

# Advanced Statistical Tools

at the Intersection of Cosmology and High-Energy & Nuclear Physics

**WORKSHOP & SCHOOL**

December 4-7, 2023

Unidad de Seminarios "Dr. Ignacio Chávez," UNAM.

# Code of conduct

## Expected Behavior:

- **Participate Authentically and Actively:** Engage genuinely and actively. By doing so, you contribute to the success and impact of this event.
- **Exercise Consideration and Respect in Communications and Actions:** Be mindful of how you communicate and act, demonstrating consideration and respect towards others.
- **Strive to Collaborate Instead of Generating Conflict:** Foster collaboration and teamwork rather than creating conflicts. Approach discussions with an open mind and a willingness to work together.
- **Refrain from Degrading, Discriminatory, Abusive, or Harassing Behavior and Language:** Avoid adopting behavior or language that is degrading, discriminatory, abusive, or harassing. Treat others with kindness and empathy.
- **Be Aware of Your Surroundings and Fellow Participants:** Stay conscious of your environment and the well-being of your fellow participants. Alert community leaders if you observe a potentially dangerous situation, someone in distress, or violations of this Code of Conduct, even if they seem trivial.

By adhering to these guidelines, we aim to create a workshop environment that is inclusive, respectful, and conducive to positive interactions for everyone involved.

# Code of conduct

## **Unacceptable Behavior:**

The following behaviors are considered harassment and are unacceptable within our community:

- Violence, threat of violence, or violent language directed towards another person.
- Jokes or discriminatory language (sexist, racist, homophobic, transphobic, etc.).
- Posting or displaying sexually explicit or violent material.
- Personal insults, particularly those related to gender, sexual orientation, race, religion, or disability.
- Inappropriate photography or recording.
- Sustained disruption of community events, including talks and presentations.

## **Consequences of Unacceptable Behavior:**

Unacceptable behavior by any community member will not be tolerated. If an individual engages in unacceptable conduct, organizers may take any action they deem appropriate, up to and including temporary suspension or permanent expulsion from the event without prior notice.

## **If You Witness or Experience Unacceptable Behavior:**

If you are a victim or witness of unacceptable behavior, or if you have any concerns, please contact an event organizer as soon as possible.

# Organizing Committee PIIF-IFUNAM

Aurore Courtoy  
(co-chair)



Mariana Vargas Magaña  
(co-chair)



Marcos García



Manfred Kraus



Myriam Mondragón



## External Academic Advisors

Sébastien Fromenteau  
(ICF-UNAM)



Alberto Vázquez  
(ICF-UNAM)



# Acknowledgments



Programa de Investigación del Instituto de Física 2023 (PIIF23)

# PIIF PROJECT

## Programa de Investigación del Instituto de Física 2023 (PIIF23)

- This project proposes bringing together **13 experts from the Institute of Physics** in various fields of high-energy physics, nuclear physics, astroparticle physics, and cosmology to explore **interconnections and synergies** through interdisciplinary collaborations. The initiative involves the training of human resources, with the participation of approximately **60 students and 2 postdoctoral** researchers.
- **High-energy physics, nuclear physics, astroparticle physics, and cosmology** are closely interconnected and complementary research areas, making interdisciplinary approaches relevant. The proponents represent communities in electroweak and flavor physics, astroparticles and cosmology, QCD and hadronic physics, neutrinos and dark matter, and string theory.
- Through an interdisciplinary project, the goal is to study various phenomena and models, exploring connections and seeking a global explanation that presents a broader view of physics. The **fundamental axis of the project** will be based on the exploration of **common tools** in the involved research areas.
- The project aims to review the **latest advances in analysis tools** with a multidisciplinary approach to enrich and strengthen investigations in subfields and **promote collaboration** among the proponents.

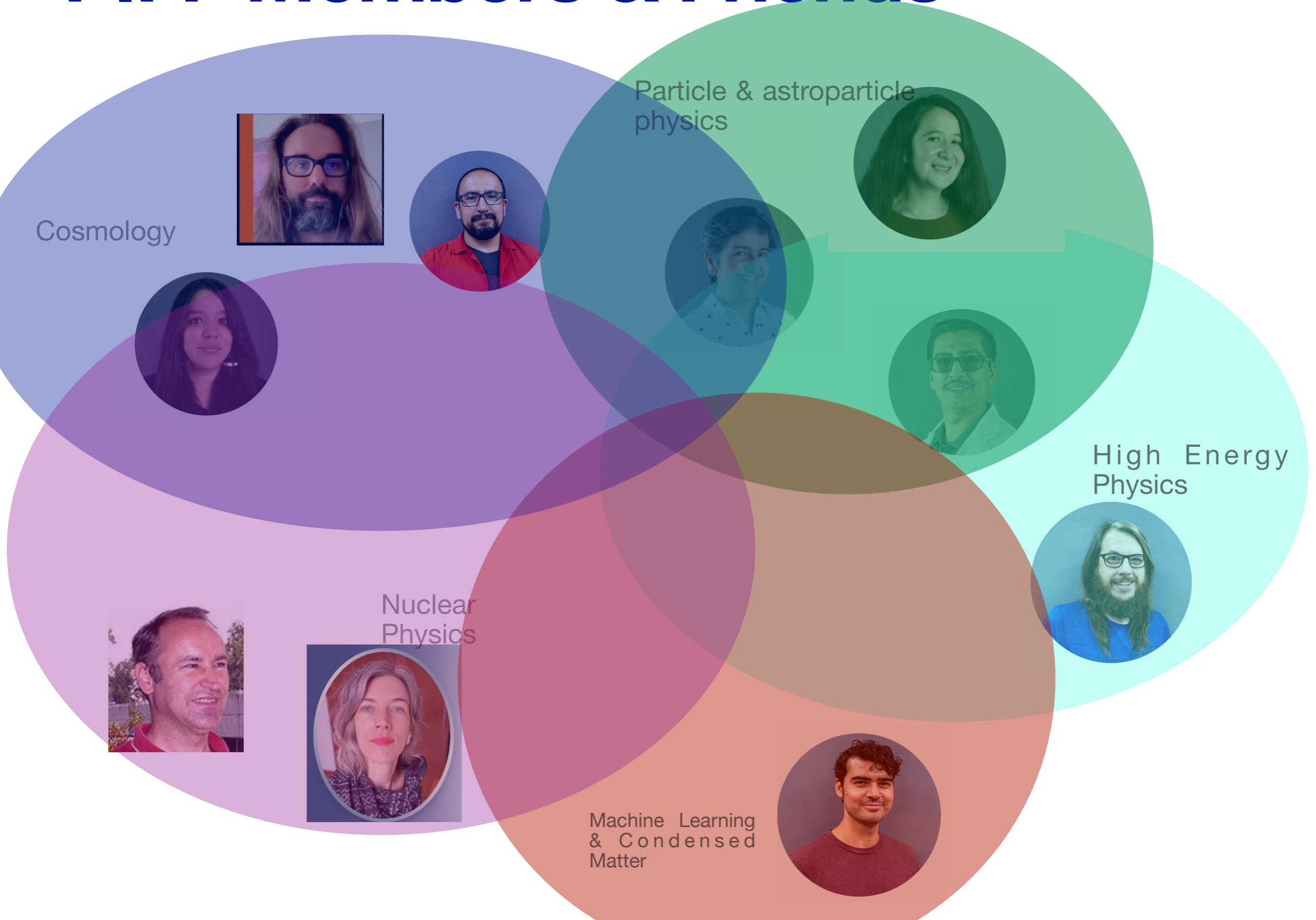
# PIIF Members

Table 1: Participantes y sus contribuciones

Participante	Contribución
Mariana Vargas Magaña	<b>Responsable</b> del proyecto, Coordinadora del taller-escuela de Herramientas en AE, y Cosmología, en particular relacionado aplicaciones a la cosmología, incluidos técnicas de IA.
Marcos García García	<b>Co-responsable</b> del proyecto. Colaborador en proyectos de cosmología teórica y física más allá del modelo estándar. En particular, EFTs y métodos numéricos en materia oscura bosónica.
Eduardo Peinado	Coordinador del taller de dispersión coherente de neutrinos-núcleo.
Eric Vázquez Jáuregui	Enlace en experimentos de detección directa de materia oscura PICO y DEAP-3600 , coordinador del taller de dispersión coherente de neutrinos-núcleo.
Aurore Courtoy	Coordinadora del taller-escuela de Herramientas en AE, y Cosmología, en particular relacionado con aplicaciones a la física nuclear, incluidos técnica de IA.
Myriam Mon-dragón Ceballos	Coordinadora del Mini-taller de BSM y astropartículas. Colaboradora en proyectos de física de sabor, física más allá del modelo estándar y astropartículas.
Saúl Ramos-Sánchez	Colaborador y responsable de esfuerzos en la construcción de EFTs basadas en cuerdas, simetrías de sabor y modelos inflacionarios, y predicciones mediante herramientas computacionales.
Manfred Kraus	Responsable de física de ondas gravitacionales y colaborador en física de AE, especialmente en QCD.
Matías Moreno	Física de aceleradores y de partículas elementales, técnicas espinoriales, Proyecto Sincrotrón Mexicano.
Jaime Besprosvany	Extensiones del modelo estándar, modelos de energía oscura y ondas gravitacionales primordiales, fundamentos de teorías de campo
Axel de la Mackbarra	Interconexión entre partículas elementales y cosmología, estructura a gran escala, energía y materia oscura
Genaro Toledo	Observables de precisión y sus implicaciones en la búsqueda de nueva física. Búsqueda de nuevos estados hadrónicos.
Catalina Espinoza	Fenomenología de modelos multi-Higgs. Coordinadora de tutoriales para herramientas computacionales en física de partículas más allá del modelo estándar.



# PIFF Members & Friends



# Event Goal

This event seeks to explore the application of statistical tools from a multidisciplinary perspective, bringing together researchers and students from the Department of Theoretical Physics at the Institute of Physics, UNAM, and researchers and students from neighboring institutions to bridge the fields of Cosmology and High Energy & Nuclear Physics.

# Event Framework

**Rational of the Conference:** Statistical methods and machine learning are increasingly relevant in high energy physics, nuclear physics and cosmology, where large sets of complex data and analyses are the norm. This event is focused in the use of statistical tools with a multidisciplinary approach.

The event includes a workshop and an advanced school (with projects) where researchers and students are expected to interact and find synergies between subfields.

## **Workshop:**

The workshop days would start with a short introductory session, followed by specific plenary talks. The speakers are expected to present their research with emphasis in the statistical methods accompanied by a brief description of problems where this methods are implemented and highlighting the open problems/questions to be faced. Free discussion sessions are planned where the chairs will guide the discussion over the open questions raised during the day.

## **Lectures/Projects:**

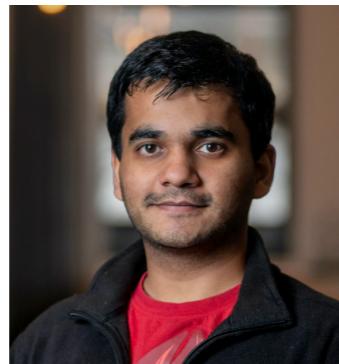
In the school, the invited speakers will present a lecture where a particular statistical method is used. It is expected that the lectures will provide the theoretical framework for any participant to apply the methodology to its own domain.

# Invited Speakers

Miguel Aragon  
(IA-UNAM Ensenada)



Modi Chirag  
(Flatiron Center)



Sébastien Fromenteau  
(ICF-UNAM)



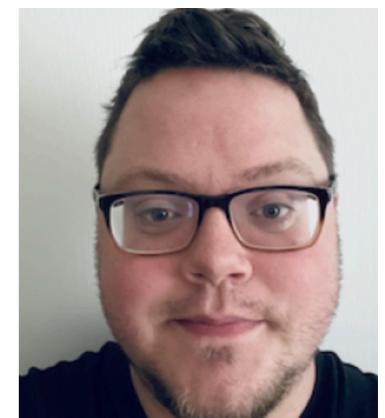
Will Handley  
(Kavli Institute for  
Cosmology, Cambridge)



William Jay  
(MIT)



Brandon Kriesten  
(Argonne National Lab)



Pavel Nadolsky  
(Southern Methodist  
University)



# Program

## Workshop: Statistical Tools in HE, Nuclear P. & Cosmology

TIME (M-W)	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	TIME (T-T)
	Chair: Sebastien	Chair: Marcos	Chair: Myriam	Chair: Myriam	
9:30 a 9:45	Intro Aurore & Mariana	Course 1: Sebastien	Spotlight talks	Course 4: Miguel Aragon	9:30 - 11:30
9:45 a 10:00			Pavel Nadolsky		
10:00 a 11:00	Will Handley				
11:00 - 11:30	Coffee	Coffee	Coffee	Coffee	11:30 - 12:00
	Chair: Sebastien	Chair: Marcos	Chair: Wolfgang	Chair: Catalina	
11:30 - 12:30	Chirag Modi	Course 2: Will Handley	Will Jay	Course 5: W. Jay	12:00 - 14:00
12:30 - 13:30	Discussion 1: Mariana & Will & Chirag		Discussion 3: Aurore & Pavel and Will		
13:30 - 15:00	LUNCH	LUNCH	LUNCH	LUNCH	14:00 - 15:30
	Chair: Manfred	Chair: Manfred	Chair: Wolfgang	Chair: Genaro	
15:00 - 16:00	Miguel Aragon	Course 3: Chirag Modi	Brandon Kriesten	Course 6: B. Kriesten	15:30 - 17:30
16:00 - 17:00	Discussion 2: Sebastien & Miguel		Discussion 4 Huziel & Brandon		
				Summary Discussion Aurore & Mariana	17:30- 18:00
	COSMO	COSMO	QCD	QCD	

# Spotlight-Talks

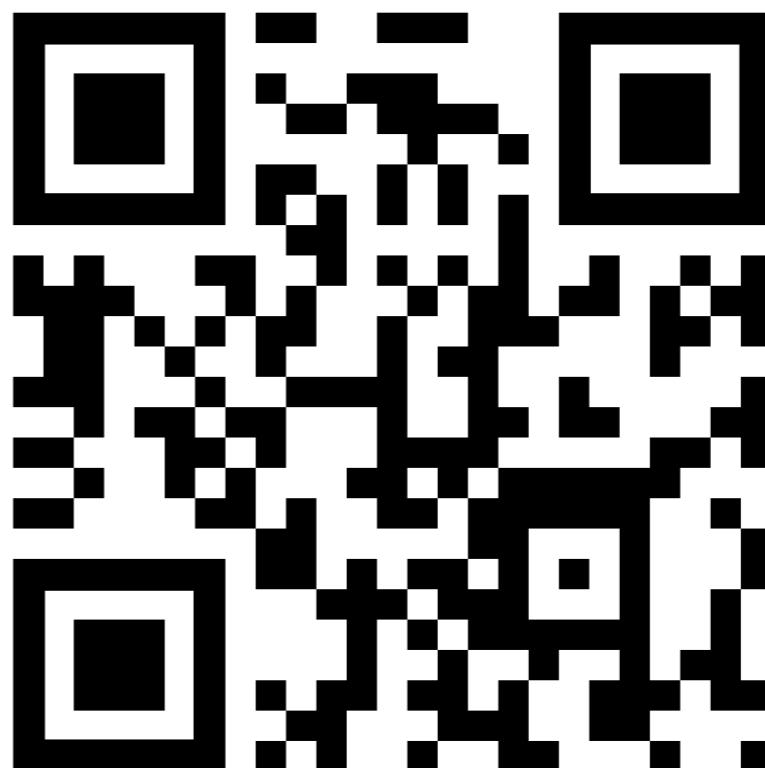
- All participants are invited to contribute, the goal is to present yourself and talk about your interest with this conference.
- 2 minutes strict !!!
- 2 slides in a google-shared presentation:
  - First slide. Presentation: Who are you?, affiliation, academic level (students write level and year, maybe advisor), Research interests, picture (if you want), contact information (institutional email)
  - Second slide. What is your interest in this conference? What is your previous experience? What are you willing to get from this event? How this event relates to your research? Add plots, diagrams , draws.

# Spotlight-Talks

- LINK SLIDE-DECK

[https://docs.google.com/presentation/d/  
1e9yVpLV99mTFxcOA6LA43RPw2r88KiHC3XT0zpBnihw/edit?  
usp=sharing](https://docs.google.com/presentation/d/1e9yVpLV99mTFxcOA6LA43RPw2r88KiHC3XT0zpBnihw/edit?usp=sharing)

<https://shorturl.at/aAQY7>



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16:00

# Discussions

- For preparing the discussions we ask the participants to contribute adding questions to the google form here:
- 

<https://shorturl.at/hQSX0>



[https://docs.google.com/presentation/d/  
MygKQhqzzRxzAqcsb5dv8YK79MdAGwpbsSg0QJPPj-E/edit?usp=sharing](https://docs.google.com/presentation/d/MygKQhqzzRxzAqcsb5dv8YK79MdAGwpbsSg0QJPPj-E/edit?usp=sharing)

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# Slack

- Join Slack Channel. <https://shorturl.at/egowM>



- <https://join.slack.com/share/enQtNjI4ODU5NDcxODgwNC0wNWRjM2Q3YTI4Y2NkMDI4OGQ0YjRiZDk2ZWNjOGRINGFkZWM2NjRmZGRhOTA5NGZmMWJiOTIyMzI0NzAzM2JI>

# Certificates

- 80% of attendance is required for the certificate.
- Will be distributed the week 10-15 December.
- Need to be request adding you name, email at:

# Logistics Meals

- 1) Confirmed Participants: They need to recover the ticket during coffee-break at the registration desk, if tickets are not recovered by the time of the meal the extra tickets will be distributed.
- 2) Participants that confirmed late. Tickets from the confirmed participants not recovered before lunch time will be re-assigned to the late confirmations. If extra tickets are left will be distributed to the participants that did not confirmed.
- 3) Participants that did not confirm. Only if after 1 and 2 are still tickets left they will be reassigned to non confirmed participants.

# School & Workshop Material

- Will be uploaded during the event at the GitHub:
-

**Enjoy**