ELECTRON-CAPTURE RATES OF NUCLEI AT STELLAR ENVIRONMENTS AND NUCLEOSYNTHESIS

Toshio Suzuki [1,5], M. Honma[2], N. Shimizu[3], Y. Tsunoda[3], T. Otsuka[4], T. Kajino[5], K. Mori[5], M. Famiano[6], J. Hidaka[7], K. Nomoto[8], K. Iwamoto[9]

[1]Department of Physics, College of Humanities and Sciences, Nihon University, Setagaya, Tokyo 156-8550, Japan
[2]Center for Mathematical Sciences, University of Aizu,
[3]Center for Nuclear Study, the University of Tokyo,
[4]Department of Physics, the University of Tokyo
[5]National Astronomical Observatory of Japan,
[6]Department of Physics, Western Michigan University,
[7]Mechanical Engineering Department, Meisei University,
[8]WPI, the University of Tokyo,
[9]Department of Physics, College of Science and Technology,

Electron-capture rates in nuclei at stellar environments are evaluated by using new shell- model Hamiltonians. A new Hamiltonian for pf-shell, GXPF1J, can describe Gamow-Teller (GT) strengths in Ni isotopes very well. In particular, large spreading in the GT strength in ^{56}Ni and ^{55}Co obtained for GXPF1J has been confirmed by a recent experiment .The updated e-capture rates as well as beta-decay rates obtained in a large region of pf-shell nuclei are applied to study nucleosynthesis in type-Ia supernova explosions and core-collapse supernova explosions as well as cooling of stars by nuclear URCA processes.
The e-capture rates with GXPF1J, which are generally smaller than those with conventional shell-model Hamiltonians such as KB3G and lead to less production of neutron-rich nuclei such as ^{58}Ni and ^{54}Cr, can thus solve the problem of over-production of neutron-rich isotopes in the Fe region compared to the solar abundance.
For more neutron-rich isotopes such as ^{78}Ni, extension of the configuration space outside the pf-shell is essential. Here, GT strength and spin-dipole strengths in ^{78}Ni are evaluated within $pf+g_{9/2}+d_{5/2}$ shells. Core-collapse supernova explosions are sensitive to the e-capture rates for nuclei around this region. Electron-capture rates of nuclei around ^{78}Ni will be discussed with shell-model as well as with RPA calculations.