

# HIGHER ORDER NORMALITY OF PROJECTIVE ALGEBRAIC VARIETIES

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Let  $X$  be a projective algebraic variety of dimension  $n$  in  $\mathbb{P}^r$ , such that the linear span of  $X$  is  $\mathbb{P}^r$ . Let  $\mathcal{I}(X)$  be the sheaf of ideals of  $X$ . The cohomology groups  $H^i(\mathbb{P}^r, \mathcal{I}_X(j))$ ,  $i, j \geq 0$  are the most basic invariants of the projective algebraic variety  $X$ . A conjecture of Zak states that these groups vanish for  $i \geq 1, j \geq 0, i+j < \frac{n}{r-n-1}$ . We talk about the current state of this conjecture and three related problems:  
1- The number and the degree of defining equations of projective algebraic varieties  
2- Multisecant lines of varieties of small codimension  
3- Irregular surfaces in  $\mathbb{P}^r$