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Non-Analyticity in Time of Solutions to the KdV Equation

It is proved that formal power series solutions to the initial value problem $\partial_t u = \partial_x^3 u + \partial_x(u^2)$, $u(0, x) = \varphi(x)$, with analytic data φ belong to the Gevrey class G^2 in time. However, if $\varphi(x) = 1/(1+x^2)$, the formal solution does not belong to the Gevrey class G^s in time for $0 \leq s < 2$, so it is not analytic in time. The proof is based on the estimation of a double sum of products of binomial coefficients.

Keywords: KdV equation, non-analyticity, Gevrey spaces, binomial coefficients.

MSC: 35A10, 35A20, 35K55, 35Q53; 05A10, 05A19, 11B65.