# Path-integral approach on light reflection from a plasma surface

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In many studies on laser-plasma interaction, a primary assumption has been made such that the reflection of a laser pulse propagating to a plasma surface takes place at the critical plasma density [1]. However, in general, there are nonzero reflections from underdense plasmas. Furthermore, a plasma wave can be resonantly excited in the near critical plasma [2], which can significantly change the laser-plasma interaction dynamics. In this work, to provide an unified description of the light reflections from underdense and overdense plasmas, we develop an analytic model describing the reflection amplitude by using the path-integral approach. Figure 1 shows a sketch of one reflection path from a position $x_l$ in the plasma. By integrating all the reflection paths propagating back to the vacuum, we obtain analytic solution of the reflection amplitude. Our model well reproduces results of 1-dimensional particle in cell simulation. In the presentation, we explain the physical meaning of our analytic model in more details and the prospect of our approach.

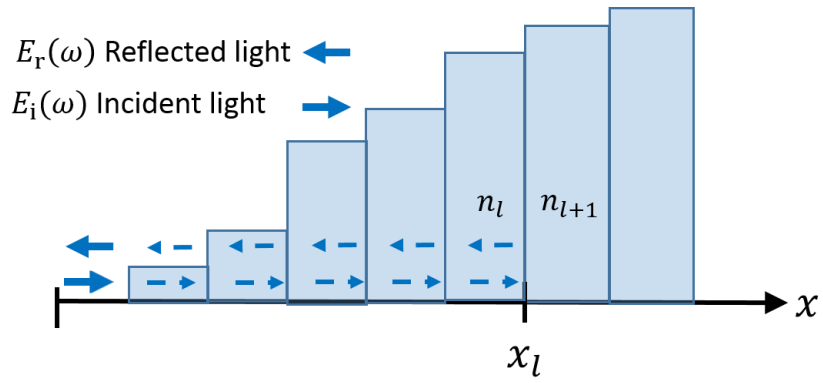


Fig. 1. Sketch of a reflection path, where the incident wave is transmitted $l$-1 times through the discretized plasma layers, reflected at $x=x_l$, and transmitted back to the vacuum.

[1] S. K. Mishra, A. Andreev, and M. P. Kalashinikov, Opt. Express **25**, 11637 (2017), and references therein.

[2] S. K. Rajouria, M. K. K K, and V. K. Tripathi, Physics of Plasmas **20**, 083112 (2013).