



Yale University

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To Dr. Neal Coates, Chair of the Tenure Committee:

It is a great pleasure to be writing to you to enthusiastically support Dr. James Drachenberg's application for promotion to tenure at Abilene Christian University. Dr. Drachenberg has made numerous significant scientific and leadership contributions to the field, including serving as Deputy Spokesperson of the STAR collaboration, providing critical contributions to peer-reviewed publications on topics related to QCD, and leadership in the ongoing construction of STAR's Forward Upgrades.

Dr. Drachenberg and I are long term collaborators on the STAR experiment, of which I am currently one of the two elected Spokespersons. Jim focuses on our Cold QCD program, while I am studying the properties of the medium produced in the collision of heavy-ions at relativistic energies. Since Jim's research interests in STAR are slightly different to mine, in this letter I will only briefly touch on the importance of his publications to the field. I am sure others will provide a much more nuanced appraisal. With that said, we have been working closely together for the past six years as we served in leadership positions on STAR. From 2017 until this March, Jim was one of the Deputy Spokespersons of STAR, and prior to that he was convener of our Cold QCD physics working group (PWG). He continues to serve as Chair of STAR's Analysis Blinding Committee and is coordinating the production of scintillator tiles for our forward hadron calorimeter in the labs at ACU. That Jim holds, or has held, so many positions in STAR reflects the breadth of his talents, and the respect our community has for his scientific and his leadership skills.

RHIC is an amazingly versatile accelerator, with the ability to not only collide relativistic heavy-ions, but also longitudinally and transversely polarized protons. RHIC is the *only* machine in the world capable of colliding polarized protons, and STAR's Cold QCD physics working group exploits this unique opportunity to probe the intrinsic spin structure of the proton, with a particular focus on determining the gluon's contribution to the total spin of the proton. Jim has made key contributions to our Cold QCD program both as convener and principle author, including significant involvement in the publication of 8 papers over the past 2 years. In STAR, principle authors are those collaborators who make a significant and immediately relevant contribution to the ideas, analyses, and paper process directly leading to the publication. Our PWG conveners are appointed by the Spokespeople in recognition of their expertise in that research area. Besides organizing and leading the working group, they are also responsible for reviewing and approving results for inclusion in STAR talks and manuscripts.

I want to draw specific attention to our 2018 article (PRD 97, 032004 (2018)), on which Jim was a principle author. This paper demonstrates, for first time, the extraction of non-zero Collins asymmetries; which are sensitive to transversely polarized quarks in a polarized proton. These results are now being used in so-

called “global fits” by theorists to test universality and factorization-breaking in the transverse momentum-dependent formulation of perturbative QCD.

Our Cold QCD program is also exploring the quark and anti-quark spin structure of the proton. For example, the enhanced statistical precision of the longitudinal spin asymmetries for W^+ and W^- bosons reported in the PRD 99, 051102 (2019), to which Jim also contributed, revealed a difference between anti-up and anti-down quark helicities in the range of $0.05 < x_{BJ} < 0.25$ which is opposite to the asymmetry extracted for spin-averaged quark-sea distributions.

The leadership qualities Jim displayed as convener of the Cold QCD PWG led Dr. Zhangbu Xu, my Co-Spokesperson at the time, and myself to ask Jim to serve as one of our Deputy Spokespeople. Since neither Dr. Xu or myself are experts in spin physics, during his 3 year term as Deputy we relied heavily on Jim’s expert opinion on multiple aspects of the Cold QCD program. This included assisting with the approval process of a new forward-physics initiative which is now scheduled for FY2021. The need to constrain the initial state of nucleon in cold nuclear matter at very high and low x_{BJ} motivated this new forward program which requires the construction and commissioning in STAR of a suite of new detectors. An NSF MRI grant, on which Jim is a co-PI, is enabling the successful completion of the calorimeter for this upgrade. Jim was always proactive on the management team, contributing not only to the scientific discussions, but also to improving the climate in the collaboration.

One of the most important tasks Jim undertook as Deputy, and continues to work on today, was to chair the Analysis “Blinding” Committee (ABC). In 2018 STAR collected Ru+Ru and Zr+Zr data at $\sqrt{s_{NN}} = 200$ GeV. These isobar data were taken with the goal of obtaining a definitive answer as to whether chiral magnetic effects (CME) are apparent in high-energy heavy-ion collisions. Proof of CME in these data would confirm the simultaneous existence of ultra-strong magnetic fields, chiral symmetry restoration, and topological charge changing transitions. The analysis and publication of these results is one of the highest priorities of the RHIC program and the DoE Office of Nuclear Physics. Since the results are so critical and the signal is expected to be small, it was recommended that we “blind” our analysis to remove the possibility of unconscious biases affecting the results. The heavy-ion community had not blinded analyses previously, so we needed a committee to first outline the necessary protocols and then ensure that the procedures were correctly followed by the analyzers. Jim is the chair of this committee and he has done an outstanding job in this challenging task. He not only heeded advice from the experts, but also showed relentless good cheer and equanimity as the collaboration argued about the best approach, or even if such an approach was needed; there was initial skepticism from some key analyzers. Via a process of iteration and an ability to cut to the crux of an argument Jim drew a reluctant collaboration to consensus. Indeed, in their May 2020 executive summary the BNL Nuclear and Particle Physics Program Advisory Committee (PAC) noted “Doing a blind analysis was a suggestion made by the PAC several years ago. Designing the blind analysis protocols needed in this context to make such a suggestion feasible and real is a very substantial undertaking, and the PAC was impressed and pleased with what STAR has done, and with how far they have come.” Much of the credit for this success goes to Jim.

At ACU, and previously at Lamar, Jim has actively engaged a “small army” of undergraduates in his research program and Jim, and the other STAR faculty members at ACU, have been very successful in obtaining grants for their research from our national funding agencies. As mentioned above, Jim is currently focused on the construction of the Forward Hadron Calorimeter for our upgrade program. He is coordinating a team which is producing scintillator tiles in the labs at ACU. This project serves not only as an amazing

hands-on hardware experience for the students but is also providing critical detector components for STAR. The ongoing COVID-19 related travel restrictions unfortunately mean his team, and another undergraduate group, cannot travel to BNL to assist with installation of other sub-system components into the STAR detector this summer, and we are struggling to identify enough alternative personnel. We sincerely hope they can all return next year; we miss them not just as extra hands but also for the enthusiasm and inquisitiveness they bring to the lab each summer. Many of the students who work with Jim make such good progress that they are able to present posters on their studies at the annual Conference Experience of Undergraduate (CEU) program which is an integral part of the APS's Division of Nuclear Physics Fall conference series. Another invaluable experience for young scientists.

I hope my comments have been helpful. Dr. Drachenberg's research is both broad and creative, and I strongly recommend that you promote Jim to tenure. He is clearly qualified having made significant and visible contributions to the field that have had an impact in the larger physics community. He has also helped build and maintain a strong group at ACU that is receiving good funding and successfully training students to be creative and productive scientists.

Yours Sincerely,

A handwritten signature in black ink, appearing to read 'Helen Caines', with a stylized flourish underneath.

Dr. Helen Caines
(Professor of Physics)