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On the beauty of physics

The concept of beauty is an essential part of life. For instance, beauty as defined by human symmetry and balanced proportions was a central theme in Ancient Greece, the cradle of Western civilization. Beauty in nature, as characterized by pristine mountains and transparent rivers, easily captivates and consumes the keen observer... To live in the absence of beauty would be to remain submerged in the monotonous darkness of entropy.

Beauty in physics as an abstract concept including a mathematical aesthetic quality, succinctness, and usefulness. Dirac, the foremost proponent of mathematical beauty in modern physics, once said “*it is more important to have beauty in one’s equations than to have them fit experiment.*” As much as I admire Dirac’s physics I tend to diverge a little with him on this one. Mathematical beauty loses its value if the equations don’t agree with experiment. In this regard, beauty might be considered a necessary but not sufficient condition for good physics. Hence, one might say that in physics *it is the experiment that renders final judgment on the beauty of a theory.* In fairness to Dirac, it is said that he was also a proponent of the school of thought known as *instrumentalism* and according to this doctrine physical theories should relate to measurable quantities.

The definition of beauty and elegance in equations, as the definition of elegance and beauty in general, varies according to the observer. Besides the concept of aesthetics, succinctness is a very important element. Succinctness represents the power of a theory to describe nature in a compact, and useful, formulation. The lesser the better. In this regard, it should be mentioned that one of the most celebrated results in recent theoretical physics the *Ward identities* were disclosed to the world in a paper, including a few equations, which was only about one-half page long.

One of the nicest compliments that I have been paid, as a physicist, was in the mid 1990s when after giving a talk on the generalized multiple-prism grating dispersion theory a physicist in the audience (whose name was Warburton) commented: “Your equations look like well-written music.”

A further aspect of beauty in physics, not usually considered, is beauty in experimental physics: the powerful sight of a visible laser beam as it propagates through space, the awesome and colorful impression of a light beam as it disperses,... the incredibly complex, and yet orderly, light pattern resulting from N -slit interference.

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