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Joints of Varieties

The joints theorem of Guth and Katz states that n lines in $\mathbb{R}^3$ form at most $O(n^{3/2})$ joints, where a joint is the intersection point of 3 non-coplanar lines. The proof of this result introduced a number of techniques that are now part of the standard toolkit of the polynomial method. We generalize this result from lines to varieties. One special case of our result states that n planes (2-flats) in $\mathbb{F}^6$ form at most $O(n^{3/2})$ joints, where a joint is the intersection point of 3 planes that do not all lie in a single hyperplane. Our results introduce new techniques for applying the polynomial method to higher-dimensional objects.

Joint work with Hung-Hsun Hans Yu and Yufei Zhao.