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**COSMOLOGY
Q & A**

**LIGHTNING
STRIKES REVISITED**

**PHYSICS IN
INDONESIA**

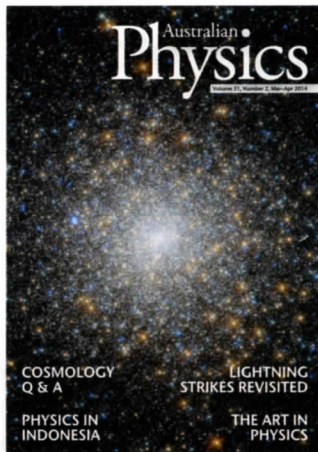
**THE ART IN
PHYSICS**

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Cover

The globular cluster M15, as seen by the Earth-orbiting Hubble Space Telescope. To a small telescope, M15 appears to be a slightly fuzzy star. Hubble sees over 100,000 stars packed together so tightly that if the Sun were at the centre, thousands of stars, white dwarfs and neutron stars would be found within the distance to Proxima Centauri, the nearest star to the sun. There are a million times more stars in our galaxy, and the part of the universe that we can see has a hundred billion galaxies. Cosmology, ambitiously, tries to study it all (see article by Luke Barnes, Cosmology Q & A, p42).
Image credit: NASA/ESA

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The Art in Physics - Creating "LABPUNK"

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Sometimes physics fascinates just because of its aesthetics. It could be the artistic appeal of an experimental image, a beautiful object used in doing physics, a pleasing curve that relates parameters... The authors of this article see possibilities for art in the artefacts of physics – in bits of lab equipment, experimental results, and theoretical models. One is a scientist with a passion for art, the other an artist with a passion for science. Collaboratively they are making original works of art which may be worn as jewellery, or enjoyed as sculpture, by re-purposing physics artefacts.

What is Labpunk?

The Art in Physics-Creating LABPUNK project is a dialogue between science and art. This project has been gestating for some time. University of Queensland Physics lecturer Wegener has collected, over years, items of lab "junk" that appeal because of their aesthetics and their stories. This collection has become a physics wunderkammer [1] - a cabinet of curiosities. This term, originally used to describe a room filled with natural history objects, as shown in Figure 1; now typically refers to a collection of items with memories specific to the owner. In Wegener's physics wunderkammer, the artefacts of physics resonate with her scientific aesthetic. The objects also appeal to Milroy, an artist, whose academic studies coincidentally began at The University of Queensland Physics Department. Both believe these items deserve a second chance, to be re-purposed. This mutual appreciation for physics artefacts, shared interests in physics and experiences as metalsmiths has led to an alchemical collaboration between science and art, as items from the physics wunderkammer are transformed from lab junk to LABPUNK - artworks with depth and attitude, souvenirs of the work of physicists. The term LABPUNK (coined by Norman Heckenberg [2]) references the Steampunk movement. Steampunk is associated with 19th century science-fiction focused on steam-powered machinery; it refers to artistic styles and fashions developed from the aesthetics of this fiction [3]. The Art in Physics - Creating LABPUNK project follows a strong tradition of images of science inspiring art and design. This includes W.H. Bragg and W.L. Bragg supplying diagrams of crystal structures to designers [4] and the Angstrom Art initiative [5]. While there is often an edgy, technical look to wearable design objects with this inspiration, it doesn't have to be the case, and in many of the LABPUNK works, elements of the style and form as

well as techniques of traditional fine jewellery-making are used. In Figure 2, Wegener and Milroy examine a delicate silver bangle modelled on the molecular structure of green fluorescent protein.

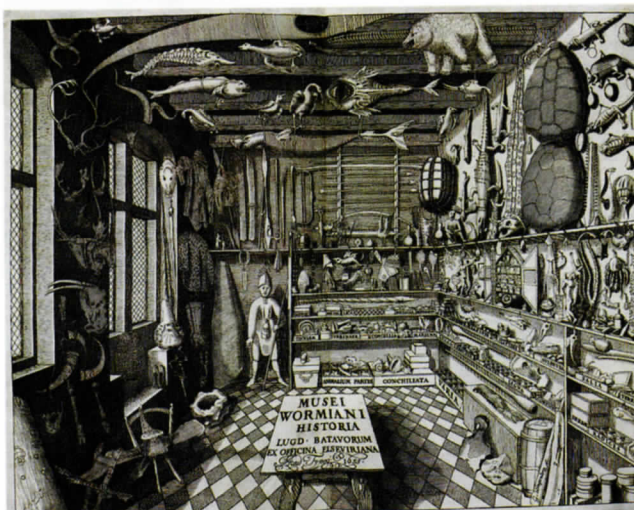


Figure 1: Engraving of a cabinet of curiosities. Imperato, F. 1599. Dell Historia Naturale, Naples. Smithsonian Museum.

This year's Australian Institute of Physics Congress, themed "The Art of Physics", is an ideal platform from which to explore LABPUNK physics art jewellery. It is also an opportunity for the wider physics community to participate in The Art in Physics - creating LABPUNK project. Wearable works of art and small sculptural objects will be created specifically for the 2014 AIP Congress. Each of the plenary speakers will be given an original, unique and wearable work of art to keep as a memento of the conference.

A Call to Participate

A warm invitation is extended to the physics community, including scientists and their suppliers, teachers and stu-

dents, to be part of this project. One way to participate is by donating material. Your donation could be:

- something physical that is languishing in the lab - like a broken, fractured, or scratched object, or scrap material (particularly metal);
- a sample of an interesting material you are working on;
- a visual prompt, either theoretical (like a graph of a function with an appealing curve) or some representation of data (such as an astronomical image or experimental plot).



Figure 2: Wegener and Milroy 2014

To give you more of an idea of the types of things that would be welcomed, here are examples of what the project already has: – laser rod, high-purity aluminium, lenses, niobium, perforated metal sheet from electronics boxes, gold mirror, sapphire resonator, brass fittings, nickel mesh, platinum wire, calcite crystal, neoprene O-rings. A sizable collection has already been gathered around Brisbane, and items from further afield would be greatly appreciated. The donated raw material (both physical and conceptual) will be transformed into small art objects. They will include lapel pins and other pieces of jewellery. A collection of these pieces will be shown at AIP Congress 2014 in

December. Conference attendees will have the option of participating in the project by wearing selected pieces. The LABPUNK conference exhibition will be interactive, and it is anticipated that the artworks will provoke dialogue between participants as the back stories of the pieces, the origins of the raw materials and the scientists involved are revealed during the course of the conference.

Aims of the project

On reflection, the Art in Physics - Creating LABPUNK project, while initiated by a common compulsion to create, has at its core four main aspirations:

The first is to re-purpose lab “junk” and other physics artefacts into works of art. Examples are shown in Figures 3 and 4. The raw materials, the laboratory or scientific activity they originate from, and other background information informs the final piece.

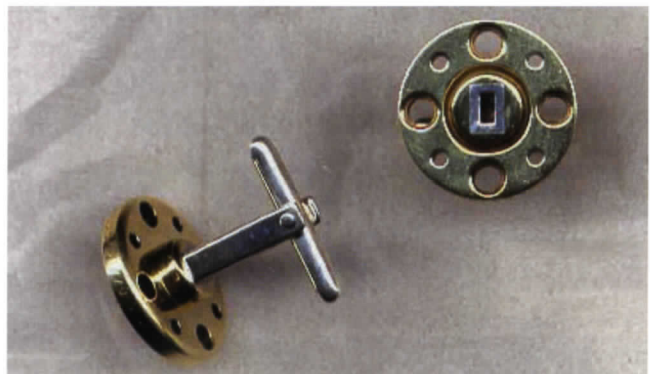


Figure 3: Cufflinks constructed from silver waveguide with brass flange, and sterling silver. (Waveguide courtesy of Norman Heckenberg).



Figure 4: Aluminium dish incorporating diaphragm from superorbital expansion tube

The second aspiration is to record this dialogue between physics and art. Despite the oft-perceived incompatibilities of the objective (science) and the subjective (art), there are many areas of overlap - materials, instruments, a problem-solving approach and experimentation [6]. One area of commonality is the creative process. As Einstein famously claimed “Imagination is more impor-

tant than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand" [7]. By examining lab "junk" from a very different (artistic) perspective, new links may be revealed and explored. A process of documentation and reflection accompanies this project. It is planned to include conference presentations, a website and publication of an art book. All participants will be acknowledged in the project's publications.



Figure 5: Sterling silver bangle/sculpture inspired by molecular model of Green Fluorescent Protein (Model reference courtesy of Seth Olsen).

The third aspiration is to make new links and strengthen existing linkages within and beyond the physics community. By donating materials and/or wearing the works of art, participants will be linked to the physics and physicists involved. Wearing a bangle whose form is based on a model of molecular structure (Figure 5) has sparked conversations with scientists recognising the form and artist-jewellers asking about it. An example of existing links between the communities of scientific and creative industries is the location of a business growing crystals for lasers in the centuries-old gemstone mining and processing town of Idar-Oberstein, Germany. Another link is the way that modern physics technology is being utilised in jewellery-making. The industry uses technology that was once the domain of physics research labs, for example, in laser-cutting gemstones (see Figure 6). Laser-welding metals in the making and repair of jewellery is being increasingly used because of the technique's advantageous highly-localised heating. Recently, laser-welding and patterning of titanium has been explored to extend traditional jewel-

lery-making techniques [8].



Figure 6: Ring of sterling silver with laser-cut amethyst.

The fourth aspiration of this project is to address the finite. Often scientists make models based on the infinite, while knowing that reality is finite. Conservation laws are at the very heart of physics. By re-using lab junk, we are acknowledging that the resources available to us are finite. With this resource limitation in mind, we are keeping materials in circulation, rather than dismissing them as waste. Recycling and re-purposing materials has a long tradition with metalsmiths. Nothing is ever discarded; items are repaired, dismantled to their component parts, refined and re-made into new objects. This strategy fits with a theme in contemporary arts of sophisticated and stylish recycling, which includes clothing [9] and jewellery, where "urban mining" sees donated jewellery disassembled then reconfigured into contemporary pieces [10]. Exemplifying this practice, in 2012 Wegener and Milroy exhibited work in the peer-reviewed Jewellers and Metalsmiths Group of Queensland "100% Recycled" exhibition [11].

A bigger picture

The Creating LABPUNK project will continue after the AIP Congress. A museum/gallery exhibition of LABPUNK is planned in Brisbane, inviting the public at large to experience the (art) world of Physics - its community and achievements.

Finally ...

In summary, we are using physics "relics" to make art objects and celebrate linkages within and beyond the physics community. If this project announcement and call to community has piqued your interest, please email wegener@physics.uq.edu.au as soon as possible. Donations can be posted to Margaret Wegener, Physics, The University of Queensland, 4072. We would greatly appreciate receiving donations to be used specifically for the AIP Congress by August, 2014.

References

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- [9] Tokyo Recycle Project <http://masahironakagawa.com/works/trpstatement-en.html>
- [10] "Participation + Exchange", 15th Biennial Jewellers and Metalsmiths Group of Australia Conference, 12-14 July 2014, Brisbane <http://www.participationandexchange.com/>
- [11] "100% Recycled" exhibition <http://www.visualartist.info/JMGQ/100-recycled-nbsp>

Dark field illuminates X-ray imaging

Radiation that does not play a part in conventional X-ray imaging has been exploited by physicists in the UK to provide comprehensive snapshots of an object's physical and chemical state. Potential applications of the new technique, known as "dark-field hyperspectral X-ray imaging", include identification of stress build-up inside engineered structures, security scanning of illicit materials, and analysis of medical biopsies.

Normal radiography of the kind used in hospitals relies on the phenomenon of absorption. A beam of X-rays is fired at an opaque object and the radiation that emerges on the far side is captured by a photographic film or digital detector, with the image mapping variations in electron density inside the object. However, the image cannot be used to identify the materials that make up the object in question.

That limitation has been overcome in the latest work, which has been carried out by Robert Cernik of Manchester University and colleagues at Manchester and the Rutherford Appleton Laboratory in Oxfordshire. Instead of recording what is known as an X-ray beam's "bright field" – the radiation that passes through the sample – the new approach involves measuring a portion of the "dark field" – the radiation scattered or emitted by the object. "Usually great lengths are taken to remove the scattered radiation," says Cernik, "but in fact that radiation contains all sorts of extra information not available in conventional imaging."

The technique involves placing a sample in the path of a relatively wide polychromatic X-ray beam and then positioning a pinhole aperture a few degrees off the beam axis on the far side of the sample. A sensitive, multi-pixel detector then captures the radiation that emerges from the pinhole. Cernik explains that the set-up provides a new way of recording diffraction patterns from the sample. Conventional scattering experiments shine a monochromatic beam onto a crystal, which is rotated until the angle between the beam and crystal structure is such that the diffracted waves interfere constructively to produce a peak in output intensity. In the latest work, the sample and detector can remain fixed because each pixel is designed to record light intensity across a range of different wavelengths, producing what are known as "data cubes". With data from any one pixel revealing diffraction peaks at specific wavelengths, the combined output from all the pixels allows the various chemical elements and compounds that make up the sample, as well as their crystal structures, to be identified.

AUTHOR BIOGRAPHIES



M.J. (Margaret) Wegener is a lecturer in Physics at The University of Queensland and current Deputy Chair of the AIP's Physics Education Group. She is involved in physics education via teaching, professional service and research. Major themes of her work are the development of technology-enhanced and inquiry based learning activities. Her PhD centred on making and analysing holograms and was symptomatic of her deep interest in the interrelationship between science and the arts. She has learned metalsmithing through the Goldsmith's School, Brisbane and the Jewellers and Metalsmiths' Group of Australia for more than a decade.



A.K. (Anita) Milroy is artist-in-residence at Green Vale Gallery, Brisbane, and is currently focusing her art practice on research. Milroy is a PhD candidate at Central Queensland University. Her research topic is "Episteme, Techne and Poiesis - Visualisations of Extinction and Evolution in Queensland Flora". It is practice-based and crosses the disciplines of science and art. Milroy is working with the Queensland Museum's Ancient Environments Program, creating visualisations of evolution and extinction through palaeobotanical specimens, whilst exploring new technological methods of specimen representation. Milroy also teaches part-time at the Goldsmith's School, Brisbane.