Cosmochemistry with CHILI

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CHILI (the CHicago Instrument for Laser Ionization) [1] has recently been upgraded to its full designed capability, with the addition of: (1) a motionless-blanking Ga^+ gun capable of sputtering with a lateral resolution of a few tens of nm; and (2) a multibounce mirror system that allows photoionization laser beams to pass 14 times through the sputtered cloud of atoms, greatly increasing sensitivity.

CHILI has already seen significant applications in cosmochemistry and geochemistry, all done with laser ablation at a lateral resolution of ~1 µm and without the multibounce mirror system. Fe and Ni isotopes in mainstream SiC grains from AGB stars show the effects of both galactic chemical evolution and neutron capture [2]. Sr and Ba isotopes in presolar SiC grains of Type X show two different types of isotopic patterns, representing the variety of heavy element nucleosynthesis sites with Type II supernovae [3]. Fe and Ni isotopes in Type X SiC grains show that significant neutron capture effects occur in Type II supernovae [4]. Sr, Mo, and Ba isotopes in presolar SiC grains of Types AB1 and AB2 show that they come from Type II supernovae and J-type carbon stars, respectively [5,6]. More recently, Ni isotopic measurements in a Semarkona chondrule [7] and Orgueil carbonates [8] have shown surprisingly large Ni isotopic mass fractionation effects, but no excess ^{60}Ni, indicating that the early solar system $^{60}Fe/^{56}Fe$ was significantly below the levels of $(1–5)\times10^{-7}$ reported in earlier SIMS measurements. Back to Earth, Sr isotopic compositions of apatite inclusions in Nuvvuagittuq zircons show that the early crust had a broad range of compositions, from mafic to highly silicic [9].

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