Evaluation of the Global Relay of Observatories Watching Transients Happen (GROWTH) PIRE: 2016-17 Annual Progress Report

A California Institute of Technology
Partnerships for International Research and Education (PIRE) project
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Executive summary

GROWTH is an international scientific collaborative project in astronomy, studying the physics of fast-changing events in the cosmos like supernovae, neutron stars or black hole mergers, and near-earth asteroids. The intention of this project is to continuously observe and gather data of cosmic transient events in the first 24-hours after detection, before many of them fade away in intensity below the sensitivity of telescopes. Project activities are conducted among undergraduate students, graduate students, postdocs, partner institution faculty, and researchers.

Since the last Annual Report (September 2016), the project has implemented and produced the following:

- GROWTH affiliated undergraduate and graduate courses
- Graduate student and postdoc internship program
- Summer Research Program for undergraduate students
- Project research, publications, and presentations

Project highlights since the last Annual Report:

- The project has **expanded its international reach** through the addition of Liverpool John Moores University (United Kingdom) as the 14^{th} partner institution.
- Project members have been **successfully producing high-impact scientific publications**. As of May 8, 2016, project members have produced 42 publications in journals with an average impact 35 times that of the average journal.
- All partner institutions except for two are involved in international collaboration through publications. Most of the collaborative efforts (assessed through publications) involve **international collaboration and multiple project partners**.
- Not only are project members publishing high-impact articles, but they are also **discussing GROWTH research globally**. Project members have given 46 presentations or talks in 12 nations.
- GROWTH is **training and promoting graduate students and postdocs** through involvement in the publication process. These young scientists are listed as authors on 69% of published articles.
- GROWTH courses continue to increase undergraduate and graduate student knowledge about astronomy/astrophysics and skills in research and data analysis through **utilizing project data** to teach students **through hands-on and real world applications** in the classroom.
- The internship and Summer Research programs continue to not only advance postdoc, graduate student, and undergraduate students' research skills, but also **foster collaboration skills** in participants and **provide opportunities to work in international teams**.

Consider these adjustments:

Of the 12 postdocs and graduate students who were not listed as authors on publications, three (25%) have completed an internship.	Moving forward, project leads and host mentors should **encourage graduate student and postdoc interns to develop a plan for producing a manuscript featuring their data collected during their internship. The plan should be put in place before departing their host institution.** This can help improve research productivity among graduate students and postdocs, and may also provide a pathway for continued collaboration.
Both internship programs are contributing to the development of participants' research and collaboration skills, suggesting that continued collaboration may lead to further growth in both areas.	**In order to foster international collaboration after the internship is complete, project leads should consider creating a platform for continued communication.** This can help foster both pedagogical and international collaborative relationships. A regularly scheduled telecon may allow young scientists to share their research and receive feedback on their work. This may also provide a pathway to additional publication/presentation opportunities.
Social network analysis revealed varying levels and types of collaborations, including co-publications, among project members, with U.S. partners being central in the network. Most of the collaborations among individuals in the project tend to be within their own institutions.	**Project leads should conduct a network visioning exercise** to decide what the ideal collaboration network should look like. This exercise can be used to determine the extent to which different institutions and project participants (such as postdocs, graduate, and undergraduate students) should be collaborating. This can also be utilized to determine publication output levels and the extent to which project members should collaborate internationally to publish.

Overall, the GROWTH project has been producing high quality international research in high impact journals, as well as preparing students for further education and careers in astronomy and astrophysics. Young scientists are being mentored at all levels of the project and being involved in publications.

Evaluations in the upcoming year: Summer Research Program, Spring and Fall courses, Annual Progress Survey, project network analysis.

Evaluation and report overview

Background

In 2015, the California Institute of Technology received funding for a Partnerships for International Research and Education (PIRE) grant from the National Science Foundation (NSF) for the Global Relay of Observatories Watching Transients Happen (GROWTH) project. GROWTH is an international scientific collaborative project in astronomy, studying the physics of fast-changing events in the cosmos like supernovae, neutron stars or black hole mergers, and near-earth asteroids. GROWTH is led by Caltech and has partnered with fourteen universities and research institutions (six in the USA and eight internationally in India, Sweden, Taiwan, Japan, Israel, Germany, and the United Kingdom). The intention of this project is to continuously observe and gather data of cosmic transient events in the first 24-hours after detection, before many of them fade away in intensity below the sensitivity of telescopes. Project activities are conducted among undergraduate students, graduate students, postdocs, partner institution faculty, and researchers.

Evaluation approach

The current report includes formative evaluation which provides feedback on project implementation and a summative evaluation which assesses the impact of the project and progress made toward reaching stated goals in years one and two. Findings from this report should be used by project leads to demonstrate the impact of the project to NSF and to discuss ways to enhance the impact of the overall project. The summative evaluation is driven by three goal areas. The corresponding evaluation questions for each goal area are listed below.

Goal 1: Research – Has the PIRE grant advanced new knowledge, collaboration, and discoveries in astronomy/astrophysics?

- To what extent has project research advanced scientific discovery?

Goal 2: Education and Workforce Development – Has the PIRE grant developed a sustainable STEM workforce by creating a pipeline of STEM-trained students, educators, and workers?

- To what extent have undergraduate students, graduate students, and postdocs increased their knowledge and skills through research experiences?
- To what extent have undergraduate students, graduate students, and postdocs developed an interest in the field, scientific careers, and continuing education?

Goal 3: Capacity Building (Partnerships & Sustainability) – Has the PIRE grant enabled GROWTH scientists to collaborate and develop international relationships to strengthen research that will support educational and scientific achievements in the field of astronomy/astrophysics?

- To what extent has the project facilitated domestic/U.S. collaborations?
- To what extent has the project facilitated international collaborations?

Evaluation measures

Evaluators developed surveys in conjunction with project administration and activity leads. Surveys contained Likert scale items and open-ended questions that measured participants' knowledge gains, increase in skills related to research, increase in collaboration skills, and interest in careers and continuing education. Unless otherwise noted, participants rated all Likert scale questions on a five-point scale. Publications and articles were accessed through the project's online library, and bibliometrics were researched and reported from the Scimago Journal Rankings,[1] and Eigenfactor websites.[2]

Data collection and analysis

Surveys were administered through online platforms (internships, Summer Research Program, ASTR 680 course, Social Network Analysis [SNA]) or hardcopy (AY 122 and ASTR 310 courses). Quantitative results were analyzed using means and response frequencies, and qualitative data were coded for themes. The social network data were analyzed through the network analysis software, Gephi. This report includes both new data on activities conducted between the last annual report (September 2016) and this annual report (May 2017), and summaries of findings from previous reports in the last year.

1. http://www.scimagojr.com/journalrank.php
2. http://www.eigenfactor.org/projects/journalRank/journalsearch.php

Project Timeline

The timeline below displays major events in the GROWTH project's lifespan. Major Year 1 milestones include the first international internships for graduate students and postdocs, the first Summer Research Program for undergraduates, and the first GROWTH affiliated courses for undergraduate and graduate students. Year 2 milestones include the addition of a new partner institution/nation: Liverpool John Moores University in the United Kingdom, and GROWTH publications.

Month	Activity
Year 1 (2015-16) [Activities are reported in Year 1 Annual Report]	
October	
November	
December	
January	UG[a]- First course (AY3) affiliated with the GROWTH project begins at Caltech (7 students were enrolled in this course).
February	
March	
April	
May	
June	UG- First undergraduate students participated in the Summer Research Program.
July	
August	UG/GS- Second set of GROWTH affiliated courses (ASTRO 310, ASTRO 680, AY122a) began (51 students are enrolled in these courses).
September	
Year 2 (2016-17) [Activities are reported in Quarter 2 and 3 reports]	
October	
November	
December	GS/PD- 8 graduate students and postdocs have completed internships.
January	UG/GS- Third set of GROWTH affiliated courses (AY3, YSC2217, A51, AS6005) began (37 students are enrolled in these courses).
February	
March	Project wide- Liverpool John Moores University joined GROWTH.
April	
May	Project wide- 42 articles have been published by members of GROWTH.
June	UG- Second group of undergraduate students will participate in the Summer Research Program.
July	
August	
September	GS/PD- Second group of graduate students and postdocs (n = 5) will have completed internships.

a. Activity targeted populations: UG- Undergraduates, GS- Graduate students, PD- Postdocs, Project wide

Figure 1. GROWTH project timeline

Project Participation

The following table shows demographic information for active GROWTH participants by year. Year 2 includes Year 1 participants who stayed in the project and new Year 2 participants. A UK partner was introduced to the project in Year 2, bringing in five senior investigators. Female participants decreased in both number and percentage from Year 1 to Year 2, which is due to undergraduate students leaving the project; however, undergraduate participation fluctuates across years, mainly due to participation in the Summer Research Program. The two participants that left from Montgomery College were both undergraduate students. Five new undergraduates joined the project in Year 2 and two undergraduates have continued from Year 1.

Of the young scientists that have left the project, one postdoc left to work as a project scientist at another university; and one graduate student graduated and now has an industry job with Google. Another graduate student stayed within the project, but has moved into a postdoctoral position.

	Year 1 (n = 64)		Year 2 (n = 67)	
Participant Demographics	Number	Percentage	Number	Percentage
Gender				
Female	22	34%	19	28%
Male	42	66%	48	72%
Institution				
California Institute of Technology	16	25%	14	21%
Humboldt University	1	2%	3	4%
Indian Institute of Astrophysics	1	2%	1	2%
Inter University Centre for Astronomy and Astrophysics	3	5%	3	4%
Ishigakijima Observatory, NAOJ, Japan	1	2%	1	2%
Liverpool John Moores University	--	--	5	7%
Los Alamos National Laboratory	1	2%	1	2%
Max Planck Institute for Astronomy	1	2%	1	2%
Montgomery College	2	3%	--	--
NASA Goddard Space Flight Center	1	2%	1	2%
National Central University, Taiwan	1	2%	1	2%
Oskar Klein Centre, University of Stockholm	11	17%	11	16%
Pomona College	2	3%	1	2%
San Diego State University	3	5%	2	3%
Tokyo Institute of Technology	8	13%	8	12%
University of Maryland, College Park	6	9%	7	10%
University of Wisconsin, Milwaukee	3	5%	4	6%
Weizmann Institute of Science	3	5%	3	4%
Role in Project				
Graduate students	21	33%	21	31%
Postdoctoral fellows	17	27%	15	22%
Senior investigators	18	28%	24	36%
Undergraduate students	8	13%	7	10%

Figure 2. Project participation by gender, institution, and role

GROWTH partner institutions

The map below shows **partner nations**, with the number of participating institutions noted. The countries with the largest number of partner institutions are the U.S. (n=6), followed by India (n=2).

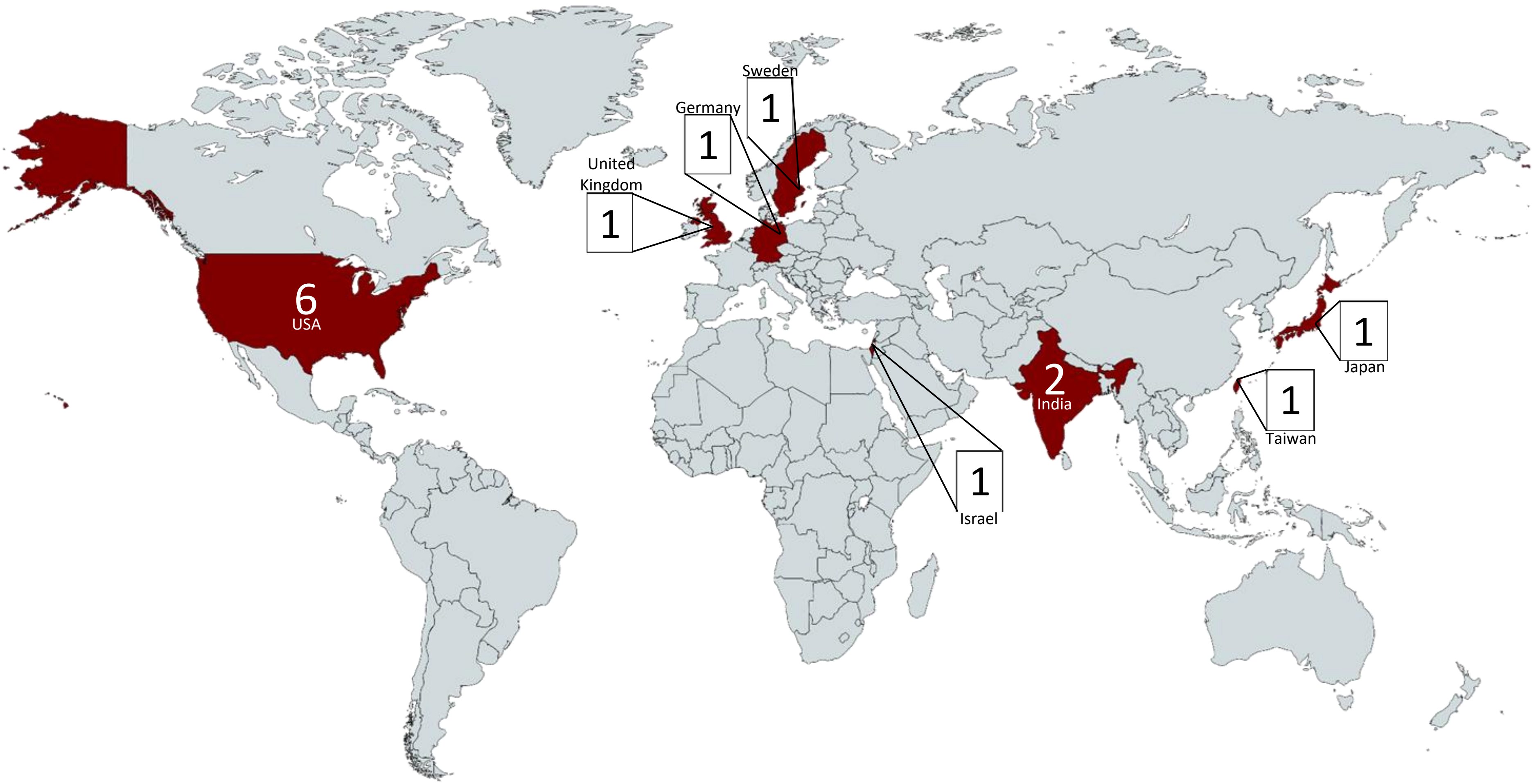

Figure 3. GROWTH partner institutions and nations

Progress made towards research as explored through research products (Goal 1)

Evaluators examined the project's research progress through research products, including publications, and conference presentations/colloquium talks, workshops, and poster presentations. The impact of publications is explored through three bibliometrics. GROWTH members' knowledge of project research will be assessed using the annual progress survey, which will be administered October 2017 and reported in a quarterly report. It should be noted that only published articles are considered, since there is no available information on manuscripts that have been prepared and/or submitted.

Publications

Publishing in academic, peer-reviewed journals is one major indicator of the strength and productivity of the international collaboration aspect of the GROWTH project. GROWTH leads have targeted 55 publications across the life of the project. In Year 2, project members have published 27 articles in astronomy/astrophysics, which is nearly half of the 5-year target. At this rate, the project will not only meet this goal but exceed the project target by the end of 5 years. The table below shows the number of publications produced by project members each year.

Project year	Publications[a]	Project members as authors[b]
Year 1 (2016-17)	15	29
Year 2 (2017-18)	27	30
Year 3 (2018-19)	Not Yet Reported	Not Yet Reported
Year 4 (2019-20)	Not Yet Reported	Not Yet Reported
Year 5 (2020-21)	Not Yet Reported	Not Yet Reported
Total project to date	42	39

a. Publications information was pulled for analysis on May 8, 2017 and does not reflect any changes made to database after this date.

b. Project member totals are unduplicated counts

Figure 4. Publications by year and number of GROWTH authors publishing for each project year

Publication impact was assessed using three bibliometrics: Eigenfactor (standard [EF] and normalized [EFn]), Impact Factor, and h-index, as well as the number of GROWH articles published in each journal. For all bibliometrics used, there is no set range of values, rather each factor is computed within themselves and allows for comparisons between journals.

Eigenfactor is a measure of the importance a journal has in the scientific community and includes the number of articles published in a journal and its citations compared to all scientific articles published. **Normalized Eigenfactor (EFn)** is the same measure as Eigenfactor, except that all scientific journals are standardized, so that the average journal has a score of 1. Journals with EFn > 1.0 are more influential than the average journal. **Impact Factor** is a measure of how frequently the average article published by a journal is cited. The **h-index** is a measure of the number of articles published in a journal and the impact of the journal. The h-index can also be applied to individual authors to assess their work's impact.

The table below displays the journals where GROWTH articles have been published and the respective bibliometrics (only published submissions are included in the table) for Years 1 and 2. All of the journals that have available Eigenfactor scores, and that published work of project members, were above average (EFn = 1.0). The most impactful journal based on all bibliometrics, where GROWTH work is published, was *Science*, which has a Normalized Eigenfactor of 136.9, indicating this is an extremely influential journal (about 137 times as influential as the average journal). The average Normalized Eigenfactor for all listed journals is 34.99. When *Science* is removed, the average Normalized Eigenfactor is 22.25. The GROWTH project continues to publish in high impact journals, which helps facilitate the reach of the GROWTH project's research.

Journal	Eigenfactor	Normalized Eigenfactor	Impact Factor	h-index	Published articles
arXiv	N/A	N/A	0.643	N/A	6
Astronomy & Astrophysics	0.280	31.4	5.185	214	3
Monthly Notices of the Royal Astronomical Society	0.354	39.7	4.952	239	3
Nature Physics	0.154	17.2	18.791	179	1
Publications of the Astronomical Society of Japan	0.014	1.6	1.961	76	1
Publications of the Astronomical Society of Pacific	0.023	2.6	4.422	116	2
Science	1.222	136.9	34.661	915	1
The Astronomical Journal	0.074	8.3	4.617	191	1
The Astrophysical Journal	0.521	58.3	5.909	325	20
The Astrophysical Journal Letters	0.169	18.9	5.487	82	4
Average for all journals	0.312	34.99	8.663	260	4.2

Figure 5. Publication bibliometrics by journal

GROWTH publications have anywhere from 1 to 13 authors and have been cited anywhere from 0 to 98 times per article. For Years 1 and 2, GROWTH articles have been cited 382 times, with an average of 9 citations per article. This is above the average number of citations for articles published in the fields of astrophysics and astronomy over the past two years (average number of citations from 2015-17 =1.6) (Web of Science, 2017).[3] Fourteen project publications have been cited more than 9 times, and two of those have been cited more than 20 times.

[3] Information found at: https://apps.webofknowledge.com/CitationReport.do?action=home&product=WOS&search_mode=CitationReport&cr_pqid=10&qid=10&SID=1BPqhTChDg5w2oNuH3C

Of the 42 GROWTH publications, about two-thirds of the articles (69%) featured postdocs as authors and over half of them (55%) have graduate students listed as authors. Out of the 36 postdocs and graduate students currently in the project, 24 (67%) of them were listed as authors. Of the postdocs and graduate students who were listed as authors on publications, five (21%) have completed an internship. This indicates that the GROWTH project is fostering an environment where young scientists have opportunities to contribute to impactful research and publications. For a full list of publications, see Appendix A. For citations, number of authors, and number of postdocs and graduate students on each publication, see Appendix B.

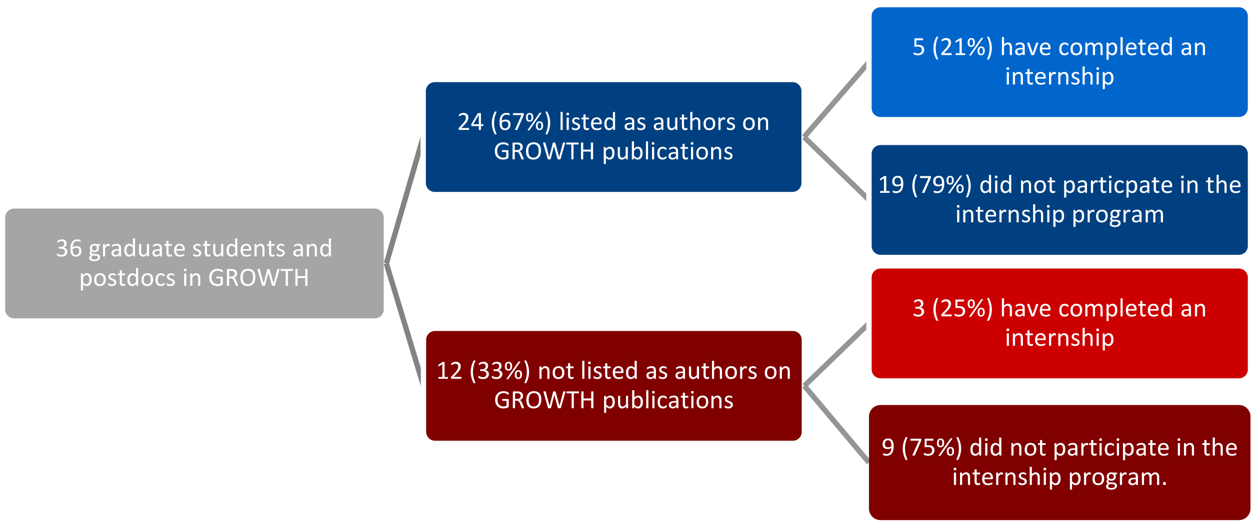

Figure 6. GROWTH graduate students and postdocs as authors on publications

Presentations and talks

GROWTH project members, aside from disseminating research and work through academic journals and publications, give presentations around the globe. In total, 19 project members have given 46 presentations in 12 nations, of which six are not partner nations. Within the United States, project members have presented in ten states and the District of Columbia and the Virgin Islands. A majority of these locations (nine) are not affiliated with partner institutions. By reaching out to nations and U.S. states not affiliated with the project, members are expanding the visibility of GROWTH, as well as its research, beyond the scope of the project. For detailed information of the number of presentations for each location, see Appendix C.

Presentation type	Number of presentations[a]	GROWTH members participating[c]
Talk	47	13
Workshop	2	2
Poster	6	4

a. Presentations were pulled for analysis on May 8, 2017 and do not reflect any changes made to database after this date
b. One presentation was not categorized as talk, workshop, or poster and, therefore, is not counted here.
c. Project members are counted once per category, even if they gave multiple presentations of that type

Figure 7. GROWTH presentations and talks

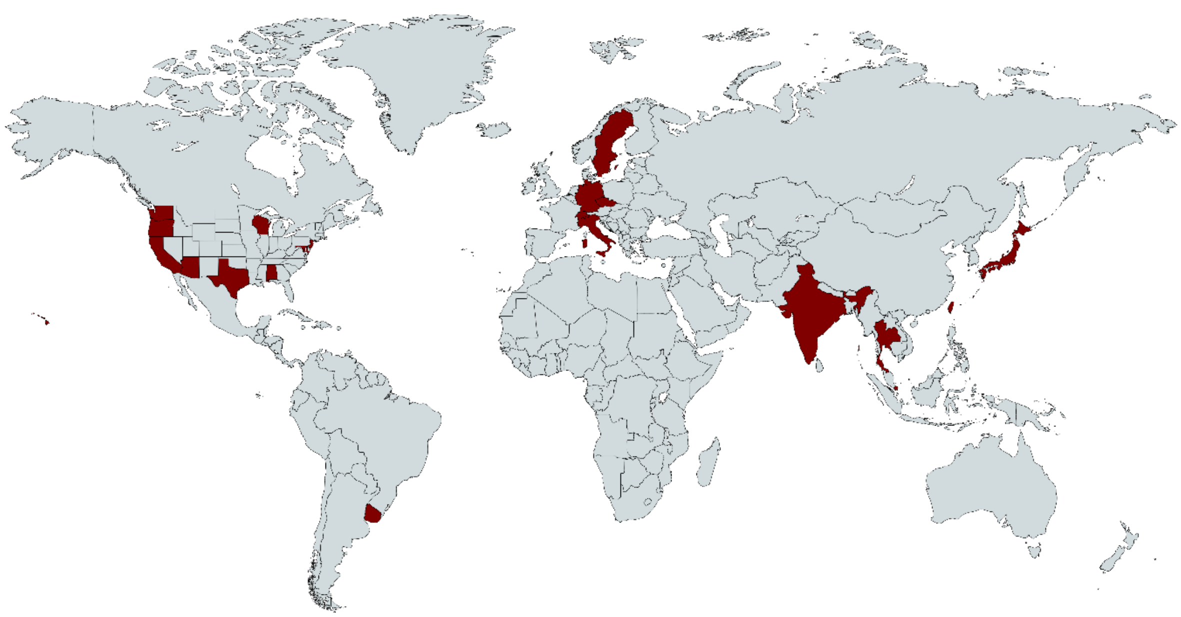

Figure 8. Locations of GROWTH presentations and talks

Progress made towards increasing student knowledge/ skills and interest in astronomy/astrophysics (Goal 2)

The following two sections of the report refer to five activities (information in parentheses indicates where the information was reported for the first time):

- GROWTH affiliated courses
  - Spring 2016 courses: 7 students (Year 1 Annual Report)
  - Fall 2016 courses: 51 students (Year 1 Quarter 3 Report)
  - **Spring 2017 courses: 37 students (Year 2 Annual Report- Current)**

- GROWTH internship and Summer Research Programs
  - 2016 Undergraduate Summer Research Program: 8 students (Year 1 Quarter 3 Report)
  - **Postdoc and graduate student internships: 10 postdocs and graduate students (Year 2 Annual Report- Current)**

Note: those activities in **blue** are being reported for the first time in this annual report.

Comprehensive findings for all activities that have not been previously reported are included in this report. For those previously reported activities, this annual report will focus on the following summative evaluation questions:

- To what extent have undergraduate students, graduate students, and postdocs increased their knowledge and skills through coursework and research experiences?
- To what extent have undergraduate students, graduate students, and postdocs developed an interest in astronomy/astrophysics, careers in and continuing education in the fields of astronomy/astrophysics, and in increasing their collaboration skills?

GROWTH undergraduate and graduate course overview

Since the Year 1 Annual Report, seven GROWTH courses have been offered. The map below displays the locations of those seven courses.

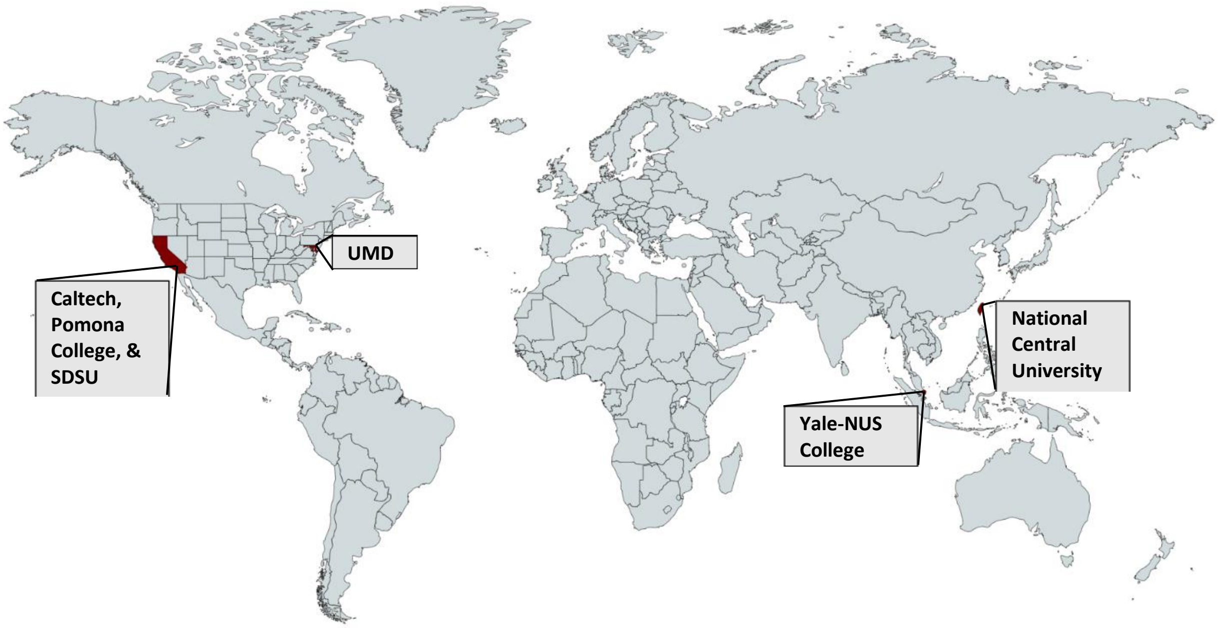

Figure 9. Map of GROWTH course offerings in Year 2

Three courses were offered in Fall 2016 and four were offered in Spring 2017. Of the four spring courses, data are available for one (AY3) and course evaluation findings are presented in the following section. The other three Spring 2017 courses will be reported in the next quarterly report. The table below displays all courses offered by the project.

Course	Institution	Date offered	Student level
AY3: Automated Discovery of the Universe	Caltech	Spr 2016/17	Undergraduate
ASTRO 310: Observational Astronomy	University of Maryland	Fall 2016	Undergraduate
ASTR 680: Astronomical Techniques	San Diego State University	Fall 2016	Graduate
AY122a: Astronomical Measurements and Instrumentation	Caltech	Fall 2016	Graduate
YSC2217: Observational Astronomy	Yale-NUS College	Spr 2017	Undergraduate
A51: Advanced Introductory Astronomy	Pomona College	Spr 2017	Undergraduate
AS6005: Advanced Astronomical Observations	National Central University	Spr 2017	Graduate

Figure 10. GROWTH courses, institutions, dates offered, and student level

The diagram below displays how GROWTH courses are meant to impact student learning.

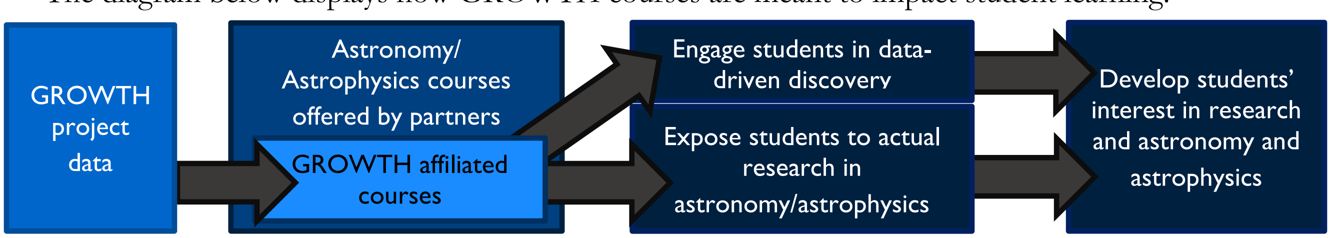

Figure 11. GROWTH course impact on student learning

Findings from AY3- Automated Discovery of the Universe (Spring 2017)

AY 3- Automated Discovery of the Universe is a freshman seminar offered by the California Institute of Technology. This is an introductory course to astronomy and the techniques and tools necessary for analysis of astronomical and astrophysical data. The seminar aims to do the following:

- Expose students to astronomical phenomenology and physics research.
- Create excitement around astronomical phenomenology and physics research.
- Improve ability to deal with big data sets, grounded in astronomical phenomenology and physics.
- Improve ability to connect diverse catalogs, grounded in astronomical phenomenology and physics.
- Improve ability to invent new algorithms, grounded in astronomical phenomenology and physics.

Demographics of survey respondents (n=4)

- Three of the five students completed the survey in its entirety and one additional student partially completed the survey.
- Two out of three respondents were female.
- One respondent was Asian, one was White, and one was multiracial.
- All respondents had STEM concentrations (two in physics and one in astrophysics).

Results should be interpreted with caution given the small sample size.

Seminar effectiveness

Generally, respondents felt the instructors were knowledgeable about the material and facilitated the course well. Three out of four respondents neither disagreed nor agreed the instructors were available during office hours and two neither disagreed nor agreed the instructors had a sense of when the class did not understand information. These could be due to course format, a series of guest lectures by visiting researchers and professors.

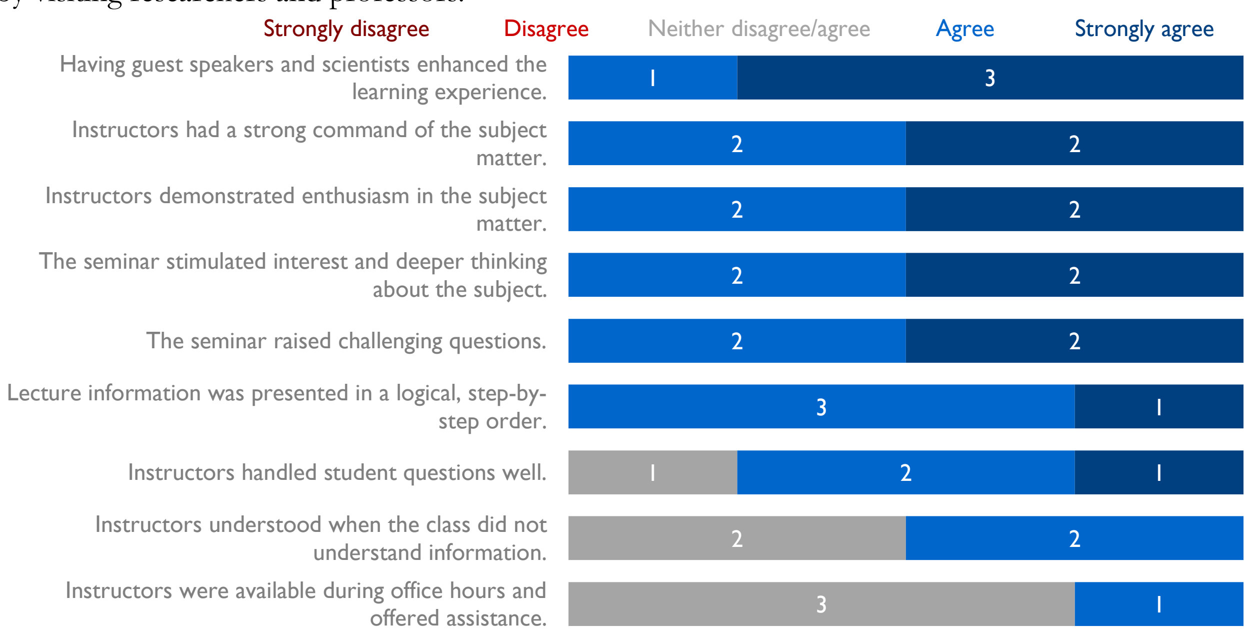

Figure 12. Effectiveness of aspects of AY3

Seminar impact

Respondents (n=4) rated their level of agreement with ten statements, which were organized into three impact areas:

- **Impact on knowledge:** four statements about increases in knowledge of general astronomy/ astrophysics, specifically time domain astronomy, and understanding of the research process.
- **Impact on skills:** three statements about increases in skills related to conducting research, analyzing data, and written and oral presentation.
- **Impact on interest in the field:** three statements about increases in excitement, interest, and passion for astronomy/astrophysics, astronomy/astrophysics research, and being an astronomer.

Findings suggest that the course had the greatest impact on students' skills and interest in the field. All respondents agreed or strongly agreed they got hands-on experience with data and experience presenting findings. Knowledge items focused on specific concepts had slightly lower ratings; however, this is to be expected given the depth of these items compared to the items related to skills and interest.

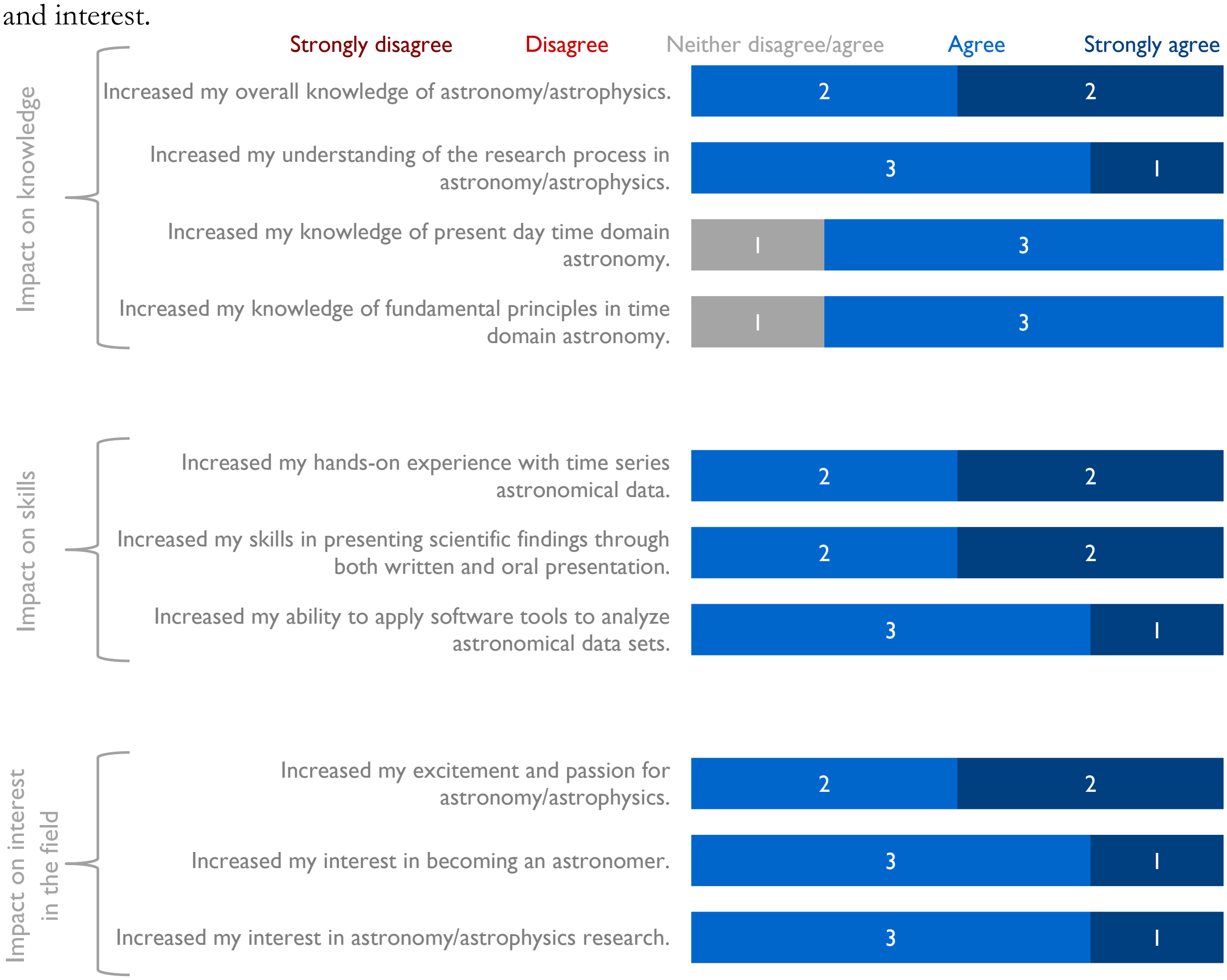

Figure 13. AY3 impact on students

Influence on educational and career trajectories

Respondents (n=3) reported on how the seminar impacted their educational and career trajectories in three areas:

- **3** respondents have a STEM focus and plan to stay in that area.
- **3** respondents had an increased interest in pursuing further studies astronomy or astrophysics.
- **3** respondents are interested in participating in astronomy or astrophysics research projects.

> "I am interested in participating in astronomy or astrophysics research because I find the cosmos fascinating. This summer I will (hopefully) be working on the semi-analytical modeling of ultra-faint galaxies."
>
> "Yes, as they are personally rewarding and have the potential to contribute to answering many still unanswered questions in astronomy."
>
> "I believe the hands-on experience will be beneficial for my future research after grad school."

Seminar suggestions

Respondents suggested that the course should make more explicit the amount of programming in the course, with one respondent stating there was a "heavy amount of programming" and that the course should provide "more tutorials on python." One respondent suggested having notes prepared before the class to make it easier to follow along with the lecture.

Summary of findings from Fall 2016 courses

Three GROWTH affiliated courses were offered in the Fall of 2016 and evaluations were completed by 34 out of 41 students (83%). The courses increased students' astronomy/astrophysics skills/knowledge, and increased their interest in astronomy/astrophysics careers and continuing education. The extent to which these courses have impacted these areas are reported below.

Increased knowledge and skills

Nearly all student respondents reported they had very high levels of growth in their knowledge and skills related to astronomy/astrophysics. They also noted that having the opportunity to utilize real-world data and collect their own data were key to their experiences. Students reported the most growth in their skills in and ability to work with data, specifically in using data analysis tools such as Python and Unix. The students had mixed ratings when it came to assessing their growth in presenting scientific research through writing or oral presentations, however, they reported at least some growth in these areas. Some respondent comments are below:

- "It gave a very practical viewpoint of astrophysics and observational techniques."
- "This course showed me truly what research in the field of astronomy meant. It gave me a better idea of what kind of research I would do as a grad student."
- "It is very practical and interesting and it's important to combine real life study with class."
- "I became much more involved in the "Dirty Work" of data analysis. I started the class highly unconfident of my abilities to complete such tasks."

Increased interest in astronomy/astrophysics, careers in and continuing education in the fields of astronomy/astrophysics

Almost all respondents reported increased interest in astronomy/astrophysics research, careers, and continuing education in the field. The courses allowed respondents to learn about areas of research that were of interest to them, which likely contributed to their increased interest in the field and continuing education. Respondents shared that gaining confidence and skills contributed to their increased interest in future careers and education in astronomy/astrophysics. Some respondent comments are below:

- "It has helped me discover in what area of astronomy I could like to focus my career/studies."
- "Encourage me to look into multiwavelength observations in my area of research."
- "It's been one more step in convincing me I want to go into research."
- "This course has affected my interest in a positive way, such that it has solidified my desire to work in a STEM related field."

GROWTH Graduate Student and Postdoc Internships

Since the Year 1 Annual Report, five graduate students and postdocs, and five undergraduate students have participated in the internship and Summer Research programs. The following table shows the following for each intern: project role, home institution, visiting institution, and length of internship. The map below displays the locations of the internships over the past year and number of interns at each location.

Student	Project role	Home institution	Visiting institution	Internship length
Intern 1	Postdoc	Caltech, US	Stockholm University, Sweden	2.5 weeks
Intern 2	Postdoc	Caltech, US	National Central University, Taiwan	4 weeks
Intern 3	Graduate	Stockholm University, Sweden	Caltech, US	1 week
Intern 4	Graduate	Stockholm University, Sweden	Caltech, US	4.5 weeks
Intern 5	Graduate	Caltech, US	Tokyo Institute of Technology, Japan	2 weeks
Intern 6	Undergraduate	IUCAA, India	National Central University, Taiwan	4.5 weeks
Intern 7	Undergraduate	San Diego State University, US	Weizmann Institute of Science, Israel	8 weeks
Intern 8	Undergraduate	University of Maryland, US	National Central University, Taiwan	8.5 weeks
Intern 9	Undergraduate	Pomona College, US	IUCAA, India and Pomona College, US[a]	9 weeks
Intern 10	Undergraduate	Caltech, US	Liverpool John Moores University, UK	10 weeks

a. This student split his/her internship between both institutions

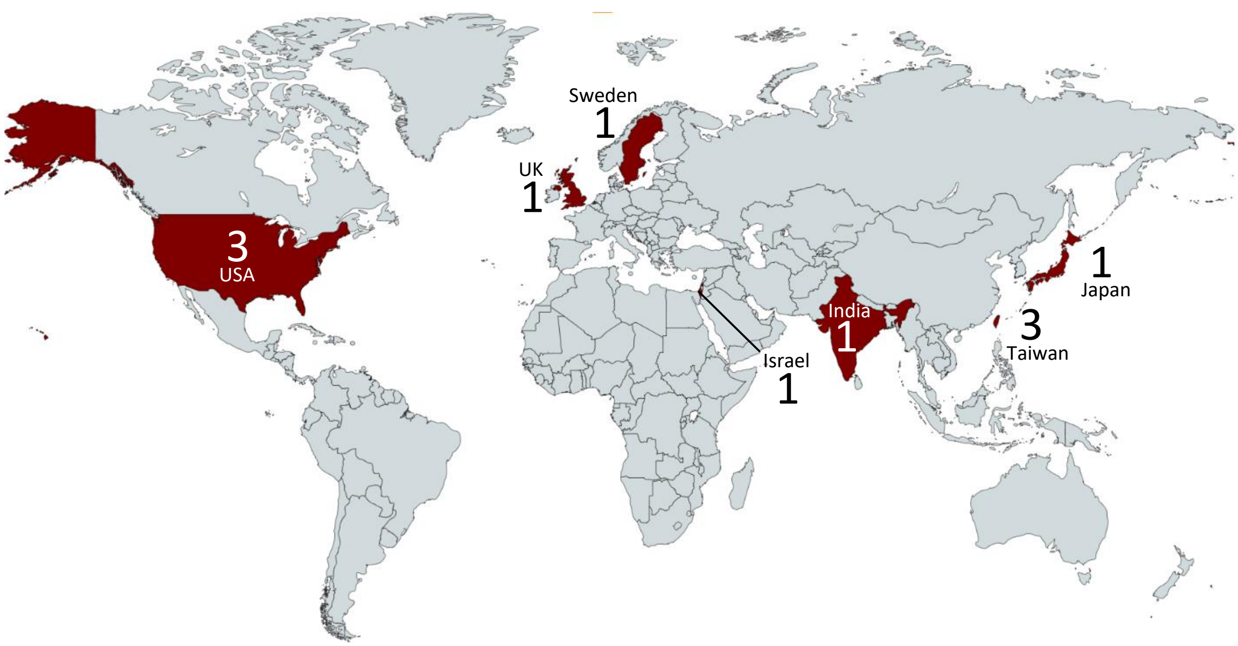

Figure 14. GROWTH internship locations and number of interns hosted in Year 2

Findings from GROWTH graduate student and postdoc internships

GROWTH offers international internships for graduate students and postdocs to further their research knowledge and skills by collaborating with GROWTH project members in a different region. Internships took place between November 2016 and March 2017, with the average internship lasting about 3 weeks. A total of five graduate students and postdocs participated in the internship program during this time, however only 4 students provided feedback on their experience. Results should be interpreted with caution given the small sample size. GROWTH internship objectives are to provide:

- Opportunities to advance research skills in the area of astronomy/astrophysics
- Opportunities to develop intercultural competencies
- Opportunities to successfully work in diverse international teams

Demographics of internship respondents (n = 4)

- Four of the five interns completed the survey
- Three of the four respondents were male
- Three of the respondents were Caucasian/white
- Two of the respondents were graduate students and two were postdocs
- Three of the respondents conducted research in understanding of newborn supernovae and one conducted research in the detection and follow-up of small near earth asteroids and their orbits

Impact of internship experience on collaboration

Respondents (n=4) reported on their experience with networking opportunities during their internship. Overall, respondents reported high levels of agreement that they had opportunities to network (4.25/5.00) and work with like-minded people (4.25/5.00). In addition, respondents rated six items focused on international collaboration. All respondents agreed or strongly agreed that collaboration is beneficial, they are motivated to collaborate, and are confident in their ability to do so. Items related to gaining cultural awareness and approaching work in a manner specific to the host culture had lower ratings. However, this is to be expected given the complexity of shifting the nature of one's work.

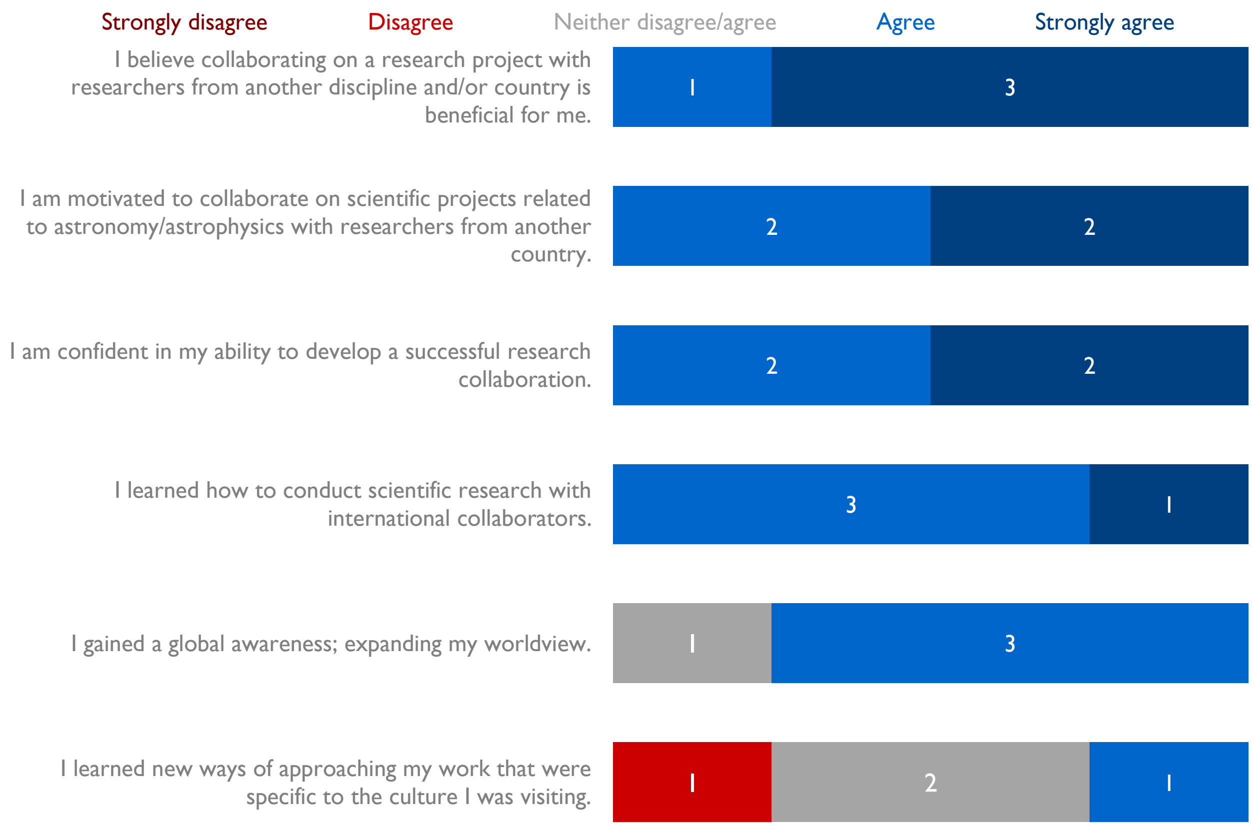

Figure 15. Impact of internship experience on interns' perception of collaboration

In addition to these items, the post-internship survey asked the respondents to indicate their agreement with three items related to strengthening/creating collaborations and enhancing understanding of collaboration before and after the internship. Respondents reported moderate agreement (3.33/5.00) before their internship and strong agreement (4.85/5.00) after. In general, all findings on collaboration suggest graduate students and postdocs are open to and interested in international collaboration which will likely contribute to their success in the project.

Impact of internship experience on research, education, and careers

Respondents (n = 4) retrospectively rated their before and after internship agreement with five statements about research and career readiness. Respondents reported increases in all research and career readiness items. They had the most growth in their knowledge of careers available in astronomy/astrophysics and their ability to identify possible research projects. It is likely that collaboration opportunities provided by the project have contributed to the growth in these areas. Given that graduate students and postdocs likely feel more set in their research and career pathways, it is expected that there would be less growth in items related to interest and preparation for careers in astronomy/astrophysics and exposure to peer research.

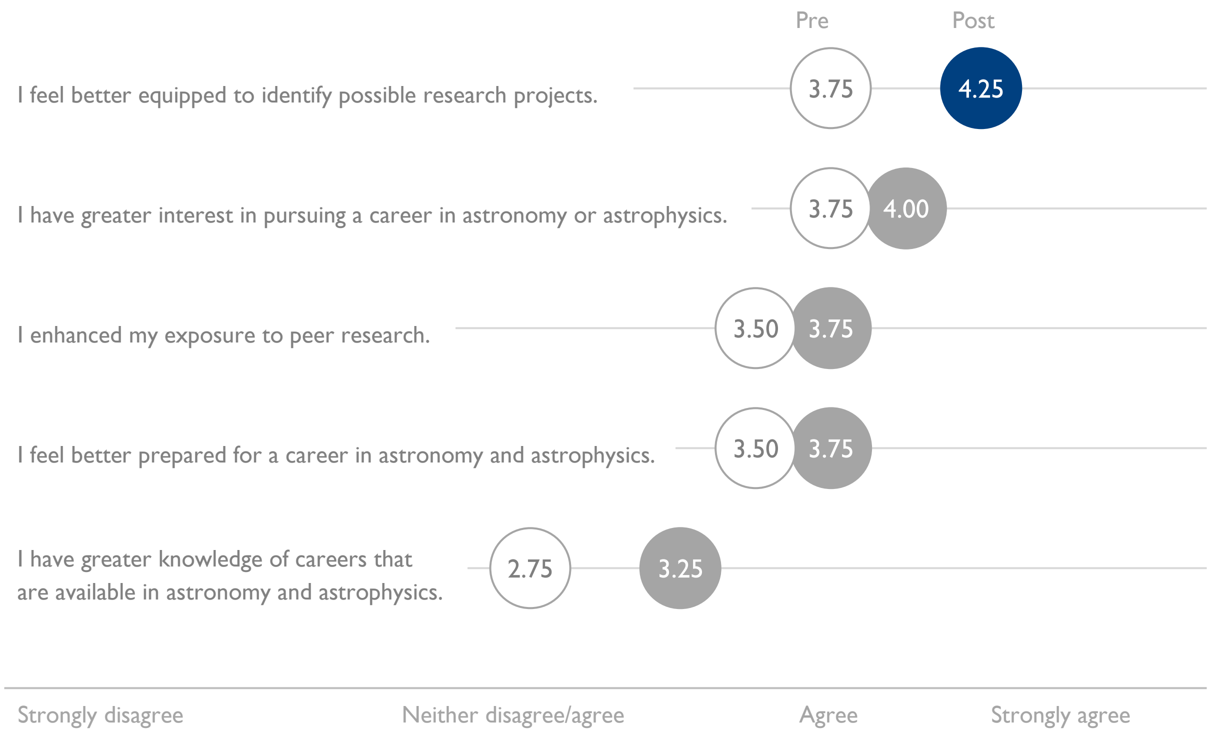

Figure 16. Impact of internship on interns' career readiness and direction

Impact of internship experience on research skills and motivation

Respondents (n = 4) rated their level of agreement about increased confidence and factors that sustain interest, which included four statements about confidence in and passion for research, being challenged, and exposure to new ideas. Overall, respondents agreed with all statements, but had the highest level of agreement with gaining confidence doing research in the field. The lowest rated item was about feeling exposed to new ideas. This could be due to the graduate students and postdocs working primarily in areas of research with which they familiar. Moving forward, it could be a goal of the internships to expose the graduate students and postdocs to innovative and cutting edge techniques, which would introduce them to new ideas in the field.

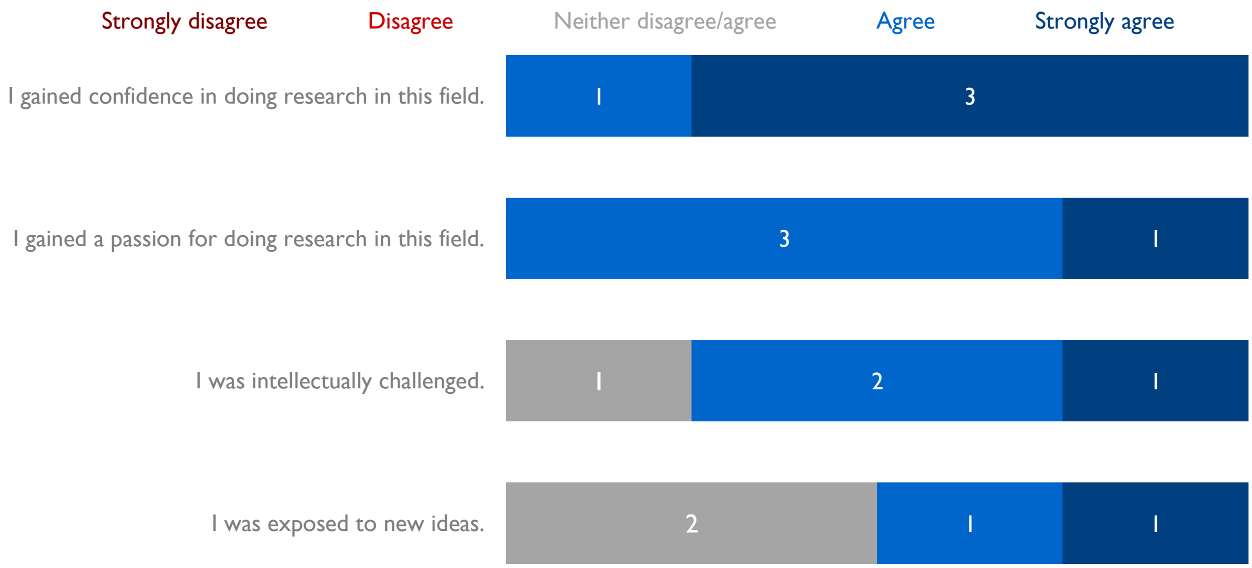

Figure 17. Impact of internship on confidence and factors that sustain interest

Perceived value of internship experience

The evaluator assessed the overall experience of the internship through examining if participants' (n=4) needs and expectations had been met and if the participants perceived the internships as valuable, including being assigned meaningful tasks. Overall, 100% of respondents strongly agreed that the internship was valuable to them. One respondent reported disagreement with two statements regarding the meaningfulness of internship. This may be due the length of the internship, as two respondents mentioned the time was too short in which to complete their project. Again, all findings should be interpreted with caution due to the small sample size.

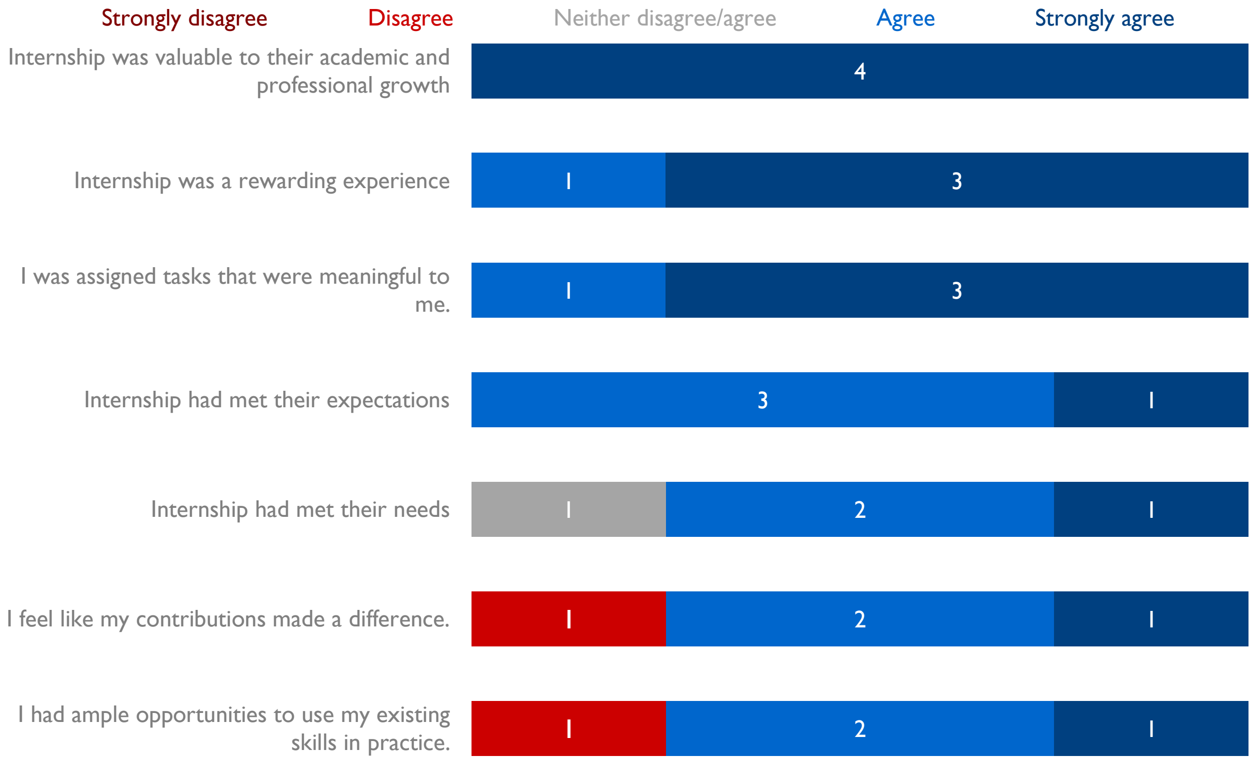

Figure 18. Interns' perceived value of internship

Internship logistics

Logistics was divided into two subscales: overall experience and experience with hosts. Generally, respondents agreed that they had a positive experience with their host, as well as a positive overall experience. Respondents reported the highest level of agreement that their host was a good match for their interests. This is a sign of success for the project, as matching hosts and interns appropriately will allow for the interns to get the most out of their experience. Respondents reported mixed feelings about the length of the internship. This could be due to the average internship lasting around 20 days, which may not be long enough to complete the necessary work. Additionally, although all respondents felt their host matched their academic interests, not everyone felt they received good supervision and feedback. Project leads may want to consider a weekly or mid-point check-in with the graduate students and postdocs to ensure their research is on track.

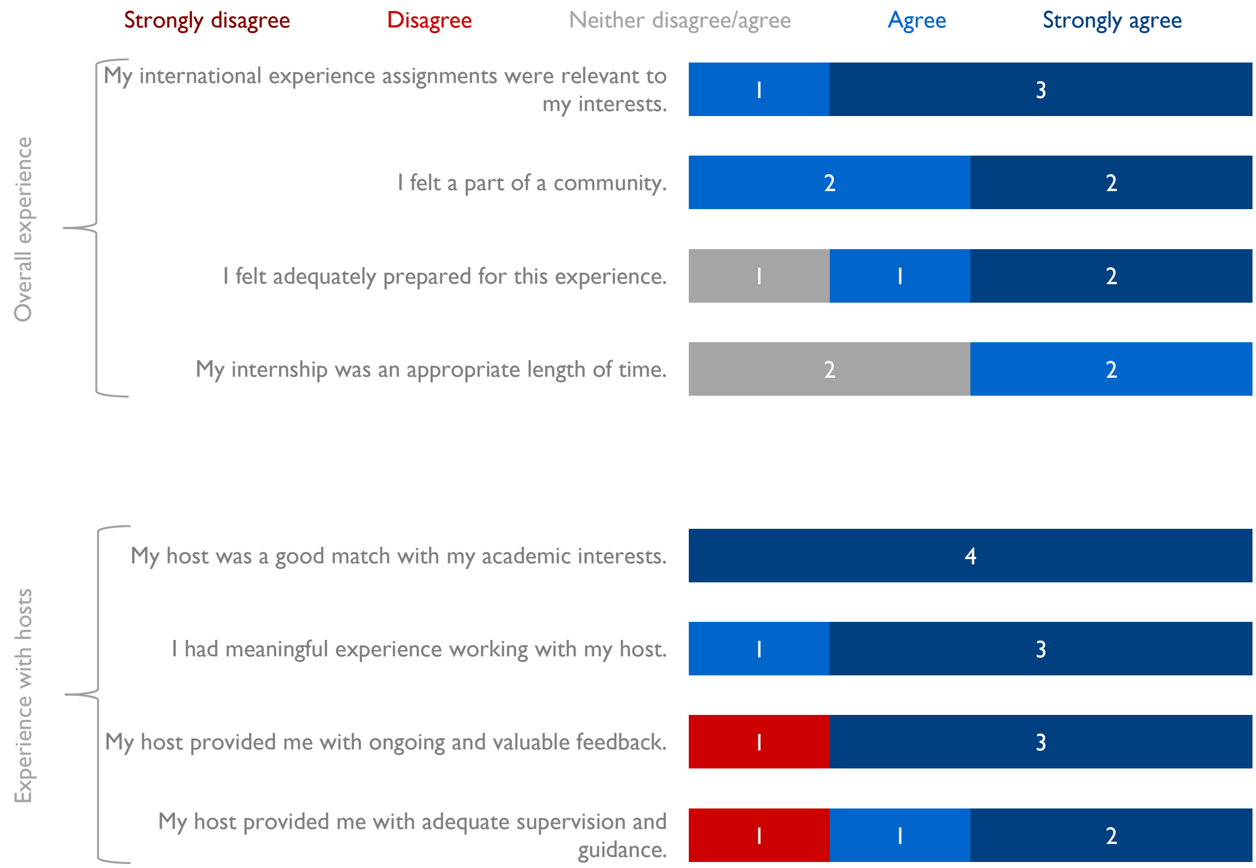

Figure 19. Intern's rating of internship logistics

Participant feedback on assistance

Respondents (n = 4) shared the **assistance they found helpful** and the **assistance that would have been helpful** from both their home and visiting institutions. In general, respondents found support from both home and host institutions helpful. Respondents appreciated the assistance from both home and visiting institutions regarding planning their research and applying for the internship. On the other hand, participants wished they had received more information about their visiting locations, such as conferences and social activities, as well as more information about mentors and local researchers. Specifically, more clarification on how the host institution and intern's host fit into, not only GROWTH, but the larger astronomy/astrophysics field might be beneficial to the interns.

	Assistance found helpful	Assistance that would have been helpful
Home institution	• Information on how to apply and the application process • Plan for the research process • Staff handling housing and flight information	• Better understanding about non-GROWTH collaboration of the host • Connecting with a local mentor • Information about local events, such as conferences, events, dinners, workshops, during the time of the internship

Host institution	• Help with coordinating a talk
	  ○ Getting feedback and understanding the importance of research
	  ○ How research fits in with other research at host institution
		• A one-on-one meeting
		• More information about social activities

Summary of findings from Summer 2016 Summer Research Program

In the summer of 2016, five undergraduates participated in the Summer Research Program, an international internship opportunity, and evaluations were fully completed by four of the students and partially completed by one student. The Summer Research Program was focused on increasing students' astronomy/astrophysics skills/knowledge, increasing their interest in astronomy/astrophysics careers and continuing education, and impacting students' intercultural competencies and their ability to successfully work in diverse international teams. The extent to which this program impacted these areas are reported below.

Increased knowledge and skills

Most of the respondents reported increased confidence and skills as a researcher and they were highly satisfied with their experience conducting hands-on research. On average, respondents agreed or strongly agreed with all items relating to increased confidence and skills as a researcher, especially increased passion for doing research. All of the respondents reported that their mentors were a good match for their academic interests, which likely contributed to their confidence and skills as a researcher.

Increased interest in astronomy/astrophysics, careers in and continuing education in the fields of astronomy/astrophysics

All respondents felt the experience was valuable to their academic and professional growth, and almost all felt more prepared for graduate school after participation. While respondents had increased interest in graduate school, their interest in careers did not change as much, which is likely due to the students already being highly interested in astronomy/astrophysics careers.

Increased intercultural competencies and the ability to successfully work in diverse international teams

Respondents reported the most growth in their collaboration readiness, which included strengthening and creating collaborations and enhancing understanding of collaboration. They found the Summer Research Program to be valuable and reported positive attitudes towards their mentors, especially in regard to mentors offering assistance.

Progress made towards strengthening partnerships (Goal 3)

Evaluators examined progress made towards strengthening partnerships by analyzing individual-level collaborations and by assessing publications that came out of those collaborations. The project collaboration Social Network Analysis (SNA) is used as a measure of participant and institutional collaboration and publications are used as a measure of the products of collaboration. Both of these assessments will explore the following evaluation questions: to what extent has the project facilitated 1) domestic/U.S. collaborations and 2) international collaborations?

Participant-level collaborations

In Year 1, evaluators investigated the collaborations among the members of the project (n = 58) using SNA. The social network map displays those who completed the survey (n = 24) and those that did not complete the survey, but were selected by the survey completers (n = 25). If a participant did not complete the survey and was not selected by anyone else as a collaborator, they do not appear in the network (n = 9). By conducting the SNA, evaluators were able to visualize the collaborative network of the GROWTH project.

The SNA revealed that the project members tend to collaborate within their own institutions, more than across different institutions. Members from Caltech tend to be the most influential members in the project's collaborative network. Undergraduate students and postdocs are the least influential on the network, which is to be expected for undergraduate students given their role in the project. Moving forward, the project leads should start to conceptualize their ideal network, so growth can be measured across years. Peripheral members of the network should be encouraged to collaborate more with the project. By identifying the barriers and facilitators of participation, project leads can help facilitate collaboration.

A small number of participants completed the network survey in year 1 and many changes have happened since the initial survey. The Year 2 network survey will be conducted in October 2017 and differences in the two networks will be analyzed to assess changes from Year 1 to Year 2. The collaborative SNA diagram is displayed on the next page, along with a legend for the partner institutions.

California Institute of Technology
Indian Institute of Astrophysics
Los Alamos National Laboratory
National Central University
Pomona College
Tokyo Institute of Technology
University of Wisconsin, Milwaukee
Humboldt University of Berlin
Inter-University Centre for Astronomy and Astrophysics
NASA
Oskar Klein Centre at Stockholm University
San Diego State University
University of Maryland, College Park
Weizmann Institute of Science

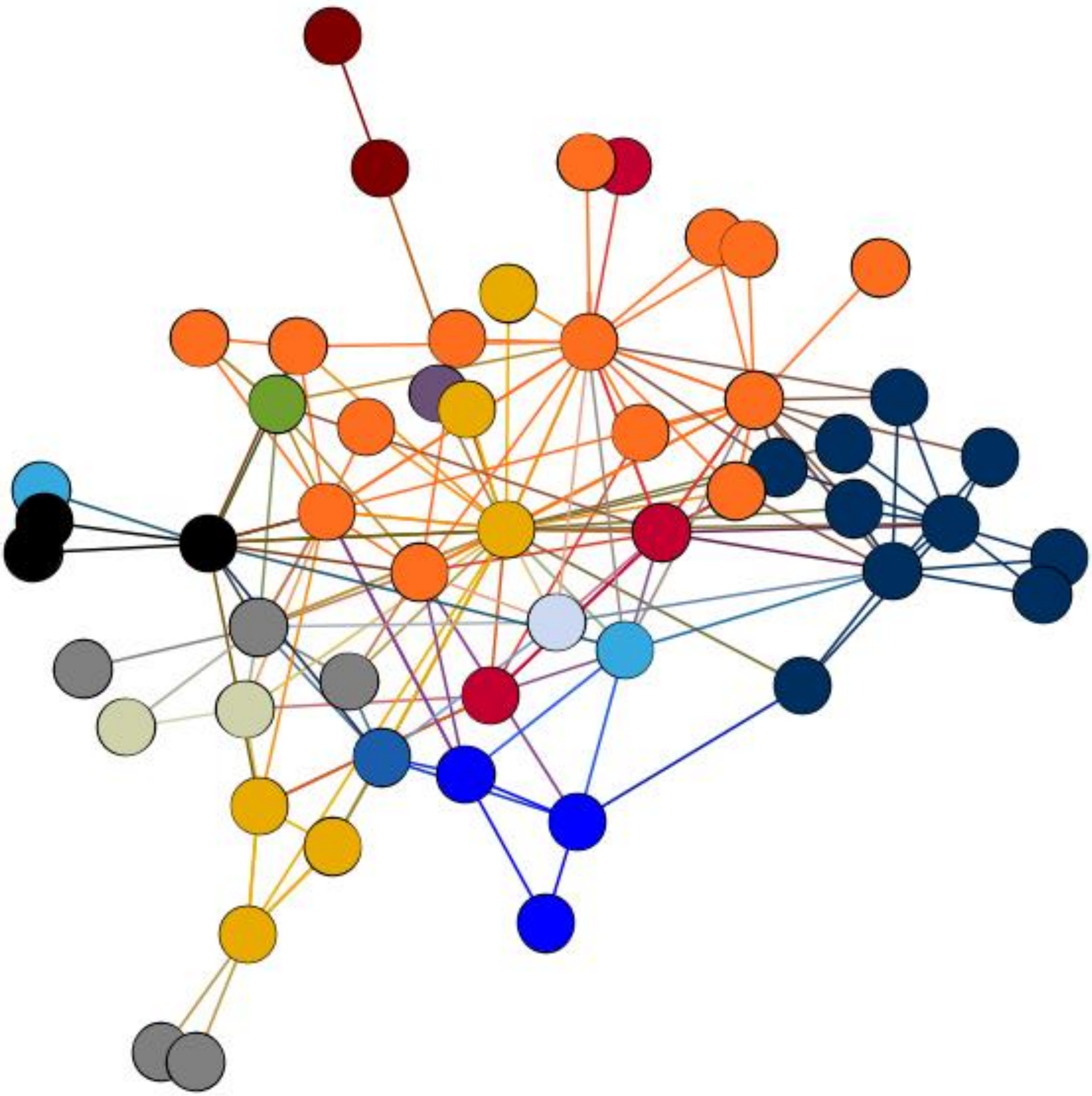

Figure 20. Year 1 GROWTH collaboration network

Collaborations assessed through products (publications)

Publications that have resulted from the project members and partner institutions were used as a proxy measure for collaborations, especially international collaborations, as these publications can be used to show both the frequency of collaboration and the extent that a publication involves international partners. The evaluator mapped the publications that project members have authored with each other to assess international collaborations.

Note: the following map and diagram only displays actual publications and does not take into developed and/or submitted manuscripts. There could be more publication collaboration occurring among project members than displayed in the map and diagram.

The partner institutions involved in publications have been mapped on their exact geolocation. Circles depict institutions, while lines depict the publication collaborations which have occurred between institutions. The circles and lines are further distinguished by color, with American institutions colored **blue**, European institutions colored yellow, and Asian institutions colored **red**. Collaboration lines between institutions of the same continent are colored the same as the circles. For example, publication collaboration between two American institutions have a blue line between two blue circles. Collaboration lines between institutions on different continents are colored as follows:

- **Green** lines signify collaborations between American and European institutions.
- **Purple** lines signify collaborations between Asian and American institutions.
- **Orange** lines signify collaborations between European and Asian institutions.

Key terms to understand the publications maps:

- Frequency is how many times an institution has collaborated with another institution on individual publications. The thicker lines signify more collaborations on publications and thinner lines signify fewer collaborations on publications.

The international publication map is featured on the next page.

Figure 21. GROWTH international publication network map

Since the United States is the location of six of the 14 partner institutions, a diagram of the United States partner institutions is displayed below. Each partner institution is labeled in the diagram. The width of the lines represents the frequency of collaboration between the partner institutions.

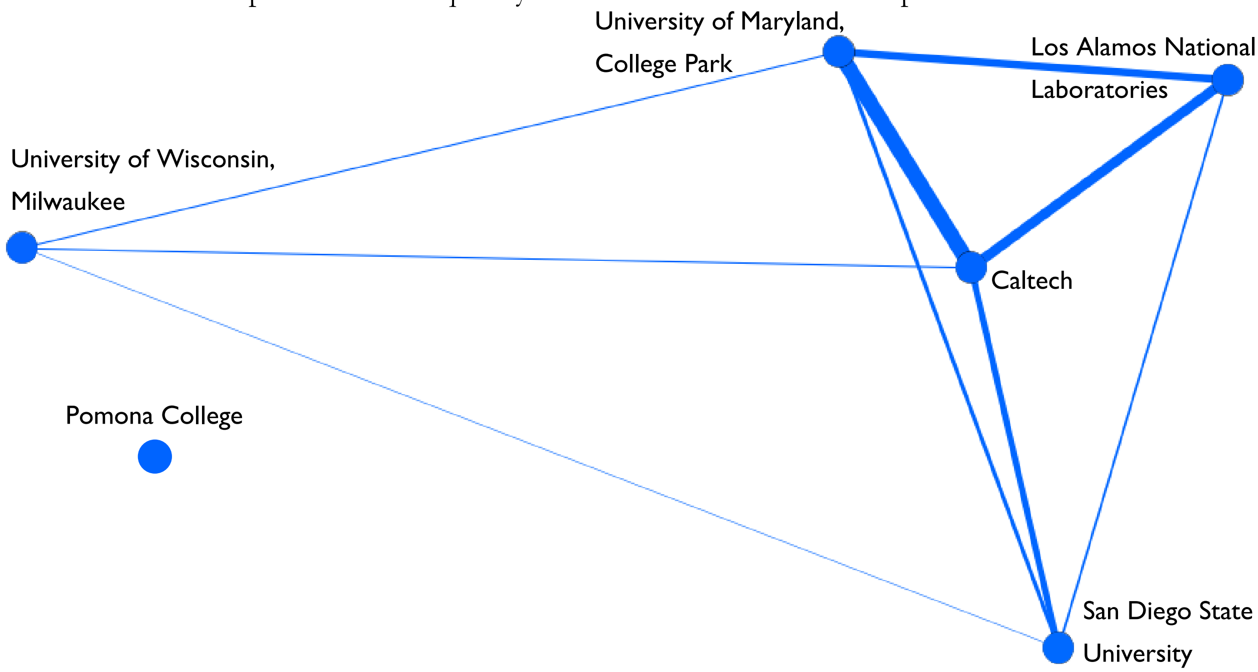

Figure 22. GROWTH U.S. publications network diagram

Key findings from the publication maps are as follows:

- The American institutions and European institutions collaborate frequently.
- As illustrated by the width of the lines the Asian institutions have made connections with other institutions, but they are not publishing together with those institutions as frequently as the American and European institutions.
- Indian Institute of Astrophysics and Pomona College were not present on any publications.
- Humboldt University and National Central University were the partner institutions with the lowest frequency of publications.
- There are pairs of institutions that do not have any collaborative publications, though it may not be a goal of the project to have all pairs of institutions publishing together.
- Caltech and Liverpool John Moores University were the partner institutions with the highest frequency of publications.
- Caltech and University of Maryland were the partner institutions that collaborated the most frequently on publications both within the U.S. and overall.
- Overall, the project is doing well in promoting both U.S. collaborations and international collaborations; however, more efforts should be made to include the Asian partners in these collaborations.

Evaluator recommendations

Goal 1: GROWTH research

- The project continues to publish in high impact journals, which ensures member research is widely distributed. GROWTH members should continue to publish in journals with international reach or in regional journals, such as the *Publications of the Astronomical Society of Japan,* to continue to expand the reach and exposure of project science and researchers.
  - The project has published 42 articles during the project, with 25 published in Year 2.
  - GROWTH researchers are publishing in journals that are more influential than the average scientific journal as measured by the Normalized Eigenfactor.
  - GROWTH researchers have published articles in 10 journals, one of which is in *Science*, currently the 4th most influential scientific journal.
  - Six of the journals published more than one article by a project member, with *the Astrophysical Journal* publishing 20 articles by project members.
  - Project members have produced publications that have been cited zero to 98 times, which is an average of nine citations per GROWTH article. This is above the average number of citations for articles published in the fields of astrophysics and astronomy over the past two years (average number of citations from 2015-17 =1.6) (Web of Science, 2017).[4]

- To help young scientists to grow as professionals, project members should encourage postdocs and graduate students to develop a plan for writing a journal article, using data collected during their internship, before departing their host institution.
  - About two-thirds of the articles published by GROWTH members featured postdocs as authors and just over half of them have graduate students listed as authors.
  - 24 (67%) of postdocs and graduate students in the GROWTH project were listed as authors on project publications.
  - Of the 12 postdocs and graduate students who were not listed as authors on publications, three (25%) have completed an internship, indicating they may need more mentorship to ensure they are publishing. It should be noted that perhaps these postdocs and graduate students have developed and/or submitted manuscripts; however, only information on published articles is available.

Goal 2: Education and workforce development

- Courses offered to GROWTH students continue to successfully increase undergraduate and graduate students' knowledge and skills through hands-on research experience. The courses are also successfully preparing students for future research and careers in astronomy/astrophysics.

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[4] Information found at:
https://apps.webofknowledge.com/CitationReport.do?action=home&product=WOS&search_mode=CitationReport&cr_pqid=10&qid=10&SID=1BPqhTChDg5w2oNuH3C

Course instructors and the GROWTH education lead should ensure that students are provided a pathway to participating in the project and in research, if they want to. This will continue to create a pipeline from education to research for young scientists involved in the project.

- The respondents agreed or strongly agreed that their knowledge, skills, and interest in the fields of astronomy/astrophysics increased after taking the course.
- All respondents reported that the seminar (AY3) increased their interest in pursuing further studies and participating in research projects on astronomy or astrophysics, indicating that students may benefit from a more formal pathway to participate in the GROWTH project after participating in a course.
- Literature states that undergraduate research participation is linked to several positive educational outcomes, including increased STEM retention, rates of STEM graduate school matriculation, baccalaureate cumulative grade point average, and receipt of national awards (Gilmore, Vieyra, Timmerman, Feldon, & Maher, 2015).[5]

➢ The postdoc and graduate student internship program has been successful in meeting both the program objectives (advance research skills in astronomy/astrophysics and develop intercultural competences and the ability to successfully work in diverse international teams) and the goals of the larger project. Project leads may want to consider a weekly or mid-point check-in with the graduate students and postdocs during the internship to ensure their research is on track. This can help improve mentorship and help interns formulate publication ideas before they leave the host institution

- Internship evaluation respondents reported increased confidence in their research skills.
- All respondents reported positive attitudes towards their capacity to form collaborations. Respondents also reported growth in their collaboration skills.
- Not all respondents felt they received good supervision and feedback from their host mentors.

➢ In order to foster international collaborations after the internship is complete, project leads should consider creating a platform for these young scientists to meet and receive continued mentorship. One option is a regularly scheduled telecon, which can provide a space to discuss research and receive feedback. This can also create an environment where new publication opportunities are discussed.

- Two respondents felt their internship was too short, indicating collaboration post-internship might be beneficial and could possibly compensate for the short experience.
- Respondents had lower ratings for items related to enhanced exposure to international research and collaborations.

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[5] Gilmore, J., Vieyra, M., Timmerman, B., Feldon, D., & Maher, M. (2015). The relationship between undergraduate research participation and subsequent research performance of early career STEM graduate students. *The Journal of Higher Education, 86*(6), 834-863.

- Respondents reported that the internships impacted their research and career readiness, especially their ability to strengthen and create collaborations, as well as their understanding of collaboration.
- Five (63%) of the postdocs and graduate students that have completed an internship have been listed as authors on project publications, indicating more opportunities to mentor young scientists and include them on publications.
- Research by Thompson, Conaway, and Dolan (2015)[6] shows that within their immediate research groups, students can build multidimensional social ties with faculty, peers, and others, yielding social capital that can be drawn upon for information, resources, and support.

Goal 3: Collaboration capacity (partnerships)

➢ The project should conduct a network visioning exercise to establish what level of collaboration should be occurring by members in the project. Additionally, project leadership should encourage all participants to completed the social network survey, so that a holistic understanding of project collaboration can be established.

- From the individual level, respondents reported collaborating more within their own institutions, with little connections to individuals from differing institutions in the network.
- Project members affiliated with Caltech tend to be the most integrated in the collaboration network and interacting with members from other partner institutions.
- The network survey was only completed by 24 project members and therefore provides an incomplete picture of the network. Full participation should be encouraged on the second survey to identify missing collaborations.

➢ Project leadership should discuss the desired levels of publication collaboration among members. Discussion should focus on how often members should be submitting manuscripts for publication and how often these collaborative publications should be international.

- American institutions collaborate frequently with each other and with European institutions. However, Asian institutions collaborate the least frequently with all partner institutions. Project leadership should discuss whether this is currently the desired amount of participation from these partners or if they would like to see more collaboration from Asian institutions.
- The Indian Institute of Astrophysics and Pomona College were not present on any publications. Project leads should examine any barriers to publication collaboration and then determine if and how these institutions can be brought in on new papers.
- Humboldt University and National Central University were the partner institutions with the lowest frequency of publications. Project leadership should think about whether this is the

[6] Thompson, J.J, Conaway, E., & Dolan, E. L. (2015). Undergraduate students' development of social, cultural, and human capital in a networked research experience. *Cultural Studies of Science Education, 11,* 959-990.

right level of participation by these institutions, or if they would like to see more co-authorship. Again, it should be noted that only information on published articles is available and this may not be an accurate reflection of publication collaboration. Additional manuscripts may have been developed and/or submitted, and are not yet published.

Appendix A. Project Published Articles and Corresponding Numbers

Article number	Article title
1	Detection of Broad Hα Emission Lines in the Late-time Spectra of a Hydrogen-poor Superluminous Supernova
2	Long-rising Type II supernovae from PTF and CCCP
3	Flash Spectroscopy: Emission Lines from the Ionized Circumstellar Material around <10-day-old Type II Supernovae
4	Optical and Near-infrared Observations of SN 2013dx Associated with GRB 130702A
5	Type II Supernova Energetics and Comparison of Light Curves to Shock-cooling Models
6	Galaxy Strategy for LIGO-Virgo Gravitational Wave Counterpart Searches
7	The bolometric light curves and physical parameters of stripped-envelope supernovae
8	Absence of Fast-moving Iron in an Intermediate Type Ia Supernova between Normal and Super-Chandrasekhar
9	PTF13efv—An Outburst 500 Days Prior to the SNHunt 275 Explosion and Its Radiative Efficiency
10	iPTF Search for an Optical Counterpart to Gravitational-wave Transient GW150914
11	Localization and Broadband Follow-up of the Gravitational-wave Transient GW150914
12	The peculiar Type Ia supernova iPTF14atg: Chandrasekhar-mass explosion or violent merger?
13	Time-varying sodium absorption in the Type Ia supernova 2013gh
14	iPTF15dtg: a double-peaked Type Ic supernova from a massive progenitor
15	Going the Distance: Mapping Host Galaxies of LIGO and Virgo Sources in Three Dimensions Using Local Cosmography and Targeted Follow-up
16	Radio Follow-up of Gravitational-wave Triggers during Advanced LIGO O1
17	Radio Observations of a Sample of Broad-line Type IC Supernovae Discovered by PTF/IPTF: A Search for Relativistic Explosions
18	A novel method for transient detection in high-cadence optical surveys: Its application for a systematic search for novae in M31
19	Intermediate Palomar Transient Factory: Realtime Image Subtraction Pipeline
20	Far-Ultraviolet to Near-Infrared Spectroscopy of A Nearby Hydrogen Poor Superluminous Supernova Gaia16apd
21	PS1-14bj: A Hydrogen-poor Superluminous Supernova With a Long Rise and Slow Decay
22	SN2002es-like Supernovae from Different Viewing Angles
23	Common Envelope Ejection for a Luminous Red Nova in M101
24	PTF1 J082340.04+081936.5: Hot Subdwarf B Star with a Low-mass White Dwarf Companion in an 87-minute Orbit
25	Two New Calcium-rich Gap Transients in Group and Cluster Environments
26	A Search of Reactivated Comets
27	iPTF16geu: A multiply imaged, gravitationally lensed type Ia supernova
28	Hydrogen-poor Superluminous Supernovae With Late-time H-alpha Emission: Three Events From the Intermediate Palomar Transient Factory
29	An Enhanced Method for Scheduling Observations of Large Sky Error Regions for Finding Optical Counterparts to Transits

30	Small Near-Earth Astroids in the Palomar Transient Factory Survey: A Real-Time Streak-detection System
31	Characterization of 9380 contact binaries from the CRTS Variable Sources Catalogue
32	The bumpy light curve of supernova iPTF13z
33	Color Me Intrigued: the Discovery of iPTF 16fnm, a Supernova 2002cx-like Object
34	iPTF16fnl: a faint and fast tidal disruption event in an E+A galaxy
35	iPTF16axa: A Tidal Disruption Event at z=0.108
36	Geographic and Annual Influences on Optical Follow-up of Gravitational Wave Events
37	A measurement of interstellar polarization and an estimation of Galactic extinction for the direction of the X-ray black hole binary V404 Cygni
38	Type Ibn Supernovae Show Photometric Homogeneity and Spectral Diversity at Maximum Light
39	iPTF Discovery of the Rapid "Turn-on" of a Luminous Quasar
40	Confined Dense Circumstellar Material Surrounding a Regular Type II Supernova: The Unique Flash-Spectroscopy Event of SN 2013fs
41	On the Early-time Excess Emission in Hydrogen-poor Superluminous Supernovae
42	Systematic Study of Gamma-ray-bright Blazars with Optical Polarization and Gamma-Ray Variability

Appendix B: GROWTH Publication Citations and Authors

Article #[a]	Project year published	# times cited	# GROWTH participant authors	# of GROWTH postdoc authors	# of GROWTH graduate student authors
1	Year 1	36	7	0	0
2	Year 1	10	4	1	1
3	Year 1	16	6	0	1
4	Year 1	10	6	2	1
5	Year 1	19	7	0	0
6	Year 1	20	2	1	0
7	Year 1	13	3	0	0
8	Year 1	1	5	1	0
9	Year 1	10	14	6	2
10	Year 1	20	5	0	1
11	Year 1	98	17	5	1
12	Year 1	5	4	1	1
13	Year 1	1	6	1	2
14	Year 1	11	5	1	2
15	Year 1	17	3	1	0
16	Year 2	5	4	1	0
17	Year 2	4	12	2	3
18	Year 2	0	3	0	1
19	Year 2	8	1	0	0
20	Year 2	8	1	1	0
21	Year 2	17	1	0	1
22	Year 2	5	1	1	0
23	Year 2	12	4	1	1
24	Year 2	1	5	0	1
25	Year 2	1	8	1	1
26	Year 2	0	3	1	0
27	Year 2	0	1	1	0
28	Year 2	0	3	1	0
29	Year 2	5	6	1	1
30	Year 2	2	5	1	1
31	Year 2	0	6	0	2
32	Year 2	1	2	1	0
33	Year 2	0	6	1	2
34	Year 2	4	1	0	0
35	Year 2	2	6	2	1
36	Year 2	0	8	2	2
37	Year 2	1	2	0	0

Article #[a]	Project year published	# times cited	# GROWTH participant authors	# of GROWTH postdoc authors	# of GROWTH graduate student authors
38	Year 2	3	5	1	2
39	Year 2	2	2	0	1
40	Year 2	6	8	2	0
41	Year 2	8	2	1	0
42	Year 2	0	6	2	0
Cumulative article total[a]		382	206	44	32
Average for all articles		9.1	4.9	1.1	0.8

a. Totals are cumulative and count each time a project member is listed as an author, therefore individual project members are counted multiple times in the total amount.

Appendix C: Presentations given by location

Location of presentation	# of presentations	Home of a partner institution
Czech Republic	2	No
Germany	3	Yes
India	9	Yes
Italy	1	No
Japan	3	Yes
Singapore	3	No
Sweden	2	Yes
Switzerland	1	No
Taiwan	2	Yes
Thailand	1	No
United States	26	Yes
Alabama	1	No
Arizona	1	No
California	7	Yes
Hawaii	1	No
Maryland	2	Yes
New Jersey	1	No
Oregon	1	No
Texas	9	No
US Virgin Islands	1	No
Washington	1	No
Washington, D.C.	1	No
Wisconsin	2	Yes
Uruguay	1	No