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Explicit Evaluation of Double Gauss Sums

Let n be a positive integer, p a prime, s an integer coprime to p and $Q = ax^2 + bxy + cy^2$ is an integral binary quadratic form. For any rational number α, we set $e(\alpha) := e^{2\pi i \alpha}$.

Consider the exponential sum given by $G(Q; s; p^n) := \displaystyle\sum_{x,y=0}^{p^n-1} e\left(\frac{Q \cdot s}{p^n}\right)$. We call this a double Gauss sum.

Using elementary methods, we give an explicit evaluation of these double Gauss sums, and show where we may apply this result. With time remaining, we will discuss how to expand these methods to deal with a general case.