



**Thursday, January 22**

Scaife Hall Auditorium  
Room 125 4:30 p.m.  
Refreshments at 4:00 p.m.



**Associate Professor Donhee Ham**

Harvard Electrical Engineering  
and Natural Sciences

**Donhee Ham** is John L. Loeb Associate Professor of the Natural Sciences and Associate Professor of Electrical Engineering at Harvard University, where he is with the School of Engineering and Applied Sciences (Programs: Electrical Engineering and Applied Physics). He received the B.S. degree in physics from Seoul National University, Korea, in 1996, where he graduated summa cum laude with the Valedictorian Prize as well as the Presidential Prize, ranked top 1st across the Natural Science College, and also with the Physics Gold Medal (sole winner). Following 1.5 years of mandatory military service in the Republic of Korea Army, he proceeded to California Institute of Technology, where he received the M.S. degree in physics in 1999 working on general relativity and gravitational astrophysics, and Ph.D. degree in electrical engineering in 2002 winning the Charles Wilts Doctoral Thesis Prize, Best thesis award in Electrical Engineering. His doctoral work examined statistical physics of electrical circuits. He was the recipient of the IBM Doctoral Fellowship, Li Ming Scholarship, IBM Faculty Partnership Award, IBM Research Design Challenge Award, Silver Medal in the National Mathematics Olympiad, and the fellow of the Korea Foundation of Advanced Studies. He shared Harvard's Hoopes prize with William Franklin Andress. ... (For more information about Professor Donhee Ham, visit our ece seminar website. )

**CMOS RF Biosensor Utilizing  
NMR – A Circuit Designer's  
Approach to Early Disease  
Detection**

I will present our recent work that showcases how silicon RF chips can be used not only for wireless RF applications, but also for biosensing aimed at early disease detection. The main function of our RF chip is to manipulate and monitor RF dynamics of protons in water via nuclear magnetic resonance (NMR). Target biological objects such as cancer marker proteins and viruses alter the proton dynamics, which is the basis for our biosensing. The RF chip has a receiver noise figure of only 0.6 dB. This high sensitivity made possible our construction of an entire NMR system around the RF chip in a 200-g platform, which is 600 times lighter, 400 times smaller, yet 60 times more mass sensitive than a state-of-the-art commercial benchtop NMR system. With an ability of sensing one biomolecule in 40 trillion water molecules, our system is a circuit designer's approach to pursue early disease detection and improve human healthcare in a low-cost, portable platform.

**ECE Seminar Hosts**

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