Scientific models

What do astrophysicists mean when they say they know how a star form, live and die? They mean they have a model or models and this model correctly predicts and describe the birth, life and death of a star confirmed through observations and experiments. Unfortunately the role of models or scientific theories are often misunderstood. A scientific model is not reality but is a mental image described by mathematical equations. It must describe what we see and make predictions. A model of how a star functions is only a scientific model when nuclear fusion at the core of the star is understood and the behaviour of gas under extreme conditions are described by mathematical equations. A model is a partial theory. No matter how accurately it describes the formation and life of a main sequence star or the death of a star. It is always an approximation of the real star, never the star itself.1)

Another widespread misconception is that experiments are carried out to refine scientific models to better and better precision. But this is untrue. Quite the opposite, scientists carry out experiments to test models for inaccuracies, to test calculations and predictions, to find out where other theories might improve on current theories.

What happens when a theory does not meet the required standards? It can be amended or even kept. A good example is Newton's theory of gravity. It cannot accurately predict the orbit of the planet Mercury. Einstein's Theory of General Relativity explained this very accurately. This did not mean that Einstein's theory replaced Newton's theory of gravity. Newton's theory is still used to calculate the orbit of a satellite. Of course Einstein's General Relativity can also be used but it is much more difficult, so why bother?

The Standard Model of Particle Physics is constantly under attack for not being able to predict or explain Dark Energy or Dark Matter. Is this a reason to discard the Standard Model? No. We do not even know what Dark Energy and Dark Matter are. When know what they are the Standard Model may have to be amended. But the Standard Model is a very successful model accurately describing what we observe and there is no reason to discard it.

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1. The Universe A Biography. John Gribbin, Penguin Books. U.K.