

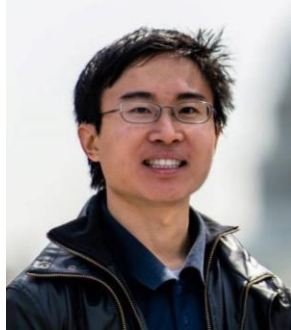


WILLIAM & MARY

CHARTERED 1693

Final Oral Examination for the Ph. D. Degree

Department of Physics



Adithia Kusno

**“Pion Form Factor at High Momentum Transfer
on Lattice Quantum Chromodynamics”**

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William Small Physical Laboratory, Rm 122

Williamsburg, Virginia 23187-8795

Open to the Public

Abstract We explore the calculation of pion form factor at high momentum transfer. The determinations of the spectrum of the pion is performed on dynamical lattices with two volumes and with pion masses heavier than twice the physical mass. We employ an anisotropic lattice using a tree level improved clover quark and gauge actions featuring two lighter degenerate flavors of quarks, and a heavier quark tuned to approximate the quark mass gap with the lightest two quarks. We utilize the technology necessary to isolate a single matrix element via the use of variationally optimized operators. This exploratory calculation constitutes the very first determination of the electromagnetic form factor of pion at high momentum transfer within a first principle approach to QCD performed using distillation framework to give a quantitative picture, relevant to the experimental measurements at Jefferson Lab. Focusing on two regimes where the long distance or low momentum regime relevant for the calculation of the charge radius and the short distance or high momentum regime describing the approach to quark and gluonic degrees of freedom. We find that our calculation agree within a value below that of the vector meson dominance pole form appropriate to low momentum transfer and above that of the asymptotic perturbative QCD calculation at high momentum transfer. Our calculations show that in principle we can reach higher momentum transfer values by implementing the method of momentum smearing in our quark field design to further explore the region where the perturbative QCD result emerges at higher momentum transfer.

Bio: Adithia Kusno was born in Jakarta, Indonesia. His late father, a physics professor, encouraged scientific inquiry. Since his youth Adithia has always enjoyed studying science and philosophy. He majored in Nuclear Physics at Pelita Harapan University in Indonesia, receiving a full scholarship for his undergraduate physics studies from the Surya Institute. After completing his senior thesis on the topic of Monte Carlo for radiation therapy dose calculations, he graduated in January 2008 magna cum laude. For two years he worked as an editor for high school physics textbooks.

Adithia entered College of William & Mary in Fall 2009. In 2011, he joined Prof. Kostas Orginos' Lattice QCD group. His research in the study of hadronic form factor at high momentum transfer helps to link a non-perturbative QCD with perturbative QCD. He and his wife Sasha met at church in 2014 and are expecting their firstborn son on Christmas Day. After graduation, he hopes to continue in the field of physics and instill a love of science in their children.