

- Brian Harbourne,

Title: New work on unexpected varieties with a short history and connection to Lefschetz properties

Abstract: This talk will describe recent work on unexpected hypersurfaces, its connection to failures of Lefschetz properties and our expanding notion of what an unexpected variety is. The field grew out of an inspiring paper by Di Gennaro, Ilardi and Valles (J. Lond. Math. Soc. 2014) relating certain failures of the Strong Lefschetz Property to occurrence of singular hypersurfaces. This led Cook, Harbourne, Migliore and Nagel (Compositio, 2018) to define the concept of and explore the geometry of plane unexpected curves and their connection to failure of Lefschetz properties, in turn leading to additional work by several groups (including Bauer, Malara, Szemberg and Szpond (Manus. Math. 2018) and Harbourne, Migliore, Nagel and Teitler (HMNT: Mich. Math. J. 2019)) further exploring the geometry and occurrence of unexpected curves and expanding the focus of this work to unexpected hypersurfaces. Initially the focus had been on the failure of a single general fat point to impose independent conditions on a vector space of forms comprising the homogeneous component of an ideal defining some subscheme (usually points) in projective space. The conclusion of this talk will be on new work of Harbourne, Migliore and Tutaj-Gasinska (HMT, in preparation) expanding this perspective. We show that the idea from HMNT of using cones to obtain unexpected hypersurfaces with respect to a single general fat point generalizes to linear fat spaces of dimension greater than 0. In addition, we apply results of Dumnicki, Harbourne, Roe, Szemberg and Tutaj-Gasinska (arXiv:1901.03725 which studies unexpected fat schemes of lines in \mathbb{P}^3) to get new examples of unexpected surfaces in \mathbb{P}^3 .