Proposal All Reviews: 1800700

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Agency Name:	National Science Foundation
Agency Tracking Number:	**1800700**
Organization:	
NSF Program:	Combinatorics
PI/PD:	Williams, Nathan
Application Title:	New bijective techniques in algebraic combinatorics

Review 1

Rating:

Excellent

Review:

Summary

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

his is an excellent proposal.

It is very well-organized and well-motivated, striking a good balance between background material, research exposition and plans of attack.

Its biggest strength is its coherence and big-picture vision; it definitely comes across as a mature research program, not a "laundry list" of unrelated problems.

The details of the proposal hold up as well: the proposed problems are all well-motivated, clearly explained and interesting. Each of the problems comes with an explanation of how its resolution would impact the (often non-combinatorial) field from which it arose. Additionally most of the problems come with concrete plans of attack - except for the "it's worth giving this a shot"type of problems, of course, but those get accordingly little space.

Overall I have a hard time imagining how this proposal could be significantly improved.

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

The broader impacts section is quite strong and the PI has a strong track record of leading new directions in algebraic combinatorics - particularly the successful AIM workshop in DAC and the prolific contributions to FPSAC.

Please evaluate the strengths and
weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if
applicable

Summary Statement

The PI proposes to study type-independent algebraic combinatorics coming from representation theory, coxeter theory, and geometric group theory, amongst other areas.

Review 2

Rating:

Good

Review:

Summary

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

The PI presents a strong proposal that weaves together combinatorial themes in K-theoretic Schubert calculus, MacDonald theory and simple presentations of Artin groups and monoids. The PI is only a few years beyond the PhD but has already made significant contributions to the field and has collaborated with top practitioners. A large number of problems and relevant conjectures are stated.

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

The proposer has a commendable track records of working with students on research, including in particular students in traditionally underrepresented groups. The outreach efforts appear to be strong, though perhaps somewhat less than those of other proposals under review.

Please evaluate the strengths and
weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if
applicable

Summary Statement

This is a good proposal that should be considered for funding.

Review 3

Rating:

Good

Review:

Summary

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

The proposal introduces new bijective techniques to study problems at the interplay between algebraic combinatorics, Schubert Calculus, representation theory, Macdonald polynomials and geometric group theory. The proposal aims at addressing explicit conjectures in three areas:

1) the combinatorics of minuscule K-theoretic Schubert calculus and connections to jeu-de-taquin bijections

2) the use of fixed point techniques (zeta and sweep maps) in Macdonald theory and (q,t)-statistics of affine Weyl groups

3) simple presentations of pure Artin groups and monoids in Coxeter-Catalan combinatorics by translation to non-crossing and nonnesting partitions and their generalizations.

The PI has made prior contributions to all these subjects. It is clear he has many good and creative ideas regarding combinatorial bijections. His enthusiasm can be read throughout the project description. Some of the questions were not motivated well enough. The use of font 10 made the proposal very hard to read at times. I would have preferred less projects but with better insight and a bit more explanation for non-experts. For example, Section 4 could have been omitted in order to expand the other sections.

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

Although the PI just starting his tenure-track position at UT Dallas, his is supervising independent studies of one graduate and one undergraduate. He is one of two faculty organizers for the 2018 Graduate Student Combinatorics Conference at Dallas.

The PI has a vast record supervising undergraduate research at various REUs. In particular, he has mentored several female undergraduates. Regarding diversity, jointly with a colleague from the Statistics Department, he has proposes a prototype mentoring program for funding by the Women Achieving through Community Hubs. He plans to establish an AWM student chapter.

Regarding curricula development, he plans to design both a new undergraduate and graduate course in combinatorics.

Please evaluate the strengths and
weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if
applicable

Summary Statement

The proposal has some interesting ideas and builds upon the PIs prior work (joint with several researchers) on bijective proofs of combinatorial identities inspired by geometry. The PI has a solid record of publication since graduating and has some experience proving long-standing conjectures. It is likely that at least some of the many project proposed will succeed. Although some of the problems lack sufficient motivation, overall, this is a good proposal, in the upper 40-50% of the ones I reviewed.