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Topology comparison for ET using an adapted GWINC simulation

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ET note on QND review

Review of quantum non-demolition schemes for the Einstein Telescope

ET-010-09

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Issue: 1

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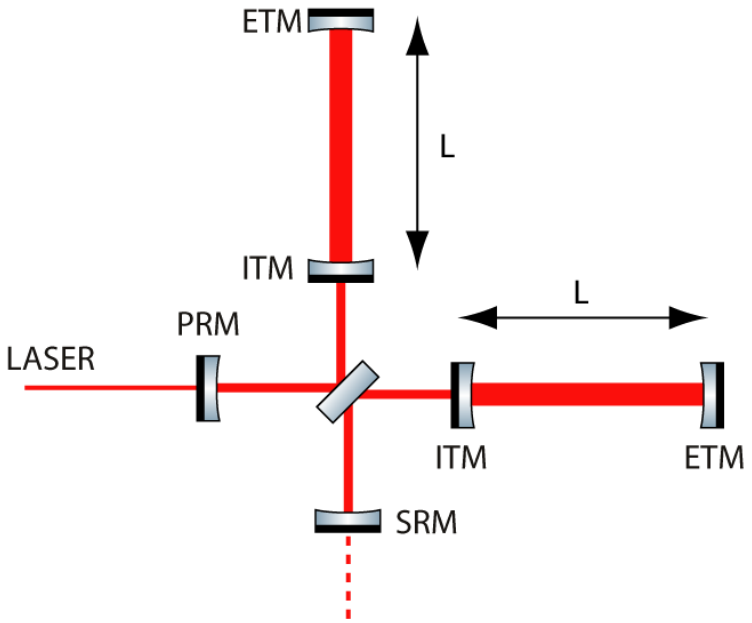
Conclusion

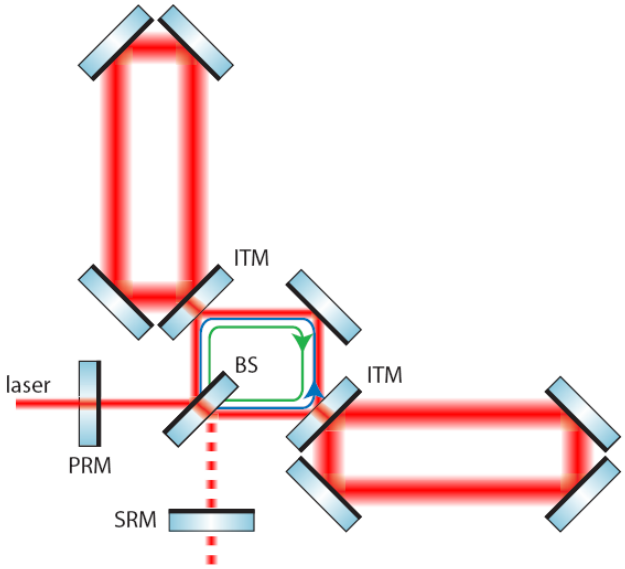
Sagnac Topology seems to give the best quantum noise performance

More realistic comparison of Sagnac and RSE topology

RSE

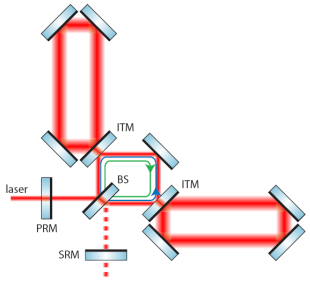


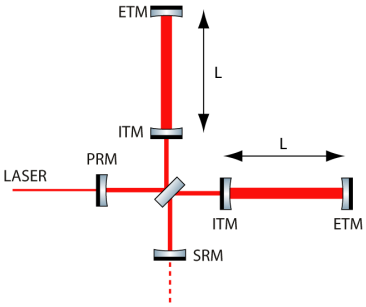
SAGNAC



Noise coupling – Sagnac compared to RSE

- Quantum noise characteristic change
- Various displacement noises couple more due to four mirror cavities, e.g. TN, Seismic noise, etc...
- Beam geometry changes and influences TN and seismic noise further
- Higher losses in four mirror arm cavity
- Etc...





Current model status

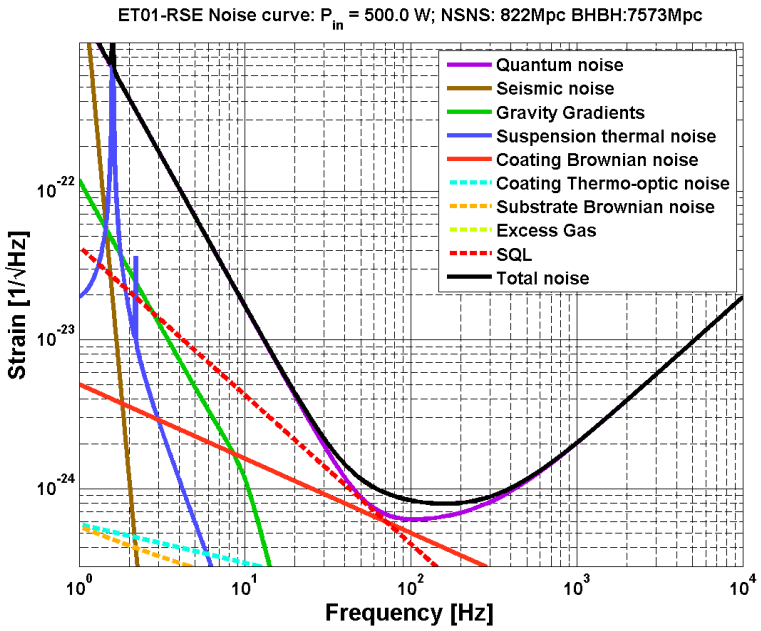
- Single detector
  - L = 10km
- Underground
  - Seismic noise reduced
  - Gravity gradient noise reduced
- Adapted thermal noises & suspension model
- Optimisation parameters
  - Input laser power P
  - SR, ITM & PRM transmissivity
  - Tuning of SRM
  - Readout quadrature with homodyne detector

Things to keep in mind

- This is a topology analysis and there is no intension to create a new baseline sensitivity curve
  - Following sensitivities are lower than the ones presented on the webpage
  - No magical factor used e.g. For the grav. gradient noise
  - No squeezing used
  - No cryogenic techniques
- Nevertheless the following comparison is valid
- The model can be changed later and a higher performing configuration can be found via optimisation

Preliminary results – BHBH optimisation

RSE – tuned SR



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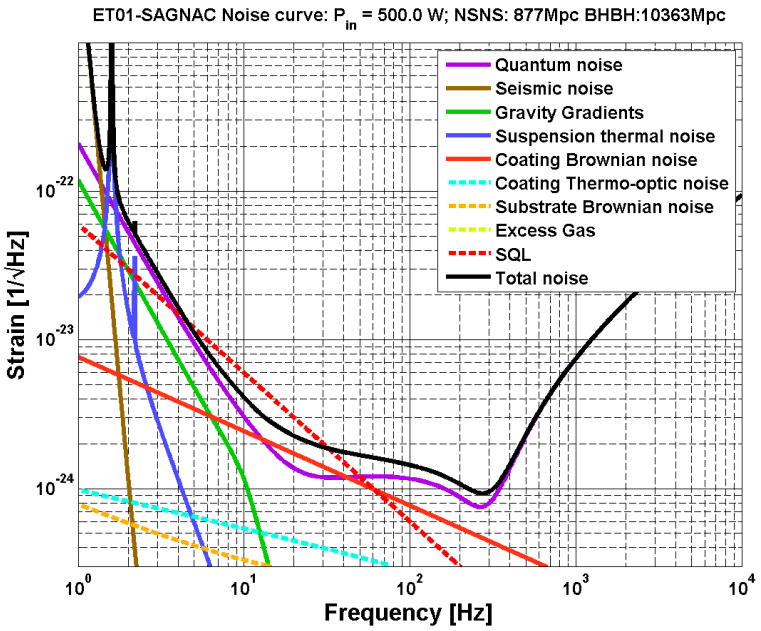
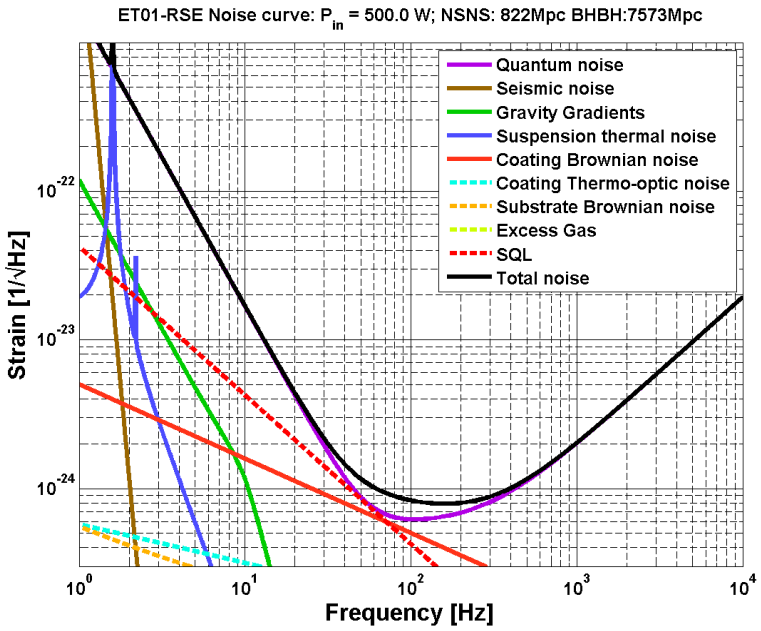


BHBH inspiral range for Sagnac topology 37% larger

Event rate increased by a factor of 2.6

Preliminary results – NSNS optimisation

RSE – tuned SR



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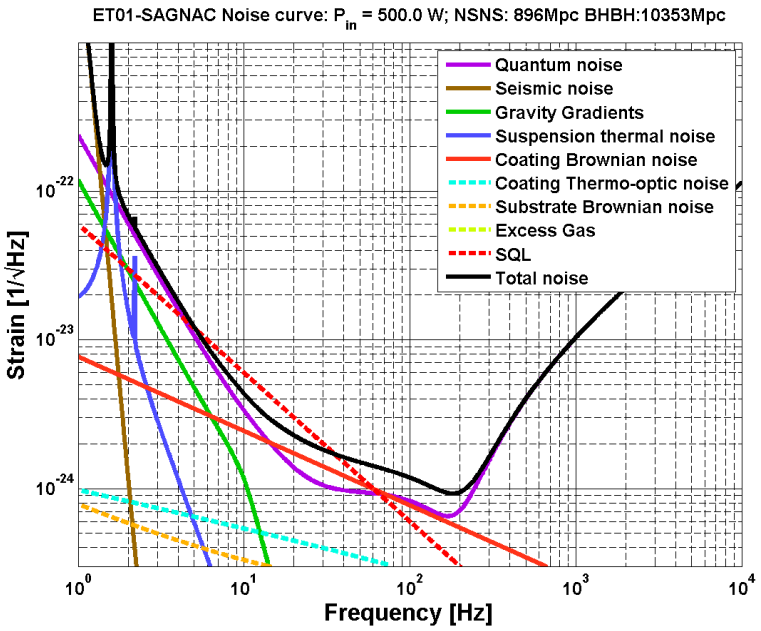

BHBH inspiral range for Sagnac topology 9% larger

Event rate increased by a factor of 1.3

To Do

- Finish coding the automatic optimisation procedure to speed up analysis
- Implement influence of beam geometry changes
  - Affects thermal noise
- Perform optimisation for RSE topology to find optimised configuration
- Etc...