## **C-SYMMETRIC SECOND ORDER DIFFERENTIAL OPERATORS WITH LARGE LEADING COEFFICIENT**

## HORST BEHNCKE AND DON HINTON\*

*Abstract.* We continue the spectral analysis of Sturm-Liouville operators with ccmplex coefficients. By means of asymptotic integration the Titchmarsh-Weyl *m*-function is determined without the nesting circle analysis. With it the resolvent is constructed. The primary case is that of a dominant leading coefficient, but Euler type cases are also considered. This leads to resolvents that are compact and even Hilbert-Schmidt.

Mathematics subject classification (2020): 34L05, 34B20, 34B27, 34B40, 34B60.

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## REFERENCES

- C. AHLBRANDT, D. HINTON, AND R. LEWIS, The effect of variable change on oscillation and disconjugacy criteria with applications to spectral theory and asymptotic theory, J. Math. Anal. and Appl. 81 (1981), 243–277.
- [2] H. BEHNCKE AND D. HINTON, Transformation theory of symmetric differential expressions, Advances in Diff. Eqs. 11 (2006), 601–626.
- [3] H. BEHNCKE, D. HINTON, AND C. REMLING, *The spectrum of differential equations of order 2n with almost constant coefficients*, J. of Diff. Equations **175** (2001), 130–162.
- [4] H. BEHNCKE AND D. B. HINTON, Hamiltonian Systems with Almost Constant Coefficients, J. of Diff. Equations 250 (2011), 1403–1426.
- [5] H. BEHNCKE AND D. B. HINTON, A Class of Differential Operators with Complex Coefficients and Compact Resolvent, Differential and Integral Equations 31 (2018), 375–402.
- [6] H. BEHNCKE AND D. B. HINTON, C-Symmetric Hamiltonian Systems with Almost Constant Coefficients, Journal of Spectral Theory 9 (2019), 513–546.
- [7] H. BEHNCKE AND D. B. HINTON, *C-Symmetric Second Order Differential Operators*, Operators and Matrices 14 (2020), 871–908.
- [8] B. M. BROWN, D. MCCORMACK, W. D. EVANS, AND M. PLUM, On the Essential Spectrum of Second-order Differential Equations with Complex Coefficients, Proc. Royal Soc. London A 455 (1999), 1235–1257.
- [9] B. M. BROWN, W. D. EVANS, AND M. PLUM, Theory for Complex Hamiltonian Systems, Proc. London Math. Soc. 87 (2003), 419–450.
- [10] E. CODDINGTON AND N. LEVINSON, Theory of Ordinary Differential Equations, McGraw Hill, York, PA, 1955.
- [11] M. S. P. EASTHAM, *The Asymtotic Solution of Linear Differential Systems*, London Mathematical Monographs, **4**, 1989.
- [12] D. E. EDMUNDS AND W. D. EVANS, Spectral Theort and Differential Operators, Oxford University Press, Oxford, 1987.
- [13] W. NORRIE EVERITT, Sturm-Liouvile Theory: Past and Present, Birkhauser, Basel, 2005.
- [14] C. FULTON, Parametrizations of Titchmarsh's  $m(\lambda)$ -functions in the limit circle case, Trans. AMS **229** (1974), 51–63.
- [15] S. GARCIA, E. PRODAN, AND M. PUTINAR, Mathematical and physical aspects of complex symmetric operators, J. Phys. A: Math. Theor. 47 (2014), 54 pp.

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- [16] I. M. GLAZMAN, Direct Methods of Qualitative Spectral Analysis of Singular Differential Operators, Israel Program for Sc. Tranl. Jerusalem, 1963.
- [17] S. GOLDBERG, Unbounded Linear Operators, McGraw Hill, New York 1966.
- [18] D. HINTON, Asymptotic behavior of solutions of disconjugate differential equations, Differential Equations, I. W. Knowles and R. T. Lewis (editors), North Holland, 1984.
- [19] T. KATO, Perturbation theory for linear operators, Springer-Verlag, New York, 1966.
- [20] R. KAUFFMAN, T. READ, AND A. ZETTL, The deficiency indes problem for powers of ordinary differential equations, Lecture Notes in Mathematics 621, Springer-Verlag, New York, 1977.
- [21] I. KNOWLES, On the Boundary Conditions Characterizing J-Selfadjoint Extensions of J-Symmetric Operators, J. of Differential Equations 40 (1981), 193–216.
- [22] I. W. KNOWLES AND D. RACE, On the point spectra of complex Sturm-Liouville operators, Proc. royal Society Edinburgh A 85 (1980), 263–289.
- [23] J. LOCKER, Spectral Theory on Non-Selfadjoint Two-Point Differential Operators, Mathematical Surveys and Monographs, vol. 73, AMS, Providence, 2000.
- [24] J. B. MCLEOD, Square-Integrable Solutions of a Second-Order Differential Equation with Complex Coefficients, Quart. J. Math. Oxford (2) 13, (1962), 129–133.
- [25] M. MUZZOLINI, Titchmarsh-Sims-Weyl Theory for Complex Hamiltonian Systems of Arbitrary Order, J. London Math Soc. 84 (2011), 159–182.
- [26] H. NIESSEN, Proof of a conjecture of Race, Proc. Roy. Soc. Edinburgh (A) 95 (1983), 243–246.
- [27] D. RACE, On the location of the essential spectra and regularity fields of complex Sturm-Liouville operators, Proc. Roy. Soc. Edinburgh (A) 85 (1980), 1–14.
- [28] D. RACE,  $m(\lambda)$ -functions for complex Sturm-Liouville operators, Proc. Roy. Soc. Edinburgh (A) **86** (1980), 276–289
- [29] D. RACE, On the essential spectra of 2n-th order differential operators with complex coefficients, Proc. Roy. Soc. Edinburgh (A) 92 (1982), 65–75.
- [30] D. RACE, The theory of J-selfadjoint extensions of J-symmetric operators, J. Differential Equations 57 (1985), 258–274.
- [31] A. SIMS, Secondary conditions for linear differential equations of the second order, J. Math. Mech. 6 (1957), 247–285.
- [32] J. WEIDMANN, Spectral Theory of Ordinary Differential Operators, Springer Lecture Notes 1258, Springer Verlag, Berlin, 1987.