Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

The Role of Salts in the Evolution of Modern Orb-Webs. VASAV SAHNI[1], TOSHIKAZU MIYOSHI, KELLEY CHEN, DHARAMDEEP JAIN, University of Akron, SEAN J. BLAMIRES, Tunghai University, TODD A. BLACKLEDGE, ALI DHINOJWALA, University of Akron — The evolution of modern viscid silk webs from ancient cribellate silk webs is associated with a 95% increase in diversity of orb-weaving spiders, and their dominance as predators of flying insects. Yet the transition's mechanistic basis is an evolutionary puzzle. Ancient cribellate silk is a dry adhesive that functions through van der Waals interactions. Viscid threads adhere more effectively than cribellate threads due to high extensibility of their axial silk fibers, and firm adhesion of the viscid glue droplets. The organic and inorganic salts present in viscid glue sequester atmospheric water that plasticizes the axial silk fibers and renders them extensible. Here, we provide direct molecular and macro-scale evidence to show that salts also generate adhesion by directly solvating the glycoproteins, regardless of water content, thus imparting viscoelasticity and enabling the glue droplets to establish good contact. This 'dual role' of salts provides a crucial link to the evolutionary transition from cribellate silk to viscid silk. In addition, salts also provide a simple mechanism to adhere even at the extremes of relative humidity, a feat eluding most synthetic adhesives.

[1]The work was done when I was at University of Akron

Vasav Sahni
The 3M Company

Date submitted: 14 Nov 2013 Electronic form version 1.4