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Confinement of active systems: trapping, swim pressure, and explosions[1] SHO TAKATORI, California Institute of Technology, RAF DE DIER, ETH Zurich, KU Leuven, JAN VERMANT, ETH Zurich, JOHN BRADY, California Institute of Technology — We analyze the run-and-tumble dynamics and motion of living bacteria and self-propelled Janus motors confined in an acoustic trap. Since standard optical tweezers are far too weak, we developed an acoustic trap strong enough to confine swimmers over distances large compared to the swimmers' size and run length. The external trap behaves as an "osmotic barrier" that confines the swimmers inside the trapping region, analogous to semipermeable membranes that confine passive Brownian particles inside a boundary. From the swimmers' restricted motion inside the trap, we calculate the unique swim pressure generated by active systems originating from the force required to confine them by boundaries. We apply a strong trap to collect the swimmers into a close-packed active crystal and then turn off the trap which causes the crystal to "explode" due to an imbalance of the active pressure. We corroborate all experimental results with Brownian dynamics simulations and analytical theory.

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