

SHOCK WAVE II

Analogies

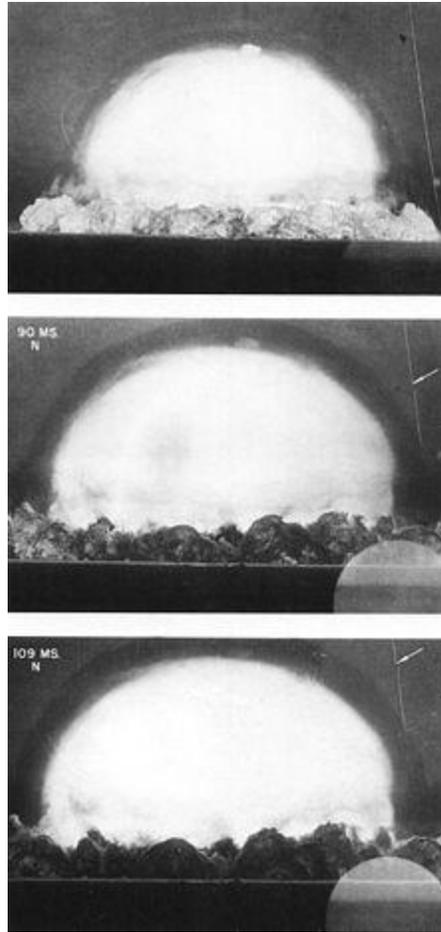
A shock wave may be described as the furthest point upstream of a moving object which "knows" about the approach of the object. In this description, the shock wave position is defined as the boundary between the zone having no information about the shock-driving event, and the zone aware of the shock-driving event, analogous with the light cone described in the theory of special relativity.

To get a shock wave something has to be travelling faster than the local speed of sound. In that case some parts of the air around the aircraft are travelling at exactly the speed of sound with the aircraft, so that the sound waves leaving the aircraft pile up on each other, similar to a tailback on a road, and a shock wave forms, the pressure increases, and then spreads out sideways. Because of this amplification effect, a shock wave is very intense, more like an explosion when heard (not coincidentally, since explosions create shock waves).

Analogous phenomena are known outside fluid mechanics. For example, particles accelerated beyond the speed of light in a refractive medium (where the speed of light is less than that in a vacuum, such as water) create visible shock effects, a phenomenon known as Cherenkov radiation.

Examples

Below are a number of examples of shock waves, broadly grouped with similar shock phenomena:



Shock wave propagating into a stationary medium, ahead of the fireball of an explosion. The shock is made visible by the shadow effect (Trinity explosion.)

Moving shock

- Usually consists of a shockwave propagating into a stationary medium
- In this case, the gas ahead of the shock is stationary (in the laboratory frame), and the gas behind the shock is supersonic in the laboratory frame. The shock propagates with a wave front which is normal (at right angles) to the direction of flow. The speed of the shock is a function of the original pressure ratio between the two bodies of gas.
- Moving shocks are usually generated by the interaction of two bodies of gas at different pressure, with a shock wave propagating into the lower pressure gas, and an expansion wave propagating into the higher pressure gas.
- Examples: Balloon bursting, Shock tube, shock wave from explosion