Poloidal Structure of Disruption Halo Currents in Alcator C-Mod

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New SOL diagnostic: Langmuir rail probes

- 21 flush-mounted Langmuir rail probes give SOL profiles from bottom to top of outboard divertor plate with fast time resolution
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- Primarily intended to measure I-V characteristics to provide $T_e(\psi)$, $n_e(\psi)$, and $V_f(\psi)$ in the SOL at the outboard divertor plate
New SOL diagnostic: Langmuir rail probes

- When run in “grounded” mode, the probes appear to the plasma to just be part of the divertor plate surface (almost)
- Current flowing in/out of the probes can be measured while in grounded mode.
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- Current flowing in/out of the probes can be measured while in grounded mode. *During disruptions, halo currents can be measured.*
Spatially-resolved halo currents are measured during disruptions.

Division between + and – currents slides down the divertor face during the current quench.
Spatially-resolved halo currents are measured during disruptions.
Plasma contact point vs time compared to +/- halo boundary

On many disruptions there is good correspondence between contact point and +/- halo boundary vs time

$I_p(t)$ and $Z_c(t)$ are also shown

Contact point is obtained from flux reconstructions using fixed filament model
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- Halo current measurements with 3 different circuit resistors have been obtained at most of the spatial positions
  - At the lowest resistance, we measure total halo current that matches our results from 20 years ago (measured with Rogowski sensors)
  - This dependence on the circuit resistor may allow us to deduce the actual SOL resistivity magnitude and SOL resistivity profile
  - Could be very useful for input to halo current modeling efforts
  - Might even be able to separate sheath potential from plasma flux tube resistance, which is exciting to SOL/divertor enthusiasts
Summary

● Divertor Langmuir rail probes provide unprecedented poloidally-resolved measurements of disruption halo currents in the SOL
  — Allows detailed comparison of quenching plasma geometry with halo current structure
  — We’re also trying to correlate halo currents with edge $q$ of quenching plasma

● Dependence on measurement resistors may yield information on SOL resistivity and structure
  — Should be useful for modeling
  — Studies of sheath potentials and other edge physics?