**Interviewer: Our first question is for you to elaborate on who you are, and what kind of research you generally work in at the University, or outside of it?**

Angela: My name is Angela Di Fulvio and I am an assistant professor in the Nuclear, Plasma, and Radiological Engineering department, NPRE, here at the University of Illinois at Urbana-Champaign, and my research focuses on the development of radiation detectors and detection systems, especially used to detect neutrons, with applications to security, safeguards, nonproliferation, and medicine. We have recently installed a new lab where we are able to also accurately characterize such systems using a high‑intensity neutron generator.

**Interviewer: How did you become involved with this project with the American Physical Society?**

Angela: I became aware of the coalition through Professor Lamb, who is also a colleague of ACDIS, and member of the Physicists’ Coalition for Nuclear Threat Reduction. The coalition is aiming at informing and activating the physics community in nuclear threat reduction, ultimately to build a nationwide network of physicists willing to be informed and advocate on nuclear threat reduction. As soon as I learned about these important outreach and educational goals of the coalition, I decided to join, without hesitation. The coalition is led by Professor Stewart Prager at Princeton.

**Interviewer: Now we have some questions about today’s perception of the nuclear threat, mostly among the public. The first question is: given your research focuses on radiation detection, could you describe how this work is important for future nonproliferation initiatives?**

Angela: My research focuses on the development of radiation detection systems for security and nonproliferation applications. It’s very important to have reliable, effective, and field-deployable technologies that can detect radiation in order to improve the capability in early detection of special nuclear materials, such as uranium or plutonium, that could be used for proliferation. One example is a new neutron detector based on deuterated stilbene that we have recently developed in collaboration with the University of Michigan, Oak Ridge National Lab and Lawrence Livermore National Lab. The detector has an unprecedented selectivity for neutrons, as compared to other types of radiation, such as gamma rays, and it is also reliable and accurate in characterizing the energy of these neutrons. So, why do we care about measuring neutrons? Well, because fissile and fissionable materials, which are used in nuclear weapons, emit neutrons. Neutrons are a very important signature to detect these types of sources. If we have a detector that is able to discriminate with high confidence a fission source from a different type of neutron source, this can improve the accuracy of current inspections and help to streamline inspection processes.

**Interviewer: Mentioning your PowerPoint, which is available on the ACDIS website, the slides do not list any nuclear close calls after the 1990s. What in today’s world could still** **contribute to erroneous or accidental deployment or detonation of nuclear weapons?**

Angela: That is a great question, and I want to answer from a few different perspectives, because it is also a complex question. Let me first clarify what close calls are in our context. A close call is an incident that could have led to one or multiple unintentional nuclear detonations. A subset of these events is reported in the slides that are available on the ACDIS website. In general, we only know of close calls that have been publicly disclosed. That said, a close call can occur because of several different reasons, typically a human error or a miscommunication, or a technological fault. For instance, in 1995, US scientists launched a rocket for scientific purposes. They wanted to study the northern lights, so they did this study in Norway, and the Russians interpreted it as an attack. At that time, Russian President Yeltsin had 15 minutes to decide whether he wanted to respond to the attack. Now, two minutes before the deadline, one of his officers advised him that the path of the missile was not a threat to Russia, and they did not respond, and only days after the Russians found out that the announcement of that launch did not reach the chain of command. So, because of a miscommunication, something terrible could have happened. Episodes like this, I think, on the one hand, are less likely to occur as the technology improves and becomes more reliable. On the other hand, these risks still exist. A*ll* international ballistic missiles in the U.S and some of the submarine-launched ballistic missiles at sea are on alert. This means that they can be launched within minutes of warning of an incoming nuclear attack. The rationale behind this strategy is to be able to respond to an attack promptly, and to be able to do that with all the capabilities intact. This strategy unavoidably increases the risk of responding to a misinterpreted attack that can just be due to human error, or some other accident or coincidence that lead the U.S. to believe they are receiving an attack when they are not. So, to answer your first question, a human error, a technical fault, or a hack in the warning system could still contribute to an accidental deployment of a nuclear weapon.

**Interviewer: Okay, thank you. The publication mentioned that "In the event of North Korea testing long range missiles that could reach the US, 30% of interviewed people would be in favor of a preemptive nuclear strike on North Korea, even if it killed a million civilians," and that forty percent of Americans underestimate the number of warheads in our arsenal. Are these numbers concerning?**

Angela: Certainly, they are. I just want to say that you’re referring to a poll which was conducted, in 2019, I believe, where 30% of the interviewed people stated that they would be in favor of an attack- or a preemptive strike- on North Korea, if NK were to test long range missiles. This is bringing us back to the perceived risk; the perceived risk of a nuclear war and its consequences. So, the perception of the risk by the public does not always reflect the real risk. This poll shows that part of the public considers a nuclear strike a viable possibility to solve international conflicts, it seems clear to me that the practical implications and consequences of a nuclear attack may not be fully understood by those poll respondents, and to the public. My mother used to remind me that in the late 70s or even in the 80s there was a serious public concern about nuclear proliferation and similar issues of the nuclear threat. However, nowadays this issue seems to be off the radar of the public while the risk is not lower than during the Cold War, and possibly is even higher, because of various countries acquiring nuclear weapon capabilities. Therefore, it’s even more important to the coalition to educate the physics community at large, and the public as a result.

**Interviewer: You mentioned just educating the community so that people are aware of today’s nuclear risks. Do you believe that the amount of pro arms control education we have now is sufficient?**

Angela: The brief answer is no; education of the public concerning arms control should be increased. There is a high level of public concern around very important issues, such as climate change and obviously at this time public health related to the pandemic outbreak of COVID-19. However, more effort should be made in making the public aware of the current nuclear threat, the difference between conventional and nuclear weapons, existing nuclear arsenals and their status. Just to make an example of something we can to some extent relate to, bombs that were dropped on Hiroshima and Nagasaki were just at least two orders of magnitude less powerful than the current nuclear weapons that the U.S. currently has in its arsenal. It is necessary to inform the public regarding arms control related policies and, in my opinion, and to some extent, also on the technical aspects related to them.

I**nterviewer: When it comes to public perception, what do you think the effects of too many people supporting the withdrawal from our nuclear treaties here in recent years, under the Trump administration, will have as an effect on society or just future negotiations?**

Angela: Perhaps you are referring to that poll, cited in my slides, that states how there is certain support towards nuclear strikes, but I also want to say that I have not seen such support towards withdrawing from treaties. As a matter of fact, the trust perceived towards these treaties by the public is still high, a poll conducted by the University of Maryland in 2019, I believe, stated that 80 percent of respondents to the question of whether they wanted the renewal of the strategic arms reduction treaty which is going to expire in 2021 were in favor of it. I think that the public acknowledges the importance of the international diplomacy, and the START treaty, as an essential bilateral agreement to control nuclear weapons.

**Interviewer: Do you think our leaders, or leaders in other democratic societies, can be trusted to make these decisions just off of the expertise of scientists instead of actually having that expertise themselves?**

Angela: I surely hope so! I think that policymaking by itself is challenging, and especially is challenging in such an evolving situation and rapidly changing scenarios to make decisions that have a long-term goal really defined. Nonetheless, I do believe that the leaders and the public should listen to science because it is objective, and scientists can provide reliable information on which to build appropriate decisions. If I think of our scientific community in the field of nuclear security in particular, I’m really proud to be part of it, especially thinking how over the last few decades the community was able to develop and even deploy radiation monitoring systems that contribute to keeping us safe. Some examples include portal monitors, at borders, ports, and airports, as well as the new detection systems that can not only detect radioactive materials, but also characterize and locate them in space. These systems did not exist before, possibly not even in a lab, and nowadays they are a reality and it is state of the art. I think that politicians should take advantage of the support that us scientists can provide through research and technological development. Obviously, bad and good decisions are always going to be taken, and only with time can we judge the policymaking process. But nonetheless, science can be a valid support to those decisions.

**Interviewer: Among your peers, do you say there is a common goal towards disarmament, or is there a gradient between how far the world should disarm when it comes to nuclear weapons?**

Angela: This is also a great question, and I certainly cannot speak for all of us, because when it comes to nonproliferation and arms control, there are so many different aspects on not only the amount of disarmament but how to implement which specific actions to take towards a common goal. What I can say is for most of us certainly the safety of the public is that common ground that we can build these statutes on, but the debate on different specific questions is still on. Debate is not always per se a bad sign; it is not a sign of weakness or incapability, but a sign of how science- specifically political science- progresses through debate, forming an opinion as it is shaped by informed scientists. Just to make a concrete example: in deterrence, should the deterrence model still be the one we have used in the Cold War, or should it perhaps be adjusted and reshaped to a new model based on the current political and technological scenarios and capabilities? Though from different perspectives, I hope that we all start from a common ground of keeping the people safe.

**Interviewer: Awesome. And then, as ACDIS is heavily involved with students here on campus, we were wanting to know some ways in which students can get involved. In what ways does studying physics benefit the cause towards arms control, and how does it intersect with other disciplines for the similar goals towards nuclear disarmament?**

Angela: This is a great question, and I think that a good knowledge of the physics of nuclear weapons is very important not only to people like me who design systems to detect and verify them, but also to political scientists who are going through the policymaking process being aware of the technical tools that they could rely on, for example, in support to a treaty. Physics is important, but to address such as complex issue as nuclear threat reduction, many different disciplines need to come together, and I think ACDIS does a great job of that with its multidisciplinary nature.

Interviewer**: How do you think that interested students could become more involved in this field of study and gain the skills needed for a future career in nuclear security?**

Angela: Here at University of Illinois, we can start from several courses that exist in NPRE, for example Energy Systems, which brings together power as well as its social implications, as well as an excellent course in physics, Physics and Global Studies [PHYS 280], which gives also a historical perspective to arms control and nonproliferation, and then let me also mention that I’m going to offer next year an advanced lab on safeguards and nonproliferation, so that’s another opportunity for further knowledge in this field for students. Let’s not forget the Undergraduate Certificate in Global Security that’s offered by ACDIS. It is an excellent opportunity to gain those skills that would allow students to work in several different units, such as academia, national labs, NGOs, political science, international relations, and so on. For graduate students, certainly they should stay tuned, because ACDIS is working on a graduate certificate in technology and security, and other graduate curricula developments. For those who want to be involved with the coalition, they should visit the website that is available in my slides (<https://sgs.princeton.edu/physicistscoalition>) and contact Dr. Prager, who will instruct interested students on how to best contribute. The outreach colloquia will start in the fall, when we will be visiting universities and giving talks to make the students and the physics community aware of the nuclear threat to refresh their knowledge, and to also recruit interested students and scientists to the cause.