

# On the joins of regular graphs and applications to nonlinear dynamics

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Networks/graphs of nonlinear oscillators have attracted interest in several scientific domains such as theoretical physics, mathematical biology, power-grid systems, and many more. In this domain, the Kuramoto oscillator has emerged as the central mathematical model for studying these networks. In our investigation of the Kuramoto model, the networks of several communities joined together often appear and provide new interesting phenomena. Since it is well-known that the structure of these networks strongly influences their dynamics, we naturally want to investigate their spectral properties. In this talk, I will introduce this circle of ideas. In particular, I will explain how we can completely characterize the spectrum of these networks. Time permitting, I will explain some applications of our results to the construction of Ramanujan graphs and discuss some problems in graph energy.