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Abstract for an Invited Paper
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Fresh Insights and Initiatives in Low Energy Scattering Processes Involving Antiparticles

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We will review aspects of the scattering of antiparticles, and in particular processes used in the controlled formation of antihydrogen atoms with low enough kinetic energies to allow their storage in magnetic minimum neutral atom traps [1-3], an advance that has led to the first determination of some of the properties of the anti-atom [4-7]. When antihydrogen is created via the mixing of dense clouds of cold positrons and antiprotons, radial transport of the antiprotons occurs due to repeated cycles of antihydrogen formation and break-up. We will describe how simulations [8] have elucidated the underlying physics, and explore some the implications for improved antihydrogen trapping efficiencies. There is renewed interest in the use of excited state positronium to form antihydrogen. We will review recent theoretical activity in this field from which accurate data for sub-eV positronium-antiproton collisions have become available for the first time [9-12]. We describe how it may be feasible to use charge exchange in collisions of positronium with ions to create a range of cold atomic species [13], including some which, to date, have not been amenable to laser cooling. 1. G.B. Andresen *et al.* (ALPHA Collaboration), Nature **468** (2010) 673 2. G.B. Andresen *et al.* (ALPHA Collaboration), Nature Phys. **7** (2011) 558 3. G. Gabrielse *et al.* (ATRAP Collaboration), Phys. Rev. Lett. **108** (2012) 113002 4. M. Ahmadi *et al.* (ALPHA Collaboration), Nature **541** (2017) 506 5. C. Amole *et al.* (ALPHA Collaboration), Nature Commun. **5** (2014) 3955 6. M. Ahmadi *et al.* (ALPHA Collaboration), Nature **529** (2016) 373 7. C. Amole *et al.* (ALPHA Collaboration), Nature **483** (2012) 439 8. S. Jonsell *et al.*, J. Phys B: At. Mol. Opt. Phys. **49 (**2016) 134004 9. A.S. Kadyrov *et al.*, Phys. Rev. Lett. **114** (2015) 183201 10. C.M. Rawlins *et al.*, Phys. Rev. A **93** (2016) 012709 11. M. Charlton *et al.*, Phys. Rev. A **94** (2016) 032701 12. I.I. Fabrikant *et al.*, J. Phys B: At. Mol. Opt. Phys. **50 (**2017) 134001 13. W.A. Bertsche *et al.*, New J. Phys. **19** (2017) 053020