A5 sub-course Introduction
般物理学理論 / Theoretical General Physics

Kipp Cannon
（RESCEU）

物理学専攻入試ガイダンス　2026 年 5 月 23 日

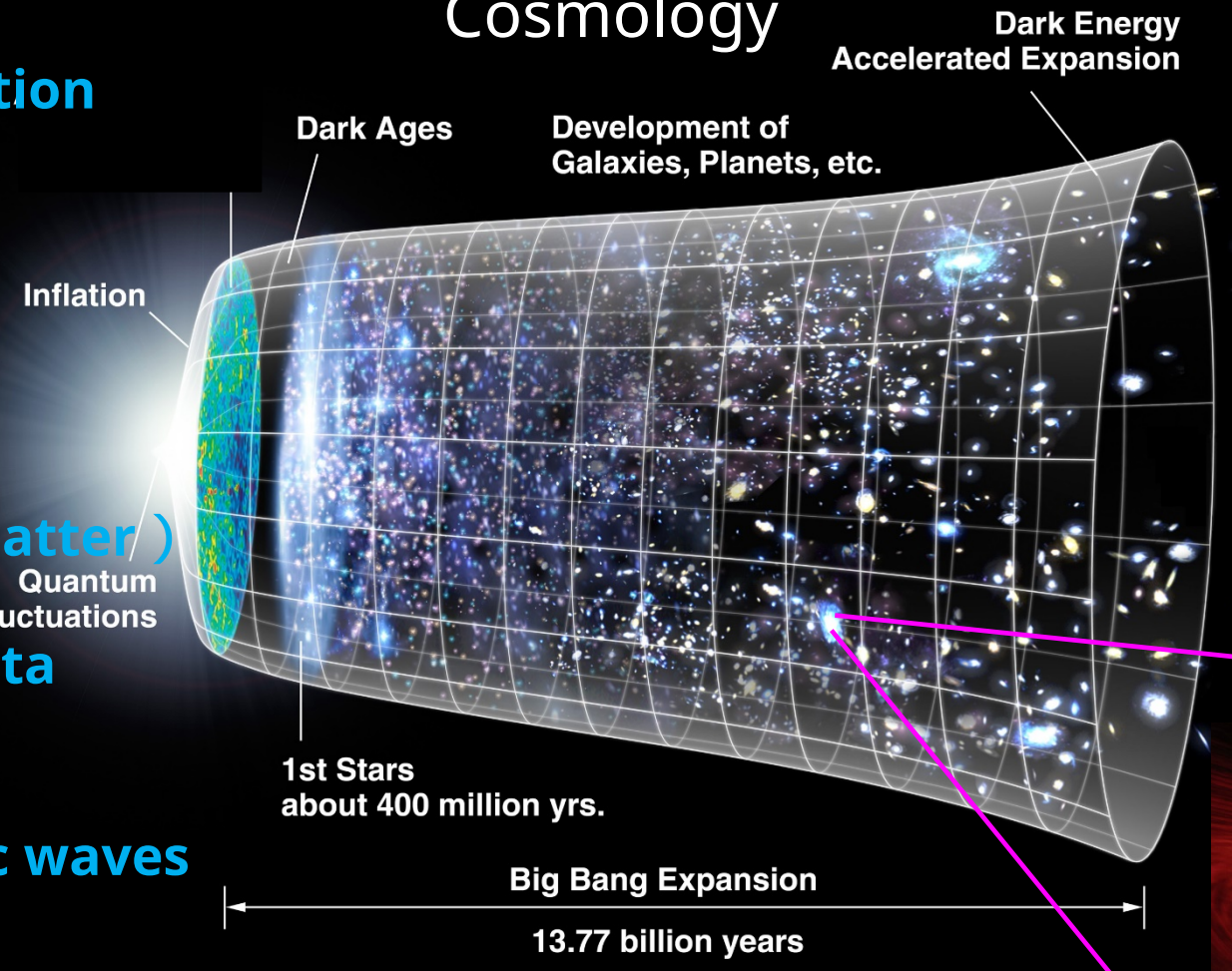
Theoretical Astrophysics & Cosmology

Early Universe　Star formation ・ Observational Cosmology

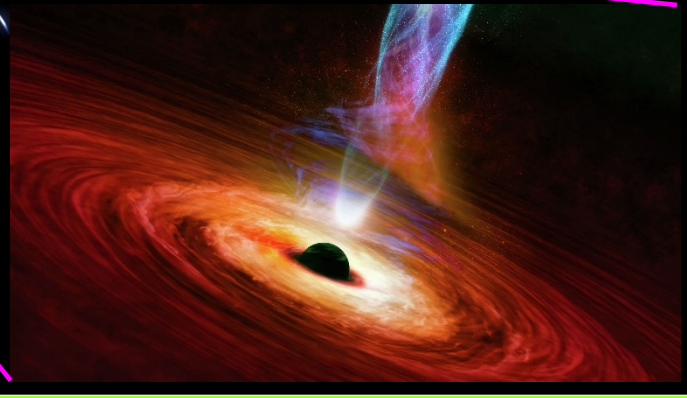
Method
- Theory
- Numerical Simulation
- Data Science

Targets
- Quantum field
- Space time
- Fluid
- N-body （Dark Matter）
- Plasma
- Observational Data

Observation
- Electromangentic waves
- Cosmic rays
- Neutrions
- Gravitational waves



High-Energy Astrophysics



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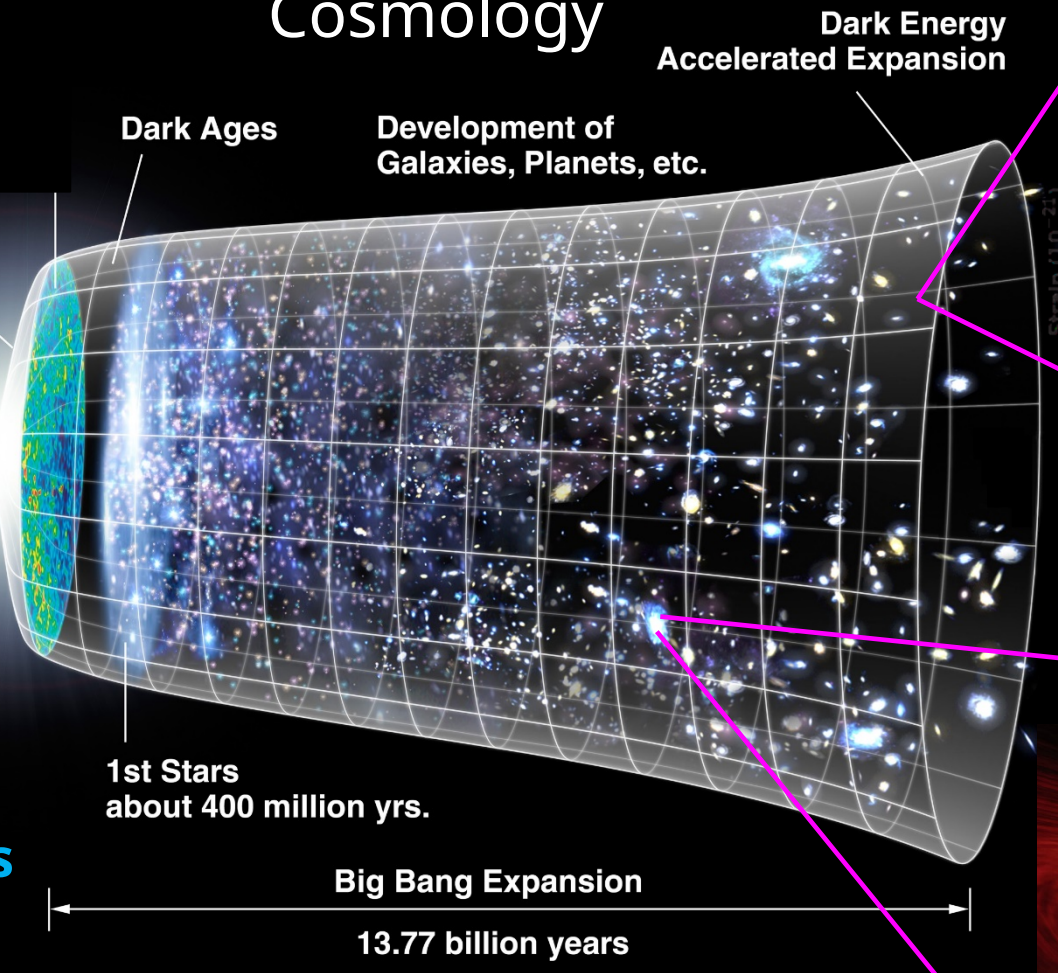

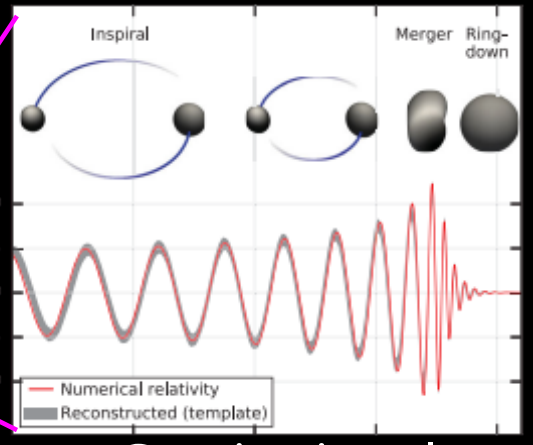

Gravitational-wave mergers

High-Energy Astrophysics

Multi-messenger Astronomy!!

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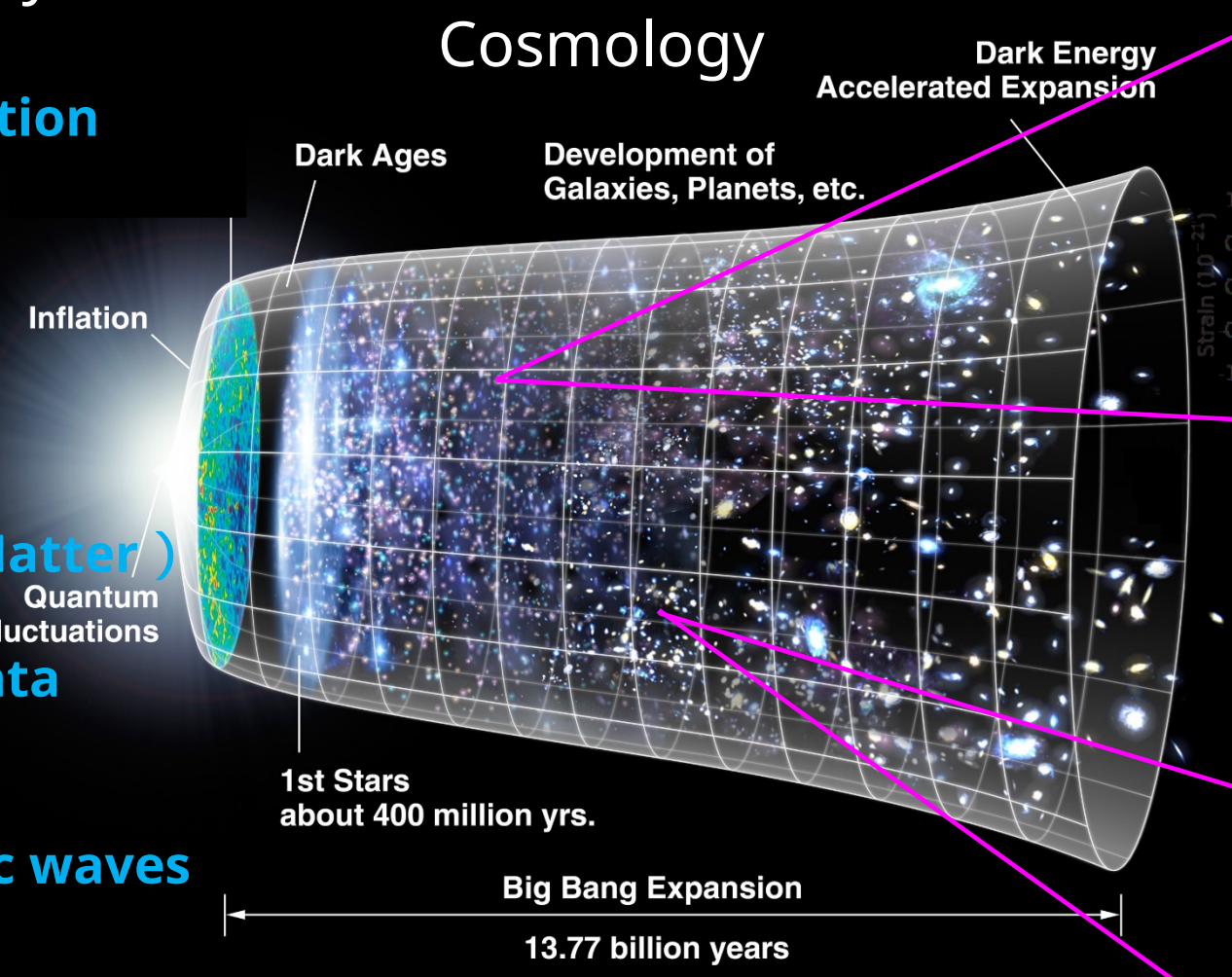
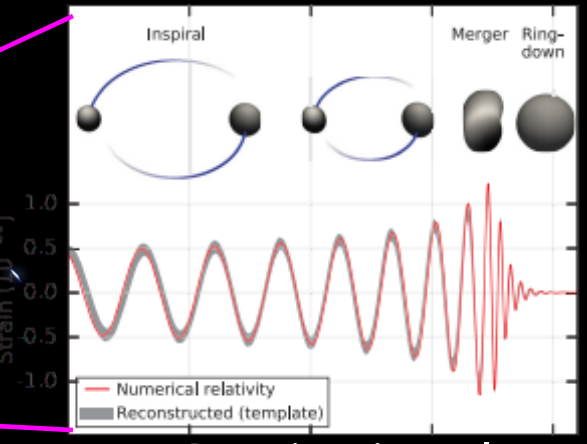




Gravitational-wave mergers

Supermassive BHs
LISA

Multi-messenger Astronomy!!

Faculty members of A5 sub-course (accepting students)

https://www.phys.s.u-tokyo.ac.jp/faculty_members

本郷
Hongo

柏
Kashiwa

名前	所属	専門分野	備考
Kipp CANNON	RESCEU	Gravitational wave observation	
Kenta HOTOKEZAKA	RESCEU	Relativistic astrophysics	
Shinji MUKOHYAMA	RESCEU	Cosmology and gravity	
Naoki YOSHIDA	Physics	Star formation and evolution	
Katsuaki ASANO	ICRR	High-energy astrophysics	
Hideyuki TAGOSHI	ICRR	Gravitational wave observation	
Masahiro TAKADA	IPMU	Observational cosmology	

Research Topics of A5 sub-course

Theory ・
Simulation
Data Science

Cosmology, Star formation

Mukohyama

Dark energy, Dark matter, Inflation, Gravity theory.

Yoshida

Galaxy and star formation, Chemical evolution, Planet formation, BH formation, Cosmological simulations, Machine learning.

Takada

Observational Cosmology, Tests of cosmology, Dark matter, Dark energy, Neutrino models
Data analysis (Subaru, LSST).

High-Energy Astrophysics

Hotokezaka

Compact objects, Binary mergers, GW, Kilonova and transients, Nucleosynthesis, Numerical relativity, hydro simulations.

Asano

High-energy astrophysics, γ-ray bursts, Relativistic jets, Cosmic rays, High-energy neutrinos, Plasma.

Gravitational-waves

Cannon

Detection algorithms, Lensed signals, Tests of gravity, Cosmology.

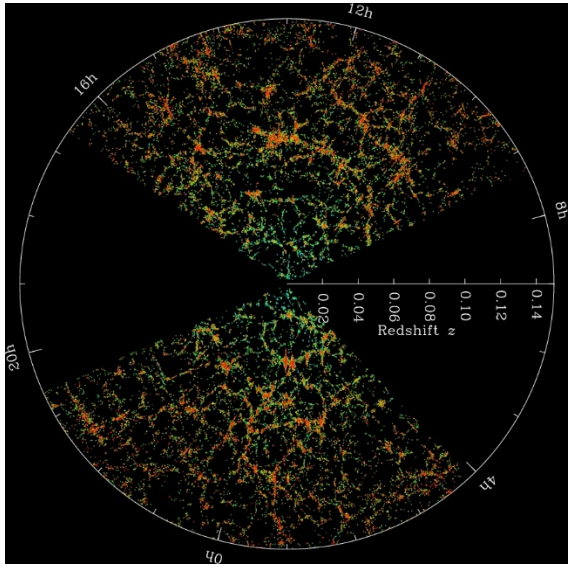
Tagoshi

KAGRA, Waveform modeling, Gravitational-wave astronomy.

Observational Cosmology ・ Star Formation

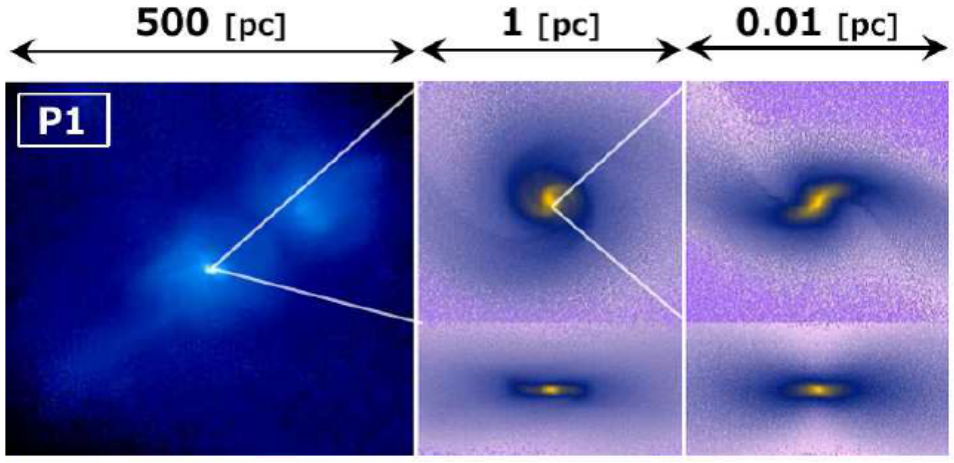
Observational Cosmology

- Large Scale Structure
- Galaxy Clusters
- Star & Galaxy formation history
- Cosmic reionization



Star Formation

- Thermal evolution of gas
- Star formation
- Planet formation
- Binary evolution
- Supermassive BH formation

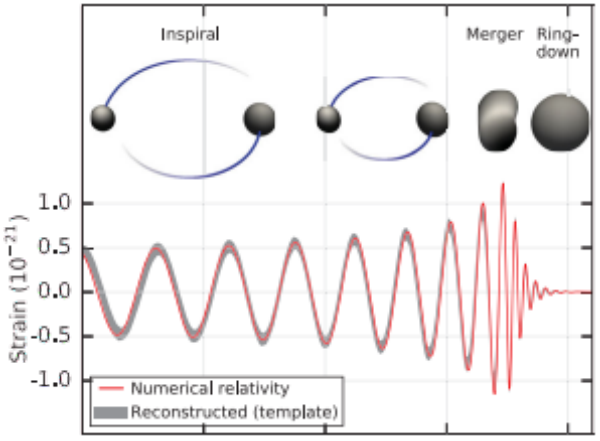


JWST has been getting excellent data.
Subaru PFS is operating. LSST is coming soon.

High-Energy Astrophysics ・ Gravitational Waves

Macrophysics

- Supernova
- Gamma-ray burst
- Relativistic jet
- Neutron star
- Black hole
- Binary merger (GW)



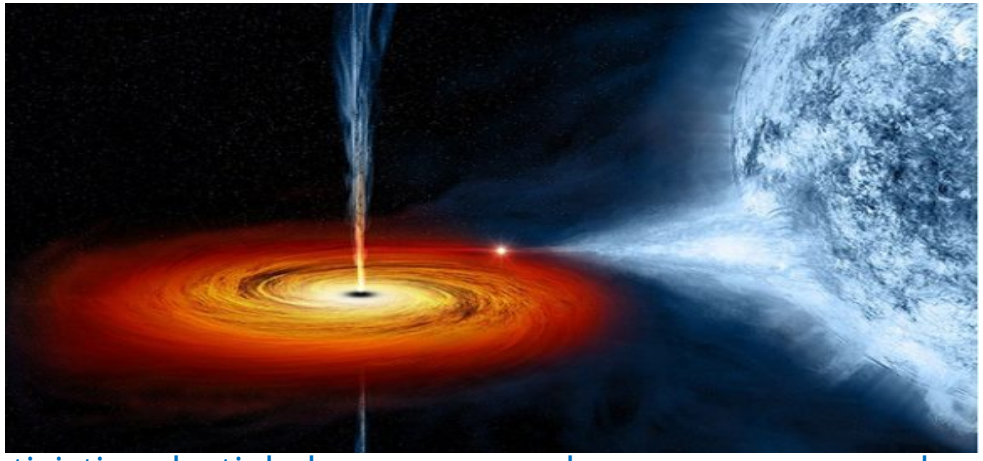
Microphysics & Radiation

- Plasma processes
- Particle acceleration （ shock, turbulence ）
- Γ-ray ・ X-ray ・ radio
- Cosmic ray （～ 10^{20}eV ）
- Neutrino
- Neucleosynthesis

Multi-messenger observations: LIGO/Virgo/KAGRA O4 Run, Next-generation of GW detectors, IceCube etc.

Katsuaki Asano （High Energy Astrophysics）

Theoretical studies of high-energy astrophysical phenomena



Relativistic celestial phenomena such as supernovae, pulsars, active galactic nucleus jets, gamma-ray bursts, and black hole objects.

This field, which has been observationally developing, still has many unresolved problems, including jet acceleration, particle acceleration, and radiation mechanisms.

Exploring diverse phenomena using diverse observations.

Visit our website!

Staff　Jiro Shimoda （Galaxy evolution and cosmic rays/supernova remnants）

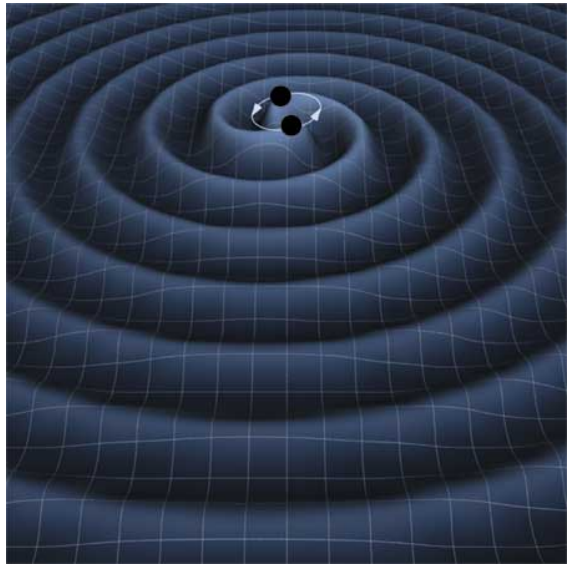
Opportunity to meet us

Today ： PM1 ； 30 ～ Room 207

Next week （30th）： AM10 ： 00 ～ at ICRR （Kashiwa）

Cannon Laboratory Group Intro

- Analyze data from gravitational-wave detectors
- Search for signals
- Interpret the signals
  - Properties of source?
  - Properties of spacetime?
- Where to find us: 6th floor Science Building 4 (RESCEU)
- **Openlabo TODAY: 1st floor Science Building 4 (RESCEU Seminar Room) and online at https://u-tokyo-ac-jp.zoom.us/j/82317933233?pwd=v4qxkWtDHP5hQNbesIp5SXxCIniU00.1**



Black Hole Collision

Openlabo URL

Lab.

Mukohyama group

Cosmology & Gravitation

https://www.resceu.s.u-tokyo.ac.jp/mukohyama_group/index_j.html
https://www2.yukawa.kyoto-u.ac.jp/~shinji.mukohyama/index-j.html

- We tackle the mysteries of the universe—such as **dark energy, dark matter and inflation**—by employing every available approach, including general relativity, quantum gravity theory, effective field theory, and particle physics.
- In addition, we conduct theoretical research to test **gravity beyond general relativity** using cosmology and gravitational waves.
- Open Lab jointly organized by RESCEU faculty members Today (May 23) from 15:30 to 17:30.
  Room 1116, 1F, School of Science Bldg. 4.
  Participation via Zoom is also available.
  https://u-tokyo-ac-jp.zoom.us/j/82317933233?pwd=v4qxkWtDHP5hQNbesIp5SXxCIniU00.1

Hideyuki Tagoshi 田越秀行 (A5 sub course)

Hideyuki Tagoshi (Prof.) 田越秀行 教授
Place: Institute for Cosmic Ray Research, Kashiwa 宇宙線研究所(柏)

Group members:
Soichiro Morisaki (Associate Prof.) 森崎宗一郎 准教授
Nami Uchikata (Assistant Prof.) 内潟那美 特任助教
2 postdocs (2 more postdocs from summer 2026)
9 graduate students (master 3, doctor 6)

Research theme: Gravitational wave data analysis and theory

- Data analysis aimed at the detection of gravitational waves with KAGRA.
- Data analysis for LIGO/Virgo/KAGRA, signal detection and parameter estimation.
- Theoretical interpretation of detected gravitational-wave signals.
  (e.g., population distributions of binary black holes, binary neutron star mergers and the equation of state, etc.)
- Theoretical studies related to gravitational waves from compact binary mergers
  (e.g., black hole ringdown, post-Newtonian approximation, etc.)

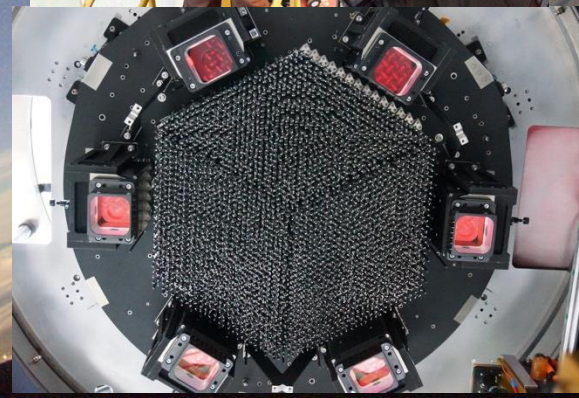
If you have any questions, please contact tagoshi@icrr.u-tokyo.ac.jp

Masahiro Takada (A5, Kavli IPMU @Kashiwa)

- Field: Cosmology
- Theory, Data, Parameter Inference
- Main focus for the next ~5 years: Subaru Prime Focus Spectrograph (PFS) project
- PFS will create a “3D” map of the Universe, using more than 4 million galaxies

- Goals: the physics of inflation, the nature of dark matter, the nature of dark energy, the neutrino mass
- Methods: weak/micro lensing, galaxy clustering analysis, AI/ML
- The current team members: 9 grad students, ~5 postdoc researchers, and many collaborators in the international Subaru projects

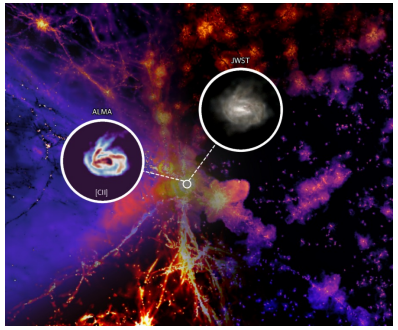
- Kavli IPMU open house on June 19 (Friday)
- Also, please email me if you are interested in or have any questions

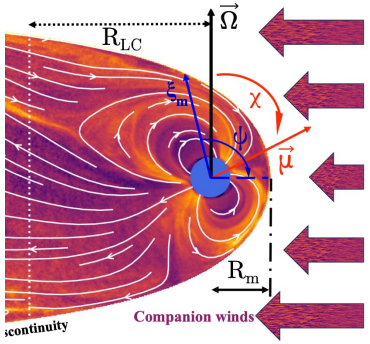


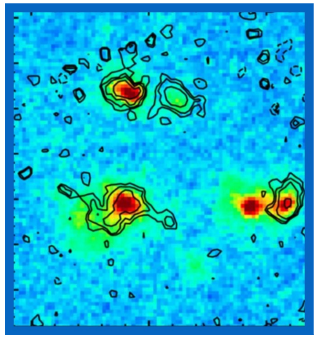
Yoshida Group: Numerical Cosmology and Astrophysics

(Yoshida, Moriwaki, Kato, Ogata, Garldi)

- Formation of stars, galaxies and blackholes
- Supernova and time domain astronomy
- Big data science with wide-field cosmology surveys
- High performance computing including quantum algorithm







Collaboration with RIKEN AIP, Kavli IPMU, and domestic universities such as Kyoto-U, Nagoya-U

International partners include Princeton U, Harvard-CfA, UCLA, SNS (Italy), Cambridge