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Title
Reverse-Engineering the Copernican Revolution: Exploring How Inverse Problems Lead to Models

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Abstract
Centuries of careful observation of the nighttime skies prior to the 16th century could not get around one simple fact: Our limited observational perspective and desire to develop a physical theory of the heavens essentially amounted to an inverse problem. The Copernican Revolution, the shift from a geocentric to heliocentric model of the solar system, represented a watershed in scientific theory as it cleared away the overly complicated Ptolemaic approach and brought forth a more coherent and encompassing framework. Here, we were motivated by the ubiquity of inverse problems in modern science and aim to gain insight into how successful theoretical frameworks are initially developed. Towards this end, we developed a simple model consisting of a point-projection of two nested phase oscillators. Despite its simplicity, the behavior of the model exhibited remarkable complexity. One approach taken was to consider what other types of 'models' would produce similar behavior. That is, though we already had the 'answer', we (re-)created an inverse problem to examine the range of possible models that could have arisen. Using the 'paradigm shift' led by Copernicus as a lens, we attempted to tie our analysis back to understanding what strategies exist to optimize the decisions leading towards the development of successful theoretical frameworks.

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