# EBW-Bootstrap Current Synergy in NSTX*

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Modeling of Electron Bernstein wave interactions with electrons in the NSTX device shows that the strength of the quasilinear velocity space diffusion coefficient peaks near the trapped-passing boundary[1]. This result is obtained for second or third harmonic damping towards the plasma periphery, a region of particular interest for driving auxiliary current. Since the bootstrap current provides a major contribution to the total current in the NSTX geometry and is driven by pitch angle diffusion across the trapped-passing boundary, this motivates study of the effect of the EBW induced scattering on the bootstrap current.

The calculation of EBW current drive (EBWCD) with the GENRAY ray tracing code[2] and the CQL3D Fokker-Planck code[3] is reviewed. An approximate method for kinetic calculation of bootstrap current is shown and validated by comparison with thermal bootstrap current calculations. Synergies between EBW and BS current are described for three EBW scenarios: (1) launch from above the equatorial midplane, which gives absorption with wave resonance in the positive toroidal current direction; (2) launch from a location symmetrically below the midplane which gives absorption in the negative toroidal current direction; and (3) a balanced combination of the previous two scenarios. These three scenarios will be used to sort out EBWCD-BSCD synergy effects from the simple sum of the two currents.

The Fokker-Planck modeling results indicate that RF enhanced scattering has a small effect on the *net* driven current for the 40 percent beta NSTX discharge examined, at EBW powers up to 4 MW. However, significant modifications of the driven current profile are calculated, due to bootstrap current resulting from the additional nonthermal pressure.

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## References

[1] G. Taylor, *et al.*, “Efficient generation of non-inductive, off-axis, Ohkawa current, driven by electron Bernstein waves in high beta, spherical torus plasmas”, accepted for publication in Physics of Plasmas, October, 2004.

[2] A.P. Smirnov and R.W. Harvey, “The GENRAY Ray Tracing Code”, CompX report CompX-2000-01 (2001); Bull. Amer. Phys. Soc. **40**, 1837, Abstract 8P35 (1995).

[3] R.W. Harvey and M.G. McCoy, “The CQL3D Fokker-Planck Code”, Proc. of IAEA TCM on Advances in Simulation and Modeling of Thermonuclear Plasmas, Montreal, 1992, p. 489-526, IAEA, Vienna (1993) [available through USDOC/NTIS doc. DE93002962].