# Boundary Plasma Diagnostics for NCSX

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# Boundary plasma measurements and the corresponding diagnostics can be categorized as essential, desirable and advanced.

- Essential boundary diagnostics are required for initial operation of the device and should be operational for first plasma:
  - Recycling (Da) and Carbon Sources (CI, CII) - Visible survey cameras with wavelength line filters
    - Views perpendicular to target plates - also verifies flux geometry
    - Tangential views for 3D monitoring of recycling and impurity sources
  - Target ne, Te, J_sat - Plate mounted Langmuir probes
  - Target heat flux -
    - Thermocouples imbedded in target material
    - IRTV viewing perpendicular to targets
  - Neutral pressure - ASDEX gauges at midplane and in banana tips

# Divertor design calculations will require measurements from more complicated diagnostics

- Desirable diagnostics will be needed to determine boundary plasma characteristics that must be known before advanced divertor structures can be designed:
  - Radiated power and charge exchange power losses - Bolometer arrays
    - Two arrays with crossed views for tomography
    - Channels parallel to target plates for detailed profiles
  - Impurity content and radiated power fraction - Visible survey spectrometer
    - 300 - 900 nm range with about 0.1 nm resolution
  - Radial profiles of ne, Te, v_flow - Reciprocating probes
    - Sweep across plasma fan in banana tips
    - Sample flux surfaces that map to target plate probe arrays for 2-point modeling

# Compact stellarator boundary physics studies would benefit from more sophisticated diagnostic measurements

- Advanced diagnostics will provide the data needed for quantitative models of NCSX edge plasma behavior and optimization:
  - Impurity transport by noble gas injection - Penning gauges
  - Detachment from target plates:
    - Simultaneous images of Da and Db or Dg emission from target plates
    - Thomson scattering ne, Te measurement of target plate plasma
  - SOL - pedestal coupling:
    - Reciprocating probes at midplane with standard and Mach probe tips
    - Li-beam spectroscopy for pedestal ne
    - B IV charge exchange spectroscopy for pedestal Ti and Er
    - Edge ECE for pedestal Te
    - Reflectometry for pedestal ne gradient profile
    - Thomson scattering SOL channels capable of low ne, Te measurement