*8.962 Lecture 27 (Post-term)*
*May 24, 2018*

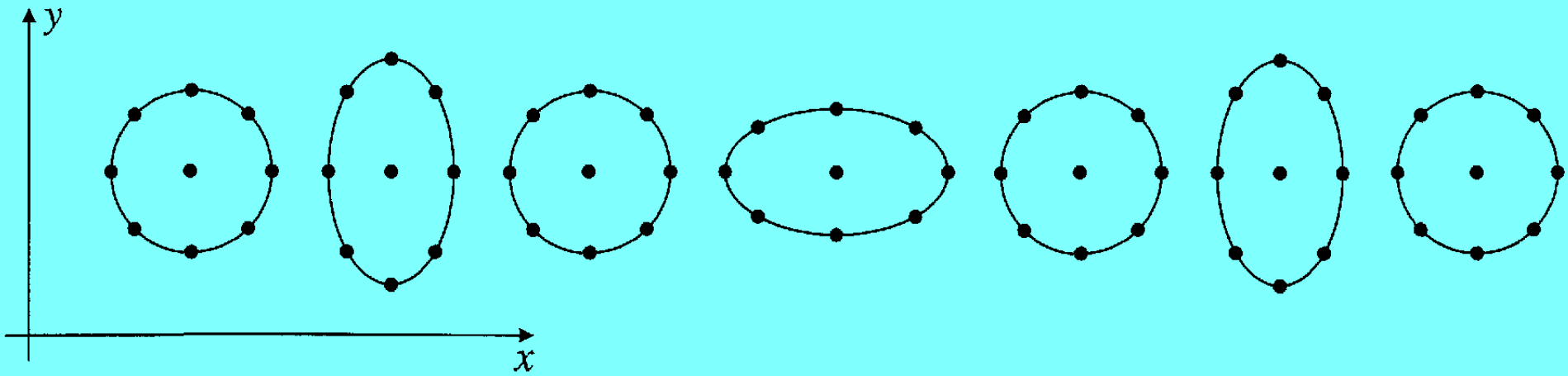
# GRAVITATIONAL RADIATION

# Carroll's Highbrow & Lowbrow Approaches to Gauge Invariance

Highbrow: coordinate-invariant description of coordinate transformations: 2 pages of text, referring to 9-page long Appendix B.

Lowbrow: Gauge invariance can also be understood from the slightly more lowbrow but considerably more direct route of infinitesimal coordinate transformations. Our diffeomorphism $\psi_\epsilon$, can be thought of as changing coordinates from $x^\mu$ to $x^\mu - \epsilon\xi^\mu$. ... Following through the usual rules for transforming tensors under coordinate transformations, you can derive precisely (7.14)– $[h^{(\epsilon)}_{\mu\nu} = h_{\mu\nu} + 2\epsilon\partial_{(\mu}\xi_{\nu)}]$ although you have to cheat somewhat by equating components of tensors in two different coordinate systems.

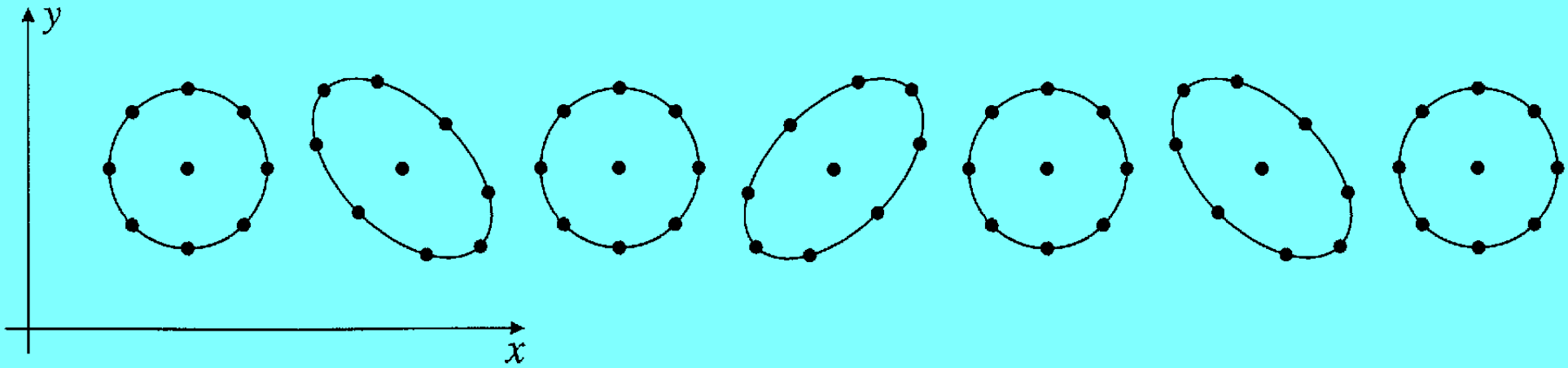
# Gravitational Wave with + Polarization




(From Sean Carroll, *Spacetime and Geometry*, Figure 7.4))

The effect of a gravitational wave with polarization $e_{11} = -e_{22}$ is to distort a circle of test particles into ellipses oscillating in a vertical and horizontal pattern.

# Gravitational Wave with $\times$ Polarization




(From Sean Carroll, *Spacetime and Geometry*, Figure 7.5))

The effect of a gravitational wave with polarization $e_{12} = e_{21}$ is to distort a circle of test particles into oscillating ellipses, at 45° relative to the previous diagram.