**Tailoring active matter collective behavior through particle anisotropy**Shannon E. Moran, Isaac R. Bruss, Sharon C. Glotze
Oak Ridge National Laboratory

moranse@umich.edu

**Abstract**

Studies of non-equilibrium systems composed of self-propelled particles --“active matter”-- have demonstrated that particle anisotropy can impact the collective behavior of the system. However, systems studied to date have served as one-off demonstrations of concept, rather than systematic treatments of anisotropy. Here, we computationally investigate the role of anisotropy in shape and active force director on the collective behavior of a two-dimensional active colloidal system. Systematic molecular dynamics study of the regular polygons was implemented using our in-house software package HOOMD-blue using computing resource on Titan.

We find that shape and force anisotropy can combine to enable critical densities lower than those found in disks, and in some cases may actually elevate the critical density. Specifically, we find that tailoring particle anisotropy can enable more “effective'' inter-particle collisions to tune the critical system density for phase separation. Additionally, we observe that the ability of clusters of anisotropic particles to stabilize rotational and translational motion results in nucleation of multiple clusters in the phase separation regime, which is not seen in systems of isotropic particles. In engineering applications for active colloidal systems, steric interactions such as those studied here may offer a simple route for tailoring emergent behaviors in active materials.