On the possible contributions of wave propagation simulations for improving the wave heating systems of fusion devices

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To start a short overview will be given on the different models able to describe the behaviour of the wave propagation as a function of the different frequency ranges corresponding to different kinds of heating systems: 20-100 MHz for the Ion Cyclotron Resonant Heating, 2-20 GHz for Lower Hybrid Heating or Current Drive, and 100-250 GHz for electron cyclotron Heating or Current Drive systems. Each system has their own specificities that will be précised, as the typical set of equations plus the assumptions needed to describe the properties of these heating or current drive systems, and for each their own validity domain. During these descriptions a special attention will be paid to the boundary conditions. A review of the specific physical problems associated to the wave heating systems specifying the role of the simulation to answer to the addressed questions coming from experiments on magnetized plasma devices devoted to Fusion. For example, the impact of the edge turbulence on the wave propagation and its consequences on the heating system performances will be presented as others (effects of the fast particles, ponderomotive effects, ...). A more focused study on RF sheath effects will be also discussed showing that such simulations require very sophisticated tools to understand partially the observations done in devoted experiments. An overview of progresses needed and requirements to have relevant predictive simulation tools for describing the wave heating systems used in fusion devices concludes this talk.