Introduction to classical mechanics

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Classical mechanics

MECHANICS is the branch of physics dealing with energy and forces, and their effect on bodies, typically the variation of position with time, that is, *motion*. Up to this point in the program, you have studied Newtonian mechanics, which is an excellent theory for most of the phenomena with which deal with in our daily lives. However, in certain limits, Newtonian mechanics fails and/or needs to be extended to properly describe nature.

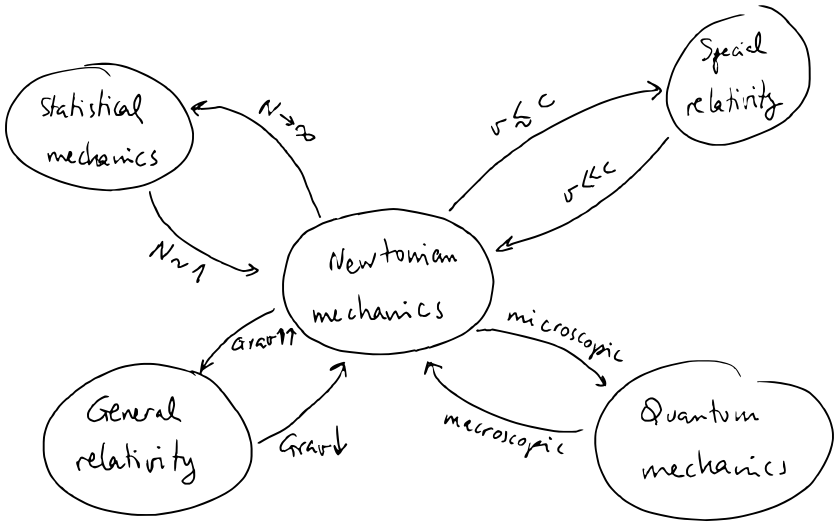

Figure 1: Newtonian mechanics and its relationship to other physical theories, which are necessary extensions in certain situations. Newtonian mechanics can be recovered from each of these theories in the appropriate limits.

There is some ambiguity as to what exactly *classical mechanics* refers to. In some books, classical mechanics refers only to Newtonian mechanics. In others, however, classical mechanics also includes special relativity. In this class, we will take the latter definition so as to include special relativity.

Overview of the class

With this in mind, the class is organized in three large blocks.

THE FIRST BLOCK is devoted to special relativity, that is, the extension of Newtonian mechanics to situations in which particles move at speeds that are close to the speed of light.

THE SECOND BLOCK is devoted to the Lagrangian and Hamiltonian formulations of classical mechanics. Here, we will learn a more general way to formulate the laws of classical mechanics (Newtonian mechanics as well as special relativity) than Newton's laws. This formulation opens the door to much more powerful interpretations of the world, which go well beyond mechanics (electromagnetism, fields, quantum fields...).

THE THIRD BLOCK is devoted to the study of central forces, which play a key role in understanding, for example, the motion of celestial bodies.

The ordering of these blocks may not appear to be the best or most logical one, but it is dictated in part by the relationship between this class and other classes in the program. Anyway, it should be fun!