

The Rise and Fall of Scientific Problems  
– On the Erotetic Organization of Physics in  
Crisis

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# Main Claims

How can we better understand the development in fundamental physics?

- ▶ Claim: research in fundamental physics is erotetically organized

Can we justify the problems that organize the field?

- ▶ Part 1: Scientific problems are complex entities that do not allow for a categorical distinction between justified and unjustified.
- ▶ Part 2: A problem resolution that does not amount to a new theory, can and has been interpreted as an unjustified problem.

# What Is A Scientific Problem?

## Nickles' Account of Scientific Problems (1981)

- ▶ A Scientific Problem *is* the demand that a certain goal be achieved plus a set of constraints.
- ▶ There is no clear distinction between empirical and conceptual problems.
- ▶ Two scientists may disagree on the set of constraints, although they share the same goal.

# What are the Constraints of a Problem?

- ▶ empirical data
- ▶ physical assumptions
- ▶ metaphysical assumptions
- ▶ theoretical framework
- ▶ mathematical methods
- ▶ mathematical structures
- ▶ ...

A justification of a scientific problem amounts to a justification of all its elements

# The Higgs Naturalness Problem

Higgs Naturalness Problem:

- ▶ G: Explain the smallness of the Higgs mass.
- ▶ A:  $m_{phys} = 125\text{GeV}$ .
- ▶ B: There is a huge gap between  $M_{Pl}$  and  $M_{EW}$ .
- ▶ C: There is nothing 'in between'  $M_{Pl}$  and  $M_{EW}$  to affect the calculation.
- ▶ D: The QFT formalism equipped with a standard interpretation.
- ▶ E: There should be no “unlikely conspiracy”
- ▶ ...

# The Erotetic Organization of Particle Physics

## Solutions:

- ▶  $\neg B$ : Hierarchy Problem
  - ▶ Bring  $M_{Pl}$  closer to  $M_{EW}$   $\rightarrow$  extra-dimensional theories
- ▶  $\neg C$ : TeV scale physics:
  - ▶ Supersymmetric models/Little Higgs/Technicolor
- ▶  $\neg D$ : Changing the standard interpretation
  - ▶ Give up on fundamental interpretations of the bare parameters
- ▶  $\neg E$ : Address the measure problem

# Tracing Out the Solution Space

## Solution Strategies

- ▶ Problem Specification
- ▶ Problem Reduction I/II
- ▶ Problem Reformulation
- ▶ Problem Precisification
- ▶ Problem Relaxation
- ▶ ...

A problem resolution that does not amount to a new theory, can and has been interpreted as an unjustified problem.