

In the last decade or so, metasurface optical components have received considerable scientific and industrial interest. The miniaturization afforded by metasurfaces could benefit astronomy in particular, which is an often-cited potential application area for metasurfaces. However, few developed examples in which metasurface components offer a unique benefit to astronomical instrumentation---substantiated by the production of scientific data---have been shown. Here, we present the Solar Imaging Metasurface Polarimeter (SIMPOL), a first-of-its-kind telescope for snapshot imaging polarimetry of the sun enabled by a high performance metasurface polarization-analyzing grating which provides for single element, snapshot imaging polarimetry. We demonstrate SIMPOL's integration into a major observatory telescope facility and the characterization of Zeeman signatures of solar magnetism. This work – among the first to demonstrate an advantage presented by metasurface optics to a real application in astronomical instrumentation – heralds the application of metasurfaces and emergent nanophotonic technologies in astronomy more broadly.