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Coupling control based on Adiabatic elimination for densely integrated nano-photonics MICHAEL MREJEN, HAIM SUCHOWSKI, TAIKI HATAKEYAMA, CHIHHUI WU, LIANG FENG, KEVIN O'BRIEN, YUAN WANG, XIANG ZHANG, NSF Nano-scale Science and Engineering Center (NSEC), 3112 Etcheverry Hall, University of California, Berkeley — The ever growing need for energy-efficient and fast communications is driving the development of highly integrated photonic circuits where controlling light at the nanoscale becomes the most critical aspect of information transfer. Here we develop a unique scheme of adiabatic elimination (AE) modulation to actively control the coupling among waveguides for densely integrated photonics. Analogous to atomic systems, AE is achieved by applying a decomposition on a three waveguide coupler, where the two outer waveguides serve as an effective two-mode system with an effective coupling of $V_{eff} = [(V^*_{13} + V^*_{23} V^*_{12}/\Delta\beta_{12})(V_{13} - V_{23} V_{12}/\Delta\beta_{23})]^{1/2}$, and the middle waveguide is the equivalent to the intermediate level 'dark state'. We experimentally demonstrate the first all optical AE modulation and its ability to control the coupling between the two waveguides by manipulating the mode index of the decoupled middle one. In addition, we show that the strong modes interactions allowed at the nano-scale offer a unique configuration of zero-coupling between all the waveguides, a phenomena that paves the way for ultra-high density photonic integrated circuits where small footprint is of crucial importance.

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