Title: Tips for giving a great talk

Speakers: Robert Spekkens
Date: October 17, 2022 - 2:00 PM

URL: https://pirsa.org/22100109

Abstract: Zoom link: https://pitp.zoom.us/j/92724220960?pwd=NFY5TEl5VE9QbE5hdVJrdUJHVUZPdz09


Tips for giving a great talk
Robert Spekkens
PI, Oct. 17, 2022

Why bother?

Good science requires good communication

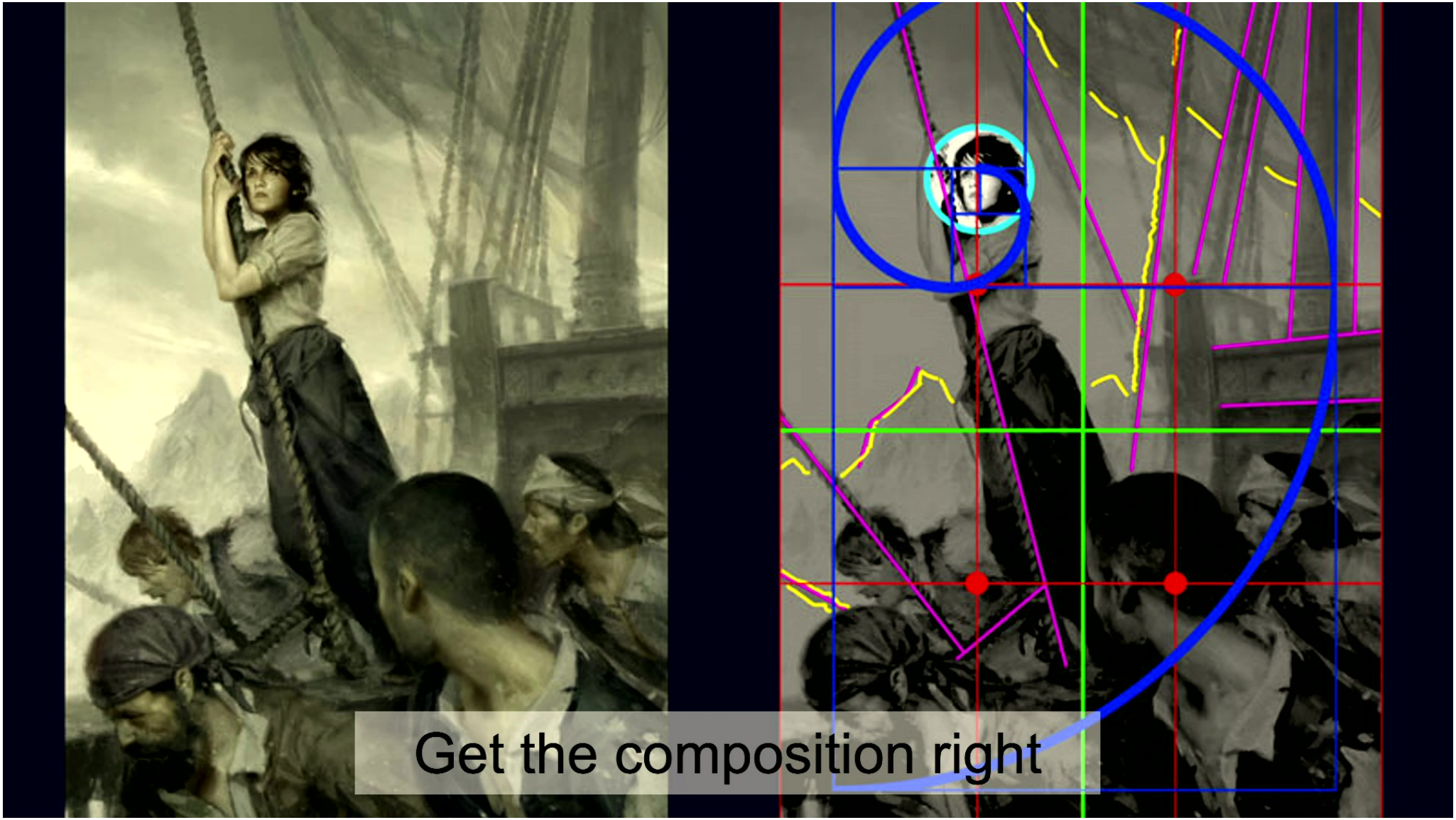
Every talk is a job talk

Public speaking is an acquired skill

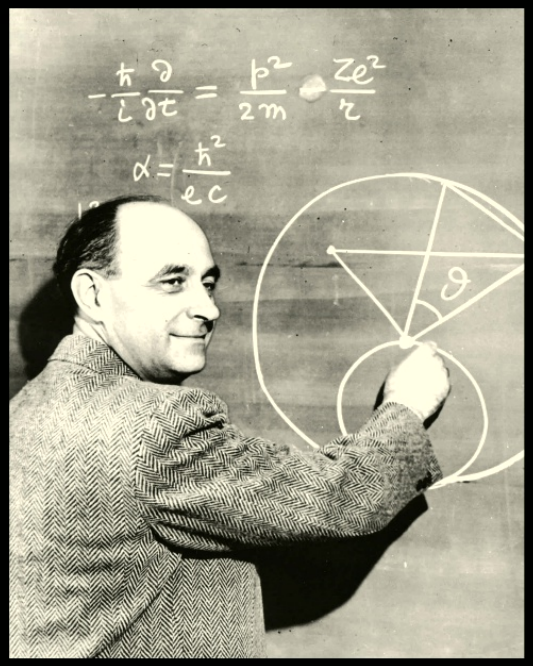
The three most important elements of a great talk:

narrative,
narrative,
narrative.

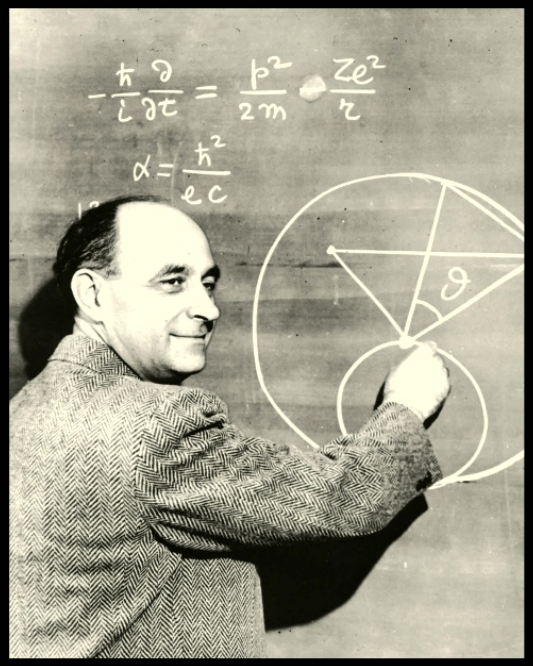

It must be clear how each
piece fits into the larger story


Get the composition right


Know your
audience!



Never underestimate the joy people derive from hearing something they already know.
--- Enrico Fermi



Never underestimate the joy people derive from hearing something they already know.
--- Enrico Fermi

But this is not the recipe for a great talk

Find good explanations!

The best explanations are those
that eliminate as many
unimportant details as possible

Feynman's lecture on general relativity

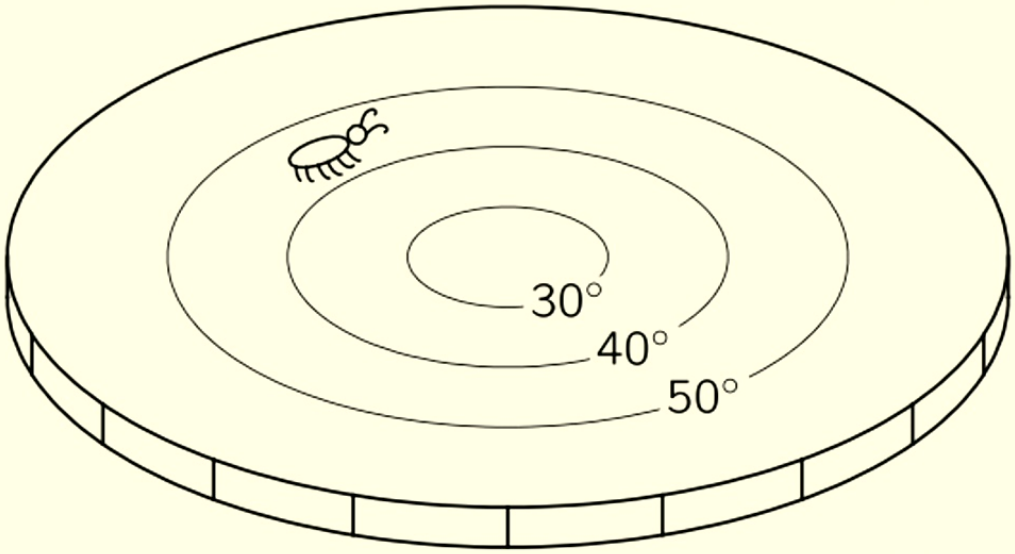
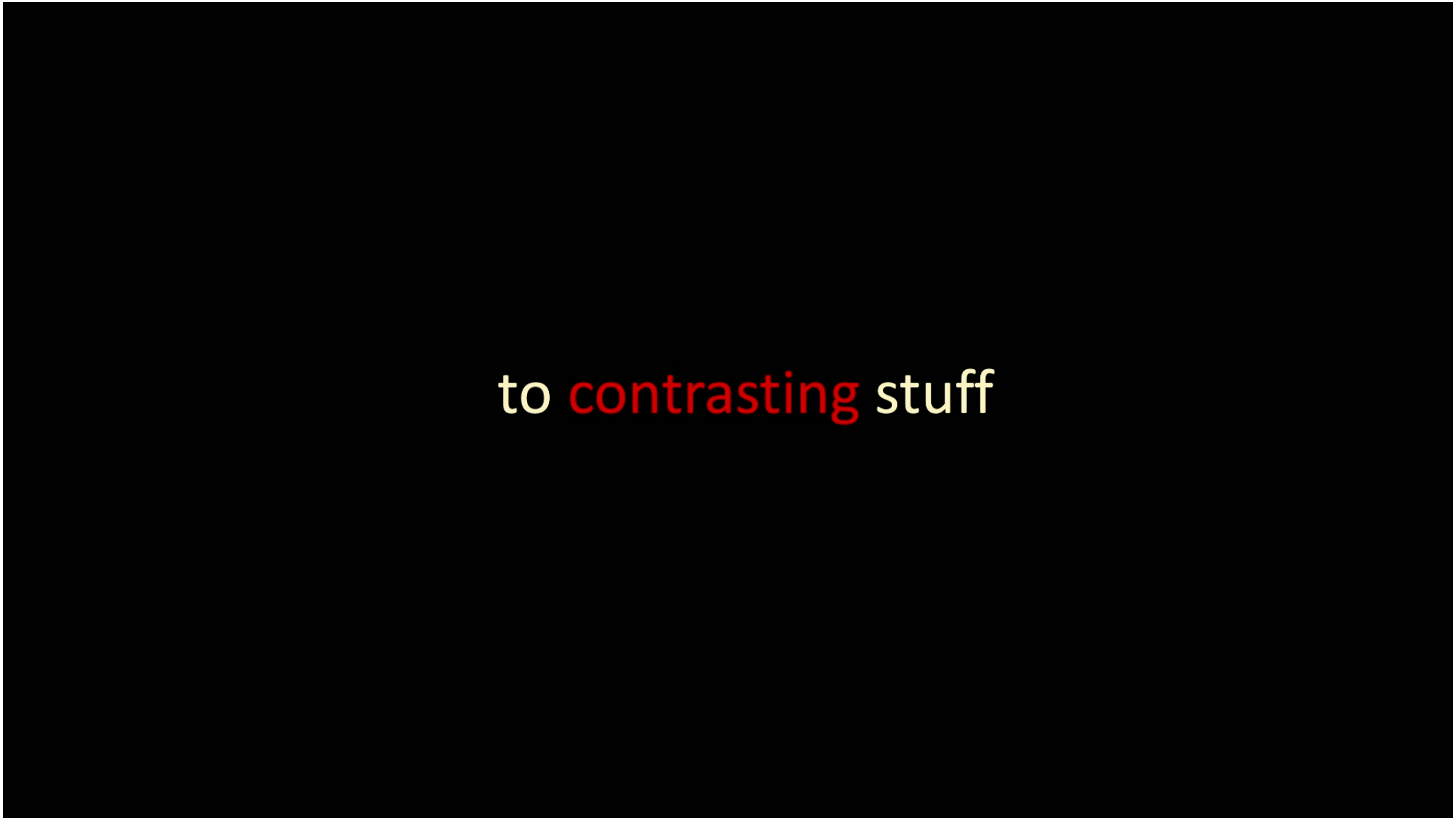


Fig. 42–3. A bug on a hot plate.

Considerations
at the level of a slide

Dark is much better

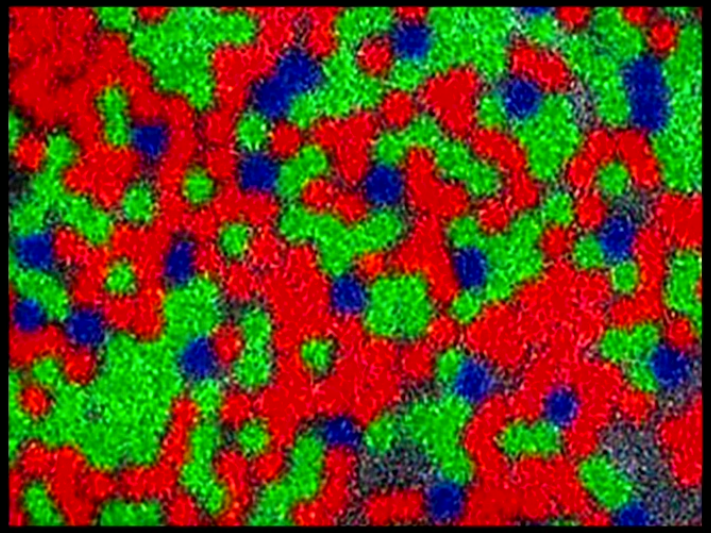
Our eyes are drawn to **big** stuff


to contrasting stuff

There is no point putting the transcript of *exactly what you are going to say* as text on your slides. It divides the audience's attention between listening to you and reading what's on your slides. Use your slides as a *complement* to what you are saying.

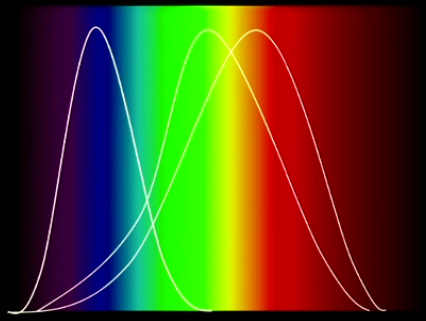
End Show Tips Use Slide Show

00:15 8:09 PM



Slide 22 of 151

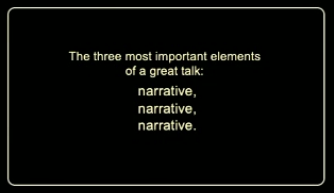
Next slide



The cells in the retina are called cones. They come in three types.

2

3



4

5

6

Sample frame title

This is a text in second frame. For the sake of showing an example.

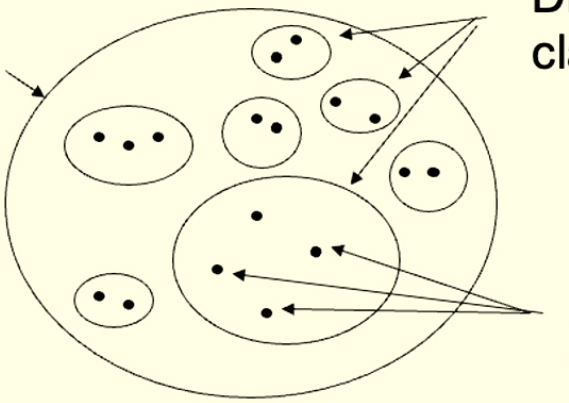
- **Text** visible on slide 1
- Text visible on slide 2
  - text sub**item**

The natural inclination: one slide per *topic*

An example

Defining the context of a procedure

The set of all procedures

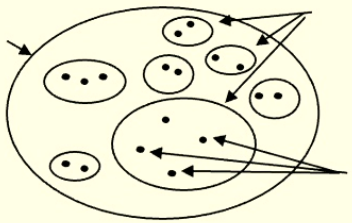


Different equivalence classes of procedures

Different contexts

Contexts for preparations in QM

The set of all preparation procedures



Different density operators ρ

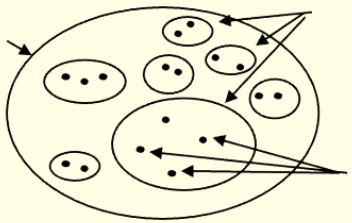
Different contexts

Preparation Noncontextuality

$$\mu_{\mathrm{P}}(\lambda) = \mu_{\rho}(\lambda)$$

Contexts for preparations in QM

The set of all preparation procedures



Different density operators ρ

Different contexts

Examples of contexts for mixed preparations:

Different convex decompositions of ρ

Many $\{p_j, |\psi_j\rangle\}$ such that
$\rho = \sum_j p_j |\psi_j\rangle\langle\psi_j|$

a.k.a. the ambiguity of mixtures

Different purifications of ρ

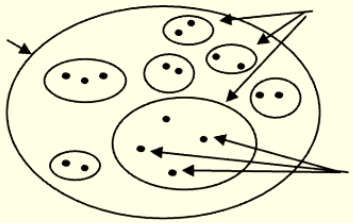
Many $|\Psi\rangle_{AB}$ such that
$\rho = \mathrm{Tr}_B(|\Psi\rangle_{AB}\langle\Psi|)$

Preparation Noncontextuality

$$\mu_P(\lambda) = \mu_\rho(\lambda)$$

Contexts for measurements in QM

The set of all measurement procedures



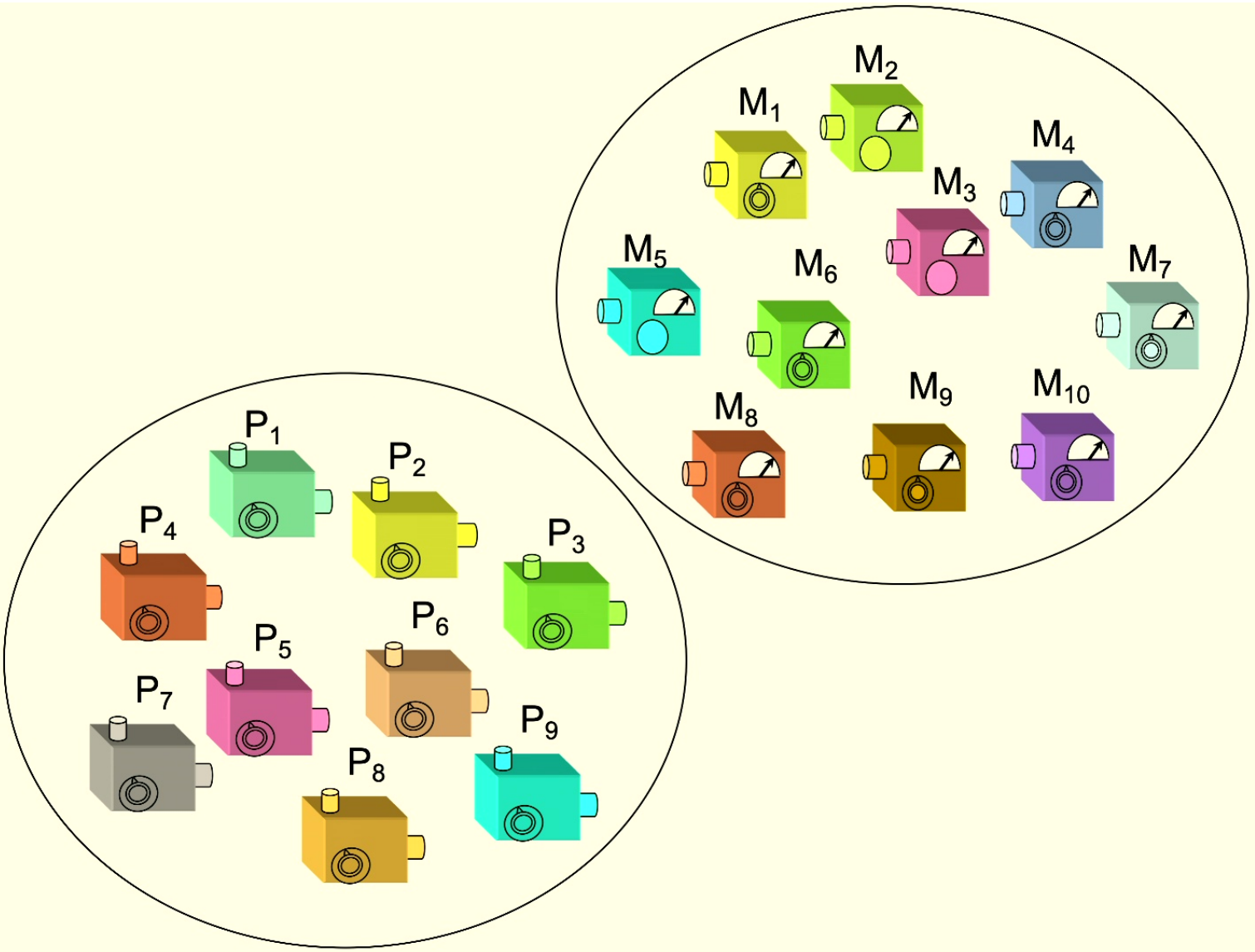
Different POVMs $\{E_k\}$

Different contexts

Measurement Noncontextuality

$$\xi_{\mathsf{M},j}(\lambda) = \xi_{\{E_k\},j}(\lambda)$$

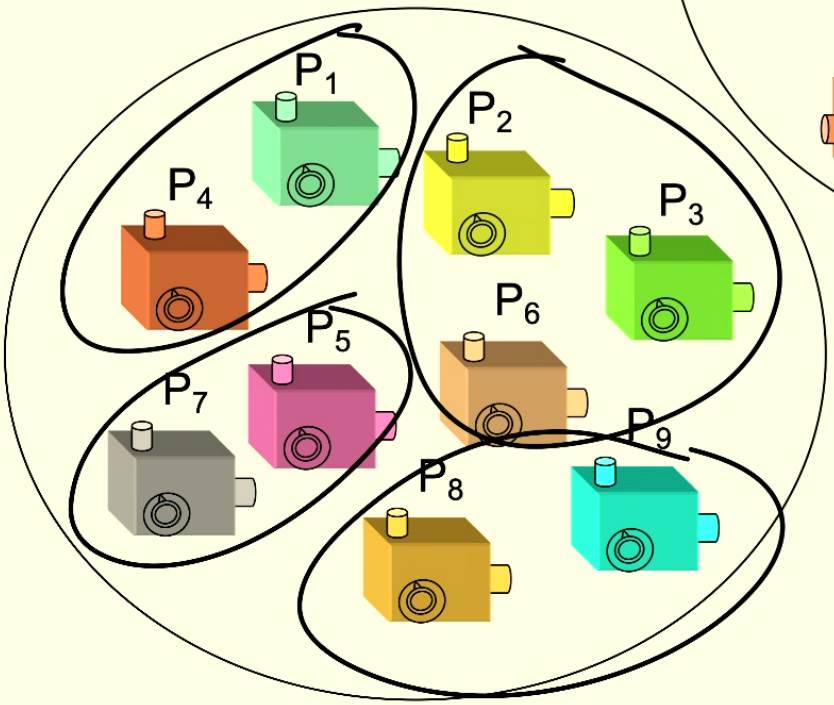
Preparation Noncontextuality

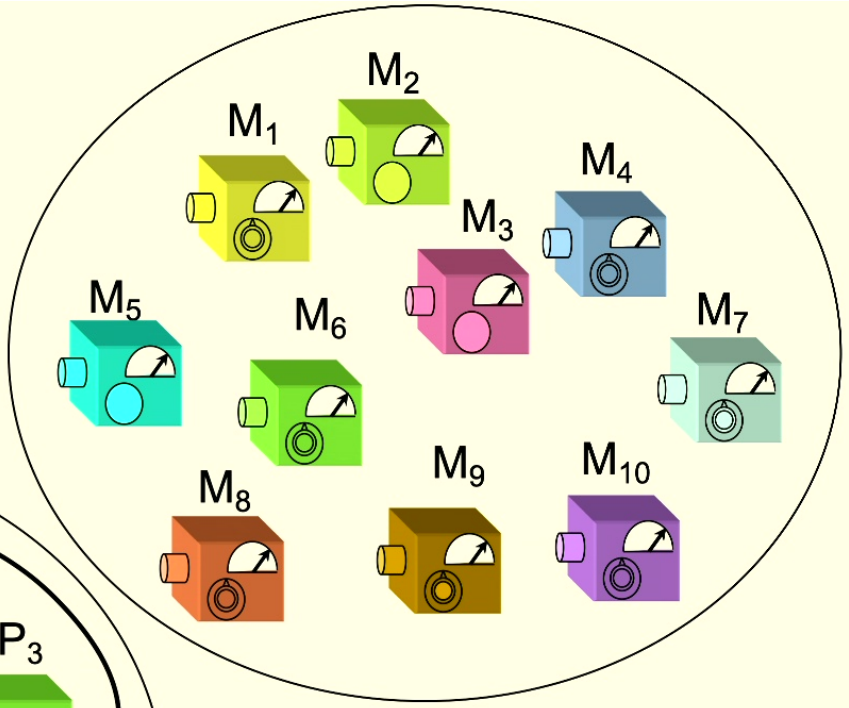

M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
P1
P2
P3
P4
P5
P6
P7
P8
P9

Operational equivalence classes of preparations

$$\mathsf{P} \simeq \mathsf{P}'$$

$$\forall \mathsf{M} : p(X|\mathsf{P},\mathsf{M}) = p(X|\mathsf{P}',\mathsf{M})$$

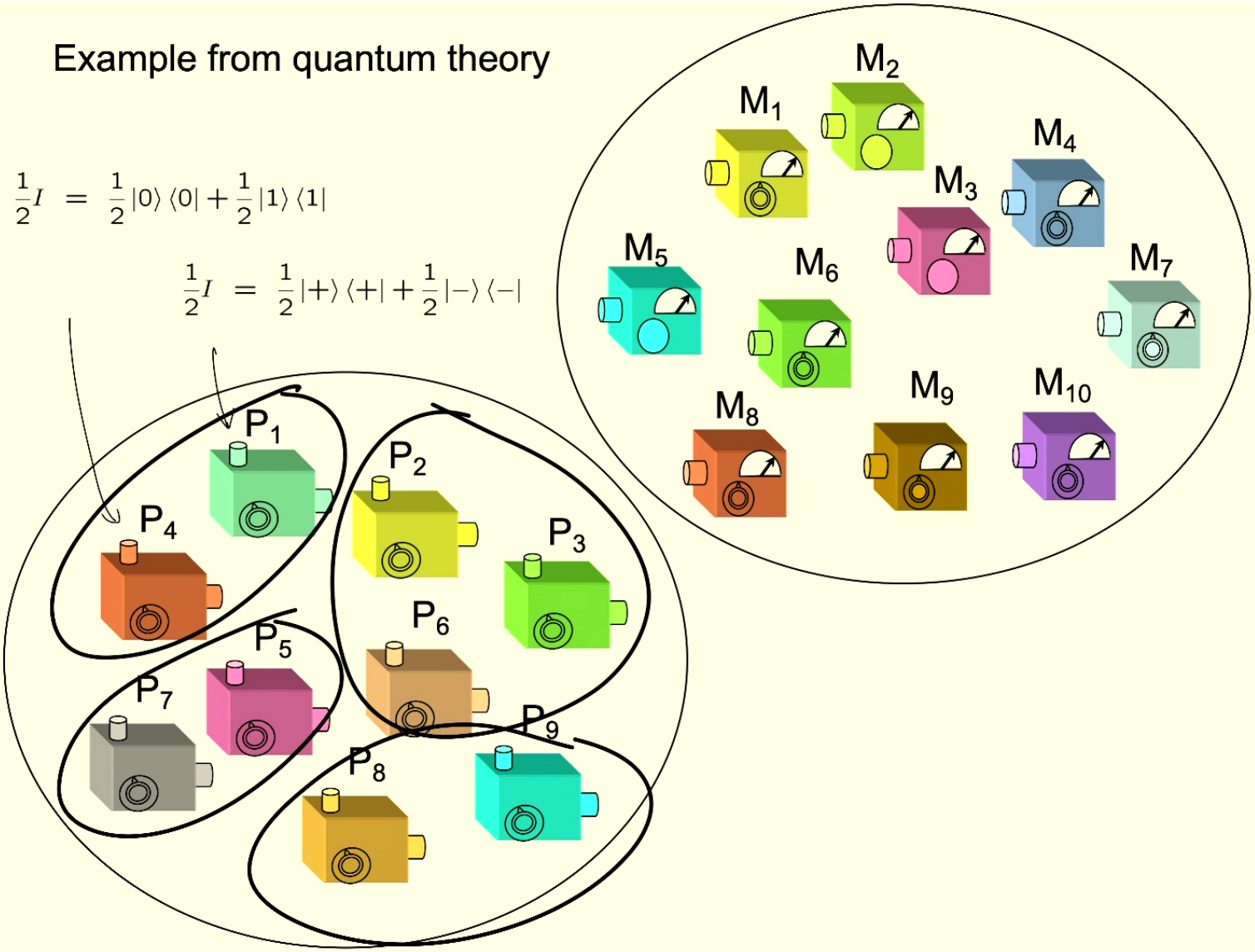


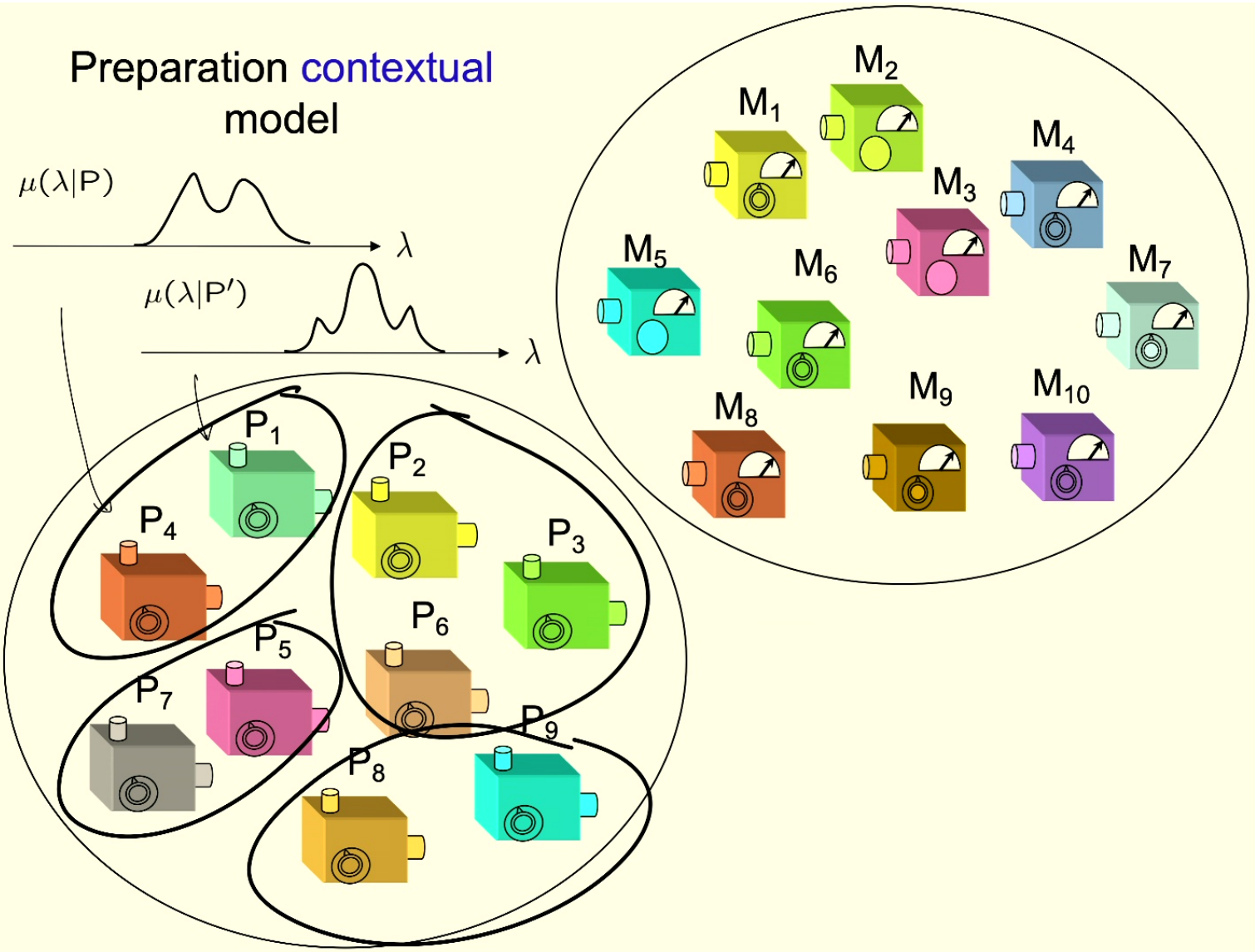


Example from quantum theory

$$\frac{1}{2}I = \frac{1}{2}|0\rangle\langle 0| + \frac{1}{2}|1\rangle\langle 1|$$

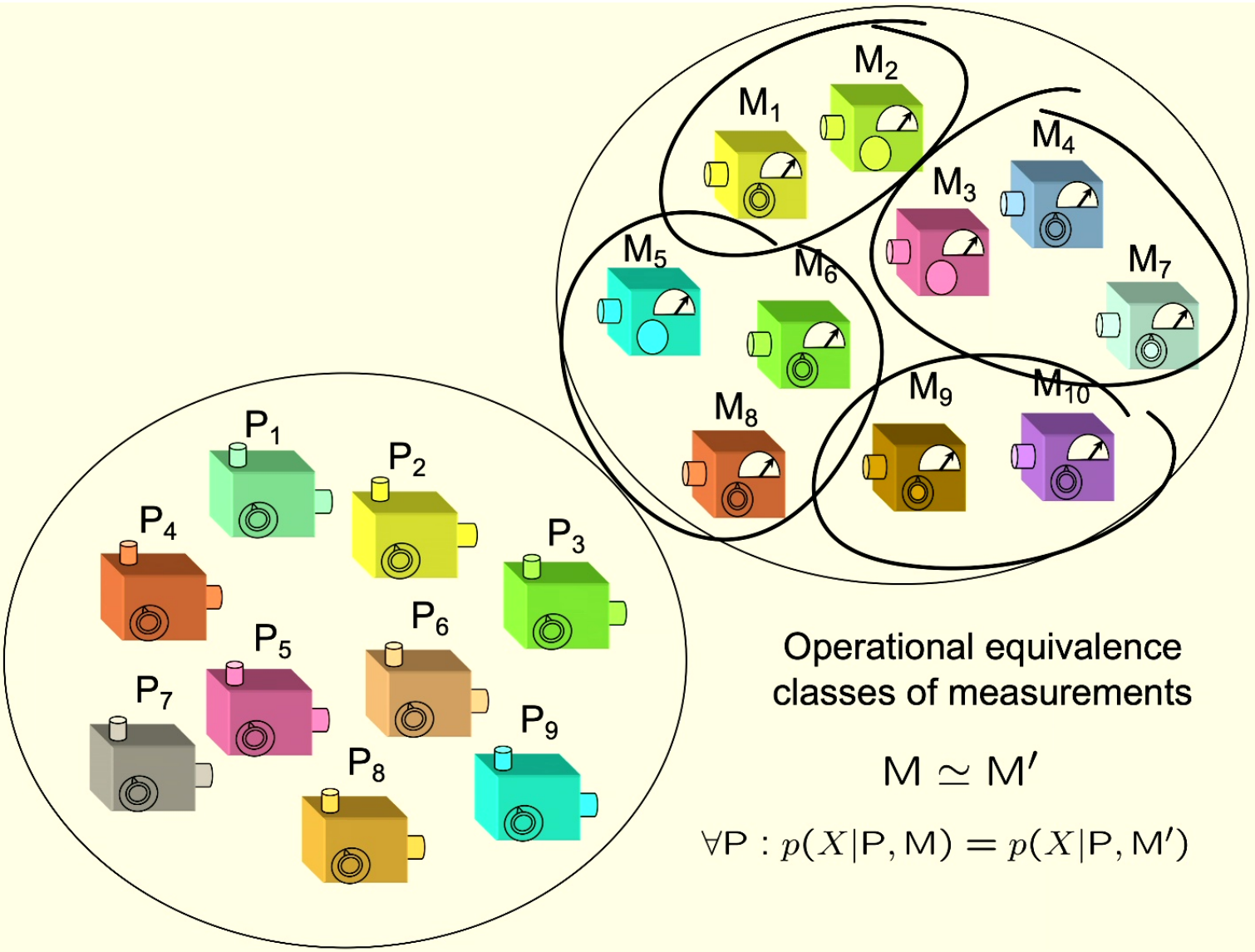
$$\frac{1}{2}I = \frac{1}{2}|+\rangle\langle +| + \frac{1}{2}|-\rangle\langle -|$$




Preparation contextual model
$\mu(\lambda|P)$
λ
$\mu(\lambda|P')$
λ
P_1
P_2
P_3
P_4
P_5
P_6
P_7
P_8
P_9
M_1
M_2
M_3
M_4
M_5
M_6
M_7
M_8
M_9
M_{10}

Preparation noncontextuality

$$\forall \mathsf{M} : p(X|\mathsf{P},\mathsf{M}) = p(X|\mathsf{P}',\mathsf{M}) \quad \longrightarrow \quad \mu(\lambda|\mathsf{P}) = \mu(\lambda|\mathsf{P}')$$



Operational equivalence classes of measurements

$$\mathrm{M} \simeq \mathrm{M}'$$

$$\forall \mathrm{P} : p(X|\mathrm{P},\mathrm{M}) = p(X|\mathrm{P},\mathrm{M}')$$

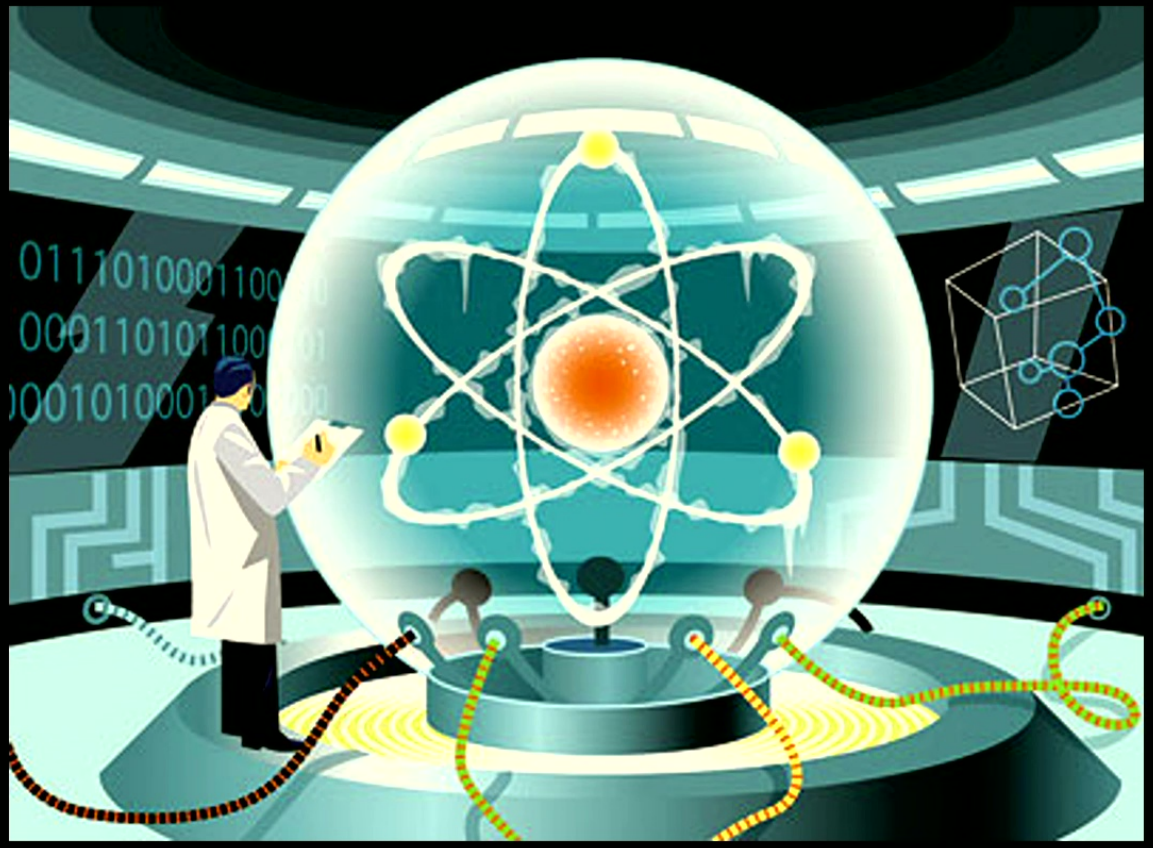
“Use fewer slides” is bad advice

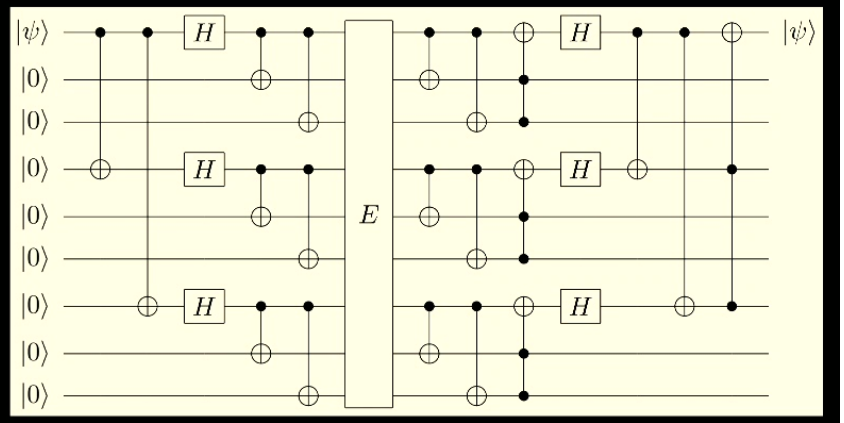
Applications:

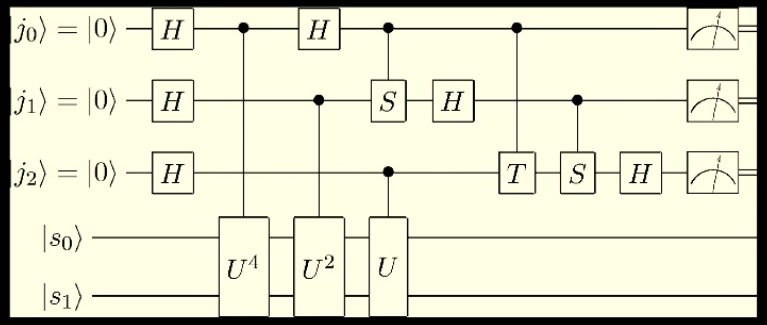
- Analyzing circuit structures in quantum computation
- Optimizing quantum communication networks
- New protocols for quantum cryptography

Applications:

Optimizing quantum communication networks




$|\psi\rangle$
$|0\rangle$
$|0\rangle$
$|0\rangle$
$|0\rangle$
$|0\rangle$
$|0\rangle$
$|0\rangle$
$|0\rangle$
H
H
H
H
H
H
E
$|\psi\rangle$


$j_0\rangle = |0\rangle$
$j_1\rangle = |0\rangle$
$j_2\rangle = |0\rangle$
$|s_0\rangle$
$|s_1\rangle$
H
H
H
H
S
H
T
S
H
U^4
U^2
U

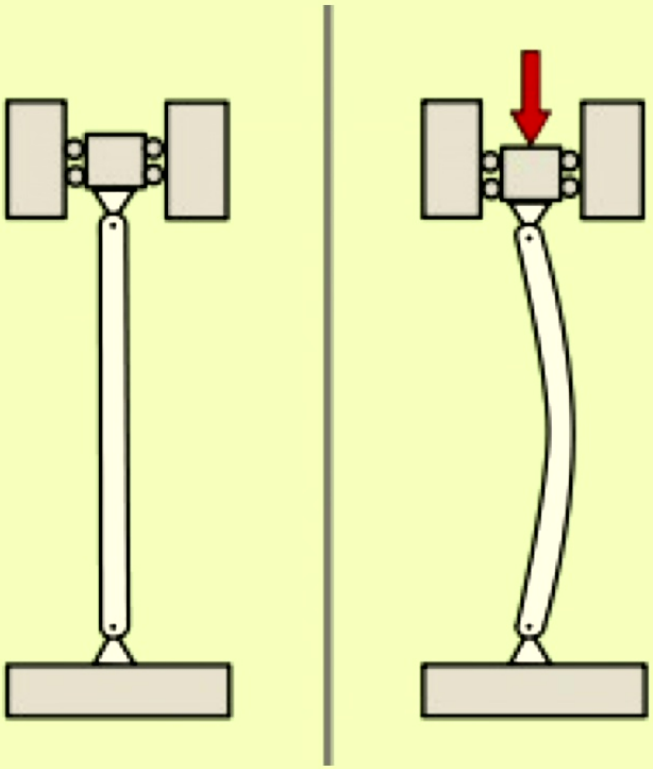
Increasing engagement

Pierre Curie
(1859 –1906)

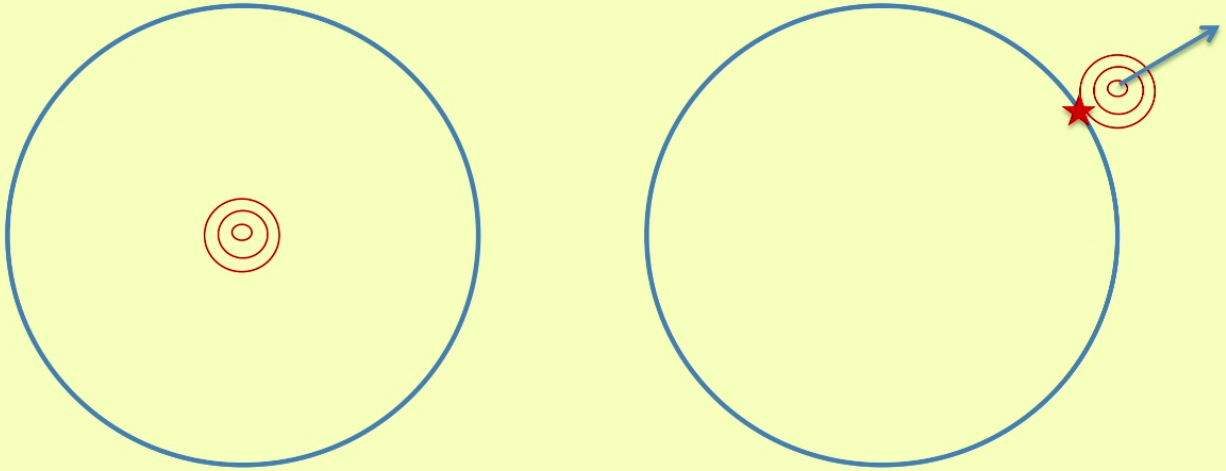
Curie's principle

Any asymmetry in a physical effect must be found in its causes

Violation of Curie's principle?

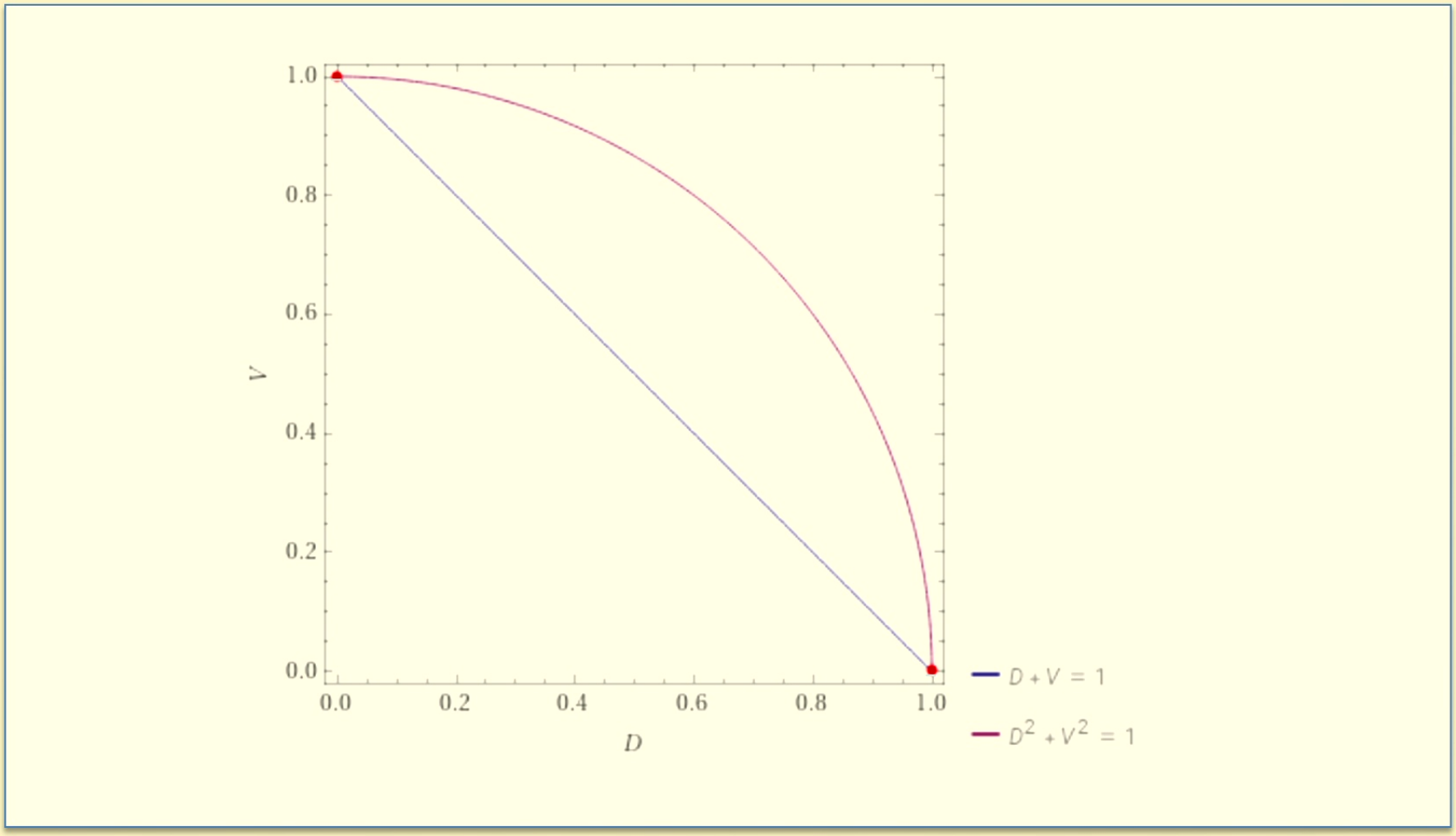


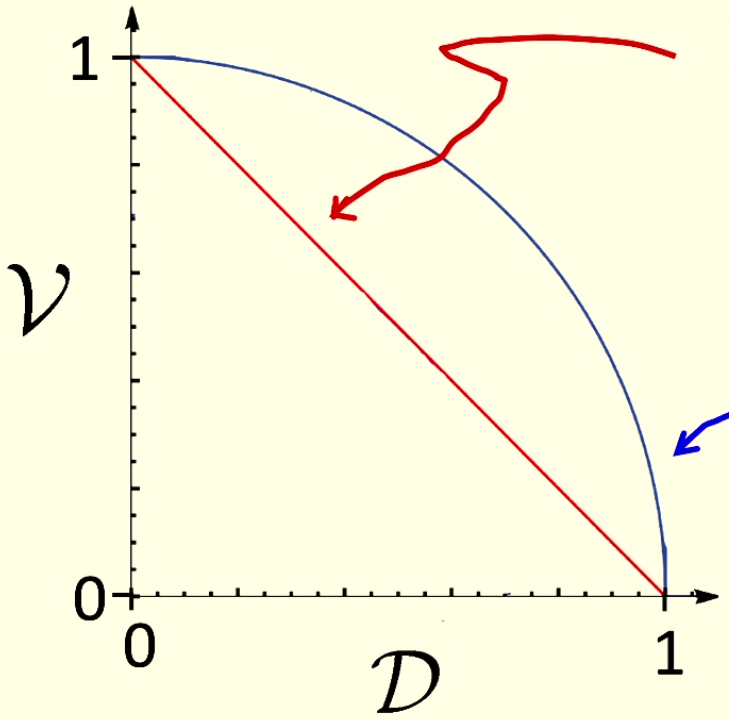
Violation of Curie's principle?



Drop the outline

Drop the conclusion-as-summary


1.0
0.8
0.6
0.4
0.2
0.0
V
0.0
0.2
0.4
0.6
0.8
1.0
D
D + V = 1
D^2 + V^2 = 1

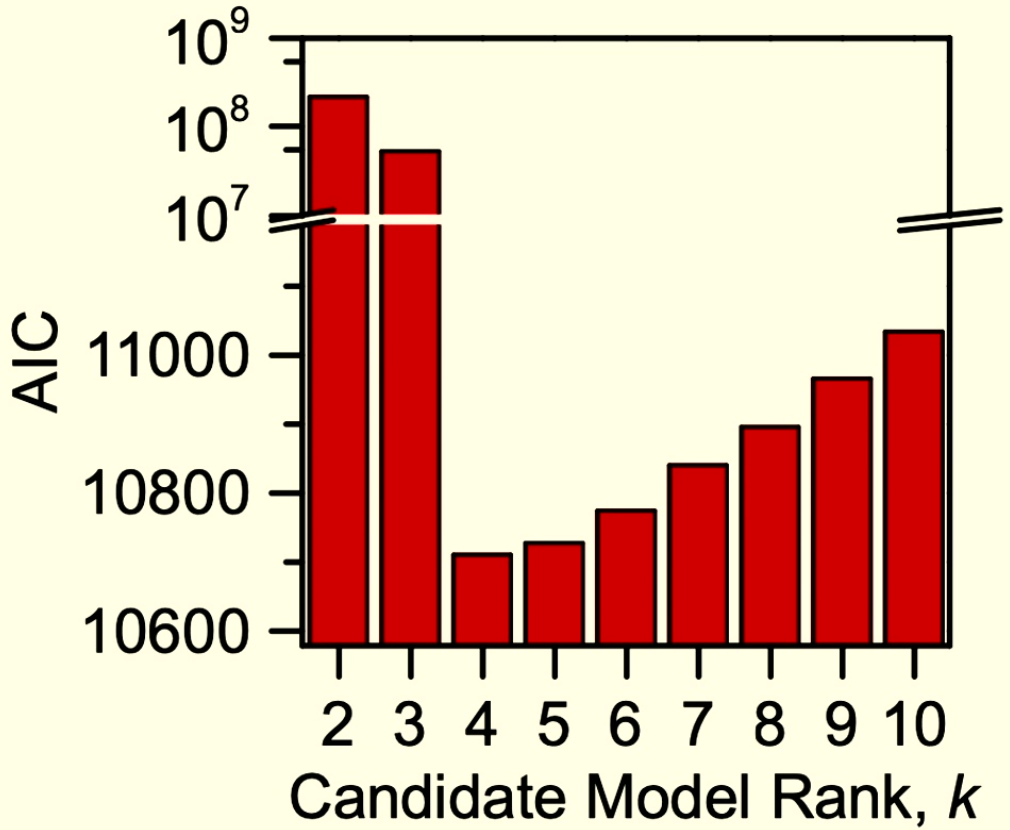


Noncontextual bound on tradeoff

$$\mathcal{V} + \mathcal{D} \leq 1$$

Quantum tradeoff

$$\mathcal{V}^2 + \mathcal{D}^2 \leq 1$$


10^9
10^8
10^7
AIC
11000
10800
10600
2 3 4 5 6 7 8 9 10
Candidate Model Rank, *k*

Mathematical proofs

$$A = \frac{1}{6} \sum_{t \in \{1,2,3\}} \sum_{b \in \{0,1\}} \sum_{\lambda} \xi(X = b | M_t, \lambda) \mu(\lambda | P_{t,b})$$

$$\xi(X = b | M_t, \lambda) \leq \eta(M_t, \lambda)$$

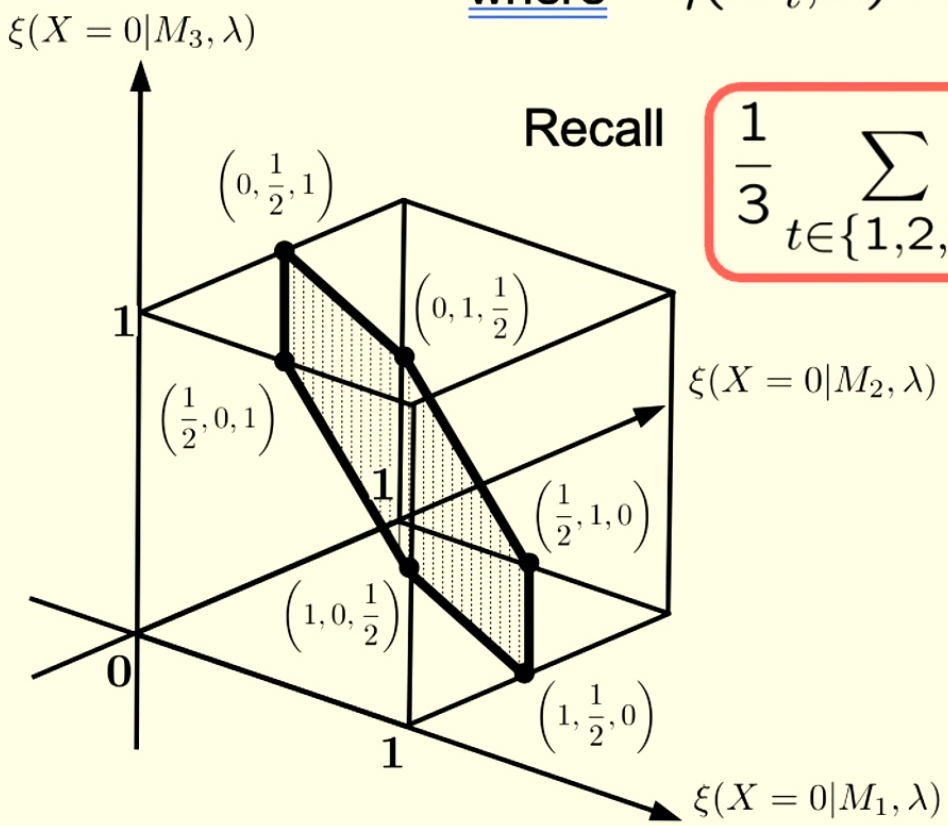
where $\eta(M_t, \lambda) \equiv \max_{b' \in \{0,1\}} \xi(X = b' | M_t, \lambda).$

$$A \leq \frac{1}{3} \sum_{t \in \{1,2,3\}} \sum_{\lambda \in \Lambda} \eta(M_t, \lambda) \left(\frac{1}{2} \sum_{b \in \{0,1\}} \mu(\lambda | P_{t,b}) \right)$$

$$\frac{1}{2} \sum_{b \in \{0,1\}} \mu(\lambda | P_{1,b}) = \frac{1}{2} \sum_{b \in \{0,1\}} \mu(\lambda | P_{2,b}) = \frac{1}{2} \sum_{b \in \{0,1\}} \mu(\lambda | P_{3,b}) \equiv \nu(\lambda)$$

$$A \leq \max_{\lambda \in \Lambda} \left(\frac{1}{3} \sum_{t \in \{1,2,3\}} \eta(M_t, \lambda) \right)$$

where $\eta(M_t, \lambda) \equiv \max_{b' \in \{0,1\}} \xi(X = b' | M_t, \lambda).$

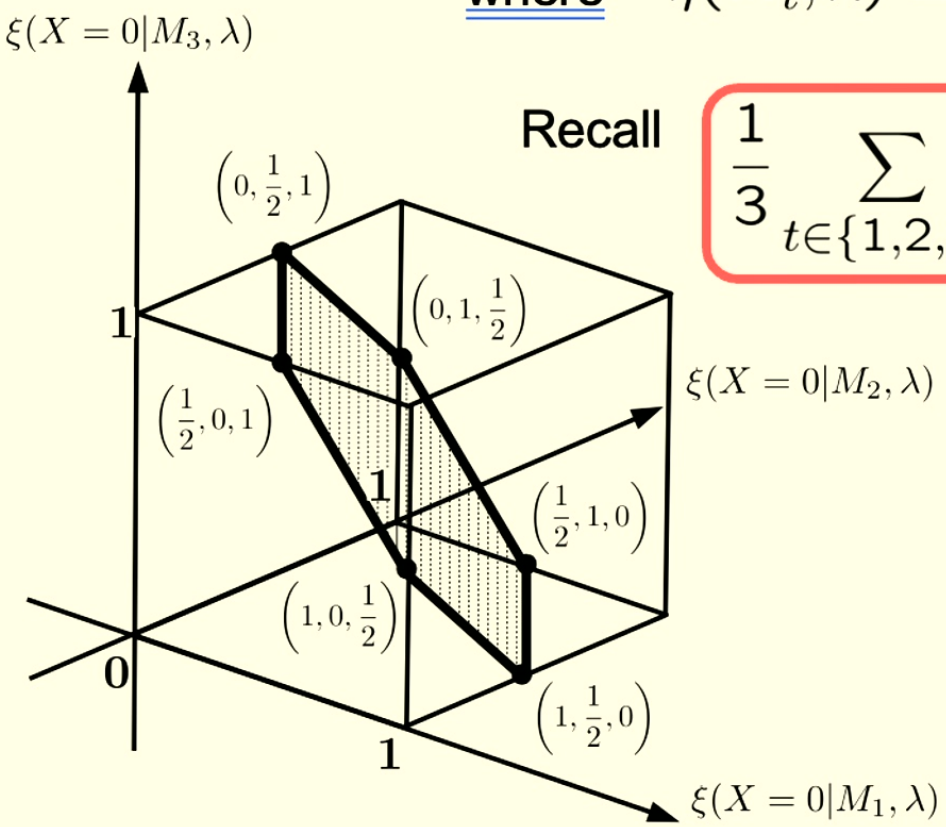


Recall

$$\frac{1}{3} \sum_{t \in \{1,2,3\}} \xi(X = b | M_t, \lambda) = \frac{1}{2}$$

$$A \leq \max_{\lambda \in \Lambda} \left(\frac{1}{3} \sum_{t \in \{1,2,3\}} \eta(M_t, \lambda) \right)$$

where $\eta(M_t, \lambda) \equiv \max_{b' \in \{0,1\}} \xi(X = b' | M_t, \lambda).$



Recall

$$\frac{1}{3} \sum_{t \in \{1,2,3\}} \xi(X = b | M_t, \lambda) = \frac{1}{2}$$

$$A \leq \frac{1}{3}(1 + 1 + \frac{1}{2})$$

$$= \frac{5}{6} \quad \text{QED}$$

Timing

If it’s too long, you can:

Eliminate material that is not critical to your thesis

Find more compact explanations

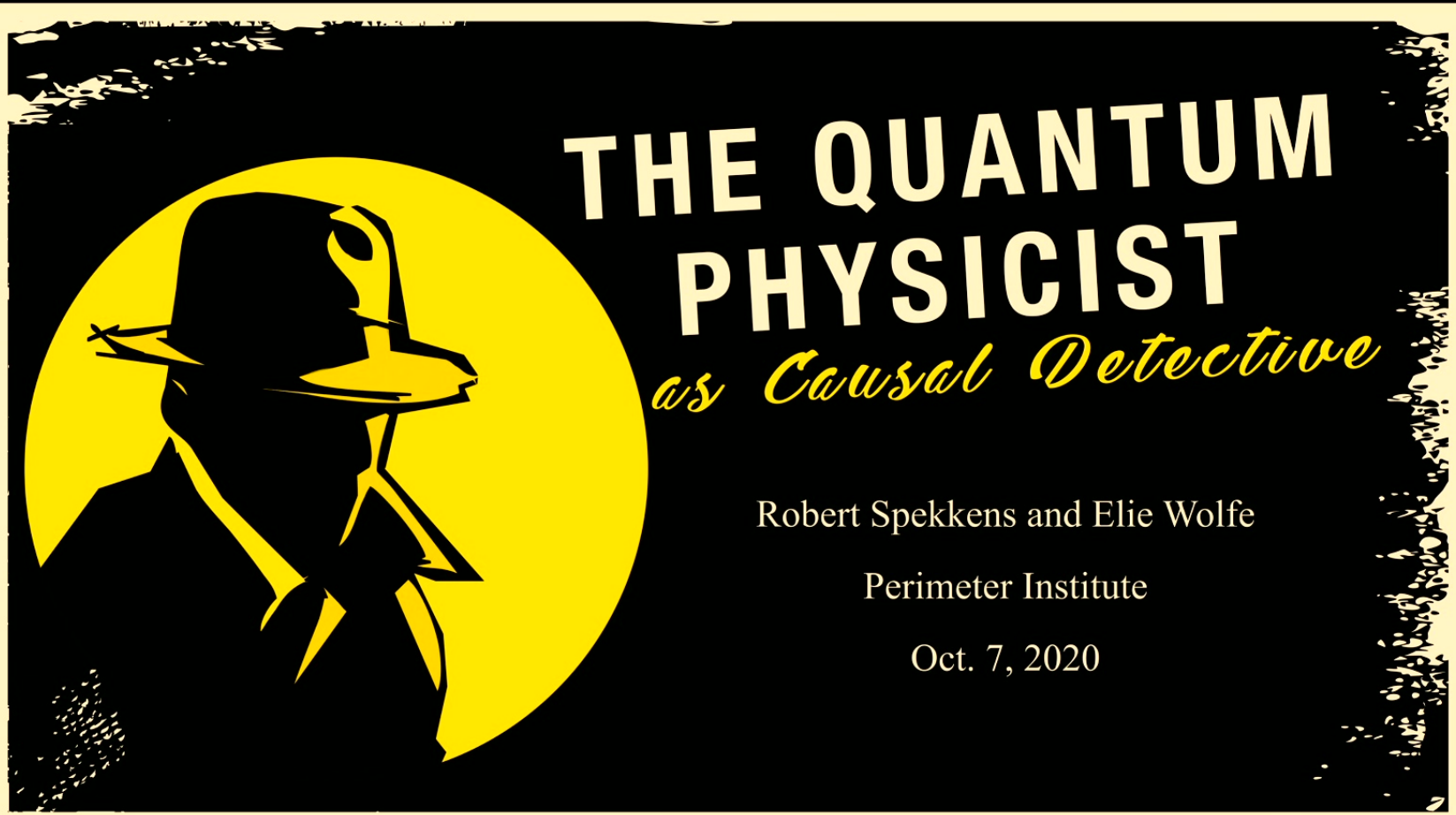
Find more compact explanations

Nailing the delivery

Speak as if you are telling a story

Practice runs

What to memorize


THE QUANTUM PHYSICIST
as Causal Detective
Robert Spekkens and Elie Wolfe
Perimeter Institute
Oct. 7, 2020


Good luck!