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Production of antimatter molecular ions MARK ZAMMIT, Los Alamos National Laboratory, MICHAEL CHARLTON, Swansea University, SVANTE JONSELL, Stockholm University, JAMES COLGAN, Los Alamos National Laboratory, DMITRY FURSA, ALISHER KADYROV, IGOR BRAY, Curtin University, ROBERT FORREY, Penn State University, CHRISTOPHER FONTES, JEFFERY LEIDING, DAVID KILCREASE, PETER HAKEL, EDDY TIMMERMANS, Los Alamos National Laboratory — Recent years have seen marked progress in the production of, and experimentation with, atomic antimatter in the form of antihydrogen, $\overline{\mathrm{H}}$. Now we investigate the feasibility of producing the anti-molecular hydrogen anion, $\overline{\mathrm{H}}_2^-$ (analogue of H_2^+, consisting of two antiprotons and a positron), in the laboratory [1]. Recently Myers [2,3] argued that spectroscopic investigations of the anti-anion can offer very sensitive tests of the CPT theorem, which is one of the primary motivations for undertaking experiments with antimatter systems. Taking into account the present day ALPHA $\overline{\mathrm{H}}$ trap [4], utilizing reaction rates calculated here, from the literature, and via detailed balance, key processes are identified that could lead to the anion production. The feasibility of these reactions are discussed in the context of present day and near future experimental capabilities. [1] M. C. Zammit et al. Phys. Rev. A **100**, 042709 (2019). [2] E. G. Myers Phys. Rev. A **98**, 010101(R) (2018). [3] E. G. Myers Hyperfine Interact. **239**, 43 (2018). [4] C. Amole et al. Nuc. Inst. Meth. In Phys. Research A **735**, 319 (2014).

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