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Potential of lower hybrid fast wave as an efficient current drive method in future fusion reactor

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An efficient current drive method should be developed for future tokamak reactors since bootstrap current is not able to soley fufill the plasma current required for enough confinement for burning plasma and current profile should be carefully controlled for stable operation. Lower Hybrid Current Drive (LHCD) has been typically considered as an current drive method of tokamak due to its supreme efficency. However, its high efficiency has not been shown in the reactor relevant high density plasma. Currently, helicon wave current drive and high field side launch LHCD have been suggested and researched in the several tokamaks such as KSTAR, DIII-D to overcome the difficulty. However, its theoretical good efficiency of helicon wave has not been shown experimentally yet, and it is not obvious the high field side LHCD is capable of efficient current drive still for high density plasma. Meanwhile, the fast wave in lower hybrid resonance frequency, so called, Lower Hybrid Fast Wave (LHFW) has a good penetration characteristic in the high density and its current drive efficiency is predicted to be as efficient as lower hybrid slow wave used in LHCD. Recently, it is shown that the current drive is possible if the density window for propagation is suitably open on VEST deice. In the study, the propagation and current drive characteristics of LHFW in ITER or DEMO are investigated through ray tracing simulation. The coupling and power transmission of LHFW is estimated with a fast wave antenna using waveguide under conceptual design for reactor grade tokamak. Based on those results, the potential of the LHFW as an altenative current drive method for the future fusion reactor is discussed and summarized.

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