

Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Commons East, Easel 49

11:00 AM to 1:00 PM

The Acoustics of Harmon Mutes

Zach Armstrong, Junior, Chemistry, Physics, University of Puget Sound

Mentor: Rand Worland, University of Puget Sound

The acoustic properties of trumpets have been studied thoroughly, but little to no previous work has been done regarding the acoustics of trumpet mutes. Harmon mutes have a distinctively "buzzy" sound when they are used in performance and it is the opinion of a large number of trumpet players who use Harmon mutes that they should be dented before they are used in performance. Modifications were made to several Harmon mutes by either denting them or drilling holes in them. An impedance head was used to measure the resonant frequencies of the trumpet and mute to see what effect these modifications had on the acoustics of the system. It was found that Harmon mutes have similar behavior to Helmholtz resonators, but significant deviations from this behavior were observed. If Harmon mutes are better understood, then a more informed decision as to whether or not they should be dented can be made.

POSTER SESSION 3

Commons East, Easel 77

2:30 PM to 4:00 PM

Improved Cooling Efficiency and Cost-Effectiveness of Bitter-Type Solenoid

Peter Yuthachack, Freshman, Chemical Engineering, Edmonds Community College

Collin Rhodes, Sophomore, Mechanical Engineering, Edmonds Community College

Duy Nguyen, Sophomore, Chemical Engineering, Physics, Mathematics, Edmonds Community College

Minpyo Kim, Sophomore, Mechanical Engineering, Edmonds Community College

Mentor: Tom Fleming, Department of Physics, Edmonds Community College

Mentor: Billy D. Jones, Edmonds Community College

High-powered electromagnets are used in many different

fields of science such as quantum physics and synthesis chemistry. Some projects require a very strong magnetic field to work. This magnet will allow students the freedom to design complex projects that utilize a strong magnetic field. However, they are generally quite expensive and only available for use at well-funded research facilities and universities. Thus, we present our research in the design and construction of a cost-effective electromagnet capable of producing a highly-uniform magnetic field that can be used to further undergraduate research at Edmonds Community College. Our principal focus is on the reduction of engineering, fabrication and maintenance costs through a novel radial-flow cooling system which can be easily 3D-printed using high-temperature plastics in conjunction with a solid Bitter-plate solenoid design, requiring far less intricate and less expensive machining processes than conventional staggered-channel Bitter-plate designs. In order to make meaningful comparisons of generated field and thermal profiles with other published designs, our design maintains general shape and structural congruence to a design by Sabulsky, et. al., yet differing significantly in the design of the cooling system.

POSTER SESSION 3

Commons East, Easel 79

2:30 PM to 4:00 PM

A Portable Vacuum Chamber for Gravitational Free-Fall Tests with Sub-Millisecond Resolution

Marisa Kemper, Sophomore, Organic Chemistry, Edmonds Community College

Phong Nguyen, Junior, Computer Science, Edmonds Community College

Naol Debele, Sophomore, Physics, Economics, Edmonds Community College

Samuel Will, Sophomore, Civil Engineering, Edmonds Community College

Mentor: Tom Fleming, Department of Physics, Edmonds Community College

Direct verifications of the validity of Newton's equations for vacuum free-fall in introductory physics laboratories are notoriously difficult due to the presence of atmospheric interactions between falling objects and their environments. The theoretical result, for example, that the gravitational acceleration of an object is independent of its mass is rather easy for obser-

vant students to experimentally reject under normal laboratory conditions. What is not so easy is to experimentally verify the validity of mass-independence in-vacuo. This is hindered by inaccessibility to vacuum environments or access to one small enough to fit in a classroom; such access is limited to organizations like NASA. We present here the construction and testing of a portable 1.5m tall extruded-acrylic vacuum free-fall apparatus designed for repeated-measures experiments of time-of-fall with a 2.5g, 40mm diameter magnetic ball over atmospheric pressure ranges $10^{-4} \text{ Torr} < p_{\text{chamber}} < 760 \text{ Torr}$. The apparatus includes 12V electromagnet catch and release system within its all-externally-housed actuating mechanisms, automatic digital data acquisition, and a planar optical laser detection system. By comparing time trials in atmosphere and in vacuum, the difference in free-fall times will be isolated and found to be due to air resistance which is not accounted for in the original Newtonian formula. Parameters for this apparatus can be modified to test other ideas for fluid dynamics, such as coefficients of drag and the effects of fluid density on objects as they move through a fluid while using the already present vacuum environment as a control.