

**A perturbative invariant of 3-manifolds  
with the first Betti number 1**

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**Abstract.** It is known that the perturbative G invariant of rational homology 3-spheres is formulated by the (arithmetic) perturbative expansion of the quantum G invariants of them. In this talk, I explain how to calculate the (arithmetic) perturbative expansion of the quantum  $SO(3)$  invariants of 3-manifolds with the first Betti number 1 to formulate the perturbative  $SO(3)$  invariant of such 3-manifolds.