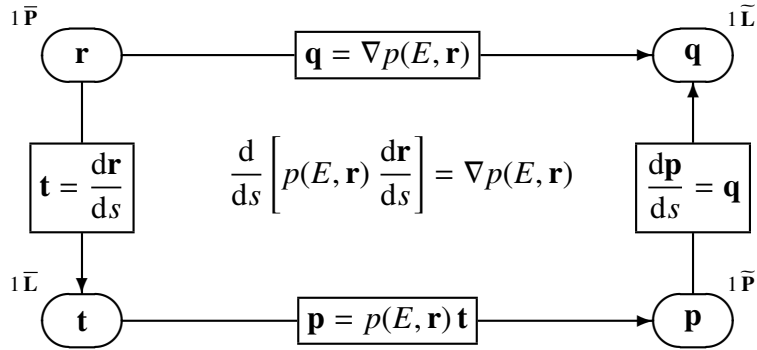


### Particle dynamics in conservative fields: Jacobi

$$p(E, \mathbf{r}) = \sqrt{2m[E - V(\mathbf{r})]}$$

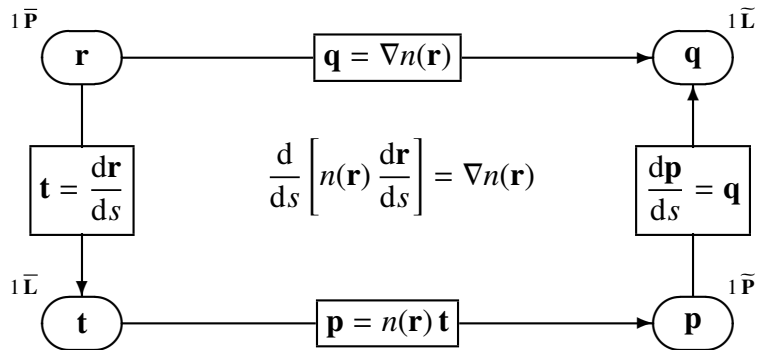
trajectory equation : given  $V(\mathbf{r})$ ,  $\mathbf{r}(0)$ ,  $\mathbf{p}(0)$ , to find  $\mathbf{r}(s)$



$\mathbf{r}(s)$  radius vector       $V$  potential energy       $\mathbf{q}(s)$  unnamed  
 $\mathbf{t}(s)$  unit tangent vector       $T$  kinetic energy       $\mathbf{p}(s)$  momentum  
 $m$  mass       $E$  total energy

### Geometrical optics: Fermat

ray equation : given  $n(\mathbf{r})$ ,  $\mathbf{r}(0)$ ,  $\mathbf{p}(0)$ , to find  $\mathbf{r}(s)$



$s$  arc parameter       $n(\mathbf{r})$  refractive index       $\mathbf{q}(s)$  unnamed  
 $\mathbf{r}(s)$  radius vector       $c$  light speed       $\mathbf{p}(s)$  ray vector  
 $\mathbf{t}(s)$  unit tangent vector