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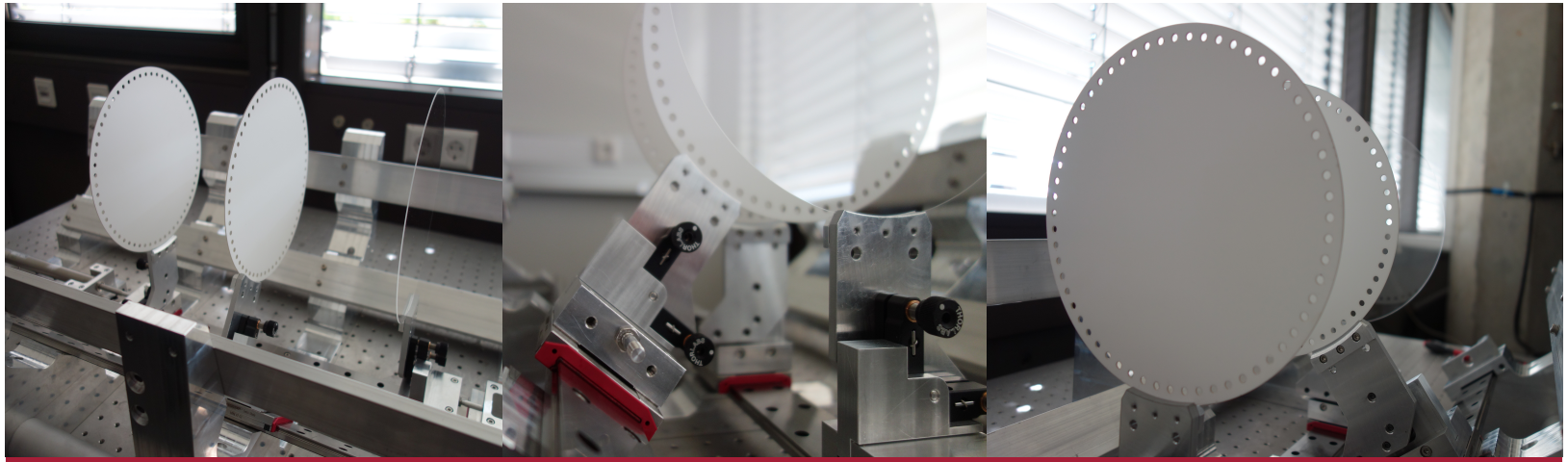


Disc Positioning Measurement for MADMAX

MADMAX Meeting Zaragoza, October 8, 2018

MADMAX Position Measurement

What do we plan to do for MADMAX?

- provide a system based on laser interferometers to measure the positions of the discs with <10 µm accuracy
- currently two options under study/development:
  1. in-house design by quantum optics group in Tübingen
  2. „commercial“ solution by company *Smartec*

Goals:

- learn about mechanical stability of the setup
- learn about influence of position changes on the boost curve
- assess if such a system is needed for the full MADMAX setup

MADMAX Position Measurement

Solution 1: Quantum Optics Group

✔promises best accuracy (much better than 1 µm)

✔absolute distance measurement

✔in principle independent of measurement distance

✘not yet proven – needs time for development
→ specifications not clear yet

✘possibly high requirements on mechanical stability, tilts, ...

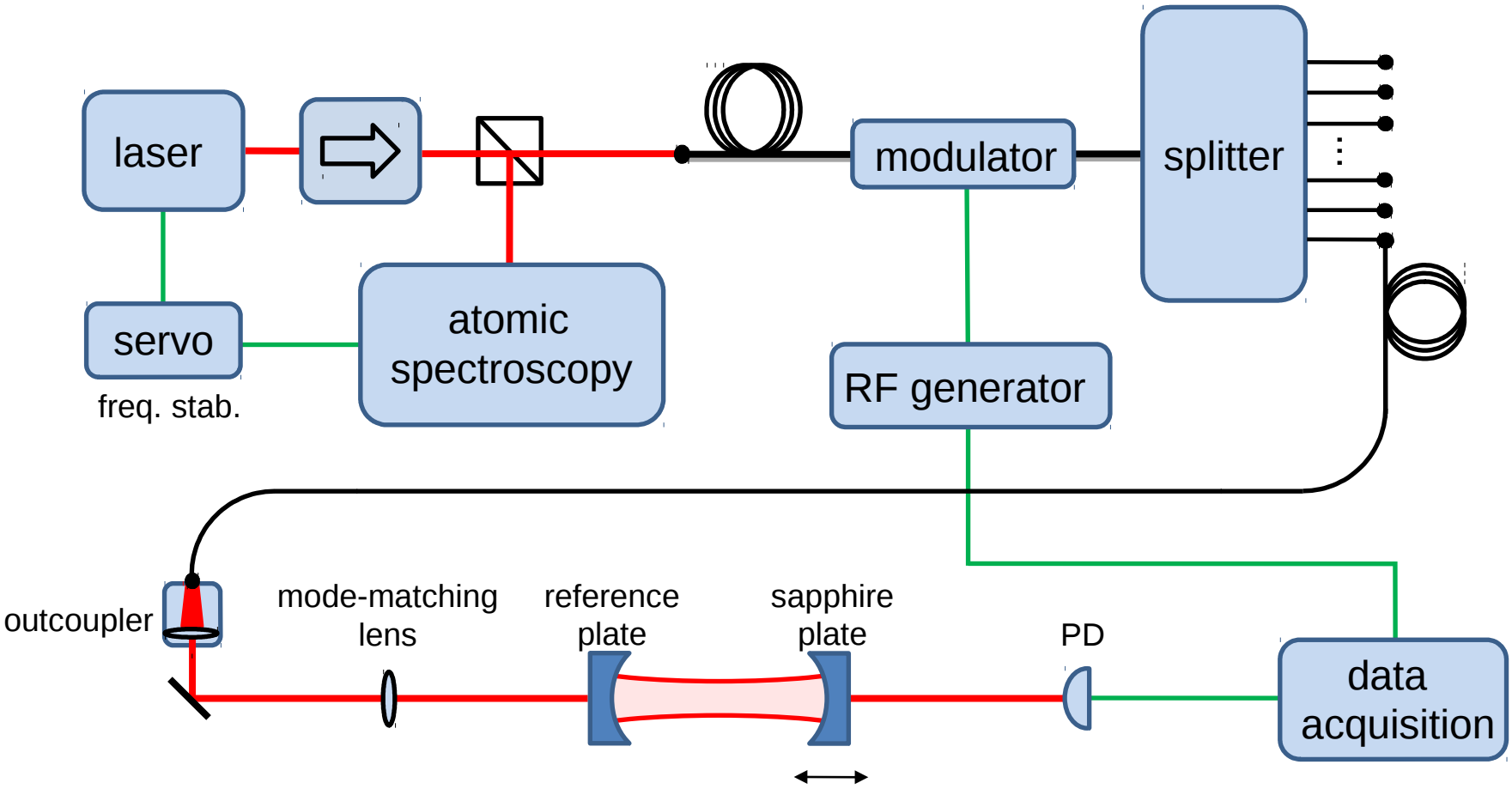
✘requires mirror alignment in vacuum vessel
(or optical feed-throughs) → expensive

✘might be „overkill“

HighFinesse
Laser and Electronic Systems

MADMAX Position Measurement

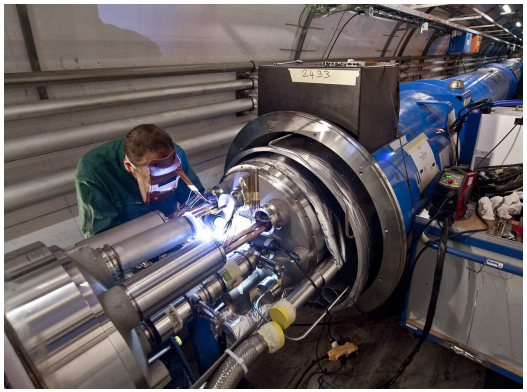
Reminder: Technical Concept



MADMAX Position Measurement

Solution 2: *Smartec*

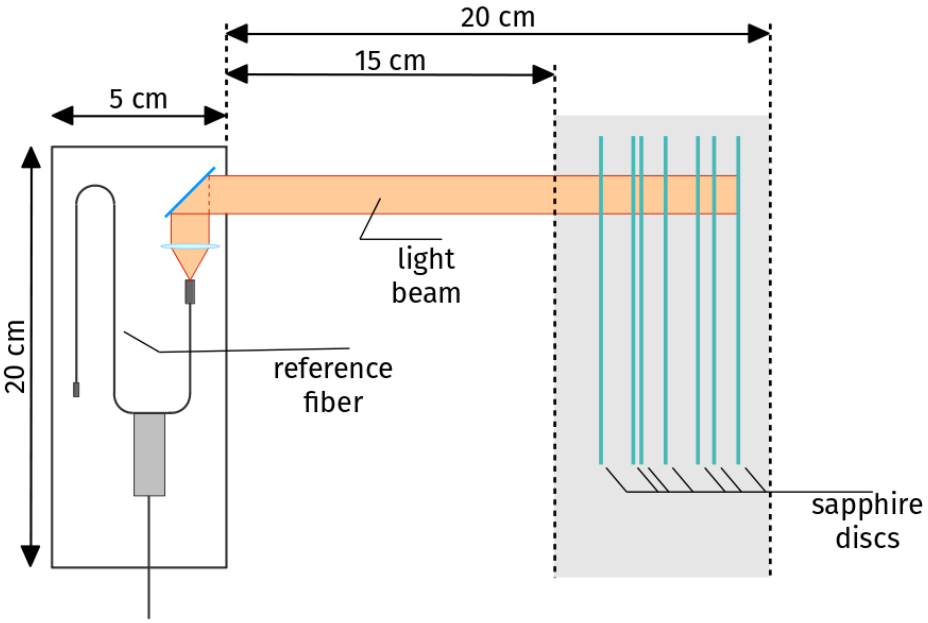
- develops fiber optic sensors to monitor integrity of (large) civil structures (bridges, dams, tunnels, skyscrapers, …)
- founded in 1996 by physicists and engineers from the Swiss Federal Institute of Technology (EPFL) Lausanne
- developed custom solutions for ITER and LHC (dipole magnets)

MADMAX Position Measurement

Smartec Technical Concept

- re-use design developed for LHC dipole magnet testing
- low-coherence interferometry using 1300 nm LED
- measure path length of reflected light beam by comparing to reference fiber of known length (Michelson interferometer)



MADMAX Position Measurement

Pros and Cons

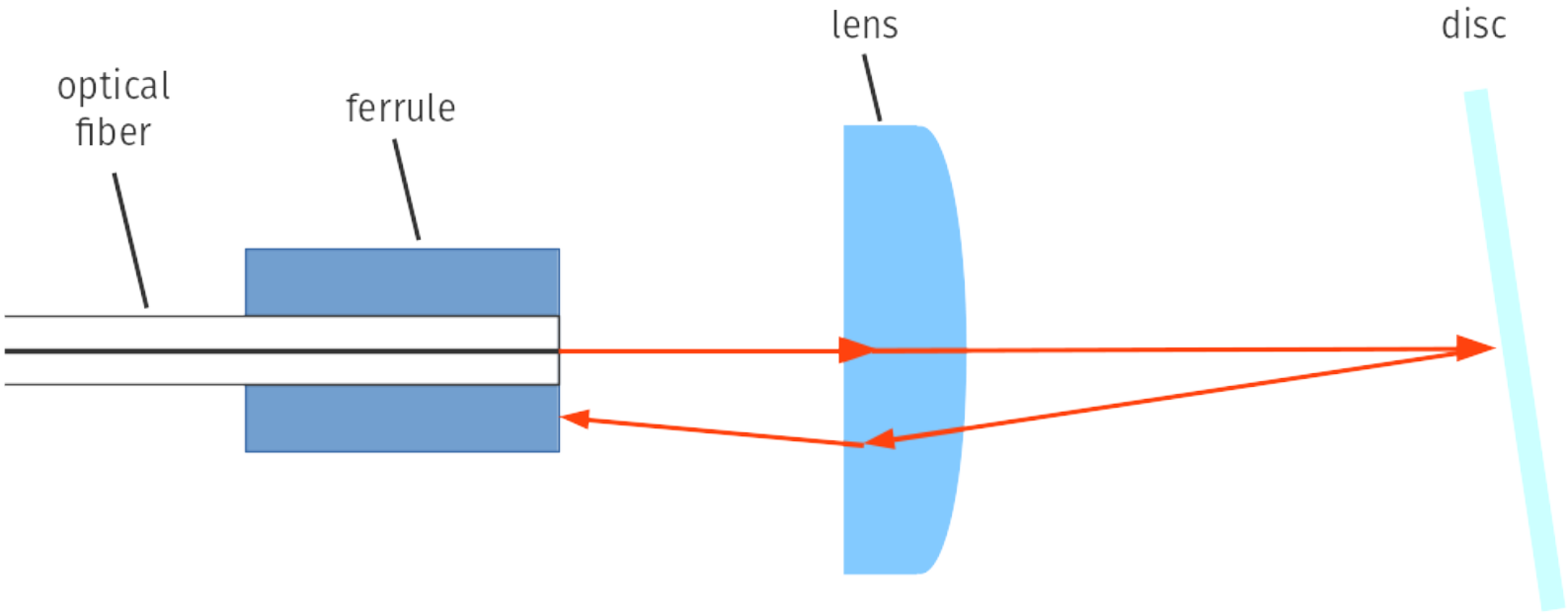
SMARTEC

- ✔ tried and tested technology – most parts commercially available
- ✔ accuracy of 1 µm should be feasible
- ✔ might be possible to measure multiple discs at once without glueing mirrors to the discs
- ✔ relatively insensitive to tilts
- ✘ limited range (due to reference interferometer)
- ✘ unknown costs

MADMAX Position Measurement

Tilt Acceptance

- using double-pass reflector
  → after 2 reflections light will always be coupled back into the fiber
- limiting factor is the back-coupling efficiency



MADMAX Position Measurement

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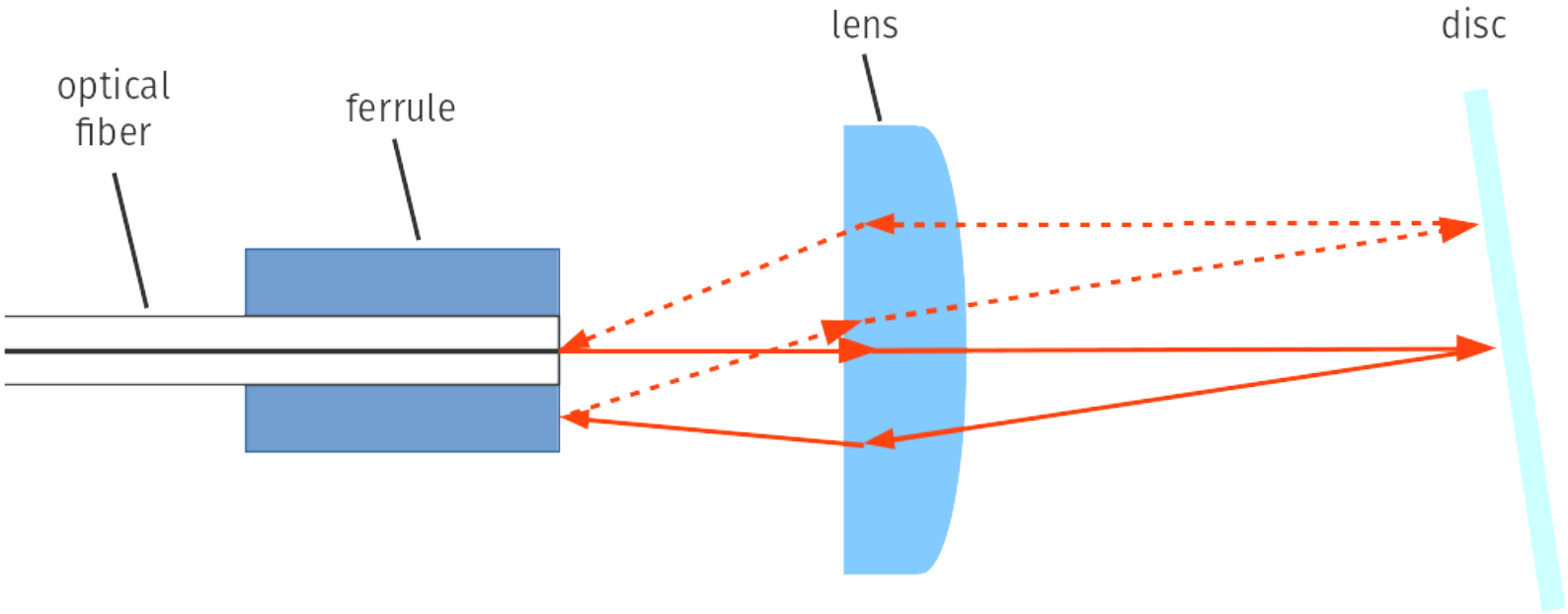

MADMAX Position Measurement

Outlook

- *Smartec* solution will be tested in the coming weeks on the mock-up in Tübingen
  → will decide if it is worth following
- meeting with quantum optics group on Friday
  → discuss status and timeline
  → try to get tangible results by the end of the year