



**LinearMeasurementsMatrix-VectorProducts**

- If  $A$  is  $n \times n$ , matrix-vector products can be simulated with  $n$  linear measurements

Trace and compute exactly with one linear measurement

- Requires  $\Omega(n)$  matrix-vector products for exact trace

- Sun, Woodruff, Yang, Zhang '21 ( $\Delta$  detection)

- Requires  $\Omega(1/\varepsilon^2)$  for approximating up to  $1 \pm \varepsilon$

• Wimmer, Wu, Zhang '14



# Linear Measurements vs Matrix-Vector Products

- If  $A$  is  $n \times n$ , matrix-vector products can be simulated with  $n$  linear measurements
- Trace can be computed exactly with **one** linear measurement
  - Requires  $\Omega(n)$  matrix-vector products for exact trace
    - Sun, Woodruff, Yang, Zhang '21 ( $\Delta$  detection)
  - Requires  $\Omega(1/\varepsilon^2)$  for approximating up to  $1 \pm \varepsilon$ 
    - Wimmer, Wu, Zhang '14

# Upper Bounds