

## Sungho Hong, PhD

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### Education

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- University of Pennsylvania** Aug 2004  
PhD in Physics - Theoretical High Energy Physics.  
Thesis: *Hadron Form Factors and Interactions: Comparing AdS/CFT and QCD.*
- Korea Advanced Institute of Science and Technology** Aug 1999  
MSc in Physics - Elementary Particle Physics.  
Thesis: *Aspects of String Theory Compactified on Orbifold.*
- Korea Advanced Institute of Science and Technology** Feb 1995  
BSc in Physics.

### Research Experience

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- Group Leader, Okinawa Institute of Science and Technology** 2012–presently  
*Computational Neuroscience Unit. Supervisor: Erik De Schutter*
- Currently studying the roles of biophysical mechanisms on neural information processing via computational methods, with a focus on the cerebellum.
  - Demonstrated that the cerebellar Purkinje neurons use a multiplexed coding scheme combining spike-time and firing rate to encode saccadic eye movements (collaboration with Hans-Peter Thier, U. Tübingen). Published in *eLife*.
  - Developing a large-scale (~ 1 million cells) computational model of the cerebellar cortex with physiological details. Published in *PLOS Comput Biol*.
  - Studied the cellular mechanisms for encoding circadian rhythms in the suprachiasmatic nucleus (SCN) and choroid plexus (with Toru Takumi, RIKEN BSI). Published in *PNAS* and *Nat Commun*.
- Researcher, Okinawa Institute of Science and Technology** 2007–2012  
*Computational Neuroscience Unit. Advisor: Erik De Schutter*
- Demonstrated that intrinsic cellular properties determine how neurons transfer information by correlated firing (with Steven Prescott, U. Toronto). This work resulted in two publications in *J Neurosci* and *Neuron*.
  - Developed a clustering method for analyzing imaging data of the *Bmal1* gene expression in the SCN neurons. Published in *J Neurosci*.
- Senior Fellow, University of Washington** 2004–2007  
*Physiology and Biophysics Department. Advisor: Adrienne L. Fairhall*
- Investigated biophysical interpretation of statistical models for neural coding by single neurons and cellular basis for adaptive information processing. This work resulted in 3 publications in *Neural Comput* and *PLOS Comput Biol*.
- Graduate Student, University of Pennsylvania** 1999–2004  
*Department of Physics and Astronomy. Advisor: Mirjam Cvetcic, Matthew J. Strassler*
- Developed superstring theory-based methods to analyze hadron-like strongly bound states for solving longstanding puzzles in nuclear physics such as the  $\rho$ -meson universality problem. This work resulted in 4 publications in *JHEP*.

## Grants and Awards

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- 2015 – 2017      Title: Role of Ion Channel Distributions in Dendritic Information Processing of the Cerebellar Purkinje Cell. PI: Sungho Hong and Weiliang Chen.  
JSPS KAKENHI (科研費) (Grant no:15K06725). Amount: ¥3,700,000.  
Role: Principal Investigator. Designed the research program and wrote the grant.
- 2012              OCNS Travel Award.

## Publications

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### *Journal Publications:*

- Wichert, I., Jee, S., De Schutter, E., **Hong, S.** (2020). Pycabnn: Efficient and extensible software to construct an anatomical basis for a physiologically realistic neural network model. *Front. Neuroinform.*, in press.
- Myung, J.\*, Schmal, C.\*, **Hong, S.\***, Tsukizawa, Y., Rose, P., Zhang, Y., Holtzman, M. J., De Schutter, E., Herzog, H., Bordyugov, G., Takumi, T. (2018). The choroid plexus is an important circadian clock component. *Nat. Commun.*, 9, 1062. (\*contributed equally)
- Sudhakar, S. K.\*, **Hong, S.\***, Raikov, I., Publio, R., Lang, C., Close, T., Guo, D., Negrello, M., De Schutter, E. (2017). Spatiotemporal network coding of physiological mossy fiber inputs by the cerebellar granular layer. *PLOS Comput. Biol.*, 13, e1005754. (\*contributed equally)
- Hong, S.**, Negrello, M., Junker, M., Smilgin, A., Thier, P., De Schutter, E. (2016). Multiplexed coding by cerebellar Purkinje neurons. *ELife* 5, e13810.
- Huang, S., **Hong, S.**, De Schutter, E. (2015). Non-linear leak currents affect mammalian neuron physiology. *Front. Cell. Neurosci.* 9, 432-41.
- Myung, J., **Hong, S.**, DeWoskin, D., De Schutter, E., Forger, D., and Takumi, T. (2015). GABA-mediated repulsive coupling between circadian clock neurons in the SCN encodes seasonal time. *Proc. Nat. Acad. Sci. USA* 112, E3920-9.
- Ratté, S., **Hong, S.**, De Schutter, E., and Prescott, S.A. (2013). Impact of neuronal properties on network coding: Roles of spike initiation dynamics and robust synchrony transfer. *Neuron* 78, 758-72.
- Hong, S.**, Robberechts, Q., and De Schutter, E. (2012). Efficient estimation of Phase Response Curves via Compressive Sensing. *J. Neurophysiol.*, 208, 2069–81.
- Myung, J., **Hong, S.**, Hatanaka, F., Nakajima, Y., De Schutter, E., and Takumi, T. (2012). Period coding of *Bmal1* oscillators in the suprachiasmatic nucleus. *J. Neurosci.* 32, 8900–18.
- Hong, S.**, Ratté, S., Prescott, S. A., and De Schutter, E. (2012). Single neuron firing properties impact correlation-based population coding. *J. Neurosci.* 32, 1413–28.
- Anwar, H., **Hong, S.**, and De Schutter, E. (2010). Controlling  $\text{Ca}^{2+}$ -Activated  $\text{K}^{+}$  channels with models of  $\text{Ca}^{2+}$  buffering in Purkinje cells. *Cerebellum*, 1–13 (online first).
- Hong, S.**, and De Schutter, E. (2008). Purkinje neurons: What is the signal for complex spikes? *Curr. Biol.* 18, R969–R971.
- Hong, S.**, Lundstrom, B.N., and Fairhall, A.L. (2008). Intrinsic gain modulation and adaptive neural coding. *PLOS Comput. Biol.* 4, e1000119.
- Lundstrom, B.N., **Hong, S.**, Higgs, M.H., and Fairhall, A.L. (2008). Two computational regimes of a single-compartment neuron separated by a planar boundary in conductance space. *Neural Comput.* 20, 1239–60.
- Hong, S.**, Agüera y Arcas, B., and Fairhall, A.L. (2007). Single neuron computation: from dynamical system to feature detector. *Neural Comput.* 19, 3133–72.

**Hong, S.**, Yoon, S., and Strassler, M.J. (2006). On the couplings of vector mesons in AdS/QCD. J. High Energy Phys. *04*, 003.

**Hong, S.**, Yoon, S., and Strassler, M.J. (2006). Adjoint Trapping: A new phenomenon at strong 't Hooft coupling. J. High Energy Phys. *03*, 012.

Erlich, J., **Hong, S.**, and Unsal, M. (2004). Matrix models, monopoles and modified moduli. J. High Energy Phys. *09*, 024.

**Hong, S.**, Yoon, S., and Strassler, M.J. (2004). Quarkonium from the fifth dimension. J. High Energy Phys. *04*, 046.

*Preprints online:*

Linderman, S.\*, Kros., L\*, **Hong, S.**, Meijas, J.F., Romano, V., Negrello, M., Bosman, L.W.J, De Zeeuw, C.I. (2020). Cerebellar Purkinje cells can differentially modulate coherence between sensory and motor cortex depending on region and behavior. bioRxiv. [doi:10.1101/2020.03.11.986943](https://doi.org/10.1101/2020.03.11.986943).

Han, D., De Schutter, E., and **Hong, S.** (2019). Lamina-specific neuronal properties promote robust, stable signal propagation in feedforward networks. bioRxiv. [doi:10.1101/596676](https://doi.org/10.1101/596676).

*Other Publications:*

**Hong, S.** (2004). Hadron Form Factors and Interactions: Comparing AdS/CFT and QCD. University of Pennsylvania Thesis (Philadelphia: University of Pennsylvania).

## **Presentations**

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*Talks in Conferences and Workshops:*

**Hong, S.** (2019) Lamina-specific neuronal properties promote robust, stable signal propagation in feedforward networks. OCNS Workshop: *Neural Multiplexed Coding* (Barcelona, Spain).

**Hong, S.** (2018). Impact of neuronal properties on network coding. NCTS Winter School: *Frontiers of Complex Systems Science*. (Taipei, Taiwan).

Han, D. and **Hong, S.** (2017). Heterogeneous layers stabilize propagation of a multiplexed spike signal in a feedforward network. Computational Neuroscience Meeting (CNS) 2017 (Antwerp, Belgium).

**Hong, S.** (2016) Multiplexed coding in the cerebellar cortex. Annual Meeting of Korean Society for Chemical Senses (Ansan, Korea).

**Hong, S.** and Myung, J. (2016) GABA-mediated phase couplings and seasonal time coding in the suprachiasmatic nucleus. Japanese Society for Mathematical Biology Meeting (Fukuoka, Japan).

**Hong, S.** (2015) GABA-mediated phase couplings and seasonal time coding in the suprachiasmatic nucleus. East Asia Joint Symposium on Biomedical Research (Okinawa, Japan).

**Hong, S.** (2015) Multiplexed coding by cerebellar Purkinje cells. OCNS Workshop: *Rate vs. temporal coding schemes: mutually exclusive or cooperatively coexisting?* (Prague, Czech).

**Hong, S.** (2015) Multiplexed coding by cerebellar Purkinje cells. Mini Symposium: *Recent Findings on the Cerebellar Microcircuitry* (Okinawa, Japan).

**Hong, S.** (2014) Exploring microcircuits in the cerebellum via computational modeling. Korean Society for Computational Neuroscience Meeting (Seoul, Korea) (*Plenary talk*).

Sudhakar, S. K., **Hong, S.**, and De Schutter, E. (2014). Patterns in network activity and information processing in a detailed computer model of the cerebellar granular layer, CNS 2014 (Quebec City, Canada).

**Hong, S.** (2012) Adaptive computation of neurons with Hodgkin-Huxley mechanisms. OCNS Conference: *60 Years of the Hodgkin-Huxley* (Cambridge, UK).

- Hong, S.** (2012) Single neuron firing properties impact correlation-based population coding. RIKEN BSI Workshop: *Circuit Function of the Brain* (Wako, Japan).
- Hong, S.** (2011) Single neuron firing properties impact correlation-based population coding. APCTP Young Computational Neuroscientist Workshop (Daejeon, Korea).
- Hong, S.,** and De Schutter, E. (2009). Rich single neuron computation implies a rich structure in noise correlation and population coding. CNS 2009 (Berlin, Germany).

*Invited Talks:*

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| Nov 2018  | Korea Brain Research Institute (Daegu, Korea)                                   |
| Oct 2017  | Center for Functional Connectomics, KIST (Seoul, Korea)                         |
| Oct 2017  | Dept. of Bio and Brain Engineering, KAIST (Daejeon, Korea)                      |
| Oct 2016  | Dept. of Brain and Cognitive Science, DGIST (Daegu, Korea)                      |
| July 2016 | Center for Functional Connectomics, KIST (Seoul, Korea)                         |
| Dec 2015  | College of Pharmacy, Hanyang University (Ansan, Korea)                          |
| July 2015 | Dept. of Neuroscience, Erasmus MC (Rotterdam, Netherlands)                      |
| July 2015 | Dept. of Cognitive Neurology, University of Tübingen (Tübingen, Germany)        |
| Aug 2013  | Blue Brain Project, EPFL (Lausanne, Switzerland)                                |
| Aug 2013  | Dept. of Neuroscience, Erasmus MC (Rotterdam, Netherlands)                      |
| Oct 2009  | Dept. of Physics, Kyoto University (Kyoto, Japan)                               |
| Oct 2009  | Graduate School of Biomedical Sciences, Hiroshima University (Hiroshima, Japan) |
| Mar 2008  | Dept. of Neurobiology, Yale School of Medicine (New Haven, CT)                  |
| Jun 2007  | Center for Brain Science, Harvard University (Cambridge, MA)                    |
| Jun 2006  | Dept. of Bio and Brain Engineering, KAIST (Daejeon, Korea)                      |
| Oct 2003  | Physics Dept., University of Washington (Seattle, WA)                           |

## Teaching Experience

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*Courses and Lectures:*

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| <p><b>Joint Lecturer, Okinawa Institute of Science and Technology (Okinawa, Japan)</b></p> <p><i>Course:</i> Computational Neuroscience (A310)</p> <p><i>Responsibilities:</i> Introduction building physiologically detailed computer models of neural systems and to a simulation platform (Materials available at <a href="https://github.com/shhong/a310_cns_2020">https://github.com/shhong/a310_cns_2020</a>).</p> | 2014-2020 |
| <p><b>Lecturer, Okinawa Course of Computational Neuroscience (Okinawa, Japan)</b></p> <p><i>Course:</i> Introduction to Numerical Methods for Ordinary/Partial Differential Equations</p> <p><i>Responsibilities:</i> Introducing differential equations and numerical methods to students with the biology background.</p>  | 2016      |
| <p><b>Graduate Teaching Assistant, University of Pennsylvania (Philadelphia, PA)</b></p> <p><i>Course:</i> Introduction to Physics</p> <p><i>Responsibilities:</i> Teaching physics lab classes, explaining experimental aims and designs, and grading reports.</p>  | 1999-2000 |

## Service and Outreach

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Academic Editor of <i>PeerJ</i> .	Since 2016
Reviewer for the <i>Computational Neuroscience Meeting</i> .	Since 2012
Reviewer for <i>PLOS Computational Biology</i> , <i>Physical Review Letters</i> , <i>Cerebellum</i> , <i>Neural Computation</i> , and <i>Journal of Physics A</i> .	Since 2004
Lab instructor in <i>Penn Summer Science Academy</i> , a summer science program for high school students.	2000
Military service (mandatory). The 72 Infantry Division, Korean Army.	1995–1996