The supernova fountain

Thierry Foglizzo, CEA Saclay, France

The explosion of massive stars plays a key role in the formation of neutron stars and the injection of heavy elements in the interstellar medium. These explosions are observed every night in distant galaxies. However, the theoretical understanding of their mechanism is still debated.
The decisive moment takes place when the stellar core collapses into a neutron star and launches of a shock wave.
After stalling for a fraction of a second, the shock wave may either accelerate and turn the collapse into an explosion, or recede to form a blackhole.
The most advanced numerical simulations have revealed the key role of hydrodynamical instabilities for the success of the explosion.
They induce inhomogeneities which affect the absorption of neutrinos, and transverse motions which influence the kick and spin of the newly born neutron star.
Surprisingly, most of this dynamics can be captured in a simple water fountain, using the analogy between shock waves and hydraulic jumps.

I will show that the complexity of supernova explosions can be made more intuitive by the use of this experimental analogue.