1 KELVIN FRIDGE EXPERIMENTAL TOOL
IS THERE A GENERATION GAP IN IDEOLOGIES IN ENVIRONMENTAL ISSUES

A Thesis Prospectus
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By
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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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On the day October 11th, 2018, Hurricane Michael (at the time it was an extratropical cyclone) had passed over Virginia. I remember the winds, the rain, and school being closed that day. Just a day earlier on October 10, 2018, Hurricane Michael had reached landfall in the panhandle of Florida as a Category 5 hurricane. At the time my grandfather was staying an hour outside of Panama City, his house was thankfully only slightly damaged, but his aunt's and another family friend had their houses completely destroyed. The destruction that was left in the wake of this hurricane, until recently, went unparalleled in Florida. The reason I bring up this story is because environmentalism is a large social issue that we as a society value, but there is a discrepancy between generations about what values of environmentalism we should focus on. I pose the research question: Why and how the generational divide is caused, or if there is one all together? I believe that there could possibly be a divide by not only the major technological advancements we have made in the past decades, including more sustainable energy systems, but also a lack of trust in governmental institutions within older generations.

Technical Portion:

My technical project is to design a device to be used by the UVA Department of Physics that will be used as an experimental tool for the Department of Physics' 1 Kelvin fridge. A 1 Kelvin fridge is a refrigerator that has a temperature range from 300 Kelvin (room temperature) to 1 Kelvin. The warmest part of the refrigerator is at the top while the coldest section is at the bottom. The way that this refrigerator can approach this temperature is a combination of two different types of liquid helium. Normally liquid helium has an average temperature of approximately 4 Kelvin, but a chemical process occurs at the bottom of the fridge that allows the helium to be supercooled to the desired 1 Kelvin temperature.

The experimental tool is designed to measure the material properties of a sample material. The main use of this device is for the Department of Physics to observe the behavior of electricity through various sample materials in the ranges between 300 Kelvin to 1 Kelvin. It is known that temperature affects many properties of materials. The property that this device is measuring is the thermal conductivity. A material's thermal resistance determines how difficult it is for heat/energy to flow; higher resistance means it is harder for heat/energy to flow, lower resistance means it is easier for heat/energy to flow. Thermal conductivity and electrical conductivity are inversely proportional in most scenarios. However, there is a critical temperature for some materials that when it is reached the electrical resistance approaches zero, so electricity, specifically direct current, is free to flow through the material with no energy loss. These materials are called superconductors (Department of Energy, 2024). The use of superconductors is primarily involved with computing, more specifically quantum computing. The final assembly of this device will test the thermal conductivity of sample materials using a

method called 3ω. This method will measure and voltage difference that will allow us to determine the thermal conductivity (Dames, 2005 & 2013).

The device is approximately 6 feet long with the bottom 4 inches housing the sample material, integrated circuit, cartridge heater, socket, necessary wiring, and thermal chuck. Starting from the bottom moving down, the sample will sit inside the integrated circuit which has a specific circuit that will allow us to use the 3ω method. This integrated circuit (ICU for short) and sample combination will sit within a socket that will have the necessary wiring soldered to the pins. The combination of the material, ICU, and socket are mounted onto a thermal chuck made out of copper. The purpose of this chuck is to create a pathway for heat to flow from the sample material to the liquid helium that sits in the bottom of the fridge. This chuck also houses a cartridge heater that is responsible for heating the material above 1 Kelvin to create a more diverse range of data. These all combine to give a device that can measure the thermal conductivity of the sample materials over a range of small temperature increments. Below in Fig.1 is a simple assembly of the bottom of the device.

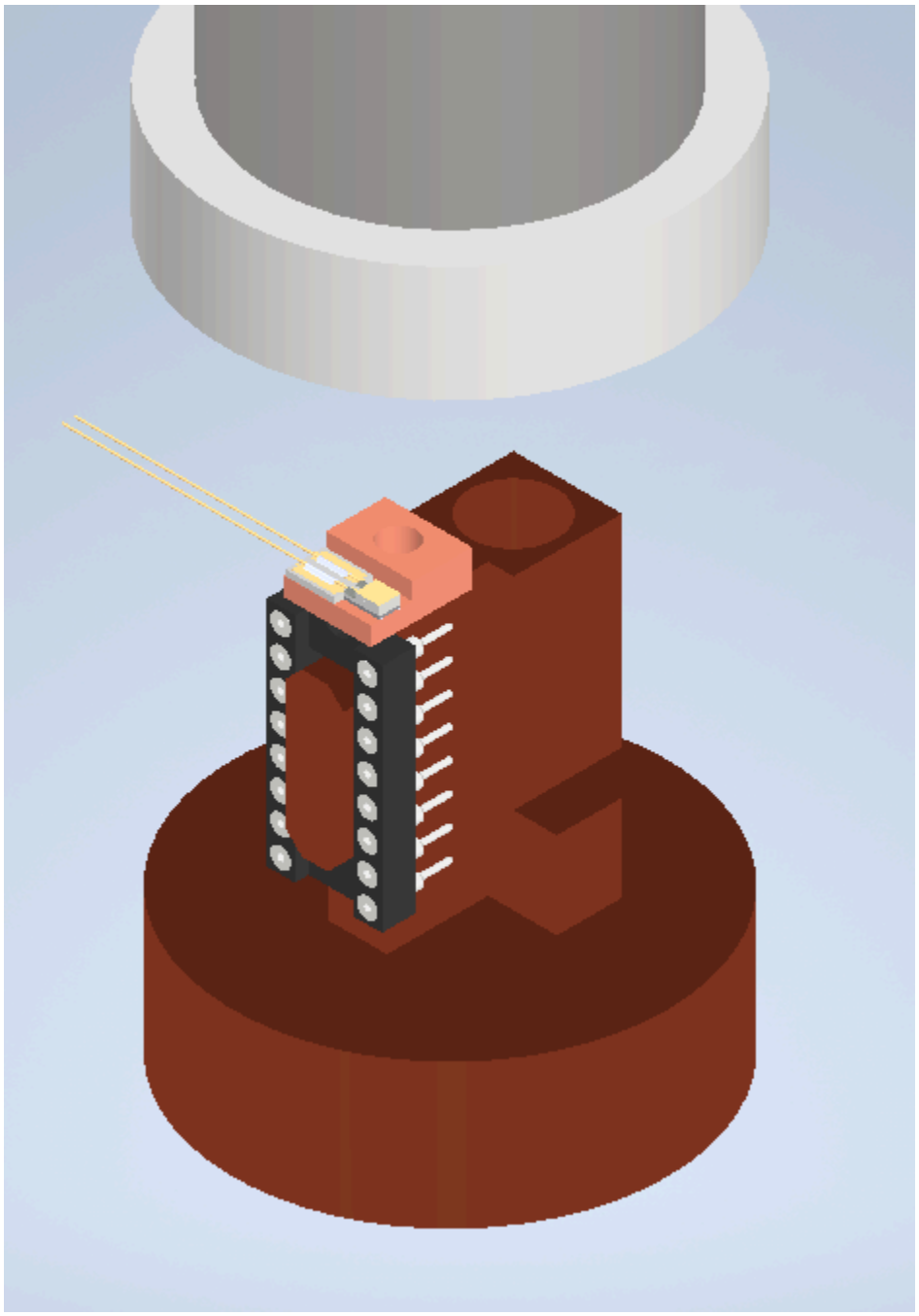

Figure 1: Simple Assembly of Socket, Chuck, & Cernox Temperature Sensor

The main goal of this device is to determine materials that will be effective to use for future use in quantum computers. The use of quantum computing is severely limited and this would allow for a potential next step in this field. While quantum computing is generally a very positive step for society, it comes with some very concerning consequences. Quantum computing is incredibly complex and will not be discussed in its entirety in this paper, but the main point is that our current computer systems rely on binary computing. Data stored in a computer is either stored as 0 or 1. These are called bits and they can be stored as a series which are called bytes. What quantum computing aims to accomplish is to not only have bits stored as 0 or 1, but also every value in between 0 and 1 infinitely increasing computing power. However, this also exemplifies the flaw of data encryption. Encrypting data is completely deterministic of the binary system that it is derived from, so with quantum computing having infinitely more computing power, data encryption derived from binary is essentially null. This could cause the most secure platforms to be able to be infiltrated with very minimal effort from the attacker. The potential effects of a major step towards quantum computing could be disastrous if it is left unregulated, but in the correct hands, quantum computing could create a new wave of technological advancement.

STS Portion:

At this point in time the world is reaching a tipping point in many environmental issues. After paper upon paper, it is clear to see that there is something we need to do about these issues and it appears that large groups of people have come to the conclusion that we have the ability to change this, yet big decisions are made in many national governments, most notably the U.S., that continue to undermine the outstanding environmental issues.

Right now, we are seeing the effects of climate change more than we have ever seen in recorded history. Most recently we have the increasing severity of natural disasters such as Hurricane Helene in Florida. We are also reaching the critical point where the average global temperature cannot be reversed. In 2023, land absorption of carbon dioxide was stunted; approximately 118 countries rely on land carbon dioxide absorption to meet their carbon neutral goals (Greenfield 2024). In an article Titled "An Interpretation of Value Change: A Philosophical Disquisition of Climate Change and Energy Transition Debate" the research question that is proposed is how do values change over time between generations. To answer the question, the authors apply theories by Isaiah Berlin and Ronald Dworkin. Isaiah's theory is that there is a moral landscape that has distinct positions that are not related to or reducible to each other, essentially there are finite, distinct opinions with no middle ground (Melnyk 2022). This lack of middle ground is what Berlin claims to cause irreconcilable conflicts and cause "tragic" choices to be made. Dworkin's theory stresses that while certain values can be conceptually different, there exists interconnections. Dworkin believes that values do not exist in isolation, but are connected networks (Melnyk 2022). The authors believe that Dworkin's approach provides a more comprehensive understanding of this change in positions on environmental issues, seeing it as a gradual and inclusive process rather than a clash between generations. However, at least in

America, it seems that there is this constant generational divide between those who make the decisions and those who must face the consequences of those decisions. With Donald Trump's winning of the 2024 presidential election, one of his goals is to reduce the funding and dismantle the Democrats' "green new scam" (McDermott and Daly 2024). Donald Trump is 78 years old and provides a good example of how someone in an older generation interprets environmental issues as well as a good example of how a politician interprets these issues. He plans on doing this by claiming to end subsidies for wind power that were included in the Inflation Reduction act of 2022. Trump is claiming to do this for the betterment of the American people by reducing energy costs, but more likely the reason is to benefit big oil companies or shareholders. Which aligns with Andersson and Westholm in describing the coproduction model that the "Future Forests" program uses in Sweden. They believe that in this model where researchers and stakeholders are supposed to work together to guide research, instead a "consensus machine" is created where major perspectives are marginalized (Andersson and Westholm 2019). Conflicts were concealed rather than directly addressed and increased the risk of "creating" knowledge that supports industrial and political agendas. Also in Slota's Bootstrapping the Boundary between Research and Environmental Management: The TMDL as a Point of Engagement between Science and Governance, Slota claims that the Total Maximum Daily Load (TMDL) was iteratively developed for policy making and then later incorporated new scientific knowledge, this bridged the gap for policy makers and researchers so that they could work together more efficiently (Slota 2022).

My research question is: Is there an ideology gap between how generations think about environmental issues, and if there is why is there one and how can we better understand it. My goal is to perform a Meta-Review analysis, Discourse analysis, and Content analysis on articles

discussing and by looking at the rankings of environmental issues over time to see if there is any correlation between age and other variables. Some articles I plan on analyzing are Value Change in Energy Systems by Ibo van de Poal and Behnam Taebi and An Interpretation of Value Change: A Philosophical Disquisition of Climate Change and Energy Transition Debate by Anna Melnyk, as well as using more sources from Google Scholar and the UVA Library databases.

I believe that both of these projects are incredibly important to solving many of the issues that we face today. Through the construction of the experimental tool we will be able to gain additional, more accurate knowledge to eventually work towards creating a quantum computer. I plan to see if there is a possible difference between ideologies between generations and how we can use this information to better solve these issues.

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