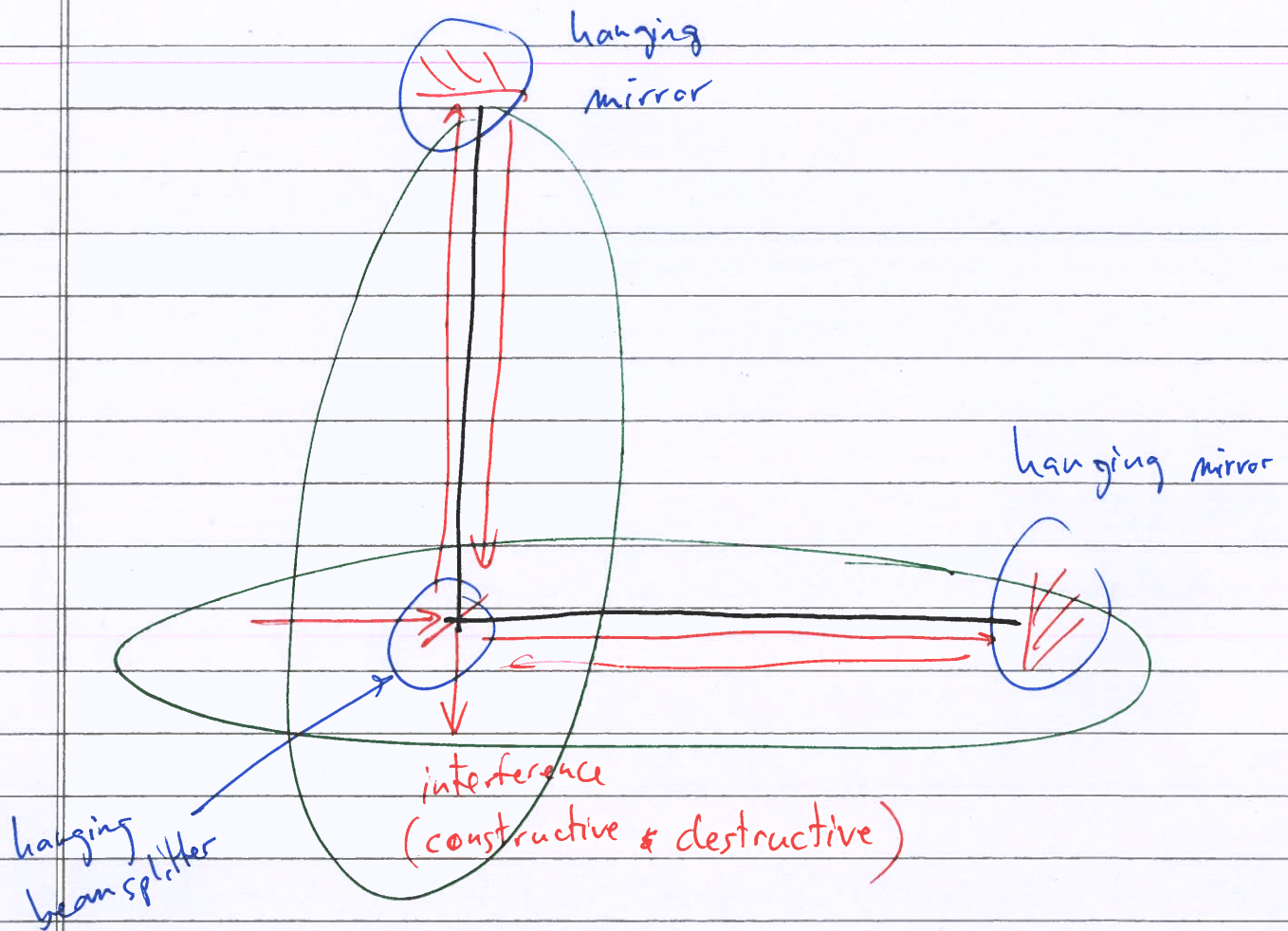


Wednesday, April 2, 2025

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Gravitational wave detection



Rubber Ruler Paradox

Example, How big is the black hole at the center of the Milky Way galaxy?

$$\begin{aligned} \text{Mass of the black hole} &\approx 4 \times 10^6 M_{\text{sun}} \\ &= 7.96 \times 10^{36} \text{ kg} \end{aligned}$$

$\underbrace{1.99 \times 10^{30} \text{ kg}}_{M_{\text{sun}}}$

$$\text{Event horizon radius} = R_s = \frac{2 G M}{c^2}$$

(Schwarzschild radius) Newton's Constant "big G"

$$= \frac{2 (6.6743 \times 10^{-11}) (7.96 \times 10^{36})}{(3 \times 10^8)^2}$$

$$= 11.8 \times 10^9 \text{ m}$$

$$\approx 12 \times 10^9 \text{ m}$$

$$\approx 12 \times 10^6 \text{ km}$$

$12 \times 10^6 \text{ km} = R_{\text{sun}}$
 $\underbrace{6.96 \times 10^5 \text{ km}}_{R_{\text{sun}}}$

$$\approx 17 R_{\text{sun}}$$

$$\Rightarrow \boxed{R_s = 17 R_{\text{sun}}} \approx 0.08 \text{ AU}$$

Note: M87 central Black hole has $R_s \approx 128 \text{ AU}$