

# ACAT 2021: Review

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# Contents

- The ACAT 2021: Hybrid Workshop
- Summary of ACAT 2021 Presentations
- Gather Town Poster Session
- Conclusion

# ACAT 2021: Hybrid Workshop

- Online (Expected 250, but 580 people registered.)
  - Zoom for presentation
  - Mattermost for discussion (@ Brookhaven National Laboratory)
  - Gather Town for 2D poster metaverse
  - Indico for homepage, registration, timetable, presentation material and video links.
  - Email for bulletin, newsletter, and other information sharing
- Offline (Expected 50, but 23 registered.)
  - Daejeon IBS Science Culture Center
  - One auditorium and 3 seminar rooms
  - No. of participants limited by the COVID regulations.
- <https://cern.ch/acat2021>
  - Individual recordings uploaded at the contribution pages.

From Alex Naumann's Summary Talk

# **SUMMARY OF ACAT 2021 PRESENTATIONS**

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# Plenary

- [Julia Fitzner](#): How WHO helps to fight the COVID pandemic with data
- [Anja Butter](#): Machine Learning for LNC Theory
- [Michael Spannowsky](#): Unsupervised Machine Learning for New Physics Searches
- [Lenka Zdeborova](#): Understanding Machine Learning via Exactly Solvable Statistical Physics Models.
- [Kevin Buzzard](#): Verifying Mathematical Proofs with Computers
- [Alberto Broggi](#): Autonomous Driving, the missing piece
- [Josh Bendavid](#): High-performance Analysis, Today and Tomorrow
- [Kang-Hun Ahn](#): Biomimetic neural network inspired by human hearing
- [Joseph Lykken](#): Quantum Computing: where is it going and what is it good for?
- [Barry Sanders](#): Quantum Computing for Data Science
- [Joshua Isaacson](#): generators and the (Accelerated) Future
- [Roman N. Lee](#): Modern multiloop calculations: Search for new algorithms and fast computer algebra systems
- [Andrien Matta](#): Outlook on software framework in nuclear physics
- [Ruth Mueller](#): Racing for what? Acceleration and Competition in the Academic Sciences

# Track 1

- Computing Technology for Physics Research
  - Improvements in the current-generation machine learning tools
  - Optical Processing Unit
  - GPU trigger which does not use machine learning
  - Beam collision point finder using machine learning
  - Simulation on FPGA
  - JUNO experimental strategy using various processing techniques (GPU, MPI, tbb)
  - Compile-time polymorphic detector description.
- I/O should be optimized, still.
- Moving from ROOT TTree to numpy arrays?
- Continuous change in hardware and software makes developer's job difficult.
- Heterogenous processing units in continuous use: CPU, GPU, FPGA, ASIC, etc.
- ML everywhere.
- Scheduler abstraction needed.

# Track 2

- Analysis - Algorithms and Tools
  - Mostly machine learning topics now.
  - Tracking for LUXE at DESY
  - Various fitting and performance talks.
- Many discussions ongoing on how to use GPU.
- ML is general now.
  - Auto encoders?
  - How to use ML in real data.
  - Problems such as floating point precision vs disturbing ML results.
- Quantum Computing is not ready yet. Also too expensive.

# Track 3

- Computing Technology for Physics Research
  - Quantum circuits
  - Machine learning and Bayesian statistics
  - Normalizing flows to extract probability density from data
  - Lattice QCD
- Theory computation codes are not open source.
  - Pdf fitting
- Milestones for reproducibility
- NNNLO calculations requires advances in PDF's, too.
- Quantum Computing for HEP problems
  - Matrix elements
  - QCD Lagrangian for event generation.
- NNLO calculations will be dominant by machine learning tools.



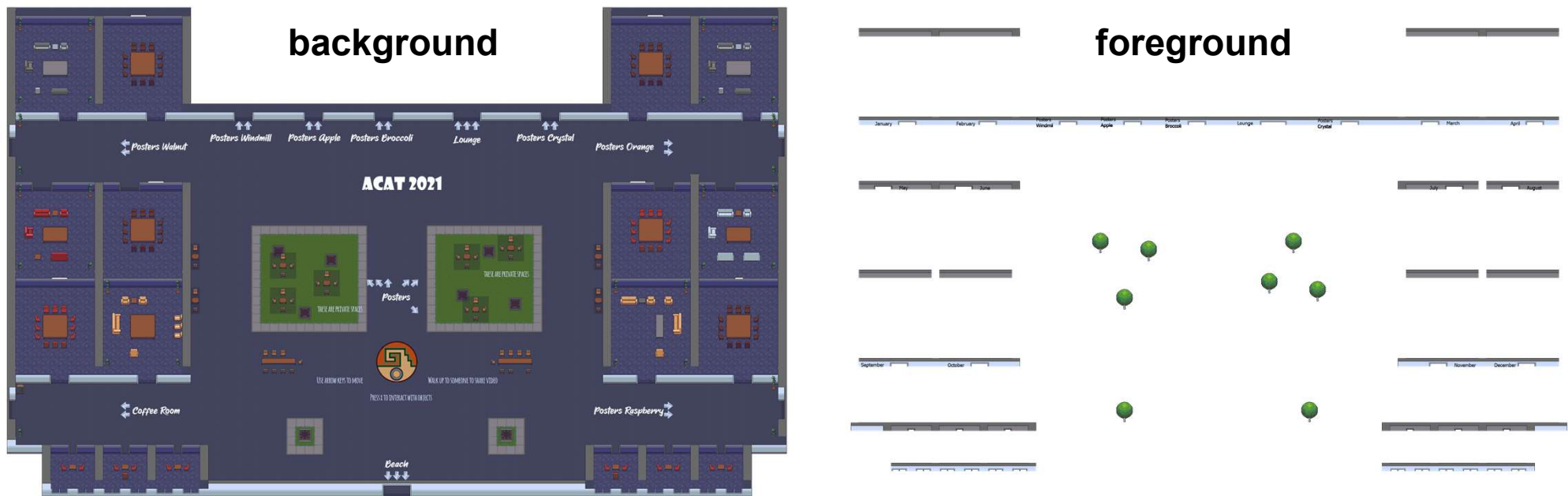
# ACAT 2021 AT GATHER TOWN

# Structure of Gather Town

- A room consists of
  - Background image (editable)
  - Foreground image (editable)
  - Objects as individual images
    - user cannot create a new type of object. Images are editable.
    - For example, poster objects, game objects.
    - Link to YouTube possible. Poster images can be uploaded at the Gather Town server.
  - Avatars as individual images (Gather gives you options.)
- Movement of avatars are controlled by Tile Effects.
  - Private area: Private chat places
  - Impassable: designates walls, boundaries, and end of space.
  - Portal and Spawn: transportation to other rooms.

# Image Manipulation

- Images can be created by any graphic tools.
  - Gather Town provides basic images at gitlab.
  - Gather community uses “Tiled” and “ImageMagick” to manipulate images.
    - One has to be careful to preserve DB info of each image.



# Object Manipulation

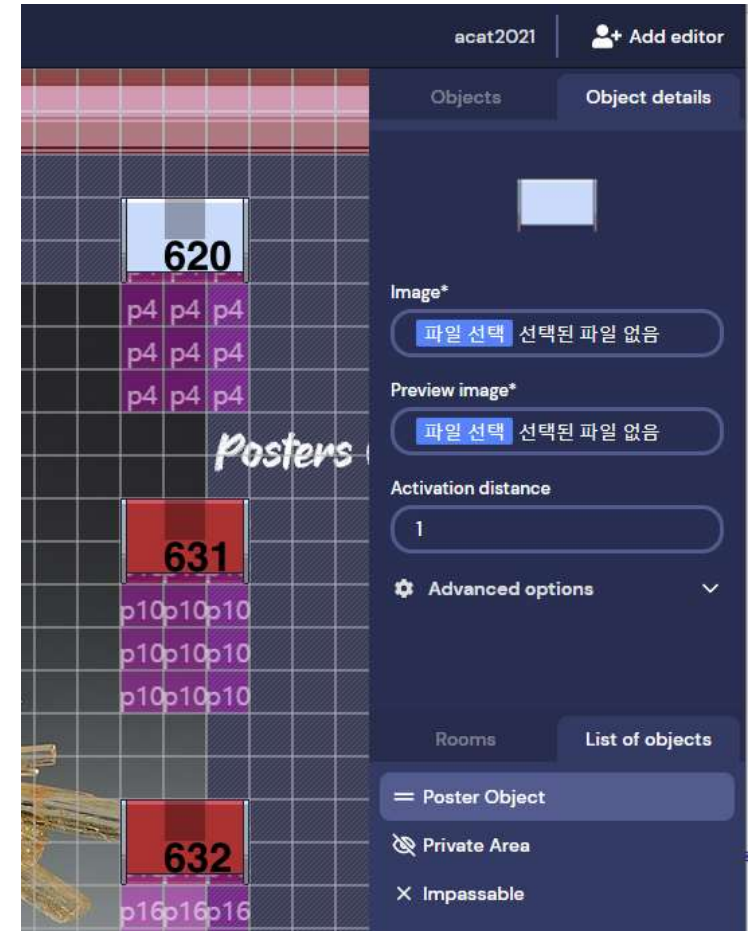
- Objects such as posters have properties in addition to their presentative images
  - Preview image
  - Main image
  - Other properties
- You can link/upload these properties either by hand,
- Or API tools provided by Gather.
  - Currently, Gather does not have API tools for pdf files.
  - API tools can be accessed by Java Scripts for mass uploading.



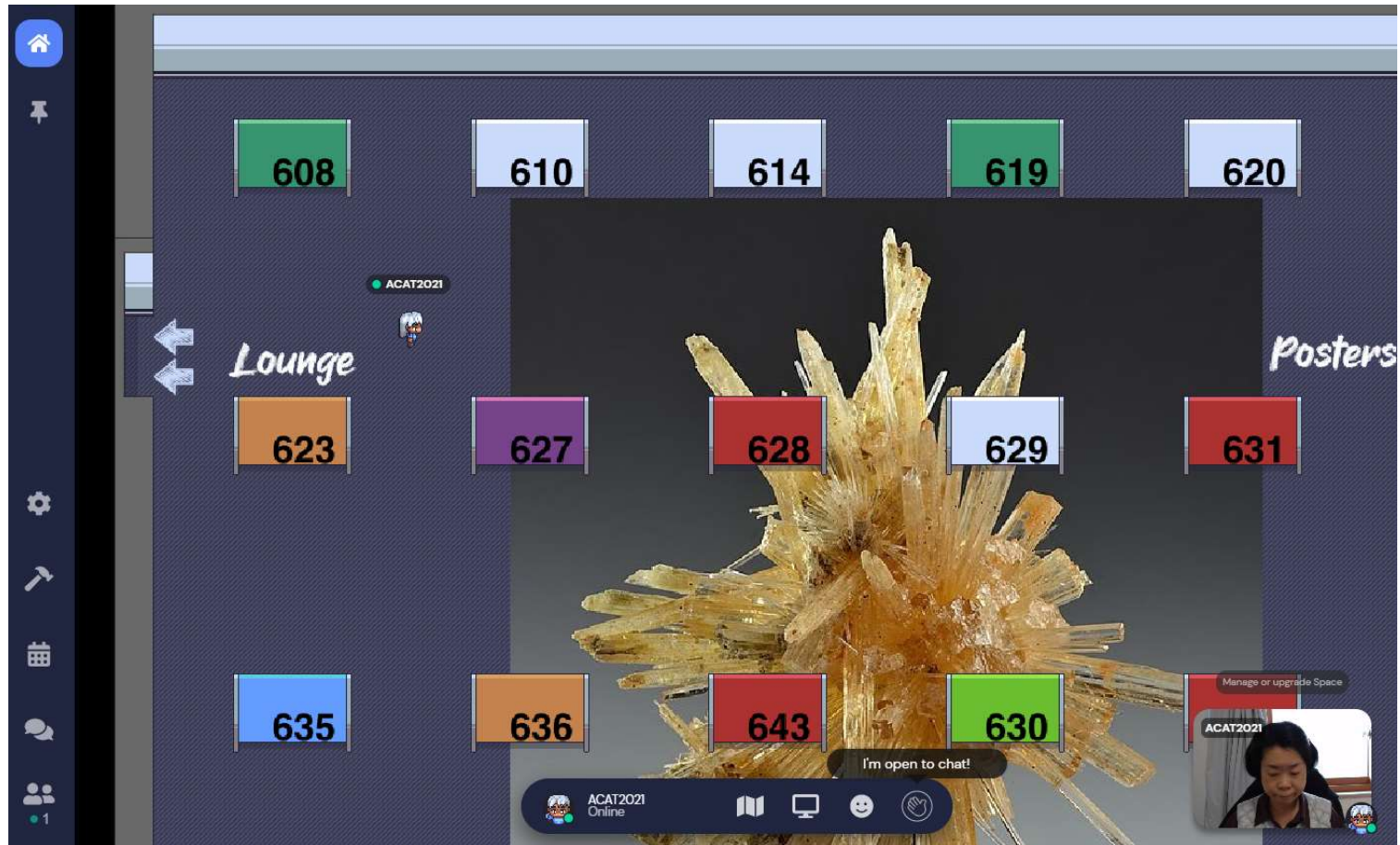
Poster set



Poster set:  
activated



# Example: Posters Crystal



# CONCLUSION

# AI and HEP

- Now machine learning is one of the common tools used by HEP.
- More and more applications of machine learning and other AI tools will be used in future.
- Quantum computing is developing, but it will take another generation to develop the method into a general tool usable by everyday researchers.

# EXTRA