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Calculations for the optical system for the first ITER plasma

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When the first plasma is generated in ITER, the machine will not be fully equipped with all in-vessel components. In particular, the equatorial launcher will not be available the equatorial launcher will not be available to provide central ECRH-heating. This leaves the upper launcher as the only option for the initial plasma breakdown. In order to direct the microwave to the desired path, which goes horizontally through the resonance layer, a dedicated optical system consisting of in-vessel mirrors and a beam dump is necessary [1], [2]. After an initial design, which required a sophisticated diffraction grating, a new design using just smooth mirrors was suggested [3].
For the simulation of the optical path including the reflections on the focusing mirrors, a physical optics code, which is part of the PROFUSION package, was used. It allows to simulate the reflection on metallic mirrors including higher order effects like mode conversion and cross polarization. Furthermore, the code was extended to calculate the spillover effects due to the limited mirror size. The irregular mirror contour can be provided numerically and the effect of the field truncation can be modeled both on terms of the power density on the vessel wall and the deterioration of the reflected beam. Another tool was developed for tracking the polarisation through the beam path. It allows to determine the direction of the E-field in the upper launcher in order to have the maximum power beam power in X-mode in the resonance layer.
The paper outlines the calculation methods and presents numerical results.
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References

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Primary author: Mr PLAUM, Burkhard (Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart,)

Co-authors: Mrs PREYNAS, Mélanie (ITER Organization, Heating & Current Drive Division); Mr CHOE, Munseok (ITER Organization, Heating & Current Drive Division)

Presenter: Mr PLAUM, Burkhard (Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart,)

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