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Critical phenomenon in tapered dielectric structures

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We demonstrate the existence of a critical behavior of a single electromagnetic mode propagating in a tapered dielectric structure. This behavior is described in terms of a critical phase velocity in the case of an adiabatic tapering. In the vicinity of this critical phase velocity, the tapered structure no longer confines the radiation and a significant fraction of the power escapes transversely.

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"posts" [22], sacrificial etching techniques, or the buckling self-assembly process [26]. However, the restriction on the hollow core's dimensions is a serious impediment.

It was shown experimentally [27,28] that in a system with a linearly tapered vacuum core [Fig. 1(c)], radiation propagates transversally when operating *below cutoff*. However, operating with a single mode *far from cutoff* by retaining the vacuum core's width fixed, opens a wide range of applications. In spectroscopy, for example, optimal resolution is achieved when only the lowest-order mode is excited [27]. Similarly, in laser-driven particle accelerators, a single TM_{01} mode is co-propagating with the particle, and the former phase velocity should be synchronized to the velocity of the particle [29].

In this study, we introduce a novel tapering method whereby