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Snowmass Assembled: My Perspective

S. James Gates, Jr.

Brown Theoretical Physics Center Director,
Ford Foundation Professor of Physics,
Affiliate Mathematics Professor,
Watson Institute for International & Public Affairs
Faculty Fellow

BTPC Director Office, Rm 110, Barus Hall, 340 Brook St., Providence, RI 02912
t: 401-863-6452 e: sylvester_gates@brown.edu w: https://sites.brown,edu/sjgates

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- Moving Particle Physics Beyond the LHC Era
- Precision as Key in All Eras
- Why Physics Should Care About DEI in All Eras

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- Moving Particle Physics Beyond the LHC Era

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Is string theory phenomenologically viable?

S. James Gates Jr

PHYSICS TODAY
Vol.59, Issue 6
01 June 2006

String theory is entering an era in which its theoretical constructs will be confronted by experimental data. Some cherished ideas just might fail to pass the test.

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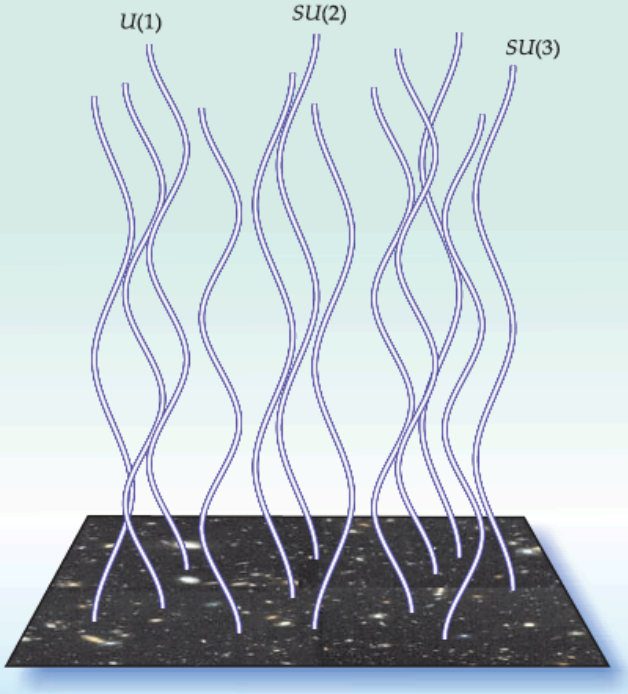
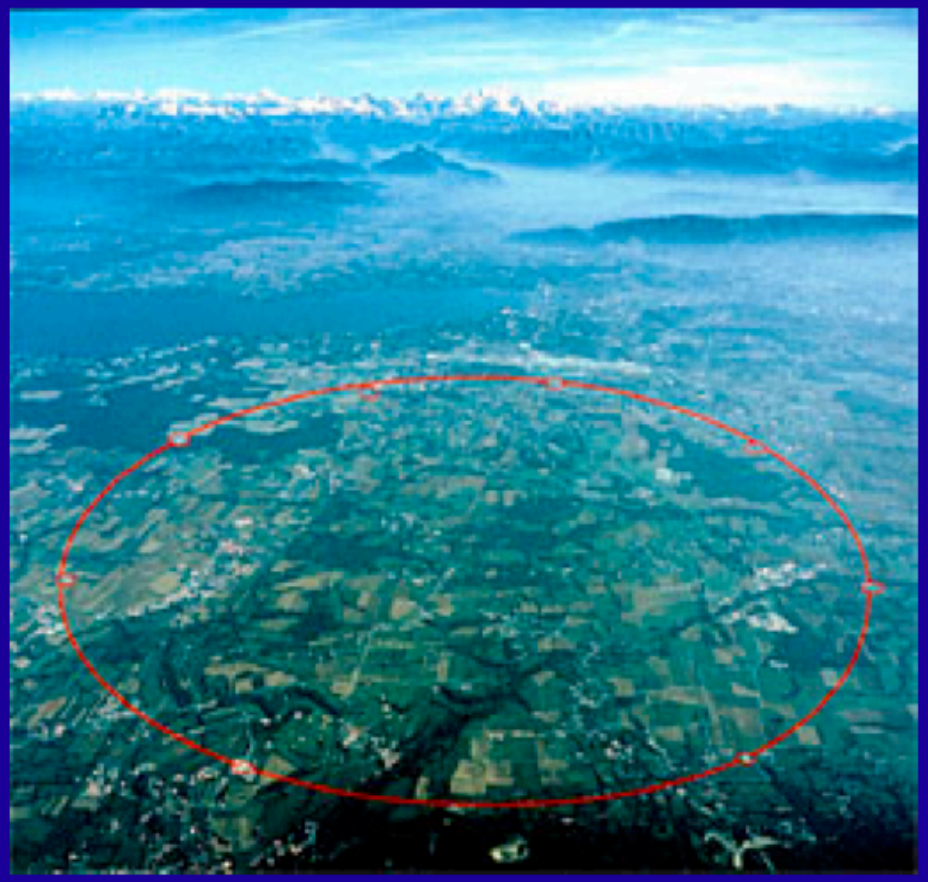


Figure 1. A fiber bundle is built from a base that has a fiber emerging from each of its points. In the standard model, the base is the four-dimensional spacetime of our universe, and each of the fibers, the simple depictions notwithstanding, is one of the gauge groups *SU*(3), *SU*(2), or *U*(1) that mathematically define the gauge transformations of the model. In 4D string theories, fibers can represent gauge groups that are not part of the standard model. (Hubble Deep Field image courtesy of Robert Williams, Space Telescope Science Institute, the Hubble Deep Field team, and NASA.)

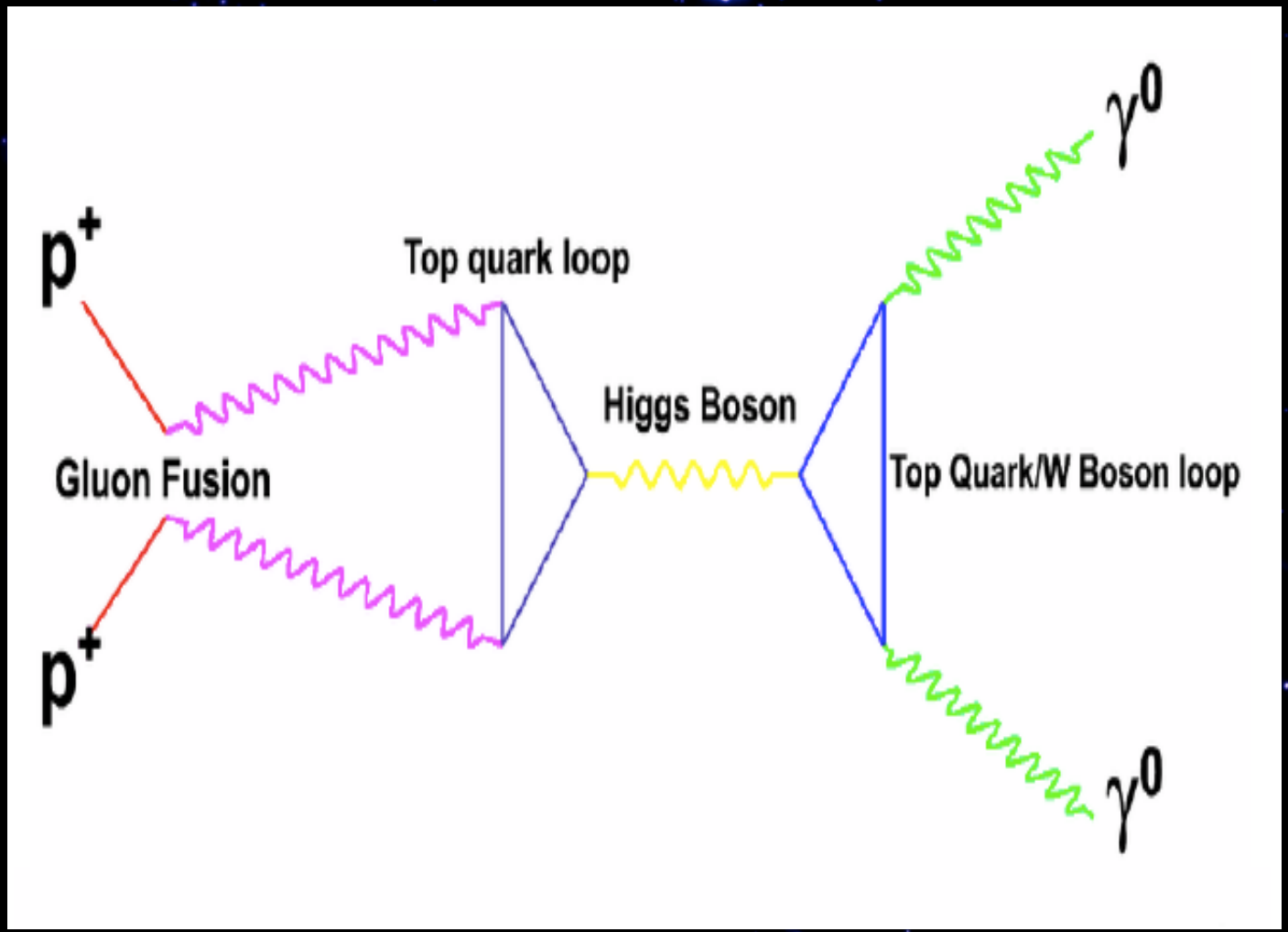
The most spectacular result would be the direct production of a particle that is the superpartner of a known particle. However, it will take great fortune for a superparticle to be directly observable. The range of masses discussed in the literature for superpartners is something like 1000 to 30 000 times the mass of the proton, which is roughly 1 GeV/c^2. With the dates of discovery and masses of the neutron and W bosons as benchmarks, one can crudely estimate the rate at which humanity is progressing in its ability to detect massive particles: about 1.5 GeV/c^2 per year. Thus, if Nature is kind enough to provide light superpartners, one might still expect about a century to pass before a superparticle is directly observed.

Much more likely, evidence for supersymmetry will emerge by indirect means. Such evidence might be provided by precision measurements of the rates of change of coupling constants, anomalies in lifetimes or branching ratios in decays of known particles, and so forth.

The Energy Frontier @ The Large Hadron Collider



A Higgs Production & Decay Process



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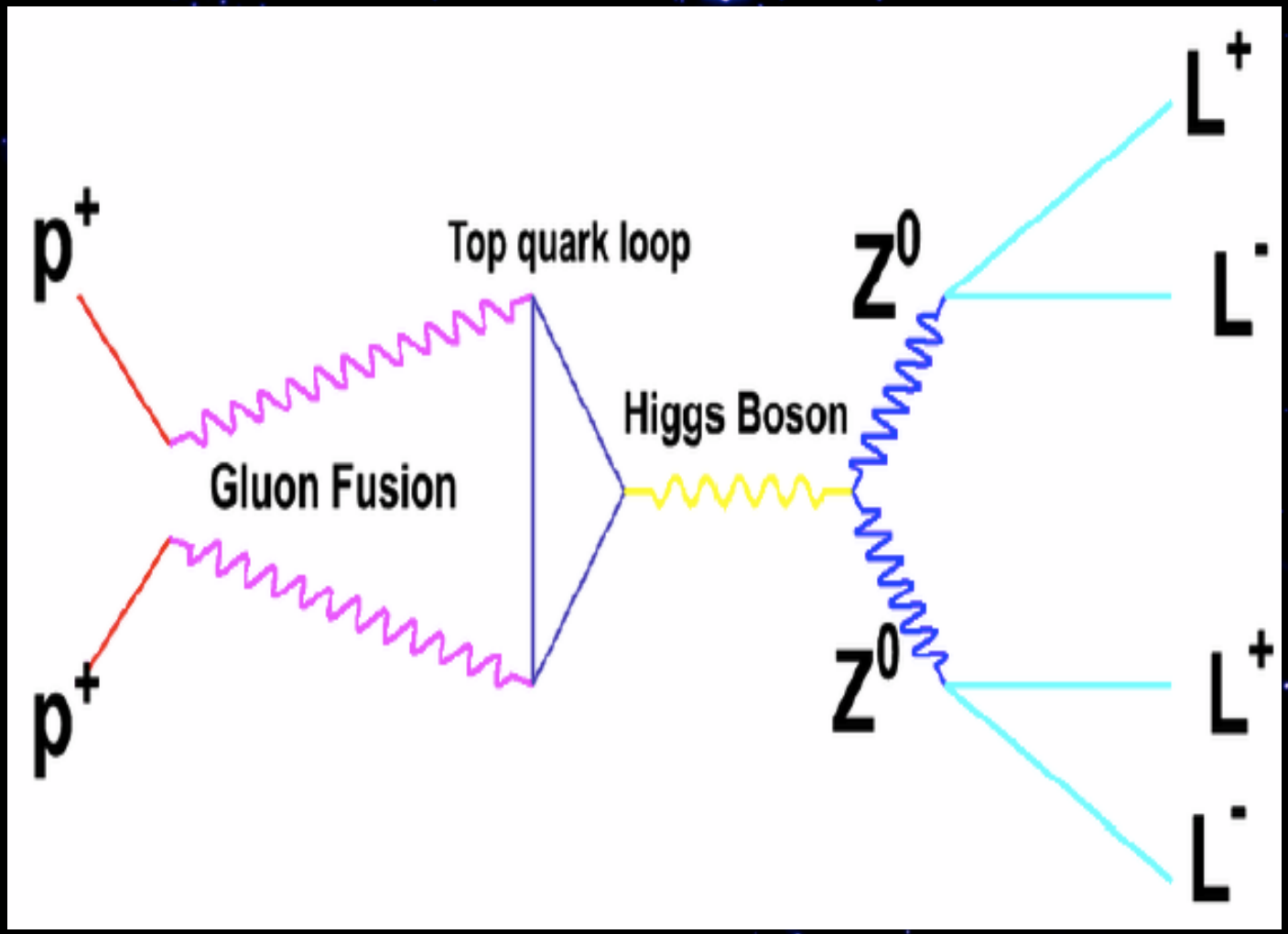

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Feature: Supersymmetry

physicsworld.com

Sticking with SUSY

When CERN's Large Hadron Collider failed to uncover evidence of new "superpartner" particles during its first run, some claimed that the theory that predicts them – known as supersymmetry, or SUSY – should be abandoned. **S James Gates, Jr**, however, argues that giving up on SUSY now would be like concluding that giant sequoia trees do not exist after surveying only the east coast of North America, and that there is more at stake than meets the eye

Physics World October 2014

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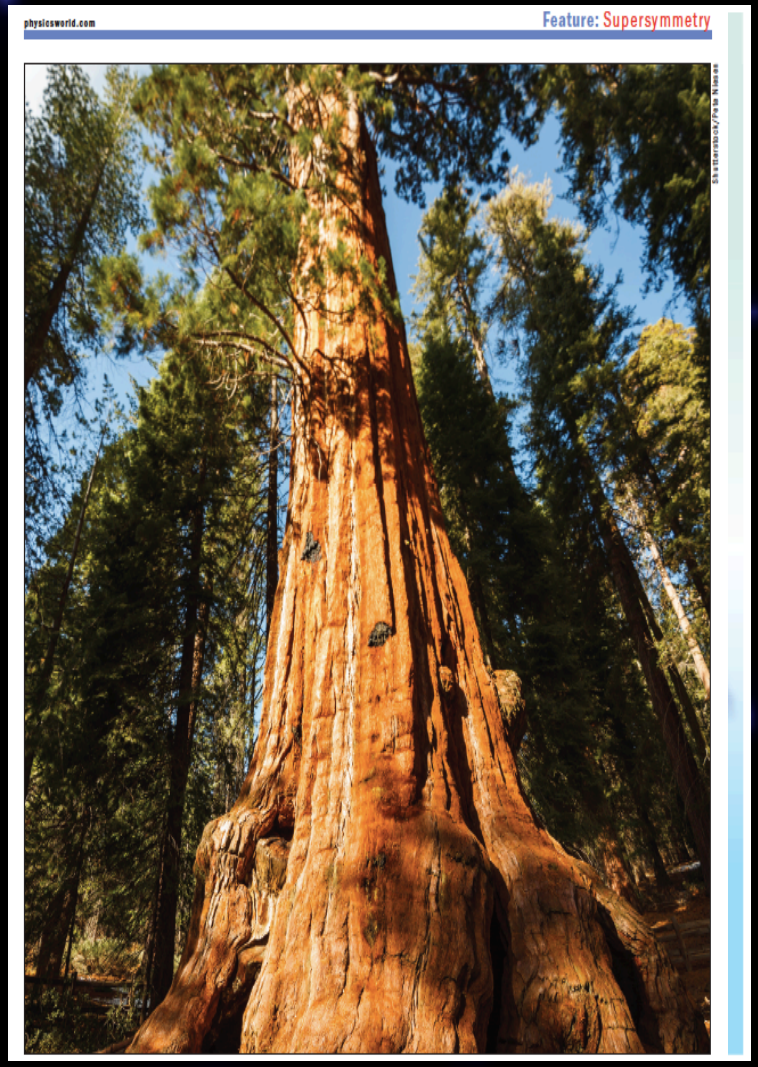

In my view, the current situation is akin to that of an explorer who, having scoured the eastern seaboard of North America, concludes that no groves of *Sequoiadendron giganteum* exist in the entire continental USA. As with this hypothetical hunt for giant sequoia trees, finding evidence for SUSY depends on the observer looking in the right place.

Only careful observation of nature can bring the clarity needed in this field. As experimentalists at the LHC prepare for upgraded operations in the next year, they will take the lead in settling the question of SUSY **At the same time. we need to be alert to the work of scientists who are looking for indication of SUSY elsewhere in the cosmos, particularly those involved in the continued search for dark matter as well as other possible astrophysical anomalies.**

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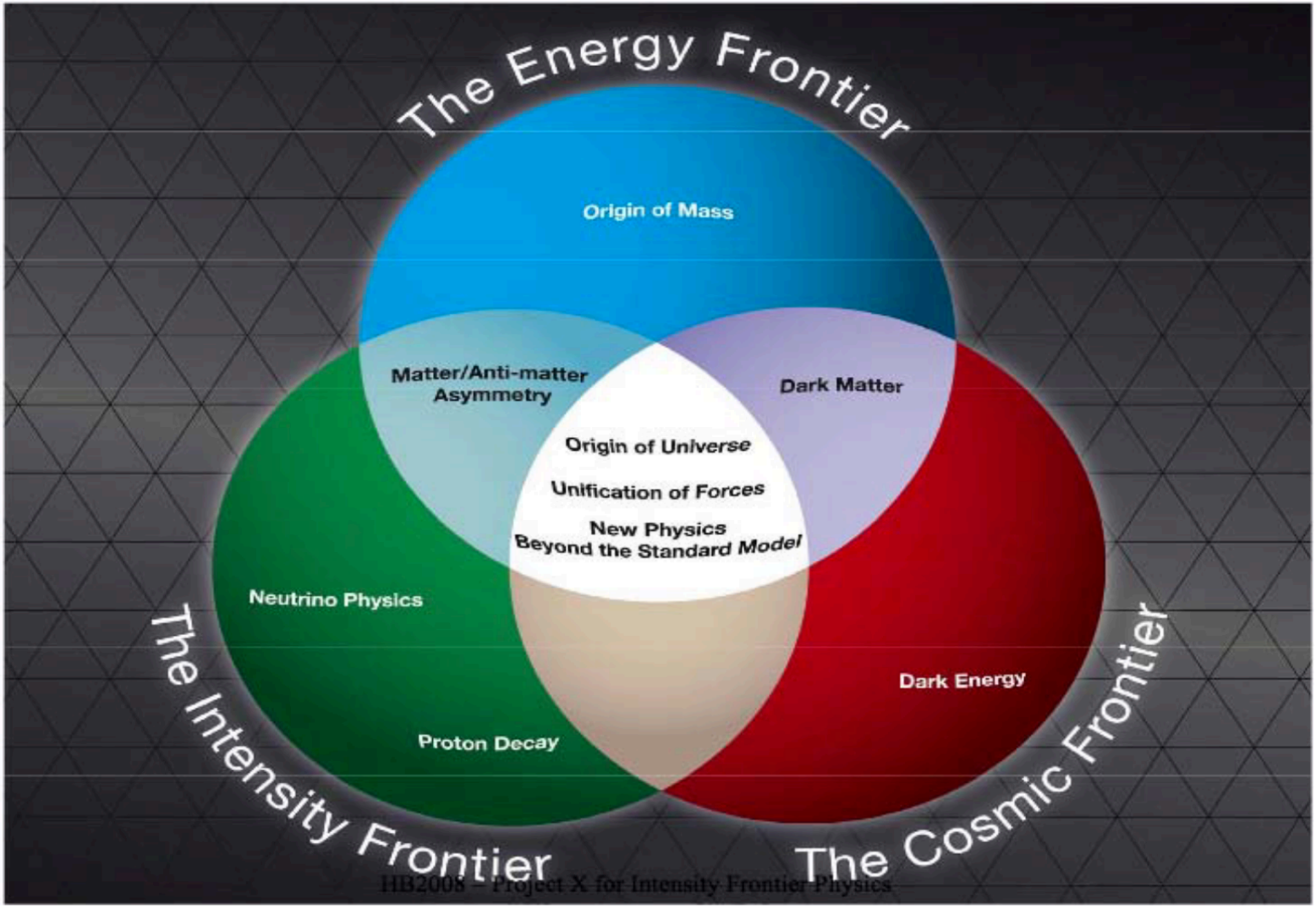
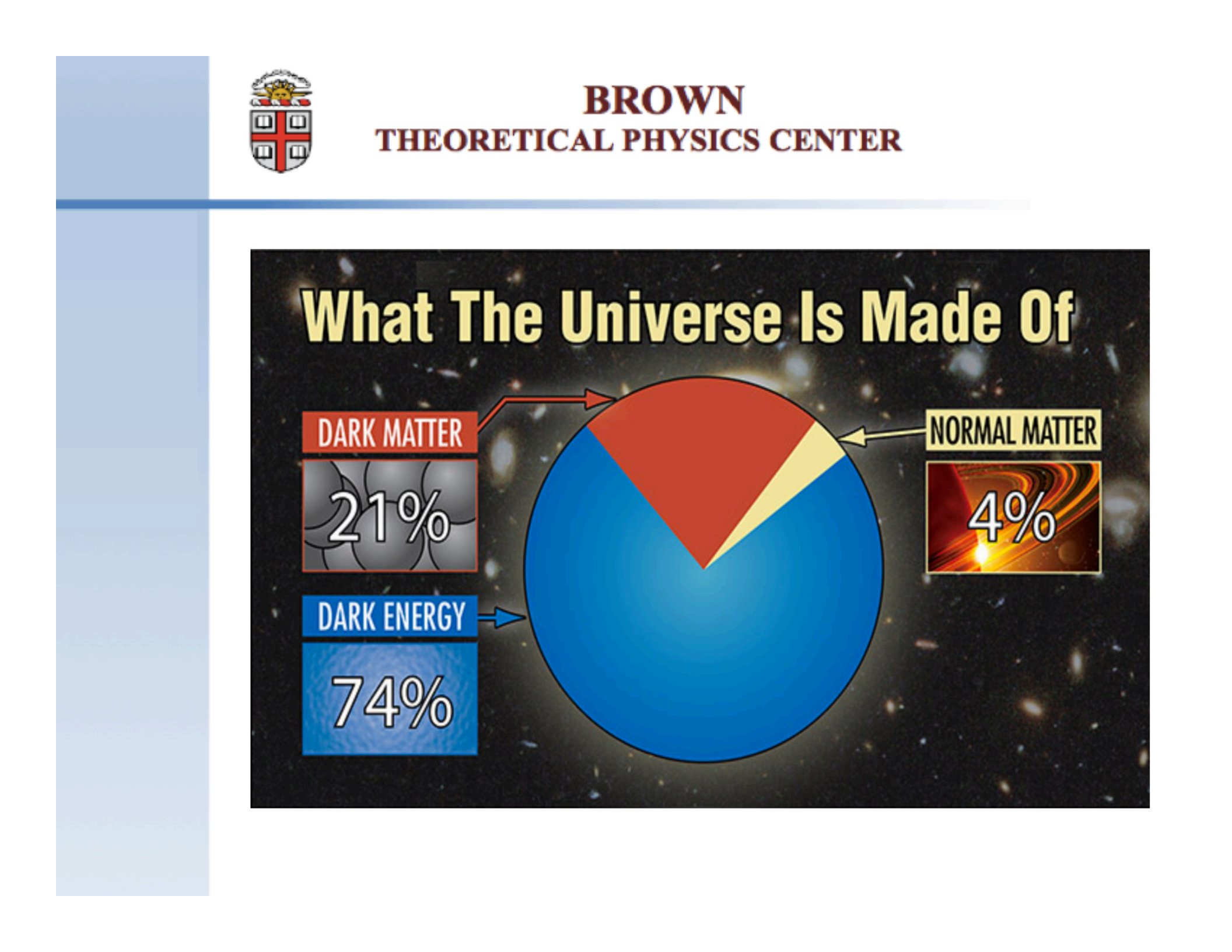
Frontiers at Fermilab

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What The Universe Is Made Of
DARK MATTER
21%
DARK ENERGY
74%
NORMAL MATTER
4%

Enhancing

Enhancing

Creative Science Investigation

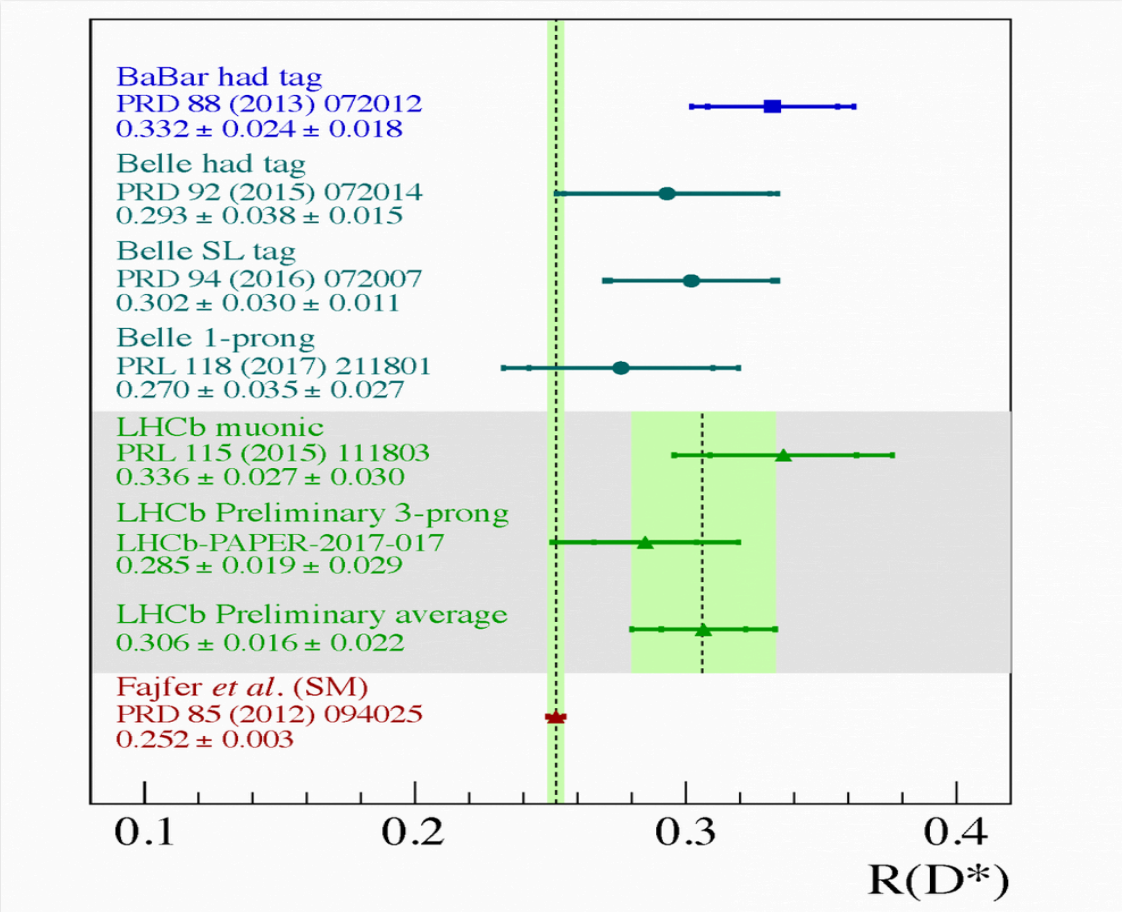
Precision in Measurement

The Best Known Number In All Of Science
Electron's Magnetic Property: The "g-Value"

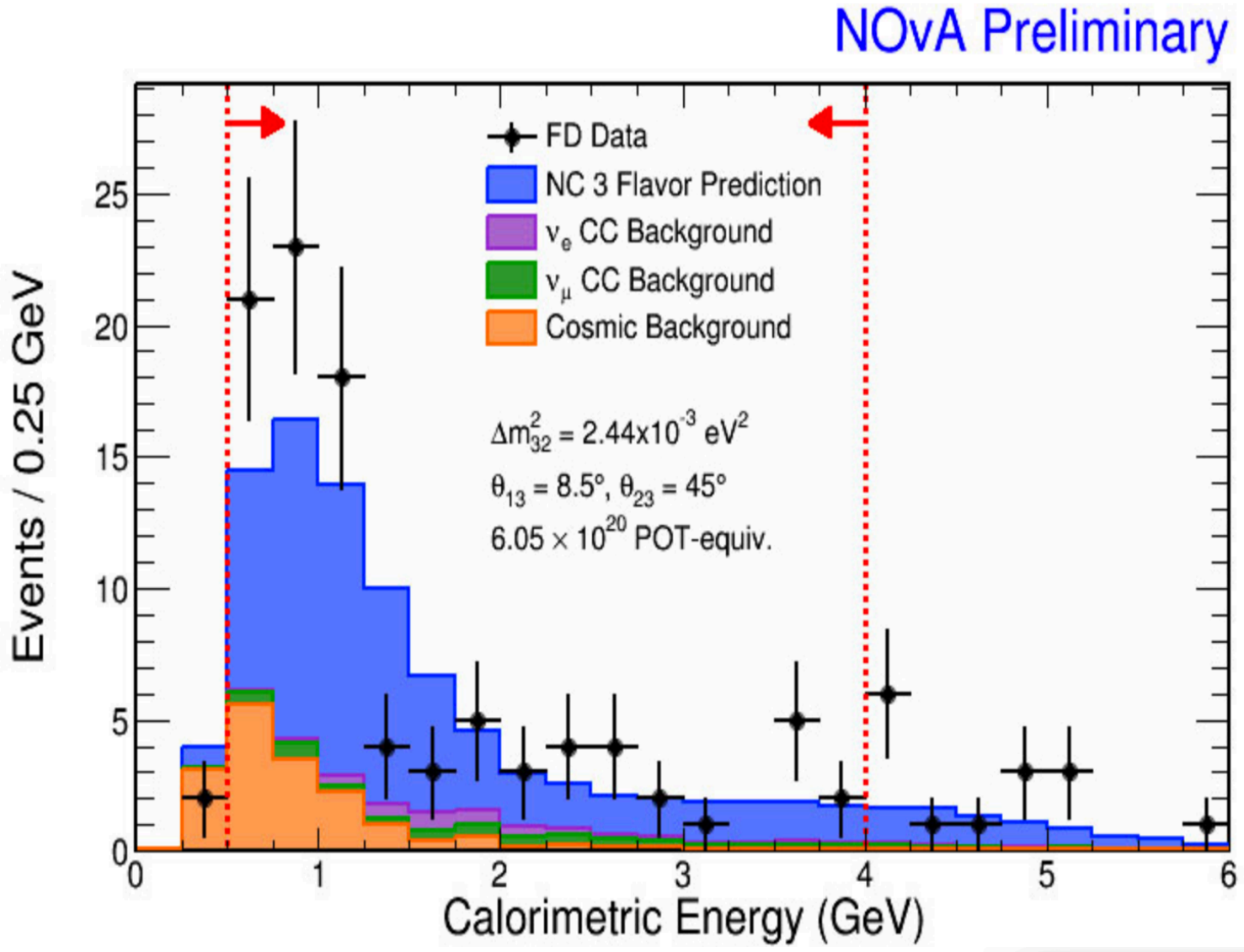
Measured g-2:	2.002 324 303 9
Theoretical g-2:	2.002 324 304 4
Delta g-2	0.000 000 004 0

These values from about a decade old and are given in example of experimental v. theoretical g-2 Values.

LHCb flavour anomalies continue to intrigue



Measurements of R(D*) from LHCb (green region), BaBar and Belle compared to the Standard Model prediction (red). The measured values from the three different experiments are all higher than the SM prediction, although the statistical significance is low.


NOvA Preliminary
FD Data
NC 3 Flavor Prediction
ν_e CC Background
ν_μ CC Background
Cosmic Background
$\Delta m^2_{32} = 2.44 \times 10^{-3}$ eV^2
$\theta_{13} = 8.5°$, $\theta_{23} = 45°$
6.05×10^{20} POT-equiv.
Events / 0.25 GeV
Calorimetric Energy (GeV)
0
5
10
15
20
25
0
1
2
3
4
5
6

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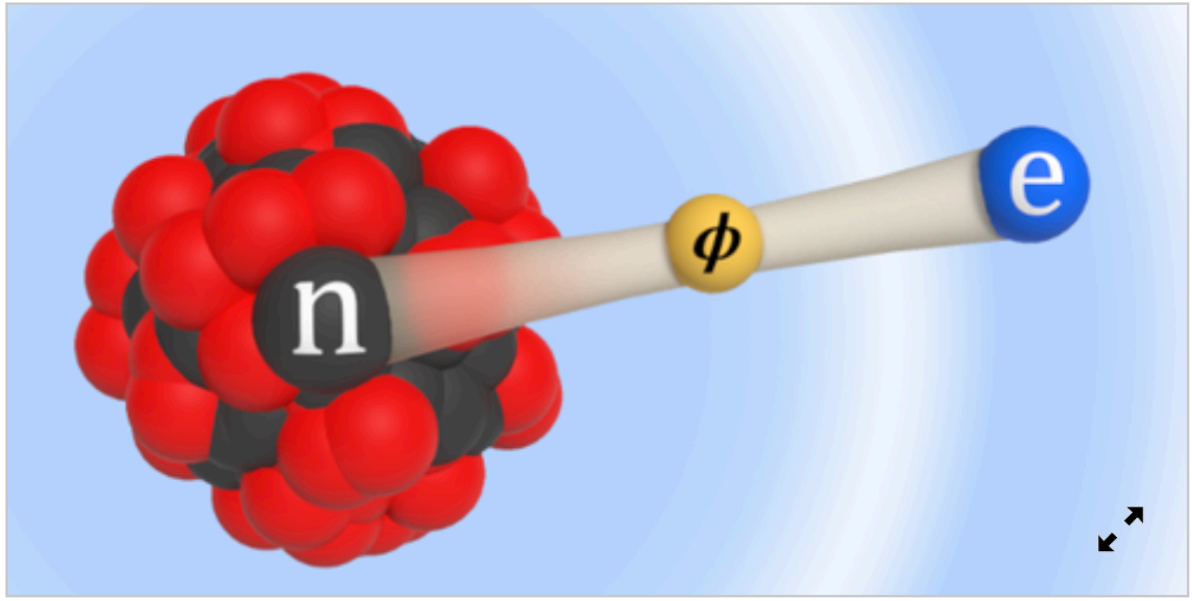
Hints of Dark Bosons

September 15, 2020 • *Physics* 13, s115

A signal predicted for a type of dark matter appears in the spectra of ytterbium isotopes.



J. Hur/Massachusetts Institute of Technology

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- BSM Physics
- Information Theory/Particle Theory Connection
- Q-I-Theory/Particle Theory Connection
- Polytopic Based High Order Scattering Amplitudes (Amplituhedron, Calabi-Yau, Cluster Algebras, etc.)

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Technically advanced accelerators and detector operated by CERN, Fermilab, IHEP, and SLAC, etc. have enabled research in particle physics, particle astrophysics, cosmic ray physics, gravitational waves and cosmology that draw people from almost everywhere on our planet to this task.

- LHC - Large Hadron Collider Energy Frontier Exemplar

Proposal for future global scale colliders include: upgrade to e+-e- scattering before resuming p-p experiments.

CEPC-Circular Electron Positron Collider
SppC - Super Proton-Proton Collider
ILC - International Linear Collider

EXO - Enriched Xenon Observatory (EXO)

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Neutrino Studies
LBNF - Long Baseline Neutrino Facility
DUNE - Deep Underground Neutrino Experiment
JUNO- Jiangmen Underground Neutrino Observatory

Gravitational Wave and VHE Gamma−Ray activities open even more exciting domains.

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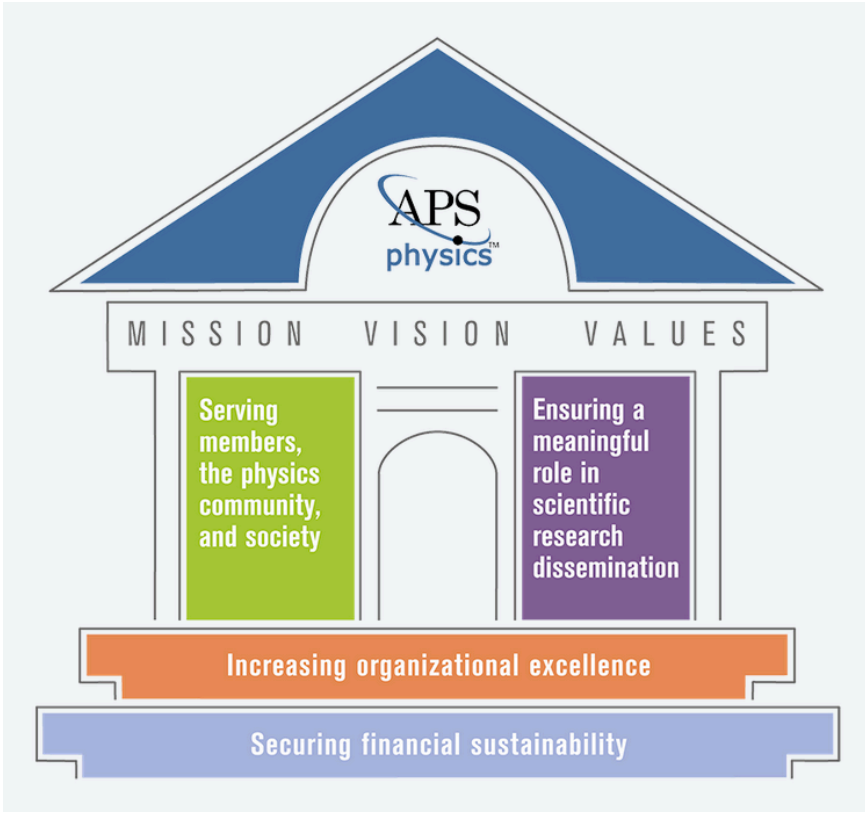

Our Values

The core values that drive our mission are:

- The Scientific Method
- Truth and Integrity
- Diversity, Inclusion, and Respect
- Partnering, Cooperation, and Open Collaboration
- Speaking Out
- Education and Learning

APS DEI (Diversity, Inclusion, & Equity):

(1.)
APS Strategic Plan
https://www.aps.org/about/strategicplan/index.cfm

(2.)
APS Board Statement on Racism in Physics
https://www.aps.org/policy/statements/executive.cfm#racism

(3.)
APS DELTA-PHY ("Change Physics") Webinar # 1
https://www.aps.org/programs/minorities/webinar.cfm

APS DELTA-PHY ("Change Physics") Webinar # 2
https://www.aps.org/programs/minorities/webinars/removebarriers.cfm

Let our discipline of physics commit to creating a brighter future DEI record that is not incarcerated within a prison of a darker past. - SJG

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Albert Einstein 1946 Lecture at Lincoln University

Einsteinian Links: Racism As A "Disease"

(1.)
Fred Jerome, and Rodger Taylor, "Einstein on Race and Racism,"
https://www.amazon.com/Einstein-Race-Racism-Fred-Jerome/dp/0813539528

(2.)
http://www.autodidactproject.org/my/einstein3.html

(3.)
https://news.harvard.edu/gazette/story/2007/04/albert-einstein-civil-rights-activist/

(4.)
https://www.lincoln.edu/news-and-events/news/albert-einstein%E2%80%99s-1946-visit-lincoln-university-featured-during-national

(5.)
https://www.nytimes.com/1946/05/04/archives/einstein-is-honored-by-lincoln-university.html

SJG Links: Education & Information

(1.)
"Equity vs. Excellence: A False Dichotomy In Science & Society,"
https://tryl2012.blogspot.com/2017/06/1995-equity-vs-excellence-false.html

(2.)
"Thoughts On Creativity, Diversity & Innovation in Science & Education," p14,
http://www.aaas.org/sites/default/files/LawDiversityBook.pdf

"Thoughts On Creativity, Diversity & Innovation in Science & Education,"
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.3836&rep=rep1&type=pdf

(3.)
U.S. Supreme Court Citation
http://docplayer.net/7772613-In-the-supreme-court-of-the-united-states.html
http://mitblackhistory.blogspot.com/2016/07/supreme-decisions-dr-sylvester-james.html

(4.)
"Einstein vs. Roberts,"
http://science.sciencemag.org/content/351/6280/1371

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Elie Wiesel 1928 – 2016

The opposite of love is not hate, it's indifference.
The opposite of art is not ugliness, it's indifference.
The opposite of faith is not heresy, it's indifference.

Alan Turing 1912 – 1954
Sometimes it is the people no one can imagine anything of who do the things no one can imagine."

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Real super-heroes are created at places like

Snowmass


So as I leave Snowmass 2020,
I have acquired a new suit of
clothes. Thank you.

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Acknowledgements:

My gratitude must be expressed to Y.-K. Kim for the invitation to give the closing address to this gathering. Additionally I wish to acknowledge Y.-K. Kim, J. Lykken, and S. Ritz for invaluable guidance in creating this presentation. Finally, I thank B. Jayatilaka, and B. Kiburg for their technical assistance.