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**CAMERON MUSCO**, University of Massachusetts Amherst  
*Structured Matrix Approximation via Matrix-Vector Products*

In this talk, I will give an overview of recent progress on the problem of structured matrix approximation from matrix-vector products. Given a target matrix  $A$  that can only be accessed through a limited number of (possibly adaptively chosen) matrix-vector products, we seek to find a near-optimal approximation to  $A$  from some structured matrix class – e.g., a low-rank approximation, a hierarchical low-rank approximation, a sparse or diagonal approximation, etc. This general problem arises across the computational sciences and data science, both in algorithmic applications and, more recently, in scientific machine learning, where it is closely related to the problem of linear operator learning from input/output samples.

I will overview recent work, where we give 1) optimal algorithms for approximating  $A$  with a matrix with a fixed sparsity pattern (e.g., a diagonal or banded matrix), 2) the first algorithms with strong relative error bounds for hierarchical low-rank approximation, and 3) the first bounds for generic structured families with sample complexity depending on the parametric complexity of the family. I will highlight several open questions on structured matrix approximation and its applications to operator learning.