

2001 Brouwer Award Winner - Jack Wisdom

Jack Wisdom (Massachusetts Institute of Technology) pioneered the application of modern nonlinear dynamics and the theory of Hamiltonian chaos in the field of solar system dynamics. As a graduate student, he was the first to apply the resonance overlap criterion to this field, demonstrating that the band of chaotic, short-lived orbits near a perturbing body results from the overlap of mean motion resonances. He subsequently solved the long-standing problem of the origin of the Kirkwood gaps. After developing an algebraic mapping to permit rapid numerical integration of trajectories near the 3/1 Kirkwood gap, Jack showed that chaotic orbits in this gap undergo intermittent jumps in eccentricity that lead to planet-crossing orbits. This not only provides a means of clearing the gap but also demonstrates a means of delivering meteoritic material to the Earth. The boundary of the numerically determined 3/1 chaotic zone corresponds to the observed boundary of the 3/1 Kirkwood gap, giving the first clear evidence of a physical manifestation of dynamical chaos in our solar system.

Through continued, careful investigations, Jack has illustrated the ubiquitous role that dynamical chaos plays in the evolution of our solar system. Through Jack's efforts, we now know that the Saturnian moon Hyperion tumbles chaotically, and that every satellite passes through a period of chaotic rotation as it tidally evolves toward synchronous rotation. We also know, from his work with student Jihad Touma, that the obliquity of Mars varies chaotically, a result with profound implications for the climate of that planet. In addition, Jack and his student, William Tittlemore, demonstrated that the anomalously high inclination of Miranda resulted from a temporary capture in the 3/1 resonance with Umbriel. Through long-term numerical integrations on a special-purpose computer, Jack and colleague Gerald Sussman shattered the long-held view of the clockwork motion of the planets by revealing the chaotic evolution of Pluto's orbit. They went on to confirm the chaotic evolution of the outer planets and the full solar system. Most recently, Jack's work with Touma has provided new insights into the complex evolution of the Moon's orbit. Throughout his career, Jack has developed numerous analytical and numerical techniques upon which our community has relied and built. A notable example is the symplectic map for the n-body problem, a technique that now forms the core of nearly every solar system dynamics integration scheme in use today. For his fundamental contributions and leadership in the field, we find Jack Wisdom an outstanding candidate for the Brouwer Award.

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