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Siqi He* (she@scgp.stonybrook.edu), State University of New York, Stony brook, NY 11794, and **Rafe Mazzeo** (rmazzeo@stanford.edu), Department of Mathematics, Stanford University, Stanford, CA 94305. *Kapustin-Witten equations with Nahm pole boundary condition.*

We will discuss Witten's gauge theory approach to Jones polynomial by counting solutions to the Kapustin-Witten(KW) equations with singular boundary conditions over 4-manifolds. We will give a classification of solutions to the KW equations over $S^1 \times \Sigma \times R^+$. We prove that all solutions to the KW equations over $S^1 \times \Sigma \times R^+$ are S^1 direction invariant and we give a classification of the KW monopole over $\Sigma \times R^+$ based on the Hermitian-Yang-Mills type structure of KW monopole equation. This is based on joint works with Rafe Mazzeo. (Received August 01, 2019)