Table 1
2018-2019 QuarkNet National Workshops

QuarkNet Center	Workshop Type (e.g., Cosmic, Data, CMS e-Lab)	Workshop Dates (Chronological Order)	Staff/Fellow Leading Workshop
Kansas State University	LIGO	June 4-5	Shane Wood
Kansas State University	Cosmic	June 6-8	Martin Shaffer
University of Minnesota	Neutrino Prototype	June 13-14	Shane Wood/Ken Cecire
Texas Tech University	Cosmic	June 13-14	Martin Shaffer
Rice University/ University of Houston	CMS Data	June 25-26	Shane Wood
Rice University/ University of Houston	Neutrino Prototype	June 27-28	Shane Wood
University of Iowa/Iowa State University	CMS e-Lab	July 9-10	Marla Glover
Black Hills State University	Neutrino Prototype	July 18-19	Shane Wood
Fermilab/University of Chicago	LIGO	July 18-19	Shane Wood
Johns Hopkins University	LIGO	July 25-26	Marla Glover
Virginia Center	Neutrino Prototype	August 6-7	Shane Wood
Colorado State University	LIGO	August 8-10	Ken Cecire
University of Washington	ATLAS Data	August 17-19	Shane Wood
University of Florida	Neutrino Prototype	August 25-26	Ken Cecire

[a]Hampton, George Mason and W&M Universities

2018- 2019 Program Year

A list of nationally-led QuarkNet Workshops (led by QuarkNet staff) during the 2018-2019 program year by QuarkNet staff is shown in Table 1. Data Camp was implemented at Fermilab from July 16-20, 2018. These are considered nationally-run workshops.

Table 2 lists the meetings and workshops held as Center-led QuarkNet workshops and those led by the *individual centers*. Together for both tables, this represents a total of 55 centers (50 centers in year 3+ of the program); 1 virtual center; and 4 sabbatical centers (based on emails from S. Wood, K. Cecire; M. Bardeen, June 21, 2019).

2019-2020 and 2020-2021 Program Years

Table 3 lists the meetings and workshops held during the 2019-2020 program year for both nationally- and center-led events. Similarly, Table 4 lists the workshops and meetings during the 2020-2021 program year (again for both nationally- and center-led events). Table 5 continues this listing of workshops and meetings during the 2021-2022 program year.

<div align="center">

Table 2
2018-2019 QuarkNet Center-led Meetings and Workshops

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Center	2018 Meeting Dates (All days)	Center	2018 Meeting Dates (All days)
Black Hills State University	July 10-14	University of California, Riverside	
Boston area	August 14-15	University of California, Santa Cruz	
Brookhaven National Laboratory	June 25-29	University of Cincinnati	Summer (no dates specified in annual report)
Catholic University of America	August 13-17, plus 3 days in fall	University of Florida	August 25-26
Colorado State University	August 8-10	University of Hawaii	June 2-3
Fermilab/University of Chicago	July 18-19	U of Illinois Chicago/Chicago State University	June 25-29
Florida Institute of Technology		University of Iowa/Iowa State	July 9-13
Florida International University		University of Kansas	June 11-13
Florida State University	August 1-2	University of Minnesota	June 12-14
Idaho State University	July 9-13	University of Mississippi	June 25-26
Johns Hopkins University	July 23-27	University of New Mexico	May 4 and one fall day
Kansas State University	June 4-8	University of Notre Dame	July 30 - Aug 3
Lawrence Berkeley National Laboratory/ Stony Brook University	June 18-22	University of Oregon	June 20-21
Northern Illinois University	June 25-29	University of Pennsylvania	
Oklahoma State University/University of Oklahoma	July 24-27	University of Puerto Rico-Mayaguez	Dec. 8-9; April 6, 2019
Purdue University		University of Rochester	
Purdue University Northwest	June 18-22	University of Tennessee, Knoxville	
Queensborough Community College		University of Washington	August 17-19
Rice University/University of Houston	June 25-29	University of Wisconsin-Madison	
Rutgers University	July 9-13	Vanderbilt University	June 25-29
Southern Methodist University	Aug 6-10	Virginia Center (Hampton, George Mason and William and Mary Universities)	Aug 6-8
Syracuse University	Aug 8-10	Virginia Tech University	July 23-26
Texas Tech University	June 13-15	Virtual Center	July 11-14
University at Buffalo	Aug 21-22	Wayne State University	

Table 3
2019 QuarkNet Workshops and Meetings: National- and Center-led

Center	2019 Dates (All days)	Workshop/Meeting	Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Black Hills State University	No activity		
Boston area	August 14-15	**Neutrino Workshop** (co-led by Center)	Mean Life Part 3: Minerva (2) Mean Life Part 2: Cosmic Muons (2) What Heisenberg Knew (1) MINERvA masterclass measurement
Brookhaven National Laboratory/ Stony Brook University	July 3	**MINVERvA Neutrino Masterclass**	MINERvA Neutrino measurement (2)
The Catholic University of America	August 5-7	CMS and Cosmics **(CMS Data Workshop)**	Shuffling the Particle Deck (0) Rolling with Rutherford (1) Calculate the Z Mass (1)
Colorado State University	July 29-31	**Neutrino Data Workshop**	Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 2: Cosmic Muons (2) Shuffling the Particle Deck (0) What Heisenberg Knew (1) The Case of the Hidden Neutrino (1) Histograms: Uncertainty (1) Mean Lifetime Part 3: MINERvA (2) Implementation Plans
Fermilab/University of Chicago	July 24-26	**Neutrino Data Workshop & Student Presentations**	Shuffling the Particle Deck (0) The Case of the Hidden Neutrino (1) Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 3: MINERvA (2) MINERvA Masterclass measurement (2) Histograms: The Basics (0) Histograms: Uncertainty (1) What Heisenberg Knew (1) Implementation Plans
Florida Institute of Technology	No activity		

Note. National-led QuarkNet workshops are in a bold-face font.
Information compiled from the workshop agenda posted on individual center pages on QuarkNet website.

Table 3
2019 QuarkNet Workshops and Meetings: National- and Center-led (con't.)

Center	2019 Dates (All days)	Workshop/Meeting	Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Florida International University	August 5-7	**CMS Workshop**	Shuffling the Particle Deck (0) Rolling with Rutherford (1) Calculate the Z Mass (1)
Florida State University	July 31- August 2	**CMS Workshop**	Shuffling the Particle Deck (0) Rolling with Rutherford (1) Calculate the Z Mass (1) Making it Round the Bend (Qualitative) (1) Making it Round the Bend (Quantitative) (2) CMS Masterclass Measurement (2)
Idaho State University Pocatello (co-conducted workshop with the University of Cinncinnati)	June 17-20	Cosmic Ray Muon Detectors (CRMD) **Neutrino Masterclass**	Assemble a complete CRMD Neutrino Masterclass
Johns Hopkins University	July 22-26	JHU Workshop	Create videos for use in the classroom Develop lesson plan/approach based on transcribed lecture recorded from a theoretical physicist
Kansas State University	March 2 April 5	Masterclass Orientation Masterclass	
	May 28-31	Cosmic Ray Workshop	Configure a cosmic ray detector Identify and describe cosmic ray e-Lab tools Create, organize and interpret a data plot Develop a plan to increase current use of data by students
Lawrence Berkeley National Laboratory	June 24-28	Physics in and through the Cosmology	The Case of the Hidden Neutrino (1) What Heisenberg Knew (1) Shuffling the Particle Deck (0) MINERvA Masterclass Measurement (2)
Northeastern University	No activity		
Northern Illinois University	June 24	Cosmic Ray Workshop	Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 2: Cosmic Muons (2)

Note. National-led QuarkNet workshops are in a bold-face font.
Information compiled from the workshop agenda posted on individual center pages on QuarkNet website.

Table 3
2019 QuarkNet Workshops and Meetings: National- and Center-led (con't.)

Center	2019 Dates (All days)	Workshop/Meeting	Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Purdue University	No activity		
Purdue University Northwest	June 13	CMS Masterclass Mini-Workshop	CMS Masterclass Measurement
Queensborough Community College		No workshop	CMS tracking detection and GPS data postings
Rice University/University of Houston	June 17-21	**CMS Data Workshop**	Shuffling the Particle Deck (0) Histograms: Uncertainty (1) TOTEM Data Express (2) Making it Round the Bend (Qualitative) (1) Making it Round the Bend (Quantitative) (2) Calculate the Z Mass (1) or Calculate the Top Quark Mass (1) CMS WWDD Measurement
Rutgers University	No date specified	Summer Research Program and 1-day Workshop	Focus on transferring summer-research material into their classrooms
Southern Methodist University	July 29-31	**Neutrino Data Workshop** (July 29-30) Center-led Workshop (July 31)	Shuffling the Particle Deck (0) The Case of the Hidden Neutrino (1) Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 3: MINERvA (2) Histograms: The Basics (0) Histograms: Uncertainty (1) What Heisenberg Knew (1) MINERvA Masterclass Measurement (2)
Syracuse University	August 15-16	**Workshop with STEP UP**	Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 3: MINERvA (2) New York Science Learning Standards 3D e-Lab (North County 3D Café)

Note. National-led QuarkNet workshops are in a bold-face font.
Information compiled from the workshop agenda posted on individual center pages on QuarkNet website.

Table 3
2019 QuarkNet Workshops and Meetings: National- and Center-led (con't.)

Center	2019 Dates (All days)	Workshop/Meeting	Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Texas Tech University	June 3-7	Summer Workshop (first 3 days) **CMS Workshop** (last 2 days)	Rolling with Rutherford (1) Shuffling the Particle Deck (1) or Quark Workbench 2D/3D (1) Calculate the Z Mass (1) CMS Masterclass Measurement (2) Exploration of Level 3 DAP (CMS e-lab)
University of Buffalo, SUNY	March 30	**CMS Masterclass**	
	August 19-20	CMS Workshop	Several new ideas for cosmic data analysis with e-Lab were presented.
University of California, Riverside	No activity		
University of California, Santa Cruz	No activity		
University of Cincinnati (Workshop co-conducted with Idaho State Pocatello)	March 8	**LCHb Masterclass**	
	June 19-20	**Neutrino Data Workshop** (2 days) 1-day Workshop	Shuffling the Particle Deck (Level 0) What Heisenberg Knew (Level 1) The Case of the Hidden Neutrino (Level 1) Mean LifeTime Part 3: MINERvA (Level 2) MINERvA Masterclass Measurement (Level 2) During 1-day Workshop (and LCHb Masterclass): Rolling with Rutherford (Level 1) Marking it 'Round the Bend QuarkBench Workbench 2D/3D (Level 0) Calculate the Z Mass (Level 1) Implementation Plans
University of Florida	No activity		
University of Hawaii	No activity		
University of Illinois at Chicago/ Chicago State University	July 8-12	**CMS Workshop**	Rolling with Rutherford (1) Two separate studies (the speed of muons and the rate of multiple muons in cosmic ray air showers)
University of Iowa/Iowa State University	No activity		

Note. National-led QuarkNet workshops are in a bold-face font.
Information compiled from the workshop agenda posted on individual center pages on QuarkNet website.

Table 3
2019 QuarkNet Workshops and Meetings: National- and Center-led (con't.)

Center	2019 Dates (All days)	Workshop/Meeting	Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
University of Kansas	June 12-14	Computing in the Physics Classroom	Construct lesson plan Each group constructs student computing exercises Try out student computing exercise on other groups Groups report out on classroom exercise
University of Minnesota	April 6	**Neutrino Masterclass**	MINERvA Analysis
	June 12-14	**Minnesota Workshop: Neutrinos, CMS & e-Labs**	Histograms: Uncertainty (1) What Heisenberg Knew (1)
University of Mississippi	No activity		
University of New Mexico	September 7	Tour	Technical and historical tour of scientific heritage sites of Los Alamos, NM.
University of Notre Dame	Summer Weekly Meetings Special Events	**Weekly Teacher Meetings** **Summer Research** **QuarkNet Week** **ATLAS Masterclass** (March 15)	Discussions about physics and teaching ATLAS Masterclass.
University of Oklahoma/Oklahoma State	July 17-19	Workshop ATLAS Masterclass	Discussed QuarkNet materials in the classroom Conducted a masterclass for teachers and demonstrated how they can use a masterclass with their students.
University of Oregon	June 20-21	**ATLAS Data Workshop**	Rolling with Rutherford (1) Quark Workbench (1) or Shuffling the Particle Deck (1) Calculate the Z Mass (1) Mass of US Pennies (0) Atlas Z-path Masterclass Measurement
University of Pennsylvania	No activity		
University of Puerto Rico	November 2-3	Cosmic Ray	
University of Rochester	No activity		

Note. National-led QuarkNet workshops are in a bold-face font.
Information compiled from the workshop agenda posted on individual center pages on QuarkNet website.

Table 3
2019 QuarkNet Workshops and Meetings: National- and Center-led (con't.)

Center	2019 Dates (All days)	Workshop/Meeting	Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
University of Tennessee, Knoxville	July 12-13	**MicroBooNE Masterclass Development Workshop**	Neutrino Masterclass Status μβ Masterclass
University of Washington	No activity		
University of Wisconsin Madison	No activity		
University of Wisconsin River Falls	No activity		
Vanderbilt University	June 24-28	CMS Workshop	Using CRMD and e-lab facilities. Set up a standard CRMD in telescope configuration.
Virginia Center (College of William and Mary, Hampton University, and George Mason University)	March 9 April 6 August 5-7	**CMS Masterclass Neutrino Masterclass Workshop: Theme Data Analysis CMS**	Histograms: Uncertainty (1) Making it Round the Bend (Qualitative) (1) Making it Round the Bend (Quantitative) (2) What Heisenberg Knew (1) Energy, Momentum, and Mass (1) TOTEM Data Express (2) CMS Masterclass Measurement (2) Signal & Noise Reflections and Brainstorming
Virginia Tech	August 5-7	Catching Gravitational Waves	LIGO e-Labs Create lesson plans for e-Labs incorporated into classrooms.
Virtual Center	August 12-13	CMS Analysis and Step UP	CMS Masterclass Measurement
Wayne State	No activity		
National Program held at Fermilab	July 15-19, 2019	**Data Camp**	Rolling with Rutherford (1) Shuffling the Particle Deck (0) QuarkNet Workbench 2D/3D (0) Mass of U.S. Pennies (0) Calculate the Top Quark Mass (1)

Note. National-led QuarkNet workshops are in a bold-face font.
Information compiled from the workshop agenda posted on individual center pages on QuarkNet website (February 15, 2020)

Table 4

2020 QuarkNet Workshops and Meetings: National- and Center-led (December 2019-September 2020)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Black Hills State University	No activity		
Boston area/Brown University	December 10 (2019)	Fall Meeting	STEP UP presentation Review of activities in the Data Activities Portfolio.
	February 25	Winter Meeting	New features of iSpy software were presented (planned to be used in a masterclass on March 28; which was cancelled because of COVID-19). Newtonian analysis applied to recent observations.
	May 5	**Wednesday Webinars** (QW2) (Zoom)	History of neutrino experiences and discoveries
	Summer	Neutrino Virtual Workshops (Six, 1.5 hour Zoom sessions)	First tried on June 22-24 (see Kansas State). Also participated in six on-line talks about the Standard Model of Particle Physics.
Brookhaven National Laboratory	No activity		
The Catholic University of America	No activity	Because of COVID-19, the center did not hold a workshop during the summer. When they reached out to teachers at the beginning of the summer; they found that most teachers were overwhelmed doing training at their schools to prepare for teaching on-line in the fall; thus no workshop.	
Colorado State University	August 5	**STEP UP Virtual Workshop** (1-day)	QuarkNet: Changing the Culture (0) QuarkNet STEP UP: Careers in Physics (1) QuarkNet STEP UP Women in Physics (2) Presentation on DUNE experiments. Implementation plans developed by teachers.
Fermilab/University of Chicago	July 28-30 (half-days)	**Muon Virtual Workshop**	Remote use of: Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 3: MINERvA (2) Mean Lifetime Part 2: Cosmic Muons (2) Also engaged in Big Analysis of Muons (BAMC) and STEP UP activities in the DAP. Implementation plans developed by teachers.

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table 4 (con't.)
2020 QuarkNet Workshops and Meetings: National- and Center-led (December 2019-September 2020)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Florida Institute of Technology	No activity		
Florida International University	No activity		
Florida State University/ (University of Florida)	July 22-24 (half days)	**Virtual Workshop** (last day of workshop shared with University of Florida)	Focus on distance learning adapting: Rolling with Rutherford (1) The Case of the Hidden Neutrino (1); and, other activities Share-A-Thon Machine learning and artificial intelligence. Implementation plans developed by teachers.
Idaho State University	No activity		
Johns Hopkins University	August 3-6	Summer Workshop	A series of talks, e.g., introduction to particle physics; machine learning in particle physics; dark matter; gravity waves; and sharing of best practices and favorite tools/tech. Simulation activity with a partnering teacher.
Kansas State University	February 29	Masterclass Orientation	In preparation for CRMD research project.
	June 22-24 (half days)	**Neutrino Virtual Workshop**	Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 3: MINERvA (2) The Case of the Hidden Neutrino (1) Histograms Uncertainty (1) What Heisenberg Knew (1) Share-A-Thon Implementation plans developed by teachers.

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table 4 (con't.)
2020 QuarkNet Workshops and Meetings: National- and Center-led (December 2019-September 2020)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Lawrence Berkeley National Laboratory	June 29 to July 24	Physics in and Through Cosmology (Virtual Workshop) 3 times a week for 3 hours	Rolling with Rutherford (1) Presentations by several LBNL scientists. Small group work included creating a 60-second History of the Universe; a Scientist Interview Project; and, analyzing data from ATLAS. Also a cosmic ray detector demonstration.
	July 13, 15, 16	**Big Analysis of Muons (ATLAS) BAMA**	
Northern Illinois University	No activity		
Oklahoma State University/University of Oklahoma	July 29-31 (half days)	**STEP UP Virtual Workshop**	QuarkNet: Changing the Culture (0) QuarkNet STEP UP: Careers in Physics (1) QuarkNet STEP UP Women in Physics (2) Share-A-Thon (distance learning successes) Implementation plans developed by teachers.
Purdue University	No activity		
Purdue University Northwest	No activity		
Queensborough Community	Summer	Virtual Workshop 2-week workshop with a 3-hour session each day	Activities included for example: learning about the design, assembly, and functionality of a cosmic ray data acquisition circuit, DAQ, being built by students and teachers in the QCC cosmic ray lab.
Rice University/University of Houston	No activity		
Rutgers University	Summer	Virtual Workshop	Introducing the basic concepts of quantum mechanics and quantum computing and developing methods for introducing this material into high school classrooms. Unable to hold masterclass or 2-week high school student program because of COVID.

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table 4 (con't.)
2020 QuarkNet Workshops and Meetings: National- and Center-led (December 2019-September 2020)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Southern Methodist University	July 13-15 (afternoons) July 16-17	**STEP UP Virtual Workshop**	QuarkNet: Changing the Culture (0) QuarkNet STEP UP: Careers in Physics (1) QuarkNet STEP UP Women in Physics (2) Teachers shared physics activities for the remote classroom, e.g., electricity role cards; electric circuits; virtual lab on measurement error and the Hydrogen Spectrum.
Syracuse University	August 20-21 (half days)	**CMS Data Virtual Workshop**	Activities for remote learning: Shuffling the Particle Deck (0) Rolling with Rutherford (10 Making Trends I: Cloud Chamber (0) Making Trends II: Bubble Chamber (1) Calculating the Z Mass (1) BAMC (Big Analysis of Muons in CMS) Implementations plans developed by teachers.
Texas Tech University	No activity		
SUNY University at Buffalo	No activity		
University of California at Riverside	No activity		
University of California Santa Cruz	No activity	No program this year because of COVID but the center is looking forward to launching new remote programs in 2020-2021.	
University of Cincinnati	August 3-5	Virtual Workshop Not able to participate in LHCb Masterclass because of COVID.	Remote learning and how to use Python-based Jupyter Notebooks to engage physics students in high school. Implementation plans developed by teachers.

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table 4 (con't.)
2020 QuarkNet Workshops and Meetings: National- and Center-led (December 2019-September 2020)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
University of Florida	July 22-24 (half days)	**CMS Data Analysis Virtual Workshop**	Making Tracks I (0) Rolling with Rutherford (1) Shuffling the Particle Deck (0) Calculating the Z Mass (1) Implementation plans developed by teachers.
University of Hawaii	~~March 14~~ ~~March 15~~	~~**CMS Masterclass**~~ ~~**Muons in the Classroom Workshop**~~	Both of these programs were cancelled because of COVID.
University of Illinois Chicago/ Chicago State University	July 13-15 (half days)	**Cosmic Ray Virtual Workshop**	Performed analyses and plotted data. Implementation plans developed by teachers.
University of Iowa/Iowa State University	No activity		
University of Kansas	July 7-8	Modeling Random Processes Virtual Workshop	Focus on computing physics in the classroom (e.g., particle decay and math behind exponential decays and half lives). Computational exercises including random numbers and exponential decays. Share-A-Thon on-line teaching.
University of Minnesota	~~April 4~~	~~**Neutrino Masterclass**~~ ~~**MINERvA Analysis**~~	Masterclass cancelled because of COVID.
	July 13-15 (half days)	**STEP UP Virtual Workshop**	QuarkNet: Changing the Culture (0) QuarkNet STEP UP: Careers in Physics (1) QuarkNet STEP UP Women in Physics (2) NOvA Detector Neutrino Oscillation Share-A-Thon (engaging students in distance or hybrid learning environments) Implementation plans developed by teachers.
University of New Mexico	No activity		

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table 4 (con't.)
2020 QuarkNet Workshops and Meetings: National- and Center-led (December 2019-September 2020)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
University of Notre Dame	July 6-10 (half days)	Course 1	Rolling with Rutherford (online) (1) Calculating the Z Mass (1) Basic physics and up to particle physics using data from the BAMC (Big Analysis of Muons CMS) Masterclass.
	July 13-17 (half days)	Course 2	Deep study of particle physics; programming and analyses using CMS data and Python
	August 3-5	QuarkNet Week	Learning to use Phyphox and Colab to collect, visualize and analyze phone sensor data. Review activities in Data Activities Portfolio. Implementation plans developed by teachers.
University of Pennsylvania	No activity		
University of Puerto Rico - Mayaguez	June 20		
University of Rochester	No activity		
University of Tennessee Knoxville	No activity		
University of Washington	September 10-11	CMS Virtual Masterclass	Conducted muon and electron data analysis; discussed with QuarkNet staff and lead teachers.
University of Wisconsin - Madison	No activity		
Vanderbilt University	June 22-24 (half days)	Virtual Workshop	Talks on CMS (gravitational wave detection) and relativistic heavy ion experiments. Using Cosmic Ray Muon detectors
	June 25-26 (half days)	**Neutrino Data Virtual Workshop**	understanding flow to signal. The Case of the Hidden Neutrino (1) What Heisenberg Knew (1) MINERvA masterclass measurement Implementation plans developed by teachers.

Note. National led QuarkNet workshops are in a bold face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table 4 (con't.)
2020 QuarkNet Workshops and Meetings: National- and Center-led (December 2019-September 2020)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	**Brief Summary of Activities and Data Activities Portfolio (Level)** [and/or classroom use/implementation plans]
Virginia Center (Hampton University, the William and Mary, and the George Mason University)	February 6	CMS J/Psi Masterclass	Teachers and students conducted data analysis and sharing of data through J/Psi masterclass.
	February 29	Spring Meeting	New features of the Data Activities Portfolio Teachers worked on implementation plans.
	August 3-5	Summer Virtual Workshop	Talks on future colliders; Xeonon IT. QuarkNet: Changing the Culture (0) QuarkNet STEP UP: Careers in Physics (1) QuarkNet STEP UP Women in Physics (2) BAMC (Big Analysis of Muons in CMS) masterclass measurement
Virginia Tech University	No activity	The summer workshop was cancelled because teachers were working on-line with their individual schools to prepare for on-line learning in the fall.	
Virtual Center	August 12-14 (2½ days)	Neutrino Data, STEP UP and Online Learning Workshop	Group met monthly throughout the year. Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 3: MINERvA (2) The Case of the Hidden Neutrino What Heisenberg Knew (1) Histograms: Uncertainty (1) MINERvA masterclass measurement Implementation plans developed by teachers.
Wayne State University	No activity		
Data Coding (Data Camp)	July 6-10 July 23-31	Coding Camp: Virtual	Introducing Jupyter notebook; coding and machine learning. Implementation plans developed by teachers.

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on Quark

Table 5

2021 QuarkNet Workshops and Meetings: National- and Center-led (December 2020-September 2021)

Center	2021 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Black Hills State University	June 21-25	QN Cosmic, QN Neutrino Data & Dark Matter	Shuffling the Particle Deck (0) Making Tracks I (Cloud Chamber) (0) Making Tracks II (Bubble Chamber) (1) The Case of the Hidden Neutrino (1) Mean Life Part 1: Dice (1) Mean Life Part 2: MINERvA (2) Mean Life Part 3: Cosmic Ray Muons (2) Implementation discussion and plan
Boston Area/Brown University	May 18	QuarkNet Zoom Meeting	
	August 3-4	Summer Workshop (in-person)	Implementation discussion and plans
Brookhaven National Laboratory	July 6-9	Summer Virtual Workshop	Coding exercises for Artificial Intelligence/machine learning/quantum computing, MINERvA Masterclass Implementation discussion and plans
The Catholic University of America	August 16-18	Summer Workshop (August 16, 18 online August 17 in person)	Cosmic Ray e-Lab (3) Implementation discussion and plans
Colorado State University	July 26-27	**CMS Data Workshop**	Shuffling the Particle Deck (0) Rolling with Rutherford (1) Calculate the Z Mass (1) Quark Workbench 2D/3D (0) Making Tracks I (Cloud Chamber) (0) Making Tracks II (Bubble Chamber) (1) Implementation discussion and plans

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table 5 (con't.)
2021 QuarkNet Workshops and Meetings: National- and Center-led (December 2020-September 2021)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Fermilab/University of Chicago	August 3-5 (half days)	Teaching with Data Virtual Workshop	Introduction to Coding Practice Coding for Physics Classes Implementation discussion and plans
Florida Institute of Technology	No activity		
Florida International University	~~August 5-6~~	~~Neutrino Data~~	
Florida State University/(University of Florida)	July28-30	**CMS Update & Coding Workshop**	Shuffling the Particle Deck (0) Rolling with Rutherford (1) Making Tracks I (0) Quark Workbench (0) Making Tracks II (1) Signal to Noise: The Basics (0)
Idaho State University	June 28-July 1	Summer Workshop	Shuffling the Particle Deck (online) (0) Quark Workbench (online) (0) What Heisenberg Knew (1) Totem Data Express (2)
Johns Hopkins University	July 26-30	Summer Workshop: Astrophysics	Select 3 DAP Activities Level 0: Mapping the Poles; Signal & Noise; Making Tracks I; Histograms; STEP UP Select 2 DAP Activities Level 1: Particle Transformation and Signal & Noise II or the Case of the Hidden Neutrino; or What Heisenberg Knew; STEP UP II or Making Tracks II CMS Express Data (2)
Kansas State University/University of Kansas	March 13	Masterclass Orientation	In preparation for CRMD research project.
	April 23	Orientation	
	August 2-4	Cosmic Ray Workshop the Storm Project	CMS activities and Cosmic Ray Muon detectors

Note. National-led QuarkNet workshops are in a bold-face font. Compiled from agenda and final reports posted on QuarkNet website by individual center.

Table F-5 (con't.)
2021 QuarkNet Workshops and Meetings: National- and Center-led (December 2020-September 2021)

Center	2020 Dates (All dates except where noted)	Workshop/Meeting	Brief Summary of Activities and Data Activities Portfolio (Level) [and/or classroom use/implementation plans]
Lawrence Berkeley National Laboratory	June 28-July 23	Four Week Virtual Workshop	A total of 7 teachers and 59 students participated.
	July 12 (prep) July, 16, 19, 21	Summer Workshop (3 days, 3 hours each)	Teachers engaged in fundamental particle activity and analyzed data from ATLAS
Northern Illinois University	No activity		
Oklahoma State University/University of Oklahoma	July 20-22	**ATLAS Data Workshop**	Rolling with Rutherford (1) Shuffling the Particle Deck (0) Mass of U. S. Pennies (0) Calculate Mass of Z (1) Quark Workbench (0) Making Tracks I (cloud chamber) (0) Making Tracks II (bubble chamber) (1) Signal to Noise: Basics (0) Particle Transformation (1) Implementation discussion and plan
Purdue University	No activity		
Purdue University Northwest	June 21-25	Workshop	Rolling with Rutherford (1) Quark Workbench (0) CMS data collection and analysis (masterclass-like
Queensborough Community	No dates	Workshop	Focus of workshop: How to program an Arduino Mega microcontroller board.

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Table 5 (con't.)
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Rice University/University of Houston	June 14-18	**CMS, Cosmic and STEP UP**	Shuffling the Particle Deck (0) Rolling with Rutherford (1) Calculate the Mass of Z (1) Signal and the Noise: The Basics (0) Making Tracks I (Cloud Chamber) (0) QuarkNet STEP UP: Careers in Physics (1) QuarkNet STEP UP: Women in Physics (2) Implementation discussion and plans
Rutgers University	No dates	2-week introductory workshop	Quantum computing
	No dates	1-week advanced workshop	Topics included quantum information and black holes
Syracuse University	August 16-18	**Particles, Detectors, and Neutrino Data**	Shuffling the Particle Deck (0) Quark Workbench (0) Making Tracks I (Cloud Chamber) (0) Making Tracks II (Bubble Chamber) (1) The Case of the Hidden Neutrino (1) What Heisenberg Knew (1) Histograms: Uncertainty (1)
Southern Methodist University	July 12-14	**Enquiry-based Learning Virtual Workshop (Coding)**	On-line activities: Shuffling the Particle Deck (0) Quark Workbench (0) Rolling with Rutherford (1) MINERvA masterclass intro
Texas Tech University	June 29- July 2 July 1 July 6	Annual Workshop **STEP UP Workshop** Virtual Workshop	STEP UP: Women in Physics (2) STEP UP: Changing the Culture (0) Classroom Implementation discussion and plans

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University at Buffalo –SUNY	February 27	Masterclass No workshop due to COVID	
University of California at Riverside	No activity		
University of California Santa Cruz	No activity		
University of Cincinnati	~~Aug 3, 4or 5~~	~~**STEP UP Workshop**~~	Because of COVID no workshops or masterclasses were held
University of Florida	No activity		
University of Hawaii	No activity		
University of Illinois Chicago/ Chicago State University	July 9-12	**Virtual Workshop**	Assessing the design of the moon shadow experiment
University of Iowa/Iowa State University	July 5-9	Summer Workshop	Mean Lifetime Part 1: Dice (1) Mean Lifetime Part 2: MINERvA (2) Mean Lifetime Part 3: Cosmic Muons (2) Implementation discussion and plans
University of Kansas	No activity		
University of Minnesota	March 6	Virtual MINERvA Workshop	Masterclass analysis
	August 11-13	Summer Workshop	Totem I-III activities (in development) Implementation discussion and plans
University of New Mexico	Sept 18-19	Summer Workshop	Shuffling the Particle Deck (0) Rolling with Rutherford (1) Making Tracks I (0)

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University of Mississippi	June 21	Ole Miss Workshop	Implementation notes
University of Notre Dame		Cosmic Watch Project	
	July 16	Discovery at LHC	Shuffling the Particle Deck (virtual) (0) Quark Workbench (virtual) (0)
University of Oregon	No activity		
University of Pennsylvania	No activity		
University of Puerto Rico - Mayaguez	March 3	MINERvA Masterclass	
University of Rochester	No activity		
University of Tennessee Knoxville	No activity		
University of Washington	No activity		
University of Wisconsin - Madison	No activity		
Vanderbilt University	June 21-25 June 23-24	Summer Workshop Coding Portion	Speed of light experiment General reintroduction to CRMDs Introduction and Coding with Phyton
Virginia Center (Hampton University, the William and Mary, and the George Mason University)	August 2-4	Coding Virtual Workshop	Totem Data Express (2) Particle Transformation (1) Implementation discussion and plans
Virginia Tech	August 2-4	Virtual Workshop	STEP UP: Changing the Culture (0) STEP UP: Careers in Physics (1) STEP UP: Women in Physics (2)
Virtual Center	July 22-23	Quantum Computing and Coding	
Wayne State University	No activity		
Data Coding (Data Camp)	June 21-25 and June 28-July 2	Coding Camp: Virtual	Probability and histograms using dice Modeling and graphing projectiles with air resistance Calculate the mass of a muon using CMS data Big CMS dataset analysis

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