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Preface to Symposium: Matter at Extreme Conditions: Theory and Application

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Preface to Symposium:
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The subject of "Matter at Extreme Conditions" encompasses a wide range of phenomena the thrust of which is to address the physical and chemical behaviors of materials exposed to "abnormal" conditions of high pressures, temperature extremes, or external fields. Recent advances in theoretical methodologies and first principle computational studies have predicted unusual properties and unraveled a few surprises when matter is subjected to such strains: a reversed and anomalous Doppler effects in shocked periodic media, the possible existence of low temperature liquid metallic state of hydrogen, and a superionic phase of water at high temperature and pressure. A unified approach from quantum mechanical principles allows for exploring such diverse and disparate subjects as ultracold plasmas in a strong magnetic field, and the dynamic aspects of Bose-Einstein condensates. These topics, which are aptly presented in this symposium, are but a few examples of interesting discoveries and methodologies in this active and exciting area of research.

The development of reactive force fields from quantum mechanical principles for use in conjunction with molecular dynamics provide us with an invaluable tool for large-scale simulations to study the chemical transformations and decomposition products of complex organic systems at extreme conditions. Simulations implementing classical fields can provide an unprecedented access to the short time scales of chemical events that occur in dense fluids at high-temperature, and for the study of atomic clusters under strong laser pulses.