

## EFFECTS OF OPERATING PARAMETERS ON THE BEAM SPECIES OF DIII-D NEUTRAL BEAM ION SOURCES\*

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The DIII-D fusion science research facility employs positive-ion based neutral beam ion sources for plasma heating and current drive experiments. Ion species produced inside the arc chamber of an ion source determine the composition of the neutral beams injected into the plasma and in turn affect the energy deposition along the cross section of the plasma. Arc chamber design and operation schemes are the predominant factors in the ion species mix. When deuterium gas is used for the discharge three deuterium ion species (atomic  $D_1^+$  and molecular  $D_2^+$  and  $D_3^+$ ) are produced in the arc chamber of the DIII-D neutral beam ion source. The atomic ion  $D_1^+$  has the highest percentage of the three species, normally about 80% of ions produced. Measurements have shown that both  $D_1^+$  and  $D_2^+$  decrease slightly with lower arc power discharges. However,  $D_3^+$  increases at a higher rate when arc power is reduced. Changing the fraction of the ion species can be beneficial to or meet the needs of some specific plasma experiments. Attempts to manipulate the ion species mix by changing the operating parameters of the arc chamber/ion source has been performed. These operating parameters include filament temperature, arc power, beam energy, and gas flow. Interesting results were obtained and they show that arc power is the dominant factor on the species mix. We were not able to significantly change the ion species mix by varying the operating parameters within the operation window when the ion source is operated at a constant beam energy. However, the  $D_3^+$  fraction increases to three times higher when the ion source is operated at a much lower arc power (for 50 keV beam energy operation) than the higher arc power required for ion source operation with beam energy between 75 to 80 keV.

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\*Work supported by U.S. Department of Energy Contract DE-AC03-99ER54463.

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Prefer:

Oral  
 Poster

Topic Category:  
Heating and Current Drive