1. Purpose of Experiments
Include immediate goal of the experiments, scientific importance and/or programmatic relevance. Refer to any relevant program milestones.

Prepare and condition the ICRF systems, while also using PCI and reflectometer systems to detect the location of RF mode conversion in H-D plasmas with large H/D ratio.

2. Background
Discuss Physics Basis of the proposed research. Prior results at Alcator or elsewhere, and any related work being carried out separately.

After each vessel opening, the ICRF systems need to be tested to ensure proper operation and the antennas need to be conditioned to ~40 kV or 1.5 MW per transmitter for 1 sec. Conditioning and testing also needs to be done post boronization and when the J-port coax transmission line has been reconfigured. This conditioned state is obtained largely by simply running the RF systems, initially at low power, for longer and higher power pulses. Monitoring the total energy through an antenna may also provide a useful measure of antenna condition.

After an opening and prior to plasma operation, vacuum conditioning to 40 kV will be performed on all antennas. During this operation, the diagnostic measurements are tested to ensure proper functionality particularly arc detection and verification of electrical length between directional coupler one and the stub tuner.

Large ratios of H/D are common after vessel openings, so this circumstance will be exploited to obtain measurements that will enable optimization of a later experiment to determine the density peaking of each isotope by measuring the H/D ratio in the plasma core and the edge ratio based on the Dα spectroscopy.

3. Approach
Describe the methodology to be employed; explain the rationale for the choice of parameters, etc. Describe the analysis techniques to be employed in interpreting the data, if applicable. If the approach is standard or otherwise self-evident, this section may be absorbed into the Experimental Plan.
Once vacuum conditioning is completed, standard 5.4 T discharges are required. The power is started at ~200 kW with each antenna system operating isolated from the others. Once 1 MW of power has been reached, N₂ or Ne seeding should be utilized to avoid unnecessary damage to plasma facing components (PFCs). The power is raised until 1.5 MW per transmitter is reached. If the H/D is sufficiently low, the systems are run simultaneously initially at lower power levels. If all proceeds well, the plasma will enter H-mode and high power and high voltage conditioning can be performed.

The toroidal magnetic field strength will be varied during each pulse to sweep the mode conversion location across the fields of view of the PCI and reflectometer systems.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

- Toroidal Field: 5.0-6.8 T
- Plasma Current: 0.8-1.0 MA
- Working Gas Species: D
- Density: n04~0.8 x 10²⁰ m⁻²
- Equilibrium configuration (if possible, refer to database equilibria): USN or inner wall limited discharge for L-mode portion of run plan and LSN for H-mode phase.

4.2 Auxiliary Systems

- RF Power, pulse length, phasing: J-port: full power 78 MHz, co-, ctr- and heating phasing
- D and E-port: full power.
- Pellet Injection (species): none
- Impurity blow-off injection: none
- Diagnostic Neutral Beam: none
- Special gas puffing: neon as 1090922 or N₂, 3He B-side upper 15 psi when necessary
- Other:

4.3 Diagnostics

List required diagnostics, and any special setup or configuration, e.g. non-standard digitization rate.

Standard set and PCI, plus 3He monitor, FRC-ECE, and 110 GHz reflectometer if available.

5. Experimental Plan

Both sections must be filled in.

5.1 Run sequence Plan

Specify total number of runs required, and any special requirements, such as consecutive days, no Monday runs, extended run period – 10 hours maximum – etc.
Past experience suggests anywhere from 2 to 5 days is required for initial conditioning after a vent and typically 1 day for post boronization conditioning. For transmission line changes, 1 day is typically required to condition and test the system.

5.2 Shot sequence plan
For each run day, give detailed specification for proposed shot sequence: number of shots at each condition, specific parameters and auxiliary systems requirements, etc. Include contingency plans, if appropriate.

Begin with each antenna running separate (~0.3 sec and 200 kW each) into L-mode discharges and n04~0.8 x 10^{20} m^{-2}. Continue until RF pulses are fault free and then increase the power in 200 kW increments until maximum power level is reached (1.5 MW per transmitter). Once 1 MW of power has been reached, N_2 or Ne seeding should be utilized to avoid unnecessary damage to plasma facing components (PFCs). If using 50 MHz, start with 75 msec gas puff for \(^3\)He and monitor FRECE for direct electron heating associated with mode conversion.

Once the H/D ratio is reasonable, overlap D, E, and J-port antennas at reduced power levels and begin long pulse conditioning to maximize Joules per discharge. Conditioning should be continued for as long as significant density and H evolves during antenna operation.

If H-mode is achieved, raise power to simultaneously reach 35 kV and 1.5 MW per transmitter.

1091109021 is a canonical shot, but the B_T will be higher and it will be swept during the ICRH pulse (see detail below).

B_T will be repeatedly swept by up to 1 T, the precise limits of the sweep will be chosen to move the mode-conversion region across the field of view of the PCI and/or reflectometer systems. For instance, with a core n_H/n_e~0.2 and ~80 MHz ICRF, B_T should vary from 5.8 to 6.7 T to scan the PCI view; for n_H/n_e ~0.1, the B_T sweep should span 5.3-6.3 T. The desired B_T values will be proportional to the RF frequency. If more than one frequency is in use we’ll focus on the lowest one (keeping all H cyclotron resonance locations off the antennas will probably push the mode-conversion of higher frequency waves to unviewable locations).

The B_T sweep will start ~0.1 seconds after the beginning of the RF pulse with B_T at its high value, the first sweep to the low value will take 0.3 sec, the return sweep will take 0.4 sec, and the last sweep to low field will take 0.3 sec.

If the core n_H/n_e is ≥0.3 the usable range of B_T is ≤0.5 T, so more sweeps of shorter duration would probably be used.

If the mode-conversion location is viewable with the FRC-ECE system, the ICRH power will be modulated to look for modulation in T_e that will indicate the mode-conversion location. This will be limited to frequencies below 78 MHz and hydrogen fractions below 30%.
6. Anticipated Results
Discuss possible experimental outcomes and implications. Indicate if the program may be expected to lead to publications, milestone completions, improved operating techniques, etc. Indicate if the experiments are intended to contribute to a joint research effort, or an external database.

Prepare RF systems for physics campaign.

The radial width of the PCI signals from the mode-converted waves will probably vary as the mode-conversion region moves; we’ll be looking for the circumstances that produce the narrowest PCI signal width. This will maximize the precision of the later experiment comparing density peaking of H and D.

The estimations we make of core $n_{H}/n_{e}$ will be compared to the value of $n_{H}/n_{e}$ obtained from edge $D_{\alpha}$ for a preliminary comparison of the relative density peaking of H & D. This will guide the later experiment’s choice of target $n_{H}/n_{e}$ which will be obtained by H puffing.

7. References
Include references both to external and internal literature or communications which bear on this proposal.