PROJECT SUMMARY

Intellectual merit: Contemporary galaxy formation models combine the well-established Λ Cold Dark Matter cosmology with baryonic physics in order to provide a general framework for galaxy evolution. However, the predictions on how galaxies evolve are not unique, and the timescales and mechanisms through which the main baryonic components of galaxies – bulges, bars, and disks – assemble remain hotly debated. Furthermore, these hierarchical models of galaxy evolution have been purported to exhibit several troubling inconsistencies with observations, including the sub-structure problem, the angular momentum problem, and the problem of bulgeless galaxies. In order to glean direct insights into galaxy evolution, as well as test current models, this program puts forward *a comprehensive exploration of the structural assembly of bulges, the properties of bulgeless galaxies, and the merger history of galaxies as a function of environment and redshift, out to early epochs within 3 Gyr after the Big bang, when the Universe was less than 16% of its present age.* While this program is very ambitious, three key factors render it timely and feasible. The PI is a a team member of five large science collaborations and has access to the extensive reduced panchromatic datasets needed for this project. Within these collaborations, she and her research group are leading several of the science papers in the area of expertise relevant for this program, and they have completed two extensive studies which develop the methodology, demonstrate the feasibility, and put forth some milestone results on the two core themes of this program: the assembly of of bulges and the merger history of galaxies. The empirical results will be compared to theoretical models and the PI will continue on her tradition to work closely with theorists in order to advance the concurrent development of the theoretical framework. It is anticipated that this program will bring new and crucial results, which will be a stringent test-bed for hierarchical models of galaxy evolution. It will advance our understanding of how the fundamental building blocks of the Hubble sequence assembled over the last 11 billion years.

Broader Impact: Through a holistic approach to research, teaching, and education/outreach over the past four years, the PI and her collaborators have assembled a rich cutting-edge suite of activities and educational tools. Taking advantage of these extensive resources, this program proposes five timely teacher professional development workshops, focusing on exploring galaxies and the cosmos. Seventy-five high school teachers will immerse themselves in a deep 3-day/2night residential professional development workshop. During this time they will eat meals with astronomers and learn about their research by visiting the domes in which they observe. Teachers will work in groups to practice galaxy activities that align with National Standards for Science Education that they can then take back to their classrooms and use with their students. They will receive DVDs containing all materials used in the workshop as well as recruitment materials to attract students into the astronomy field. Each teacher will reach 100 students and over 5 years this project will affect 22500 high school students and 75 teachers. Many of the students impacted will be minorities since Texas has the second fastest growing Hispanic demographic in the country. The proposed program uses both current research and technology. The benefit of this program to society is a better trained and competitive scientific and technological workforce.