CHILI—THE CHICAGO INSTRUMENT FOR LASER IONIZATION—READY TO GO.

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Introduction: CHILI (Chicago Instrument for Laser Ionization) is a nanobeam resonance ionization mass spectrometry (Nano-RIMS) instrument that has been built at the University of Chicago over the last five years. CHILI is designed for isotopic and chemical analysis at the ~10 nm scale with a useful yield of ~40 %, capabilities well beyond those of currently available secondary ion mass spectrometry (SIMS) or RIMS instruments.

Technical description: CHILI is equipped with a liquid metal ion gun for sputtering at 10 nm spatial resolution and a 1.5 W, 351 nm Nd:YLF laser for ablating atoms from samples at 1 µm spatial resolution. We have built six tunable Ti:sapphire lasers of our own design, which are pumped by three 40 W, 527 nm Nd:YLF lasers, for resonance ionization of up to three elements simultaneously from the atom cloud. A time-of-flight mass spectrometer with nearly 100 % transmission is used to separate the photoions according to their mass-to-charge ratio before they reach the microchannel plate detector. A field-emission scanning electron microscope and a Schwarzschild optical microscope are integrated for sample imaging. A detailed technical description of CHILI has been given previously [1,2].

Instrument status: CHILI's six tunable lasers are now operational and outperform earlier generation lasers. The ablation laser has achieved a spot size of ~1 µm. The final electronic components, for switching high voltages at nanosecond timescales, are now completed, after a delay of two years because of a massive backlog at the switch manufacturer. All major subsystems of CHILI are controlled by our own software, and we are developing 3D imaging of isotopic and chemical composition. Currently, we are preparing for the first measurements with CHILI.

Outlook: CHILI's strengths will be in isotopic and chemical analysis at lateral resolutions from ~10 nm to a few micrometers and unprecedented analytical sensitivity. Among the samples planned for analyses with CHILI are those from sample-return missions: Stardust cometary and contemporary interstellar dust; Genesis solar wind; as well as Hayabusa and OSIRIS-REx asteroidal samples. Other samples include presolar grains, to study stellar nucleosynthesis, and refractory inclusions, chondrules, and interplanetary dust particles (IDPs), to investigate early Solar System processes and their chronology. Beyond that, we are open to collaborate with anyone with an exciting cosmochemical problem that requires ultimate sensitivity and spatial resolution. The lasers are currently tuned to simultaneously measure Sr, Zr, and Ba isotopic compositions, and CHILI will analyze presolar grains (to better understand asymptotic giant branch, AGB, stars [3]), hibonite-rich refractory inclusions (to see whether heavy element isotope anomalies accompany ^{50}Ti and ^{48}Ca anomalies [4]), IDPs and Stardust cometary material (to search for isotope anomalies), and Genesis collectors (to make the first measurements of heavy element abundances in solar wind).

References: [1] Stephan T. et al. 2013. *Lunar & Planetary Science* 44:#2536. [2] Stephan T. et al. 2014. *Lunar & Planetary Science* 45:#2242. [3] Liu N. et al. 2014. *Lunar & Planetary Science* 45:#2049. [4] Kööp L. et al. 2014. this meeting.