# Problems of Modern Physics

## Lecture 1

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# Dynamics of scientific ideas

# Idea as a virus

| Elements of the epidemic process | Viruses | Ideas |
| --- | --- | --- |
| • Agent | • Infectious material | • Idea |
| • Infective | • Case of disease | • Author of paper |
| • Susceptible | • Person | • Reader |
| • Removal | • Death of immunity | • Loss of interest |

W. Goffman, V. A. Newill, Generalization of epidemic theory: an application to the transmission of ideas. *Nature* **204**, 225 (1964)

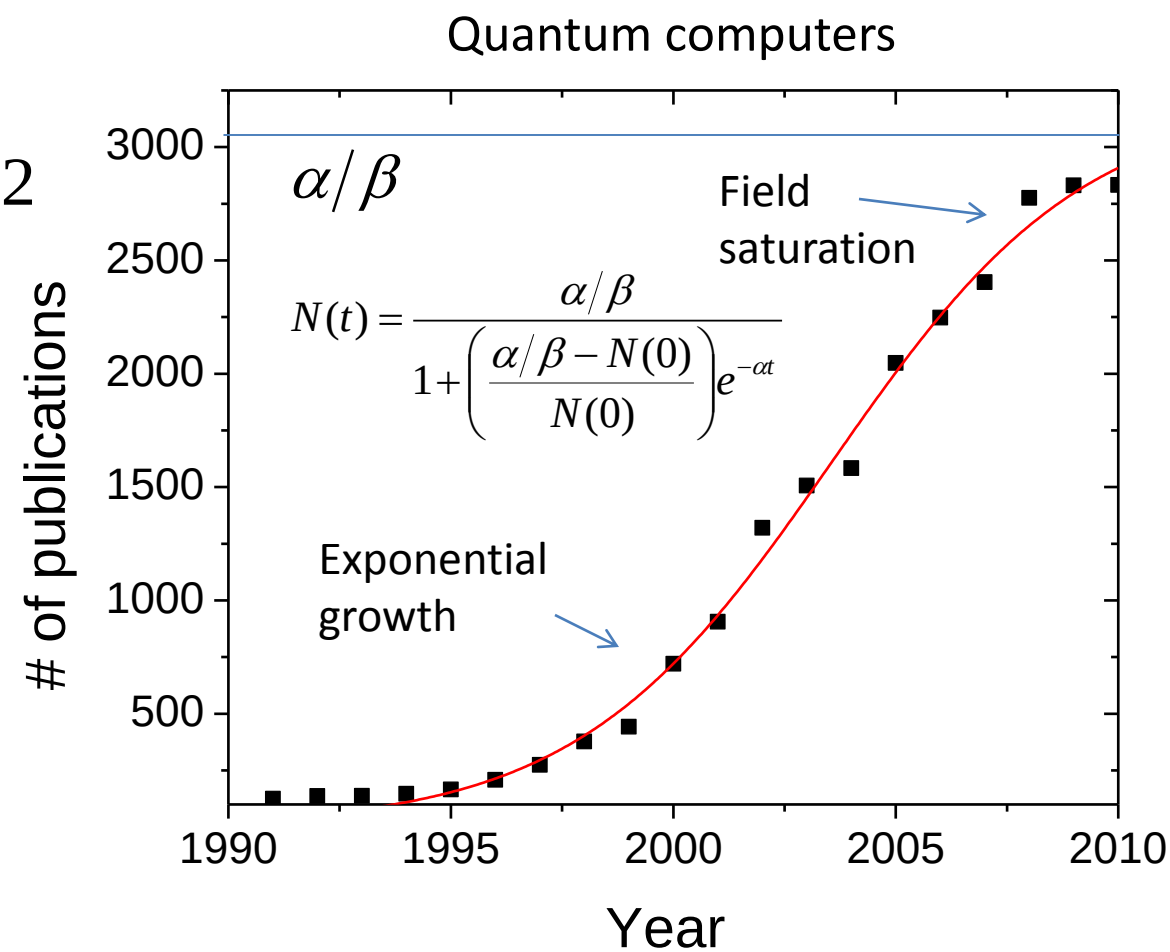
# Population dynamics model

## Lotka-Volterra equation

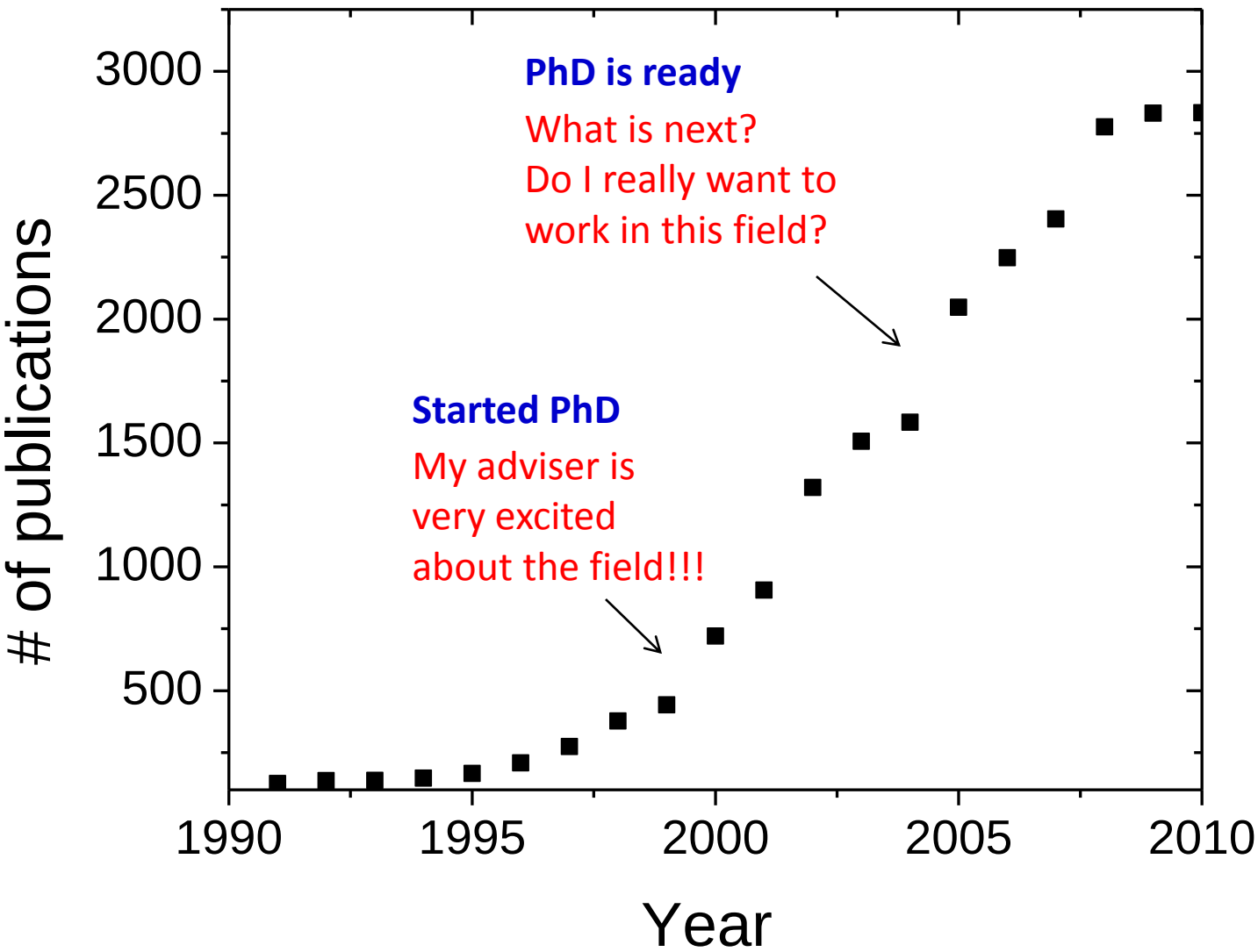
$$\frac{dp}{dt} = \alpha p - \beta p^2$$

Exponential growth

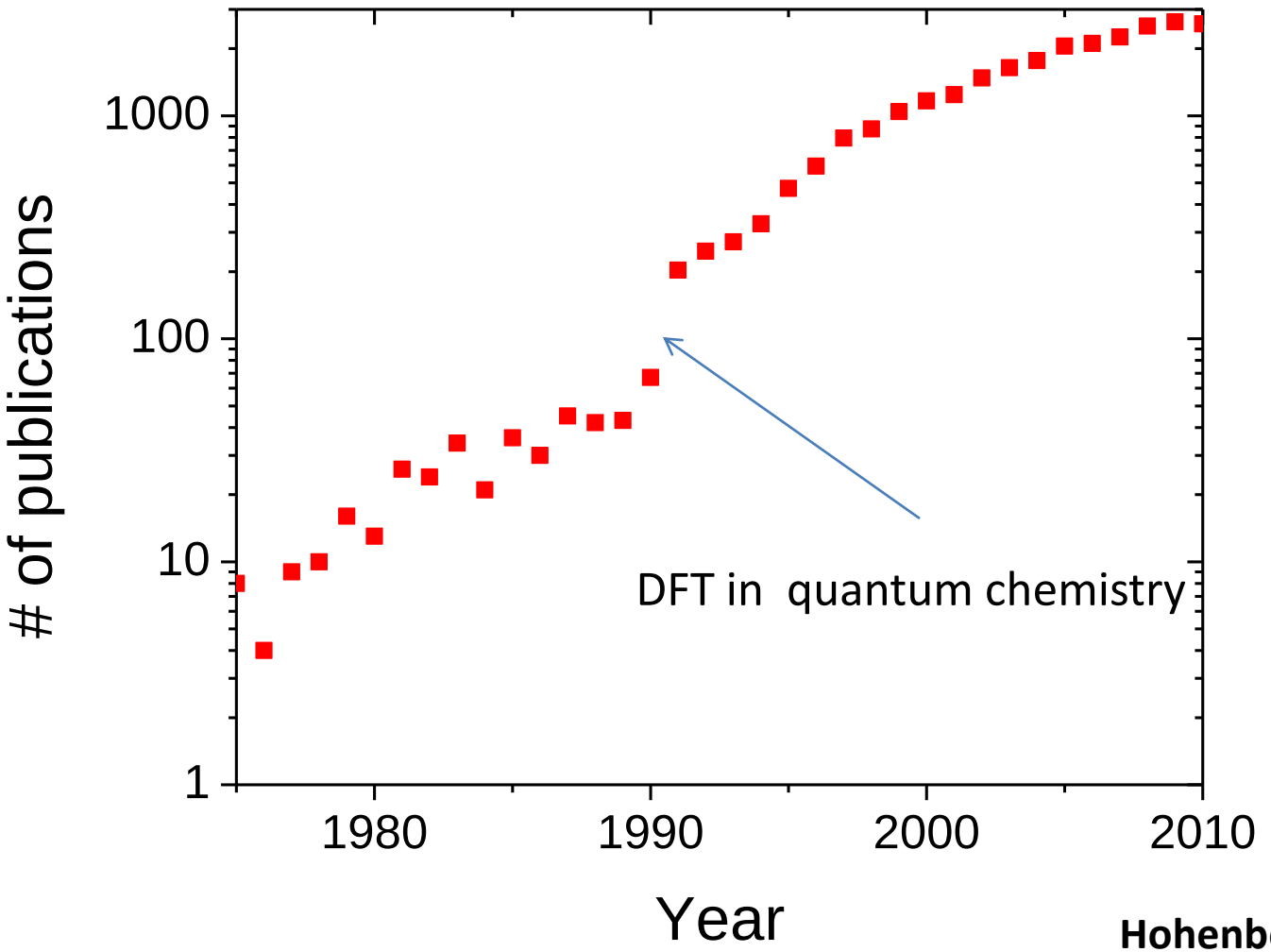
Saturation



# What should I do with my PhD work?

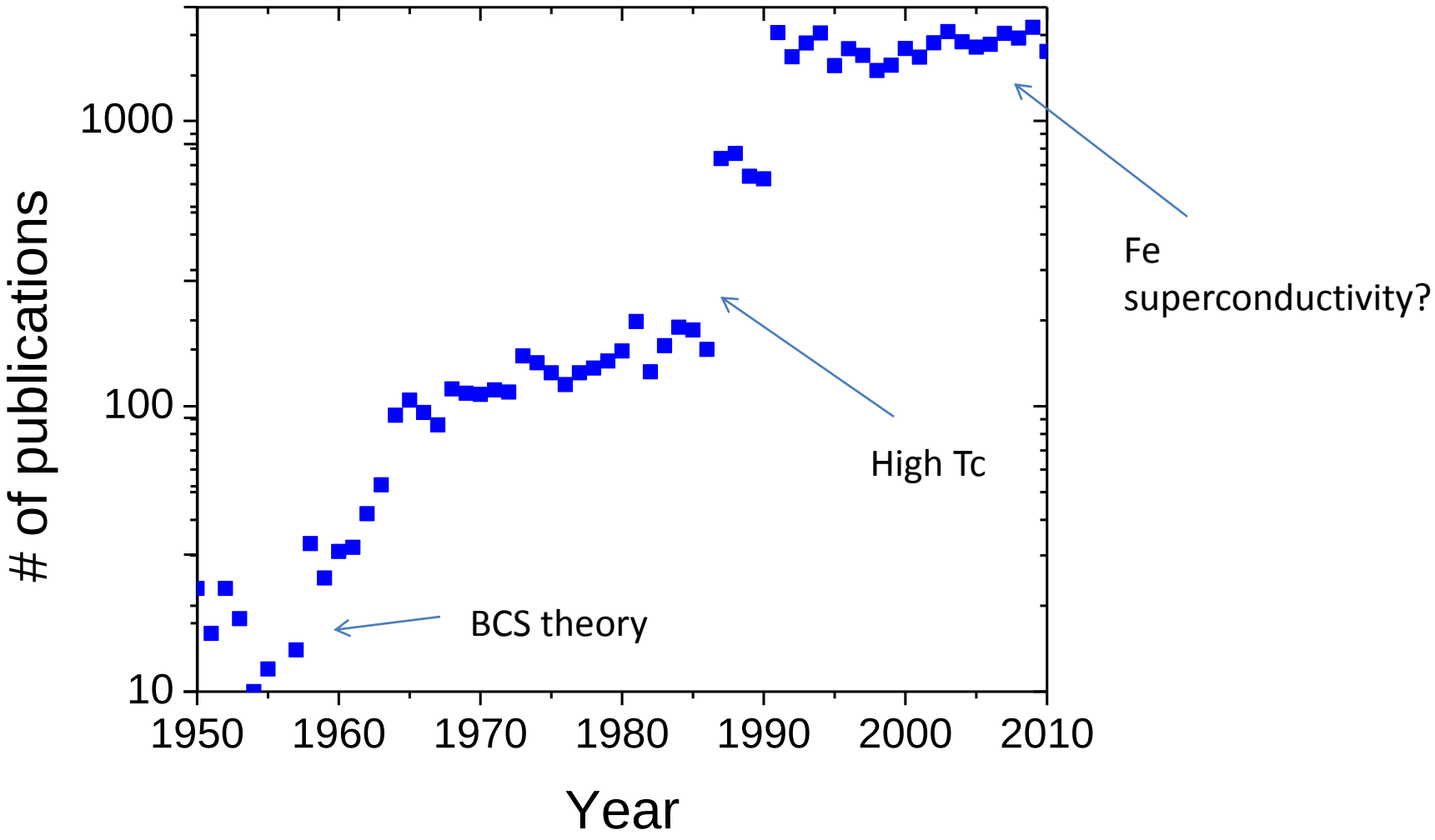


# Example 1: Density functional theory




**Hohenberg -Kohn theorem 1964**
**Kohn-Sham theorem 1965**

# Example 2: Superconductivity



# How ideas evolve?

Mutations:

- Inclusion
- Cross mutations

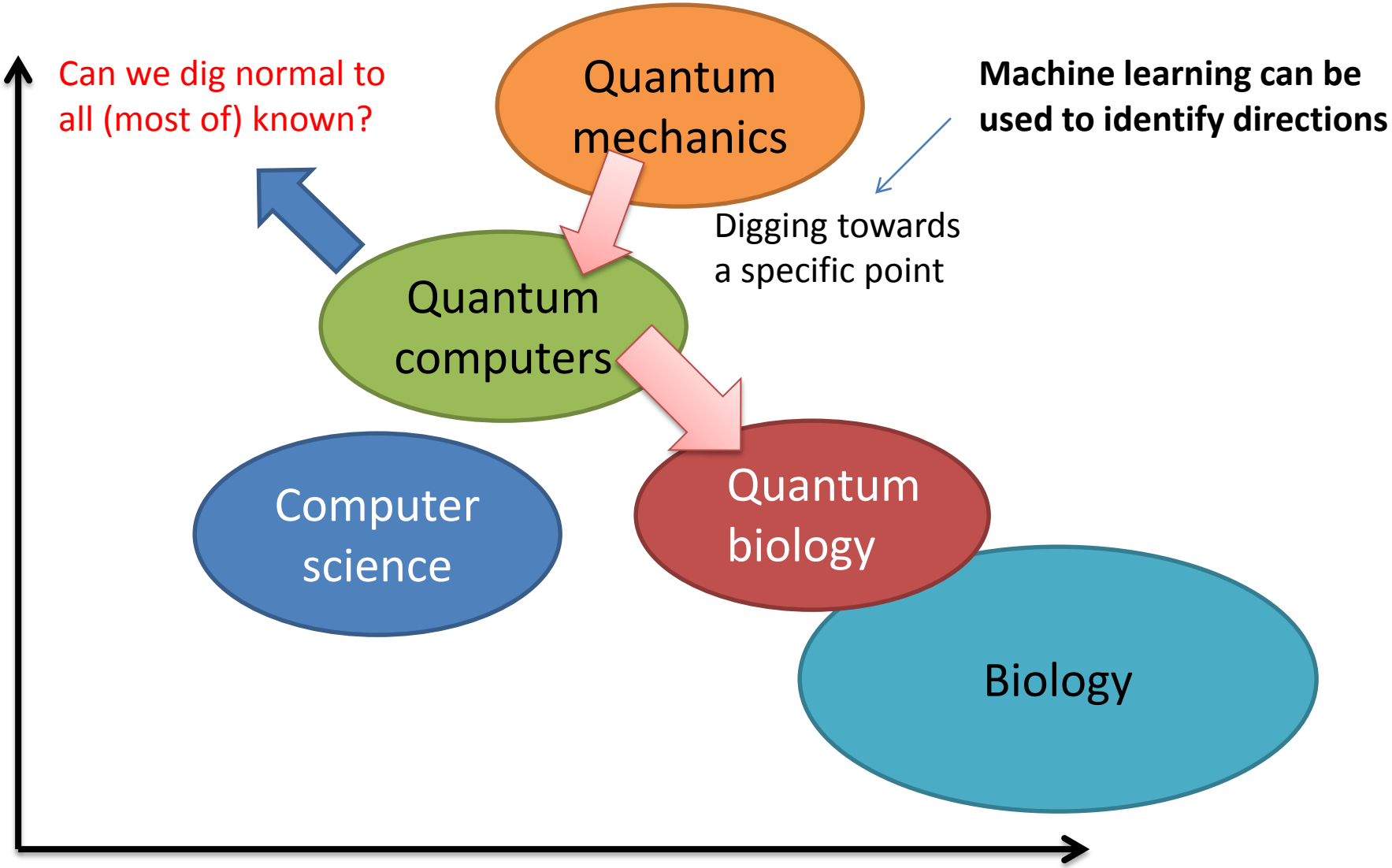
Nonlocal!
Not limited to single fields

Can we predict a breakthrough?

- Automatic learning of classifiers
- Noise analysis

**More to read:**


1. W. Goffman, G. Harmon , Nature **229**, 103 (1971)
2. M. Schmidt, H. Lipson, Science **324**, 81 (2009)

# Diggers model

N-dimensional space of ideas (network?)