ETpathfinder workshop

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WP6 Optics: Plans & Thoughts

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ETpathfinder v0.1

- As it looks now, will only have **two silicon mirrors** ready within reasonable time
- What shall we do with those, and which further preparation do we need?

Single cavity, 1550nm, let's-see-how-cryogenic?
Coat as two ITMs to have nice (?) silicon transmissive optics to re-use later on; which arm?

"Science case", i.e. what do we want to learn? Cooling, controls, 1550nm laser with low-noise cavity, …

Laser integration
1550nm PSL from AEI will arrive mid-year

Coatings
Opportunity for SiO2/Ti:SiO2/SiN with LMA?

Auxiliary optics
Taking stock and finishing orders, e.g. HRTS coatings, IMC, …

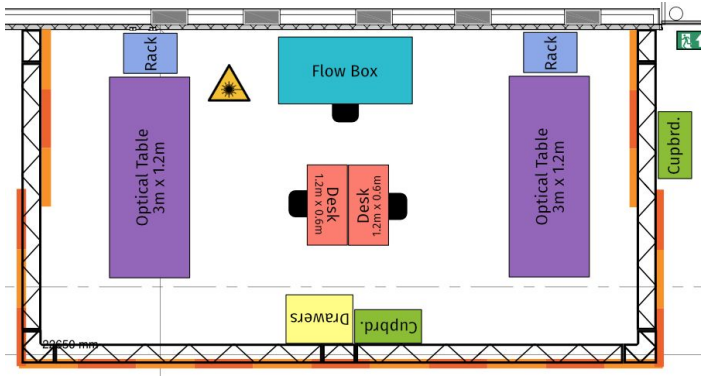
Setting it up & timeline
Planning of people, projects, responsibilities, connections w/ WPs 4,5,7

Funding for further optics & polishing
Grant opportunities & project definitions? NL Groei fonds allocation?

To-Do:

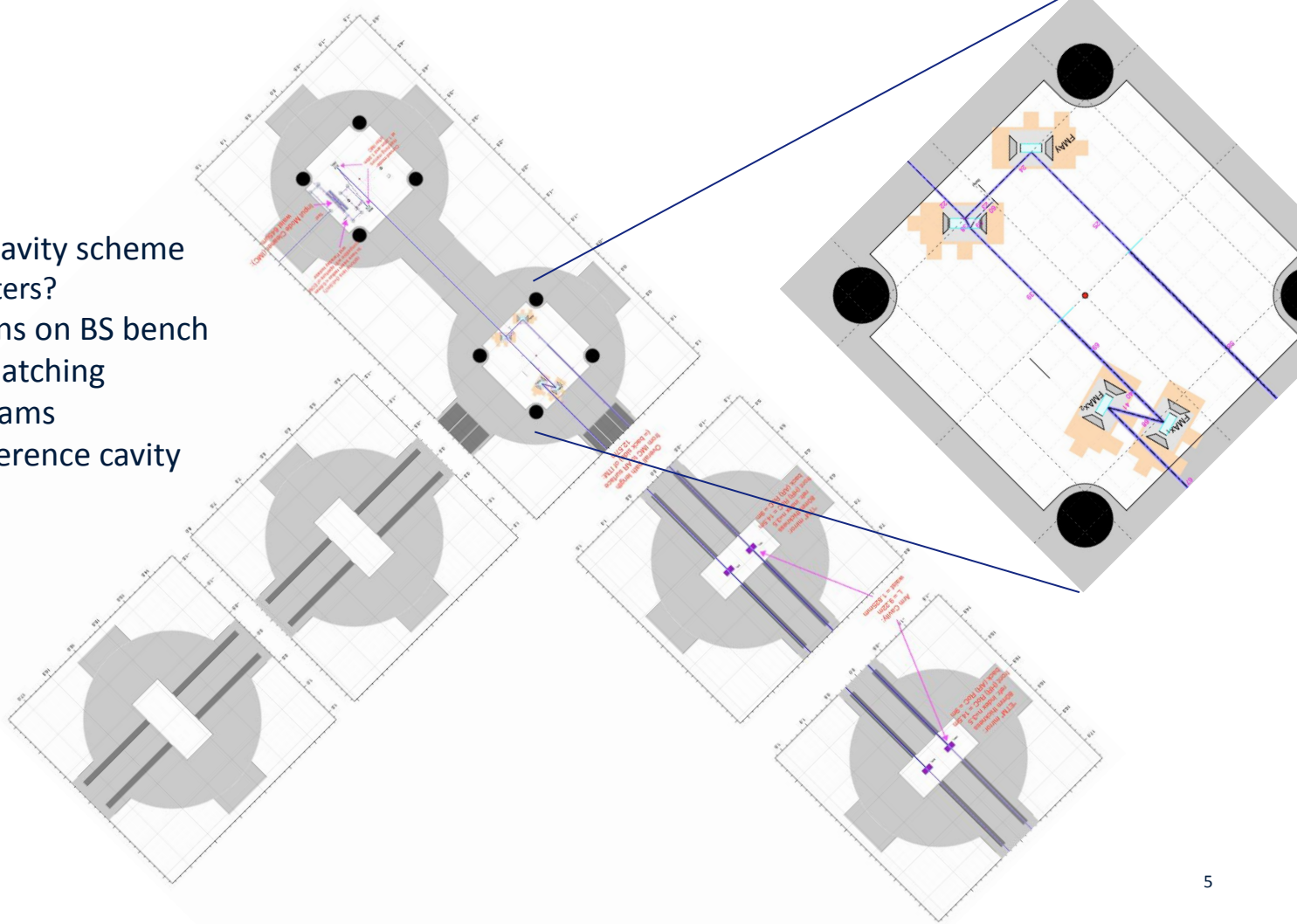
Done! Infrastructure

- Laser corner is now finally usable! Lots of work put in w.r.t. setting up trusses, power and networking, optical tables, tools and materials, health & safety, …
- Computing infrastructure also mostly complete, missing final steps of DAQ system
- Current Experiments (partly ETpathfinder, partly other grant work)
  - Speedmeter & Squeezing @ 1550nm
  - “Two-colour”: creating 1550nm and 2090nm
  - Optical levers



Layout

- Move to single cavity scheme
  - Beam splitters?
- Fix HRTS positions on BS bench
- Finalise mode matching
- Add auxiliary beams
- Possibility of reference cavity measurements?

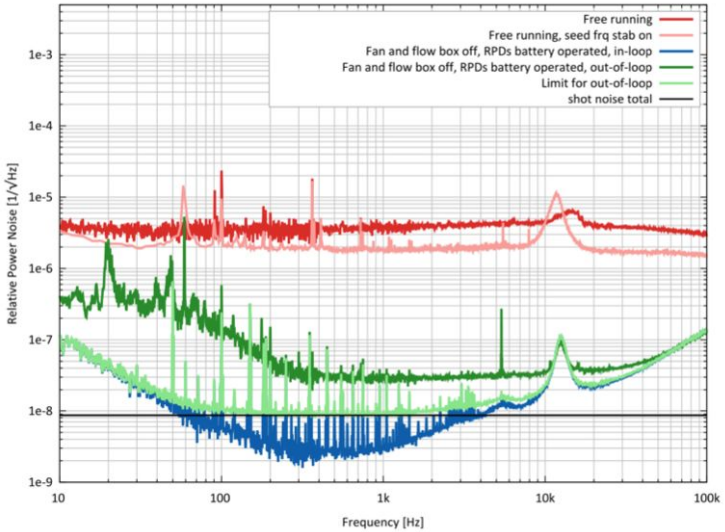


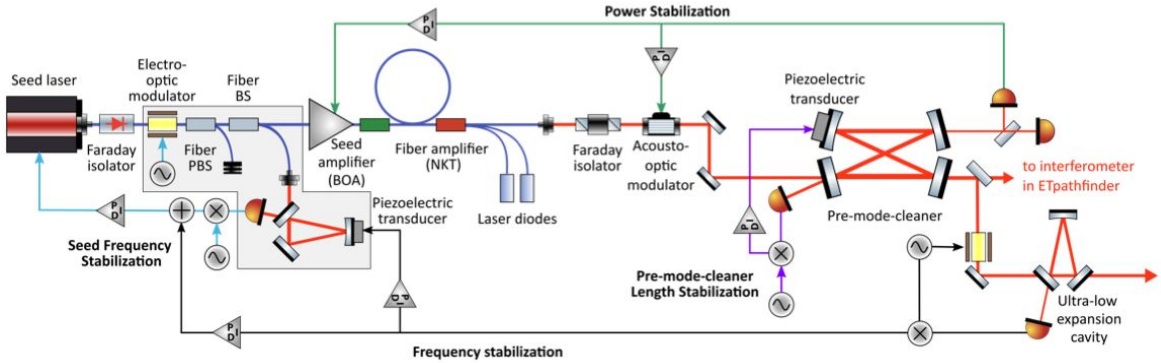
To-Do: Optics

- HRTS mirrors
  - Substrates are here, but they are still uncoated, need to decide on reflectivities
- Main mirrors
  - What kind of characterisation can we/should we/must we do once the mirrors are here?
  - Need to decide on a coating
- Mode-matching optics
  - Finalise curvatures, reflectivities
  - Several mount designs + fabrication missing (relatively simple, but needs care wrt vacuum compatibility):
    EOM, FI, Newport mounts
- IMC
  - Need to update spacer design for vacuum compatibility & fabricate
  - Need the optics and in-vacuum PZT + cabling
- Other parts
  - Beam dumps

1550nm Laser

- Science case for optics:
  Low-frequency laser stabilisation (frequency/amplitude), made possible by the very quiet suspended benches
- Stabilising AEI-built pre-stabilised laser onto cavity on BS/INJ bench
- Need to work on time line for this experiment



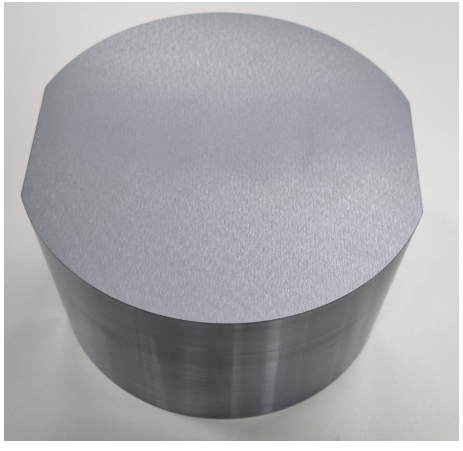


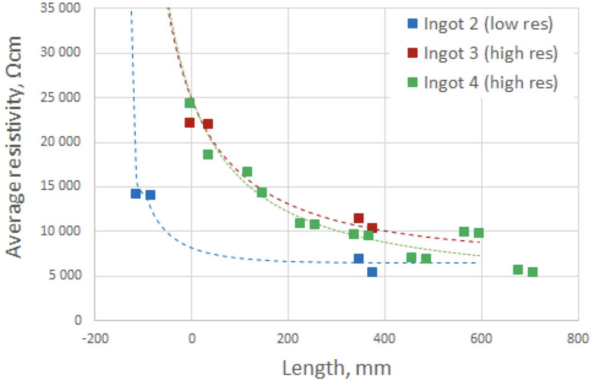
Silicon?

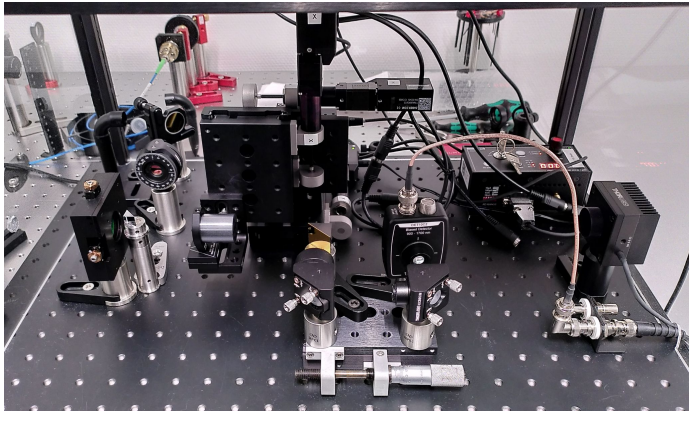
Getting silicon mirrors is one problem, but we also need to “understand’ them

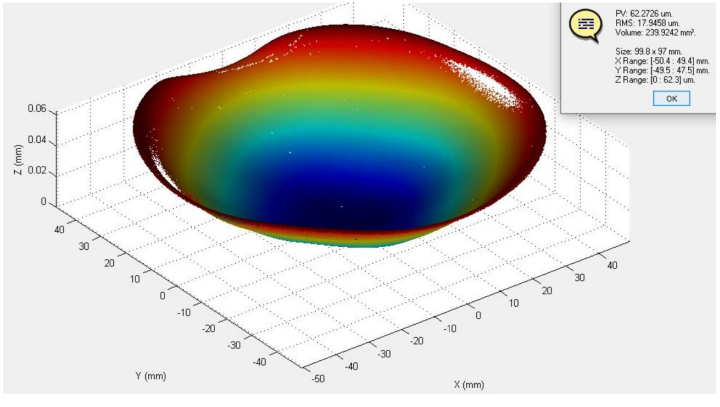
- Polishing and absorption
- Resistivity and absorption
- Birefringence

What else can and should we find out about silicon with the tools and possibilities that we have?









Key Topics

HRTS & auxiliary optics and small mechanics

Main Mirrors next steps

Silicon optics manufacturing and characterisation

Optical Layout

Laser experiment timeline

in-vacuum mode-cleaner / reference cavity

Outlook

Path to more optics
How do we get to 8+N mirrors?

Characterisation of silicon
Absorption, birefringence, polishing, …

2090nm
New wavelength, new challenges; taking over the ILT 2090nm laser

Capability-building within ETpathfinder and beyond
Metrology, simulation experience, industrial collaboration

Funding for R&D and integration
Grant opportunities?

Missing tasks
What should we be looking into, but aren’t?