Fermilab Today

Thursday, May 7, 2015

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Wilson Hall Cafe menu

Chez Leon menu

Weather at Fermilab

Announcements

Today's New Announcements

Budker Seminar - May 11

Indoor soccer

"What is Thought?" open discussion - today

National Day of Prayer Observance - today

Wilson Hall east drinking fountains out of service today

Barn Dance - May 10

Volunteers needed for Employee Health and Fitness Day on May 12

Interpersonal Communication Skills on May 20

Interaction Management course (three days) scheduled for June 28, July 9, July 28

Mac OS X security patches enabled

Living Green! new Fermilab Library book display

Fermilab Board Game Guild

From *symmetry*

DECam's far-out forays

The Dark Energy Camera does even more than its name would lead you to believe. *Photo: Reidar Hahn*

The Dark Energy Survey, which studies the accelerating expansion of our universe, uses one of the most sensitive observing tools that astronomers have: the Dark Energy Camera.

Built at Fermi National Accelerator Laboratory and situated on the Victor Blanco 4-meter telescope in Chile, the camera spends 30 percent of each year collecting light from clusters of galaxies for DES.

Another chunk of time goes to engineering and upgrades. The remaining one-third is split up among dozens of other observing projects.

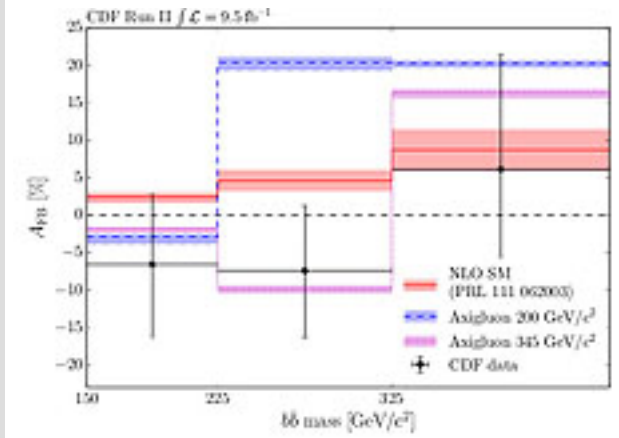
A recent *symmetry* article looked at some of those projects — the ones that are studying objects within our solar system. In this follow-up, we give a sampling of how DECam has been used to reach even farther into the universe.

Studying stellar oddballs
The sun is a "normal" star, humming along, fusing hydrogen to helium in its core. Most of the stars in the universe produce energy this way. But the cosmos contains a whole collection of stranger stellar objects, such as white dwarfs, brown dwarfs and neutron stars. They also include exploding stars called supernovae. Ten projects use the DECam to study these stellar varieties.

Armin Rest, an astronomer at the Space

Frontier Science Result: CDF

Looking for axigluons



This plot shows the forward-backward asymmetry in bottom quark production at the Tevatron as a function of the mass of the bottom-antibottom system compared to predictions with and without axigluons.

When a top-antitop quark pair is produced at the Tevatron, does the top quark go more often in the direction of the collision beam's proton or antiproton?

Early measures of the forward-backward asymmetry — the difference in direction between an outgoing pair of particles relative to the incoming colliding particles — showed a larger effect than predicted, but after much followup there is now reasonable agreement between observation and prediction.

Recent theoretical developments summarized by Alexander Mitov at the Top at Twenty conference show contributions to the asymmetry not understood earlier. And recent experimental results from the Tevatron, summarized by Ziqing Hong, now include a new CDF measurement of the bottom, or *b*, quark forward-backward asymmetry.

The bottom quark is a partner of the top. In an early speculative theory, the top quark asymmetry was due to a quantum mechanical interference between a gluon — the carrier of the strong force — and a massive, hypothetical partner called an axigluon. At hadron colliders such as the Tevatron and the LHC, the

Wednesday Walkers

Swim lessons at Fermilab Pool

Adult water aerobics at Fermilab Pool

Scottish country dancing Tuesday evenings at Kuhn Village Barn

International folk dancing Thursday evenings at Kuhn Barn

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Telescope Science Institute in Baltimore, Maryland, leads two of those projects. In the past two years, he has spent 28 nights at the Blanco Telescope looking for supernovae.

In both projects, Rest looks for light released during stellar explosions that has bounced off dust clouds on its way to our night sky. These "light echoes" preserve information about the blasts that caused them — for example, what type of star exploded and how it exploded.

"It is as if we have a time machine with which we can travel back in time and take a spectrum with modern instrumentation of an event that was seen on Earth hundreds of years ago," Rest says.

DECam's expertise in taking fast pictures of big areas makes this search much more efficient than it would be with other instruments, Rest says.

Read more

—Liz Kruesi

Photo of the Day

Sun shines on shells by the shore

Turtles sunbathe in Swan Lake. *Photo: Bridget Scerini, TD*

In the News

Particle slam! LHC restarts (low-energy) proton collisions

From *Discovery News*, May 5, 2015

For the first time since the Large Hadron Collider was shut down in 2013 for its two-year hiatus for a power upgrade, the world's most powerful particle accelerator has restarted and, this morning at 9:30 a.m CET (4:30 a.m. ET),

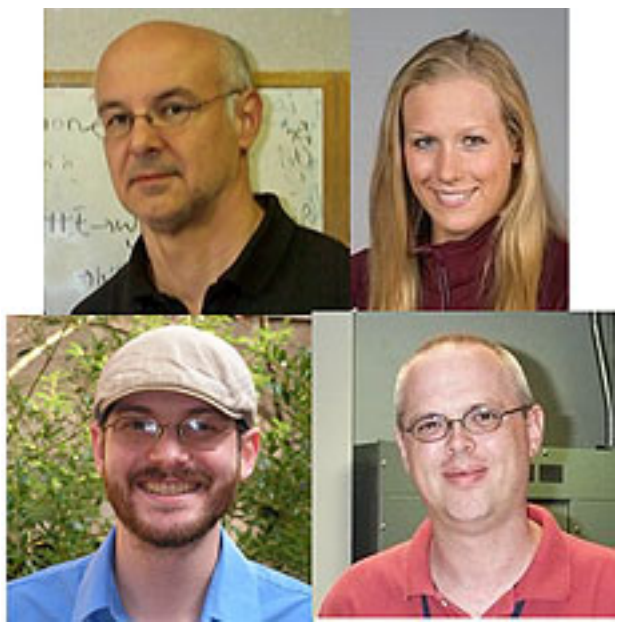
existence of very heavy axigluons has been ruled out, but low-mass axigluons could be hiding under large backgrounds. CDF probes this low-mass region by measuring the *b* quark asymmetry.

The key experimental challenge — separating the *b* quark jet (which has 1/3 the charge of an electron) from the anti-*b* quark jet (which has -1/3 the charge of an electron) — was achieved using a technique that measures the total charge of each jet. CDF then measured the asymmetry in three different regions of the total system mass. A "smoking gun" for an axigluon would be an asymmetry that reverses direction, with the *b* swapping its preference for forward or backward at a particular energy.

The above figure shows the measured *b* quark asymmetry compared to predictions in three different regions. The result shows little asymmetry and somewhat disfavors axigluons with mass less than 200 GeV/c^2. But because of the large experimental uncertainties, stealth axigluons with masses greater than 345 GeV/c^2 could still be out there.

—Andy Beretvas and Dante Amidei

Learn more



These scientists are the primary analysts for this result. Top row, from left: Dante Amidei (Michigan), Sarah Henry (Texas A&M). Bottom row, from left: Jon Wilson (Michigan, now at Texas A&M), Tom Wright (Michigan).

In the News

Astronomers find most distant galaxy ever

From CBS News, May 5, 2015

began slamming particles together.

However, these first collisions at an energy of 450 gigaelectronvolts (GeV) are very pedestrian when compared the record-breaking energies the LHC is designed to ultimately carry out.

Read more

Talk about a galaxy far, far away.

Using data from NASA's Hubble and Spitzer space telescopes and the Keck I 10-meter telescope at the W. M. Keck Observatory in Hawaii, an international team of astronomers, led by Yale University and University of California scientists, identified what they believe is the most distant galaxy ever measured.

Read more