



LIGO high-frequency response to length- and GW-induced optical path length variations

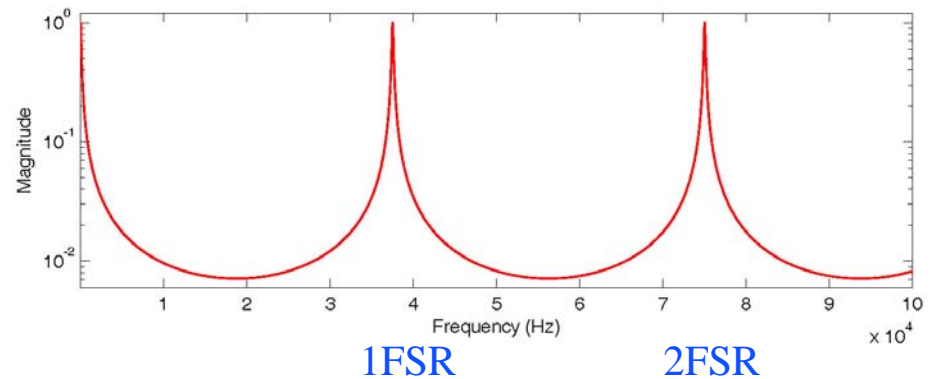
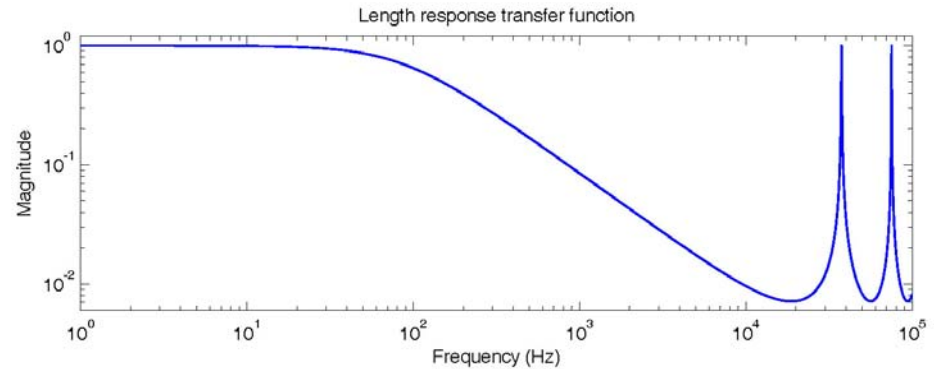
Rick Savage

Malik Rakhmanov and Hunter Elliott

$$H_L(s) = \frac{1 - r_a r_b}{1 - r_a r_b e^{-2sT}}$$

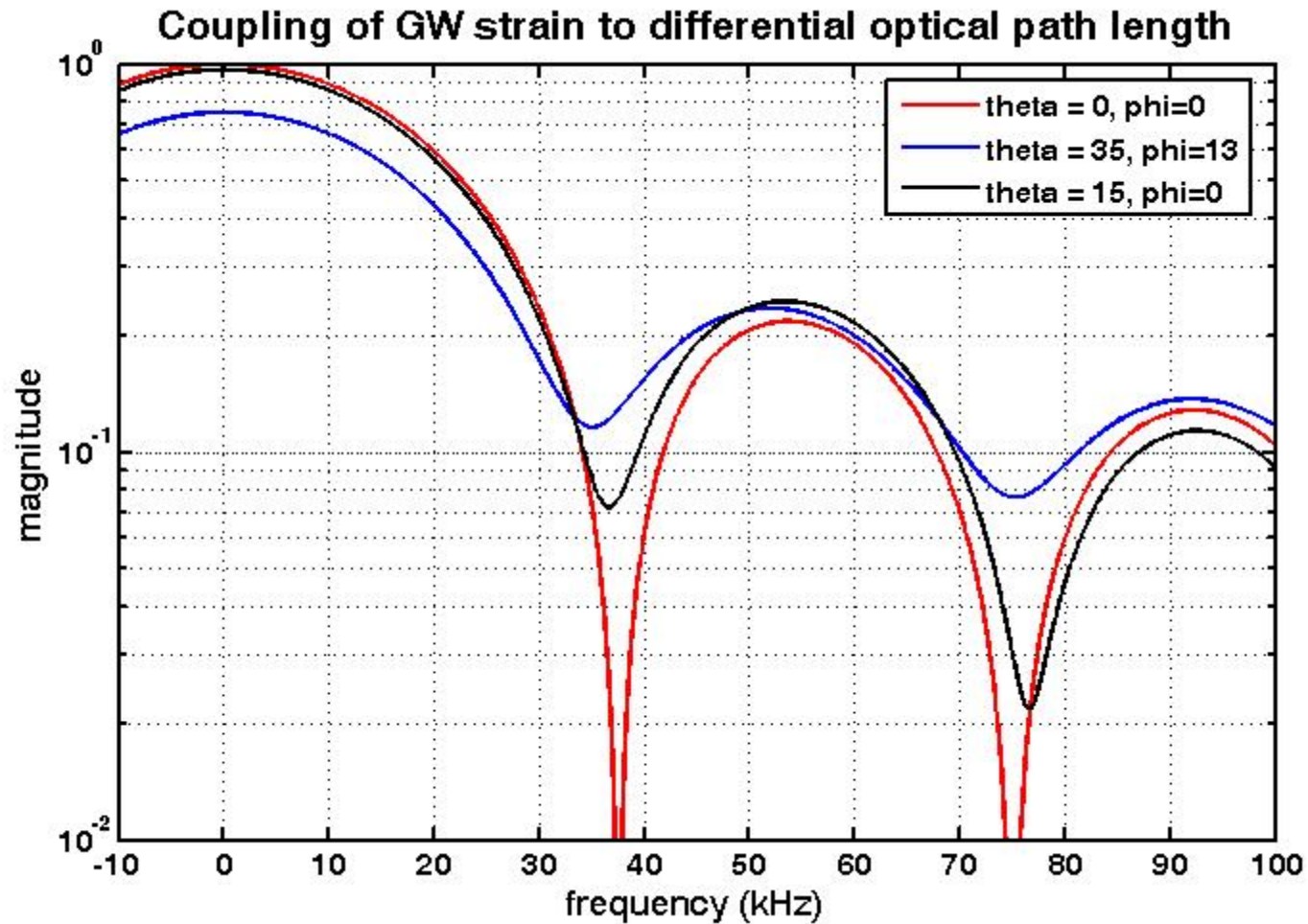
r_a, r_b : mirror reflectivities
 T : cavity transit time

Square root of the familiar Airy profile

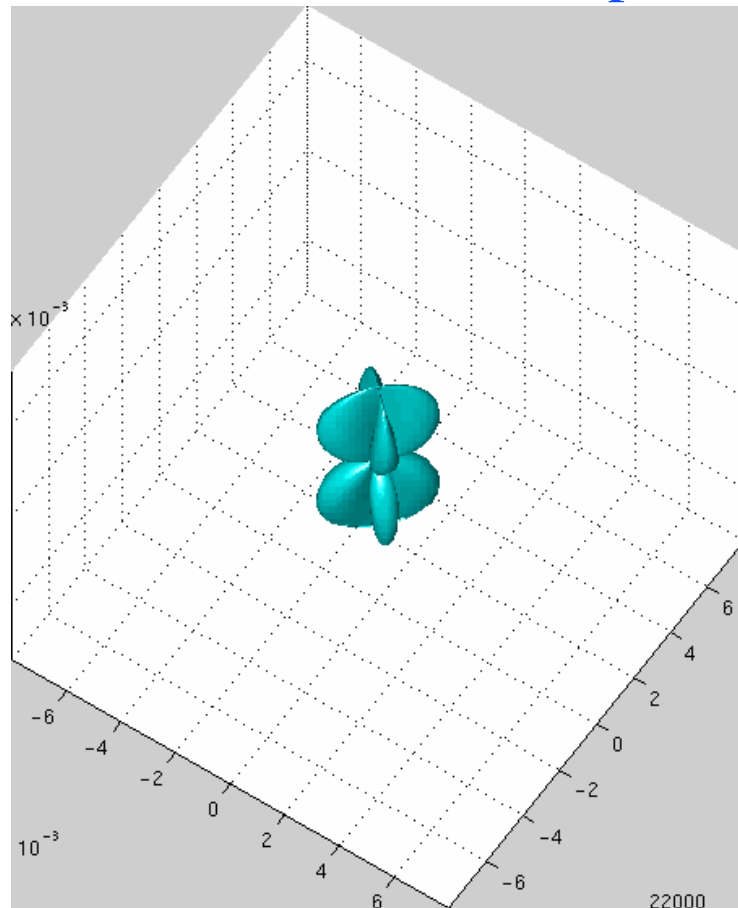




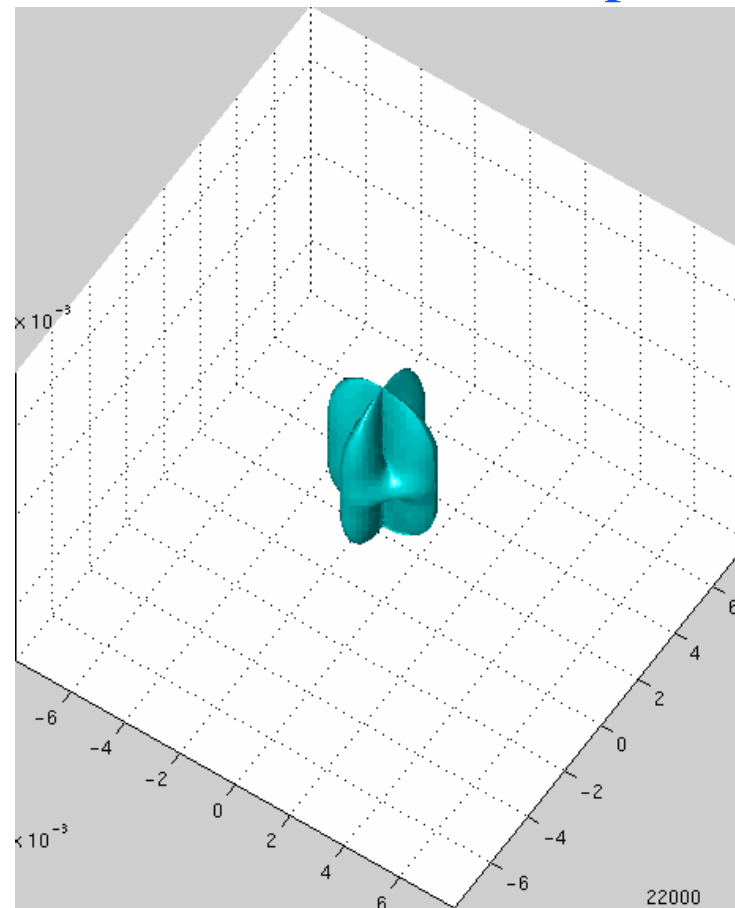
Coupling of GW to differential OPL change



Cross pol.



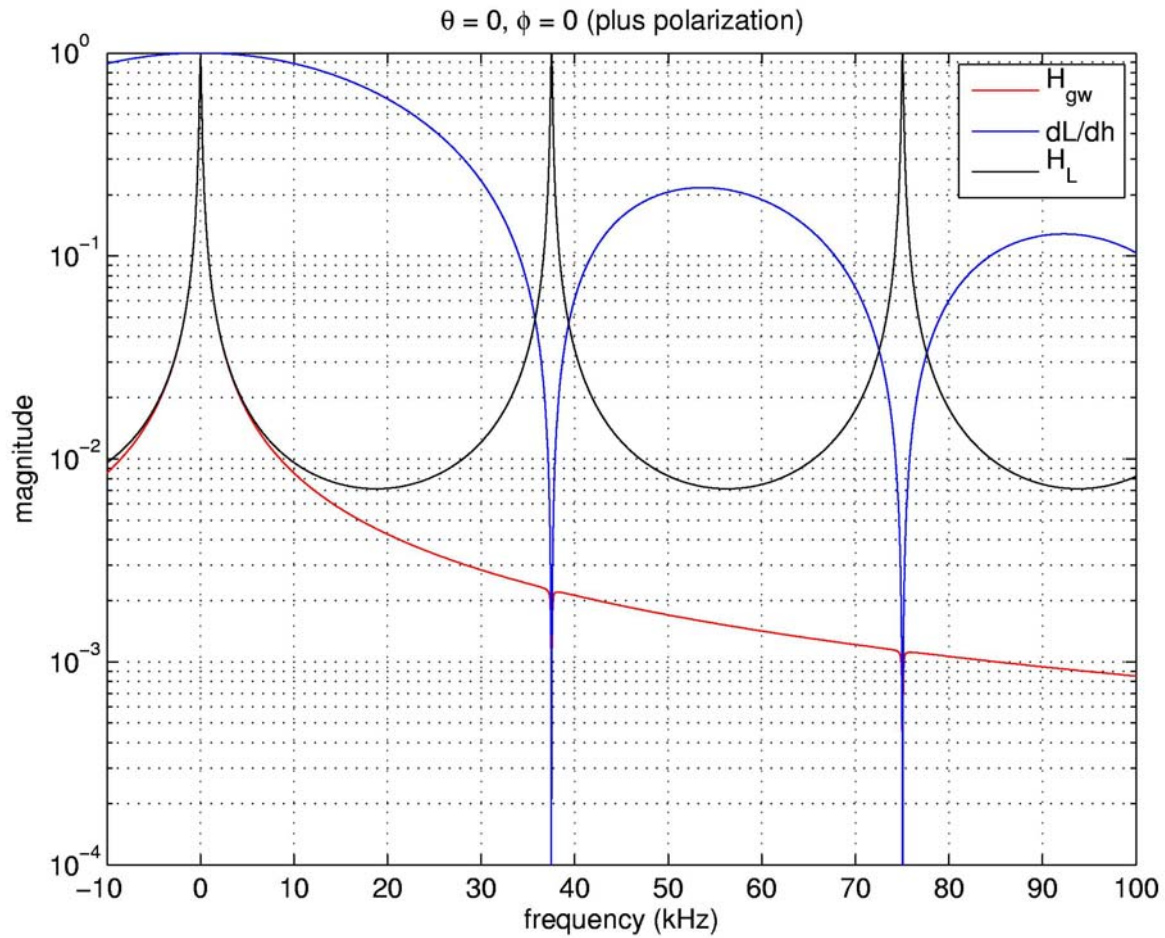
Plus pol.



Animations by Hunter Elliott

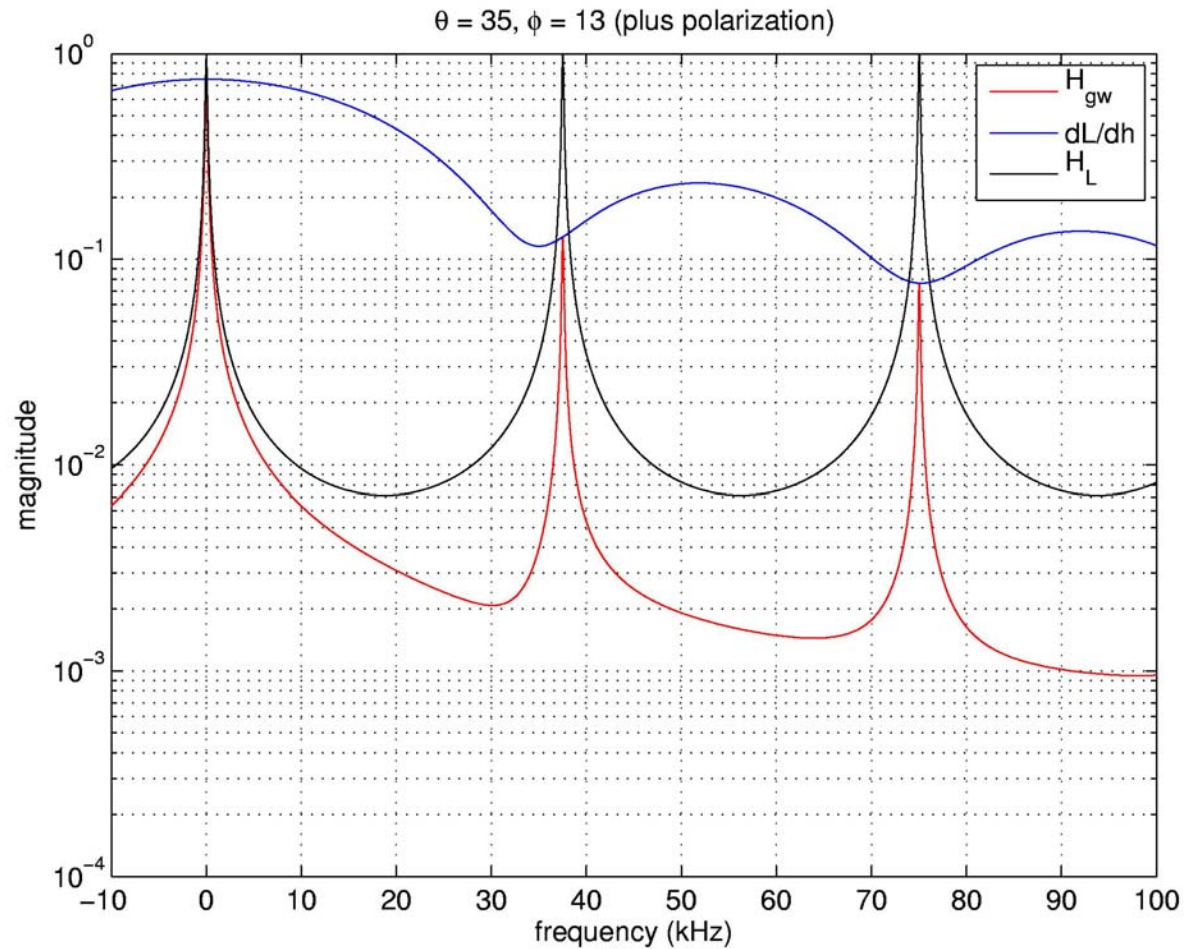


Interferometer response to GW



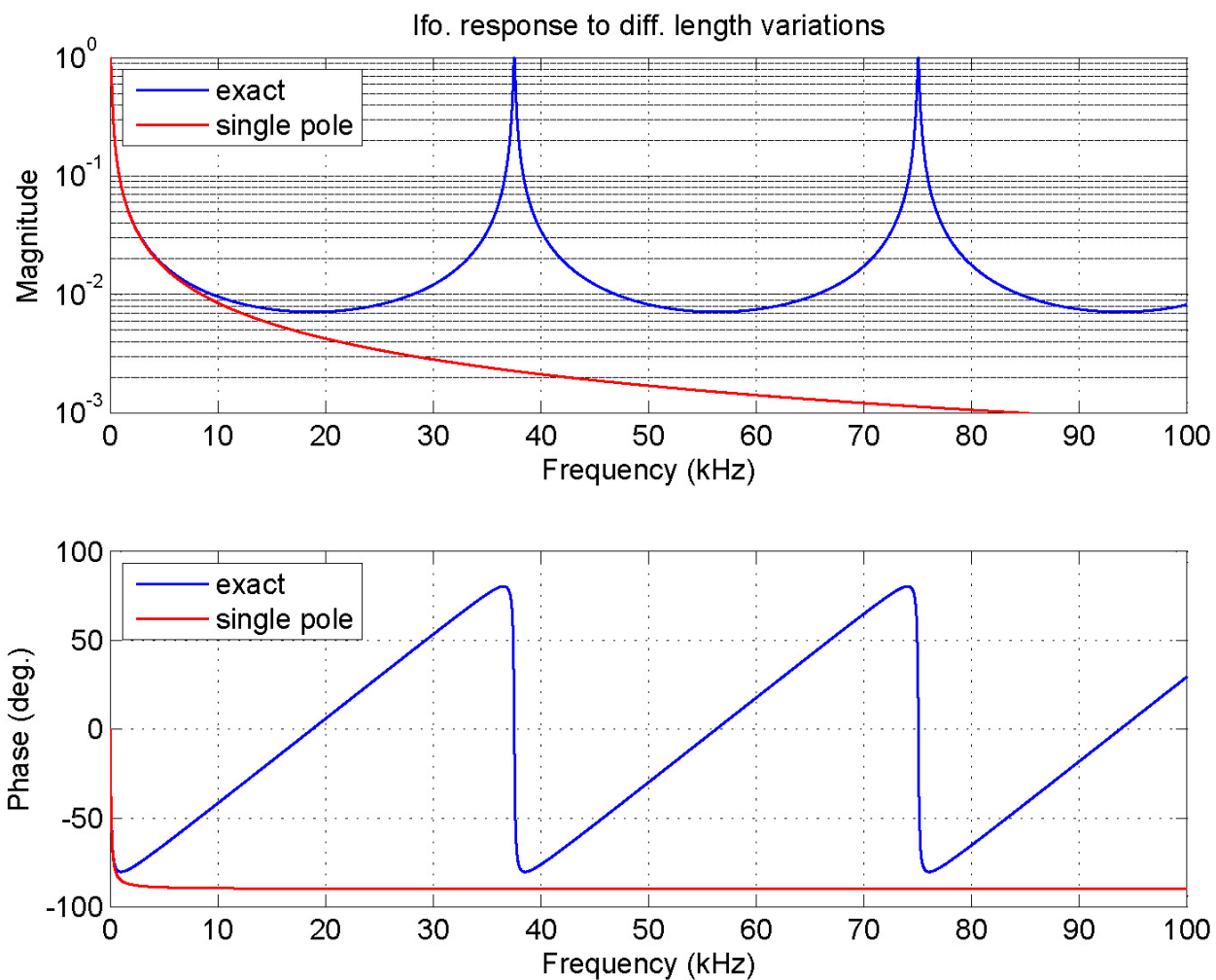


Same plot for different sky location



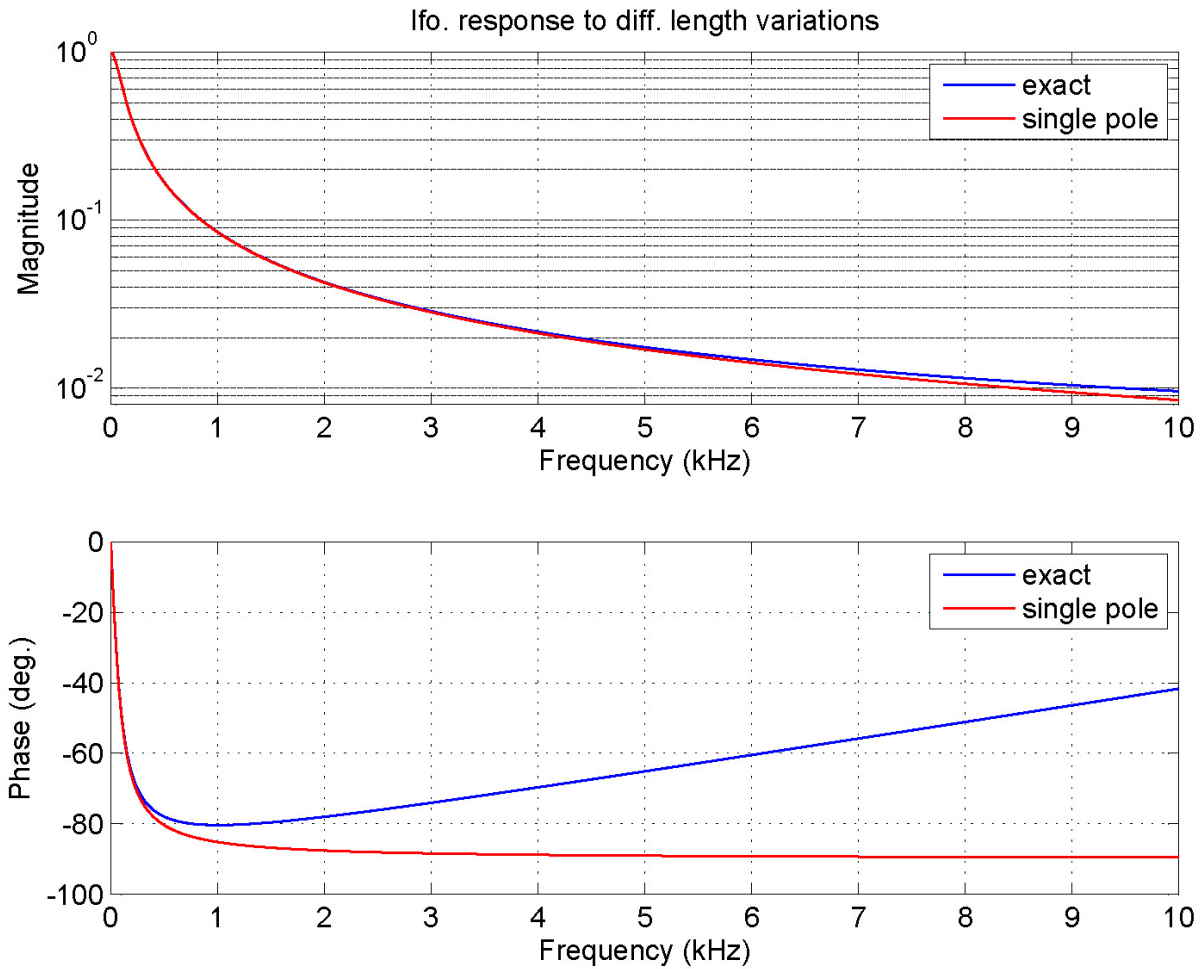


Approximations – single pole for length response



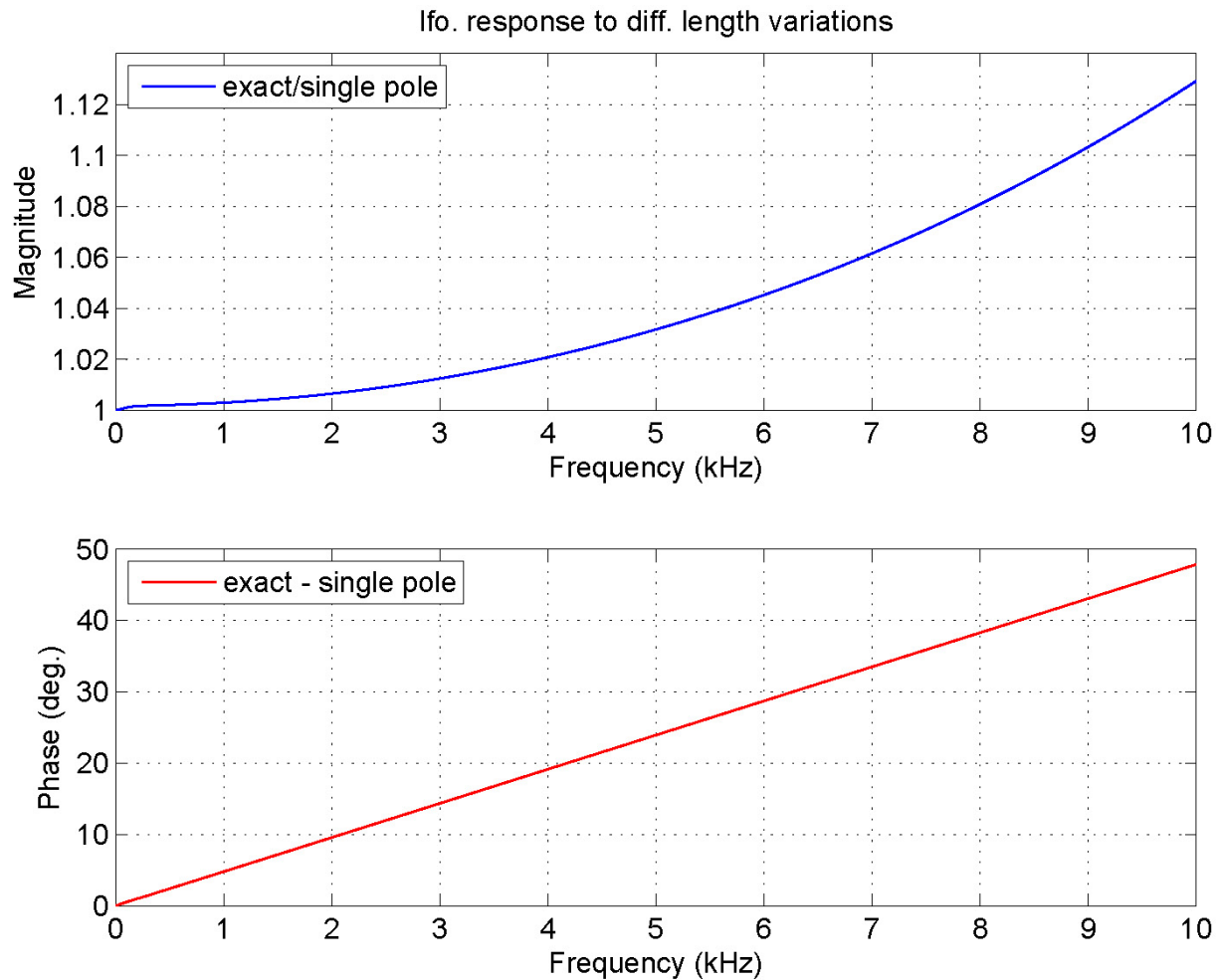


Detail DC to 10 kHz



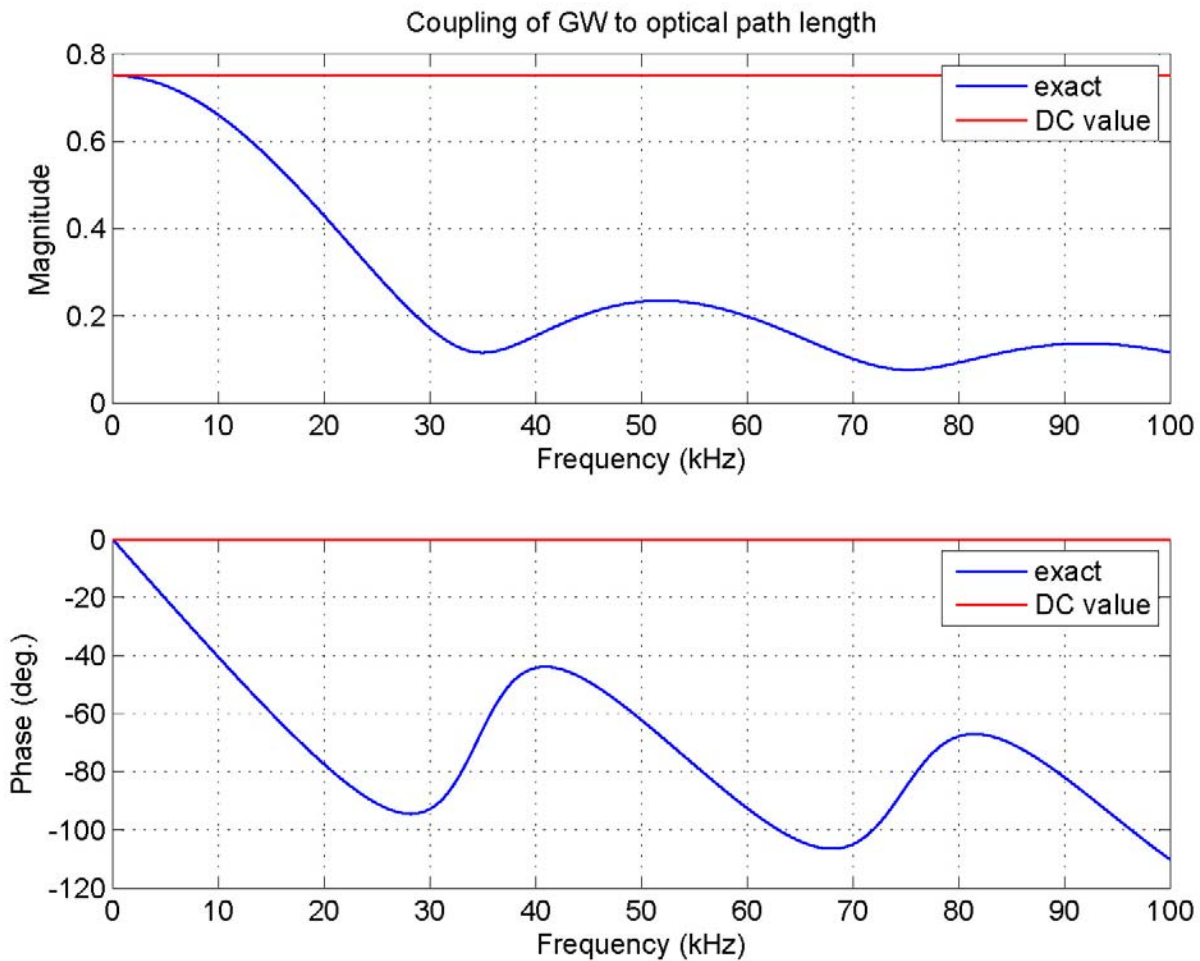


Length response discrepancy

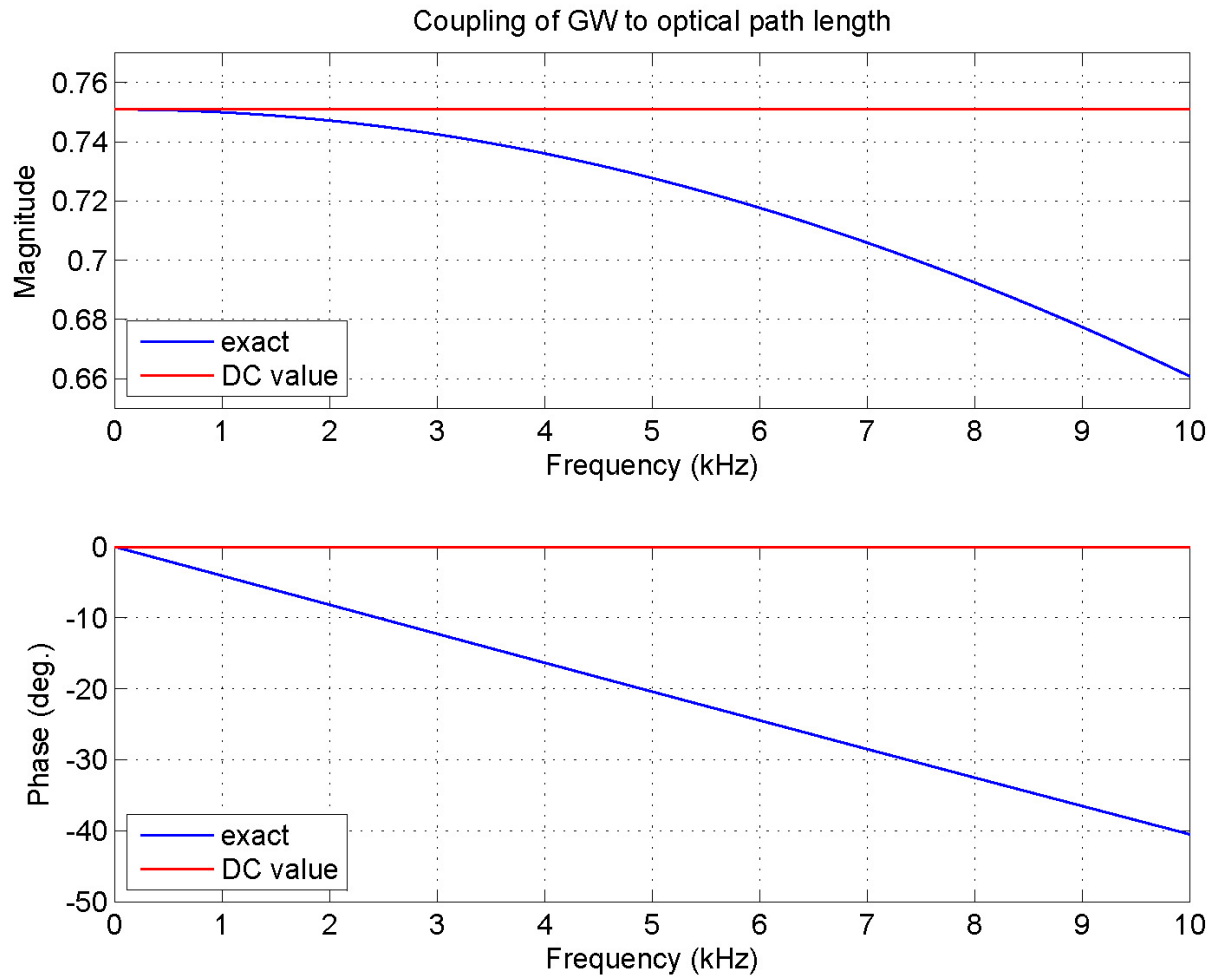




GW coupling to diff. OPL ($\theta = 35$, $\phi = 13$)

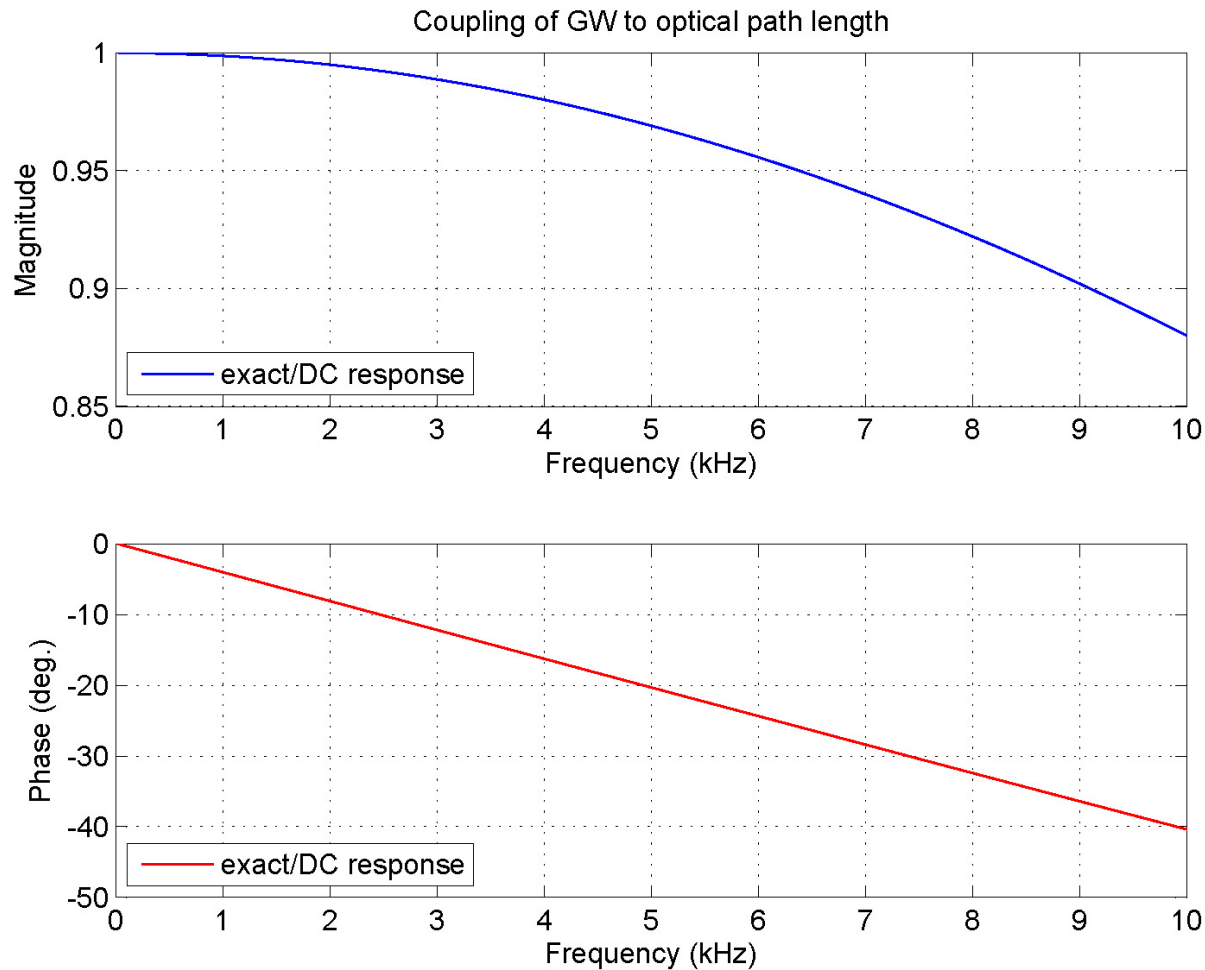


Detail to 10 kHz



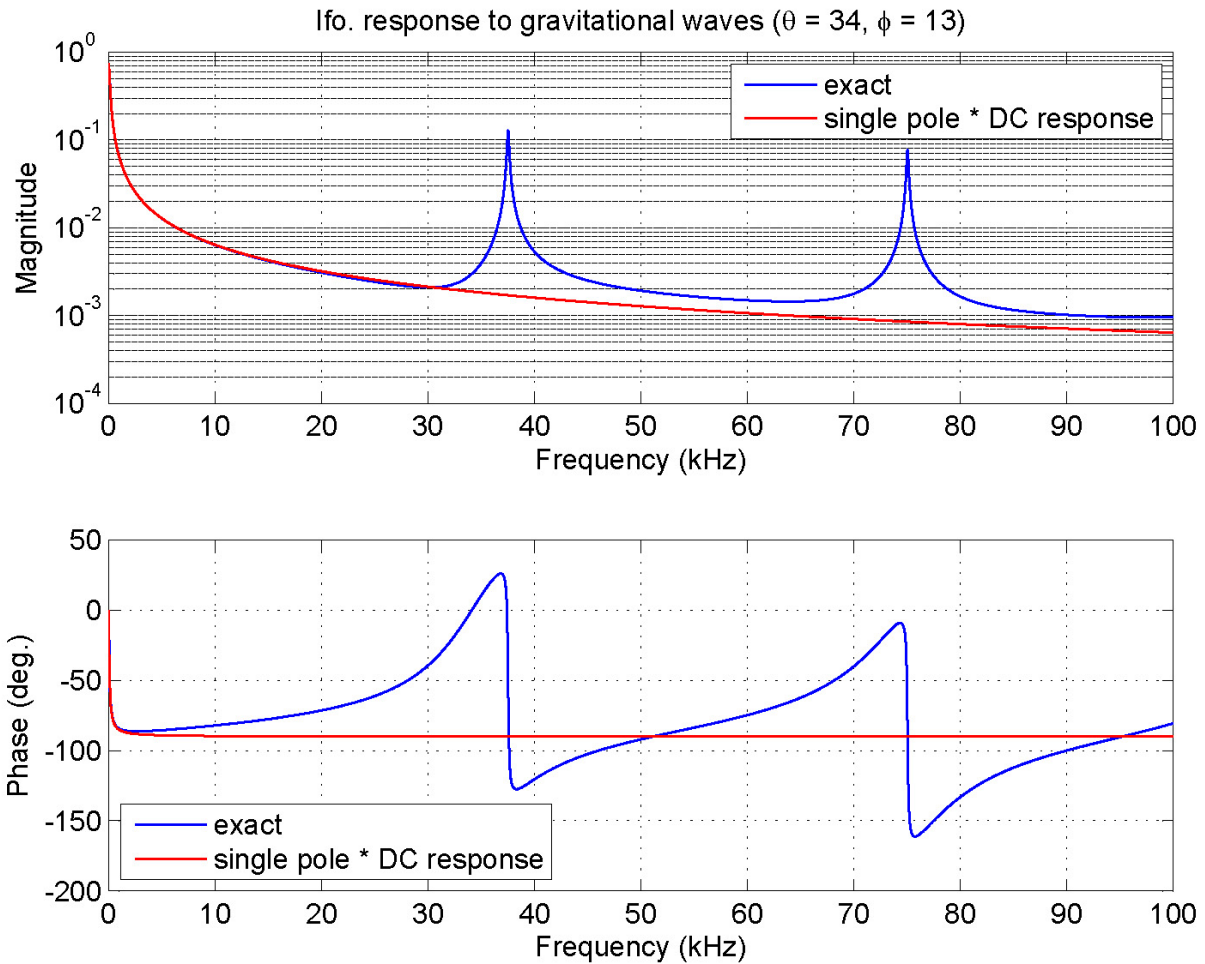


Ratio of exact coupling to DC value



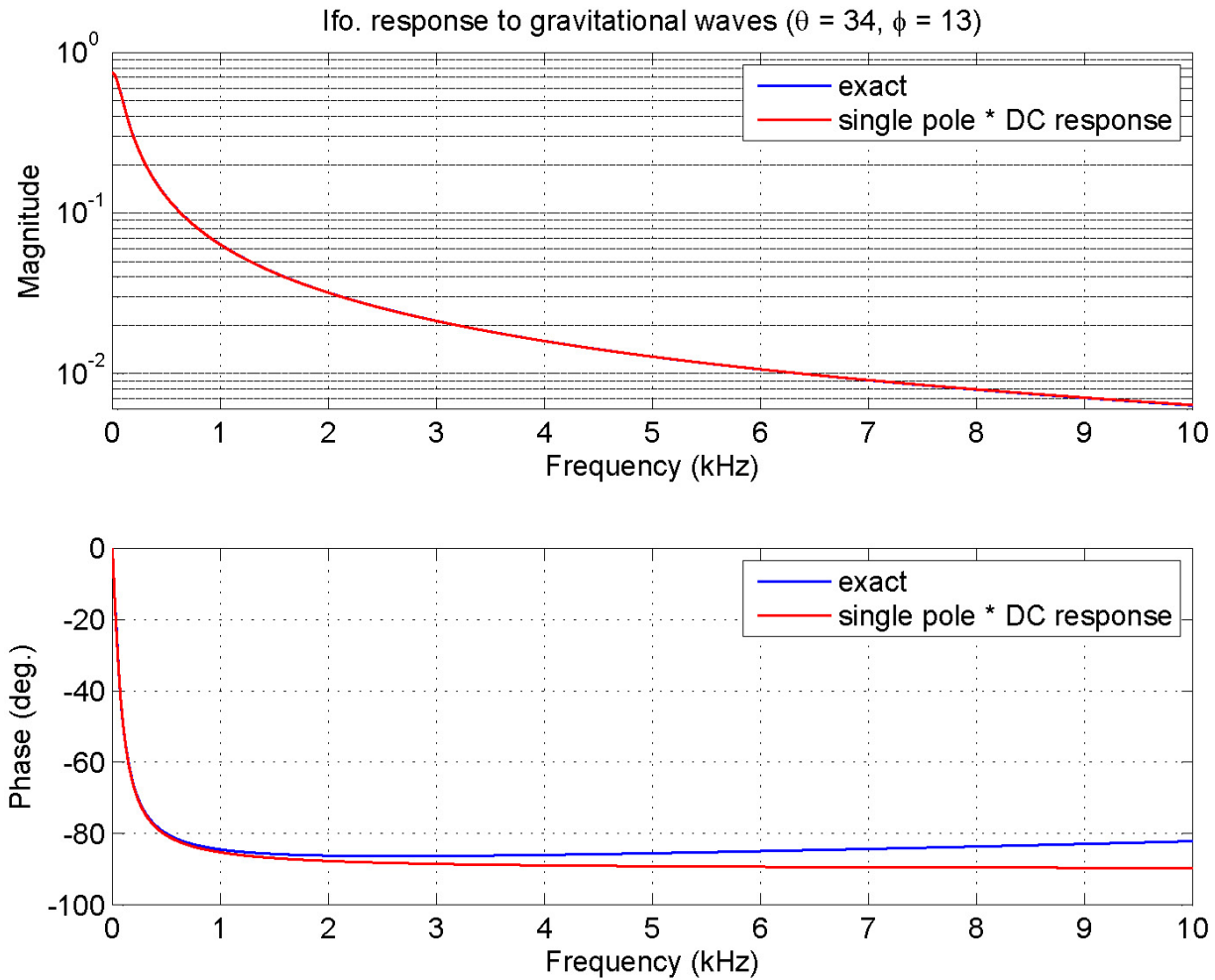


Interferometer response to GWs



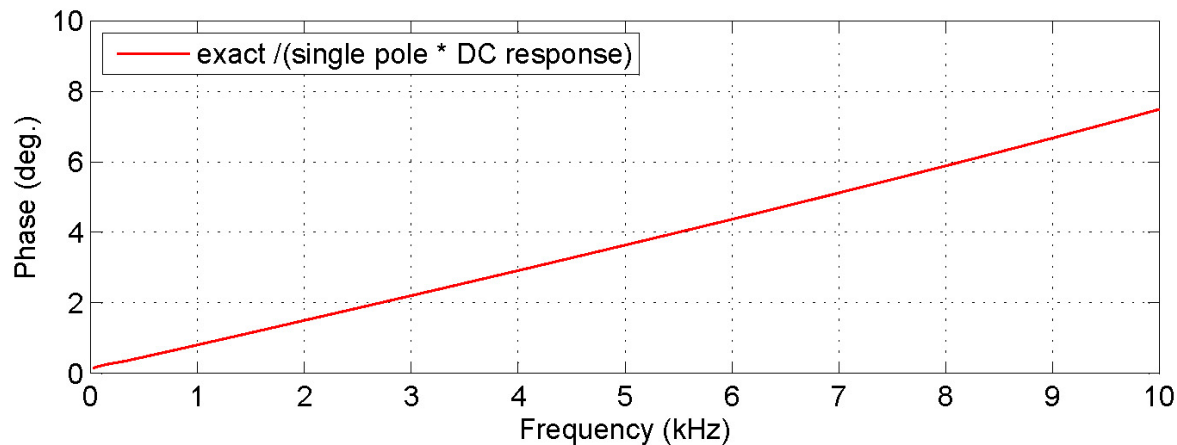
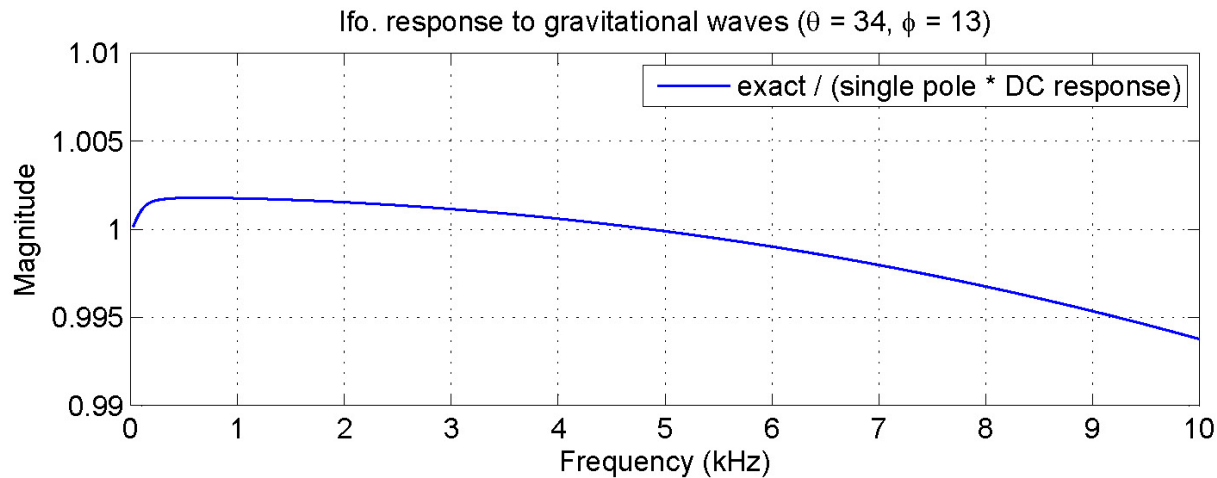


Detail to 10 kHz





Ratio of exact response to approximation



Two approximations
(*single pole length
response and
DC GW response*)
compensate for each
other:

magnitude within 1%

phase within 10 deg.