symmetrybreaking
extra dimensions of particle physics
A joint Fermilab/SLAC publication

VOLUME 07 ISSUE 02
APRIL 10

VIEW CURRENT ISSUE

Rewriting textbooks and remeasuring the particle data booklet at the LHC

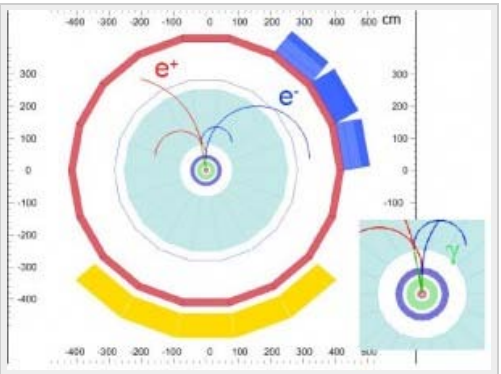
June 14, 2010 | 6:07 am

Textbooks were being rewritten during last week's Physics at LHC conference.

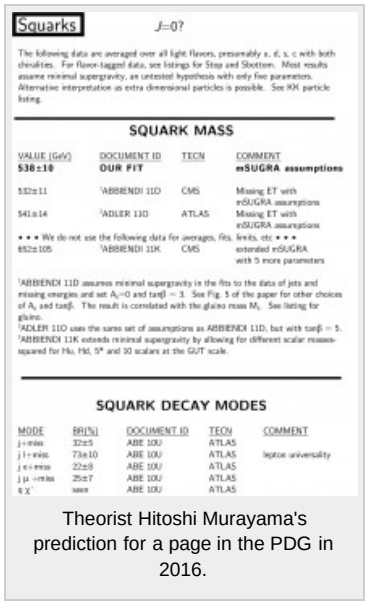
"I was sitting in the session, listening to the ALICE talk by Andrea Dainese from Padova on Wednesday morning, and suddenly I knew: I could replace all the textbook bubble-chamber pictures from the sixties in my lectures," said DESY's Thomas Naumann, a member of the ATLAS collaboration.

Naumann's revelation was sparked by an image showing a neutral pion decaying into two photons that then convert into two electron-positron pairs in the the ALICE inner tracker. Generations of physicists have learned about the history and characteristics of neutral pions, also called pi zero particles, in their undergraduate classes and textbooks. Until now, the decay of a pi zero particles was always illustrated with a picture from a 1950s- or 1960s-era bubble chamber experiment.

Pi zeros aren't rare; in fact their decays are responsible for most of the photons seen in the LHC detectors. They are used as standard candles to calibrate detectors, which is why every student of particle physics has to know them inside out. They're also one of the many known particles being rediscovered by particle physicists using the first LHC collision data.



A pi-zero particle decay, as seen by the ALICE detector at the LHC. Image credit ALICE Collaboration


Squarks J=0?

SQUARK MASS

VALUE (GeV)	DOCUMENT ID	TECN	COMMENT
538±10	**OUR FIT**		**mSUGRA assumptions**
532±11	[1] ABBIENDI 11D	CMS	Missing ET with mSUGRA assumptions
541±14	[2] ADLER 11O	ATLAS	Missing ET with mSUGRA assumptions
• • • We do not use the following data for averages, fits, limits, etc • • •			
652±105	[3] ABBIENDI 11K	CMS	extended mSUGRA with 5 more parameters

[1] ABBIENDI 11D assumes minimal supergravity in the fits to the data of jets and missing energies and set A_0=0 and tanβ = 3. See Fig. 5 of the paper for other choices of A_0 and tanβ. The result is correlated with the gluino mass M_3. See listing for gluino.
[2] ADLER 11O uses the same set of assumptions as ABBIENDI 11D, but with tanβ = 5.
[3] ABBIENDI 11K extends minimal supergravity by allowing for different scalar masses-squared for Hu, Hd, 5* and 10 scalars at the GUT scale.

SQUARK DECAY MODES

MODE	BR(%)	DOCUMENT ID	TECN	COMMENT
j-+miss	32±5	ABE 10U	ATLAS	
j l-+miss	73±10	ABE 10U	ATLAS	lepton universality
j e-+miss	22±8	ABE 10U	ATLAS	
j μ-+miss	25±7	ABE 10U	ATLAS	
q χ^0_1	seen	ABE 10U	ATLAS	

Theorist Hitoshi Murayama's prediction for a page in the PDG in 2016.

The particle physicist's bible, the booklet published by the Particle Data Group or PDG, played an important role at the Physics at LHC conference. It contains tables with all the possible data for all existing and hypothetical particles, such as their mass, charge, flavor, lifetime and decay modes. LHC physicists are rediscovering the known particle families from strange through charm, and bottom through (hopefully soon) top, and in a matter of weeks they have almost reached the statistical precision currently listed in the PDG for many measurements.

The known particles aren't the only ones being reassessed; theoretical physicists are also hard at work refining their predictions about particles and their behavior. In his talk, theorist Hitoshi Murayama of Japan's Institute for the Physics and Mathematics of the Universe showed his vision of what the PDG could look like in a few years. A slide from his talk—originally called 'Theories of Beyond the Standard Model Physics' but renamed "How stupid theorists are and Why LHC matters"—features a page from the PDG in 2016.

by Barbara Warmbein

Guest author
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