The efficiency of Lower Hybrid Current Drive (LHCD) in Alcator C-Mod discharge shows a pertinently high density (line-averaged $n_e > 10^{19} \text{m}^{-3}$), diverted plasma as seen by the look of the electron hard X-ray (HXR) backscattering and reduction in loop voltage. VUV, VUV, and infrared light, as well as measurements of $\gamma$-ray in the SOL, show significant change in the high density regime with the application of Lower Hybrid power. Poloidal dependence of LHCD induced hydrogen Lyman-alpha emission in high density plasma was investigated using a filtered poloidally-viewing Hamamatsu camera. Due to limitations in the camera radial resolution, a priori assumptions of the emission pattern were used to extract global emission values. Correlations of total Lyman-alpha power are made versus density. Lyman-alpha emission was correlated to various experimental parameters for the dependency of power loss. The measurements indicate that Lyman-alpha power is enhanced globally by LHCD.

**Abstract**

A priori with the application of Lower Hybrid power, Poloidal dependence of voltage. VUV, VUV, and infrared light, as well as measurements of $\gamma$-ray in the SOL, show significant change in the high density regime with the application of Lower Hybrid power. Poloidal dependence of LHCD induced hydrogen Lyman-alpha emission in high density plasma was investigated using a filtered poloidally-viewing Hamamatsu camera. Due to limitations in the camera radial resolution, a priori assumptions of the emission pattern were used to extract global emission values. Correlations of total Lyman-alpha power are made versus density. Lyman-alpha emission was correlated to various experimental parameters for the dependency of power loss. The measurements indicate that Lyman-alpha power is enhanced globally by LHCD.

**Poloidal Dependence of Lyman-alpha Power**

The system was designed to assist in generating advanced sce- narios, referred to plasma. It also will extend for extended length discharges in the near future.

**Future Work and Conclusions**

- Reduced sensitivity of HXR camera affects analysis of the measured profile shape or $T_e$, other quantifiable parameters must be found for representing fast electrons.
- Calculations of the total Lyman alpha power loss begins the quantification of SOL dynamics as they relate to the LHCD density limit.
- Correlation to density displays threshold effect, total power rise.
- Future correlations to other parameters key for determining this power loss mechanism.

**Acknowledgements**

This work is supported by the US DOE awards DE-FG02-92ER54512 and DEAC02-76CH03073. Thanks go out to the entire PSFC and the Alcator C-Mod team for their assistance on this work.

**References**


**Lower Hybrid Wave Neutral Excitation, Ionization and SOL Power Loss of the Alcator C-Mod Tokamak**


1Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, MA

**Method**

The total power from the B-port Lyman Camera cannot be calculated using typical inversion principles.

$$I_n = \int dV = (A_v) \int d\varepsilon (n_e) \int d\theta$$

The measurements are made with angular dependence, which can be converted to a path integral.

$$I_{Lyman} = \int d\varepsilon \int dt \int d\theta = \int d\varepsilon \int d\theta$$

The measured chord power resolved around the vessel ($I_{Lyman} = \int f \varepsilon dt + \int f \varepsilon d\theta$) and summing the chords yields the total power.

**Lyα, Emission Varies with LHCD**

Right is the flux derived, mapped viewing areas repre- senting the Lyα emission regions. Each chord area is used to derive the emissivity weighted height ($\langle e \rangle$).

**Lyα, Emission Increases with LHCD in H-modes**

- Poloidally viewing Lyα system viewing magnetic field lines connected to the LH launcher show similar enhancement of emission for connected versus disconnected field-lines.
- Data taken from end of LHCD pulses measures a relative change in emit- ted Lyα power. Total change of emitted Lyα power is 5kHz. It fol- lows a threshold behavior seen in the total SOL emission.

**Line Averaged $n_e$**

- $n_e < 10^{19} \text{m}^{-3}$.
- $n_e > 10^{19} \text{m}^{-3}$.
- $n_e = 10^{19} \text{m}^{-3}$.
- $n_e = 10^{20} \text{m}^{-3}$.
- $n_e = 10^{21} \text{m}^{-3}$.

**References**


**Lyα, Power Correlation to $n_e$**

- Calculated total power typically on the order of 100 kW.
- Changes are similar in magnitude and time response to previous Lyα results.
- Calculations assume a toroidal symmetry.
- The loss of energy (as determined by electron cooling rates) will be on the order of 2~3 times the ly- man energy loss value.
- Most LHCD results of this type are from L-mode plasmas.