

Quarks to Quasars

Paper #2 Assignment: Making Sense of the Standard Model?

Draft due Tuesday Feb. 5 by 6 pm
Final Version due Friday Feb. 15 by 6 pm
[Submit to Sakai drop box]

Type: newspaper column (including excerpt from original letter) and response letter

Format: Word document (double spaced)

Length: column = two paragraphs (half page) on separate sheet; response letter = 3-4 pages

Part of your job as the science reporter for a large newspaper is to write a weekly column responding to letters from readers, entitled "Ask Dr. Science". In most cases, the letters you receive are much too long to allow for a detailed published response. Thus, for your column, you usually excerpt a small section of the letter and publish a one or two paragraph reply. Being conscientious about your job, you also always reply individually to each letter writer, sending back a more complete response to their queries. With these responses you always suggest a few references for further reading (typically from the Science Section of the New York Times or from the journals Science or Nature). Below is the most recent letter addressed to you. Please construct (1) a newspaper column response and (2) a detailed reply to this letter.

Dear Dr. Science,

I have been learning about the standard model of particle physics in my first-year seminar at Hiram College. Much to my dismay, the more I learn about this topic, the more perplexed I become. After some reflection, I have identified three features of this model that strike me as less than sensible. First, from the historical perspective we have been pursuing, particle physics appears to be nothing more than a descriptive science; something akin to butterfly collecting, where new species are "discovered" and named. I understand that the standard model involves some higher level of organization of these species, but it appears to remain primarily descriptive rather than being predictive. Surely there is something more to particle physics than butterfly collecting ... but I don't quite see what it is. Second, in addition to organization, the standard model is supposed to bring simplification to our understanding of the fundamental constituents of matter. However, the number of components going into the model does not immediately suggest simplicity. The six quarks, six leptons, and four force-carrying particles add up to a total of sixteen different basic objects (and each quark and lepton has a distinct anti-matter counterpart). To make matters worse, each quark (and anti-quark) comes in three different colors and the gluons that carry the quark-binding strong force are "bi-colored" giving eight of these. With this large number of components (sixty in all!), in what sense can this model be considered "simple"? My final issue with the standard model is that the quarks and gluons, which make up half of the particles in the model, have never been observed in isolation. And rather than being considered an experimental embarrassment, this fact has been incorporated as a theoretical feature of the model. From my understanding of how science works, I sense something fishy about this quark model. Can it possibly be legitimate for a scientific theory to be constructed such that some of its basic elements are, by design, hidden from view?

Skeptically yours,

A Curious College Student
Hiram, OH