# Budget Justification

**Elements: Improving tools based on data-description standards for gigabyte-scale data sets**
PI: Amy Roberts

## A. Senior Personnel

**A1. Principal Investigator (Amy Roberts):** Assistant Professor Amy Roberts at CU Denver will serve as the Principle Investigator (PI) on this project. She will commit half a summer month per year and and an additional 10% time in year 3, requested as a course release. Costs for years 2 and 3 include 3% annual cost-of-living increases. Her responsibilities will include facilitating community adoption of the tools, working with the community to determine the focus of the software development, and guiding and mentoring the staff and students. In addition, she will supervise one master's student from the Integrated Sciences program.

The PI is requesting support in excess of two months from the NSF in years 1 and 2 of this proposal. As detailed in the table below, if both the SuperCDMS Operations proposal and this current proposal are fully-funded, the PI would receive 2.4 months of salary support from the NSF from 7/15/2019 to 7/14/2021.

This support level is justified because (1) CU Denver's standard teaching load is four courses per academic year and (2) CU Denver Physics has neither a Master's nor a Ph.D. program in Physics. Although the PI does have access to Master's students from the Integrated Sciences program, these students specialize in many different fields and cannot always rely on their cohort for technical support. Thus, additional oversight of the group ($\sim$1 scientific programmer, $\sim$1 master's student, $\sim$4 undergraduates) is required during the academic year.

| | 8/15/2018 - 7/15/2019 | 7/15/2019 - 7/14/2020 | 7/15/2020 - 7/14/2021 | 7/15/2021 - 10/30/2022 |
|---|---|---|---|---|
| **SuperCDMS Collaborative Proposal (NSF 1809769)** | | | | |
| Summer Salary | 0.5 | 0.5 | 0.5 | – |
| Course Buyout | – | – | – | – |
| **SuperCDMS Collaborative Proposal, Operations (Pending, NSF 1809769)** | | | | |
| Summer Salary | 0.5 | 0.5 | 0.5 | – |
| Course Buyout | 0.9 | 0.9 | 0.9 | – |
| **Current Proposal (Pending, NSF 19-548)** | | | | |
| Summer Salary | – | 0.5 | 0.5 | 0.5 |
| Course Buyout | – | – | – | 0.9 |
| Total (months) | 1.9 | 2.4 | 2.4 | 1.4 |

Table 1. Reqeusted salary support from all received and pending NSF grant applications, in months. Note that "year 1" in this text refers to the suggested start date of this proposal, 11/1/2019.

# B. Other Personnel

**B1. Scientific Programmer (Nikki Ramirez):** The PI requests support for a scientific programmer, Ms. Ramirez, at 9.6 calendar months in each of the three years of this work with an annual salary of $43,000. Costs for years 2 and 3 include 3% annual cost-of-living increases. This salary is commensurate with starting salaries for computer science majors in the Denver area.

Ms. Ramirez has recently joined the PI's group as a Student Assistant Level IV and will be graduating with a B.S. in Computer Science and a minor in Creative Writing in May of 2019. Her programming expertise, together with her extensive experience writing and editing a wide variety of writing, are particularly valuable to the work proposed because community adoption will require readable documentation.

The scientific programmer will work in collaboration with the PI and develop software, software documentation, and work closely with scientists and students in the group to identify issues and solutions for analysis of large data sets with the software. In addition, the scientific programmer will help coordinate the yearly workshop proposed as a part of this work.

**B2. Post Doctoral Scholars:** No funds for postdoctoral researchers are requested.

**B3. Graduate Student (TBH):** One Master's student from the Integrated Sciences program or Computer Science program will be employed to assist with development of the software, testing of documentation, and development of example analyses relevant to the nuclear physics community. This student may also provide computational mentorship to other students in the group.

Wages are based on $18/hour in year 1 with projected 3% annual cost-of-living increases thereafter. Although this rate is low compared to the typical internship rates available to computer science master's students, the PI has had success recruiting excellent students at this wage because the work experience in the PI's lab offers significantly more variety, autonomy, and responsibility than typical corporate internships. The student will work half-time during the academic year and full-time during the summer.

**B4. Undergraduate Students (SA-IV, $18.00/hr):** The PI requests funding for an undergraduate researcher at $18.00/hr working part-time during the semester and full-time during the summer.

The PI is currently employing one undergraduate, Joshua Elsarboukh, at this level. He is the primary contributor to efforts within SuperCDMS to make our previously-difficult analysis environment available to collaboration members through a one-click web interface. In Year 1 of the proposal he will be the main contributor to testing the standards-based tools on standard Super-CDMS analyses. Josh is expected to graduate in Year 2 of this work and we are already training the students who will eventually take his place. The primary responsibilities of the new hire in year 3 may shift according to the interests and goals of the student.

CU Denver provides guidelines for salary ranges for student work and state that students who are performing independent research work should be classified as Student Assistants Level IV. Funding students at a competitive wage is particularly critical at CU Denver, where most students work part- or full-time. In addition, this funding request is for students who have considerable

computational skill and can work independently. Such students are often senior and often cannot spend time on research without fair compensation, particularly if they have exhausted the limit on federal financial aid. The PI requests funds at this level to ensure that this research opportunity has access to all qualified students.

**B5. Undergraduate Students (SA-III, $12.50/hr):**   The PI requests academic year and summer support for two undergraduate students at $12.50/hr that totals ?? (?? annually).

These students will be employed as research assistants to assist other members of the group with testing of documentation and creation of new documentation where needed. Depending on their interests and skills, students may be assigned to be the shepherd for a particular analysis and/or to help organize the proposed workshops. The PI expects students to work 10 hours/week during the semester and 30 hours/week during the summer months.

## C. Fringe Benefits

Fringe benefits are charged as direct costs on all salaries and wages. The rate is 27% for faculty, 28% for professional research staff (with 12-month appointments), 19% for postdocs, 1% for enrolled students (AY) and 2% for un-enrolled students (summer).

## D. Equipment

The following equipment (nonexpendable tangible personal property having a useful life of more than one year, and an acquisition cost of $5,000 or more per unit) is requested in support of this project:

**D1. Dell PowerEdge Server:**   A PowerEdge server costing $12,204 (see attached quote) is requested to increase capacity at the Stanford Linear Accelerator (SLAC) web-accessible analysis environment. This server is identical to servers already in the SLAC pool and will require minimal personnel overhead to install.

This server will support the web-accessible analysis environment, which significantly improves the PI's group's ability to develop, deploy, and test analysis software across the SuperCDMS collaboration. Interest and use has been growing rapidly and an additional server will ensure that this environment remains stable and available for increased demand.

## E. Travel

**E1. Domestic:**   The PI requests a travel budget of $9,660 ($3,220/year) is requested for the PI and either a student or the scientific programmer to attend one (1) annual 3-day conference in years 1-3 to disseminate project results and engage with the community served by the software. The PI requests travel funds for herself and a student because (1) networking with other PIs and industry representatives is critical to the overall development of this community project and (2) students attending conferences gives them a deeper understanding of community needs and their place in the community and builds the community's trust in them.

Prospective conferences include the yearly Low Energy Community Meeting (LECM) as well as the International Conference on Computing in High Energy and Nuclear Physics (CHEP) and the Scientific Computing with Python conference (SciPy). , The LECM rotates between nuclear labs in the midwest while CHEP and SciPy are typically held in major US cities. The amount includes airfare, meals/lodging, ground transportation, and registration fees. Estimated breakdown of costs are as follows:

| Trips | Days | | PI(s) | Student(s) | |
|---|---|---|---|---|---|
| 1 | 3 | | 1 | 1 | |
| Airfare | Meals | Hotel | Transit | Conf. Reg. PI | Conf. Reg. Student |
| $500 | $70 | $150 | $200 | $300 | $200 |

Table 2. Itemized domestic travel costs.

**E2. Foreign:** No funds for foreign travel are requested. While there are some relevant international conferences, the PI believes that focusing efforts on the domestic science community provides an compelling and cost-effective scope for this proposal. International scientists interested in collaborating can be supported through teleconferencing.

# F. Participant Support Costs (20 Participants)

Participant support costs are not subject to MTDC. Because fostering and strengthening community adoption and feedback is critical to the success of the proposed work, the PI plans to recruit up to 20 early-career scientists, late-career scientists, and industry representatives to participate in a yearly 4-day workshop focused on teaching scientists about the tools and using community feedback for rapid development of needed features. To make the workshop accessible and economical, remote participation will be fully supported; as many as 10 participants are expected to be remote.

**F0. Scholarships:** The PI requests $7,000 for scholarships to support early-career researchers and provide additional funding for care-giving scientists who wish to attend but need to travel with their dependent. These funds may also be used to offset costs for invited scientists. Scholarship applicants must write a brief description of their use of the funds.

**F1. Stipends:** No funds explicitly allocated to stipends are requested.

**F2. Travel:** No funds explicitly allocated to travel are requested.

**F3. Subsistence:** The PI requests $2,000 for lunches. Additional food will be paid for through registration fees.

**F4. Other:** The PI requests $1,000 for the rental of audio-visual equipment and university production services.

## G. Other Direct Costs (Included in MTDC):

**G1. Materials and Supplies:**  We request $2,000 in year 1 to purchase an additional workstation for software development and testing. We request $4,000 in years 2 and 3 to either purchase additional workstations or to replace aging laptops. Laptops are included in this budget request because all the students in the lab commute to campus and a durable, reliable laptop significantly increases the time students are able to spend doing research.

**G2. Publication Costs/Documentation/Dissemination**  No funds are requested for dissemination of research. Hosting the software and community forum through github, gitlab, and discourse is free for academic and open-source use and provide functionality that has allowed many other open source projects to thrive; the PI expects these resources to be adequate for this project as well. Free, long-term archiving of the software and documentation is available through Zenodo and free hosting of paper preprints is available through arXiv and figshare.

**G3. Consultant Services:**  No funds for consultant services are requested.

**G4. Computer Services:**  No funds are requested for computer services. While computers in the PI's lab are managed by CU Denver Information Technology, that cost is built into the overhead.

**G5. Subawards:**  The proposed work has no subawards.

**G6. Other:**  The PI requests three licenses for a professional vector-graphics program (Adobe Illustrator), an annual cost of approximately $600. This software is supported on a wide array of devices and is used by students to create documentation that is easy to share and edit.

## G. Other Direct Costs (not included in MTDC)

**G1. Graduate tuition:**  The PI requests a total of $41,407 to pay for the tuition and student fees for a master's student in the Integrated Sciences program for three years. This amount includes the cost of student health care. This support is in addition to the student assistantship described in Section B3.

The PI requests both tuition and student-assistantship support for a master's student to ensure that this research opportunity remains accessible to all qualified students. CU Denver has the privilege of serving many non-traditional students, first-generation students, and students who are otherwise under-represented in STEM. Financial support is often essential for these students to fully participate in the scientific community.

## H. Indirect costs

Using DHHS negotiated rates, indirect costs are calculated based on a rate of 55.5%, applied to a base of Modified Total Direct Costs.