In this talk I will show that any classical communication protocol that can approximately simulate the result of applying an arbitrary measurement (held by one party) to a quantum state of $n$ qubits (held by another) must transmit at least $2^n$ bits, up to constant factors. The argument is based on a lower bound on the classical communication complexity of a distributed variant of the Fourier sampling problem. Two optimal quantum-classical separations follow as corollaries. First, a sampling problem which can be solved with one quantum query to the input, but which requires order-$N$ classical queries for an input of size $N$. Second, a nonlocal task which can be solved using $n$ Bell pairs, but for which any approximate classical solution must communicate $2^n$ bits, up to constant factors.

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