# COMPARISON OF CALCULATED NEUTRAL BEAM SHINE THROUGH WITH MEASURED SHINE-THROUGH IN DIII–D*

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A comparison of the calculated shine through of neutral particle beams in the DIII–D plasma to measured values inferred from the target temperature rise is reported. This provides an opportunity to verify the shine through calculations and makes them more reliable in those cases where the shine through can not be measured. The DIII–D centerpost neutral beam target tiles are safe-guarded against excessive beam shine-through by pyrometry and thermocouple (TC) arrays on the tiles. Shine-through beam power is calculated from the measured temperature changes reported by the target tile TC array. These measurements are performed at the beginning of each operational year at DIII–D. Theoretically, the beam energy deposited into the plasma can be expressed as a function of the change in beam density: $E_{b->p} = \varepsilon \left[\int(dt) * \int(dV) * \int(-dsN_b(s))\right]$. The expression for beam density propagating in a plasma is: $\frac{dN_b(s)}{ds} = -N_b(s)n(s)\sigma$. Where $N_b(s)$ is the beam particle density, n(s) is the plasma density, and $\sigma$ is the interaction cross section, and $\varepsilon$ is the energy per beam particle. The beam energy deposited onto the centerpost (shine-through) is then of the general form: $E_{cp} = \varepsilon \left[\int(dt) * \int(dVN_b(a))\right]$, where; $N_b(a) = A\left[N_b(0)e^{-(na\sigma)\gamma} + C\right]$. Given that a, is the plasma radius, (na) is the line density. $N_b(0)$ is the initial beam density. Where A, C and $\gamma$ are system dependent constants. The line density and uncollided beam density are measured quantities. Values of $\sigma$ are available in the general literature. Neutral beam energy deposition in plasma (of known density) is inferred by comparing the results of a series of shine-through measurements for the 1997 campaign at DIII–D to the expected shine-through given by theory.

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