Behind the Scenes of the Universe

FROM THE HIGGS TO DARK MATTER

GIANFRANCO BERTONE
Cosmic rays and astrophysics proceedings of the 3rd School on Cosmic Rays and Astrophysics: Arequipa, Peru, 25 August-5 September 2008, Carlos Javier Solano Salinas, Jun 30, 2009, Science, 278 pages. The purpose of the School was to promote cosmic ray physics and astrophysics within the Latin American community. These proceedings aim to provide a comprehensive overview of ....

Quantum physics a fundamental approach to modern physics, John S. Townsend, 2010, Science, 411 pages. This innovative modern physics textbook is intended as a first introduction to quantum mechanics and its applications. Townsend's new text shuns the historical ordering that ....


Dark Side of the Universe Dark Matter, Dark Energy, and the Fate of the Cosmos, Iain Nicolson, Mar 19, 2007, Science, 184 pages. Once we thought the universe was filled with shining stars, dust, planets, and galaxies. We now know that more than 98 percent of all matter in the universe is dark. It emits ....

Adventures in Cosmology, David L Goodstein, 2011, SCIENCE, 410 pages. This volume tells of the quest for cosmology as seen by some of the finest cosmologists in the world. It starts with "Galaxy Formation from Start to Finish" and ends with "The ....

Proceedings of the First NCTS Workshop, Astroparticle Physics, Husain Athar, Guey-Lin Lin, Kin-Wang Ng, Jan 1, 2002, Science, 184 pages. This volume contains detailed articles by theorists and experimentalists in the newly developing field of astroparticle physics. A large variety of topics are covered. These ....

Cosmology and the Evolution of the Universe, Martin Ratcliffe, Aug 12, 2009, Science, 207 pages. This volumes in the Greenwood Guides to the Universe series covers the current scientific understanding of the creation and evolution of the universe.

An Introduction to Mathematical Reasoning, Peter J. Eccles, Dec 11, 1997, Mathematics, 350 pages. This book eases students into the rigors of university mathematics. The emphasis is on understanding and constructing proofs and writing clear mathematics. The author achieves ....

Status and Prospects of Astronomy in Germany 2003-2016 Memorandum, Andreas Burkert, Günther Hasinger, Deutsche Forschungsgemeinschaft, Jun 23, 2008, Science, 223 pages. This white paper identifies the main issues and major recommendations for German astronomical research. Their implementation will require initiative from all partners and will ....

A Course in Mathematical Analysis, Volume 1, D. J. H. Garling, Apr 25, 2013, Mathematics, 314 pages. The first volume of three providing a full and detailed account of undergraduate mathematical analysis.

A Modern Approach to Quantum Mechanics, John S. Townsend, Jan 1, 2000, Science, 476 pages. Inspired by Richard Feynman and J.J. Sakurai, A Modern Approach to Quantum Mechanics allows lecturers to expose their undergraduates to the excitement and insight of Feynman's ....

A Guide to Functional Analysis, Steven G. Krantz, Jun 6, 2013, Mathematics, 150 pages. This book is a quick but precise and careful introduction to the subject of functional analysis. It covers the basic topics that can be found in a basic graduate analysis text ....
The discovery of dark matter has led to a worldwide race to identify the nature of this mysterious form of matter. In his popular science book Behind the Scenes of the Universe: From Higgs to Dark Matter, which appeared on Thursday 10 October with Oxford University Press, UvA physicist Dr Gianfranco Bertone gives an introduction to the problem of dark matter in the universe, as well as an actual overview of this extensive research topic.

In his book, Bertone illustrates the far-reaching implications of this discovery. There is a significant chance that we are about to witness a pivotal paradigm shift in Physics. The same experiments that allowed the 2012 discovery of the Higgs boson at CERN’s Large Hadron Collider - for which the 2013 Nobel prize in Physics was awarded to Peter Higgs and François Englert on October 8 - might soon lead to discover the existence of Dark Matter particles. Together with the many upcoming Astroparticle experiments both underground and in space that are about to start, the hunt for dark matter particles is taking place internationally at full speed, said Bertone.

The discovery of dark matter has shaken the foundations of Cosmology and Particle Physics, sparking a scientific revolution that has profoundly modified our understanding of our Universe and that is still far from over. Pioneering astronomers in the 1920s and 1930s had already noticed suspicious anomalies in the motion of celestial bodies in distant galaxies and clusters of galaxies. It was, however, only at the end of the 20th century that the scientific community was confronted with an astonishing conclusion: the Universe is filled with an unknown, elusive substance that is fundamentally different from anything we have ever seen with our telescopes or measured in our laboratories. This substance, called dark matter, constitutes one of the most pressing challenges of modern science.

Dr Gianfranco Bertone is associate professor at the centre of excellence GRAPPA (GRavitation and AstroParticle Physics Amsterdam), one of the research priority areas of the UvA. Within GRAPPA, theoretical physicists, astrophysicists and particle physicists have joined forces to find answers to the deepest questions from astroparticle physics and cosmology.

In this book, aimed at the general reader with an interest in science, the author illustrates in non-technical terms, borrowing concepts and ideas from other branches of art and literature, the far-reaching implications of this discovery. It has led to a worldwide race to identify the nature of this mysterious form of matter. We may be about to witness a pivotal paradigm shift in Physics, as we set out to test the existence of dark matter particles with a wide array of experiments, including the Large Hadron Collider at CERN, as well as with a new generation of Astroparticle experiments underground and in space.

An outstanding and captivating account of our current knowledge of the material composition of our Universe, and the extraordinary efforts undertaken around the world to identify the true nature of
dark matter. The book succeeds in describing timely topics in cosmology in an accessible and entertaining style, and in delivering a sense of the enormous scientific challenges in this field (Volker Springel, Heidelberg Institute for Theoretical Studies)

The next few years will be an incredibly exciting time in the search for dark matter in the universe. In this thoroughly enjoyable book, Gianfranco Bertone brings an expert's knowledge and enthusiasm to the subject. It really brings the reader up to the cutting edge of current research. (Sean Carroll, Caltech)

Gianfranco Bertone, Associate Professor, University of Amsterdam Gianfranco Bertone is an Associate Professor at the University of Amsterdam, where he investigates topics at the interface between Particle Physics and Cosmology. After a PhD at the University of Oxford and the Institute of Astrophysics in Paris, he has held teaching and research positions at the Fermi National Accelerator Laboratory, the University of Padova and the University of Zurich, before going back to Paris as a permanent CNRS researcher. He joined in 2011 the new center of excellence in Gravitation and Astroparticle Physics of the University of Amsterdam. He is the editor of the book "Particle Dark Matter: Observations, Models and Searches" and the editor-in-chief of the journal "Physics of the Dark Universe."

That's the gift Gianfranco Bertone has given us. Although published by the scholarly and prestigious Oxford press, _Behind the Scenes of the Universe_ is anything but stuffy. Bertone leads us through the discovery of what we now call dark matter and the history of the increasingly intense search for the particles that most physicists believe make it up, bringing us up to the minute as that search arrives at its present do-or-die moment. He does this in a relaxed, clear and vivid style, as if he were explaining it all to a good friend. And somehow he's able to give that friend a thorough tour of this fascinating and challenging scientific quest in just 160 pages.

We learn that dark matter isn't just a curiosity or a puzzle to be solved, but something fundamentally different from the particles and forces scientists know and understand, and as such, a key gateway to the undiscovered physics that lies beyond the standard model, new territory that physicists are desperate to explore. We come to understand the urgent need to find out what dark matter actually is, and the decades of dedicated, increasingly sophisticated research it has driven. He clarifies how that search has been shaped and guided by theories such as supersymmetry and string theory, and how any theory that purports to explain dark matter or tell researchers what to look for has to run a gauntlet of increasingly sharp theoretical and observational constraints.

If Bertone is right, the next generation of experiments--incredibly sensitive detectors buried deep under the earth, orbiting observatories, and particle accelerators starting with the LHC--will either find one or more dark matter particles or rule out all the leading contenders by the end of this decade. Readers who follow the flow of science news know that new dark-matter findings are being reported almost every week. Most are negative, ruling out more and more of the possible candidates. But recently a handful of experiments have found tantalizing hints of this elusive and mysterious prey. Those who have had the pleasure of reading _Behind the Scenes of the Universe_ will have the advantage of knowing just how these findings--new limits or purported discoveries--fit into the big picture, a picture that Bertone has so generously provided.

It puts a beam of protons into the emptiest vacuum in the solar system. It's colder than the depths of space. It accelerates those protons to 99.999999% the speed of light - then does the same to an identical beam travelling in the opposite direction. Each of the trillions of protons goes round the circle more than 11,000 times a second.

The matter we can detect accounts for less than 5% of the Universe that should be there. A significant chunk of the missing 95% may be dark matter made from heavier siblings of the fundamental particles we already know. The Higgs Boson's heavier cousins - if they're there - may give our first glimpses of the dark Universe.

This page is best viewed in an up-to-date web browser with style sheets (CSS) enabled. While you
An extraordinary discovery has recently shaken the foundations of cosmology and particle physics: the Universe is filled with an unknown, elusive substance that is fundamentally different from anything we have ever seen with our telescopes or measured in our laboratories. It is called dark matter, and identifying its nature constitutes one of the most pressing challenges of modern science. In my talk, I will argue that we may be about to witness a pivotal paradigm shift in physics, as we set out to test the existence of some of the most promising dark matter candidates with a wide array of experiments, including the Large Hadron Collider at CERN, as well as with a new generation of astroparticle experiments underground and in space.

Dr. Gianfranco Bertone received his PhD at Oxford University and the Institute of Astrophysics in Paris. He has held teaching and research positions at the Fermilab, the University of Padova, the University of Zurich, and the CNRS Paris. In 2011 he joined GRAPPA, the new center of excellence in Gravitation and Astroparticle Physics at the University of Amsterdam.


Instead, Jenkins sits on the side of the room of the Cirque School studio in Hollywood, intently focused on the steel blades in his hands. The Wolverine-reminiscent weapons are called kamas, and Jenkins grips them with controlled strength as he quietly goes through the motions of his 30-second audition routine.

Jenkins, 24, who flew to Los Angeles from his home in Warrenton, Va., along with his father and coach Ron Jenkins, is one of hundreds of people to audition for "Marvel Universe Live," a live-action arena stunt show that will unite many of Marvel’s most popular superheroes, including Spider-Man, the X-Men and the Avengers. The Los Angeles event was one of several casting calls for "Marvel Universe Live" held across the country, including in Las Vegas and New York. (Auditions in Orlando, Fla., are slated for Sunday.)

When he finally took his turn in front of the casting director and stunt coordinator, Jenkins launched into a routine, slicing the air with his kamas, punching, kicking and spinning mid-flip. His performance elicited applause from his fellow tryouts, and he walked back to his father on the sidelines, beaming.

Though casting decisions have yet to be made for the roughly 50-performer show, Juliette Feld, executive vice president with Feld Entertainment, which is producing the arena show, and Marvel’s chief creative officer, Joe Quesada, on Saturday revealed a first look at "Marvel Universe Live" for 2,000 fans at New York Comic Con.

During Marvel’s signature "Cup O’ Joe" panel, Feld introduced the creative team behind the arena show and unveiled the show’s logo (check it out in the gallery above) as well as two teaser videos. The show, slated to start touring 85 North American cities in July 2014, will be helmed by Emmy winner Shanda Sawyer as director, writing duo Adam Wilson and Melanie Wilson LaBracio and stunt coordinator Andy Armstrong (who served as stunt coordinator for the 2011 Marvel film "Thor"), among others.

The videos (watch them below) hint that the show’s plot might revolve around the Tesseract-powered device, which fans will recognize from "The Avengers" and "Captain America." One of the videos also features a behind-the-scenes glimpse at the making of the
Because our shows tour, we can’t have an excess amount of performers on hand, Ferris said. So we need the most diverse and versatile group of performers traveling with us at any given time. They have to have multiple skill sets. If they don’t currently possess every skill set we need, we need to at least see that they have the absolute potential, no question, that we can train them to do the other things as well. We can’t have a one-trick pony situation.

The way that they would be able to support a costume, whether it’s something that requires a large build that can sustain a lot of weight, or if we’re looking for someone that’s super limber and bendy and we can contort them into small spaces, she said. We look very much at their physique, their body type, the way they move.

We can always tell when somebody is new to the industry and they’re just starting their professional career, Ferris said. Sometimes that’s a real asset for us because we can shape them and mold them and train them our way from the get-go. Other times, there are roles that are so key that we have somebody that’s a true veteran that’s seasoned. So we’re really going to have a diverse group of people.

This really encompasses people’s ability to bring a character to life; a specific character that people already know inside and out, she said. The characterization, the acting, what the audience is going to connect with ultimately when they watch the show, not just watch a bunch of people do circus tricks. They want to get pulled into the story.

We recently got curious about what happens when you make things really cold. And we started getting interested in how you can wind up with these supercooled substances, where individual atoms begin to act like one another -- as if many, many atoms were just one atom. And then Robert hit the supercooled jackpot: he found a scientist who had created one of these super slow states (the coldest stuff ever in the universe it turns out) and then used it to slow, and eventually stop, the fastest stuff in the universe: light.

Lene Vestergaard Hau -- this physicist who makes Zeus mythology a reality -- blew our minds. Unfortunately, we weren’t able to get out to Massachusetts to see her light-stopping skills in action, but Harvard was nice enough to send along some behind-the-scene shots and video from Lene’s lab. The video below (apologies for the warbly sound, but the images are worth it), is a bit of a crash course on Lene’s work, and Lene herself seems baffled by what she’s done: "This is weird, this is really weird..." The first thirty seconds nicely show you the glow and hum of the lasers in the lab, emitting a warm, orangey-yellow light, evocative of a room full of candles.