We discovered a new hexagonal metallic antiferromagnetic phase in the Cu-Mn-As system. Electrical switching and read-out of tetragonal CuMnAs inspired a world-wide research effort in metallic antiferromagnets. Phase equilibria in this system (Fig. a) however is poorly understood.

We synthesized crystals of hexagonal Cu$_{0.8}$Mn$_{1.2}$As and determined their chemical (Fig. b) and magnetic structure (Fig. c) through X-ray and neutron scattering supported by first principles density functional theory. No previously-known material of any composition has the same arrangement of atoms, so our work creates new possibilities for designing and engineering materials.

Conclusion: The discovery of new metallic antiferromagnetic phases advances fundamental understanding of this important new class of materials.