

Testimony of Dr. Harriet Kung
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Introduction

Thank you, Chairman Lucas, Ranking Member Lofgren, and Members of the Committee. It is with great pleasure that I join you today to represent the Department of Energy (DOE) at this hearing to discuss the critical role of interagency partnerships in delivering on our missions at DOE and supporting the broader U.S. innovation ecosystem.

My name is Harriet Kung, and I am the Deputy Director for Science Programs in the DOE Office of Science, where I oversee the majority of scientific research programs within our office, from Advanced Scientific Computing Research to Nuclear Physics and beyond. As this committee is well aware, the Office of Science's core mission is to deliver the scientific discoveries and major scientific tools that will transform our understanding of nature and advance the energy, economic, and national security goals of the United States. Over the decades, the investments and accomplishments in basic research and enabling research capabilities made by the Office of Science and its predecessor agencies have provided the foundations for countless new technologies, businesses large and small, and entirely new industries. These investments have contributed immensely to our nation's economy, to our national security, and to our quality of life.

In my testimony today, I'd like to focus on three key points:

First, DOE's interagency engagements span fundamental and applied research, development, demonstration, and deployment, involving offices across the entire Department. While my testimony today will largely focus on those partnerships that we steward in the Office of Science, the Department welcomes continued discussions on the broader suite of partnerships across the agency.

Second, DOE engages in interagency partnerships only where such partnerships are aligned with our mission space and where the Department can provide complementary capabilities and expertise to deliver on shared outcomes. We leverage our unique and world class research infrastructure at the DOE National Laboratories and across the Office of Science's 28 user facilities, to provide access to capabilities, many of which can be found nowhere else in the world. We bring our mission-driven focus on energy, economic, and national security to these partnerships.

Finally, I want to take this opportunity to highlight some of the incredible outcomes we have delivered in partnership with our sister agencies, both here and across the broader U.S. research and development enterprise. Together, we have unlocked the human genome, accelerated diagnostics and treatments for COVID, and delivered new insights on the fundamental building blocks of our universe. These advancements represent just a few of the many groundbreaking discoveries taking place in the U.S. R&D enterprise.

The sections below provide representative examples of some of the important work DOE's Office of Science has conducted in partnership with the National Science Foundation (NSF), National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), and U.S. Department of Agriculture (USDA). I will also touch on our long history of partnership with the National Institutes of Health (NIH) and the recent multi-agency collaborations launched in response to the COVID-19 crisis.

Before going any further, I want to take the opportunity to thank this Committee for your collaborative, bipartisan efforts on the CHIPS and Science Act. We know the hard work that went into crafting that legislation and appreciate the inclusive approach this Committee took to engage the Department and other agencies here today in that process. Your hard work on the CHIPS and Science Act positions DOE and the Office of Science to not only rise to meet today's most pressing scientific and technical challenges, but to expand our capabilities to support the interagency partnerships we are here to discuss.

Along these lines, I also want to take the opportunity, on behalf of DOE, to thank you for the opportunity to provide technical assistance on the discussion drafts you have prepared on interagency partnerships. We appreciate the Committee's support for DOE establishing and sustaining mutually beneficial collaborations on topics of national importance, while also maintaining the Department's flexibility to develop collaborations from the bottom up and in response to new frontiers of scientific discovery and innovation. Many of our most successful partnerships have been driven from the bottom up by our scientific and technical subject matter experts.

Interagency Partnership for Science, Energy, and Security

The Office of Science has a long and fruitful history of coordination and collaboration with R&D funding agencies across the Federal Government. These partnerships allow us to leverage DOE's unique expertise and capabilities to address the most challenging science and technology problems with mutual benefit to the American public and in alignment with the missions of DOE and our partners. We are continuously looking for new opportunities for collaboration to ensure maximum utilization of government-funded science and technology and to minimize duplication. These impactful engagements have all contributed to the Office of Science's ability to meet DOE's missions in science, energy, and national security.

The Office of Science primarily engages with other agencies through White House-led working groups and activities, bilateral and multilateral collaborations, and coordination of laboratory projects funded directly by other agencies. The Office of Science plays a leading role in numerous ongoing efforts, led by our colleagues at the White House, to develop and implement

coordinated, government-wide strategies for the advancement of the most impactful science and technology priorities, including Artificial Intelligence (AI), Quantum Information Science (QIS), microelectronics, fusion science, and climate change where staying at the S&T forefront is vital for national security and competitiveness. Due to the breadth of our research portfolio and expertise, the Office of Science plays a critical role in almost every major interagency group focused on science and technology. We sit on approximately 120 active committees, subcommittees, and working groups, and serve as chair of close to 20. Our technical experts have also been instrumental in the development of policies that promote the sharing and use of research products derived from Federal R&D investments, while protecting the U.S. from misappropriation.

We are also committed to bilateral and multilateral interagency collaboration on foundational research activities, including with the NSF, NASA, NOAA, USDA, and NIH. Such collaborations have led to transformative advances in areas such as particle physics, climate science, and biomedicine. Partnership mechanisms range from informal to formal and include signed agreements, such as Memoranda of Understanding (MOU), joint facility construction projects, co-sponsorship of federal advisory committees, coordinated funding opportunity announcements, joint workshops, shared peer review, and more. We enter into multiple new partnerships each year and maintain dozens more.

The Office of Science possesses unique computational and experimental facilities, expertise in science at scale, and oversees an unparalleled National laboratory complex, which are utilized by other agency personnel and researchers. Many of the transformative scientific discoveries made by the research community are enabled by our stewardship of 28 scientific user facilities, which are available to all researchers based on the scientific merit of their proposed research. These tools include the world's most powerful computers, brightest X-ray light sources, most intense neutron sources, fastest information network, and specialized capabilities, such as nanofabrication and multiple modes of imaging, within centers for nanoscience and bio-characterization.

National Laboratory projects funded by other agencies play an important role in strengthening core capabilities at the laboratories that, in turn, enable the laboratories to better serve the Department and the Nation. Examples of this include life sciences research funded by the NIH, emergency response work funded by the Department of Homeland Security, and computational research and capacity at Office of Science laboratories funded by many other Federal agency sponsors. The expertise of the laboratory staff, and the research capabilities they help develop and employ, are invaluable assets that serve to advance the frontiers of fundamental scientific discovery, train the scientific and technical workforce in the U.S., and develop the tools and advanced instrumentation that keep our Nation at the forefront of innovation.

Furthermore, The DOE National Laboratories are essential resources that the Nation turns to in emergencies. In response to COVID-19 and other crises, the Office of Science and the 17 DOE Laboratories worked closely with agency partners to ensure our expertise, capabilities, and unique facilities could be leveraged to support the U.S. response.

Interagency Partnerships: The National Science Foundation

The partnership between NSF and the Office of Science spans all research programs within the two agencies and encompasses a wide range of activities from formal interagency agreements, co-funding research and user facilities, and co-directing federal advisory committees. There are numerous examples to choose from, a select few that are mentioned below.

Our partnership in Basic Plasma Science and Engineering, which began in 1996, is one of the longest-running interagency joint programs in the federal government. Under the partnership, the Fusion Energy Sciences (FES) program within the Office of Science and NSF sponsor a funding opportunity announcement for fundamental plasma science and experts from the two agencies jointly decide which proposals NSF will fund and which proposals FES will fund.

In the field of particle physics, the Office of Science partners with the NSF Physics Division to support two flagship experiments at the Large Hadron Collider (LHC), the CMS and ATLAS collaborations, which continue to provide deep insights into properties of the Higgs boson. The SC-NSF Joint Oversight Group (JOG) for the LHC jointly review the US-supported LHC program on a regular basis to provide oversight on operations. In addition, the Office of Science supports the Tier 1 computing capabilities for the CMS and ATLAS collaborations, while NSF supports the bulk of the Tier 2 computing.

Building on the Memorandum of Agreement between DOE and NSF on Quantum Information Science (QIS), the two agencies coordinate on the investment strategy and build bridges between DOE's Quantum Information Science Research Centers and NSF's Quantum Leap Challenge Institutes. DOE and NSF, along with the National Institute of Standards and Technology (NIST), also plan to enhance cooperation in QIS workforce development with an emphasis on broadening participation from underrepresented and underserved communities.

The Office of Science and NSF solidified their commitment to partner through an overarching MOU that was signed on January 4, 2023. In addition to existing areas of collaboration, possible topics for new or increased cooperation include, but are not limited to, biotechnology, QIS and quantum engineering, AI and machine learning, advanced manufacturing, microelectronics, climate science, and clean energy. Both agencies also have an interest in coordinating their development of a capable STEM workforce through research, education, and training initiatives that foster diversity, equity, and inclusion.

Interagency Partnerships: The National Aeronautics and Space Administration

For decades, the Office of Science has supported numerous activities that contribute to a broad range of space science interests. This includes fundamental research in science areas of interest to NASA and collaborative research efforts between the Office of Science and NASA. The MOU between DOE and NASA that was established in 2020 created new mechanisms to explore additional partnerships in science and technology development between the Office of Science and NASA's Science Mission Directorate. Compelling opportunities for future coordination and collaboration have been identified in areas such as space-based quantum sensors and quantum communication, space weather, high-throughput robotics for research in the space environment, and joint analysis of data from terrestrial and space-based telescopes.

Among the longest and most scientifically fruitful collaborations between the Office of Science and NASA is the Alpha Magnetic Spectrometer (AMS). Located on the International Space Station since 2011, the AMS project is searching for evidence of dark matter and the cosmic domains of anti-matter and characterizing the types of cosmic nuclei as a function of location in Earth's atmosphere. Since the end of FY 2022, the AMS detector has observed more than 210 billion cosmic ray events. Thanks to the close partnership between NASA, DOE, and the international AMS Collaboration, the potential lifetime of this unique experiment has been extended at least 5 years. The Office of Science and NASA are currently discussing the future of this scientific experiment, including a potential upgrade to the detector to allow for its continued operation throughout the lifetime of the ISS.

The future of the Office of Science's partnership with NASA is bright. For example, the High Energy Physics program and NASA jointly support a novel pathfinding science mission to the far side of the moon as part of NASA's Commercial Lunar Payload Services Program. The success of this experiment can enhance our understanding of the early stages of the universe, after the first atoms formed before the formation of stars and galaxies.

Interagency Partnerships: The National Oceanic and Atmospheric Administration

DOE, through the Office of Science, and NOAA advance our understanding of the complex Earth system, including modeling and simulation of the changing climate and coastal research. Each agency tackles scientific challenges in this domain through the lens of their mission—basic science, energy, and security for DOE; applied science for climate, weather, oceans, and coasts, and conservation of coastal and marine ecosystems and resources for NOAA. These efforts, as evidenced by the breadth of engagement between our two agencies, are complimentary and leveraged for mutual benefit and the benefit of the U.S.

The execution of NOAA's mission has meant developing earth system models, and DOE has maintained a long-standing partnership to support their efforts. Now in its twelfth year, NOAA and DOE's earth system modeling partnership is facilitated by Oak Ridge National Laboratory (ORNL), which provides multiple supercomputers, referred to as *Gaea*, to support sub-seasonal to decadal earth systems forecasts using NOAA's Finite-Volume Cubed-Sphere Dynamical Core. ORNL also conducts research in the area of seasonal to subseasonal prediction and analysis, working with multiple Earth system models. NOAA has long-term objectives to extend *Gaea* and other systems so that they can leverage graphics processing units, commonly known as GPUs, which are foundational to DOE's current exascale computers. Doing so would enable higher fidelity solutions and the inclusion of computationally expensive physics elements in NOAA's models.

For more than 30 years, the U.S. Global Change Research Program (USGCRP) has effectively coordinated research activities among agencies, including both DOE and NOAA, with interagency working groups established to cover climate modeling, coastal research, and observations. Through collaboration, the participating agencies are more effective in leveraging each agency's assets to achieve a greater scientific return on investment. Additional interagency coordination between DOE and NOAA in advanced computing is enabled through groups on

Networking and Information Technology Research and Development and the Future Advanced Computing Ecosystem Subcommittee. These and similar engagements ensure DOE is positioned to provide awareness of DOE's development of next-generation computers and avenues for targeted collaboration with other agencies in leveraging these assets in service of their missions.

Interagency Partnerships: The U.S. Department of Agriculture

DOE and the USDA have a long history of partnership in both science and applied R&D. This has included basic science in support of food, agriculture, and bioenergy, and applied R&D in sustainable transportation fuels, energy-water-agriculture nexus, and water data infrastructure. Currently, DOE's Office of Energy Efficiency and Renewable Energy is partnering with USDA and other agencies on a sustainable aviation fuel grand challenge.

The Office of Science's Biological and Environmental Research (BER) program and the National Institute of Food and Agriculture (NIFA) at USDA share many interests and complementary responsibilities for the support of research and outreach. A relatively recent example of this partnership was the DOE-USDA Plant Feedstocks program (2006-2018) that was a highly successful research collaboration on bioenergy crops. This effort and other shared interests were outlined in an MOU from 2015. BER supports four Bioenergy Research Centers that provide a portfolio of diverse and complementary scientific strategies to address the challenges to cost-effective production of biofuels and bioproducts from plant biomass. USDA Agricultural Research Service units located in both Louisiana and Illinois are current partners in BER's Center for Advanced Bioenergy and Bioproducts Innovation, which has a multidisciplinary, integrative approach to increasing the value of energy crops and uses a "plants-as-factories" approach to the research for the production of high-value fuels and products. USDA researchers are also active partners on several projects stemming from BER funding opportunities for research related to bioenergy and a broader bioeconomy. Also, DOE and USDA representatives serve together on the Biomass Research and Development (BR&D) board to help align mutual research interests. Both agencies are currently cooperating on reports called for under the Biotechnology and Biomanufacturing Executive Order (Sept 2022). In applied bioenergy R&D, the Bioenergy Technologies Office (BETO) at DOE together with the USDA has supported the Integrated Biorefinery Optimization program to strengthen the U.S. bioenergy industry for efficiently converting biomass feedstocks into commercially viable biofuels and bioproducts.

Interagency Partnerships: The National Institutes of Health

The partnership between DOE and the NIH is a representative example of the mutual benefit that comes from collaboration between agencies having unique but complementary missions. The history of coordination and collaboration between DOE and the NIH spans decades and includes early efforts to pioneer ion beam therapy of cancer and map the human genome and joint funding for the SPEAR3 upgrade at the Stanford Synchrotron Radiation Lightsource.

The Office of Science has continued this tradition by supporting a robust portfolio of collaborative efforts across multiple NIH Institutes and Centers. With the National Nuclear

Security Administration (NNSA), the partnership with the National Cancer Institute (NCI)—now in its 7th year—continues to develop new computing tools that integrate novel AI and Uncertainty Quantification technology and that take advantage of the Department’s advances in computing—including Frontier, the Nation’s first exascale computer—to accelerate discovery in cancer research. The Office of Science continues to support the long-standing partnerships with NCI to advance specific areas of cancer research and technology development, including large-scale simulations of proteins that play an important role in cancer development and progression, deep learning-enabled drug response predictions, and near real-time cancer surveillance through automated extraction of clinical information. We are pleased to share that two projects under the collaboration are among the first research teams using Frontier to advance the goals of the Cancer MoonshotSM and DOE grand challenges in exascale AI. Finally, the Office of Science continues to coordinate with the National Institute of General Medical Sciences and National Institute of Biomedical Imaging and Bioengineering on the development of and support for bioimaging capabilities that utilize the unique capabilities of SC’s X-ray light sources.

We are also establishing entirely new, multi-disciplinary partnerships. Recently established collaborations with NIH in both AI and computational neuroscience can contribute to advancing both of these fields. Over the past year, we have been exploring with the NIH Brain Research Through Advancing Innovative Neurotechnologies® (BRAIN) Initiative the opportunity for DOE to bring its expertise in imaging, computing, and data science to bear on the transformational challenge of comprehensively mapping the neural structures in complex brains. The technical innovations required to meet this challenge, as well as the scientific discoveries that would arise from developing wiring diagrams in complex brains, can be similarly impactful to advancing the Office of Science mission, including in the development of novel AI technologies and neuro-inspired computing architectures.

Multi-agency Partnerships to Address National Priorities: The National Virtual Biotechnology Laboratory and the COVID-19 Global Pandemic

During the COVID-19 crisis, DOE stood up the National Virtual Biotechnology Laboratory (NVBL), bringing together the expertise and capabilities of DOE’s 17 national laboratories in the nation’s fight against COVID. As this effort was initiated, we consulted with other agencies to define the most critical challenges that would take advantage of DOE’s unique strengths in the physical sciences. For example, our expertise in trace detection and characterization were used to support the Food and Drug Administration (FDA), Centers for Disease Control (CDC), and Department of Defense (DOD), to establish national guidelines used in millions of clinical tests. NVBL assessed the quality of commercial test kits coming into the U.S. market and kept kits off the market that would yield erroneous results due to contamination. NVBL researchers also evaluated sample pooling approaches that reduced test costs by a factor of ten. DOE’s world-leading scientific user facilities were used to determine X-ray structures of SARS-CoV-2 virus to support vaccine and anti-viral approvals by FDA. These resources, along with DOE’s high-performance computers, also supported NIH in the rapid evaluation of purported anti-virals that flooded the news. These powerful computers were also used to support decision makers at agencies like CDC, FEMA, and the U.S. Bureau of Economic Analysis by building a data

platform to forecast disease transmission, stress on public health infrastructure, and economic outlook for the nation, providing in-depth understanding of COVID-19 impacts.

Building on the success of NVBL, we have established a new initiative—the Biopreparedness Research Virtual Environment, or BRaVE—that will support basic research that leverages DOE’s experimental and computational capabilities to develop next generation epidemiological models, accelerate drug discovery and development, advance disease diagnostics and surveillance, and develop new materials to reduce disease transmission. As with NVBL, interagency partnerships are critical to the success of this initiative, and our researchers are encouraged in the funding opportunity to collaborate with their colleagues at NIH, CDC, or other agencies. Thanks to the support for DOE’s work on biopreparedness that is provided through the CHIPS and Science Act, we are well positioned to build on the success of NVBL and contribute to a whole-of-government effort to be prepared to face future biological threats.

Conclusion

As demonstrated by the select examples provided, conducted in partnership with NSF, NASA, NOAA, USDA, NIH, and the recent multi-agency collaboration during COVID-19, the Office of Science has a long and fruitful history of coordination and collaboration with R&D funding agencies across the U.S Government. The Office of Science primarily engages with other agencies through White House-led working groups and activities, bilateral and multilateral collaborations, and coordination of national laboratory projects funded directly by other agencies, and the Office of Science User Facilities also play host to researchers supported by a wide range of Federal Agencies. These partnerships allow us to leverage DOE’s unique expertise and capabilities to address the most challenging science and technology problems for mutual benefit to the American public. As such, we are continuously looking for new opportunities for collaboration to ensure maximum utilization of government-funded science and technology and to minimize duplication of effort. With the passage of the CHIPS and Science Act, DOE and the Office of Science are poised to not only grow to meet today’s most pressing scientific and technical challenges, but also to pursue additional partnerships with other agencies.