School of Mathematical and Statistical Sciences
Arizona State University

M E M O R A N D U M

DATE: 04/28/2026

TO: Faculty and Students

FROM: Professor Shuang Zhou

Chair of the Defense for Jennifer Rastegar

For the PhD in Statistics

Committee Members:
Richard Hahn
Robert McCulloch
Shiwei Lan
Yi Zheng

DEFENSE ANNOUNCEMENT

Candidate: Jennifer Rastegar - Statistics, PhD

Defense Date: Thursday, June 18, 2026

Defense Time: 10:00 AM

Virtual Meeting Link: https://asu.zoom.us/j/82295856477 Room: WXLR A546

Title: A Hierarchical Gaussian Process Approach to Electron Scattering Data with Structured Noise

Please share this information with colleagues and other students, especially those studying in similar fields. Faculty and students are encouraged to attend. The defending candidate will give a 40-minute talk, after which the committee members will ask questions. There may be time for questions from those in attendance. However, guests are invited to attend as observers and will be excused when the committee begins its deliberations or if the committee wishes to question the candidate privately.

ABSTRACT
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ABSTRACT

Collecting experimental data is fundamental to modern scientific inference. However, measurements obtained from complex experiments are often affected by correlated noise, structured error, limited sample sizes, and multiple sources of uncertainty. This dissertation develops a hierarchical Gaussian process framework for studying uncertainty propagation and nuisance parameter estimation under a variety of structured error assumptions. Motivated by electron-scattering experiments associated with the proton radius problem, this work incorporates constraints on the mean function that satisfy known form factor properties while modeling correlated experimental noise through hierarchical covariance structures.

Extensive simulation studies are conducted using synthetic datasets generated under varying noise levels, correlation structures, and sample size configurations in order to evaluate model behavior under challenging experimental conditions. In particular, this framework investigates the sensitivity of parameter recovery, variance estimation, and uncertainty quantification to prior specification, covariance assumptions, and heteroscedastic error structure. The results demonstrate how hierarchical Gaussian process models can be used to characterize uncertainty, assess model stability, and study structured experimental variability in complex scientific systems.