Lines in algebraic subsets of infinite-dimensional projective spaces and connectedness

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Abstract

Let V be an infinite-dimensional vector space over a field K and $X \subseteq P(V)$ the zero-set of finitely many homogeneous K-forms. Assume that K is either algebraically closed or a finite field. Here we prove that for all $P, Q \in X$ there are K-lines $D,\ R$ such that $P \in D$, $Q \in R$, $D \cap R \neq \emptyset$ and $D \cup R \subseteq X$. We also give effective versions of these results when $dim(V)$ is finite, but large.