

Geometry, Physics, and Representation Theory  
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**Quantum difference equations for Nakajima varieties**

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**Abstract.** Let  $QH(X)$  be a quantum cohomology ring of some variety  $X$ . The operation of quantum multiplication defines a flat connection on  $H^2(X)$  also known as quantum differential equation. In this talk I will discuss the generalization of this picture to the quantum K-theory of  $X$  given by a quiver variety. The corresponding differential equation is now substituted by difference equation, which can be considered as a "flat difference connection" on a lattice (the Picard group of  $X$ ). We expect the difference equations to play a role in different areas of representation theory and mathematical physics. In particular I will discuss the application of difference equation to enumerative geometry of 3-folds, which roughly speaking states that "the fundamental solution of difference equation for  $X=(\text{Hilbert scheme of points on } A_n \text{ surface})$  is given by K-theoretic Donaldson - Thomas vertex".