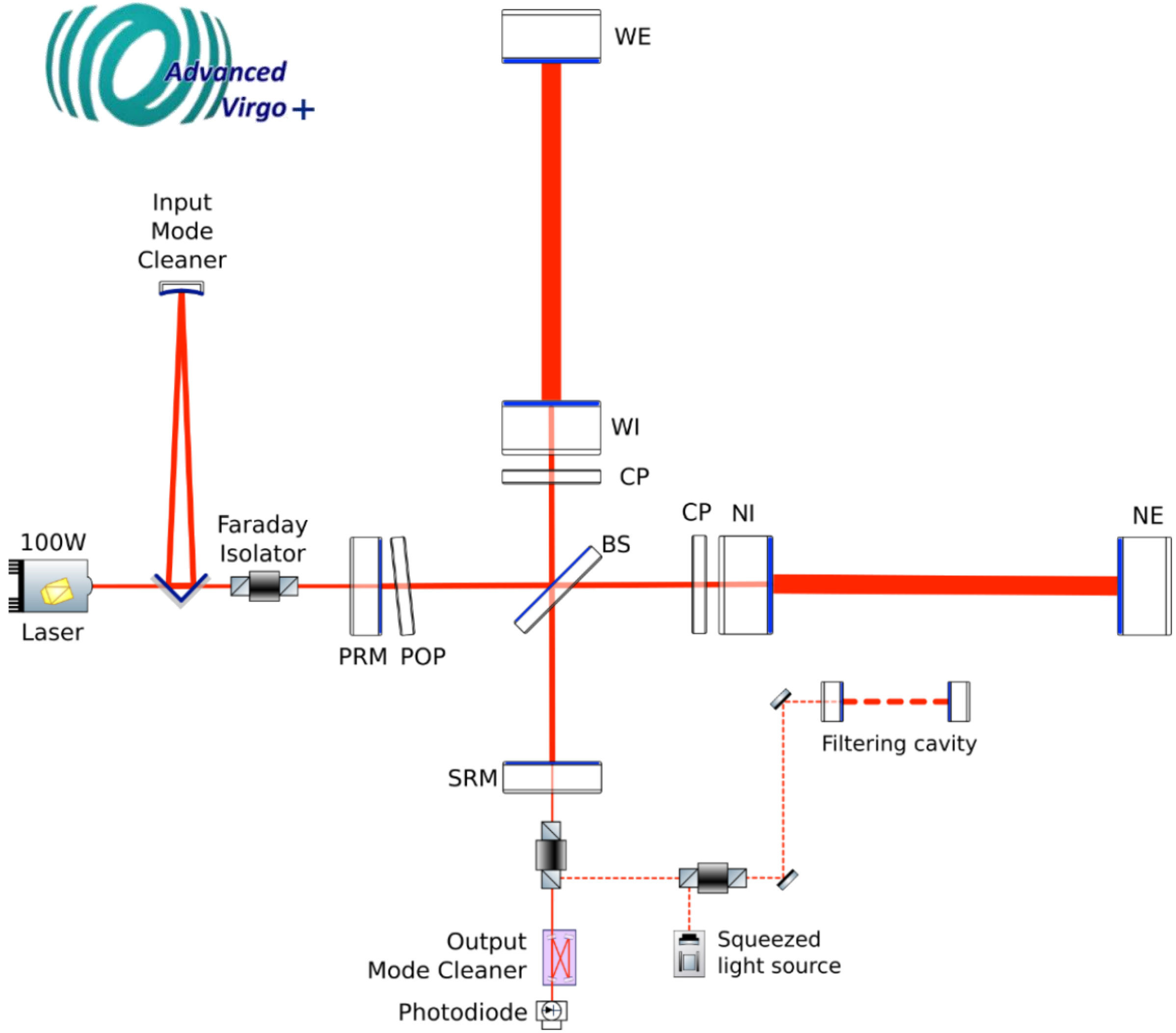
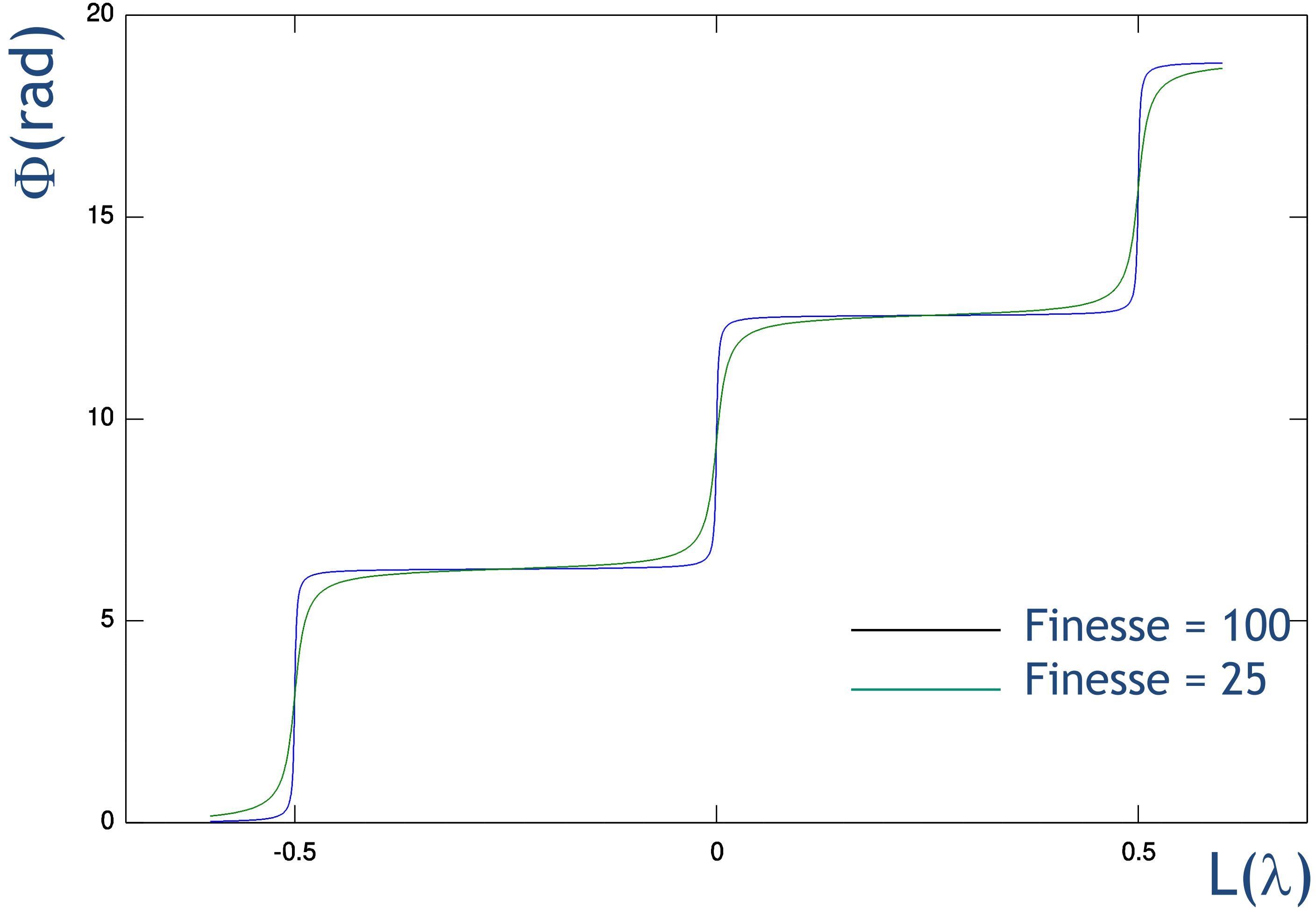
A typical GW detector

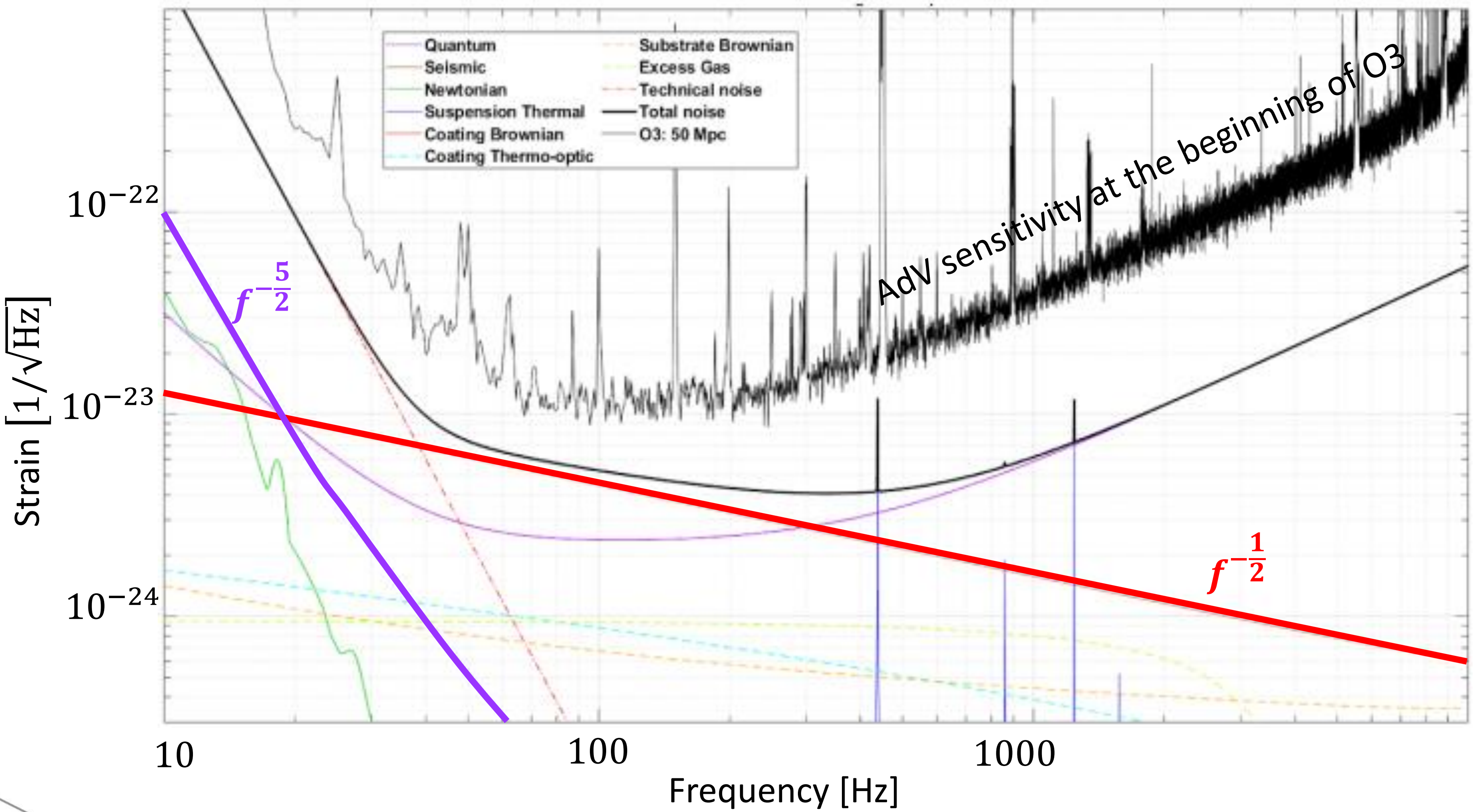


	AdV+ Phase I
Laser & Injection	
Laser power	130 W
Power into the interferometer	40 W
Input mode-cleaner length	143 m
Input mode-cleaner finesse	1000
Injection throughput	85%
Modulation frequencies	6 MHz, 8 MHz, 56 MHz
Interferometer optical configuration	
Arm cavities length	3 km
Arm cavities finesse	450
Power recycling gain	39
Signal recycling	Yes
Mirrors	
Beam splitter	55 cm x 6.5 cm, 34 kg, T=50%
Input Test masses	35 cm x 20 cm, 42 kg, T=1.4 %
End Test masses	35 cm x 20 cm, 42 kg, T=5 ppm
Power Recycling mirror	35 cm x 10 cm, 21 kg, T=5%
Signal recycling mirror	35 cm x 10 cm, 21 kg, T=40%
Detection	
Output mode-cleaner	Single cavity, Finesse = 1000
Detection losses	< 10%
Photodiodes quantum efficiency	99%
Suspensions	
Mirror suspensions	Monolithic, fused silica fibers
Vibration isolation	Super-attenuators
Quantum noise reduction system	
Squeezed vacuum source	12 dB
Filter cavity	L = 285 m, Finesse = 10000
Injection losses	< 10 %
Phase noise	40 mrad
Newtonian Noise Cancellation	
Sensors	Indoor seismic sensors
Noise reduction factor	3

The displacement sensitivity of a F-P cavity



A typical sensitivity curve



Main equations

$$\langle \Delta T \, \Delta V \rangle = 0. \qquad (112.5)$$

$$\langle (\Delta T)^2 \rangle = T^2 / C_v, \qquad (112.6)$$

$$\langle (\Delta V)^2 \rangle = -T (\partial V / \partial P)_T. \qquad (112.7)$$

If T is measured in degrees, $\langle (\Delta T)^2 \rangle = kT^2/C_v$.

STATISTICAL PHYSICS

by

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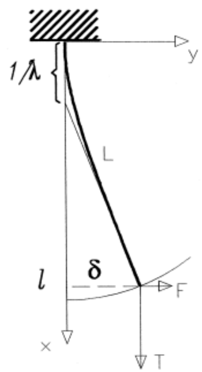
Fluctuation-Dissipation Theorem

$$(x^2)_\omega = \hbar \alpha'' \coth \frac{\hbar\omega}{2T} = 2\hbar\alpha'' \left\{ \frac{1}{2} + \frac{1}{e^{\hbar\omega/T} - 1} \right\}. \qquad (124.9)$$

F-D T: classical limit $\quad S_{xx}(\omega) = \dfrac{4k_B T}{\omega} \alpha''$

$$\alpha'' = \frac{\text{Dilution} \cdot \varphi}{\text{Rigidity}} = \frac{W_{diss}}{{F_0}^2} \longrightarrow S_x(f) = \frac{2k_B T}{\pi^2 f^2} \frac{W_{\text{diss}}}{F_0^2}$$

Levin's equation



G. Cagnoli et al. / Physics Letters A 272 (2000) 39–45

$$k_G = \frac{T}{L}\left(1 + \frac{1}{2}\sqrt{\frac{YI}{TL^2}}\right)$$

$$k_{el} = \frac{T}{2L}\sqrt{\frac{Y_0 I}{TL^2}}$$

8th Edoardo Amaldi Conference on Gravitational Waves

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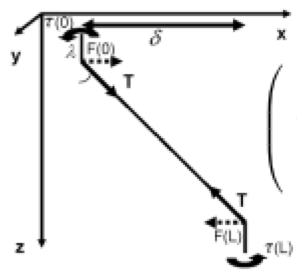

$$\begin{pmatrix} F_x(0) \\ F_x(L) \\ \tau_y(0) \\ \tau_y(L) \end{pmatrix} = \begin{pmatrix} -\frac{T}{L-2\lambda} & \frac{T}{L-2\lambda} & -\frac{T\lambda}{L-2\lambda} & \frac{T\lambda}{L-2\lambda} \\ \frac{T}{L-2\lambda} & -\frac{T}{L-2\lambda} & \frac{T\lambda}{L-2\lambda} & -\frac{T\lambda}{L-2\lambda} \\ -\frac{T\lambda}{L-2\lambda} & \frac{T\lambda}{L-2\lambda} & -\frac{T\lambda(L-\lambda)}{L-2\lambda} & \frac{T\lambda^2}{L-2\lambda} \\ -\frac{T\lambda}{L-2\lambda} & \frac{T\lambda}{L-2\lambda} & -\frac{T\lambda^2}{L-2\lambda} & -\frac{T\lambda(L-\lambda)}{L-2\lambda} \end{pmatrix} \begin{pmatrix} X(0) \\ X(L) \\ \theta_y(0) \\ \theta_y(L) \end{pmatrix}$$