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**Laser cooling molecules** VALENTINA ZHELYAZKOVA, AKI MATSUSHIMA, Imperial College London — Laser cooling is a simple technique routinely used to cool atoms down to temperatures in the mK range. As the presence of a closed transition is essential for the cooling to work, laser cooling is usually not tractable in molecules due to their complex structure. Molecules can rotate and vibrate and usually only scatter a few photons before they end up in a dark state. In particular, the molecule often changes a vibrational state in the absorption-emission cycle. Recently, a whole class of polar molecules (e.g. CaF, SrF, BaF and TiO) has been shown to possess a highly diagonal Franck-Condon matrix, which makes them viable candidates to be laser cooled. We demonstrate a scheme for laser cooling of a supersonic beam of CaF and SrF radicals. The Franck-Condon factor for the relevant transition makes it possible for the molecules to scatter $10^4$ photons with only one or two vibrational repump lasers. We show evidence of longitudinal slowing and cooling in CaF and beam brightening and cooling in SrF.

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