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Synchronization behavior in linear arrays of negative differential resistance circuit elements HUIDONG XU, STEPHEN TEITSWORTH, Duke University — We study the electronic transport properties in a linear array of nonlinear circuit elements that exhibit negative differential resistance, and find that state-cluster synchronization emerges when there is heterogeneity in the element properties. This type of synchronization is associated with a non-uniform spatial distribution of total applied voltage across the array elements, as well as the formation of multiple stable branches in computed current-voltage curves for the entire array. Unlike most synchronizing systems studied previously [1], this system possesses coupling between elements that displays both positive and negative feedback depending on the state of each element. An empirical order parameter is defined which quantifies the degree of synchronization. We also find that the degree of synchronization is strongly dependent on the *ramping rate* of the total applied voltage to the array, with complete synchronization observed in the limit of small ramping rate. This model provides a basis for describing related nonlinear phenomena in more complex electronic structures such as semiconductor superlattices [2]. [1] A. Pikovsky, M. Rosenbaum, and Jürgen Kurths, *Synchronization: a universal concept in nonlinear sciences* (Cambridge University Press, Cambridge, 2001). [2] M. Rogozia, S. W. Teitsworth, H. T Grahn, and K. H. Ploog, Phys. Rev. B**65**, 205303 (2002).

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