

Fundamentality, Simplicity and Mass-Energy: Du Châtelet's Theoretical Philosophy as a Reflection on Contemporary Physics

Early modern philosophy (= EMP) is particularly innovative and original in certain respects. In the early modern period, we observe the rise of a new scientific paradigm, i.e., mechanical philosophy, seeking to replace the past Aristotelian science. Mind-body dualism gains traction. A distinct set of causal theories, such as occasionalism, pre-established harmony or physical influx are re-discovered, developed, or significantly altered compared to their historical predecessors. For the first time in the history of philosophy, laws of nature are systematically postulated, their status being discussed and the issue of how to quantify them raised. These are just a few examples. All of these substantiate the claim that EMP deserves our undivided attention. At the same time, this kind of innovativeness and originality of EMP is what I shall call an *intrinsic reason* of why the study of EMP is worthwhile. I take it to be intrinsic because it picks out salient contributions of EMP itself and justifies their importance in the light of a progressivist meta-story about the history of philosophy.

In this presentation, I attempt to establish a different but equally important *extrinsic reason* why EMP is worth our time and effort. This is because it can stimulate discussions in contemporary theoretical physics about physical reality. I call this an extrinsic reason because it shows the merit of studying EMP outside the confines of a historiography of EMP specifically or a historiography of philosophy more generally. In this presentation, I will focus on one outstanding early modern philosopher whose thinking about matters such as fundamentality, simplicity, space, time, matter and force can serve as a *reflection pump* for the hard problems of contemporary theoretical physics: Émilie Du Châtelet (1706–1749).

Like contemporary theoretical physicists, Du Châtelet is dedicated to the study of fundamental reality. She postulates the existence of simple beings endowed with primitive active and primitive passive force. Simple beings are true substances and they are ontological rock-bottom. They are fundamental, that is, they are not grounded in other things. Likewise contemporary physics is likewise committed to the discovery of fundamental entities. According to Du Châtelet, simple beings and their interactions through forces give rise to bodies. Bodies are endowed with derivative active and passive force and they are extended. For her, bodies follow the laws of motion, i.e., mechanics. She argues that derivative force is tied to matter and hence anticipates the notion of mass-energy. In contemporary physics, too, bodies are macroscopic entities. They obey the laws of classical mechanics, but they consist of protons, neutrons and electrons let alone quantum particles. Electric, nuclear, and molecular forces explain the cohesion of bodies. Space and time, for Du Châtelet, are relative. The positing of bodies and our own perception give rise to space and time. In contrast to Newton, she steers clear of conceiving of time and space in absolute terms. Near-contemporary developments in physics, notably, special relativity, show the constraints of Newtonian mechanics. Physicists agree that gravity alters the space-time manifold. While Du Châtelet does not express her views on the matter, her theory does not prevent her from accepting these implications. Du Châtelet did not think of gravity as a fundamental force. Rather, she thought that gravity would have a mechanical cause. However, the nature of gravity and what gives rise to it is a matter of ongoing discussion in contemporary physics, too. Du Châtelet conceptualises the world in analogy to a harmonious machine that conserves its living force measured by mv^2 . In parallel, Noether's theorem¹ in our physics states that symmetries mirror conservation laws. Finally, the hardest problem in contemporary physics remains the issue of how to reconcile the microscopic realm of (quantum) particles with the macroscopic realm of gravity and space-time as laid down in general relativity. Clearly, Du Châtelet does not have an answer to this problem. Still, the relation between

¹ Emmy Noether (1882–1935), ground-breaking German physicist and mathematician.

simple beings, their internal determinations and forces and macroscopic bodies, space and time likewise need to be reconciled.

Du Châtelet's theoretical reflections help us take stock of the entities and relations we have in theoretical physics and to develop a critical and reflective lens.

Keywords: Émilie Du Châtelet, early modern metaphysics, early modern natural philosophy and contemporary physics.