AdVirgo, Optical Configuration Working Group

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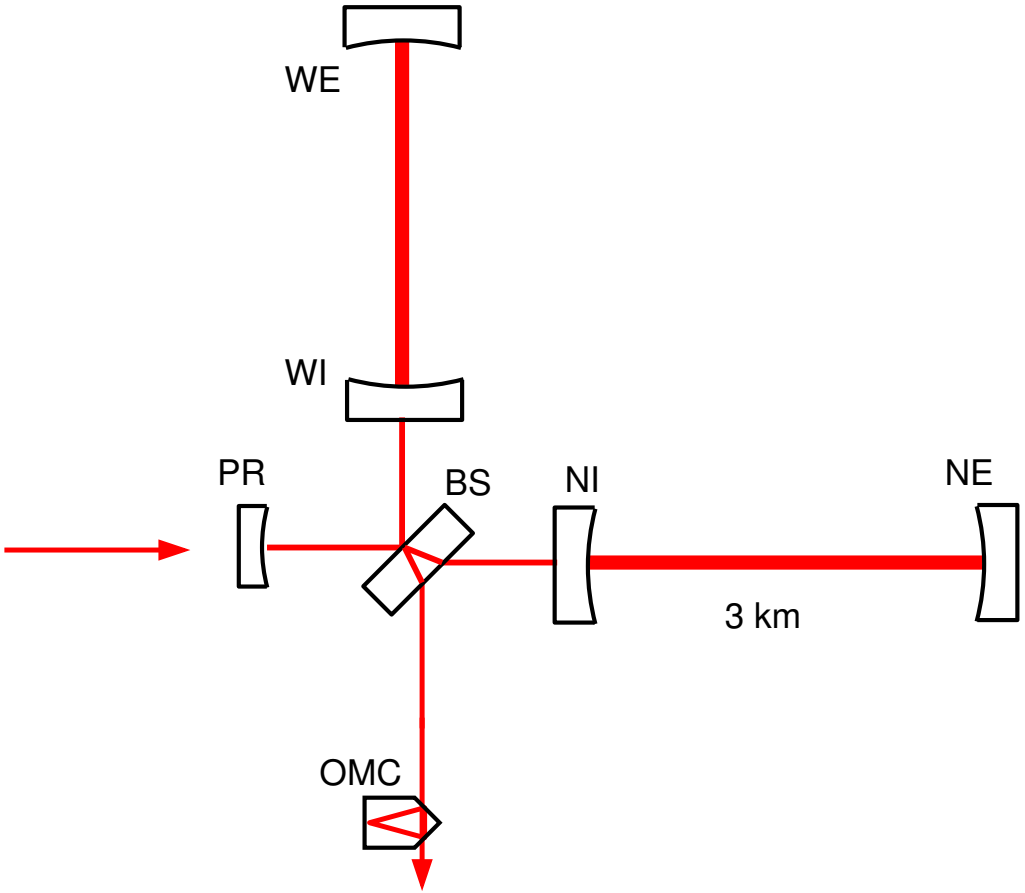
Introduction

Interferometer Configuration for Advanced VIRGO Working Group

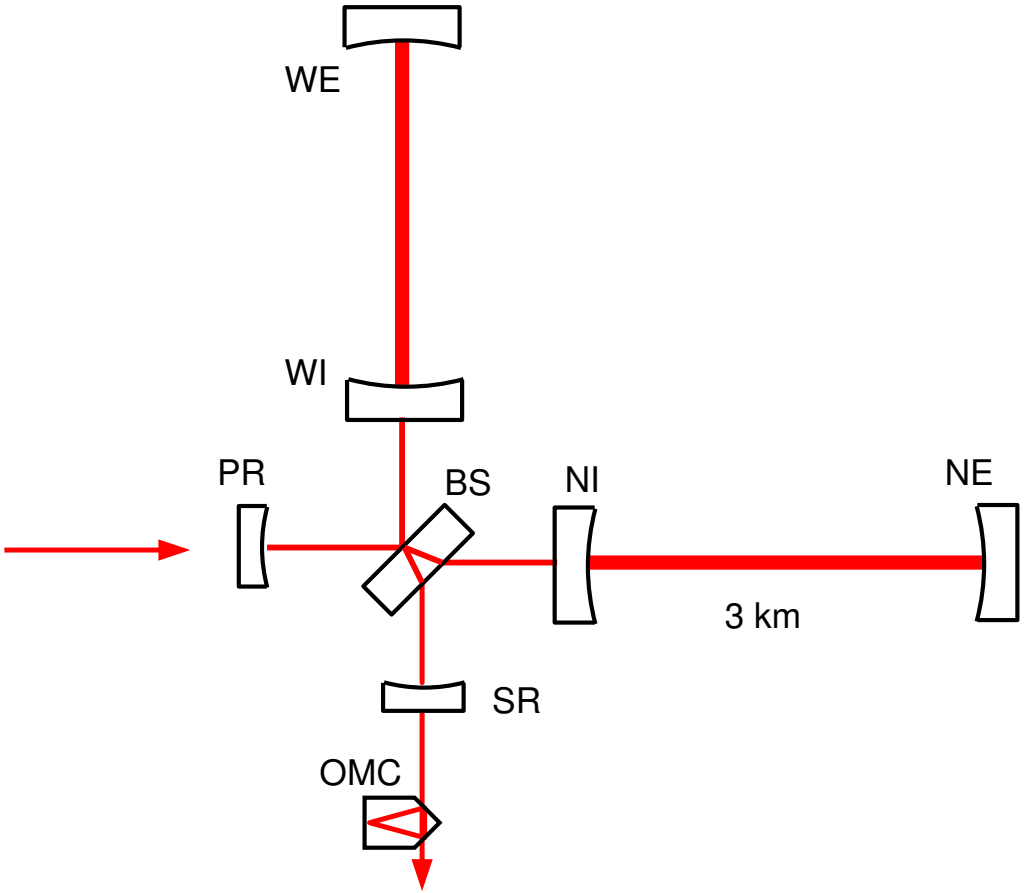
- Goals:
  - Organise the work required to design the optical layout for Advanced VIRGO
  - Complete the section 'New Interferometer Parameters' section in the white paper
  - Provide specification for new mirrors (and other long lead time items)
- Status:
  - Group has been introduced and a first meeting (teleconference) has been held
  - Primary tasks have been identified
  - Tasks have *not* been assigned to persons
- Today:
  - Consolidate the task list
  - Discuss the basic options
  - Motivate people to join in and subscribe to a task

Simplified Optical Layout



- move beam waist to the centre of the arm cavities
- add Signal Recycling
- or non-Gaussian beams (or ...)

Simplified Optical Layout



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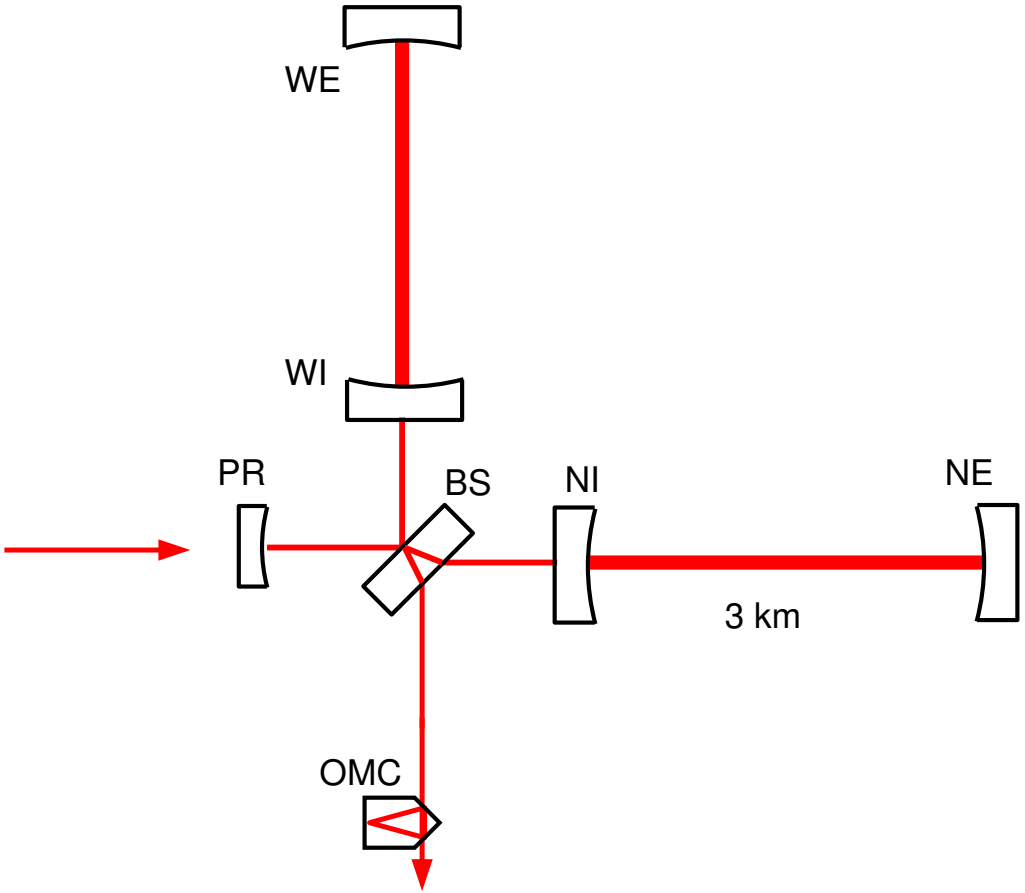

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The Tasklist

Email send to Virgo-list on 20/03/06:

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Beam geometry related tasks:
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o choose finesse and geometry of arm cavities
  - input: required power
  - output: beam shape in the IFO and basic mirror coating specifications
  - date: ??
  - person: ??

o compute beam geometry
  - input: arm cavity geometry
  - output: free apertures at all locations
  - date: ??
  - person: ??

o compare stable versus flat-flat PRC
  - input: arm cavity geometry, RF frequencies
  - output: alignment tolerance for both cases
  - date: ??
  - person: ??
```

...

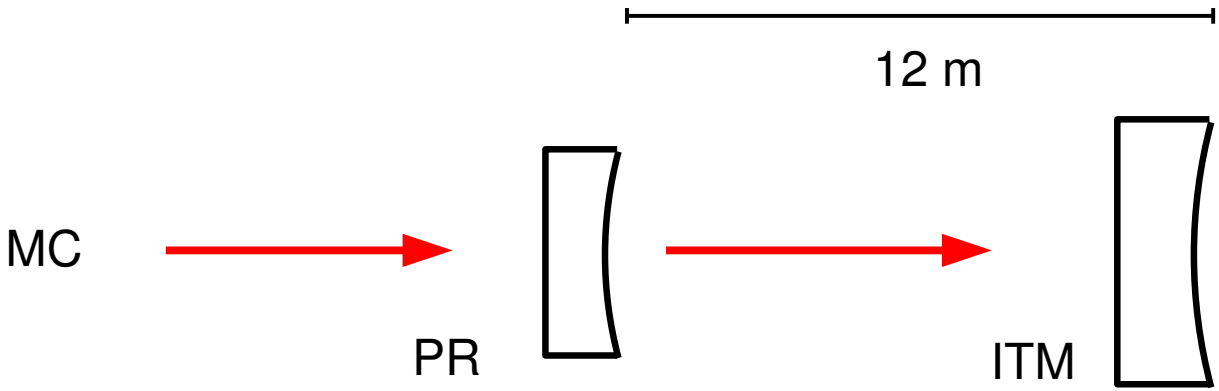
Envisaged Output

- parametrised formula for SR response (or sensitivity)
- mirror coating specification
- beam shape and position throughout the IFO
- substrate size and geometry (i.e. the constrains on it from ray tracing)
- number and position of readout ports (i.e. the impact on the outer geometry of the vacuum system and around it)
- basic parameter set that can be used for various simulation input files

Beam geometry related tasks

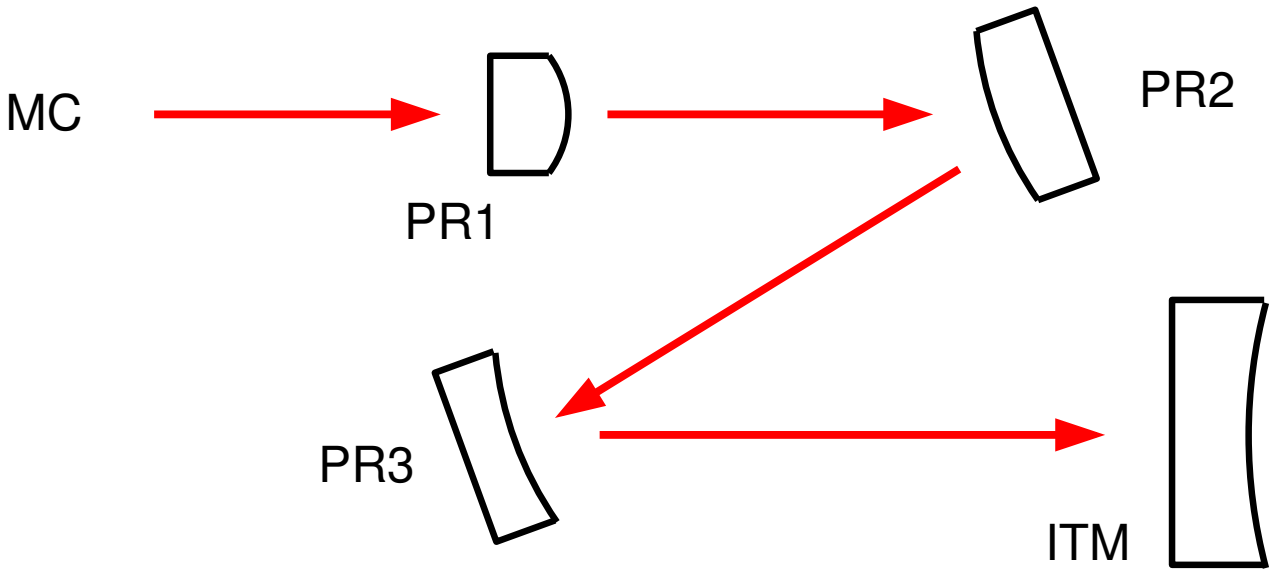
- choose finesse and geometry of arm cavities (input: required power, output: beam shape in the IFO and basic mirror coating specifications)
- compute beam geometry (input: arm cavity geometry, output: free apertures at all locations)
- compare stable versus flat-flat PRC (input: arm cavity geometry, RF frequencies, output: alignment tolerance for both cases)
- compare optical layouts with and without wedged mirrors (input: required output signals, geometry of inboard vacuum tanks, output: feasibility of locking schemes, required changes to viewports next to WI and NI)

Stable Recycling Cavities



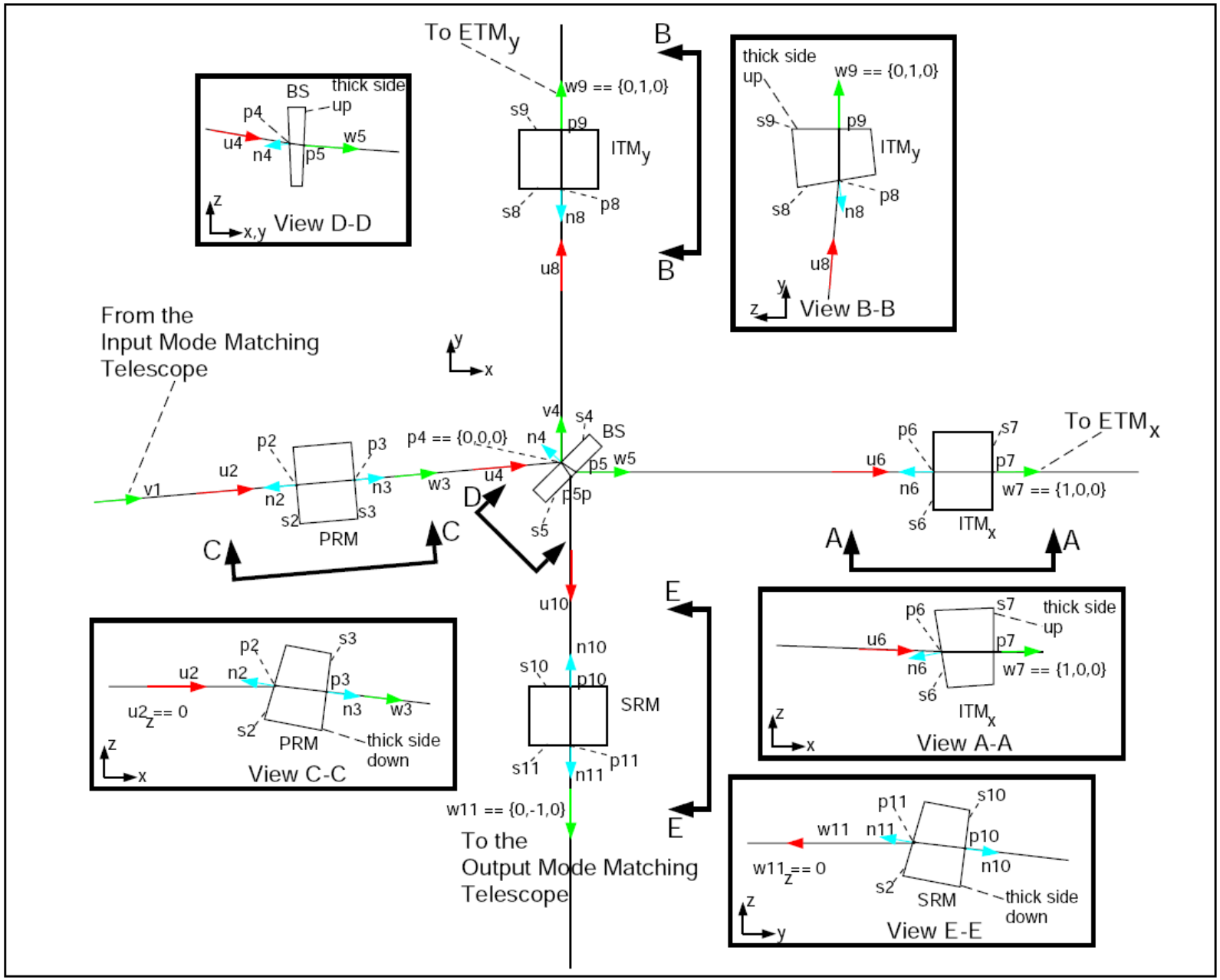
(Rayleigh range: several hundred meters)

Stable Recycling Cavities



(proposed for AdLIGO)

Geometry vs. Wedges (LIGO-T010076-01)



SR related tasks

- investigate the effects of mirror-losses analytically
- investigate the effects of BS contrast defects analytically
- compute required light power from SR sensitivity curves (input: current thermal noise model, output: circulating light power)
- relate white-paper section 2.1.4 and 4.7
- quantify the mode-healing effect in the SRC

Non-Gaussian beams

- investigate scattering losses of special coatings mirror
- investigate the effects of BS contrast defects
- compute sensitivity curve with 'realistic' parameters
- test the compatibility of non-Gaussian beams with SR

However, the use of non-Gaussian beams in Advanced VIRGO is not realistic without some dedicated experimental research.

Simulation related task

- prepare Courty/LeBars code for new VIRGO layouts
- prepare SIESTA for new VIRGO layouts
- Finesse for new VIRGO layouts
- prepare OptoCad for new VIRGO layouts
- prepare alignment 'tolerancing' simulation: RF sideband behaviour in the recycling cavities versus mirror alignment (input: RF frequencies, optical layout)

Unsorted tasks

- investigate parametric instabilities in the arm cavities
- compare RF versus DC readout

Summary

- The working group must propose one or several optical layouts
- It is vital to produce tangible parameter lists
- At the same time the collaboration must start to discuss the different possibilities