Portledge School Research Program to Utilize High Power Laser Module

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Portledge School (Locust Valley, NY) is expanding its research program for Upper School students. The research program provides opportunities for our Science, Technology, Engineering, Arts, and Mathematics (STEAM) scholars and other motivated students to pursue their interests in depth.

Scientists almost always work collaboratively. Thus, the students will have a more authentic experience by working on interlocking projects that interweave and support each other.

One of our students is passionate about jet engines and has spent a year studying air flow in a model. This focus on jet engines can be expanded into a collaborative effort, providing opportunities for several students over a period of a few years. A series of projects can be assembled, building eventually towards the characterization of a model turbine jet engine.

A laser module such as a high power violet laser (half watt, 405 nanometer wavelength) from Endurance Laser can be used as a probe of the varying chemical nature of the model jet engine output. Backscatter and transmission of the beam via the

exhaust gases will be captured optically and analyzed for spectral shifts. The shifts will be compared as the engine cycles through its warmup, steady state, and cool down periods.

Such a complex project will require several key steps. First, the laser must be controlled in space and time. Spatial control can be achieved by mounting it to one of the research program's existing resources, viz., a student-developed and built precision 3D positioning device which operates manually, with fine resolution (7 microns) in two directions. Currently, a Raspberry Pi computer is harnessed to the device and a preliminary control program has been implemented. Code improvement will lead to full computer control and fine resolution in all three directions. Temporal control can be achieved with modulation of the beam power. To that end, we have programmable arbitrary waveform generators and programmable power supplies and amplifiers.

Second, students would correlate laser backscatter and throughput with chemical changes by using simple and safe chemical vapors independent of a model jet engine. This in itself is a project of great interest, and can involve students interested in chemistry, spectroscopy, and computer coding. The coding would be based on data acquisition and mathematical analysis of the spectral content (also known as Fourier or Laplace analysis).

With all of these pieces well orchestrated, it would be possible to analyze the output of a model turbine engine.

Generous support from Endurance Laser LLC can serve as a nucleus of further support, both internal and external, to fund this vision.