Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

**The dynamic and geometric phase transition in the cellular network of pancreatic islet** XUJING WANG, University of Alabama at Birmingham — The pancreatic islet is a micro-organ that contains several thousands of endocrine cells, majority of which being the insulin releasing $\beta$-cells. $\beta$-cells are excitable cells, and are coupled to each other through gap junctional channels. Here, using percolation theory, we investigate the role of network structure in determining the dynamics of the $\beta$-cell network. We show that the $\beta$-cell synchronization depends on network connectivity. More specifically, as the site occupancy is reducing, initially the $\beta$-cell synchronization is barely affected, until it reaches around a critical value, where the synchronization exhibit a sudden rapid decline, followed by an slow exponential tail. This critical value coincides with the critical site open probability for percolation transition. The dependence over bond strength is similar, exhibiting critical-behavior like dependence around a certain value of bond strength. These results suggest that the $\beta$-cell network undergoes a dynamic phase transition when the network is percolated. We further apply the findings to study diabetes. During the development of diabetes, the $\beta$-cell network connectivity decreases. Site occupancy reduces from the reducing $\beta$-cell mass, and the bond strength is increasingly impaired from $\beta$-cell stress and chronic hyperglycemia. We demonstrate that the network dynamics around the percolation transition explain the disease dynamics around onset, including a long time mystery in diabetes, the honeymoon phenomenon.

Xujing Wang
University of Alabama at Birmingham

Date submitted: 21 Dec 2012 Electronic form version 1.4