





Squeezing in GEO600

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Squeezing in GEO600



AEI squeezed light source & coherent control scheme

Squeezer implementation at GEO600

- optical
- different control schemes

Sensitivity improvement ... present & future

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The GEO600-Squeezer



• Custom made breadboard: 1,35m x 1,15m, 120kg

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GEO600 Squeezer - optical scheme





Phase noise vs. strong squeezing



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GEO600 Squeezer - coherent control



GEO600 Squeezer - coherent control







GEO600 squeezed light source cavity



- PPKTP as non-linear medium
- Linear cavity design
- High mechanical stability
- sealed air gap
- low intra cavity loss = high squeezing escape efficiency



Squeezing in GEO600

Lots of squeezing!

with only some mW pump power



II % optical
loss on the
squeezing
board,
including
diagnostic
homodyne
detector

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 Diagnostic homodyne detector introduces extra loss of 4% which can be substracted for application in GW-detector



Local squeezing after one year at GEO

CDS system remote controls analog electronics
Duty cycle >99%



Transport of the GEO600-Squeezer



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Transport of the GEO600-Squeezer



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Transport of the GEO600-Squeezer



 Not a single damage during transport

• started 9am,

wiskey at 3pm

• 2 days for

realignment

after 2 weeks local
 squeezing measured
 again

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Squeezing alignment with a bright beam



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Laser frequency synchronization



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First "squeezing" at GEO



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Longitudinal squeezing phase lock



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Optical loss for the squeezing



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Loss chart



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Squeezing with the new SRM

Spectrum plot using Kaiser window



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Phase lock: Different sensor & actuator



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Squeezing over the weekend

Spectrum plot using Kaiser window



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Full power & squeezing



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What's next

 Improvement of phase lock DCstability or noise locking scheme for very low frequencies

 Automatic alignment. Almost unexplored yet. Perhaps OMC refl. signals useful as well?



• More squeezing:

- Reduce OMC losses
- Lower loss setup between squeezer and GEO
- Increase of longitudinal phase locking bandwidth

What we have learned so far

 The GEO600 squeezed light source is working very well

 I0dB squeezing available
 long term stable



Gained experience how to implement squeezing into the interferometer world.

- optically
- control scheme
- For higher detected(!) squeezing levels lower optical loss on the interferometer side is required.
- Still several lessons left to learn...

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