Electronic structure of van der Waals materials: its characters and measurements

Changyoung Kim

Department of Physics and Astronomy, Seoul National University and
Center for Correlated Electron Systems, Seoul National University

Van der Waals materials has been at the center of condensed matter physics research for the past decade. They possess variety of novel physical properties such superconducitiy and two-dimensional (2D) magnetism. The weak bonding between layers makes exfoliation and stacking possible, even allowing us to manipulate physical properties. Many of these physical properties are determined by the electroic structure. Therefore, obtaining and understanding the electronic structure of van der Waals materials is one of the first steps in the study of the materials.

In this tutorial lecture, I will overview characteristic features in the electronic structure of various van der Waals materials such as Dirac bands, valleys, spin split bands and Berry curvature, among others. Experimental observation of these aspect of the electronic structure is therefore indispensable. Angle resolved photoelectron spectroscopy (ARPES) is the most suitable technique to study electronic structures of solids, especially for 2D materials. I will briefly introduce the ARPES technique - basic principles and current status of the technique. State of the art ARPES systems have energy resolution better than 1 meV, allowing precision measurements. In addition, there have been steady efforts to achieve ARPES in different environments. I will survey several special techniques that are currently being used or developed for the study of van der Waals materials. Some of the examples are spin-resolved ARPES and circular dichroism ARPES. I will discuss how these techniques can be used to study van der Waals materials.