Reproducibility and Replication of Experimental Particle Physics Results

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ABSTRACT

Recently, much attention has been focused on the replicability of scientific results, causing scientists, statisticians, and journal editors to examine closely their methodologies and publishing criteria. Experimental particle physicists have been aware of the precursors of non-replicable research for many decades and have many safeguards to ensure that the published results are as reliable as possible. The experiments require large investments of time and effort to design, construct, and operate. Large collaborations produce and check the results, and many papers are signed by more than three thousand authors. This paper gives an introduction to what experimental particle physics is and to some of the tools that are used to analyze the data. It describes the procedures used to ensure that results can be computationally reproduced, both by collaborators and by non-collaborators. It describes the status of publicly available data sets and analysis tools that aid in reproduction and recasting of experimental results. It also describes methods particle physicists use to maximize the reliability of the results, which increases the probability that they can be replicated by other collaborations or even the same collaborations with more data and new personnel. Examples of results that were later found to be false are given, both with failed replication attempts and one with alarmingly successful replications. While some of the characteristics of particle physics experiments are unique, many of the procedures and techniques can be and are used in other fields.

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