



Sungwook E. HONG

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# Sungwook E. HONG

## Research Interests

Large-scale Structure of the Universe; Cosmological Simulations; Deep Learning in Astronomy; Astrobiology; Cosmic Reionization; Astronomical Instrumentation

## Education

**2004 – 2011, Korea Advanced Institute of Science and Technology**  
MS & PhD Integrated Degree in Physics

**2000 – 2004, Korea Advanced Institute of Science and Technology**  
BS in Physics

## Experience

**Oct 2020 – , Korea Astronomy & Space Science Institute**  
Senior Researcher

**Sep 2018 – Sep 2020, University of Seoul**  
Research Professor

**Dec 2016 – Aug 2018, Korea Astronomy & Space Science Institute**  
Researcher

**Jan 2013 – Nov 2016, Korea Institute for Advanced Study**  
KDES/QUC Research Fellow

**Oct 2011 – Jan 2013, Chungnam National University**  
Postdoctoral Researcher

**Mar 2011 – Sep 2011, Korea Advanced Institute of Science and Technology**  
Postdoctoral Researcher

## Awards

**2020, Young Astronomer's Award, Korea Astronomical Society**  
*for contributing the Korean astronomy by participation of large-volume numerical simulations for understanding the large-scale structures of the Universe, and by development of data analysis and application methods for understanding the nature of dark energy.*

**2015, Annual Best Science Paper Award, The Korea Federation of Science and Technology Societies**  
*Title: 2D genus topology of 21-cm differential brightness temperature during cosmic reionization*



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## Service

### Journal Reviewer

- Monthly Notices of the Royal Astronomical Society (3 times)
- Journal of the Korean Astronomical Society
- Publications of the Korean Astronomical Society

### Conference Organizer

- 2021, Korea Astronomy Machine Learning Workshop
- 2020 – , Workshop on Instrumentation for Astronomy and Space Science
- 2019, Workshop on ML in Astronomy and Astrophysics
- 2017 – 2018, K-GMT Science Program Users Meeting
- 2014, 2016 & 2020, KIAS Workshop on Cosmology and Structure Formation

### Committee

- 2019 – , Instrumentation Division, Korean Astronomical Society
- 2019 – , Korea Astronomy Machine Learning (KAML)
- 2017 – 2018, K-GMT Science & Instrumentation Working Group
- 2017 – 2018, The 2nd K-GMT Science White Paper Committee

### Conference Session Chair

- 2021, PASCOS 2021 — 26th International Symposium on Particles, Strings & Cosmology
- 2020, Workshop on Joint Australian and Korean Contributions to SKA
- 2017 – , Korean Astronomical Society Meeting
- 2018, 5th Korea-Japan Workshop on Dark Energy — Starobinsky's Universe
- 2015, SKA in Seoul — Asia-Pacific Regional Workshop on HI Science

## Media Coverage

### Jul 2021, Physics & High Technology (물리학과 첨단기술)

“A conversation among young astrophysicists (젊은 천체물리학자 대담)”  
(co-author)

### Sep 2017, The Math Donga Magazine (수학동아)

“Imagination with mathematics: How does the Universe look like? (수학으로 펼친 상상: 우주는 어떻게 생겼을까?)” (consultant)

### Apr 2017, The Math Donga Magazine (수학동아)

“Mathematics is the alien language! (수학은 외계어!)” (consultant)

### Mar 2017, Horizon (과학의 지평)

“Analysis of 21cm radio signal from the epoch of cosmic reionization (우주 재이온화 시기, 그리고 21cm 전파 신호 분석)” (author)

### Oct 2016, The Science Donga Magazine (과학동아)

“To the universe: Answer me, alien civilizations!” (전 우주에 고한다, 외계문명 응답하라!)” (author)

### Mar 2015, Horizon (과학의 지평)

“Spatial and velocity distribution of galaxies in cluster from cosmological simulations” (우주 거대 구조 시뮬레이션에서 은하단 내부의 공간/속도 분포)” (author)



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## Publications

[Weak-lensing mass reconstruction of galaxy clusters with convolutional neural network](#)

Hong, S.E., Park, S., Jee, M.J., Bak, D., & Cha, S., ApJ submitted, arXiv:2102.05403

[Revealing the local cosmic web from galaxies by deep learning](#)

Hong, S.E., Jeong, D., Hwang, H.S., & Kim, J., ApJ 913, 76 (May 2021)

[The Horizon Run 5 cosmological hydrodynamic simulation: Probing galaxy formation from kilo- to giga-parsec scales](#)

Lee, J., Shin, J., Snaith, O.N., *et al.*, ApJ 908, 11 (Feb 2021)

[Cosmological parameter estimation from the two-dimensional genus topology — Measuring the expansion history using the genus amplitude as a standard ruler](#)

Appleby, S., Park, C., Hong, S.E., *et al.*, ApJ 907, 75 (Feb 2021)

[Deep-learning study of the 21-cm differential brightness temperature during the epoch of reionization](#)

Kwon, Y., Hong, S.E., & Park, I., JKPS 77, 49 (Jul 2020)

[Cosmological information from the small-scale redshift space distortions](#)

Tonegawa, M., Park, C., Zheng, Y., *et al.*, ApJ 897, 17 (Jun 2020)

[Cosmological parameter estimation from the two-dimensional genus topology — Measuring the shape of the matter power spectrum](#)

Appleby, S., Park, C., Hong, S.E., Hwang, H.S., & Kim, J., ApJ 896, 145 (Jun 2020)

[SCUBA-2 Ultra Deep Imaging EAO Survey \(STUDIES\) IV. Spatial clustering and halo masses of submillimeter galaxies](#)

Lim, C.-F., Chen, C.-C., Wang, W.-H., *et al.*, ApJ 895, 104 (Jun 2020)

[Constraining cosmology with big data statistics of cosmological graphs](#)

Hong, S., Jeong, D., Hwang, H.S., *et al.*, MNRAS 493, 5972 (Feb 2020)

[MANIFEST metrology toolkit](#)

Goodwin, M. & Hong, S.E., Proc. SPIE 11203, 112031C (Jan 2020)

[Alcock-Paczynski test with the evolution of redshift-space galaxy clustering anisotropy](#)

Park, H., Park, C., Sabiu, C.G., *et al.* ApJ 881, 146 (Aug 2019)

[Multiple rooks of chess: A generic integral field unit deployment technique](#)

Chattopadhyay, S., Ramaprakash, A.N., Khodade, P., *et al.* Proc. SPIE 10706, 107065S (Jul 2018)

[Noise characterization of IUCAA digital sampling array controller](#)

Chattopadhyay, S., Ramaprakash, A.N., Joshi, B., *et al.* JATIS 4, 036002 (Jul 2018)

[Wide-field multi-object spectroscopy with MANIFEST](#)

Lawrence, J., Ben-Ami, S., Brown, D.M., *et al.* Proc. SPIE 10702, 10702A6 (Jul 2018)

[DOTIFS: Spectrograph optical and opto-mechanical design](#)

Chung, H., Ramaprakash, A.N., Khodade, P., *et al.* Proc. SPIE 10702, 107027A (Jul 2018)



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**Minkowski tensors in two dimensions: Probing the morphology and isotropy of the matter and galaxy density fields**

Appleby, S., Chingangbam, P., Park, C., *et al.* ApJ 858, 87 (May 2018)

**Cosmological constraints from the redshift dependence of the Alcock-Paczynski effect: Dynamical dark energy**

Li, X.-D., Sabiu, C.G., Park, C., *et al.* ApJ 856, 88 (Apr 2018)

**A question of separation: Disentangling tracer bias and gravitational non-linearity with counts-in-cells statistics**

Uhlemann, C., Feix, M., Codis, S., *et al.* MNRAS 473, 5098 (Feb 2018)

**Cosmological parameter estimation using the genus amplitude — Application to mock galaxy catalogs**

Appleby, S., Park, C., **Hong, S.E.**, & Kim, J., ApJ 853, 17 (Jan 2018)

**Small-scale effects of thermal inflation on halo abundance at high- $z$ , galaxy substructure abundance, and 21-cm power spectrum**

**Hong, S.E.**, Zoe, H., & Ahn, K., PRD 96, 103515 (Nov 2017)

**CMB spectral distortion constraints on thermal inflation**

Cho, K., **Hong, S.E.**, Stewart, E.D., & Zoe, H., JCAP 08(2017), 002 (Aug 2017)

**Cosmological constraints from the redshift dependence of the volume effect using the galaxy 2-point correlation function across the line of sight**

Li, X.-D., Park, C., Sabiu, C.G., *et al.* ApJ 844, 91 (Aug 2017)

**Topology of large-scale structure of galaxies in two dimensions — Systematic effects**

Appleby, S., Park, C., **Hong, S.E.**, & Kim, J., ApJ 836, 45 (Feb 2017)

**Cosmological constraints from the redshift dependence of the Alcock-Paczynski effect: Application to the SDSS-III BOSS DR12 galaxies**

Li, X.-D., Park, C., Sabiu, C.G., *et al.* ApJ 832, 103 (Dec 2016)

**AAO Starbugs: Software control and associated algorithms**

Lorente, N.P.F, Vuong, M.V., Shortridge, K., *et al.* Proc. SPIE 9913, 99130U (Aug 2016)

**Evolution of galaxy habitability**

Gobat, R. & **Hong, S.E.**, A&A 592, 96 (Aug 2016)

**The most bound halo particle-galaxy correspondence model: Comparison between models with different merger timescales**

**Hong, S.E.**, Park, C., & Kim, J., ApJ 823, 103 (May 2016)

**Radio and X-ray shocks in clusters of galaxies**

**Hong, S.E.**, Kang, H., & Ryu, D., ApJ 812, 49 (Oct 2015)

**Horizon Run 4 simulation: Coupled evolution of galaxies and large-scale structures of the universe**

Kim, J., Park, C., L'Huillier, B., & **Hong, S.E.**, JKAS 48, 213 (Aug 2015)

**Effects of thermal inflation on small scale density perturbations**

**Hong, S.E.**, Lee, H.-J., Lee, Y.J., Stewart, E.D., & Zoe, H., JCAP 06(2015), 002 (Jun 2015)

**March of the Starbugs: Configuring fibre-bearing robots on the UK-Schmidt optical plane**

Lorente, N., Vuong, M., Satorre, C., *et al.* Proc. ADASS XXIV, 265 (Mar 2015)



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**Field target allocation and routing algorithms for Starbugs**

Goodwin, M., Lorente, N., Satorre, C., *et al.* Proc. SPIE 9152, 91520S (Jul 2014)

**2D genus topology of 21-cm differential brightness temperature during cosmic reionization**

Hong, S.E., Ahn, K., Park, C., *et al.* JKAS 47, 49 (Apr 2014)

**Shock waves and cosmic ray acceleration in the outskirts of galaxy clusters**

Hong, S.E., Ryu, D., Kang, H., & Cen, R., ApJ 785, 133 (Mar 2014)

**The possibility of inflation in asymptotically safe gravity**

Hong, S.E., Lee, Y.J., & Zoe, H., IJMPD 21, 1250062 (Jul 2012)

**Anthropic likelihood for the cosmological constant and the primordial density perturbation amplitude**

Hong, S.E., Stewart, E.D., & Zoe, H., PRD 85, 083510 (Apr 2012)

**The causal structure of dynamical charged black holes**

Hong, S.E., Hwang, D.-i., Stewart, E.D., & Yeom, D.-h., Class. Quant. Grav. 27, 045014 (Feb 2010)

**Critical review on holographic measure over the multiverse**

Hong, S.E., Yeom, D.-h., & Zoe, H., Int. J. Conf. Ser. 1, 377 (Dec 2009)

**Black hole complementarity with local horizons and Horowitz-Maldacena's proposal**

Hong, S.E., Hwang, D.-i., Yeom, D.-h., & Zoe, H., JHEP 12(2008), 080 (Dec 2008)



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## Scientific Talks

### Weak-lensing mass reconstruction of galaxy clusters with convolutional neural network

- Sep 2021, *ESA/ESAC Galaxy Cluster Mass Meeting 2021*, Online
- Oct 2020, *Korean Astronomical Society Meeting 2020*, Daejeon, Korea
- Jul 2020, *Korean Physics Society Spring Meeting 2020*, Online
- Feb 2020, *The 9th Survey Science Group Workshop*, Jeongseon, Korea

### Revealing the local cosmic web from galaxies by deep learning

- Jul 2021, *CLUES Collaborational Meeting*, Online (invited)
- Dec 2020, *7th Korea-Japan Workshop on Dark Energy*, Online (invited)
- Nov 2020, *Astroparticle: The Next Frontier of Fundamental Physics*, Pohang, Korea (invited)
- Nov 2020, *AAPPS-DACG Workshop on Astrophysics, Cosmology and Gravitation*, Online
- Nov 2020, *The 9th KIAS Workshop on Cosmology and Structure Formation*, Seoul, Korea
- Aug 2020, *14th International Conference on Gravitation, Astrophysics, and Cosmology*, Online
- Oct 2019, *Korean Physics Society Fall Meeting 2019*, Gwangju, Korea
- Oct 2019, *Korean Astronomical Society Fall Meeting 2019*, Seoul, Korea

### Deep-learning study of the 21cm differential brightness temperature during the epoch of reionization

- May 2021, *East Asia SKA Workshop 2021*, Online

### Repeatability of very-large-scale structures in the Horizon Run 4 simulation

- Apr 2019, *CosKASI Conference 2019—The Correlated Universe*, Jeju, Korea
- Feb 2019, *XVI Tartu-Tuorla Cosmology Meeting*, Tartu, Estonia (invited)
- Nov 2018, *The 8th KIAS Workshop on Cosmology and Structure Formation*, Seoul, Korea
- Oct 2018, *Korean Physics Society Fall Meeting 2018*, Changwon, Korea
- Jan 2018, *The 7th Survey Science Group Workshop*, Jeongseon, Korea

### Mock galaxy catalogs in Horizon Run 4 & Multiverse simulations

- Jan 2019, *IMS Workshop 2019*, Seoul, Korea
- Nov 2016, *The 7th KIAS Workshop on Cosmology and Structure Formation*, Seoul, Korea
- Oct 2015, *Korean Astronomical Society Fall Meeting 2015*, Hongcheon, Korea
- Jun 2015, *Innovative Cosmological Simulations with Machine Learning and Statistics in the Era of LSST*, Pittsburgh, USA
- Feb 2009, *SDSS-KSG Winter Workshop*, Jeongseon, Korea



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**Small-scale features of thermal inflation: CMB distortion, substructure abundance, and 21cm power spectrum**

- Apr 2018, *Korean Physic Society Spring Meeting 2018*, Daejeon, Korea
- Jul 2017, *13th International Conference on Gravitation, Astrophysics, and Cosmology*, Seoul, Korea
- Oct 2015, *FRP: The Origin and Evolution of the Universe*, Pohang, Korea

**Concept design of fiber-fed kilo-object spectrograph**

- Apr 2017, *CosKASI Conference 2017—Cosmological Quests for the Next Decade*, Daejeon, Korea
- Oct 2016, *Korean Astronomical Society Fall Meeting 2016*, Daejeon, Korea

**Algorithm development for Starbugs: Robotic positioner for MANIFEST**

- Feb 2015, *The 3rd Survey Science Group Workshop*, Jeongseon, Korea
- Feb 2014, *The 2nd Survey Science Group Workshop*, Jeongseon, Korea

**Effect of the cosmological constant on the number density of Milky-way-like galaxies**

- Nov 2012, *The 5th KIAS Workshop on Cosmology and Structure Formation*, Seoul, Korea (invited)
- May 2012, *The KASI-APCTP Joint Mini-workshop on Science and Technology of BigBOSS*, Jeju, Korea
- Feb 2012, *Survey Science Group Workshop*, Jeongseon, Korea
- Jul 2011, *11th RESCEU/DENET Summer School: Dark Energy in the Universe*, Kumamoto, Japan

**Strong accretion shock waves in cluster outskirts and possibility of cosmic ray population inversion**

- Nov 2012, *APCTP Workshop on Magnetic Fields in Astrophysics*, Pohang, Korea
- Oct 2012, *Korean Astronomical Society Fall Meeting 2012*, Gwangju, Korea
- Sep 2012, *TRP Mini Workshop on Theories and Practices in Large Scale Structure Formation*, Gwangju, Korea (invited)
- Apr 2012, *Korean Astronomical Society Spring Meeting 2012*, Gyeongju, Korea

**2D genus topology of 21cm differential brightness temperature during cosmic reionization**

- Dec 2011, *APCTP Mini-Workshop on Recent Progresses in Dark Universe and Astro-Particle Physics*, Seoul, Korea
- Feb 2011, *East Asia Young Astronomers Meeting 2011*, Jeju, Korea
- Aug 2010, *10th RESCEU/DENET Summer School: Dark Energy in the Universe*, Kochi, Japan



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## Lectures

**Jul 2020 –, KIAS Astrophysics Summer School, Online**

Astrophysics & artificial intelligence

**Spring 2020, University of Seoul, Seoul, Korea**

Physics seminar III

**Sep 2019 – Jun 2020, University of Seoul, Seoul, Korea**

Man, universe and civilization

**Jan 2019 – Sep 2020, Schools for Korea Astronomical Olympiad, Gohung & Yangju, Korea**

Cosmology

**Dec 2018, Special Lecture at University of Seoul, Seoul, Korea**

Understanding of modern physics: Cosmology

**Apr 2018, Special Lecture at Ewha Womens University, Seoul, Korea**

Large-scale structures in the universe

**Feb 2018, The 7th We Love Galaxies, Gapyeong, Korea**

Astronomy with computer simulations

## Colloquiums & Seminars

**Understanding large history of universe with its large-scale structure**

- Sep 2021, Colloquium at *Korea Astronomy and Space Science Institute*, Online
- Apr 2021, Colloquium at *Jeonbuk National University*, Jeonju, Korea
- Apr 2021, Colloquium at *Chungnam National University*, Online

**Machine learning in astrophysics**

- Jul 2021, Seminar at *Daejeon Oryu Elementary School*, Daejeon, Korea
- Dec 2019, Colloquium at *Sejong University*, Seoul, Korea
- Nov 2019, Colloquium at *Daegu Gyungbuk Institute of Science and Technology*, Daegu, Korea
- Sep 2018, *The 2nd Deep Neural Network Workshop*, Seoul, Korea

**Revealing the local cosmic web from galaxies by deep learning**

- May 2021, *Turkey & Korea Machine Learning Meeting*, Online
- Mar 2021, *Yonsei Lab for Dark Energy Special Lecture*, Online

**Mock galaxy catalogs in Horizon Run 4 & Multiverse simulations**

- Oct 2020, *Korea Astronomical Society Meeting 2020*, Daejeon, Korea (acceptance speech of the *Young Astronomer's Award*)
- Feb 2019, *Colloquium at Tartu Observatory*, Tartu, Estonia
- Jul 2018, *Colloquium at University of Seoul*, Seoul, Korea

**Effect of the cosmological constant on the number density of Milky-way-like galaxies**

- Dec 2011, Colloquium at *Sogang University*, Seoul, Korea
- Sep 2009, Colloquium at *İzmir Institute of Technology*, İzmir, Turkey