Increasing the Accessibility of Solar Science through Interactive Demonstration

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1. Background and Objective:

Spectropolarimetry is one of the primary scientific techniques used by the NSF's Daniel K. Inouye Solar Telescope to measure the Sun's magnetic field [1 ,2, 3]. It is vital to our future understanding of solar and space weather phenomena. However, despite spectropolarimetry's importance in the astronomical community, there exists a lack of educational and outreach resources for the technique available to general public.

Therefore, our goal has been to design a fun demonstration that can translate the topic of spectropolarimetry for a general audience without a strong scientific background. By creating a demonstration that engages participants in a kinesthetic, interactive activity analogous to processes that spectropolarimetry is based upon, we hope to show that incorporating interactive elements into scientific demonstrations increases understanding of complex topics.

2. What is Spectropolarimetry?

- Spectropolarimetry is a scientific technique that uses the polarization of light from the Sun to classify the strength and direction of solar magnetic fields.
- By measuring the polarization of light, at different wavelengths and locations on the Sun, the Inouye Solar telescope can build a comprehensive model for the Sun's coronal magnetic field.
- Due to its power in resolving magnetic fields, spectropolarimetry is one of the most important techniques currently utilized by the Inouye Solar Telescope.
- This has the potential to advance our understanding of of space weather phenomena and their origins.

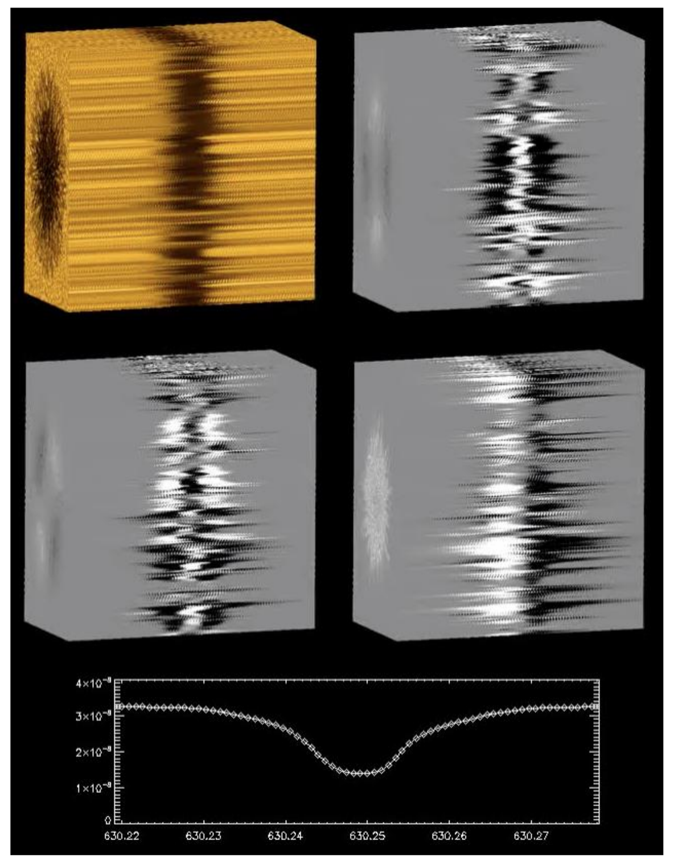

Fig. 1: The full polarization state of light from a sunspot. This state is composed of the intensity as well as degree of circular and linear polarization. All parameters are analyzed at the wavelengths indicated in the bottommost plot. [1].

3. Goals for Demonstration

I. Encourage the general public to engage with the science performed at the Inouye Solar Telescope
II. Increase the accessibility of a complex scientific technique through kinesthetic interaction
III. Show how we can decode polarized light to receive information about the magnetic field at its source
IV. Make it fun!

4. Interactive Activity

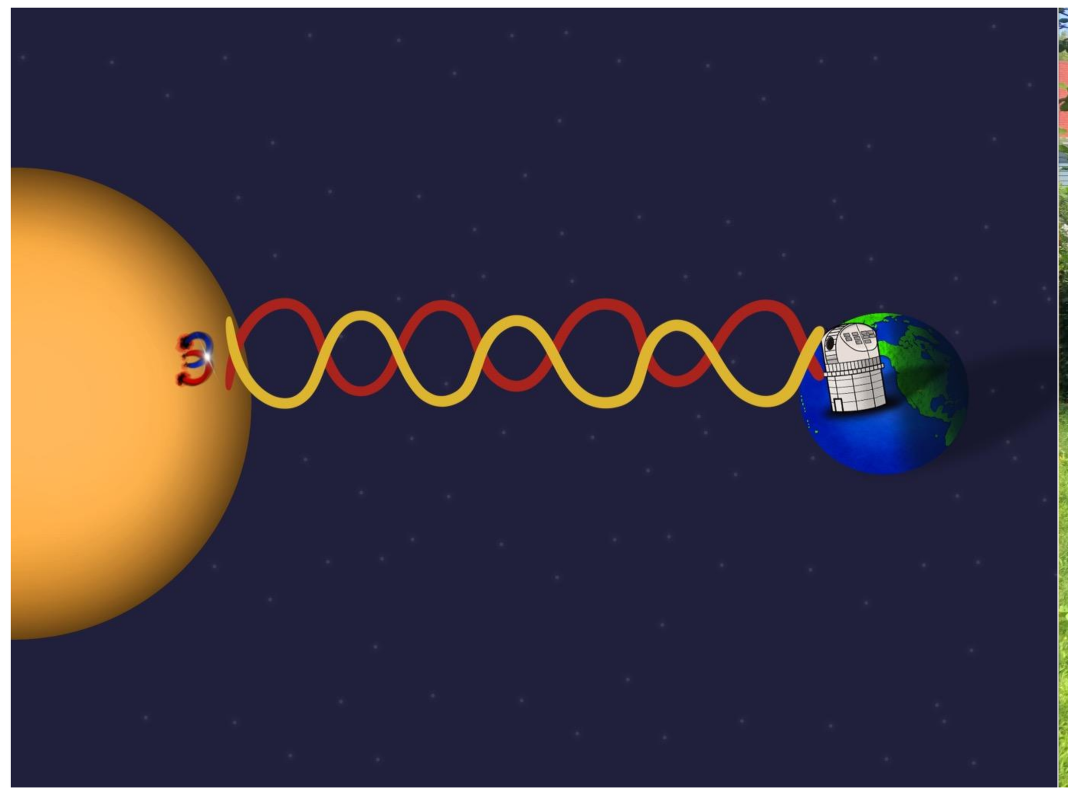

Fig. 2a: A graphical depiction of spectropolarimetry as performed by the Inouye Solar Telescope. The magnetic field on the Sun is encoded into the polarization of different wavelengths of light. This polarized light is then analyzed by the telescope when the light reaches Earth.

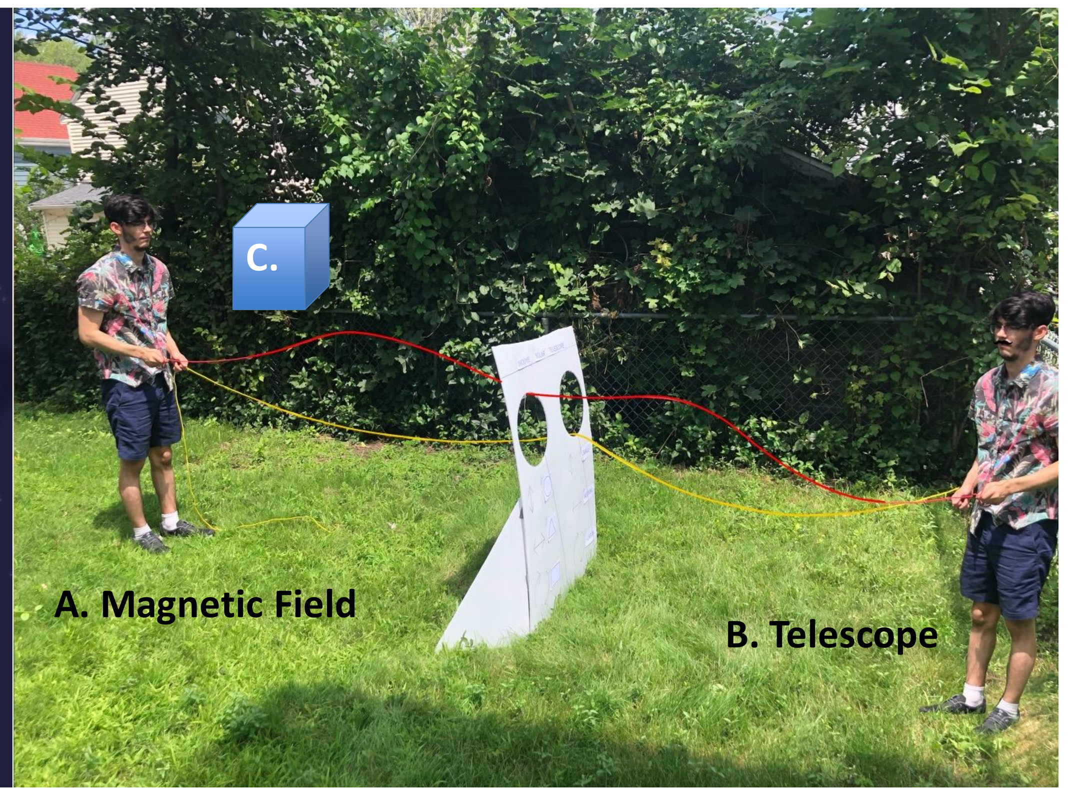

Fig. 2b: The set-up of the interactive activity. Analogous to the procedure shown in 2a, a participant on the ''Magentic Field' side polarizes two strings in a certain pattern. A participant on the 'Telescope' side then observes and decodes the pattern to recreate the original object.

- In this activity, participants are placed on the **A. Magnetic Field** side or the **B. Telescope** side.
- The **Magnetic Field** side is given an object, indicated by **C** in Figure 2b.
- Following the guide shown in Figure 3, the **Magnetic Field** participant encodes information about the object into the polarization of the two different colored strings, a stand-in for the polarizing effect of a solar magnetic field.
- The **Telescope** participant then decodes the polarization of the strings to recreate the object without every seeing it.

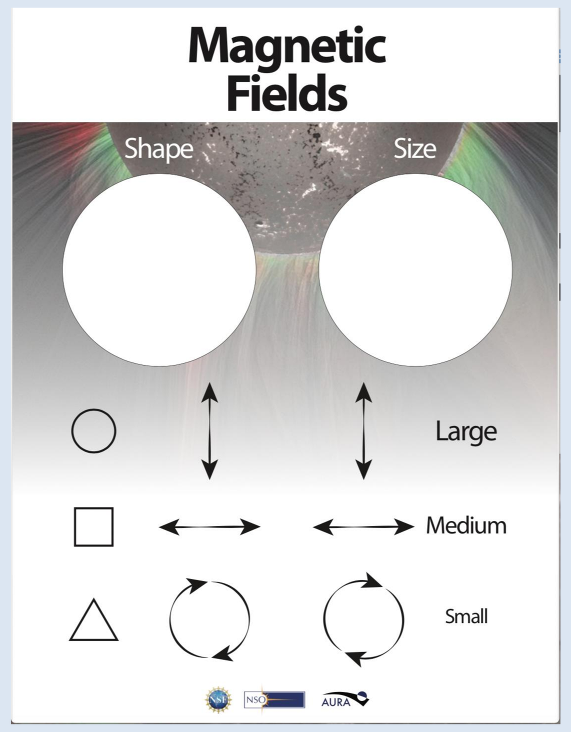

*Fig. 3: Polarization Guide for the **Magnetic Field** side of the activity*

5. Overview

1. Introduction to the wave motion of light
2. Exploration of Polarization and Polarization filters
3. Interactive Activity analogous to the encoding process of Spectropolarimetry
4. Discussion of the activity and real-life applications of spectropolarimetry

6. Preliminary Results

- When tested with a focus group comprised of fellow REU interns and university students, the demonstration was received positively.
- **All participants self-reported an increase in their understanding of spectropolarimetry and its role in the Inouye Solar Telescope after the activity, with an average increase of 51%.**
- Participants noted in the exit survey that it was the combination of physical demonstration and interactivity that best helped them understand the science, pointing out specifically the effectiveness of the slinky in demonstrating wave motion.

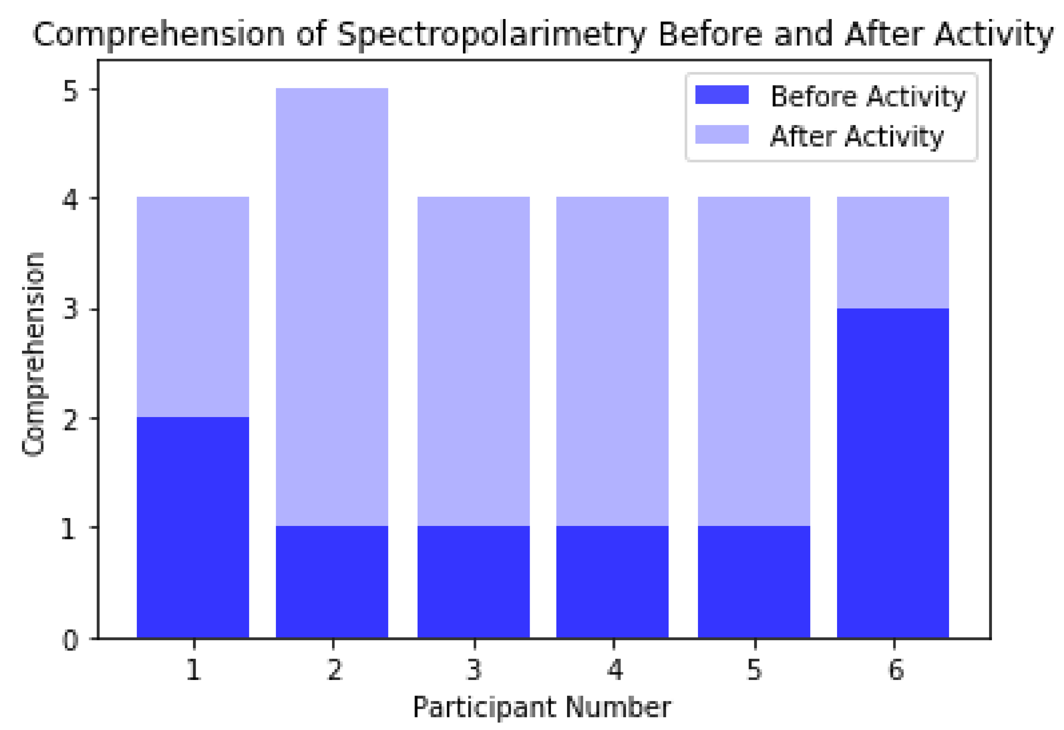

Fig. 4: Self-reported increase in comprehension post-activity

7. Next Steps

Expand the focus group, with an emphasis on increasing the diversity of scientific backgrounds participating in the demonstration.

Develop alternate versions of the demonstration for groups at different education levels. For example, by incorporating a moving object and adding direction of motion and speed as strings, we could make the demonstration more suited to a higher level of education.

Explore the use of this form of interactive demonstration in other areas of solar physics.

Acknowledgements

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References

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