Towards cold collisions in a molecular synchrotron

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Previously, we demonstrated a synchrotron consisting of 40 straight electric hexapoles arranged in a circle with a 50 cm diameter. In this synchrotron, multiple packets of ammonia molecules were kept together in a tight bunch while completing over a 1000 round trips [1].

We added a beam line that will inject co-propagating packets of hydrogen molecules. These packets are synchronized with the cyclotron frequency of the ammonia molecules, such that a packet of ammonia molecules will encounter a 'fresh' target, every round trip. Since the number of collisions scales with the number of roundtrips, a more than 100-fold enhancement with respect to a crossed beam setup is expected.

Because of the co-propagation of the hydrogen, by seeding the hydrogen in a heavy noble gas, and by cooling down the valve that release the hydrogen, we can reach a relative velocity down to 200 m/s, corresponding to a collision energy of 1 cm^{-1} (1.4 K). This comfortably allows us to look for low-energy collision resonances that have been predicted to occur up to ~25 cm^{-1} [2].

[1] *Multiple packets of neutral molecules revolving for over a mile*, P.C. Zieger, S.Y.T. van de Meerakker, C.E. Heiner, H.L. Bethlem, A.J.A. van Roij, and G. Meijer, Phys. Rev. Lett., 2010, 105, 173001
[2] Ad van der Avoird, Gerrit C. Groenenboom, private communications