Abstract Submitted
for the OSS08 Meeting of
The American Physical Society

**Structural Physics of Bee Honeycomb** FORREST KAATZ, Owens Community College, ADHEMAR BULTHEEL, TAKESHI EGAMI, University of TN — Honeybee combs have aroused interest in the ability of honeybees to form regular hexagonal geometric constructs since ancient times. Here we use a real space technique based on the pair distribution function (PDF) and radial distribution function (RDF), and a reciprocal space method utilizing the Debye-Waller Factor (DWF) to quantify the order for a range of honeycombs made by *Apis mellifera*. The PDFs and RDFs are fit with a series of Gaussian curves. We characterize the order in the honeycomb using a real space order parameter, $OP_3$, to describe the order in the combs and a two-dimensional Fourier transform from which a Debye-Waller order parameter, $\boldsymbol{u}$, is derived. Both $OP_3$ and $\boldsymbol{u}$ take values from [0, 1] where the value one represents perfect order. The analyzed combs have values of $OP_3$ from 0.33 to 0.60 and values of $\boldsymbol{u}$ from 0.83 to 0.98. RDF fits of honeycomb histograms show that naturally made comb can be crystalline in a 2D ordered structural sense, yet is more 'liquid-like' than cells made on 'foundation' wax. We show that with the assistance of man-made foundation wax, honeybees can manufacture highly ordered arrays of hexagonal cells.

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Date submitted: 08 Feb 2008 Electronic form version 1.4