International Center for Hadron Astrophysics
ICEHAP CHIBA UNIVERSITY

ICEHAP Seminar

Date Nov. 30 Thu. 14：30～16：00

Location ICEHAP Office (Engineering Research Bldg.1 Room609-1)

By Dr. Edouard Audit （CEA / Maison de la Simulation）

Title

『Numerical simulations of super-luminous supernovae』

Abstract

All massive stars below about 100-solar-mass end their lives with the formation of an iron core that collapses to a proto-neutron star. The fate of the overlying stellar layers is determined by the interplay between accretion onto the compact remnant and neutrino energy deposition in the infalling material, both orchestrated by numerous fluid instabilities. When successful, this mechanism leads to a core-collapse supernova (SN) with a peak luminosity of a billion times that of the sun and an explosion energy comparable to several times the binding energy of the matter outside the collapsed core. Until recently, the diversity of SNe was generally attributed to the inner workings of stellar progenitors, for example whether the star was initially massive or light, extended or compact, rotating or not, or endowed with a large iron core. While critical in determining the outcome of the explosion, these important features only partly explain the emerging panoply of SN observations.

Indeed, the considerable diversity now revealed by high-cadence, un-targeted surveys of the sky suggests that the recent, pre-explosion, history of the star and its immediate surroundings are a major component in shaping SN light curves and spectra.

In this presentation I will present the progress toward building a realistic simulation pipeline to simulate SNe in their full complexity and variety, from explosions diversity to the light curves and spectral signatures, taking into account the dynamics of the ejecta and their interactions with various CSM configurations. This pipeline is mainly composed of a 3D multi-groups radiation-hydrodynamics code and of detailed time-dependent nonLTE radiative codes.

Various results obtained on super-luminous interacting SNe light curves and spectra will be presented. They illustrate how the presence of circumstellar mater around exploding stars can greatly modify the observed properties of the explosion.Numerical issues and the new challenge presented by Exascale systems will also be briefly discussed.