

### **1. Title:**

Strong-field physics using waveform-controlled mid-infrared pulses

### **2. Abstract:**

One of the unique features of strong-field light-matter interactions is its dependence on electric field,  $E(t)$ , of driving laser pulses unlike typical nonlinear interactions that rely on laser intensity profile,  $I(t)$ . This enables to control tunnel-ionized free electrons with sub-optical-cycle precision or with a bandwidth of optical carrier frequency, which leads to attosecond science in gas phase or petahertz electronics in solid phase, respectively. Mid-IR laser pulses are beneficial for scaling the kinetic energy of electrons and thereby emitted photon energy of high-harmonic generation (HHG) in gases and solids. In particular, mid-IR wavelength is suitable for HHG in low-band gap materials. In this talk, I discuss recent results of HHG driven by waveform-controlled mid-IR laser pulses: 1) Enhanced HHG up to the soft X-ray region driven by mid-IR pulses mixed with their third harmonic ( $w+3w$  mixing) and 2) Solid-state HHG in silicon using synthesized sub-cycle mid-IR pulses. Additionally, a long-wavelength IR source based on 2 micron pumped intrapulse difference-frequency generation will be presented.

### **3. Speaker's Bio:**

Dr. Kyung-Han Hong is a Principal Research Scientist and Principal Investigator of MIT Research Laboratory of Electronics and an expert in novel ultrafast laser sources and extreme nonlinear optics in the mid-IR. The most recent works include the development of ultrabroadband single-cycle mid-IR sources, demonstration of mid-IR laser filamentation and water-window soft X-ray high-harmonic generation. He is also currently working for the Compact X-ray FEL project at Arizona State University. He authored and coauthored about 100 journal papers and more than 160 international conference papers. Dr. Hong has been a PI or co-PI of research grants funded by AFOSR, ONR, and DOE, related to novel mid-IR laser sources and their applications. He serves as a regular reviewer of numerous optics journals and US-government-funded grant proposals. He is also a Topical Editor of High Power Laser Science and Engineering (Cambridge University Press).

Dr. Hong was educated at Korea Advanced Institute of Science and Technology (KAIST), where he completed his B.A. (1996), his M.S. (1998) and Ph.D. (2003) degrees, all in Physics. After his Ph.D., in 2003 and 2004, he did postdoctoral work at the University of Michigan under Prof. Gérard Mourou. Dr. Hong had been a Senior Research Scientist at the Advanced Photonics Research Institute, GIST when he joined MIT in 2007.