Detailed program and schedule of "Introductory school on phenomenology of QGP" School of particles and accelerators (IPM), 12-16 Feb 2023 (23-27 Bahman 1401).

# **Detailed program:**

4 Lecturer: <u>M. Asadi,</u>

Subject: Relativistic Hydrodynamics,

**Outlines:** 

1. Introduction

# 2. Brief review of non-relativistic hydrodynamics

- Ideal fluid
- Dissipative fluid
- Hydrodynamic modes

# 3. Relativistic hydrodynamics

- Hydrodynamic variables
- Constitutive relations
- · Zeroth-order hydrodynamics
- First-order hydrodynamics

# 4. Hydrodynamic equations and correlation functions

- Simple diffusion and Kubo formula
- Canonical approach to hydrodynamic response functions
- Retarded functions in relativistic hydrodynamics at  $\mu = 0$
- Retarded functions in relativistic hydrodynamics at  $\mu \neq 0$
- · Variational approach to hydrodynamic response functions

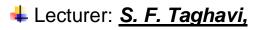
# 4 Lecturer: S. M. A. Tabatabaee mehr,

# Subject: Kinetic Theory,

### Outlines:

- 1- Basic concepts, relativistic Boltzmann equation.
- 2- Boltzmann's H-Theorem.

3-Advanced topics: Quantum transport theory, chiral kinetic theory.



# Subject: Phenomenology of QGP,

#### **Outlines:**

# An introduction

- A quick overview of the heavy-ion collision physics
- A basic picture of the collectivity in HIC.
- A basic overview of the observables.

#### -Heavy-ion initial state and pre-equilibrium:

- Nuclear structure.
- Ab initio QCD initial states -> color glass condensate -> IP-Glasma
- More phenomenological models -> TrENTo, MC-Glabuer
- Pre-equilibrium stage

#### - Collective evolution:

- Modeling the collective evolution -> hydrodynamic, kinetic theory (only from a phenomenological point of view)
- Current collective models in the market -> VISHNU, MUSIC, ...
- Collectivity in small systems.

# - Experimental measurements and Bayesian analysis

- Latest updates about the experimental observables related to the collectivity
- Bayesian analysis approach to extract the model's free parameters from the experiment.
- A quick summary

4 Lecturer: F. Taghinavaz,

#### Subject: Thermal Field Theory,

Outlines:

- 1) Review of statistical mechanics,
- 2) Imaginary time formalism: path integral representation of partition function,
- 3) Linear response theory,
- 4) Real time formalism: closed time path and thermofield double,
- 5) Symmetry breaking at finite temperature.

# Schedule:

Sunday, Feb 12, 2023		
9-9:15	Opening ceremony	
9:15-10:45	Thermal Field Theory	
11-12:30	Thermal Field Theory	
13:30-15	Phenomenology of QGP	
15:15-16:45	Relativistic Hydrodynamics	

Monday, Feb 13, 2023		
9:15-10:45	Kinetic Theory	
11-12:30	Relativistic Hydrodynamics	
13:30-15	Phenomenology of QGP	
15:15-16:45	Thermal Field Theory	

Tuesday, Feb 14, 2023		
9:15-10:45	Relativistic Hydrodynamics	
11-12:30	Thermal Field Theory	
13:30-15	Kinetic Theory	

Wednesday, Feb 15, 2023	
9:15-10:45	Kinetic Theory
11-12:30	Relativistic Hydrodynamics
13:30-15	Thermal Field Theory
15:15-16:45	Phenomenology of QGP

Thursday, Feb 16, 2023		
9:15-10:45	Thermal Field Theory	
11-12:30	Kinetic Theory	
13:30-15	Relativistic Hydrodynamics	
15:15-16:45	Phenomenology of QGP	