CONVERSATIONS WITH SCIENTISTS

# Anton Såmark-Roth: Looking for the "Island of Stability"

Interview Date: April 2021

Anton Såmark-Roth /M. Bank

***"An island of more stable nuclei in the very heavy element region does exist. We have already investigated parts of it. What remains to be answered is whether the increased stability will result in a maximum lifetime of a few minutes (what we already have seen), or if there are undiscovered isotopes with lifetimes of years, or billions of years."***

*Anton Såmark-Roth is a doctoral candidate and researcher in nuclear physics at Lund University in Sweden. Prior to joining the Ph.D. program in the fall of 2016, Såmark-Roth spent five years completing a master's degree in engineering physics at Lund. During the same period, Såmark-Roth played professional handball for four seasons in the best league in Sweden. Just embarking on his career, he already has published ten peer-reviewed journal articles.*

*Såmark-Roth's research focuses on* "*shedding light on the properties of the heaviest atomic nuclei through spectroscopy experiments." He is working with a new type of germanium detector, called Compex, to develop "a state of the art particle-γ coincidence detection chamber." The detection chamber is being designed to "improve understanding of nuclear shell structure" and answer two paramount research questions: How heavy can atomic elements be? And, where is the island of stability?*

*Below are Såmark-Roth's April 27, 2021 responses to questions posed to him by* Today's Science. *Some of the questions deal with how he became interested in science and began his career in nuclear physics while others address particular issues raised by the research discussed in Magical Thinking: Flerovium "Stability" a Mirage.*

**Q. When did you realize you wanted to become a nuclear scientist?**

A. As I went through my undergraduate education in Engineering Physics, I had my first real encounter with nuclear physics. The subject caught my interest. This was much because of the substantial impact nuclear physics has on our society, but also since I did not quite grasp it all. This triggered me to dive deeper into the fundamentals. The more I read, the more intrigued I became. Through lectures, I was introduced to the field of nuclear structure and the exciting experiments on superheavy nuclei. When the opportunity to join Lund's prominent nuclear structure group came, I did not hesitate. As I am closing in on my dissertation in June of this year, I am now on the finishing line of the Ph.D. studies, the first part of the academic journey.

**Q. Are there particular scientists, whether you know them in person or not ,that you find inspiring?**

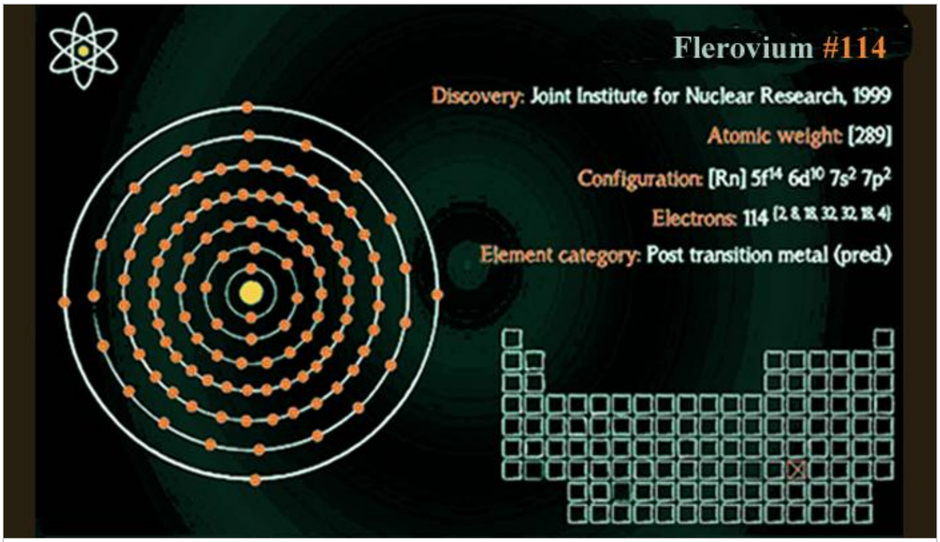
A. My main inspiration is my Ph.D. supervisor Dirk Rudolph. His dedication to nuclear structure and work ethics, spreads to all the people within our team and creates a great atmosphere to work in. The race to discover new chemical elements has involved many very successful scientists. Their stories and achievements are other sources of inspiration. See for instance the book *Superheavy: Making and Breaking the Periodic Table* by Kit Chapman.

**Q. What do you think is the biggest misconception about your profession?**

A. Rather a misconception related to my field. The discovery of new *chemical* superheavy elements is primarily owed to advances in experimental nuclear *physics*.

**Q. The quick-and-dirty account of your results, I think, is that it was believed that flerovium would have reasonably long-lived isotopes, but that turns out not to be true. First—is this more or less an accurate statement of what you found? Second, do you see this as having implications beyond this experiment or element? Do you think the idea that we will find "islands of stability" in the high-atomic-number elements is wrong, or needs adjusting?**

A. The results of our experiment do not rule out the existence of long-lived flerovium isotopes per se. They rather provide evidence that the next proton magic number likely does not correspond to element 114, flerovium. The extra stability associated with the magic number of protons may instead show up for heavier elements. The next main candidate is element 120, which is yet to be discovered.

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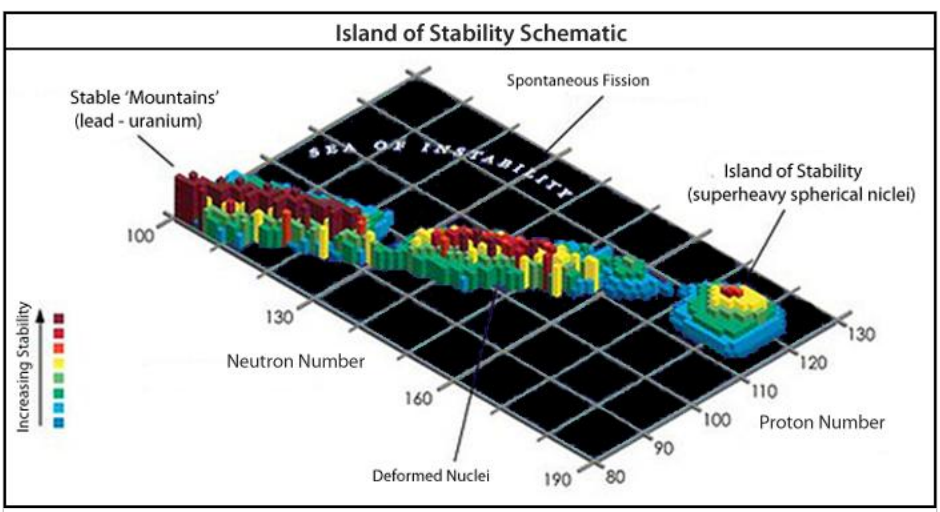
The experimental findings provide first-of-a-kind anchor points for nuclear structure theory. They pave the way for better theoretical models and a deeper understanding of the intrinsic structure of the heaviest atomic nuclei. We can, for instance, learn whether the shapes of these nuclei are spherical (soccer ball), prolate (American football) or assume more complicated shapes. With advances in theory comes further insights into the stability and location of the superheavy island of stability.

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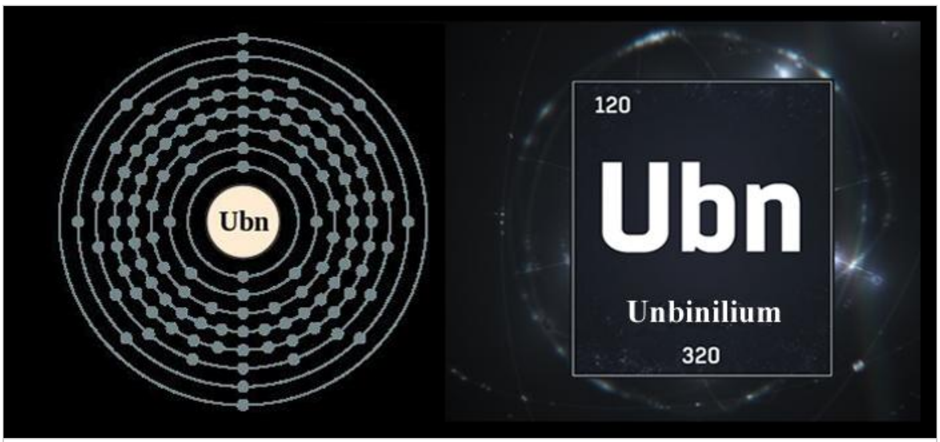
**Q. I feel like there's a general sense that it would be exciting/cool to find long-lived high-atomic number elements, but I at least have no idea what would be the advantage or utility of such elements. Would they open up new technological possibilities, or is it something else?**

A.  It would definitely be cool, and this is part of what has been tantalized nuclear physicists ever since the first predictions came in the late 1960s. Likely their special chemical properties can trigger innovations, but I think we need to learn more about them first. As the superheavy elements are currently produced at a rate of only a few atoms per day, in this sense we need to develop more efficient ways to synthesize and study them.

**Q. There is considerable excitement over a recent muon experiment showing possible deficiencies with the standard model. Does this have any connection to or implications for the work you are doing?**

A.  Not that I am aware about. A possible connection is that both are fundamental science, which drive technology and analytic methods forward.

**Q. After flerovium, are there any other elements that are practical targets for research into possibly long-lived high-atomic-number elements?**

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A.  Following the flerovium experiment, the search for the next proton magic number aligns with the search for new elements as the next main candidate being element 120. Experiments at the Superheavy Element Factor in Dubna, Russia, have already taken up the hunt for its prestigious discovery. That said, we have yet to develop an experimental technique with which the synthesized superheavy nuclei hold more neutrons. In fact, it is likely that the most long-lived superheavy nuclei may exist for elements that have already been discovered.

**Q. Where do you spend most of your workday? Who are the people you work with?**

A. Time at work is typically either spent in the lab setting up detectors for various types of measurements or analyzing the acquired data and writing about the results in the office. My colleagues in the research group are ambitious individuals who come from many countries all around the world: United Kingdom, Russia, Ukraine, Columbia, Germany and Sweden. Our diverse backgrounds make for great conversations and our dedication to nuclear physics unites us. Among the international collaborators are some 50 scientists and engineers from various institutions around the world who are experts in specific aspects of the experiment's bits and pieces, hardware and software.

**Q.  What do you find most rewarding about your job? What do you find most challenging about your job?**

A.  Most rewarding is to see something no one has ever seen before (on Earth). Most challenging is, among distinguished scientists across the world, to actually be the one seeing it first.

**Q. What has been the most exciting development in your field in the last 20 years? What do you think will be the most exciting development in your field in the next 20 years?**

A.  Around the turn of the millennium, element 114 (flerovium) was discovered in novel experiments carried out in Dubna, Russia. By accelerating a beam of calcium-48 and colliding them with targets of actinide elements, the Russian recipe opened up a new era to study superheavy nuclei. Elements up to 118 (oganesson) were discovered and atomic nuclei living for several minutes have been observed. Now facilities are upgrading their accelerators such that higher beam intensities can be achieved and with new techniques, thicker targets are manufactured. The exciting developments will allow for the synthesis of new elements and isotopes. Combined with more sensitive detection systems, rarer phenomena may be investigated. The efforts will push our general understanding of the atomic nucleus forward and provide deeper insights in the long-sought island of stability.

**Q. How does the research in your field affect our daily lives?**

A.  Perhaps most significantly, in school's chemistry classes you may need to learn the names of more chemical elements.

**Q.  For young people interested in pursuing a career in science, what are some helpful things to do in school? What are some helpful things to do outside of school?**

A.  Two tips which apply in and outside of school: Strive to ask questions on whatever you don't fully understand or what you want to learn more about. Read about scientific advances and discuss them with your teachers, friends and family.