**Noise sources** (20 pages including figures)

*4. Quantum Noise (McClelland, Mavalvala, Schnabel,)*

Content:

A. Basic quantum noise formalism including definition of coherent state, vacuum state, squeezed state (any other state?)

B. Shot Noise limit, Radiation pressure noise/readout noise limit,

Standard quantum limit

of a free mass interferometer

C. Modifying quantum noise internally

- output optics (ie signal recycling and variants *- is this part of a different chapter already?) DHR –YES, in CH2 and in LSC Chapter in V2*

- opto-mechanics

D. Modifying quantum noise externally – squeezed state injection

(*or could swap the order of “C” and “D”,* Further topics here include filter cavities, beating the SQL this way)

F. QND – measuring speed not position

G. Putting it all together - example quantum noise floors of future detectors ???? (or something like this) (*RS would skip “G”)*

H. Current state of the art??? - do we need something like this?

In hand: (*or can/should we present the state of the art already in “C” to “D”?* )

* shot noise in FPMI and in SRecycling;
* squeezing has been shown to reduce SN
* squeezed state generation technology

TBD

* audioband frequency dependent squeezing
* quantum radiation pressure noise not yet seen in a free mass interferometer
* SQL not observed
* Likewise no speed meter device