ADVANCED INTERFEROMETER CONFIGURATIONS
LSC 3 MEETING
AUGUST 13-15, 1998

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LIGO-G980113-07-M

LSC Advanced Interferometer Configurations
for LIGO ~2004 and ~2008 up-grades

K.A. Strain
08/98

SCOPE: interferometer topology
(Michelson/Sagnac/RSE/DR)
Readout system
(modulation/control signals/Quantum readout)

TASKS: design/ choice/ optimization

DRAFT white paper:-

Review of possible configurations/techniques
(including estimates of date of earliest implementation)
Outcome: DR/RSE prime candidates for 2008

Program for RSE/DR development

Proposal(s) for optimization of 2004 interferometer to enable best use of reduced suspension (thermal) noise.

- status OK
- work needed LSC3

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Configurations considered (2004)

Cost and manpower limited

- Retain basic Power Recycled FP Michelson core
- Consider effects of reduced absorption silica
- Consider alternative readout schemes
  (All resonant modulation/ external modulation)

+ overall optimization of finesses/gains/input power

- Additionally evaluate possibility of adding DR/RSE at `2004' stage in event of delay and/or modified detection priorities

Configurations considered (2008)

- DR/RSE full development program
  - optimization
  - control/readout design
  - *thermal/misalignment tolerance

Other configurations (post 2008)

- Sagnac interferometer core
- *All reflective (diffractive) optics
- Quantum readout

All need significant additional basic R&D before a concrete proposal can be made to LIGO

* with Laser & optics WG

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DR/RSE Development

Optimization

(following the lead of suspension folks)

Signal recycling schemes encourage optimization of an interferometer to match expected SIGNALs (in the context of seismic/thermal noise).

Sensitivity can be enhanced by:-

- optimizing light energy in arms
  - balance of core optics properties
  - match FP finesse and PR factor according to thermal properties of core optics
- fitting response curve shape:-
  - target signal spectrum
  - avoid maximum sensitivity at DC

Cost functions allow optimization for:-

- Coalescing binaries alone *
- `new' narrowband sources alone
- multiple sources with serial search
- multiple sources with simultaneous search (needs subjective weighting)

* using tools such as those for CBis provided by Finn

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DR/RSE Development

Control / readout design

Benchtops in progress (Caltech/ UF/ACIGA-ANU)

STAIC workshops
(focus on RSE/DR control)

Design to running of suspended mass prototype(s)
(Caltech/MIT/UF/ACIGA-ANU)

Experience transfer from GEO

Thermal / misalignment tolerance

Laser & Optics coordinated work (Stanford +++)

STAIC workshops

FFT, E2E models (MIT, Caltech)

Aim to have an outline program agreed here (LSC3)
with aim of delivering in 2006

Additional contributions welcome, especially in the above areas: communicate in any form (e.g. during AIC sessions).

DR/RSE Development

Outline optimization program

Look at optimizing 60W input system (example)

how can DR/RSE improve the SNR for CBis?

vary t^2_{ITM} , PR factor, tuning, t^2_{SEM}

opimization for given seismic/thermal noise (include rad. pressure too)

optimization over varying mirror loss (etc.)

look at other sources

how close to internal thermal noise can a `narrow band' detector reach?

This is a good opportunity for input from other parts of the LSC

Note 1, Linda Turner, 08/20/98 11:14:30 AM
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