Budget Justification—*Using Generalized Adversarial Networks to ensure trusted science results and maximize science reach within the dark matter community*

Budget Years:

Year 1: 9/1/2023 – 8/30/2024

Year 2: 9/1/2024 – 8/30/2025

Year 3: 9/1/2025 – 8/30/2026

A. Senior Personnel

The University of Colorado Denver defines a fiscal year as 07/01 – 06/30.

A1. Principal Investigator: Amy Roberts

Assistant Professor Amy L. Roberts is the PI on this project. She has been a member of the CDMS collaboration since 2014 and is the technical coordinator for data quality for operations. Her group is responsible for (1) supporting GAN training and development by providing physics and experimental data expertise, (2) identifying and implementing domain-specific tests of generated data, and (3) testing the use of generated data as a tool for measuring bias in analysis.

Roberts is requesting 0.25 summer months of support for each year of this proposal and 0.09 academic months for each year of this proposal. Costs for Year 2 and Year 3 includes a 3% annual COL increase. Fringe benefits are charged as direct costs on all salaries and wages. The rate is 29.23% for faculty.

A2. Co-Principal Investigator: Farnoush Banaei-Kashani

Associate professor Farnoush Banaei-Kashani is Co-PI on this project. He specializes in applying big-data methods to solve domain-specific problems and has collaborated with PI Roberts for the last three years. His group is responsible for (1) identifying and implementing appropriate methods for generating data that respect physics constraints, (2) documenting successful methods for re-use, and (3) supporting efforts to evaluate the use of generated data in dark-matter data analysis.

Banaei-Kashani is requesting 0.25 summer months of support for each year of this proposal. Costs for Year 2 and Year 3 includes a 3% annual COL increase. Fringe benefits are charged as direct costs on all salaries and wages. The rate is 29.23% for faculty.

B. Other Personnel

B1. Master of Integrated Science (MIS) student (Roberts): To Be Named

PI Roberts requests support for a Master's level student in years 1 and 2 of the award with an undergraduate degree in physics or a related STEM field. We plan for an hourly wage of $18.00/hr with the student working an average of 16.25 hrs/wk and 40 wks/yr. Lower wages prohibit economically disadvantaged students from participating; this both restricts the talent available for this project and further deepens inequity in the field. A wage of $18.00/hr is within the university pay rate guides and has successfully retained diverse, talented students.

We also include tuition in all years for the Master's level student consistent with the university rates and fees. This tuition is included to ensure the recruitment of qualified students. In order to support our multi-disciplinary integrated sciences curriculum we have assumed the student will take half their credits in the engineering school ($642/credit) and half through the College of Liberal Arts and Sciences ($388/credit).

Hourly wages beyond Year 1 include a 3% annual COL increases. The tuition cost in Year 2 accounts for

the 5% increase in tuition and 3% increase in student fees anticipated for CU Denver.

The MIS graduate student will develop expertise on SuperCDMS data and two analyses that are particularly sensitive to changes in the noise environment and detector behavior: the low-mass search and the annual modulation search. They will lead the effort to understand the impact of change-detection algorithms on the final data analysis.

This Master's student will support Co-PI Banaei-Kashani's group in the development of the automated data generation by providing data expertise, domain-specific data evaluation, and verifying analysis results with the generated data.

B2. Master of Computer Science student (Banaei-Kashani): To Be Named

We request support for a Computer Science Master's student in all years of the award. We plan for an hourly wage of $24.00/hr with the student working an average of 12.5 hrs/wk and 40 wks/yr. A wage of $24.00/hr is the baseline wage in the Computer Science department for Master's students and has successfully retained diverse, talented students.

We also include tuition and fees in all years for the Master's level student consistent with the university rates and fees for a student in the College of Engineering. This tuition is included to ensure the recruitment of qualified students.

Hourly wages beyond Year 1 include a 3% annual COL increases. The tuition cost in Year 2 accounts for the 5% increase in tuition and 3% increase in student fees anticipated for CU Denver.

Banaei-Kashani's student will (1) improve the data-generating code based on results from domain-specific tests, (2) implement physics constraints, and (3) provide support for re-use of the code during analysis efforts.

1 C. Equipment:

None.

2 D. Travel:

D1. Domestic: Funds are requested for PI Roberts or her student to attend a domestic conference in Year 2, estimated to cost $2000. The target conference is the DANCE-ML conference, which brings together dark matter and neutrino experiments to explore the role of machine learning in next-generation science efforts.

Table 1: Breakdown of domestic conference attendance.

Trip Component	Cost Per Person	Persons	Totals
Travel	$400	1	$400
Accommodation	$800	1	$800
Per Diem	$300	1	$300
Registration	$500	1	$500
Total	$2000	-	$2000

E. Participant/Trainee Support Costs:

None.

F. Other Direct Costs:

None.

G. Direct Costs:

Summing sections A through F, we arrive at a total direct cost for this proposal as $192,529, with $61,165 in Year 1, $65,479 in Year 2, and $65,886 in Year 3.

H. Other 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.

This rate is applied, on this grant, to: Faculty salary and student hourly wage after fringe rate added (totalling $99,927), and travel (totalling $2,00).

The total indirect costs for this proposal are $56,569, with $17,943 in Year 1, $19,591 in Year 2, and $19,035 in Year 3.

I. Total and Indirect costs:

Summing sections A through F, we arrive at a total cost for this proposal as $249,098, with $79,107 in Year 1, $85,070 in Year 2, and $84,921 in Year 3.