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代表作名稱：

★ L. Accardo, *et al.* (AMS collaboration) “High Statistics Measurement of the Positron Fraction in Primary Cosmic Rays of 0.5–500 GeV with the Alpha Magnetic Spectrometer on the International Space Station.” *Physical Review Letters* 113 (2014): 121101.

★ M. Aguilar, *et al.* (AMS collaboration) “Electron and Positron Fluxes in Primary Cosmic Rays Measured with the Alpha Magnetic Spectrometer on the International Space Station.” *Physical Review Letters* 113 (2014): 121102.

★ M. Aguilar, *et al.* (AMS collaboration) “First Result from the Alpha Magnetic Spectrometer on the International Space Station: Precision Measurement of the Positron Fraction in Primary Cosmic Rays of 0.5–350 GeV.” *Physical Review Letters* 110 (2013): 141102.

得獎簡評：

灰野禎一，東京大學物理系博士，現任中央研究院物理研究所副研究員，在德國之高能物理實驗(BESS)中，在宇宙線先進反質子的研究有非常重要的貢獻，尤其是澄清了以往實驗上的錯誤並加以修正。在尋找反物質——暗物質的 AMS 計畫中，經過非常嚴密的磁鐵分析，灰野博士建議即刻以永久磁鐵取代超導磁鐵，這一舉措是 AMS 實驗能夠成功的重要關鍵。此外，其帶領的小組發展了極精密的監測宇宙線位置，即每兩分鐘的精確度達 1 micron（微米）。由於灰野博士出眾的知識與經驗，透過 AMS 實驗數值的分析，使吾人由電子及正子更深入了解宇宙中的暗物質。

得獎人簡歷：

Dr. Sadakazu Haino is an experimental particle physicist specializing in the cosmic-ray physics. He started his research activity in 1999 under late Prof. Shuji Orito followed by Prof. Akira Yamamaoto with the BESS (Balloon-borne Experiment with Superconducting

Spectrometer) project in Japan. He studied and worked in many aspects of experimental physics including R&D, construction and development of particle detectors, spectrometer integration, development of online data acquisition system, data taking operation during the balloon flights, and offline data analysis. He obtained his Ph.D. in 2004 from the University of Tokyo on the thesis of "Measurements of Galactic and Atmospheric Cosmic-ray Absolute Fluxes". His works have been published in three articles as a corresponding author and more than ten articles as a co-author. Among them, his representative publication [S. Haino *et al.*, *Physics Letters B* 594 (2004): 35] has been cited for more than 150 times according to INSPIRE database.

In 2005, Haino went to Perugia, Italy with a post-doc fellowship for foreigners in INFN (Istituto Nazionale di Fisica Nucleare) to work on the AMS (Alpha Magnetic Spectrometer) project with Prof. Roberto Battiston who is now the president of ASI (Italian Space Agency) and Prof. Bruna Bertucci. Since then, he has been working as a core member of offline data analysis in the AMS project. AMS is an international collaboration with several hundreds of scientists from Asia, America and Europe lead by Academician Samuel C.C. Ting of MIT. Haino is responsible for the track reconstruction software and alignment of the silicon tracker. He is also one of the developers of the official AMS offline analysis software.

In 2012, Haino joined the National Central University in Taiwan as an assistant professor working with Prof. Yuan-Hann Chang. Then since 2014 he is a member of Institute of Physics, Academia Sinica as an associate research fellow working with Academician Shih-Chang Lee. He is now leading data analysis activity of AMS Taiwan group with about ten post-docs and students who are stationed at CERN (European Organization for Nuclear Research) and working closely with Academician Ting and MIT team.

Recently AMS collaboration has published five papers in Physical Review Letters, most of which have been selected as Editors suggestions. Among them, three publications were selected as his representative works for this award. The first publication was selected in 2013 APS (American Physical Society) Physics Highlights, where only a few publications are selected every year, and cited more than 370 times in two years according to INSPIRE database.

代表作簡介：

Cosmology and astrophysics provide several convincing evidences of the existence of Dark Matter. Understanding its nature is one of the most important goals in fundamental physics in the 21st century. Alpha Magnetic Spectrometer (AMS) is conducting a unique long duration mission to uncover the mystery of Dark Matter through precision measurements of energy spectra of cosmic-ray antiparticles, positrons and antiprotons.

AMS was installed on the International Space Station (ISS) in May, 2011, and since then 16 billions of cosmic ray data have been recorded every year. The awarded works were published in 2013 and 2014. In these works we have presented the measurement of positron

fraction (number of positrons over number of positrons plus electrons) in cosmic rays as well as absolute fluxes based on 10 million positron and electron events identified on the ISS.

AMS is a magnetic spectrometer consisting of powerful 1.4 kG permanent magnet and nine layers of silicon Tracker which are located along 3m length and can determine the trajectory of incoming particles in 10 micron precision. Antiparticles (positrons and antiprotons) have exactly the same physics property but only the sign is opposite. Thus the bending direction inside the magnetic field is opposite each other. Haino has developed algorithms and software to reconstruct the trajectory, momentum and the charge sign. It was an essential contribution to the experiment in order to distinguish antiparticles from particles among huge number of cosmic-ray charged particles.

Positrons and antiprotons can be produced through the collision of primary cosmic rays like protons and nuclei with interstellar medium such as Hydrogen gas. They are called secondary cosmic rays. Based on particle physics and cosmic-ray propagation model, it is expected that the positron fraction is decreasing as a function of energy if positrons are all secondary origin. Our data are quite different from that and the fraction reaches the minimum at 8 GeV followed by a steady increase. If we look at higher energy our data demonstrate that above 200 GeV the positron fraction is no longer increasing. The energy at which the positron fraction ceases to increase (corresponding to the turning point energy at which the positron fraction reaches its maximum) has been measured to be 275±32 GeV. Thus we have concluded that our observations show the existence of new physical phenomena. Our data are consistent with positrons produced by annihilations of dark matter particle of mass of the order of 1 TeV, which is about 1000 times heavier than protons. However there are still other possibilities of the source of the observed positron excess from astrophysical origin like pulsars. To determine if the observed new phenomena is from dark matter or from astrophysical sources, measurements are underway by AMS to determine the rate of decrease at which the positron fraction falls beyond the turning point at 275 GeV.

得獎感言：

AMS project would not have been realized without continuous, hard, and long efforts for 20 years by all the AMS collaborators from Asia, Europe and the U.S. under the strong leadership by Academician Samuel C.C.Ting of MIT. I would thank Profs. R.Battiston, B.Bertucci, and colleagues in Perugia, Italy who supported me when I first joined AMS. I would thank Profs. S.C. Lee of Academia Sinica and Y.H.Chang of NCU as well as colleagues of AMS Taiwan group for the strong support and working together. I would thank to deputy director Prof. T.K.Wong and the secretary Ms. T.S.Liu of Institute of Physics, Academia Sinica for their help and encouragements of my work. I thank to Academia Sinica and MOST for recognizing the relevance of my work and the funding support. Finally I thank to my family for support so that I can concentrate on my work.