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

   Determine BES diagnostic signal levels from beam emission and benchmark spectroscopic model. Gain experience in tuning optical bandpass filters to optimize diagnostic performance. Attempt to measure the beam penetration. Obtain first radial profiles of density fluctuation level and assess if s/n is sufficient to measure fluctuations in the deep core. Evaluate effects of beam width (and therefore need for aperture) on wave-number sensitivity.

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

   The BES diagnostic observes the Balmer transition \(H_\alpha\) of excited states of beam neutrals. The emission occurs over multiple spectral lines due to motional Stark splitting. These lines, in turn, are Doppler shifted by an amount determined by the view geometry and the beam energy. To further complicate matters, there are three energy components of the beam (full, half, and third) that triple the number of lines. Plus, all the lines are substantially broadened by beam divergence and the finite acceptance angle of the optics. Optimal operation of the diagnostic captures as much of this emission as possible while avoiding collection of the \(D_\alpha\) emission from the plasma edge and minimizing bremsstrahlung.

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.

   Measured brightnesses as functions of bandpass-filter tuning will be compared to a BES simulation code coupled with a beam penetration code. The codes require electron temperature and density profiles and \(Z_{eff}\) as input (hence the diagnostics requested below). If the simulation code predicts measured brightnesses accurately, it can be used to tune the bandpass filters a priori instead of by trial and error or by using a separate spectrometer.
4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

**Toroidal Field:** Any

**Plasma Current:** Any

**Working gas species:** H or D

**Density:** lowish \( (< 3 \times 10^{20}m^{-3}) \)

**Equilibrium configuration** (if possible, refer to database equilibria): Any

**Pulse length, typical current & density waveforms, etc.** Refer to database or sketch desired waveforms:
Waveforms constant during 0.1 s DNB pulse

4.2 Auxiliary Systems

**RF Power, pulse length, phasing:** Any, but constant during DNB pulse

**Pellet Injection (species):** None during DNB pulse

**Impurity blow-off injection:** None during DNB pulse

**Special gas puffing:** None during DNB pulse

**Other:** DNB into plasma for at least 0.1 s

4.3 Diagnostics

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

\( H_\alpha \) spectroscopy, \( T_e(r), n_e(r), Z_{eff} \) (for model validation). (Not required early on)

4.4 Neutron Budget

Estimate the neutron dose rate at the site boundary. Give basis for estimate. (Once some experience has been gained a standard formula will be provided for estimating dose rates.)

Low neutron rate anticipated.

5. Experimental Plan

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.

No special requirements: measurements to be taken in background, including during DNB conditioning.
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.

No special requirements: measurements to be taken in background, including during DNB conditioning.

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.

Benchmarking of the BES simulation and beam penetration codes will facilitate tuning of optical bandpass filters for routine operation. Fluctuation measurements should indicate if signal levels and wave-number sensitivity are sufficient to measure level and spectrum of density fluctuations in the plasma interior and whether beam aperturing and/or detector cryo-cooling will be necessary.

7. References
Include references both to external and internal literature or communications which bear on this proposal. See Section 2.