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Restricted Exponentiation in Fields of Algebraic Power Series

Ron Brown (1971) proved that a valued vector space of countable dimension admits a valuation basis. This result was applied by S. Kuhlmann (2000) to show that every countable real closed field admits a restricted exponential function, that is, an order preserving isomorphism from the ideal of infinitesimals $(\mathcal{M}_K, +)$ onto the group of 1-units $(1 + \mathcal{M}_K, \cdot)$. A natural question arose whether every real closed field admits a restricted exponential function. In this talk, we give a partial answer to this question. To this end, we investigate valued fields which admit a valuation basis (as valued vector spaces over a given countable ground field K). We isolate a property (called TDRP in our paper) for a valued subfield L of a field of generalized power series $F((G))$ (where G is a countable ordered abelian group and F is a real closed, or algebraically closed field). We show that this property implies the existence of a K-valuation basis for L. In particular, we deduce that the field of rational functions $F(G)$ (the quotient field of the group ring $F[G]$) and the field $F(G)$ of power series in $F((G))$ algebraic over $F(G)$ admit K-valuation bases. If moreover F is archimedean and G is divisible, we conclude that the real closed field $F(G)$ admits a restricted exponential function.