Sabbatical Report
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My sabbatical activities included three main projects:

1. I was invited to chair a panel on mentoring at the "Advancing Inclusive Leaders in STEM: 20 Years of the PDP" Conference. I led the panel and was lead author on the companion paper: "Applying Principles of the PDP Towards Mentoring". This work was in collaboration with colleagues from University of California - Santa Cruz and University of Colorado – Boulder. The paper has cleared editorial review and is to be published in In S. Seagroves, A. Barnes, L. Hunter, A. Metevier, & J. Porter (Eds.), *Impact through inquiry: Twenty years of preparing leaders in effective and inclusive education at the Institute for Scientist & Engineer Educators.* UC Santa Cruz: Institute for Scientist & Engineer Educators.

   Abstract:
   In this paper, we explore how core principles of the mentoring training offered by the Institute for Scientist & Engineer Educators (ISEE) Professional Development Program (PDP) have been adopted by PDP alumni and applied in different contexts. The core themes of the mentoring work conducted by ISEE, which are Inquiry, Equity & Inclusion, and Assessment, form an extensible basis for PDP participants to use as they develop their own mentoring programs. The panel/paper is structured to briefly identify core components of mentoring in the PDP model and then discuss how former PDP participants have applied these in a variety of other venues. With the goal of broadening access & persistence in STEM, the PDP emphasized: the role of ownership and agency, the practice of explanations, the creation of opportunities for recognition, providing formative assessment, and a recognition of and introduction to STEM culture. The PDP has had a unique way of "staying with" participants and provided a framework for mentoring in other modalities including: peer-to-peer, informal, and in the development of new formal programs. These offshoots include key PDP ideas such as: providing support for belonging in STEM, placing value on teaching, promoting adaptability and cultural relevance, and a "training the trainers" modality of mentorship. The panelists will provide examples from programs for undergraduate students, graduate students, teaching professionals, and faculty. The session also provided opportunities for attendees to share their experiences and take-away lessons from the PDP model of mentoring and some of the panel feedback is included in this paper. The ISEE community has a shared vocabulary, toolset, and ethos that continues to inform alumni mentoring since the inception of the PDP.

Figure 1. A word-cloud of panel attendees' PDP-inspired "key-aspects" to mentoring. The size of the text indicates frequency in response. "Growth Mindset" made up 10% of attendee responses. *(Excerpt from manuscript)*

2. I produced a student co-authored paper entitled: "Modeling Supernovae as an Optically Thick Fireball". This is work in a brand new field for me, modeling the highly energetic deaths of stars, supernovae, and has grown out of work I have supervised as part of the Department of Physics & Astronomy's Capstone Research program. The paper is nearly complete and will be submitted to the *Journal of Undergraduate Research in Physics*.

Abstract:

We calculate the properties of 138 stellar supernovae using data from the Open Supernova Catalog. We generate temperatures, radii, luminosities, and velocities using a spherically symmetric optically thick fireball model. These modeled parameters reveal trends that are common across different types of supernovae. We have identified distinct phases that appear across Type Ia, II, II P, and IIb supernovae and a bifurcation in the modeled radial growth behavior of these types. We note that there is a long period of reasonable continuous growth (Phase 1), giving credence to our simple model of an optically thick fireball. The modeled radius reaches a maximum value beyond which it is flat or decreases (Phase 2). The temperature we observe at the maximum modeled radius, 4500 kelvin, suggests that the loss of opacity due to electron recombination sets the timeline where our model no longer applies. We observe the fastest modeled fireball velocities, largest modeled fireball radii, and maximum modeled luminosities for Type Ia supernovae. As a group, Type Ia supernovae reach a maximum luminosity that is 8.5 times more luminous than Type II supernovae. We present a summary table that contains modeled parameters of supernovae and their timings by supernova classification type.

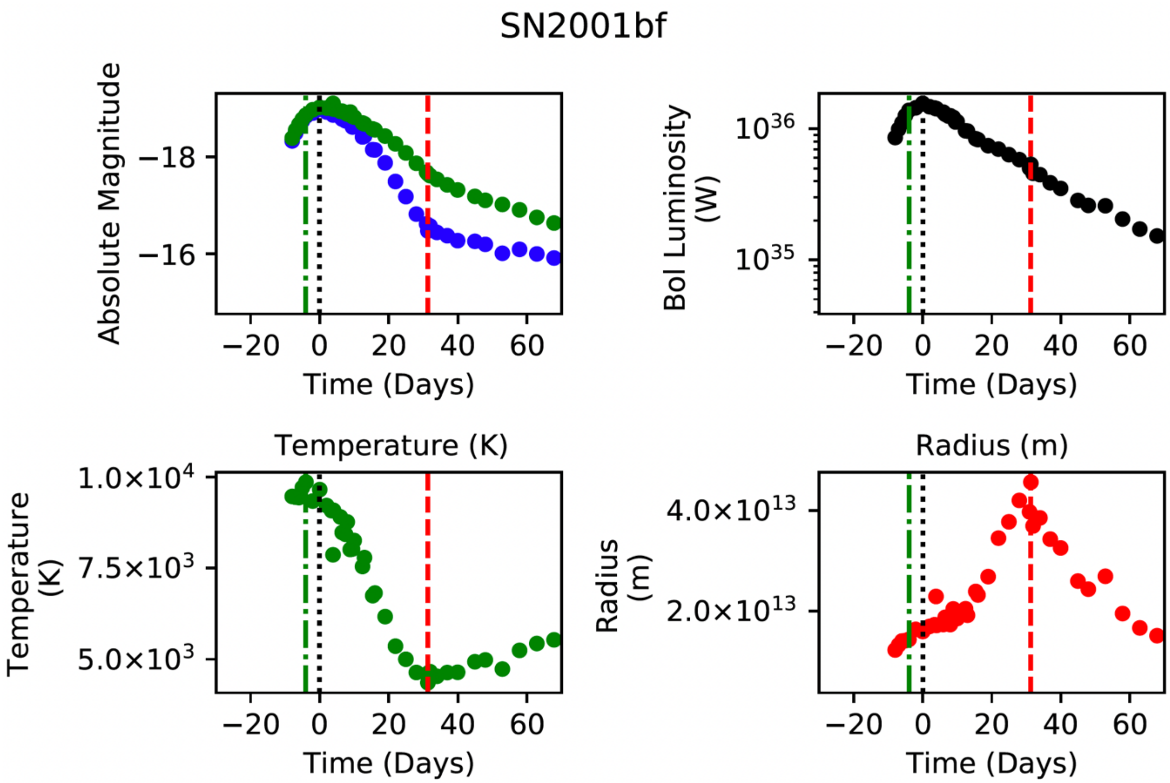

Figure 2. Plots of the absolute magnitude in the B and V band, bolometric luminosity, radius, and temperature for a sample Type Ia supernova (SN2001bf) generated using photometric data from the Open Supernova Catalog. The color magnitudes and the distance to the supernovae allow us to approximate its luminosity and the difference between B and V magnitudes is an indicator of the fireball's temperature. Temperature, luminosity, and radius are related through the Stefan-Boltzmann equation (Equation 5). These plots provide a timeline of the supernova. The fireball begins by growing, heating, and getting brighter. Eventually it dims and cools while continuing to grow. This timeline led us to create a phase model of the lifetime of the event. The dash dotted (green) grid line signifies the maximum modeled temperature, the transition from phase 1a to phase 1b. The dotted (black) grid line signifies maximum luminosity, the transition from phase 1b to 1c. The dashed (red) grid line signifies maximum radius, the transition from phase 1c to 2. Beyond phase 2, we see the modeled radius begin to decrease, evidence of a change in optical thickness signifying the model assumptions no longer hold.

3. I continued work on the development of series of laboratory experiments demonstrating the "Science of Climate Change". The time-sensitive nature of projects 1 (the conference panel and companion volume) and 2 (the supervision of student research) made me prioritize these projects. I am transitioning the climate activities into a set of laboratory activities. During the sabbatical, I planned five of my intended twelve labs and purchased equipment to pilot them during my next instance of teaching Physics 102: Descriptive Physics Lab.

With the work supported by my sabbatical, I have collaborated with national colleagues, produced work in a new field in co-authorship with students, and developed new laboratories.