Abstract: In this talk, I will present some recent results on the asymptotic behavior of the extreme eigenvalues and eigenvectors of the high dimensional spiked sample covariance matrices, in the supercritical case when a reliable detection of spikes is possible. Especially, we derive the joint distribution of the extreme eigenvalues and the generalized components of the associated eigenvectors, i.e., the projections of the eigenvectors onto arbitrary given direction, assuming that the dimension and sample size are comparably large. In general, the joint distribution is given in terms of linear combinations of finitely many Gaussian and Chi-square variables, with parameters depending on the projection direction and the spikes. We also apply the results to various high dimensional statistical hypothesis testing problems involving both the eigenvalues and eigenvectors. Specifically, we propose accurate and powerful statistics to conduct hypothesis testing on the principal components. These statistics are data-dependent and adaptive to the underlying true spikes. Numerical simulations also confirm the accuracy and powerfulness of our proposed statistics and illustrate significantly better performance compared to the existing methods in the literature.

This talk is based on a joint work with Zhigang Bao, Jingming Wang and Ke Wang.

Bio: Xiucai Ding is currently an Assistant Professor of Statistics in UC Davis. He obtained his PhD from the University of Toronto in 2018 and worked as a postdoctoral researcher in Duke from 2018-2020. His research interests include: Random Matrix Theory and the Theory of Spin Glasses and their statistical applications, non-stationary time series analysis, manifold learning, and machine learning.