Physicists featured in NOVA documentary on Einstein's famous equation

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Huge floodlights cut across the cavernous expanse of the Stanford Linear Detector and illuminate the outer wall of the control room. Coils of artificial fog seethe from a machine hidden at the end of a makeshift plank walkway raised several feet off the floor. The mist floats along the planks and rises toward the ceiling, several stories above the heads of the bustling camera crew. The wall of the control room is a massive grid of switches and multi-colored lights that blink like goblin eyes. The entire space - which houses equipment once used in the world's largest physics collaboration - has assumed an eerie, underworld quality. It is Harry Potter meets particle physics.

"All right, gang, shall we be clever about this and be done by four o'clock?" calls Gary Johnstone, producer and director of E=mc^2, a documentary film about the history of the equation that changed the way that physicists conceptualize the universe. The film, a NOVA production, will air Oct. 11 on public television.

"It is the major science documentary of the year, a collaboration between four national television stations—Channel 4 in Britain, NOVA in America, Arte in France and NDR in Germany," says Neil Calder, communications director for the Stanford Linear Accelerator Center (SLAC). "We are very happy that they chose to feature SLAC." The film, which is 110 minutes long and consists of historical play-acting and narration of stories of the individuals behind each term of the equation, will end with three minutes featuring young physicists at SLAC—Mike Kelsey, a research associate on the BaBar project; Caolionn O'Connell, a

graduate student in particle physics; and Stephon Alexander, a theoretical physicist. The filmmakers hope to bring the equation and its history into the modern context by demonstrating its continued importance in research today.

"Action!" shouts Johnstone, sitting on a large wooden crate that temporarily serves as a director's chair. People strategically positioned on stairs that zigzag up toward the ceiling begin climbing. The camera pans the scene, focusing on Kelsey, calmly making his way across the platform of planks toward the control room of the Linear Detector, used by the BaBar team between 1989 and 1999.

The BaBar project is a SLAC-based collaboration involving 550 physicists from 73 institutions and nine countries that attempts to understand why matter exists in the universe. Einstein's equation, which describes the properties of light and matter and the conversion between the two, is foundational for this work.

At the time of the Big Bang, two types of substances existed: matter and anti-matter. When the substances came together, they annihilated each other. "The fact that we exist, that matter anywhere in the universe exists is the result of an excess of matter over anti-matter," explains Kelsey. "What we want to know is why this imbalance occurred."

The answer may be a phenomenon called charge-parity (CP) violation that describes the decay rates of certain subatomic particles. The physicists try to create this process by shooting electrons at each other down the length of the accelerator. Upon collision, they burst, shooting smaller particles in multiple directions. The behavior of the subatomic particles produced allows physicists to compare decay rates of particles and anti-particles.

For Johnstone and the film production team, the BaBar research captures

the ongoing possibilities of Einstein's equation. But the purpose of the film is to illuminate the people behind the physics, says Johnstone. So after a wrap at SLAC, the crew heads up to San Francisco to meet Alexander at the jazz club where he plays saxophone.

Calder, who came to SLAC four years ago from the European Laboratory for Particle Physics (CERN) in Switzerland and has worked for several decades to bring physics to the public in an understandable way, appreciates the effort to show the lives of physicists beyond the laboratory. He hopes that the film will help educate the layperson about how dynamic and alive physics can be and about the interesting lives that physicists lead.

"There is this conviction that people are either science people or arts people," says Calder. "This is not true. Scientific subjects are intimidating to many people because of the math, though understanding the concepts of physics is far less difficult than understanding a poem by T. S. Eliot."

Physics has long been perceived as exceedingly complex and the scientists who study it, aloof geniuses. A new website called the Quantum Diaries (interactions.org/quantumdiaries/) is attempting to change this stereotype by posting web logs, or blogs, of physicists from all over the world. In their blogs, the physicists write not only about physics but about their lives as well—their dreams, worries and day-to-day experiences. Both O'Connell and Alexander keep blogs and their youth and enthusiasm for physics attracted the filmmakers' attention.

For most people, physics and daily life exist in parallel planes, never intersecting. The NOVA documentary takes a formula that everyone knows, but very few understand, and deconstructs it, infusing it with the "wild and romantic," says Johnstone. The film delves into the lives of the people behind the science to show that physics is just one piece of a

much larger, human drama.

In his most recent blog, Stephon "Steff" Alexander, a native of Trinidad, uses the concept of the doppelganger in a conversation he creates between his "SLAC Steff" and his "Trinidad Steff" about the experience of being in the documentary. The Trinidad self reflects on his connection to Einstein: "Deh doing a docudrama about the making of a famous equation discovered by Einstein, E=mc^2. An since we make use of dis equation all de time at SLAC and some of we work on related ideas deh decided to come down an capture daily life."

Source: Stanford Linear Accelerator Center (by Kendall Madden)