Snowmass2021 - Letter of Interest

The CERN-IARI Project and New Opportunities for Integrated Arts Research Collaborations at Universities and National Laboratories

Authors: Mónica Bello[1], Janet Biggs[2], Agnieszka Mędlar[3], Ágnes Mócsy[4], Joey Orr[5], John P. Ralston[6], and Daniel Tapia Takaki[6]

Endorsements: Paul Ardenne[7], Purnaprajna Bangere[3], Paul Cazeux[3], Tamara Falicov[8], Maryrose Flanigan[9], Kevin Hamilton[10], Lynn Hershman Leeson[11], Toby Jurovics[12], Mark Levinson[13], Walter Melion[14], Patricia Olynyk[15], Joonha Park[3], Barbara Polla[16], Sarlyn Reece Hardy[17], Asher Remy-Toledo[18], Danielle Siembieda[19], Veronica Stanich[9], Celka Straughn[5], Daniel Szyld[20], Lisa Tedesco[14], Kelsa Trom[21], and Roel Van Beeumen[22].

(1) CERN, Arts at CERN, 1211 Geneva, Switzerland;
(2) Visual Artist, Brooklyn, NY 11211, USA;
(3) Department of Mathematics, The University of Kansas, Lawrence, KS 66045, USA;
(4) Pratt Institute, Brooklyn, NY 11205, USA;
(5) Spencer Museum of Art, The University of Kansas, Lawrence, KS 66045, USA;
(6) Department of Physics and Astronomy, The University of Kansas, Lawrence, KS 66045, USA;
(7) Professor of History, The University of Amiens, Art Critic and Curator in the field of contemporary art, Amiens, France;
(8) Associate Dean for Research, Arts and Humanities, CLAS, The University of Kansas, KS 66045, USA;
(9) Executive Director, Alliance for the Arts in Research Universities (A2ru), Ann Arbor, MI 48109, USA;
(10) Dean, College of Fine and Applied Arts, University of Illinois at Urbana-Champaign, Champaign, IL 61820, USA;
(11) Artist Filmmaker, Professor Emeritus, University of California Davis, Davis, CA 95616, USA;
(12) Director, Barry Lopez Foundation for Art & Environment, Coyote, NM, USA;
(13) Director/Producer of Particle Fever, New York, NY, USA;
(14) Emory University, Laney Graduate School and Fox Center for Humanistic Inquiry, Atlanta, GA 30322, USA;
(15) Director, Creative Research Institute, Director of Graduate School of Art, Florence and Frank Bush Professor of Art, Washington University in St. Louis, St. Louis. Co-director, the Leonardo/ISAST, NY LASER, New York, USA;
(16) Gallery Owner, Analix Forever, 1225 Chêne-Bourg, Switzerland;
(17) Director, Spencer Museum of Art, The University of Kansas, Lawrence, KS 66045, USA;
(18) Director, Hyphen Hub, NY 10011, USA;
(19) Managing Director, Leonardo/ISAST, Oakland, CA 94612, USA;
(20) Department of Mathematics, Temple University, Philadelphia, PA 19122-6094, USA;
(21) Head of Programs, NEW INC, New Museum, New York, NY 10002, USA;
(22) Research Scientist, Berkeley Lab, Berkeley, CA 94720-8150, USA.

Email contacts: monica.bello@cern.ch, janetbiggs1@gmail.com, amocsy@pratt.edu, amiedlar@ku.edu, joeyorr@ku.edu, ralston@ku.edu, and Daniel.Tapia.Takaki@cern.ch

Abstract: Recent collaborative work between scientists and artists has opened new perspectives in how multidisciplinary collaborations can be carried out between fields that are often considered to be orthogonal to each other. Physicists working in the field of fundamental physics at CERN and other U.S-based national laboratories and institutions have engaged in such projects in recent years. At the same time, there are ongoing programs in the field of contemporary arts on how to conduct true research among artists and scientists. The University of Kansas via the Integrated Arts Research Initiative has provided some novel ideas on how such collaborations can be established and expanded. We describe the current status and projects between physicists, mathematicians, visual artists, and curators from CERN, the University of Kansas Department of Physics and Astronomy, Department of Mathematics, and Spencer Museum of Art. We highlight the impact that educational projects with social engagement can have for multiple fields.

Introduction. In recent years several university groups and national laboratories working in the field of fundamental physics have developed educational materials, lectures, and dedicated programs that link the arts and sciences. CERN has created a dedicated program called *Arts at CERN*[1] that has proven to be very successful in establishing collaborations between artists and particle and nuclear physicists. This has been done via a residency arts program and several open competitions, which have resulted in exhibitions and artwork that have been displayed at CERN, universities, and art galleries around the world. U.S.-based national laboratories, like Fermilab and Brookhaven, have also developed similar programs. Such initiatives are not unique to the field of fundamental physics. Yet particle and nuclear physics research has been very appealing to artists because of the ideas, methods, and inspiration of physicists wanting to answer fundamental questions of the Universe and because this research has a strong interdisciplinary component. It has, therefore, attracted the attention of the public and the art community, especially after recent findings like the Higgs boson, searches for physics beyond the standard model, and quark-gluon plasma studies. Physicists are also fascinated by the laws that govern the dynamics of the Universe and the possible connections of such ideas, methods, and findings with contemporary art.

Several dedicated professional conferences have led recent work in this direction. For example, in 1998 at Southwestern College in Winfield, Kansas, Reza Sarhangi organized the first Bridges Mathematics, Art, Music, Architecture, Education, Culture annual conference to bring together artists and scientists interested in pushing the boundaries and exploring unknown territories. Since then, *"the goal of the Bridges Organization is to foster research, practice, and new interests in mathematical connections to art, music, architecture, education, and culture"*[2]. In 2010, the Museum of Science, Boston, launched the NSF-funded project *Dimension of Public Engagement with Science* to engage in the dialogue between scientists and the broader public on the social values of scientific discoveries, stimulate public interest and understanding of science, and provide new perspectives on scientific research by increasing the participation of a diverse public.

The University of Kansas (KU) has developed several collaborative projects between artists and scientists and has been participating in the Arts at CERN project. KU is unique in the United States thanks to programs led by the Spencer Museum of Art (SMA) in collaboration with other units, such as the Department of Physics and Astronomy and the Department of Mathematics, together with both domestic and international artists. KU has established the Integrated Arts Research Initiative (IARI)[3] to infuse the arts into the research culture of KU by advancing interdisciplinary projects across the sciences and humanities in collaboration with the SMA. To this end, IARI supports one inquiry each academic year that is broadly enough conceived to address practitioners from a range of fields. Artistic practice is understood as a research method and integrated into the inquiry from its conception. IARI rethinks the academic art museum as an active participant in research across the sciences and humanities. It positions the museum to thoughtfully participate in the formulation of research questions and the methods that produce knowledge. As an art museum initiative, IARI also conceives of artistic practice as its own method of knowledge production. IARI, therefore, invites artists and academics to engage in research together and consider how being in conversation with different methods can inform research across disciplines. IARI is currently supporting a collaborative inquiry among four different researchers: Janet Biggs (visual artist), Agnieszka Międ lar (mathematician), Joey Orr (curator), and Daniel Tapia Takaki (physicist), in collaboration with Mónica Bello from the Arts at CERN. This collective aims to use the time-based medium of film and video as a particular kind of data set to address problems and questions in the field of fundamental physics, including particle, nuclear, and quantum mechanics, applying several novel mathematical methods. The inquiry enables each collaborator to use methods derived from their respective fields to explore shared questions among the group. It also opens possibilities to engage with a broad spectrum of researchers, from video artists and curators to physicists,

[1] https://arts.cern/

[2] http://bridgesmathart.org

[3] https://spencerart.ku.edu/integrated-arts-research-initiative

mathematicians, philosophers, and others. From a broader perspective, rigorous inquiries that integrate a spectrum of practices can help formulate institutional research values in ways that address the complexities of our emerging contemporary contexts. This work is signaled in the larger field by such organizations as the Society for Artistic Research and the Alliance for the Arts in Research Universities, and in such scholarly journals as the *Journal for Artistic Research* and *Leonardo*. By conveying, constructing, disrupting, and redefining practices, protocols, and assumptions across physics, computational mathematics, and the fine arts, our current collaboration strives to expand the scope of the potential made possible through multiple perspectives and voices. We are exploring intrinsic links between physics, mathematics, and the arts through experimentation and play, as well as rigor and scholarship. We ourselves, and by extension a broad cross-disciplinary audience, are finding excitement and impact in the creation of a culture of questioning.

Research Inquires. Some of our research questions include:

- Can physics and mathematics be embedded in the process of and integral to a work of art?
- Can artists use physics and mathematics to make an artwork?
- Can physicists and mathematicians be inspired by art to build new scientific knowledge?
- Can art revolutionize the transmission of mathematical concepts of the physical universe to students and the public?
- Can collaboration across disciplines be generative and substantive in the respective fields?
- Can IARI trigger opportunities and engagement across education and research institutions?
- Can art, mathematics, and physics guide research across fields of inquiry?
- Can the arts and sciences both advance understanding as science and creative practice?

Public Outreach and Educational Opportunities. Visual art is an excellent communication tool. It has been used to expose general audiences to the sciences and humanities in many ways. For example, *Particle Fever* (2013) directed by Mark Levinson used documentary film making to reveal the first round of experiments at CERN's Large Hadron Collider. In the field of nuclear physics, physicists Ágnes Mócsy has made the documentary *Smashing Matters: Behind the Science Scene* that has triggered educational projects on art and sciences, as well as collaborations between artists [15;16] and students [17;18]. The Exploratorium museum of science, technology, and art is an example of a museum with a sole mission to create public experiences of art and science integration.

The SMA regularly partners with researchers on the Broader Impacts section of grants to the National Science Foundation. Through IARI, the museum specifically makes the case that artists themselves are researchers. In 2019, the museum mounted a major exhibition, *knowledges*, funded by the National Endowment for the Arts that looked at artistic practice as research method. In coordination with the exhibition, the museum also produced a publication, *Inquiries*, and several short-format documentaries that captured the work of contemporary artists working across several knowledge domains. This work was also the focus of the national convening for the Alliance for the Arts in Research Universities, an organization that supports a full range of arts-integrative research. An inquiry from this work will be organized for the 2021-2022 academic year, including an exhibition.

We anticipate that the CERN-IARI project will serve as a model for future science-arts collaborations in fundamental physics, mathematics, and other fields. And new educational and outreach projects will follow from this work.

References

[1] Allegue, Ludivine, Simon Jones, Baz Kershaw, Angela Picini. Eds. *Practice-as-Research in Performance and Screen*. Hampshire and New York: Palgrave Macmillan, 2009.

[2] American Mathematical Society (AMS). *"Mathematical Imagery"*. http://www.ams.org/publicoutreach/math-imagery/math-imagery.

[3] Balkema, Annette W. and Henk Slager. Eds. *Artistic Research*. Amsterdam and New York: Rodopi. (Lier en Boog Series of Philosophy of Art and Art Theory, Volume 18), 2004.

[4] Barrett, Estelle and Barbara Bolt. Eds. *Practice as Research: Approaches to Creative Arts Inquiry.*. London and New York: I.B. Taurus, 2007.

[5] Bell Larry, Caroline Lowenthal, David Sittenfeld, Katie Todd, Sarah Pfeifle, and Elizabeth Kunz Kollmann. *Public Engagement with Science: A guide to creating conversations among publics and scientists for mutual learning and societal decision-making*. Museum of Science, Published under a Creative Commons Attribution Noncommercial-ShareAlike license, 2017.

[6] Biggs, Michael and Henrik Karlsson. Eds. *The Routledge Companion to Research in the Arts*. London and New York: Routledge, 2011.

[7] Borgdorff, Henk. *"The Debate on Research in the Arts" in Sensuous Knowledge Focus on Artistic Research and Development, No. 2*. Bergen National Academy of the Arts, 2006.

[8] Dean, Roger T. and Hazel Smith. *"Practice-led Research, Research-led Practice in the Creative Arts"*. Edinburgh University Press, Edinburgh, UK, 2009.

[9] Eremenko, Ekaterina. *"Colors of Math"*. Documentary, Adventure. Finland, 2012.

[10] Haseman, Brad. *"A Manifesto for Performative Research"*. Media International Australia, vol. 118: 98–106, 2006.

[11] Holtz, Olga. *"The Zahir"*. Short, Drama, Mystery. USA, 2014.

[12] Macleod, Katy and Lin Holdridge. Eds. *"Thinking Through Art: Reflections on Art as Research"*. (Innovations in Art and Design Series). London and New York: Routledge, 2006.

[13] Rose Riley, Shannon and Lynette Hunter. Eds. *"Mapping Landscapes for Performance as Research: Scholarly Acts and Creative Cartographies."*. Hampshire and New York: Palgrave Macmillan, 2009.

[14] Jackson, Shannon. *"Social Works: Performing Art, Supporting Publics"*. New York and London: Routledge, 2011.

[15] Mócsy, Ágnes. *"The Unforeseen"*. Collaborative STEAMplant art project with Pamela Breda and Ira Livingstone, 2019. https://commons.pratt.edu/steamplant/project-the-unforeseen/.

[16] Mócsy, Ágnes. *"Space Between Spaces"*. Collaborative STEAMplant art project with Joseph Morris and Che-Wei Wang, 2018-2019. https://commons.pratt.edu/steamplant/project-a-space-between-spaces/.

[17] Mócsy, Ágnes. *"Glamorous Gluons"*. Collaborative art project and show with Sarah Szabo, 2014. https://www.bnl.gov/newsroom/news.php?a=25002

[18] Mócsy, Ágnes. *"Sound of the Little Bangs"*. Collaborative work with Alexander Doig and Paul Sorensen, 2010. https://www.youtube.com/watch?v=jF8QO3Cou-Q and https://www.youtube.com/watch?v=Mds4kMAsrLc.