2018 Palmetto Academy Programs:

1. Dr. Barbara Beckingham, College of Charleston, Earth Science, “Benchmarking water quality measures in stormwater ponds with remote sensing-capable methods”
   This research project will explore whether biogeochemical parameters that define the water quality in stormwater ponds can be accurately retrieved and characterized using remote sensing techniques. The research is an opportunity to work in a team in both the laboratory and the field to gain skills in using state-of-the-art analytical and remote sensing tools. This work has far-reaching implications for enabling water quality monitoring in these potentially impactful, small water bodies dotting the SC landscape.

2. Dr. Joseph Carson, College of Charleston, Astrophysics, “Investigating the Impact of Episodic Stellar Activity on Planet Formation and Evolution”
   The main science goal of our study is to further our understanding of how stellar activity impacts planet formation and evolution, via a combination of observational and numerical studies. This will further our understanding of hitherto neglected formation and evolution processes, and will allow us to guide target selection for upcoming NASA observatories, such as WFIRST, that plan to explore nearby stars that are prime candidates for hosting potentially habitable planets.

3. Dr. Joan Marler, Clemson University, Astrophysics, “Creating a Kilonova Spectrum in the Laboratory”
   This Palmetto Research Academy will focus on laboratory astrophysics using highly charged ions. Highly charged ions (HCIs) are atoms in which all or most of the electrons have been stripped off. While HCIs are rare on Earth, they are commonplace in the universe, in particularly in the high temperature and pressure environments of stars and solar winds. Within those environments, HCIs will extract electrons from target gaseous molecules and subsequently deexcite to produce detectable photons. These photons provide important information on the density, temperature and constituents of the local astrophysical environment, and understanding the charge, velocity, and species dependence of the root process of charge exchange is required if the astrophysical data are to be interpreted correctly.

4. Dr. Sudeep Popat, Clemson University, Environmental Engineering and Earth Sciences, “Microbial peroxide-producing cells for blackwater treatment during space missions”
   Water recycling, and thus wastewater treatment, is one of the key functions of life support systems (LSS) for space missions. Through this Palmetto Academy project, we seek to develop microbial peroxide-producing cells (MPPCs) as an LSS technology that treats blackwater to generate hydrogen peroxide, an important chemical, that can be used for greywater treatment and reuse. MPPCs are based on the concept of microbial fuel cells (MFCs), which rely on anode-respiring bacteria (ARB) that breakdown organics in wastewater to produce electrical current. The students assigned to this project will work on designing, constructing, automating, and operating an MPPC fed with blackwater, and will use a suite of electrochemical and chemical analytical techniques to characterize system performance.
5. Dr. Jason Rawlings, Furman University, Life Sciences, “Epigenetic regulation of lymphocyte proliferation: toward the understanding of immune suppression caused by microgravity”

Since the beginning of manned spaceflight, immunosuppression has been observed in astronauts exposed to prolonged microgravity. Exposure to microgravity, whether in space or in simulations on earth, results in failure of T lymphocytes to properly activate and proliferate in response to growth factors during an immune response. However, the effects of microgravity on other lymphoid cells, such as T cells, B cells, and NK cells is not well understood. Recent work in our lab has shown that T lymphocyte activation induces a decondensation of chromatin (DNA and the proteins that package it in the nucleus) that is required for the acquisition of growth factor responsiveness. The objective of this Palmetto Academy project are to develop assays to determine if chromatin status regulates growth factor responsiveness in these other lymphocyte populations.

6. Dr. Sakamuri Reddy, MUSC, Medical Sciences, “Proteasome function in preosteoclast cells under microgravity conditions”

The proposal studies examine proteasome activity in preosteoclast cells under microgravity (μXg). The proposal hypothesize that p62 regulates osteoclast (OCL) differentiation in μXg. These studies should identify new therapeutic targets to control high bone turnover in space.

7. Dr. Ya-Ping Sun, Clemson University, Materials Science, “Student Participation in Developing Nanomaterials-Derived Technologies for Space Applications”

Thermal management is a critical issue in current and future space missions; Light-weight materials of high thermal conductivity are required for the thermal management systems (TMS) in space; Polymeric composite materials with nano-fillers of high thermal conductivity represent an excellent solution in addressing the thermal management issue; Two-dimensional nanomaterials, nano-thin boron nitride sheets in particular, are ideal fillers in the desired light-weight composite materials for TMS in space.