Division of Mathematical and Physical Sciences	Research field	Elementary Particle, Cosmology, Theoretical Physics	Lab. ID MP14
Laboratory web site	http://hep.s.kanazawa-u.ac.jp/index-eg.html		

Research subjects

After the discovery of the Higgs particle at LHC (world wide collaborative research), the standard model of the elementary particle has been finally established. Now our next targets are what has been established by experiments but are not explained by the standard model, that is, neutrino masses and lepton mixings, dark matter, dark energy, etc. We are working for creating new models and unified models beyond the standard model, and analyze them phenomenologically focusing on the feasibility of experimental verification in the near future.
Also our laboratory has active groups working for QCD world by Monte Carlo simulation technique using super computers including the Kei at Kobe, and for fundamental investigation of the field theory, quantum systems and statistical systems using the renormalization group method, path integral method, etc.

Master/Doctor course: Education policy, curriculum, typical activity in the laboratory

Master course: The first grade students take two seminars, elementary particle physics and field theory, using English textbooks. At the beginning of the second grade, the students decide their practical subject for the Master thesis and belong to one of the research groups, after consultation with staffs.
Doctor course: Students select the primary staff or research group to work with, and collaborative research works are started. Doctor students are encouraged to go for outer activities, participating research workshops/meetings, international conferences, even foreign country institutes for months. Financial supports are usually available and determined by the laboratory meeting.
As for foreign students, we have a couple of foreign students, and all activities or correspondences in the laboratory are done in English.
The laboratory is managed by a weekly labo-meeting which must be attended by staffs and DC students, where all policies and practical financial supports for research are discussed and determined.

Daily life in the laboratory, etc.

Personal working desk with a personal computer is available for every student. Also the PC cluster machine can be used for parallel processing numerical calculations.
All relevant students of undergraduate, Master, Doctor and post Doc researchers share the laboratory rooms, and everyday free discussion on physics or related topics are strongly encouraged.
Many laboratory activities are organized like, welcome party for new comers, excursion, summer workshop, etc.
The tennis circle of laboratory has several members and they enjoy playing weekly.

Message or comments by the laboratory faculty staffs

Theoretical physics is very robust and will be a basic literacy or skill for any careers after graduation. About a half of the Master graduates take occupation as high school teachers, ICT enterprise laboratory staffs, public servants, etc. The rest half will enter the Doctor course. After taking the doctoral degree, graduates will be post doc researchers at domestic or foreign institutes, research or educational staffs at higher education organization, research laboratory staffs at ICT related large or venture companies, etc.

Recent Master theses in these 3 years (+ more if appropriate)

year.month	Thesis title (including English translation of Japanese thesis title)
2017.3	Study of the gravitational wave originated in inflation
2017.3	Indirect detection of dark matter with gamma-rays
2017.3	Deep Learning and Renormalization Group
2017.3	Tensor network renormalization analysis of 2-dimensional spin model
2017.3	W Boson Scattering in the Minimal Supersymmetric Standard Model
2016.3	Phase Structure of Ising Model
2016.3	Application of higher order tensor renormalization group analysis to finite density fermion system
2016.3	Reheating temperature and unitarity violation in the Higgs inflation model
2015.3	Direct observation of the higgs triplet model at LHC
2015.3	Analysis of the 2-dimensional Ising model by the domain wall renormalization group
2015.3	Extension of the standard model according to the scale invariance and the feasibility of testing it at LHC
2015.3	Analysis of the 2-dimensional Ising model by the domain wall renormalization group
2015.3	Reheating after the inflation in the radiative seesaw model
2014.3	Electroweak symmetry breaking due to the strongly coupled higgs sector
2014.3	High energy neutrinos transpassing the sun
2014.3	QCD phase structure under the external magnetic field by the chiral effective models.
2014.3	Conformal field theory and critical phenomena
2014.3	Neutrino masses and the dark matter from the radiative seesaw mechanism
2014.3	Finite temperature QCD phase structure under the strong magnetic fields

2014.3	Monochromatic gamma by the pair annihilation of the dark matter
2013.3	Constraints on vector like fermion
2013.3	Non-perturbative renormalization group analysis of the finite temperature and density Nambu-Jona-Lasinio model.
2013.3	Finite temperature phase transition of the SU(2) gauge theory
2013.3	Baryon number generation by the radiative seesaw models
Recent Doctoral theses in these 3 years (+ more if appropriate)	
year.month	Thesis title (including English translation of Japanese thesis title)
2017.3	Analysis of Spontaneous Mass Generation Mechanism
2017.3	Dark matter and phase transition in the early universe in a classically scale invariant extension of the standard model
2016.9	Computation of correlation functions by tensor renormalization group method
2016.3	Inflation and baryon number asymmetry in an extended radiative seesaw model
2016.3	Non-perturbative aspects of elementary particle physics
2015.9	Sub-Planckian Inflation Due To A Complex Scalar In A Modified Radiative Seesaw Model
2015.3	Finite density Gross-Neveu model analyzed by the Grassmann tensor renormalization group
2014.3	Multi component dark matter analysis of the extended standard model and its feasibility of detection
2014.3	Weak solution of the renormalization group equation and analysis of the dynamical chiral symmetry breaking
2013.3	Beyond the ladder analysis of the dynamical chiral symmetry breaking by the non-perturbative renormalization group
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