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State of the Universe

February 5, 2015

I am the Director for Space Sciences in the Strategic Operations group at Ball Aerospace, based in our Washington, DC, office. I am currently serving on a rotational assignment as Acting Director for Business Development in Civil Space and Technology, where I am leading a team of creative scientists and engineers developing solutions to the technological challenges posed by U.S. scientific discovery and space exploration programs. In this assignment, I use my PhD training every day in a profit and loss center of a Fortune 500 company, which is not at all what I imagined I would be doing when I first entered the field.

My National Science Foundation-funded postdoctoral research focused on the ways that the giant planets in our solar system interact with their surrounding space environments and with the solar wind. I was always very interested not just in *doing* scientific research, but in understanding and impacting the ways in which science *gets done*. That led me to eventually come to Washington as a **AAAS Science and Technology Policy Congressional Fellow** and to my continued work serving the science community. I came to Ball Aerospace after a number of astronomy folks working in the aerospace industry exposed me to the dynamic and satisfying contributions that can be made in the business world enabling the astronomical sciences.

Stories like mine are far from unique. At Ball, we have many employees with degrees in the astronomical sciences at the undergraduate and graduate level. They have gone on to do everything from working as high-level engineers on spacecraft and instruments, to working with the science community to formulate new mission concepts, to running programs and business units.

Others here have talked about astronomy as a gateway science. Scientists and engineers are often attracted to Ball by our innovative work in the astronomical sciences, such as the *Hubble Space Telescope* instruments, the *Kepler* mission, and the mirrors for the *James Webb Space Telescope*. They have the opportunity to build those tools of discovery, and also to contribute to programs of national need for other government agencies, the Department of Defense, the intelligence community, and the armed services.

Meg mentioned the *Kepler* mission, which is an example astronomical science driving innovation and of the type of meaningful contributions that people in industry make. The full story of the

The American Astronomical Society and Association for Women in Science thank Chairman Lamar Smith and Ranking Member Eddie Bernice Johnson for hosting this event and for their steadfast support for the astronomical sciences.

development of *Kepler* and the technological innovation required to make it successful is a whole other story in and of itself. Most recently, after *Kepler's* highly successful prime mission was completed, a reaction wheel that stabilizes the spacecraft failed, making it impossible to continue in its current state. The prime mission was complete, but the discoveries *Kepler* had made were so significant that there was scientific demand to continue the planet hunting. Our astronomy experts and engineers at Ball worked with NASA to develop a novel way to point and stabilize the telescope, enabling the spacecraft to continue its search for potentially habitable planets. On January 6 of this year, NASA announced the 1000th confirmed exoplanet discovered by the *Kepler Space Telescope*. Three of these newly confirmed planets were found to orbit within habitable zones of their parent stars.

So how do we find and keep all of these talented people who drive innovation? A theme of this panel discussion has been broadening participation, and that is definitely a priority at Ball and a concern of industry in general. If the U.S. is to remain a leader in the astronomical sciences and aerospace industry, we need all the talent available.

It's broadly understood that there is evidence that diversity is good for business. And good for business means good for creating wider economic value. That is one of the fundamental motivations for any organization to become more diverse.

At Ball we utilize a number of recruiting, formal and informal mentoring, leadership, and internship programs in addition to employee resource groups designed to support and encourage diversity and inclusion. For us, diversity truly means diversity in all senses of the word – such as thought, background, and culture in addition to traditional definitions. We take it very seriously, with leadership coming from the very top of the company. And we as individuals have the responsibility and expectation to identify and actively champion highly talented people.

I personally have benefitted from people at Ball – both women and men in senior leadership and executive positions – who have mentored me and put me forward for opportunities allowing me to stretch and develop, providing greater responsibility and more visibility. From this, I have learned to do the same. For example, I have successfully sought out very talented, earlier career women with really high potential.

I do see more diverse leaders and progress in our industry reflecting the make-up of our country. At Ball, more than 30% of our executives are female, which is high for our industry. Across industry we are seeing more people of color emerging as leaders. But frankly, across industry and the astronomical and physical sciences in general we have not seen the needle move as far as we'd like. That's really an indication that all communities – industry, government, the education sector – need to continue to work together to fully understand, address, and eliminate the barriers to broader participation.

I want to close by stressing that federal investments in science and technology are key to the economic health of our nation, the strength of the industrial workforce, and our ability to drive innovation in the astronomical sciences and beyond. For industry to innovate and create economic value, we require a robust K-12 and higher education system that produces world-class STEM-educated citizens who are prepared for the technical challenges we are in business to

address. Industry also needs opportunities to work with government agencies, federally funded research labs, and academia in order to develop cutting edge technology for scientific advances and national needs. Finally, federal investments in basic science research drive discovery and create both the demand for industry's innovation capabilities and the workforce needed to have a healthy U.S. industrial base.