

Matrix cocycles and Borel resummation

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One of the many miracles of modular forms is that their q -series have convergent asymptotics as q approaches roots of unity. This comes by analysing the action of $SL(2, \mathbb{Z})$ and the knowledge of the behaviour as q tends to zero.

In Ramanujan's last letter to Hardy, he famously introduced the mysterious mock modular forms. These were q -series with asymptotics that look like those of a modular form at roots of unity. However, after removing the leading order, there was a new divergent series that appeared, which obstructed modularity.

Thanks to work of Zwegers, it has long (at least implicitly) been known that this failure of modularity can be packaged into an $SL(2, \mathbb{Z})$ cocycle that gives rise to the Borel resummation of the associated asymptotic series. More recently, Garoufalidis-Zagier studied quantum modular forms where similar statements were then conjectured by Garoufalidis-Gu-Mariño. I will outline a proof that cocycles associated to quantum modular forms are the Borel re-summation of associated asymptotic series in an infinite family of examples. This proves that asymptotic series associated to the 4_1

and 5_2 knots are Borel summable. This is based on joint work with Veronica Fantini.

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