



# C\*-algebras with the weak expectation property and a multivariable analogue of Ando's theorem on the numerical radius

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A classic theorem of T. Ando characterises operators that have numerical radius at most one as operators that admit a certain positive 2x2 operator matrix completion. In this paper we consider variants of Ando's theorem, in which the operators (and matrix completions) are constrained to a given C\*-algebra. By considering nxn matrix completions, an extension of Ando's theorem to a multivariable setting is made. We show that the C\*-algebras in which these extended formulations of Ando's theorem hold true are precisely the C\*-algebras with the weak expectation property (WEP). We also show that a C\*-subalgebra A of B(H) has WEP if and only if whenever a certain 3x3 (operator) matrix completion problem can be solved in matrices over B(H), it can also be solved in matrices over A. This last result gives a characterisation of WEP that is spatial and yet is independent of the particular representation of the C\*-algebra. This leads to a new characterisation of injective von Neumann algebras. We also give a new equivalent formulation of the Connes Embedding Problem as a problem concerning 3x3 matrix completions.

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