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Analytic theory of the Dimits shift[1] HONGXUAN ZHU, Princeton University and PPPL, YAO ZHOU, Princeton Plasma Physics Laboratory, I. Y. DODIN, Princeton University and PPPL — The Dimits shift is the shift between the linear threshold of the drift-wave primary instability and the actual onset of turbulent transport, and is attributed to the formation of zonal flows (ZFs). We calculate this shift within the modified Terry–Horton [1] and modified Hasegawa–Wakatani [2] model. In agreement with [3], we find that the ZF causes localization of primary modes near the extrema of the zonal velocity $U(x,t)$. We show that these modes can be modeled as quantum harmonic oscillators with complex frequencies, so the growth rate can be calculated analytically and the result agrees with numerical eigenvalues. The local curvature of the velocity, $U'' = \partial_x^2 U$, stabilizes the primary modes up to a certain threshold. Beyond that, the primary mode re-emerge with growth rate modified by U'', and is also known as the tertiary instability (TI). Notably, the TI mode with the largest rate is the analytic continuation of the Kelvin–Helmholtz mode studied recently in [4]. [1] D. A. St-Onge, J. Plasma Phys. **83**, 905830504 (2017). [2] R. Numata, R. Ball, and R. L. Dewar, Phys. Plasmas **14**, 102312 (2007). [3] S. Kobayashi and B. N. Rogers, Phys. Plasmas **19**, 012315 (2012). [4] H. Zhu, Y. Zhou, and I. Y. Dodin, Phys. Plasmas **25**, 082121, (2018).

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