

2025 CTEQ-MCgen Summer School Report



The 2025 CTEQ-MCgen Summer Workshop and CyberTraining Program
Michigan State University (MSU), East Lansing MI
Jun 15 – 27, 2025



Monte Carlo
General Education Network

2025 CTEQ-MCgen Summer School Report:

The **2025 CTEQ Summer Workshop** on QCD and Electroweak Phenomenology and **2025 MCgen CyberTraining Program** was held at the Michigan State University in East Lansing, MI, USA 15-27 June 2025. The program provided a focused introduction to perturbative quantum chromodynamics, along with applications and recent experimental results. Additionally, the program included "hands-on" tutorial sessions on Machine Learning and Monte Carlo event generators organized in concert with the **MCgen Collaboration**.

This was truly a global event, with 40+ doctoral students from the USA, Europe, and Asia participating. The school was hosted by the Michigan State University and jointly organized by the Coordinated Theoretical-Experimental Project on QCD (CTEQ) and the Monte Carlo General Education Network (MCgen).

The program covered topics central to both experimental and theoretical particle physics. It provided participants with a deeper understanding and stronger command of the fundamental concepts, tools, and techniques that underpin research at current and future experimental facilities. The 2025 lectures specifically addressed the critical educational needs of junior physicists engaged in cutting-edge research. Its format emphasized close interaction between students and lecturers, fostering an engaging and collaborative learning environment. This experience equips students with the skills and perspective needed for successful careers—both within the field of physics and in broader scientific and technical domains.

The school spanned 11 days of lectures and interactive discussions, offering students the opportunity to engage closely with distinguished experts across a broad range of topics. The primary audience for the school is the next generation of physicists—typically advanced graduate students and postdoctoral researchers—from both experimental and theoretical backgrounds.

We are grateful to the local organizing committee at Michigan State University for their outstanding support in making the school a success. Committee members included **Joey Huston, Huey-Wen Lin, Pavel Nadolsky, Reinhard Schwienhorst, and Brenda Wenzlick**. **Zack Sullivan** and **Fred Olness** co-chaired the CTEQ School committee for this event. **Phil Ilten** chaired the MCgen School committee and led the organization of the Monte Carlo tutorial sessions. We also thank Michigan State University for their generous financial support of the program.

Schedule Overview

15 June 2025	16 Jun 2025	17 Jun 2025	18 Jun 2025	19 Jun 2025	20 Jun 2025
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Arrive	Day 1	Day 2	Day 3	Day 4	Free Day
8:00 - 8:45	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
9:00 - 10:00	Intro 1 Nadolsky	Intro 3 Nadolsky	PDF 2 Courtoy	VecBos/DirPh2 Olness	
10:00 - 10:30	Coffee	Coffee	Coffee	Coffee	
10:30 - 11:30	DIS 1 Stump	PDF 1 Courtoy	VecBos/DirPh1 Olness	Jets 2 Rappoccio	
11:45 - 13:00	Lunch	Lunch	Lunch	Lunch	
13:00 - 14:00	Intro 2 Nadolsky	Intro 4 Nadolsky	Higgs 1 Williams	Higgs 2 Williams	
14:00-14:30	Coffee	Coffee	Coffee	Coffee	
14:30-15:30	DIS 2 Olness	PDF /xFitter Tutorial (Olness)	Jets 1 Rappoccio	PDF /xFitter Tutorial (Olness)	
15:30+	QM Computing Ryan LaRose				
18:00 - 19:30	Dinner	Dinner	Dinner	Dinner	
19:30 - 21:00	Discussion	Discussion	Discussion	Participant Flash Talks	Free Night

15 June 2025	21 Jun 2025	22 Jun 2025	23 Jun 2025	24 Jun 2025	25 Jun 2025	26 Jun 2025	27 Jun 2025
Sunday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Arrive	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
8:00 - 8:45	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
9:00 - 10:00	FRIB Overview Talk Singh Jaideep	Results QCD/Top 1 Schwienhorst	Neutrinos 1 Sophie Berkman	Neutrinos 2 Sophie Berkman	MEs + PS MCgen	Classification MCgen	
10:00 - 10:30	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee	
10:30 - 11:30	Results EW/Higgs 1 Herndon	Results EW/Higgs 2 Herndon	MC Intro 3 MCgen	Heavy Quarks Sullivan	Hadronization MCgen	ML Intro 2 MCgen	
11:45 - 13:00	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	
13:00 - 14:00	MC Intro 1 MCgen	MC Intro 2 MCgen	FRIB Tour	Results QCD/Top 2 Schwienhorst	ML Intro 1 MCgen	Auto-Diff MCgen	
14:00-14:30	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee	
14:30-15:30	MC/ML Tutorial 1 MCgen	MC/ML Tutorial 2 MCgen	MC/ML Tutorial 3 MCgen	Zero as Hero Brock	Regression MCgen	Neural Nets MCgen	
15:30+							
18:00 - 19:30	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	
19:30 - 21:00	Discussion	Discussion	Discussion	Lansing Lugnuts Game??	Discussion	Discussion	

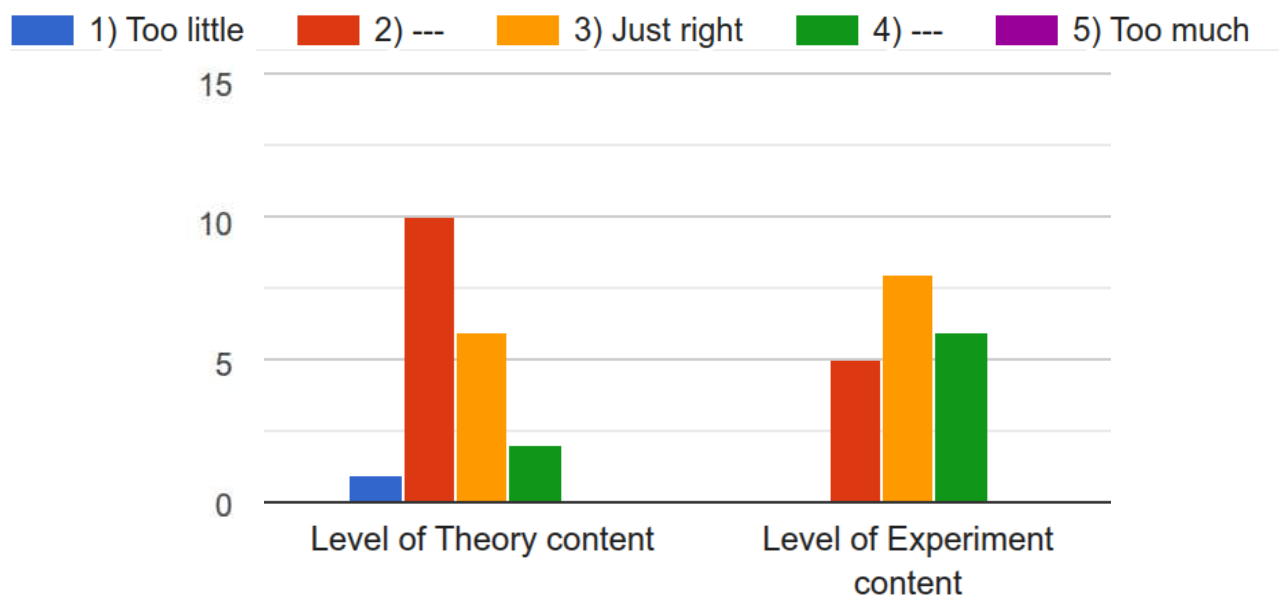
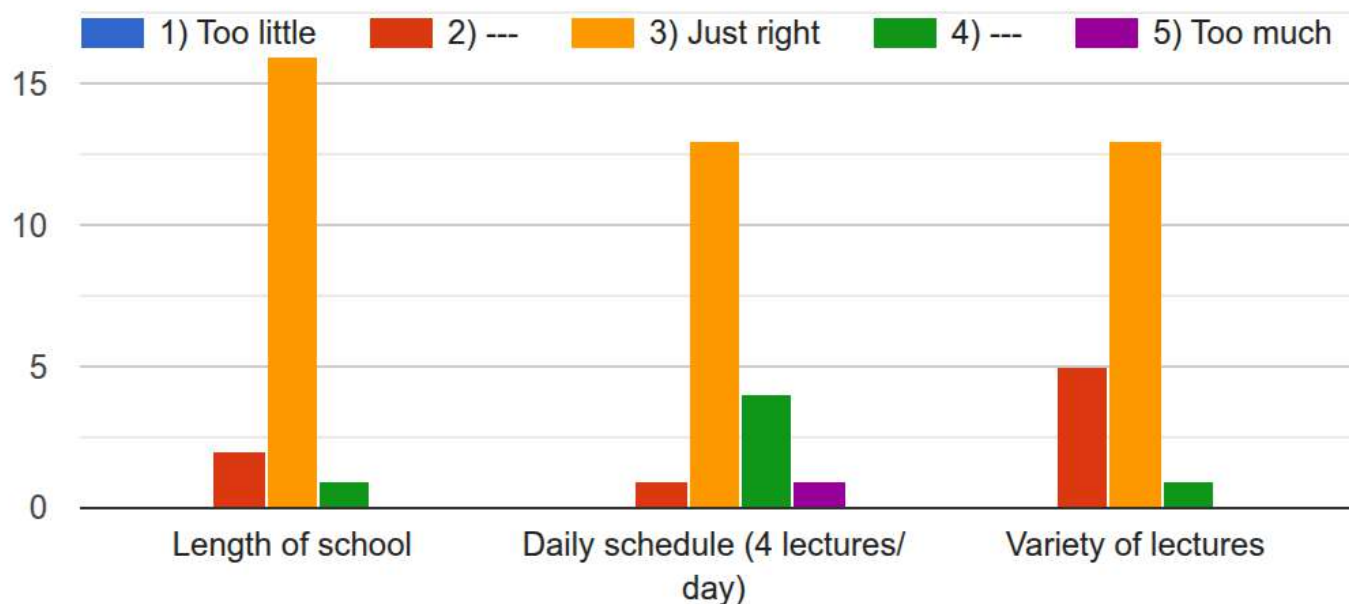
2025 CTEQ-MCgen Lecturers:

Lecturer	Institution	Topic
Pavel Nadolsky	(MSU)	Intro to QCD
Phil Ilten	(U.Cincinnati)	MC Introduction
Dan Stump	(MSU)	DIS
Ciaran Williams	(Buffalo)	Higgs
Fred Olness	(SMU)	Vector Boson
Salvatore Rappoccio	(Buffalo)	Jets (Intro & Substructure)
Zack Sullivan	(IIT)	Heavy Quarks
Sophie Berkman	(MSU)	Neutrinos/DUNE
MCgen Team	(U.Cincinnati)	MC Tutorials
Fred Olness	(SMU)	xFitter / PDFs
Matt Herndon	(UW Madison)	Results: EW & Higgs
Reinhard Schwienhorst	(MSU)	Results: QCD/Top
Aurore Courtoy	(UNAM)	PDFs
Singh Jaideep	(MSU)	FRIB Overview talk
Ryan LaRose	(MSU)	Quantum Computing
Chip Brock	(MSU)	Spin Zero as Hero

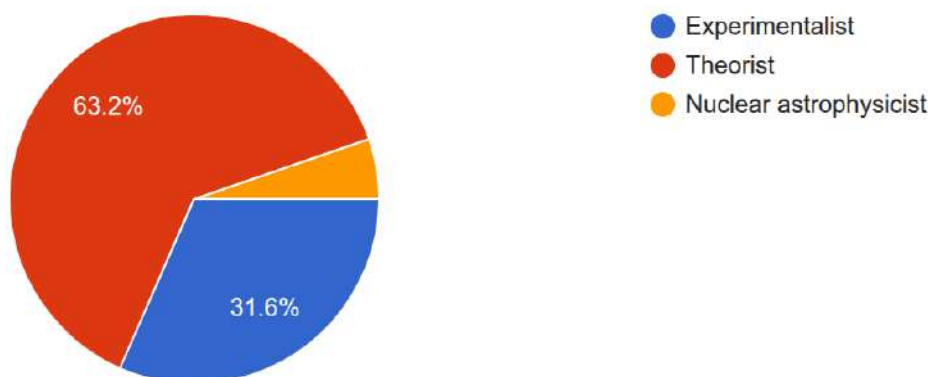
Speakers listed in approximate presentation order.

The full Indico page: <https://indico.cern.ch/event/1497407/>

Feedback on Logistics



Participant Backgrounds



Overall impression of the school:

Complete and unedited comments

- Nice
- The clear explanation of the MC event generation process vastly benefited my understanding of the role event simulation plays in our analysis. I wish I would've taken the school earlier in my program, I would suggest this school be highly recommended for students in their 2-3rd year into a PhD program.
- they were relevant for my research
- I felt most of the content in the beginning was accessible even as a nuclear background. I appreciated that.
- The school is very nice. The evening discussions are very helpful and inspiring.
- good opportunity to understand ML on which I have little background
- The school was overall very good. Not all the talks were relevant to my research, though. Some were helpful though, and it exposed me to Higgs physics, which I don't really work in at all. Conversely, I thought the course of lectures biased towards top quarks outside of the great neutrino lectures, which is almost a whole different field. Some mention of other avenues of research would be helpful for participants who, as much as anything else, are trying to learn the lay of the land so to speak. A more dedicated introduction of other probes of qcd and relevant applications of pdfs would be appropriate, such as heavy ions or any non-top studies, would be helpful in understanding the state of qcd studies as a whole, even if only 20 minutes or so is devoted to it.
- The machine learning part and lectures about top quarks were relevant to my research.
- I learned many things from areas that I was not that familiar with
- It was a great school. Talks and the people were great. Would have loved a bit more theory though.
- Awesome. And it added a lot to my knowledge.
- The school was very informative and it had the right balance between theory and experiment. The recitation sessions was always stimulating.

- I believe most of the talks and tutorials were extremely helpful. The recitations seemed daunting at first but as the school progressed they became my favorite part of the day because the discussions helped us learn a lot of things and delve deeper into the web of things we heard throughout the day and might not have thought that much about in the moment due to the time constraints and amount of information, while also preserving an informal environment. Things were overwhelming at times, but all in all, it was fun being overwhelmed
- The content was very useful. In particular, the lessons about the event generators was really helpful. It is much less of a black box after having attended this school.
- Overall, I had a good impression of the school. Although I have some more specific criticism later, in general I felt that there was a good mixture of content between experiment and theory and different subject areas. I also felt that the school did a good job of teaching a large amount of content without making it feel overwhelming.
- I learned a great deal about things related (but not directly necessary) for my research. There's a lot of QCD that I'm not formally familiar with, but I think this school helped to close that gap. The theory portions of the school (as well as the MCgen portion) were particularly valuable to me.
- Good to meet friendly people in the field
- As an experimental physics student I learned a lot of terms related to theoretical aspects and cleared many misconceptions I had. It is true that we had a lot of theory talks, but I think it should be that way in the future too. Experimental students like me can learn how to connect the experimental results with theory with solid arguments.
- Many of the talks broadened my understanding of the research I currently pursue and helped me contextualize and decide on future research plans. In this sense, the topics covered across all talks and helpful discussions sessions were fantastic. I really enjoyed my time at the school. Nevertheless, the 4 lectures a day schedule with all the non stop activities for the full duration of the first week, with weekend included were too intense, by the beginning of the second week it was absolutely impossible for me to concentrate.

External Resources:

The full Indico page:

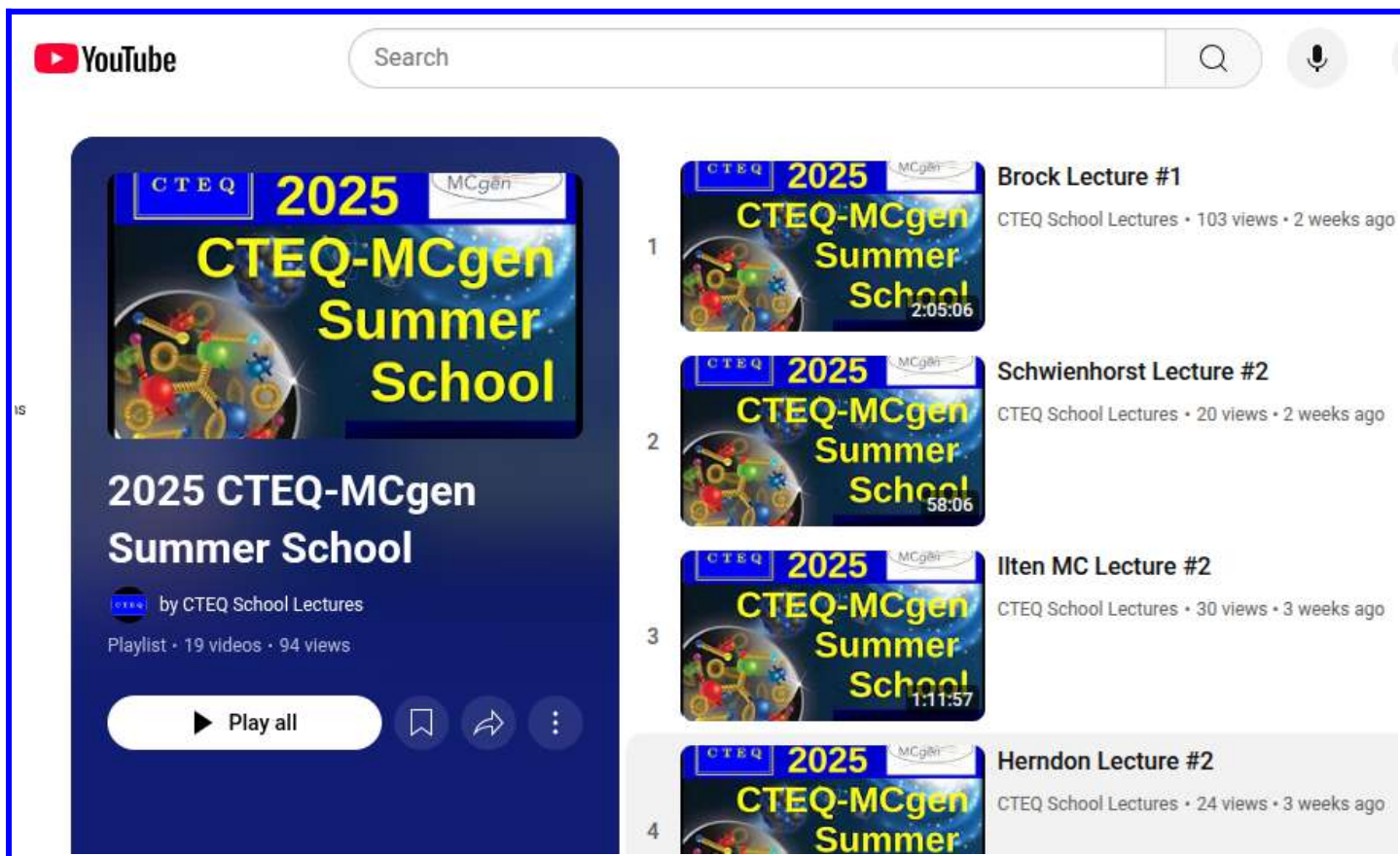
<https://indico.cern.ch/event/1497407/>

The 2025 CTEQ-MCgen Tutorials on GitHub:

<https://gitlab.com/mcgen-ct/tutorials/-/tree/2025-cteq>

Links to YouTube lecture recordings:

<https://www.youtube.com/playlist?list=PLWobttDK-kk7hfxahpclEnIbyiBRTW4rC>

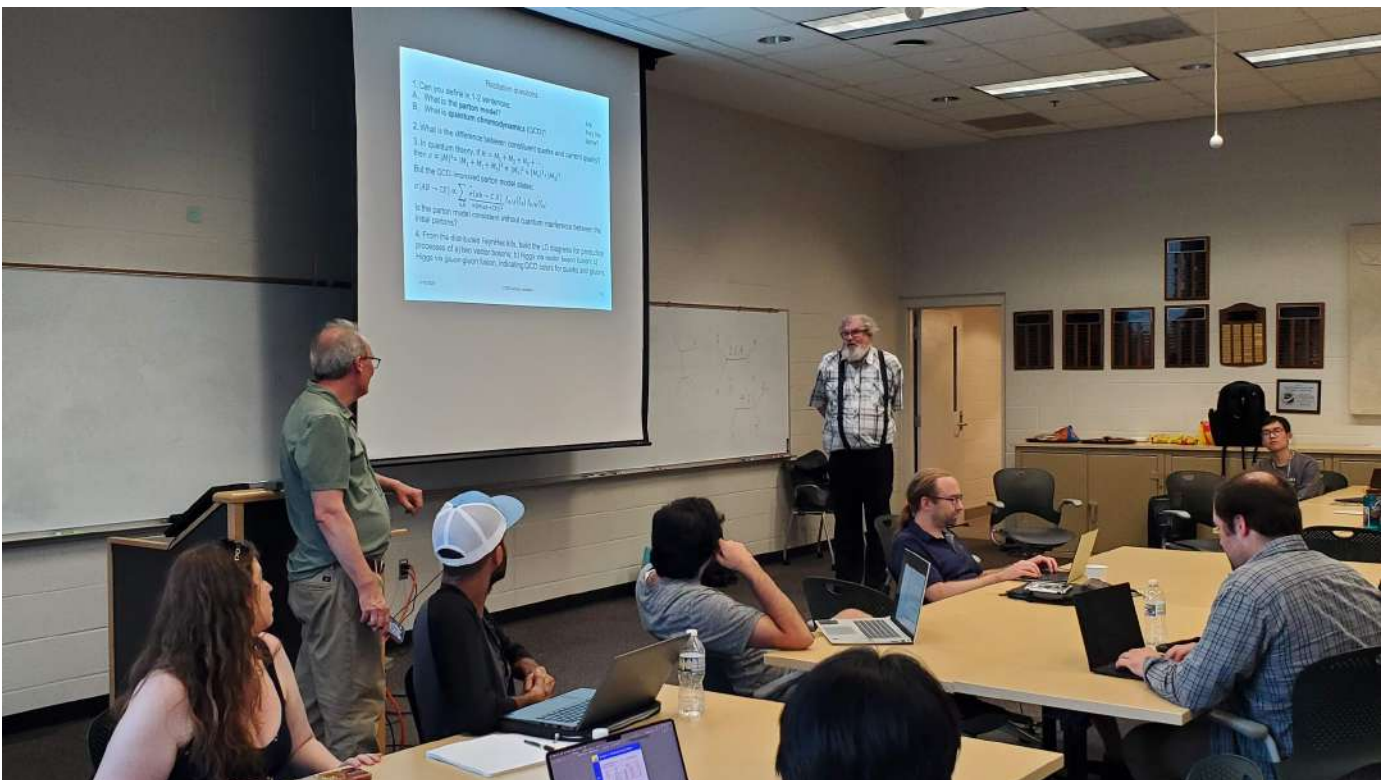


The screenshot shows a YouTube interface with a search bar at the top. Below the search bar is a large video player showing a thumbnail for the '2025 CTEQ-MCgen Summer School' playlist. The thumbnail features a blue background with a molecular structure and the text 'CTEQ 2025 MCgen CTEQ-MCgen Summer School'. Below the thumbnail, the text '2025 CTEQ-MCgen Summer School' is displayed, followed by 'by CTEQ School Lectures' and 'Playlist • 19 videos • 94 views'. A 'Play all' button is visible at the bottom of the player.

To the right of the main player is a list of four video thumbnails, each with a title, view count, and upload date:

- 1. Brock Lecture #1
CTEQ School Lectures • 103 views • 2 weeks ago
- 2. Schwienhorst Lecture #2
CTEQ School Lectures • 20 views • 2 weeks ago
- 3. Ilten MC Lecture #2
CTEQ School Lectures • 30 views • 3 weeks ago
- 4. Herndon Lecture #2
CTEQ School Lectures • 24 views • 3 weeks ago

Selected Photos:



More Selected Photos:

