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Predictive modeling of fast ion transport in the presence of magnetic islands in NSTX

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The physics of fast ion transport induced by magnetic islands can be captured using the TRANSP Kick model [1-3]. Recently, it has been shown that fast ion parameters calculated using the Kick model are necessary to explain the growth of magnetic islands in NSTX [4]. With capabilities to model both fast ion transport by magnetic islands and magnetic island growth by fast ions, it is now possible to perform a predictive modeling of the fast ion transport in the presence of magnetic islands.

To demonstrate the predictive modeling capability, a NSTX discharge #134020 with core kink displacement and magnetic island at q = 2 surface is taken as a reference, from which the neutral beam injection angle, power, and duration is modified to predict the fast ion transport, assuming the free parameters in generalized Rutherford equation do not change as the neutral beam parameters are modified.

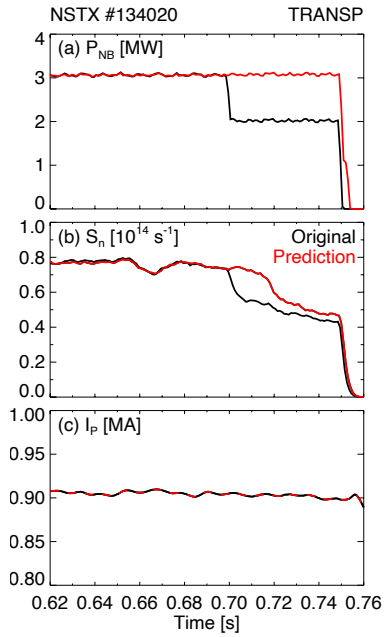

Fig. 1 Measured (black) and simulated (red) (a) neutral beam power, (b) neutron rate, and (c) plasma current

The results demonstrate the capability to self-consistently model the fast ion transport in the presence of magnetic islands ahead of experiments. A useful data for the selection of neutral beam source combination for either mode stabilization for improved performance or larger saturated island width for fast ion transport measurement can be provided.

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References

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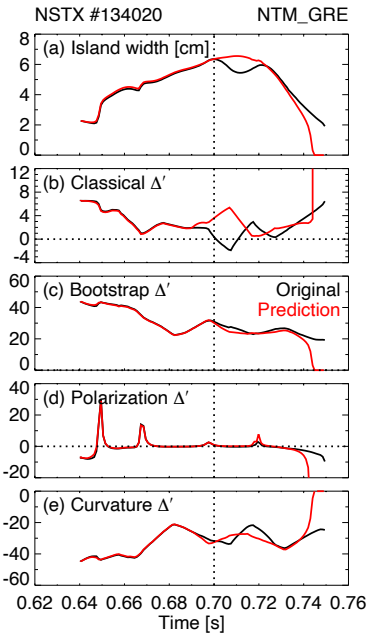

Fig. 2 Measured/calculated (black) and simulated (red) (a) island width and (b-e) modified Rutherford equation term