**EINSTEIN COMMUNITY DAY**
**LOCATION: PFERDESTAHL, HANNOVER**
**DATE: 21.10.2022**

# Workshop on Optics

---

**LED BY PROF. DR. STEFANIE KROKER**

- Bundling of people in working groups (Hannover, Hamburg, Münster, Braunschweig, Aachen, Erlangen, Bonn, Zeuthen)
- Each group gets to be introduced by a representative
  - Benno Wilke, AEI Hannover
  - Johannes Dickmann, TU Braunschweig
  - Roman Schnabel, Institute of Laser Physics Hamburg
  - Ulrich Wittrock, FH Münster
  - Patrick Baer, Fraunhofer ILT
  - Benjamin Schwab, FAU Erlangen
  - Jannik Zenner, U Bonn
  - Maria Haupt, DESY Zeuthen
  - Günther Hasinger, DZA
- Harald Lück gives valuable insights into ET key points regarding optics
  - HF detector will use fused silica
  - HF 63 cm mirror diameter, thickness half of that, 200 kg
  - 55 cm beam splitter
  - LF cryogenic, sapphire is not pure enough right now (maybe it will be suitable), silicon will be part of the baseline design
  - 45 cm diameter, 53 cm thickness, 200 kg
  - If possible, even larger mirrors would be desirable
  - Crystalline coating made from AlGaAs enable low thermal noise (B. Willke comments that recent paper by PTB has shown that thermal noise may be higher than initially expected)
  - As for the R&D schedule, optics will not be needed until the end of the entire construction process (in the 2030s at the earliest)
  - Although there are two companies who could in theory fabricate mirrors with the desired requirements, silicon as a material system still poses a major challenge
  - Scaling a finalized design is again very labor-intensive and time-consuming
  - As an example, fabricating one LIGO mirror would take about 1-2 years
- Work on large scale integration needs to be done in parallel with the R&D
- Suspension techniques at room temperate are already known, cryogenic approaches are not
- Extract 0.5 W trough the fiber requires 3 mm fibers
- Alternative: silicon ribbons, problem: attachment to the mirror itself, solution would require a taper
- Although silicon welding is still a problem, ideas are already being investigated
- Mario Martinez gives some insights on scattered light for ET:
  - Fundamental noise has to be controlled very well
  - Ideally, scattered light should not come up in the first place
  - Scattered light needs to be understood very well
- The problem of ice on the mirror coatings at KARGA has been resolved by proper cooling cycles

- Open question: The HF part will deal with high powers (3 MW), how do mirror coatings perform at these powers?
- The cleanliness of the mirrors will be an important issue, as humans will have to work in the evening (currently there are no robots)
- Experiment on spot absorbers will be conducted to get more information about that issue
- An idea was expressed to think about new methods to keep the mirrors clean. Possible solutions might be charging the mirrors or using light pressure. Charging might actually work, using light pressure would not cause a lack of light power.
- Are spot absorbers between the layers of any significance? It is mainly the particles on the surface that cause problems, since the light field drops exponentially into the mirror
- Besides spherical mirrors, aspherical phase profiles could also be of interest
- The radius of curvature has to be a couple of kilometers (around 10 km)
- The costs for upscaling AlGaAs are unforeseeable (> tens of millions €?)
- The participants agree that sharing experimental resources and expertise may be a starting point to further strengthen the collaborations.

End