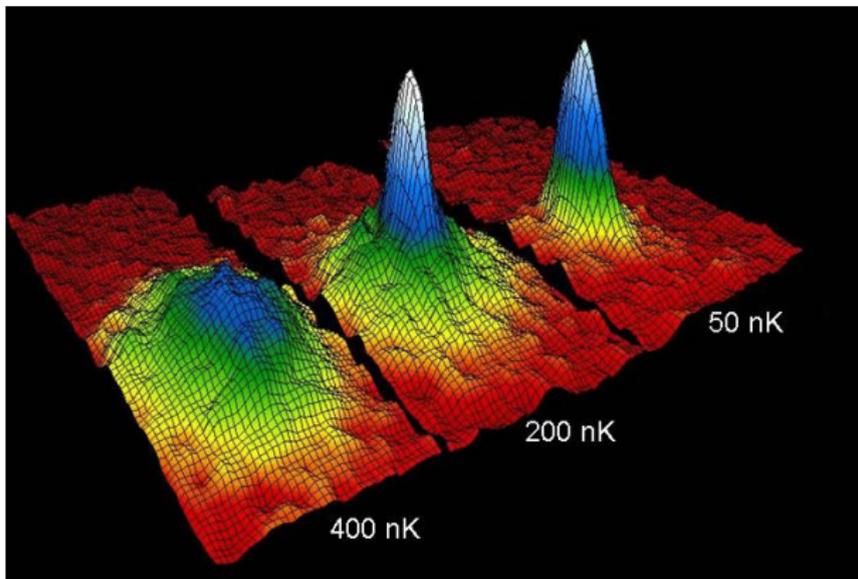


# Communicating Mathematics

Kay Kirkpatrick, UIUC

2019

# Communicating Mathematics: Imagination, Empathy, and Experience



Kay Kirkpatrick, UIUC

Urbana, Miami, and Mascouten lands, Feb. 2019



Outline (for a long talk) comes *\*after\** the motivation

1. Imagination: tell a story, and use metaphors.
2. Empathy: use large font, and pictures.
3. Experience: practice, read, attend talks.

## Make the main point of the slide large and up front

`{\large: Don't go backwards on slides or forwards many slides}`

`{\Large: This works nicely on equations too}`

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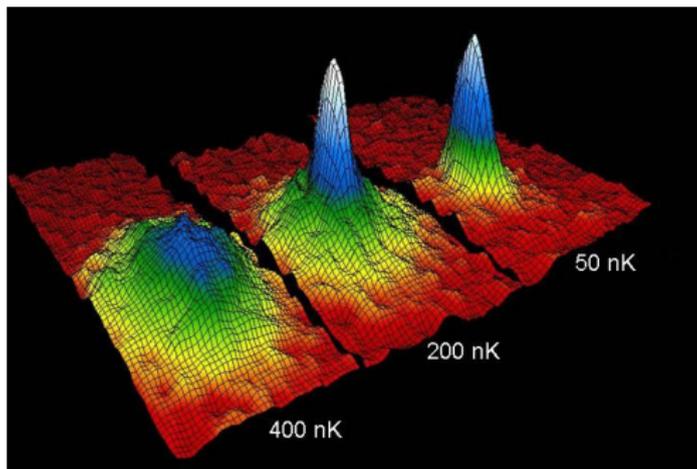
`{\huge: This works but word wrap}`

`{\Huge: This works}`

`\tiny Only for photo credits, etc. (Regular size)`

## BEFORE SLIDE: The Physics of BEC, cont.

When they turned off the trap, the gas remained coherent and moved as if it were a single macroscopic quantum particle, an “atom laser.”

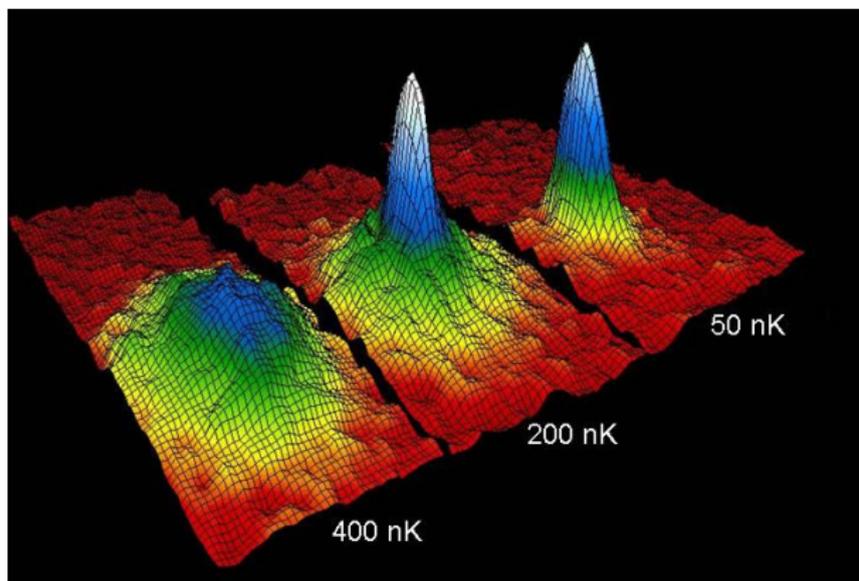


**Figure:** The bosons' momenta after the trap is removed (Atomic Lab)

Applications to interferometry, quantum computing, and more.

## AFTER SLIDE: After the trap was turned off

BEC stayed coherent like a single macroscopic quantum particle.



Momentum is concentrated after release at 50 nK. (Atomic Lab)





**Prof\Dr Kay Kirkpatrick** 🔑

@kay314159

Following



The order of different quantifiers is important:

(1) For all  $x$  there exists  $y$  such that  $y=2x+3$ .

(2) There exists  $y$  such that for all  $x$ ,  $y=2x+3$ .

(1) is true and (2) is false.

11:02 AM - 18 Oct 2018

9 Retweets 49 Likes



Have some sort of summary at the end

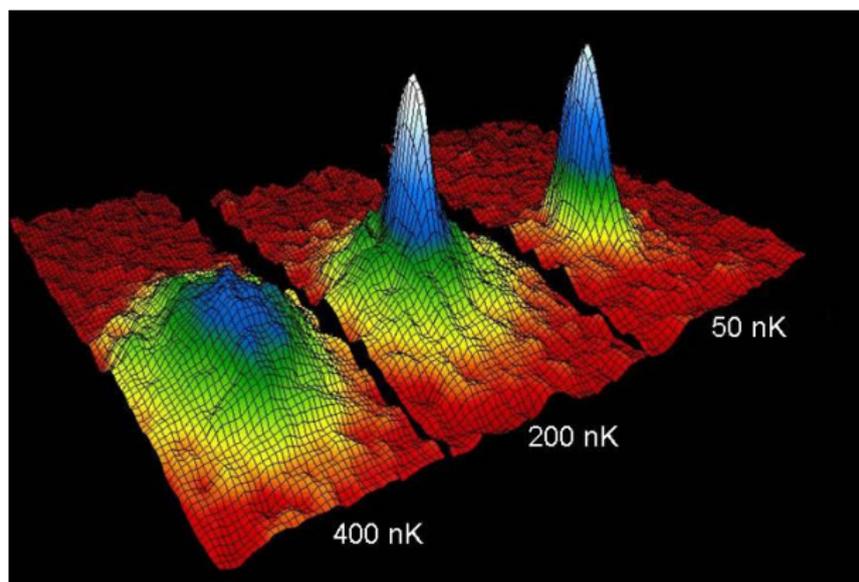
Physics, Biology



Probability, PDE, Logic

Thanks

NSF CAREER DMS-1254791, Simons Sabbatical Fellowship



<https://faculty.math.illinois.edu/~kkirkpat/writing.html>  
and [~kkirkpat/presenting.html](https://faculty.math.illinois.edu/~kkirkpat/presenting.html)

# Our CLT for interacting quantum many-body systems

**Theorem (Ben Arous, K., Schlein, 2013):** If the initial state is factorized  $\psi_N^0 = \varphi_0^{\otimes N}$  with normalized  $\varphi_0 \in H^1(\mathbb{R}^3)$ , and  $A$  is compact self-adjoint on  $L^2(\mathbb{R}^3)$ , and  $V \leq 1/|\cdot|$ , then for  $t \in \mathbb{R}$

$$\mathcal{A}_t := \frac{1}{\sqrt{N}} \sum_{j=1}^N (A_j - \mathbb{E}_{\varphi_t} A) \xrightarrow{\text{distrib. as } N \rightarrow \infty} \mathcal{N}(0, \sigma_t^2).$$

Distribution of  $\mathcal{A}_t$  from  $\psi_N = \psi_{N,t}$ .

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$$\sigma_0^2 = \mathbb{E}_{\varphi_0}[A^2] - (\mathbb{E}_{\varphi_0} A)^2 = \|A\varphi_0\|^2 - \langle \varphi_0 | A\varphi_0 \rangle^2.$$

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The variance  $\sigma_t^2$  is more subtle than replacing  $\varphi_0$  by  $\varphi_t$ .