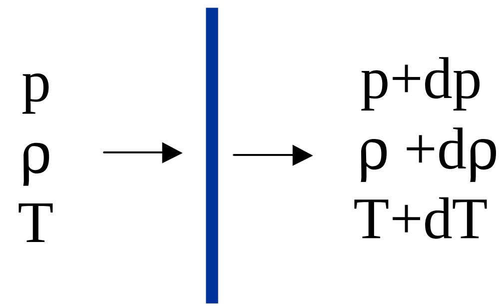
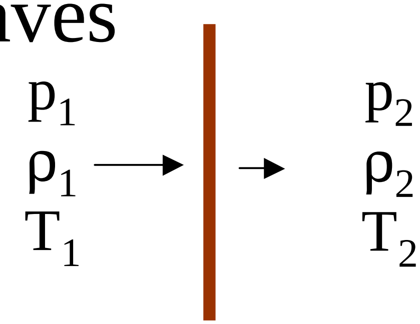
Shock Waves



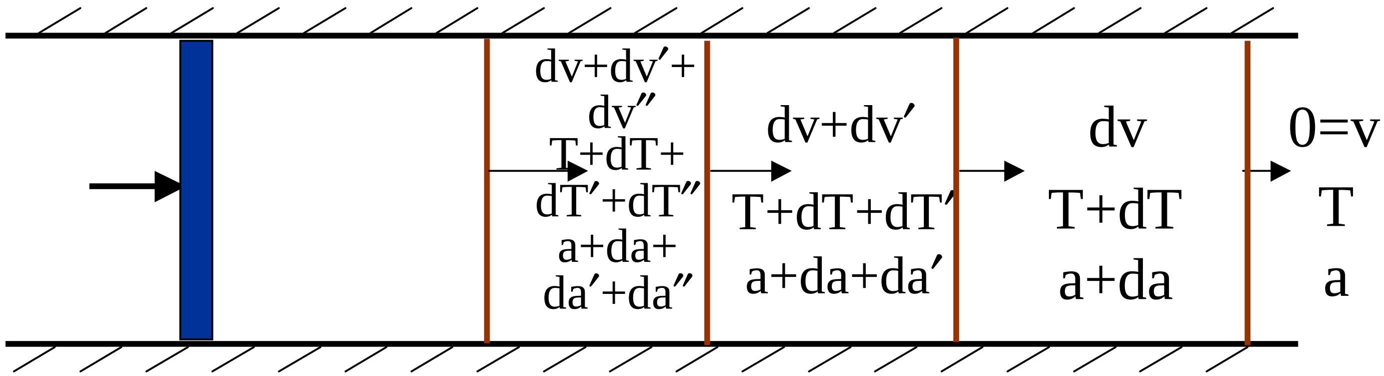
- Already examined behavior of *weak* waves
  - **sound waves**, $d\rho/\rho \to 0$
  - reversible (isentropic)
- Now look at *strong compression* waves
  - **shock waves**, $\rho_2 > \rho_1$
  - irreversible (nonisentropic)



- **Shock waves**
  - thin regions (~μm's): changes in fluid properties *nearly discontinuous*
  - rapid change in pressure/density due to *internal viscous stresses*
  - excluding radiation, *adiabatic*

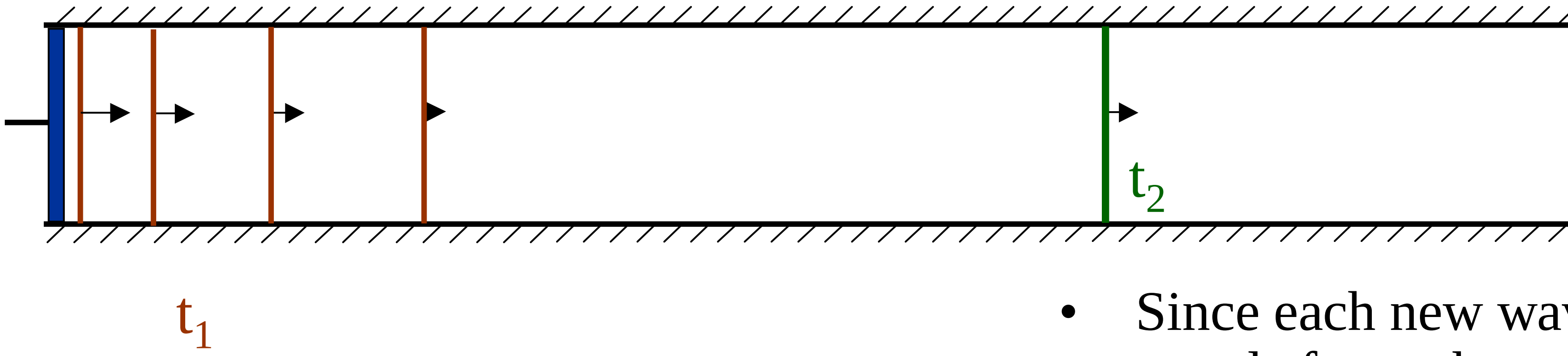
Formation of Shock Waves

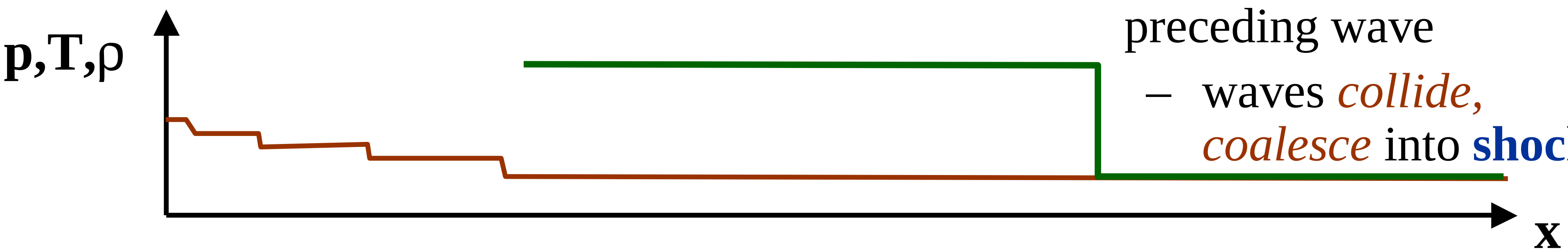
- Imagine series of discrete compression waves
  - e.g., produced by piston in tube accelerated to higher and higher velocities in discrete "pushes"



- Each pulse of piston produces weak compression wave traveling **@ speed of sound** in **moving gas in front** of it
- Each wave travels in wake of previous waves, each travels slightly faster (**v↑, and a↑ since T↑**)

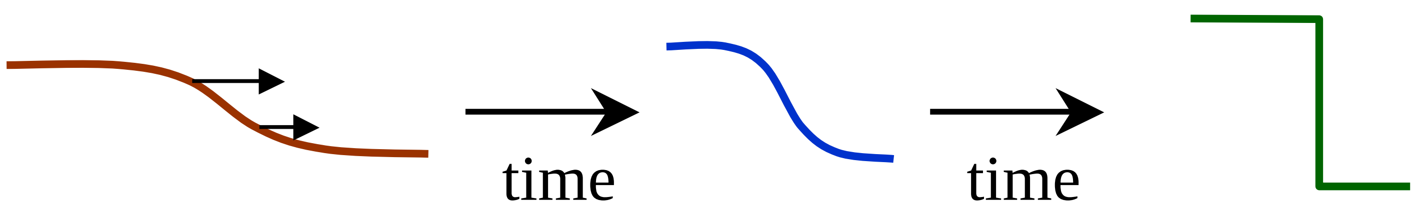
Coalescence of Compression Waves





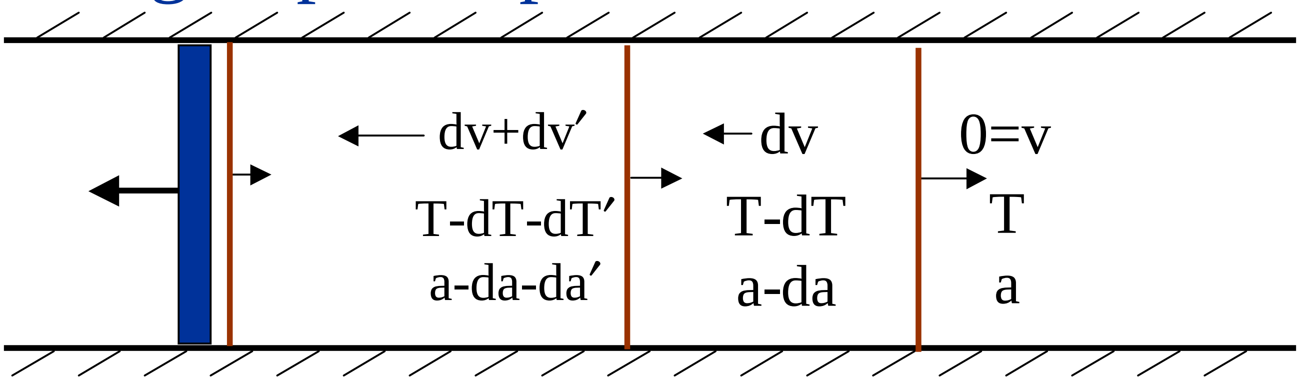
- Since each new wave travels faster than preceding wave
  - waves *collide, coalesce* into **shock**

- Similar for initially continuous compression wave

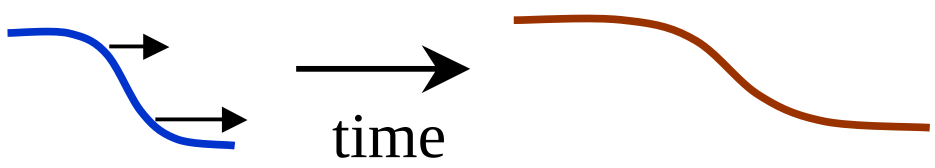


Expansion (Rarefaction) Waves

- Can group of expansion waves also coalesce?



- Successive waves see colder gas, lower **a**
  - each new wave is slower than last
- For continuous expansion wave



- So **can not create expansion "shock"**