Physics & Astronomy – by Stanley A. Cheyne

The members of the Department of Physic & Astronomy have been actively engaged in research during the past year. The relatively new Engineering Physics major will have its first graduating class this year at the 2020 commencement exercises. Twelve seniors will be graduating with a major in Physics or Engineering Physics and most of whom have conducted year-long research projects.

Last fall **Stanley A. Cheyne**, H. (Trey) O. Thurman, and **Cecil Tiblin '18** published a paper in the Journal of the Acoustical Society of America titled, "*The inferred determination of the phase speed of a bubbly liquid of less than 2 m/s by using a transfer function technique*". The propagation of sound is profoundly affected by the presence of air bubbles. Oscillating bubbles essentially increase the compressibility of the liquid causing the sound speed to decrease. The sound speed is also highly dispersive (frequency dependent). As the frequency of sound approaches the resonance of the single bubble, the speed reaches a minimum. We were able to measure a sound speed of less than 2 meters/second which may very well be the slowest sound speed ever measured in any medium.

During the summer of 2020, Dr. Cheyne will be conducting research in the study of acoustic properties of ethanol/water solutions. As ethanol is added to water, the sound speed increases and peaks at approximately 30% ethanol. It then linearly decreases as the ethanol percentage approaches 100%. Precise data is going to be acquired and used to design and construct an acoustic hydrometer in collaboration with **Dr. W. (Mike) C. McDermott**. Although, Dr. McDermott is in his 4th year serving as Dean of the Faculty, he continues to teach two physics courses per year and participate in research projects. In the advanced electronics class, Dr. McDermott is working with students to help automate the College's greenhouse with programmable sensors. Dr. Cheyne supervised **George Carter '20** who is conducting research in active noise cancellation.

Dr. Thurman has been very active in research with students. During the summer of 2019 he worked with **Jared Medwar '21** on measuring the strength of concrete using various techniques including Rebound Hammer, ultrasound pulse velocity, and two-probe DC electrical resistivity. He also supervised **Chris Zoller '20** who conducted research on electric engine flight. He focused his attention on determining the parameters required of the airfoil to provide sufficient lift given the parameters of the load produced by the batteries and the engine. He also supervised **Michael O'Malley '20** who conducted research on improving the efficiency of a Trombe wall. A Trombe wall is a passive solar heating technique that has been known for over a century and it has performed with varying degrees of effectiveness. He was focused on measuring the convective air flow induced and discovering different approaches to improve this feature. His fourth summer research student, **Peyton Tolley '20**, conducted research on automobile aerodynamics. He was focused on studying the drag and side force induced in auto-racing using our wind tunnel.

During the fall of 2019, Dr. Thurman supervised **Tyler Howerton '21** who conducted research on environmental radioactivity. He was focused on measuring radon levels in the various academic buildings on campus and detecting trace radioactive sources in the water of our ponds.

During the spring of 2020, Dr. Thurman worked with **Christian Reed '21** who is conducting research on measuring the strength of concrete through an AC resistivity technique and **Stuart Crinckley '20** who is conducting research on the construction of a magnetometer to measure the thrust from a rocket engine.

Dr. Steven D. Bloom III continues working on the automation of the College's observatory using ACP software. He continues his research in exoplanets and Blazars. During the 2019-2020 academic year he supervised **Eric Foxwell '21** on modeling the rotation curves of galaxies to estimate the percentage of dark matter.

In its first year of publication, **Dr. Jonathan W. Keohane's** textbook titled "*An Introduction to Classical Electrodynamics*" sold over 160 copies, 110 in North America, and copies were printed in the USA for the North American market, and 50 printed in the UK for the European market. Based on the sales reports, it appears that the textbook was adopted for 7 classes in North America and 3 classes in Europe. In addition, he is currently working with **Connor Frank '20** on automating the H-SC observatory.