

Approximation of the CBH Formula in Various Relatively Free Lie Algebras

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Let K be a field of characteristic 0 and $K\langle\langle x, y \rangle\rangle$ be the algebra of formal power series in noncommuting variables x, y . By the Campbell-Baker-Hausdorff formula the Hausdorff series

$$H(x, y) = \log(e^x e^y) = x + y + [x, y]/2 + \cdots$$

belongs to the completion $\hat{L} \subset K\langle\langle x, y \rangle\rangle$ of the free Lie algebra L of rank 2. We evaluate $H(x, y)$ on various relatively free Lie algebras, e.g., on the free metabelian algebra, the relatively free algebra in the variety generated by the 2×2 traceless matrices, the free centre-by-metabelian algebra, and the free nilpotent of small class-by-abelian algebras.

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