

April 30, 2023

Recommendation letter for Mr. Justin Cammarota's application

Dear Colleagues,

I am writing to provide my strongest support to Mr. Justin Cammarota's application for attending the 2023 Quantum Computing Boot Camp, to be held at the Jefferson Lab on June 20-20, 2023.

Justin is now a Ph.D. student under my supervision in the Physics Department at the College of William & Mary. Justin has completed his course work with high score and successfully passed the Ph.D. qualifying exam. He is now fully engaged in research projects toward his Ph.D. degree.

Justin focuses his research on lepton-hadron semi-inclusive deep inelastic scattering (SIDIS) in kinematic regions that are relevant to both collinear factorization and transverse momentum dependent (TMD) factorization approach, as well as the matching of theoretical formalisms to cover the overlap regime. He has had one paper published to his credit to apply TMD factorization formalisms to study the physics behind the observed single transverse spin asymmetries in SIDIS, Drell-Yan, e^+e^- annihilation into hadron pairs, and proton-proton collisions in terms of simultaneous QCD global analysis of data [Phys.Rev.D 102 (2020) 054002]. From the consistency and universality of non-perturbative distribution functions, extracted from such simultaneous global analysis of data from several different physical observables, they concluded that observed single transverse-spin asymmetries in high-energy collisions have a common origin.

Justin is extending his early work on QCD global analysis of data to the development of theoretical formalisms covering both TMD and collinear factorization regions in SIDIS and the matching between the two regions, which is very important for the study of various SIDIS processes at JLab and future EIC. With a large momentum transfer in lepton-hadron scattering, QCD and QED radiation will be induced by the hard collision. Justin is implementing the newly developed factorization approach to take care of both QCD and QED collision induced radiation on an equal footing in terms of factorization in both QCD and QED to the study of observables in SIDIS. Since he started this project, Justin has not only quickly learned how QCD factorization works for observables with a single hard scale relevant to collinear factorization approach and those with one large and one small scales relevant to TMD factorization approach, but also picked up calculation techniques to perform resummation of large perturbative logarithms, such as Sudakov double logarithms. He is completing a more theory oriented project on the matching between the collinear and TMD factorization for SIDIS and a more phenomenological project to study the impact of collision induced QED radiation to the theoretical predictions as well as the extraction of universal PDFs and TMDs.

Justin is smart and very quick in learning new things, and very careful in carrying out his work. Justin is very personable and friendly, and extremely easy to interact with. He communicates well and is good in interacting with other students, postdocs and senior faculty/staff that I witnessed when he is at JLab and was attending the recent TMD winter school in Santa Fe. Justin

asks good questions. Having Justin to attend the upcoming Quantum Computing Boot Camp at JLab will provide him a good opportunity to experience a pedagogical introduction to the QIS, coding tools and hands-on interactive lectures delivered by NP/HEP experts, and to be mentored by the experts with explicit QIS implementations of their physics problems. Such experience might allow him to get involved in projects on quantum computing for nuclear physics, enhancing his knowledge and approaches to his current research on QCD and hadron physics. On the other hand, his experience in both collinear and TMD factorization approach in both QCD and QED, and knowledge in perturbative calculations can be a valuable addition to the discussions and conversations during the Boot Camp.

In summary, I give my strongest support to Justin's application to attend the Quantum Computing Boot Camp to be held at Jefferson Lab on June 20-30, 2023 with enthusiasm. Please let me know if you need any more information.

Sincerely,



Jianwei Qiu

Associate Director for Theoretical and Computational
Physics, and Theory Center Director, Jefferson Lab;
The Governor's Distinguished CEBAF Professor,
The College of William & Mary