Products of Reflections in Smooth Bruhat Intervals

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My research deepens connections between the two seemingly very different mathematical fields of algebraic combinatorics and algebraic geometry. In particular, I focus on the Bruhat order, a well-studied partial order structure in algebraic combinatorics, and deepen its relation to the algebraic geometric notion of smoothness. My main results show how chains in this Bruhat order emerge from smooth elements. I used this discovered structure to provide a new criterion for smoothness. Finding new criterions for smoothness has been a subject of many recent papers, and my results directly contribute to this effort, increasing possibilities for further study at the intersection of combinatorics and algebraic geometry. Outside pure mathematics, my research also has potential for a broader societal impact through the lens of physics. I build on methods used in cutting-edge research to analyze the amplituhedron, a geometric structure which is a tool in quantum field theory and particle scattering. My research shows that the chains of the edges satisfy previously unknown relations, and could combine with other mathematical physics results in the near future to speed up computations of edges in the amplituhedron. Faster computations on this structure could lead to further advances in particle scattering theory, which would deepen our knowledge of the subatomic nature of the universe. Recent research at corporations such as Microsoft has also investigated how different geometric structures could be models for new quantum computation structures, and my research could prove useful in this effort, as it advances the mathematical understanding of new geometric structures.

Awards Won:

Third Award of $1,000