# **FEXAS A&M UNIVERSITY** Physics and Astronomy

#### Introduction

Prior research indicates that the development of a physics identity and increased physics self-efficacy promotes enhanced retention among students, minority underrepresented especially among populations such as female students [1,2].

There has been an increased interest in understanding how student participation in outreach programs supports the development of a physics identity, enhances retention and persistence, and supports a feeling of community [3-5].

We analysed the impact of 5 student-focused physics outreach programs at Texas A&M University (TAMU) on female students.

#### Methodology

We explored the impact of physics outreach programs on the formation of *physics* identity, recognition, and physics self-efficacy for female students. We also looked impacts on into motivation, confidence, and self-perceptions of becoming an expert in the field.

Data were collected through a 12 item questionnaire and semi-structured interviews about student experiences in TAMU outreach programs. Current and former graduate and undergraduate students were included in this study.

Questionnaire answers were transformed to numerical values from a 5-point Likert scale. Interview questions were based on the view of identity as a complex dynamic system [6]. Analysis of interviews was done by a quantitative coding process to identify themes. The code was completed by 3 researchers with an interrater reliability  $\kappa$ >0.6.

# **Empowering Women in Physics: Forming Identity Through Outreach and Engagement**

Emily Hay<sup>1</sup>, Jessi Randolph<sup>1</sup>, Callie Rethman<sup>1</sup>, Jonathan Perry<sup>2</sup>, Tatiana Erukhimova<sup>1</sup>, Jonan Donaldson<sup>1</sup>, and Daniel Choi<sup>1</sup> <sup>1</sup>Texas A&M University, College Station, TX, USA <sup>2</sup>University of Texas, Austin, TX, USA

### Questionnaire Results

• Out of 117 responses to the questionnaire, 32 responses were from female students. Respondents were not required to answer every item. • The majority of female participants felt that physics outreach had a positive impact on improving networking within the department (4.25 out of 5)

 Outreach also had a positive impact on sense of belonging for female students (4.41 out of 5)



 Female students reported themselves as confident in choice of major than male students before participating in outreach (p=0.013, d=0.747). This difference disappeared after participating in outreach (p=0.486, d=0.155).

## Interview Results



## • This student social network map for female students shows connected themes from the interviews [7].

15.2 Educations, physics identity, and physics identity, and physics identity, and physics experiences, outcome expectations, physics identity, and physics identity from motivational factors." Physical Review Physics identity, and physics identity, and physics identity from motivational factors." Physical Review Physics identity, and physics identity from motivational factors." Physical Review Physics identity from motivational factors." Physical Review Physics identity from motivation of physics identity from (2019): 020119. [3] Hinko, Kathleen & Finkelstein, Noah. Impacting University Physics Students Through Participation In Informal Science. AIP Conference Proceedings 1513, 178 (2013). [4] Kathleen A. Hinko, Peter Madigan, Eric Miller, and Noah D. Finkelstein (2016). Characterizing pedagogical practices of university physics students in informal learning environments. Phys. Rev. Phys. Educ. Res. 12, 010111 (2016). [5] Claudia Fracchiolla, Brean Prefontaine, and Kathleen Hinko. Community of practice approach for understanding identity and its development: The dynamic systems model of role identity," (2020). [6] Avi Kaplan and Joanna K. Garner, "A complex dynamic systems perspective on identity and its development: The dynamic systems model of role identity," (2020). [6] Avi Kaplan and Joanna K. Garner, "A complex dynamic systems perspective on identity and its development: The dynamic systems model of role identity," (2020). [6] Avi Kaplan and Joanna K. Garner, "A complex dynamic systems perspective on identity and its development within informal physics programs. Phys. Rev. P

less

## dentity Aspects - Curiosity, Desire to understand view - Worldview: Competitive, comparison with other and Experience - Interest developmen Becoming - Becoming a role mode Role based - Formal Affect and Experience - Empowering p<0.001



- self-efficacy.

"I wasn't sure if [physics] was a good fit for me, but I've definitely been really reaffirmed that [physics] is something that I want to do and something that I can do, something kind of **I'm actually able to do**."

### **Conclusion and Further Work**

- disciplines.

### Interview Results

• This graph shows the percentage of interviewees that spoke on these themes at least once.

• The majority of interviewees reported that outreach impacted their interest and motivation, growth mindset, performance/competency beliefs, recognition, positive persistence, and confidence and

• Female students feel more confident in their choice of major after participating in physics outreach. They report a positive impact on their sense of belonging and physics identity. This could help with retention of female students in physics, and similar outreach programs can be implemented by other STEM

• We plan to collect a broader set of data to look at the full impact of physics outreach programs on female students and other underrepresented groups.