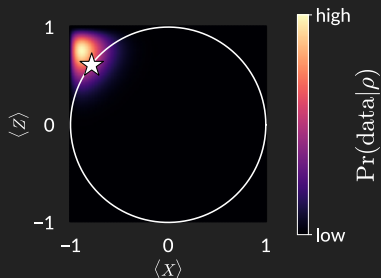


On pins and needles

The geometry of quantum measurements

Jonathan A. Gross

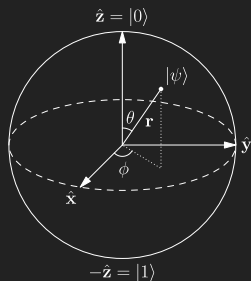
Geometry is important



Quantum inference requires optimization w.r.t. **geometric constraints**.

$$\hat{\rho} = \arg \max_{\rho \geq 0} \text{Pr}(\text{data}|\rho)$$

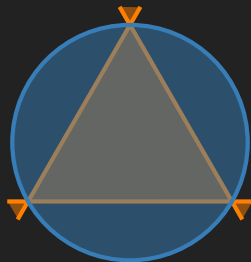
Qubits are trivial



$$\rho = \frac{1}{2}(\mathbb{I} + \mathbf{r} \cdot \boldsymbol{\sigma})$$

$$\rho \geq 0 \Leftrightarrow \|\mathbf{r}\| \leq 1 \Leftrightarrow \text{tr}(\rho^2) \leq 1$$

Higher dimensions become complicated



$$\text{tr}(\rho^2) \leq 1, \quad 3 \text{tr}(\rho^2) - 2 \text{tr}(\rho^3) \leq 1$$