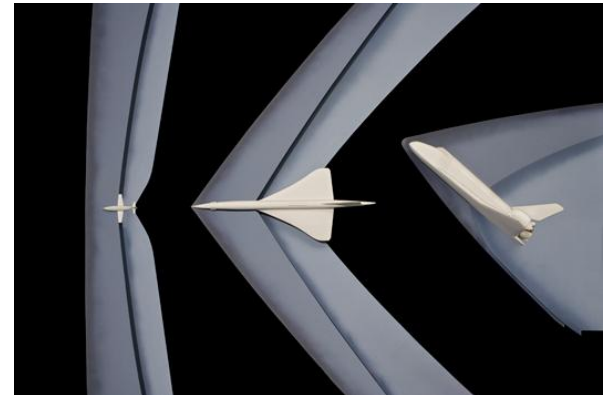# Mach's construction
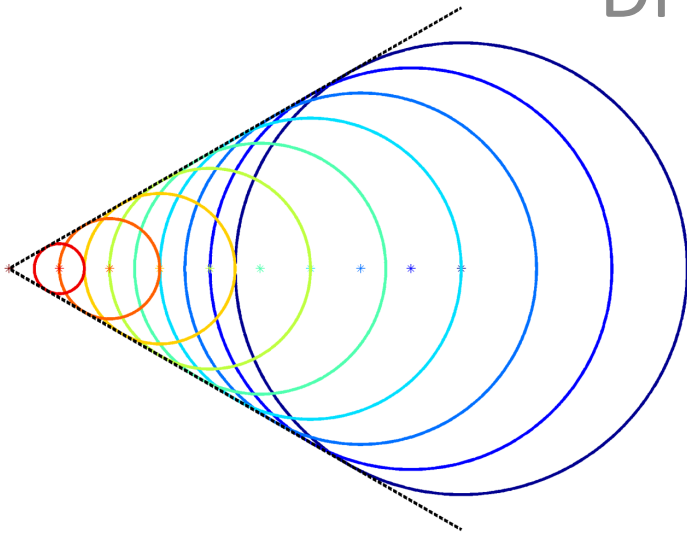
Dr Andrew French
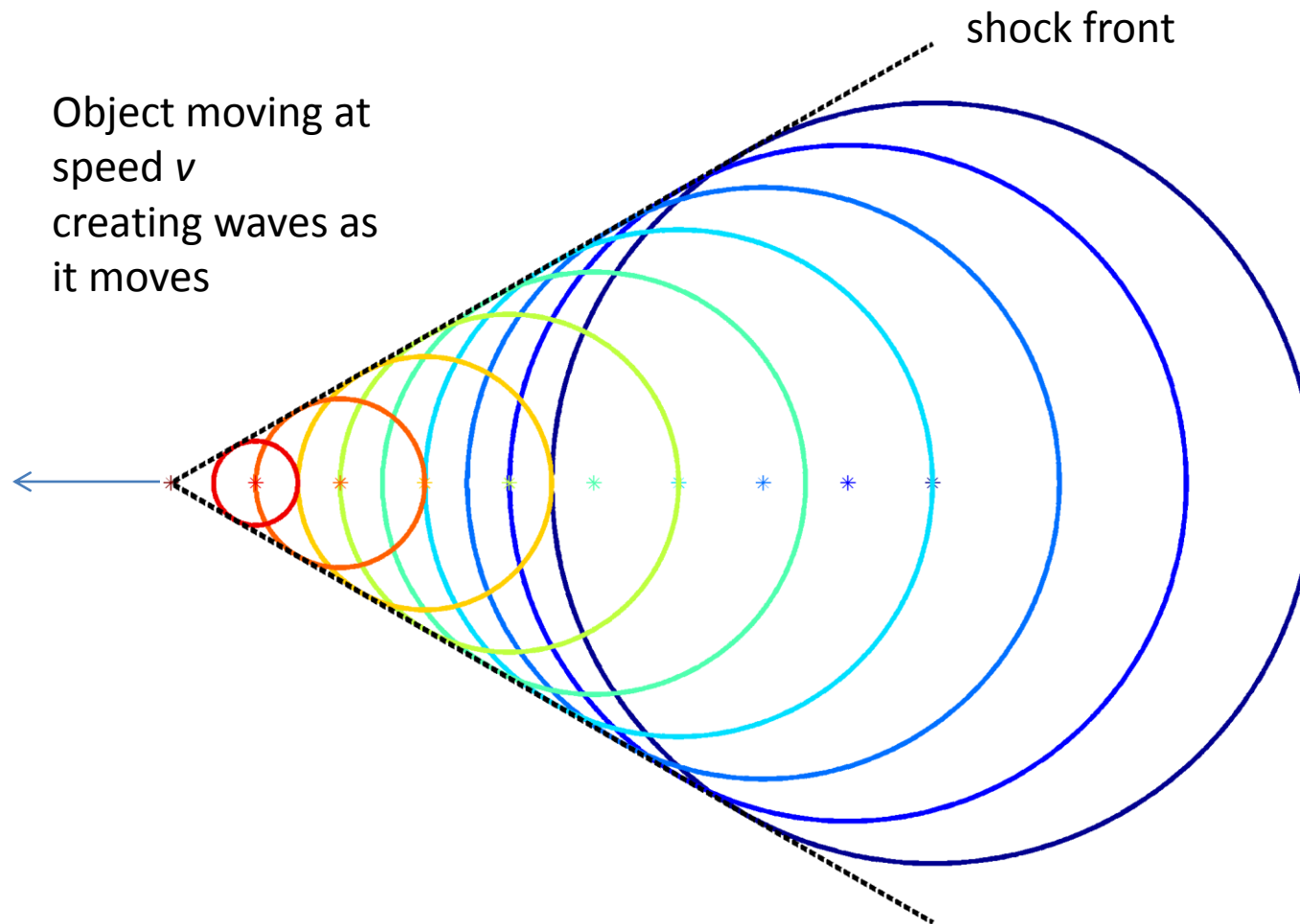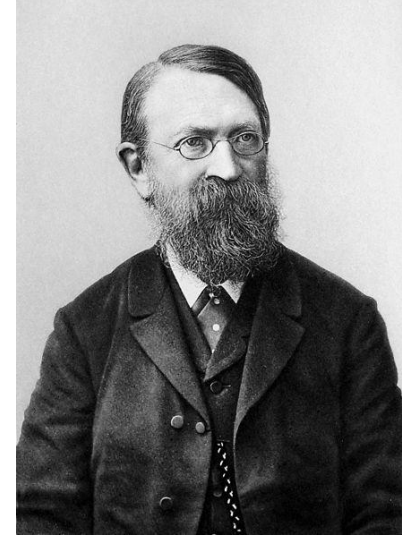
What has a supersonic shockwave got to do with some really simple trigonometry?

Mach's construction

Object moving at speed *v* creating waves as it moves

shock front

'Infinitesimally thin' spherical shells of disturbance are created continuously as the object moves. They radiate out at the wave speed *c*

3

Mach's construction

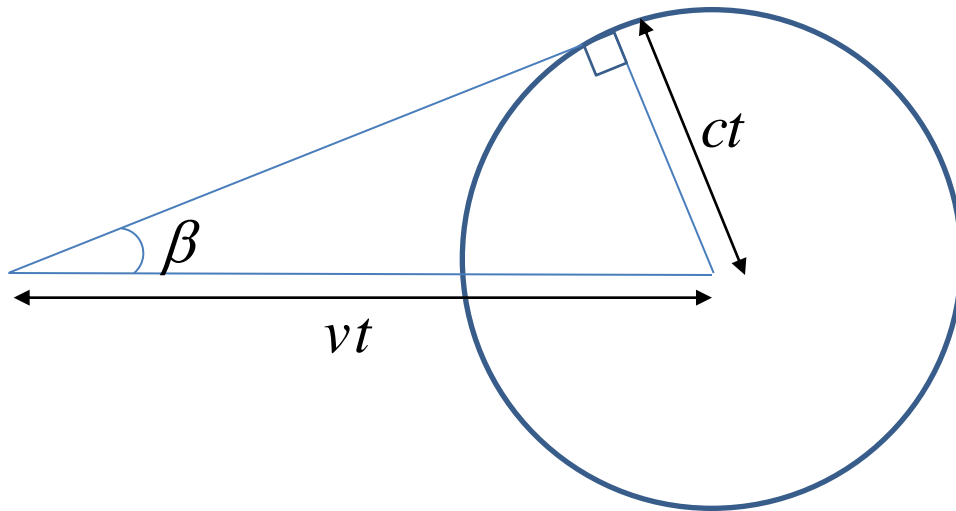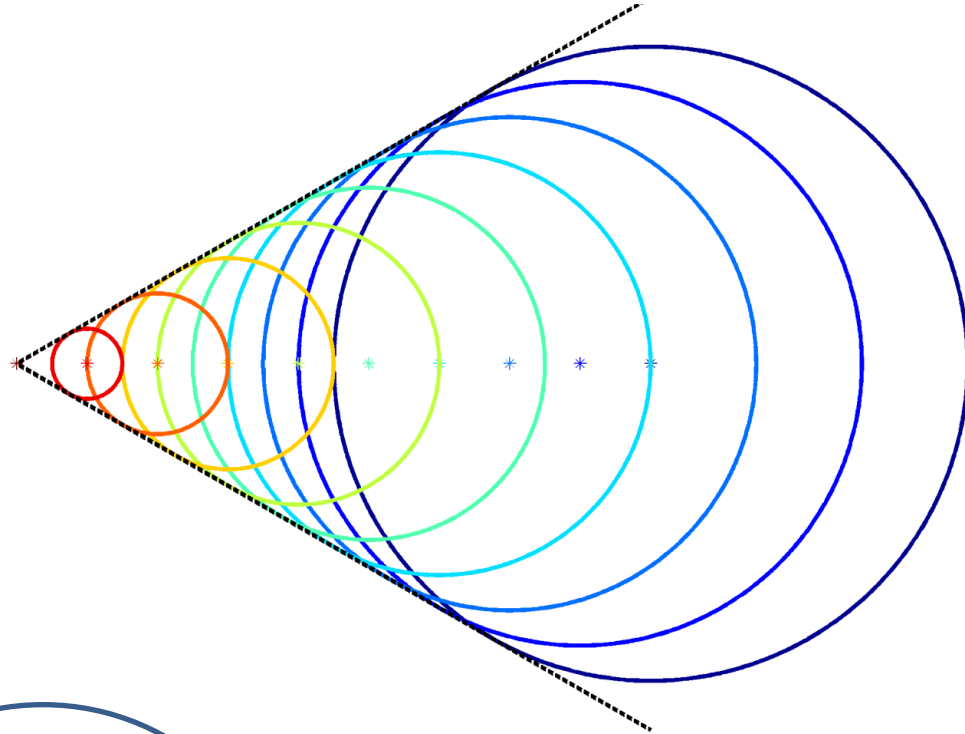v/c = 2. sin^{-1}(c/v) = 30°

- *c*   is the wave speed
- *v*   is the velocity of the
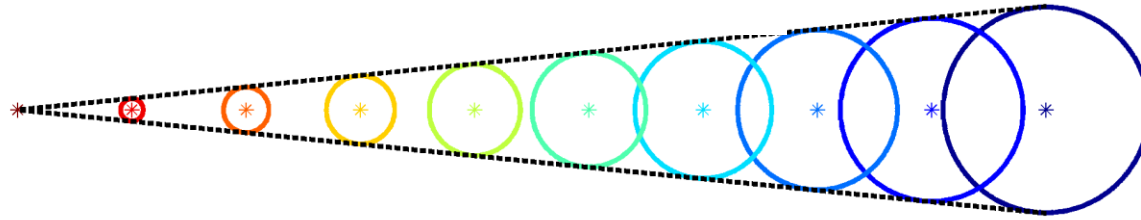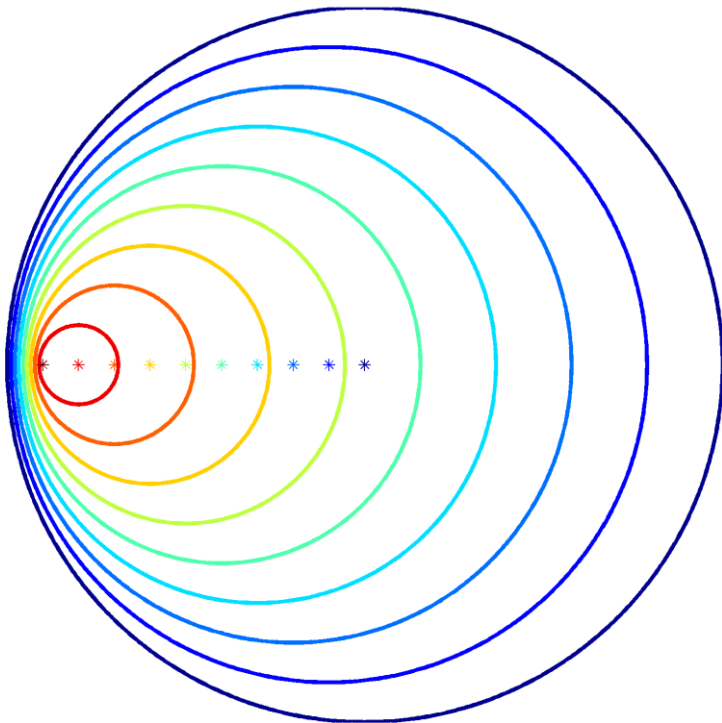   object making the waves

Mach number

$$M = \frac{v}{c}$$

$$vt\sin\beta = ct$$

$$\therefore \quad \beta = \sin^{-1}\left(\frac{c}{v}\right) = \sin^{-1}\frac{1}{M}$$

v/c = 10. $\sin^{-1}(c/v)$ = 5.7392°
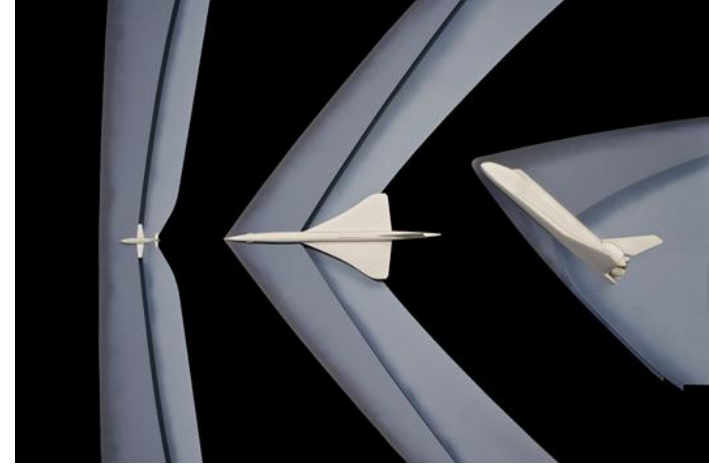
v/c = 0.9. $\sin^{-1}(c/v)$ = NaN$^{\circ}$

v/c = 0.5. $\sin^{-1}(c/v)$ = NaN$^{\circ}$
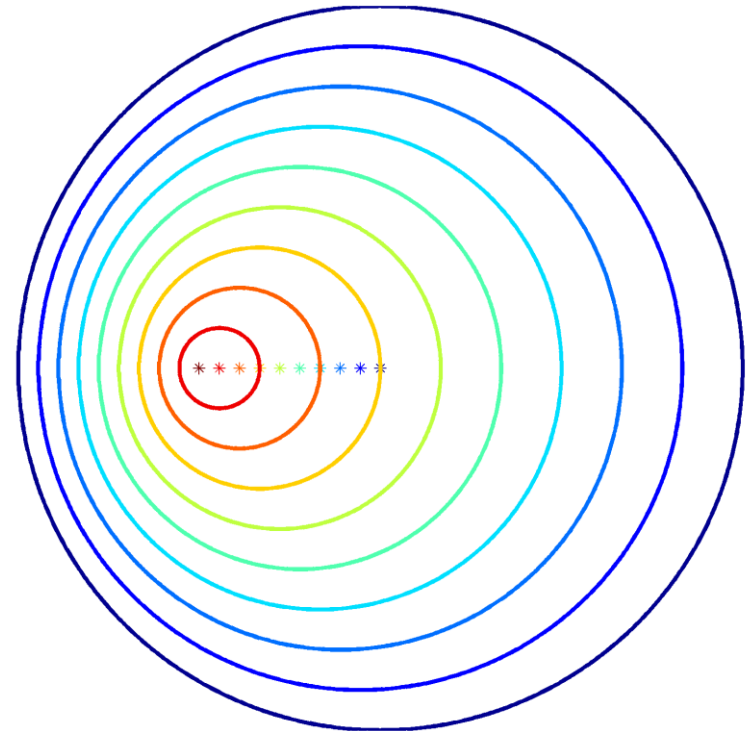
Kelvin wedge via Mach's construction?

$v/c = 3. \quad \sin^{-1}(c/v) = 19.4712^{\circ}$

$$2\tan^{-1}\tfrac{1}{4}\sqrt{2} \approx 38.9^{\circ}$$