

■ [Previous abstract](#) ■ [Next abstract](#)

Session Bc - Turbulence Theory.

session, Sunday morning, November 19

Salon C, Hyatt Regency Hotel

[Bc.04] Statistical Tests of a Sufficient Condition for a Finite-Time Singularity[†]

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A sufficient condition for the development of a finite-time singularity in a highly symmetric Euler flow, first proposed by Kida [J. Phys. Soc. Jpn. 54 2132 (1985)], and recently simulated by Boratav and Pelz [Phys. Fluids 6 2757 (1994)], is tested analytically and numerically. This sufficient condition requires that the fourth-order spatial derivative of the pressure (p_{xxxx}) at the origin be positive for all times leading up to the singularity. Two properties related to p_{xxxx} are proved by symbolic mathematics. The first one states that p_{xxxx} is positive for any mode in an independent and complete set. The second one indicates that the off-diagonal contributions to p_{xxxx} from two independent modes with very distinct wavenumbers is small compared with the diagonal contributions. These two properties indicate that the case of positive p_{xxxx} is highly probable during the time evolution of the flow. This is consistent with the result of a Monte Carlo simulation which shows that p_{xxxx} is positive with high probability over a large ensemble of initial conditions. [†]Work Supported by NSF Grant No ATM 93-10157 and AFOSR Grant No. F49620-93-1-0071.

■ [Part B of program listing](#)