For a set A over the integers and its indicator function χ_A, let

$$M(\chi_A, \alpha) = \sum_{1 \le n \le N} \chi_A(n) e(n\alpha)$$

be the exponential sum over A. Quantitative information about $M(\chi_A, \alpha)$ is useful for understanding the additive structure of A. Balog and Ruzsa, and later Keil, investigated the moments of the exponential sum over the set of r-free integers.

We investigate the analogous question in the function field setting. Building off of their techniques, we determine the precise order of magnitude of k-th moments of exponential sums over the set of r-free polynomials in the ring of polynomials $\mathbb{F}_q[t]$ for all $k > 0$. For $k > 1 + 1/r$, we acquire an asymptotic formula using a function field analogue of the Hardy-Littlewood circle method.