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W.K.H. Panofsky Prize in Experimental Particle Physics: It wasn't only about *CP*, or even *B* mesons

STEPHEN LARS OLSEN, Center for Underground Physics, Institute for Basic Science, Daejeon, Korea

Although the primary motivation and design theme for the *B*-factories and their experiments was the study of *CP* violations in the *b*-quark sector and testing the Kobayashi-Maskawa suggestion that *CP* violation could be incorporated into the Standard Model as an irreducible complex phase in the weak-interaction quark-flavor mixing matrix, both the BaBar and Belle research programs made a number of important measurements that had nothing to do with either *CP* violation or the *b*-quark sector. These include the unexpected discovery of $D^0 - D^0bar$ mixing and a number of charmoniumlike mesons with properties that do not match expectations for conventional charmed-quark anticharmed-quark (*ccbar*) mesons. In principle, these state, which are now commonly known as the *XYZ* mesons, are described in the Standard Model by the long-distance regime of QCD, but, since first-principle long-distance QCD calculations are hopelessly difficult, a number of "QCD-inspired" models for nonstandard mesons have been proposed. Some of these attribute the *XYZ* states to loosely bound meson-antimeson molecule-like structures, and others to tightly bound diquark-diantiquark tetraquarks, or quark-antiquark-gluon hybrids. None of the proposed models can give a comprehensive description of the spectrum of the observed states and their measured properties. In this talk I describe a few of the *XYZ* mesons found by BaBar and Belle and why they are considered to be nonstandard. In addition I suggest some future measurements that could be done at BESIII, BelleII and Panda that might establish patterns that may help decipher some of the mysteries of long-distance QCD. Supported by project code IBS-R016-D