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Previous Results
- AIMS was first implemented at the end of the FY2012 campaign.
- The first data demonstrate the ability of AIMS to observe the erosion and deposition of boron and to analyze the deuterium content of the wall.
- Boron prevents the high Z wall from polluting the plasma, in addition to absorbing other impurities.
- These results encouraged expansion of the capabilities of AIMS, the details of which are explained below.

The AIMS Diagnostic on Alcator C-Mod
- Depiction of the AIMS diagnostic on Alcator C-Mod. The particle accelerator is blue, and the beam is shown entering the tokamak with several different steering fields.
- Plasma-material interactions (PMI) studies are severely hampered by a nearly complete lack of in situ, time-resolved quantitative measurements of plasma-facing surface properties.
- To combat this problem, AIMS was developed to analyze the surfaces of Alcator C-Mod between shots.
- AIMS utilizes a deuteron accelerator to perform nuclear reaction analysis on the plasma-facing components of the tokamak.
  - The beam is steered by a constant, weak magnetic field.
  - The particle beam strikes the surface and generates nuclear reactions.
  - The induced nuclear reactions produce neutrons and gamma rays which can be used to determine surface characteristics.

Improved Detection Time on C-Mod
- Detection time will be decreased from 10 minutes to ≤1 minute – this allows for multiple measurements between shots.
- Multiple, smaller scintillators to avoid count rate limitations
- Increased solid angle with the addition of adjustable reentrant tube.
- Increased beam duty factor from 0.3% to 2% with new RF amplifier.
- Detection time will be decreased from 10 minutes to ≤1 minute – this allows for multiple measurements between shots.

Greater Range of C-Mod Surfaces Diagnosed
- New toroidal field (TF) power supply increases the steering magnetic field of up to 0.45 T.
- This allows beam access to the entire poloidal plane including full span of divertor.
- Additional range in the toroidal direction allows mapping of the first wall.
- The field polarity can be switched in order to reach the upper divertor.

In-situ Calibration
- The addition of a boron nitride scintillator tile allows for in-cell calibration of the beam.
- Camera allows visual analysis for validation of size and location of spot from beam modelling.
- Known elementary target reactions give in-situ detector calibration.

Improved accuracy of cross section measurements
- The MIT DANTE deuteron accelerator measures cross sections as a function of angle and energy.
- Boron cross sections measured with DANTE enabled precise calculations of reaction rates at beam energies.
- DANTE allows prototyping of new ion beam analysis techniques.

Development of High-Z Erosion Measurements
- The current data only tracks erosion and deposition of low-Z elements (in addition to ion implantation).
  - The 900 keV beam limits the direct nuclear reactions to elements with Z ≤10.
- Using nuclear reaction analysis (NRA) with implanted depth markers would allow the study of high-Z erosion rates.
- Currently investigating isotopes with useful gamma and neutron production cross sections.

In-situ calibration detector calibration. Mit DANTE accelerator

Model of boron nitride calibration tile with standard molybdenum tiles.

Modeling of the beam spot on accessible surfaces of the tokamak.