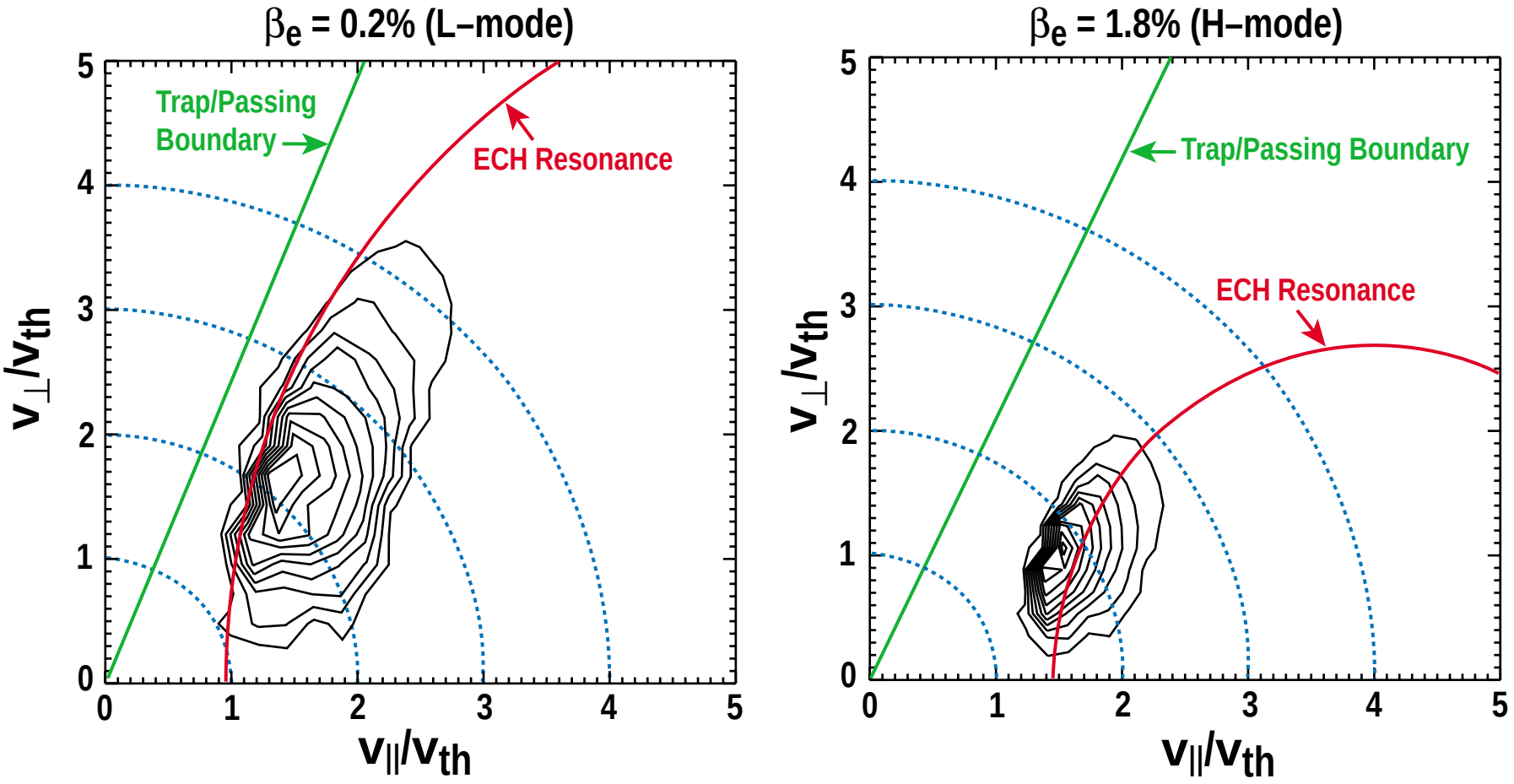
OFF-AXIS ECCD EFFICIENCY INCREASES WITH HIGHER ELECTRON BETA BECAUSE RESONANCE MOVES AWAY FROM TRAPPING BOUNDARY IN VELOCITY SPACE

- Contours of ECH driven flux in velocity space from CQL3D



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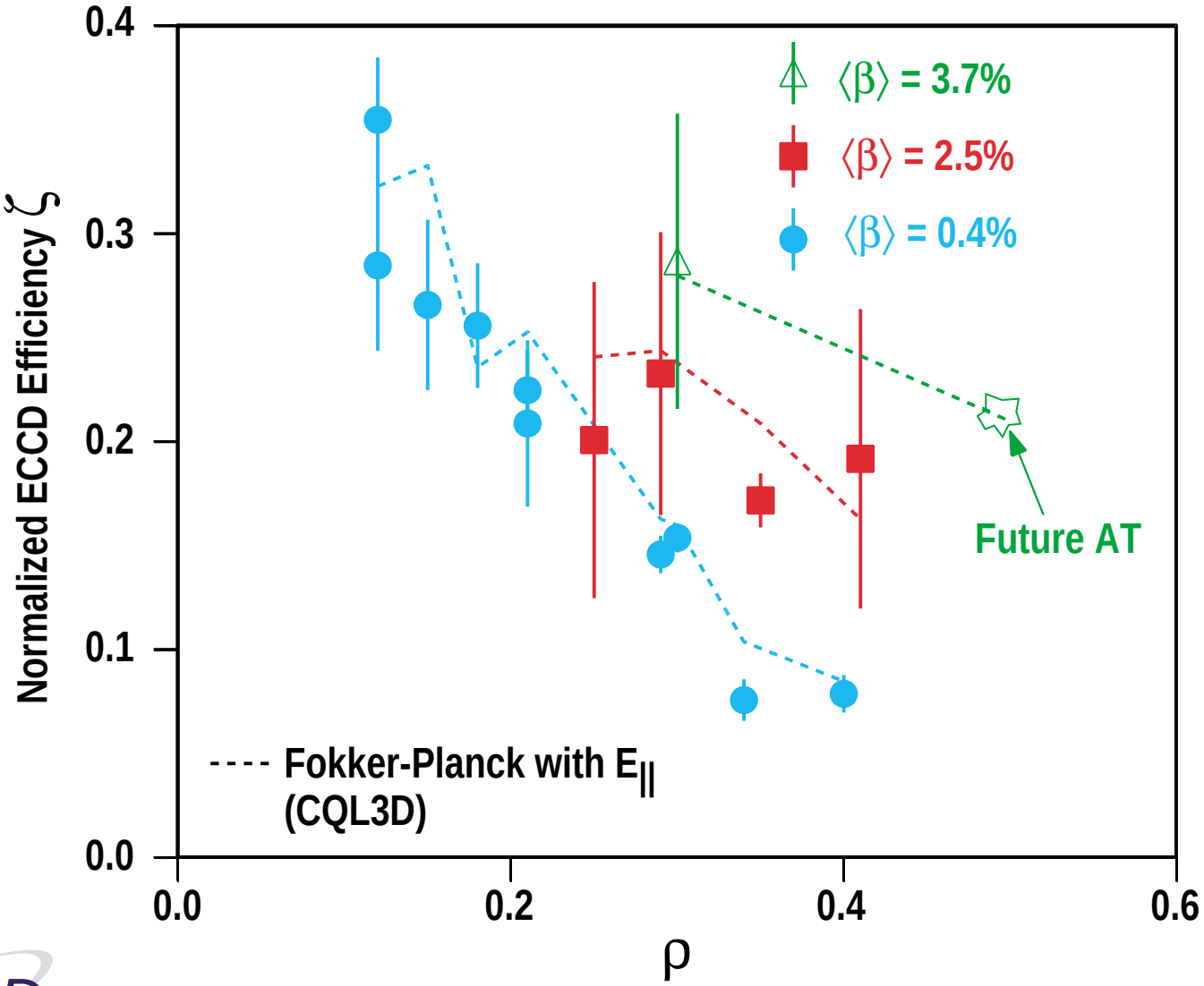
OFF-AXIS ECCD IS MORE FAVORABLE IN HIGH-β PLASMAS SINCE ECCD EFFICIENCY DOES NOT DECREASE MUCH WITH RADIUS



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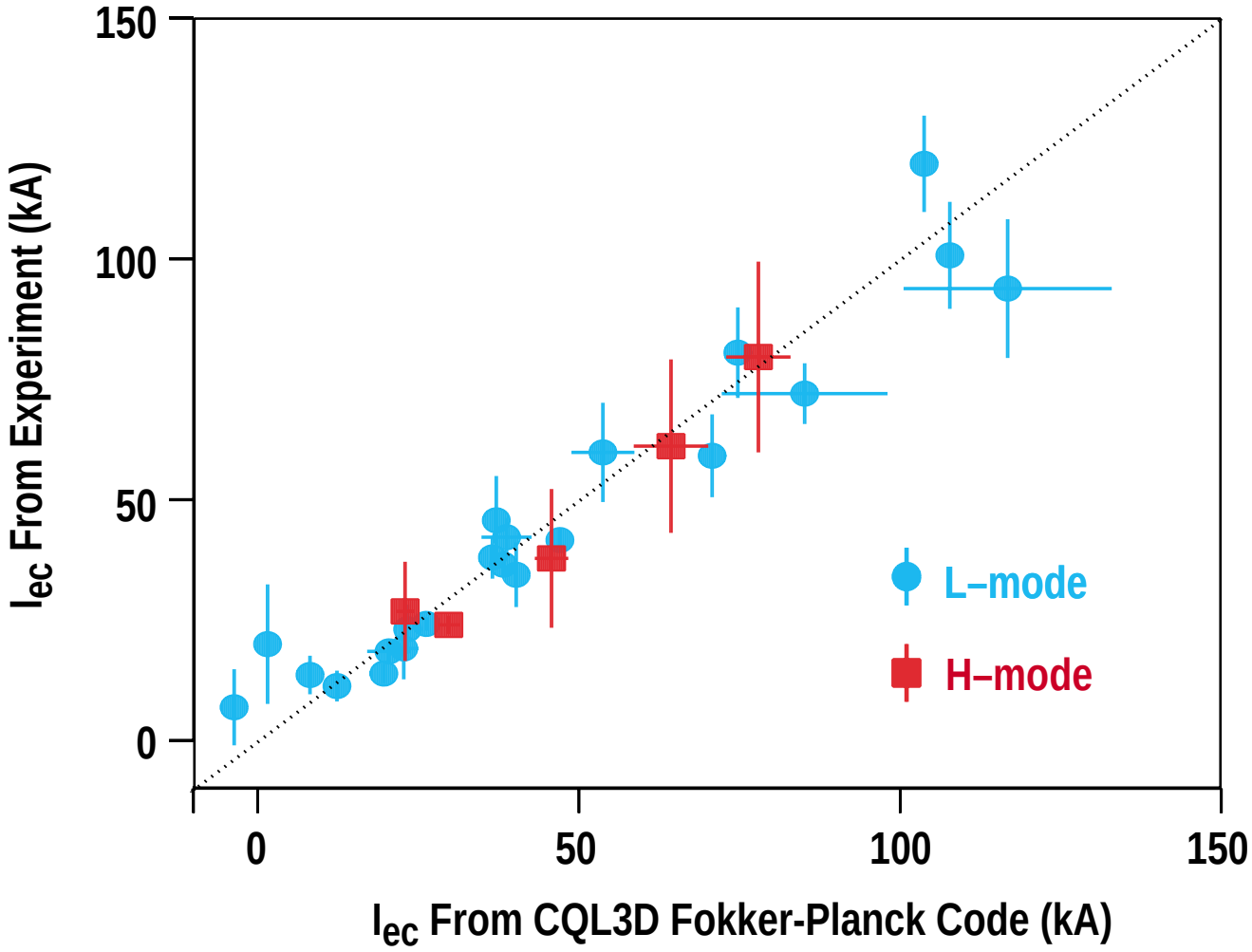
MEASURED ECCD FROM MSE DATA IS IN GOOD AGREEMENT WITH FOKKER-PLANCK CODE OVER A WIDE RANGE OF PLASMA CONDITIONS AND INJECTION ANGLES



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CONCLUSIONS

- Measured ECCD efficiency increases with electron beta, as expected owing to reduced trapping effects from
  - Stronger absorption
  - Relativistic effects

- Experimental efficiency of off-axis ECCD is in accord with theoretical needs of advanced tokamak program
  - Well on the way to validating a predictive model of ECCD

- Other talks on ECH/ECCD this morning:
  - F01.003 AT Scenario Modeling (Murakami)
  - F01.005 Stabilization of NTM (Luce)
  - F01.013 Transport Studies (DeBoo)
  - F01.014 T_e/T_i Dependence of Turbulence (McKee)