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Evolution of NASA Scientific Ballooning and Particle Astrophysics Research

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Particle astrophysics research has a history in ballooning that spans over 100 years, ever since Victor Hess discovered cosmic rays on a manned balloon in 1912. The NASA Particle Astrophysics Program currently covers the origin, acceleration and transport of Galactic cosmic rays, plus the Nature of Dark Matter and Ultrahigh Energy Neutrinos. Progress in each of these topics has come from sophisticated instrumentation flown on Long Duration Balloon (LDB) flights around Antarctica for more than two decades. Super Pressure Balloons (SPB) and International Space Station (ISS) platforms are emerging opportunities that promise major steps forward for these and other objectives. NASA has continued development and qualification flights leading to SPB flights capable of supporting 1000 kg science instruments to 33 km for upwards of hundred day missions, with plans for increasing the altitude to 38 km. This goal is even more important now, in view of the Astro2010 Decadal Study recommendation that NASA should support Ultra-Long Duration Balloon (ULDB) flight development for studies of particle astrophysics, cosmology and indirect detection of dark matter. The mid-latitude test flight of an 18.8 MCF SPB launched from Wanaka, NZ in 2015 achieved 32 days of nearly constant altitude exposure, and an identical SPB launched from Wanaka in 2016 with a science payload flew for 46 days. Scientific ballooning as a vital infrastructure component for cosmic ray and general astrophysics investigations, including training for young scientists, graduate and undergraduate students, leading up to the 2020 Decadal Study and beyond, will be presented and discussed.