The High Energy Light Isotope eXperiment program of direct cosmic-ray studies

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HELIX is a new NASA sponsored instrument aimed at measuring the spectra and composition of light cosmic-ray isotopes from hydrogen to neon nuclei, in particular the clock isotopes 10Be (radioactive, with 1.4 Myr lifetime) and 9Be (stable). The latter are unique markers of the production and Galactic propagation of secondary cosmic-ray nuclei, and are needed to resolve such important mysteries as the proportion of secondary positrons in the excess of antimatter observed by the AMS-02 experiment. By using a combination of a 1T superconducting magnet spectrometer (with drift-chamber tracker) with a fast time-of-flight detector system and ring-imaging Cherenkov detector, mass-resolved isotope measurements of light cosmic-ray nuclei will be possible up to 3 GeV/n in a first balloon flight from Kiruna, Sweden to northern Canada, anticipated to take place in early summer 2024. An eventual longer Antarctic balloon flight of HELIX will yield measurements up to 10 GeV/n, sampling production from a larger volume of the Galaxy extending into the halo. We will review the instrument design, testing, status and scientific prospects.