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*Bounds on the Torsion Subgroups of Second Cohomology*

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**Abstract:** Let  $X \hookrightarrow \mathbb{P}^r$  be a smooth projective variety defined by homogeneous polynomials of degree  $\leq d$  over an algebraically closed field  $k$ . Let  $\mathbf{Pic} X$  be the Picard scheme of  $X$ , and  $\mathbf{Pic}^0 X$  be the identity component of  $\mathbf{Pic} X$ . The Néron–Severi group scheme of  $X$  is defined by  $\mathbf{NS} X = (\mathbf{Pic} X)/(\mathbf{Pic}^0 X)_{\text{red}}$ , and the Néron–Severi group of  $X$  is defined by  $\text{NS } X = (\mathbf{NS} X)(k)$ . We give an explicit upper bound on the order of the finite group  $(\text{NS } X)_{\text{tor}}$  and the finite group scheme  $(\mathbf{NS} X)_{\text{tor}}$  in terms of  $d$  and  $r$ . As a corollary, we give an upper bound on the order of the torsion subgroup of second cohomology groups of  $X$  and the finite group  $\pi_{\text{et}}^1(X, x_0)_{\text{tor}}^{\text{ab}}$ . We also show that  $(\text{NS } X)_{\text{tor}}$  is generated by  $(\deg X - 1)(\deg X - 2)$  elements in various situations.

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