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On some exponential sums over Mersenne numbers

Let m be a positive integer, a and g integers relatively prime to m. We give estimates for the exponential sum

$$\sum_{n\le N} \Lambda(n)\exp(2\pi i a g^n/m),$$

where Λ is the von Mangoldt function, and for a number of similar sums. In particular, our results yield bounds for exponential sums of the form

$$\sum_{p\le N} \exp(2\pi i a M_p/m),$$

where p runs through primes and M_p is the Mersenne number $M_p = 2^p - 1$. These results are joint work with W. Banks, A. Conflitti, and I. Shparlinski.