In this thesis, we introduce an $SL(2, \mathbb{R})$-action on the chiral de Rham complex on the upper half plane, and study the vertex subalgebra of $\Gamma$-invariant global sections, which are holomorphic at all the cusps. The thesis can be divided into three parts. The first part includes a recollection on the theory of vertex algebras and modular forms. The second part consists of a brief review of the construction of chiral de Rham complex by Malikov, Schechtman and Vaintrob, which will be applied to the upper half plane. We consider the vertex algebra associated to an arbitrary congruence subgroup $\Gamma$, and compute its character formula. We also give an explicit formula for the lifting of modular forms to the invariant sections, and the lifting formula is essentially unique and universal. The last part discusses the relations between the generalized Rankin-Cohen bracket and the elements in the global sections, and some further properties about the vertex algebra.

Date: 15 July 2020, Wednesday
Time: 2:00 p.m.
ZOOM Meeting: https://hkust.zoom.us/j/9063102107?pwd=MnVPZ25zY0YwWFJqV29FZEE5dGRxdz09

Thesis Examination Committee:

Chairman : Prof. Jianzhen YU, CHEM/HKUST
Thesis Supervisor : Prof. Yongchang ZHU, MATH/HKUST
Member : Prof. Jingsong HUANG, MATH/HKUST
Member : Prof. Guowu MENG, MATH/HKUST
Member : Prof. Yi WANG, PHYS/HKUST
External Examiner : Prof. Cuipo JIANG
School of Mathematical Sciences / Shanghai Jiao Tong University

(Open to all faculty and students)