

## **Cross-Code Verification of Quasi-Linear ICRH Modeling Using 2-D Linear Full Wave and 5-D Monte-Carlo Particle Solver**

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An extensive benchmark of ORBIT-RF and AORSA codes has been carried out to test their predictions for standard quasi linear heating theory in linear regime. In a modeling study of the ICRF wave-plasma interaction in tokamaks, the local power absorption, calculated from ORBIT-RF without updating resonant ion characteristics, is compared with that from AORSA. The two codes use quite different numerical approaches but yield excellent agreement in prediction of fundamental heating of a minority hydrogen Maxwellian plasma in Alcator C-Mod tokamak. However a factor of two difference is found in modeling of high harmonic ICRF heating of energetic beam ions in DIII-D tokamak. The difference is currently understood as due to missing physics implemented in each code. Loss of energetic particles to the wall due to their finite orbits, which is not implemented in AORSA, produces significant differences in the outer region of the plasma. ORBIT-RF requires information between the electric field amplitudes  $E+$  and  $E-$ , and a perpendicular wave spectrum from hot plasma which are not readily available as explicit format from AORSA. These could also produce non-negligible differences. More accurate modeling is being considered.

[1] M.Choi, et al: *Nuclear Fusion* **46** (2006) S409-S415.

[2] E.F Jaeger et al: *Phys.Plasmas* **8** (2001) 1573.