BIOGRAPHICAL SKETCH

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NAME: Mukohyama, Shinji

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	END DATE MM/YYYY	FIELD OF STUDY
Kyoto University, Kyoto	BS	03/1994	Physics
Kyoto University, Kyoto	MS	03/1996	Physics
Kyoto University, Kyoto	PHD	03/1999	Physics
University of Victoria, Victoria	Postdoctoral Fellow	08/2001	Physics
Harvard University, Cambridge	Postdoctoral Fellow	09/2004	Physics

A. Personal Statement

I am a theoretical physicist specializing in cosmology and gravitation, holding professorships at Kyoto University and the University of Tokyo. My research spans braneworld cosmology, string cosmology, Hořava-Lifshitz cosmology, dark energy and dark matter, modification of gravity at long distance and time scales, the effective field theory approach to gravity, the cosmological constant problem, black hole entropy, and so on. My contributions include formulating the ghost condensation mechanism—an effective field theory (EFT) applying the Higgs mechanism to gravity—that developed into the EFT of inflation and EFT of dark energy, now standard frameworks for analyzing cosmological perturbations and confronting theories with observations. My more recent work extends these frameworks to black hole perturbations in the presence of dark energy. I published more than 250 research papers, in particular more than 90 papers in the last 5 years, in referred journals. Co-authors of my papers in the last 5 years include more than 50 young researchers (graduate students and postdocs). I gave around 40 invited talks at international conferences in the last 5 years. I am also deeply committed to mentoring young researchers; over 20 advanced degrees have been completed under my supervision, and many former students/postdocs contribute actively to cosmology and gravitational theory worldwide. I regularly organize international conferences and workshops, and am serving on the editorial boards of 5 international journals (EPJC, GRG, PTEP, AAPPS Bulletin, Universe).

B. Positions, Scientific Appointments and Honors

Positions and Scientific Appointments

2025 -	Professor, RESCEU, University of Tokyo, Tokyo
2014 -	Professor, YITP, Kyoto University, Kyoto
2014 -	Visiting Senior Scientist, Kavli IPMU, University of Tokyo, Tokyo
2008 - 2014	Associate Professor, Kavli IPMU, University of Tokyo, Tokyo
2004 - 2008	Assistant Professor, RESCEU, University of Tokyo, Tokyo

Honors

2017 - 2018	Visiting Professorship, University of Tours
2014	Lagrange Award, Institut Lagrange de Paris
2007	Young Scientist Award, Physical Society of Japan

C. Contribution to Science

1. Effective Field Theory (EFT) of Gravity: By applying the Higgs mechanism to gravity, I proposed ghost condensation, a consistent infrared modification of gravity, and its EFT. This framework developed into the

EFT of inflation, adopted by the ESA Planck team, and the EFT of dark energy, which bridges theory and observation via e.g. Boltzmann codes. More recently, I extended these EFTs to arbitrary backgrounds with timelike scalar profile, and applied the general EFT to black holes in the presence of dark energy.

a. Mukohyama Shinji, Yingcharoenrat Vicharit. Effective field theory of black hole perturbations with timelike scalar profile: formulation. JCAP. 2022; 09:010. DOI: 10.1088/1475-7516/2022/09/010
b. Arkani-Hamed Nima, Creminelli Paolo, Mukohyama Shinji, Zaldarriaga Matias. Ghost inflation. JCAP. 2004; 04:001. DOI: 10.1088/1475-7516/2004/04/001
c. Arkani-Hamed Nima, Cheng Hsin-Chia, Luty Markus A., Mukohyama Shinji. Ghost condensation and a consistent infrared modification of gravity. JHEP. 2004; 05:074. DOI: 10.1088/1126-6708/2004/05/074

2. Cosmological Constant (cc) Problem: I proposed a cosmological model towards a solution to the cc problem. We succeeded in dynamically making the cc sufficiently small. The remaining problem was how to reheat the universe after the relaxation of the cc and this was addressed by the extended model in my more recent work.
   a. Martens Paul, Mukohyama Shinji, Namba Ryo. Reheating after relaxation of large cosmological constant. JCAP. 2022; 11:047. DOI: 10.1088/1475-7516/2022/11/047
   b. Mukohyama Shinji. Gravity in the dynamical approach to the cosmological constant. Phys. Rev. D. 2004; 70:063505. DOI: 10.1103/PhysRevD.70.063505
   c. Mukohyama Shinji, Randall Lisa. A Dynamical approach to the cosmological constant. Phys. Rev. Lett.. 2004; 92:211302. DOI: 10.1103/PhysRevLett.92.211302
3. Massive Gravity Theories: I systematically studied cosmological solutions and their stability in nonlinear massive gravity and proposed the minimal theory of massive gravity—a stable theory of massive gravity realizing accelerating cosmology without dark energy.
   a. De Felice Antonio, Mukohyama Shinji. Minimal theory of massive gravity. Phys. Lett. B. 2016; 752:302--305. DOI: 10.1016/j.physletb.2015.11.050
   b. De Felice Antonio, Gumrukcuoglu A. Emir, Mukohyama Shinji. Massive gravity: nonlinear instability of the homogeneous and isotropic universe. Phys. Rev. Lett.. 2012; 109:171101. DOI: 10.1103/PhysRevLett.109.171101
   c. Gumrukcuoglu A. Emir, Lin Chunshan, Mukohyama Shinji. Open FRW universes and self-acceleration from nonlinear massive gravity. JCAP. 2011; 11:030. DOI: 10.1088/1475-7516/2011/11/030
4. Hořava–Lifshitz Cosmology: I proposed cosmological models within renormalizable and unitary quantum gravity, solving the flatness problem and generating scale-invariant perturbations without inflation, as well as providing explanations for galaxy rotation curves without dark matter.
   a. Bramberger Sebastian F., Coates Andrew, Magueijo João, Mukohyama Shinji, Namba Ryo, Watanabe Yota. Solving the flatness problem with an anisotropic instanton in Hořava-Lifshitz gravity. Phys. Rev. D. 2018; 97(4):043512. DOI: 10.1103/PhysRevD.97.043512
   b. Mukohyama Shinji. Dark matter as integration constant in Horava-Lifshitz gravity. Phys. Rev. D. 2009; 80:064005. DOI: 10.1103/PhysRevD.80.064005
   c. Mukohyama Shinji. Scale-invariant cosmological perturbations from Horava-Lifshitz gravity without inflation. JCAP. 2009; 06:001. DOI: 10.1088/1475-7516/2009/06/001
5. Brane-World Cosmology and Dark Radiation: I discovered general exact solutions describing four-dimensional homogeneous and isotropic universes in the five-dimensional braneworld model proposed by Randall and Sundrum. The extra-dimensional correction term, which I named dark radiation, is now a standard term in cosmology. I also developed a gauge invariant formalism of cosmological perturbations in the braneworld, including a 5-dimensional master equation and a doubly guage invariant junction condition.
   a. Mukohyama Shinji. Brane world solutions, standard cosmology, and dark radiation. Phys. Lett. B. 2000; 473:241--245. DOI: 10.1016/S0370-2693(99)01505-1
   b. Mukohyama Shinji. Gauge invariant gravitational perturbations of maximally symmetric space-times. Phys. Rev. D. 2000; 62:084015. DOI: 10.1103/PhysRevD.62.084015
   c. Mukohyama Shinji. Perturbation of junction condition and doubly gauge invariant variables. Class. Quant. Grav.. 2000; 17:4777--4798. DOI: 10.1088/0264-9381/17/23/301