✓ **Date & Time : Friday, August 31** at **4PM**
✓ **Venue : Seminar Room #201, Science building #3**
✓ **Speaker : Changmin Lee(Gedik Group, MIT)**
✓ **Title & Abstract :** "**Ultrafast time- and angle-resolved photoemission spectroscopy (tr-ARPES) with extreme ultraviolet laser pulses**"

Time- and angle-resolved photoemission (tr-ARPES) is a powerful technique that directly measures the transient dynamics of band structure. In a tr-ARPES experiment, one laser pulse is used to pump the system to an excited state, and a subsequent ultraviolet pulse probes the photoemitted electrons at different time delays after the arrival of the pump pulse. Most tr-ARPES measurements are carried out with low energy (6-7 eV) photons, limiting the measurement range of momentum space. Here we report the development of a wide momentum range tr-ARPES setup based on high harmonic generation (HHG) of femtosecond laser pulses.
In the first setup, we generate 11 eV laser pulses through the perturbative third harmonic generation of frequency-tripled Yb:KGW pulses in xenon gas. We obtained energy and time resolutions of 16 meV and 250 fs, respectively. We present tr-ARPES spectra taken on single crystals of a topological insulator Bi_2Se_3 and a two-gap charge density wave material $ErTe_3$.
In the other setup, we produce tunable 24, 27, 30, and 33 eV pulses through the 15th, 17th, 19th, and 21st harmonic generation of Ti:Sapphire pulses in xenon gas. In combination with an off-plane Czerny-Turner monochromator, we achieved 30 meV and 200 fs energy and time resolutions. We demonstrate the performance of the setup through the measurements on bulk crystals of transition metal dichalcogenides WTe_2 and WSe_2, and a high-temperature superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$. Our results allow non-equilibrium band structure measurements of various quantum materials that exhibit interesting phenomena far away from the center of the Brillouin zone with widely tunable photon energies.

✓ **Organized by Prof. Han Woong Yeom (yeom@postech.ac.kr_054-279-2091)**