COSM Physics News

February 1, 2016

Georgia Southern University

Physics Team Drs. James & Sarah Higdon Study Star Formation in Galaxies

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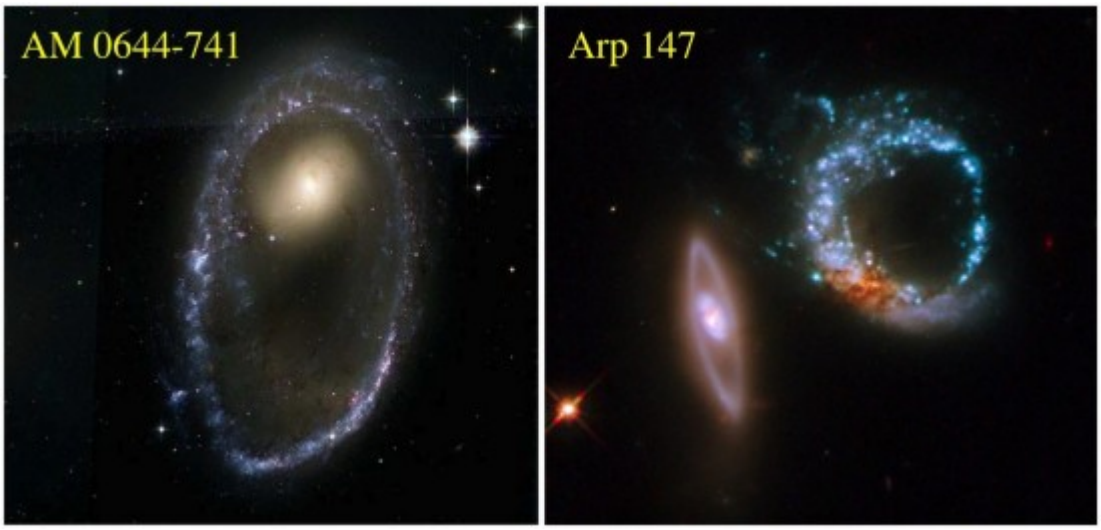


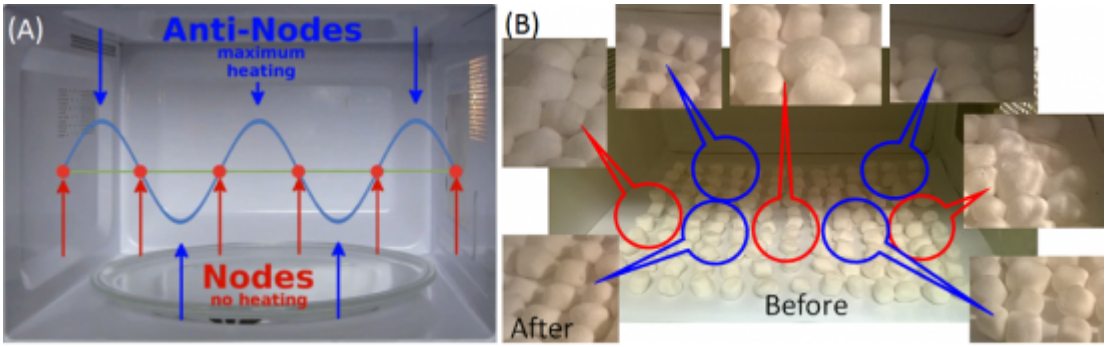
HST color images of ring galaxies AM 0644-741 and Arp 147 currently being observed with ALMA. The blue rings indicate high rates of star formation, triggered by the collision with a companion galaxy. They are, respectively, 300 and 430-million light years distant.

A study by James & Sarah Higdon investigating the peculiar star formation law of the Cartwheel ring galaxy was accepted for publication by the Astrophysics Journal Letters. Data obtained with the Atacama Large Millimeter Array (ALMA) telescope, located high in the Chilean Andes, played a crucial role in this research. They have been invited to present these (and other) results at a special ALMA workshop organized by the National Radio Astronomy Observatory (NRAO) in Charlottesville, Va. in April.

Microwave Ovens Are Not Just Kitchen Appliances

February 1, 2016

While for most of us microwave ovens are nothing but kitchen appliances used to “nuke” our breakfast, for Dr. Amarie’s students in Studio Physics 2 (Electricity, Magnetism and Optics) they are laboratory instruments. For them, the oven is a microwave resonant cavity capable of sustaining stationary electromagnetic waves (schematics, Figure A) in the microwave range characterized by nodes (cold spots) and anti-nodes (hot spots) similar to a vibrating guitar string when we play a note. But how to make the invisible waves visible, is the question? Well, we chose a very delicious approach: a platform covered first with a pattern of marshmallows (Figure B), then with Hershey’s chocolate bars “revealed” the hot spots as they melted (Figure B – inserts) and measurements were possible. To our surprise, given such a crude method, we determined a wavelength of 12.5 cm (5 inches), give or take a marshmallow, which comes within about 2% of the theoretical value of a 2.45 GHz microwave oven. As you can imagine the demo was a blast, we had to take advantage of the situation and since graham crackers started to show up out of the well-prepared students’ backpacks, the s’mores time was on! See? Physics is so sweet!



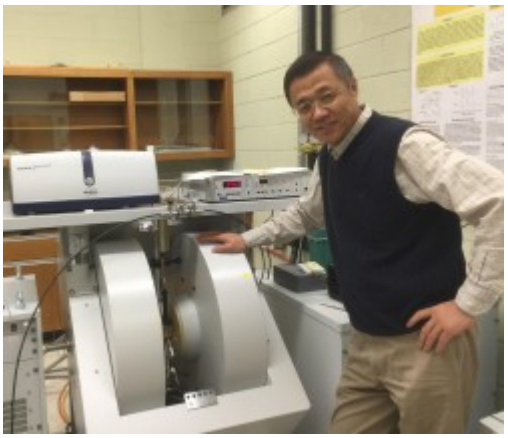
Safety Comes First

Microwave Irradiation is concerning us all. Dr. Amarie’s students in Studio Physics 2 (Electricity, Magnetism and Optics) were excited to learn about the microwave radiation levels to which we are exposed to in diverse situations. But even if we would have means to perform experimental measurements, how can we tell when enough is enough? What are dangerous exposure levels? The instructor guided his students towards federal agencies like FDA and CDC which have set standards for microwave radiation safety since the 70’s. For example, we learned together that microwave ovens have a “*safety interlock* […that] *shall prevent microwave radiation emission in excess of 5 milliwatts per square centimeter at any point 5 centimeters or more from the external surface of the oven*” [FDA – Code of Federal Regulations, *Performance Standards for Microwave and Radio Frequency Emitting Products*. (2015) 21CFR1030]. Armed with valuable knowledge, we started to explore our environment. As expected, we found the largest microwave intensity close to the oven. Our findings showed that in front of the oven’s door the radiation is maximum, and about 0.2 mW/cm^2, which is still 25× less than the federal requirement for safety. Next, we explored our classroom. Numbers seemed to vary quite randomly with values between 2.0 – 10 nW/cm^2, no matter the location: close to the fuse box, the PC monitor or under classroom projectors. Such measurement were very close to natural background measured in the park in front of the Math/Physics Building, roughly 1.0 nW/cm^2. Since all our cell phones emit in the microwave range, the next biggest attraction was about how much exposure we get when we make a call? To answer such question, over 50 students simultaneously called instructor’s office phone, than immediately placed their smartphones, on top of each other, with in 2-3 inches of the detector. Students’ learned that every time we make a phone call, we are exposed to an average microwave intensity of about 5 uW/cm^2 or 1,000 times less than the federal requirement. Let’s hope these experiments put some minds at rest.

Dr. Xiaojun Wang Research in Phosphors

February 1, 2016

Dr. Xiaojun Wang, Professor of Physics, performed very productive research when he took an educational leave last semester. He attended the 3rd International Workshop on Persistent and Photostimulable Phosphors (Arlington, TX, USA, Nov. 9-13, 2015) and gave an invited talk titled: "Photo-stimulated EPR Studies on the Trapping/Detrapping Processes of Persistent Phosphorescence." He published several papers, including one appearing in the top rated journal, *Nanoscale* (*Nanoscale* 7, 14752-9 (2015). DOI: 10.1039/C5NR04125B), and one featured on the front cover of *Dalton Transactions* (*Dalton Trans* 45, 1364-72 (2016, front cover). The latter was co-authored with a visiting professor from China, Dr. Yuxue Liu. He also made two publications, one in *J Raman Spectroscopy* and another in *Optics letters* (*Opt Lett* 40, 1434-37 (2015)) with a visiting professor, Dr. Chenglin Sun. After many years' efforts, he published an undergraduate research article (with Dr. Li Ma Professor of Physics, two physics majors (David Keene and Joshua Klingel), and a visiting scholar (Dr. Aijun Li)) in *Am J Physics* (*Am J Phys* 84, 32-37 (2016)), the most influential journal in undergraduate physics research.



Dr. Wang with the Physics Department's Electron Paramagnetic Spectrometer

In addition, using his optical techniques to precisely measure the thickness of the unique antifogging thin-films prepared by Dr. Ming and his postdoc, Dr. Jie Zhao, in the Georgia Southern Department of Chemistry, he also co-authored a paper published in *RSC Advances* (*RSC Advances* 5, 102560-102566 (2015) DOI: 10.1039/C5RA21399A). Dr. Wang continues to serve as an editor at Materials Research Bulletin (Elsevier, http://www.journals.elsevier.com/materials-research-bulletin/editorial-board/) and Light: Science & Applications (NPG, http://www.nature.com/lsa/about/index.html#Editors).

Dr. Maxim Durach Nanotechnology Computational Group Update

February 1, 2016

Two major results have been obtained by the Nanotechnology Group, led by Dr. Maxim Durach. In a paper by Applied Physical Sciences graduate students David Keene and Matthew LePain and Dr. Durach it is shown that 30-nm thick