Modeling the growth of chondrule dust rims with molecular dynamics. C. Xiang[1], L. S. Matthews[1], A. Carballido[1], M. A. Morris[2,3] and T. W. Hyde[1], [1]Center for Astrophysics, Space Physics and Engineering Research, One Bear Place #97310, Baylor University, Waco, TX, 76798-7310, USA, [2]School of Earth and Space Exploration, Arizona State University, PO Box 876004, Tempe, AZ, 85287-6004, USA, [3]Physics Department, State University of New York, PO Box 2000, Cortland, NY, 13045, USA.

Introduction: Fine-grained dust rims that surround chondrules in carbonaceous chondrites may have originated in the primitive solar nebula. This is supported by maps of the orientation of sub-micron grains in the Allende CV carbonaceous chondrite [1], by optical and scanning electron microscopy analyses of CM chondrite thin sections [2], and by theoretical models [3-6]. We present here a new numerical method to investigate the structure of chondrule rims, assuming that they were acquired in the gaseous environment of the solar nebula.

Method: We use an N-body code to study the growth of a chondrule rim through the collision of micron-sized dust aggregates with a mm-sized spherical body, which represents a chondrule. The code models the detailed collision processes of aggregates, taking into account the aggregate morphology, trajectory, and orientation of the colliding grains. The aggregates are formed from silicate spheres with a power law distribution in radius. In each iteration, a dust aggregate is shot towards the chondrule, with the relative velocity between the dust aggregate and chondrule determined by coupling of the particles to the turbulent gas environment [5]. The possible collision outcomes are sticking at the point of contact, bouncing, or rolling on the surface, which results in compaction. These outcomes are determined by the critical bouncing velocity and the critical rolling energy. For computational expediency, we restrict dust aggregates to accumulate on a small patch of the chondrule surface, measuring $\sim$120 μm by 120 μm.

Preliminary results: Figure 1 shows a rim structure from one of our numerical runs. Similar structures are divided into horizontal layers (i.e., parallel to the chondrule's surface) for analysis. The innermost layer has the highest compactness factor, and the porosity increases with vertical distance. The size distribution of monomers in each layer shows that the outer layers tend to have a higher ratio of large monomers to small monomers.

Discussion: As the porosity of the dust rim plays an important role in the collision between chondrules, these results provide useful information for predicting compound object growth. Since dust likely became electrically charged in the radiative plasma environment of the solar nebula, we will also present results comparing the formation of rims from neutral aggregates and rims formed in an environment where the chondrule and aggregates are charged. Our results will be compared with data from disaggregation of rimmed chondrules in CV chondrites [7], which show a near-linear relation between chondrule radius and rim thickness.

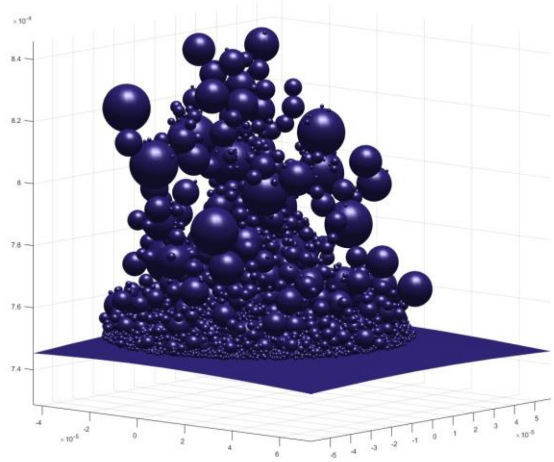

***Figure 1**: Preliminary chondrule rim structure using our N-body code. The length spanned by each horizontal axis is approximately 120 μm, while the length along the vertical axis spans approximately 100 μm.*

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