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A Focused and Collaborative Research on the Stability and Convergence of Eikonal Splitting Methods

It was in the middle of September 2010, when the PI was invited to give a lecture in the prestigious Isaac Newton Institute for Mathematics in Cambridge, England. A workshop on Highly Oscillatory Problems (HOP) was going on. About sixty scholars showed up and cutting-edge ideas were exchanged. A novel new level of collaborative and interdisciplinary researches emerged.

HOP has been common and very important to us. It pervades a very wide range of applications including modeling light beam propagations, biomedical simulations, celestial mechanics and signal processing. However, due to the highly oscillatory features, computations of HOP solutions have been extremely difficult.

The PI has been active in this field since 2007. He introduced the concept of the eikonal splitting which can be utilized for computing highly oscillatory Helmholtz solutions efficiently. However, two main challenges persist in the theoretical implementation of the advanced methodology: *What are the rigorous numerical stability and convergence?* As being pointed out by the PI and one of his collaborators, Dr. Haiwei Sun (University of Macau, China), in a recent paper [18] that *it is extremely difficult to answer the question, due to the strong nonlinearity, high oscillation and potential internal-boundary layers involved.* The research requires a cross-disciplinary board of knowledge. Therefore collaborated and focused explorations become inevitable.

This motivates the proposed URC project. It will enable the PI to pursue the aforementioned goals at a optimized teamwork level. It will enable the PI to investigate closely with his collaborators for an intensive period of time. Existing research agendas will be reinforced and extended for Baylor graduate students. This will contribute to the Mission and Vision of the University to become a world center for first-class researches.