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MAX-PLANCK-GESELLSCHAFT

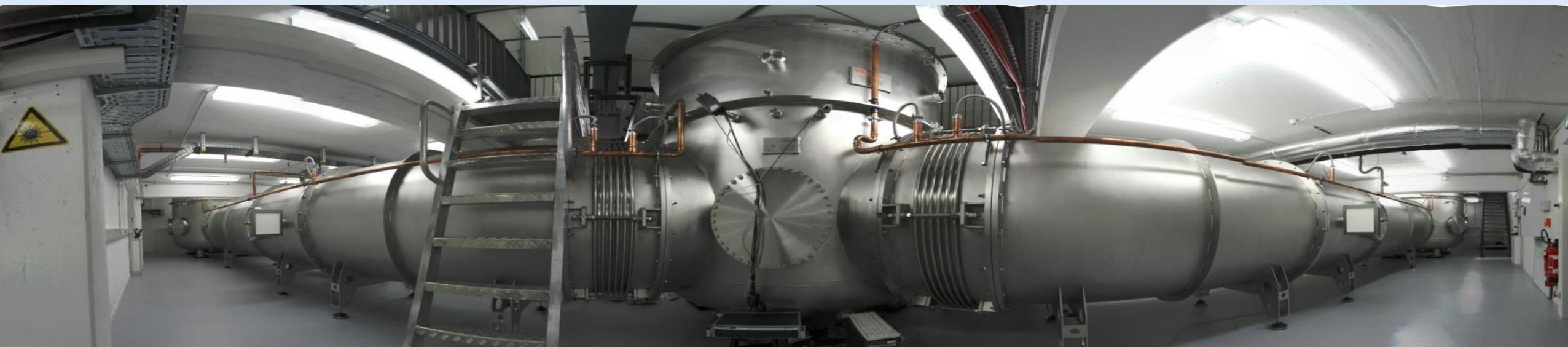
Plans for the AEI 10 m Prototype

David Wu (on behalf of the AEI 10 m Prototype team)

Albert Einstein Institute, Hannover

GWADW 2019, Isola d'Elba, Italy

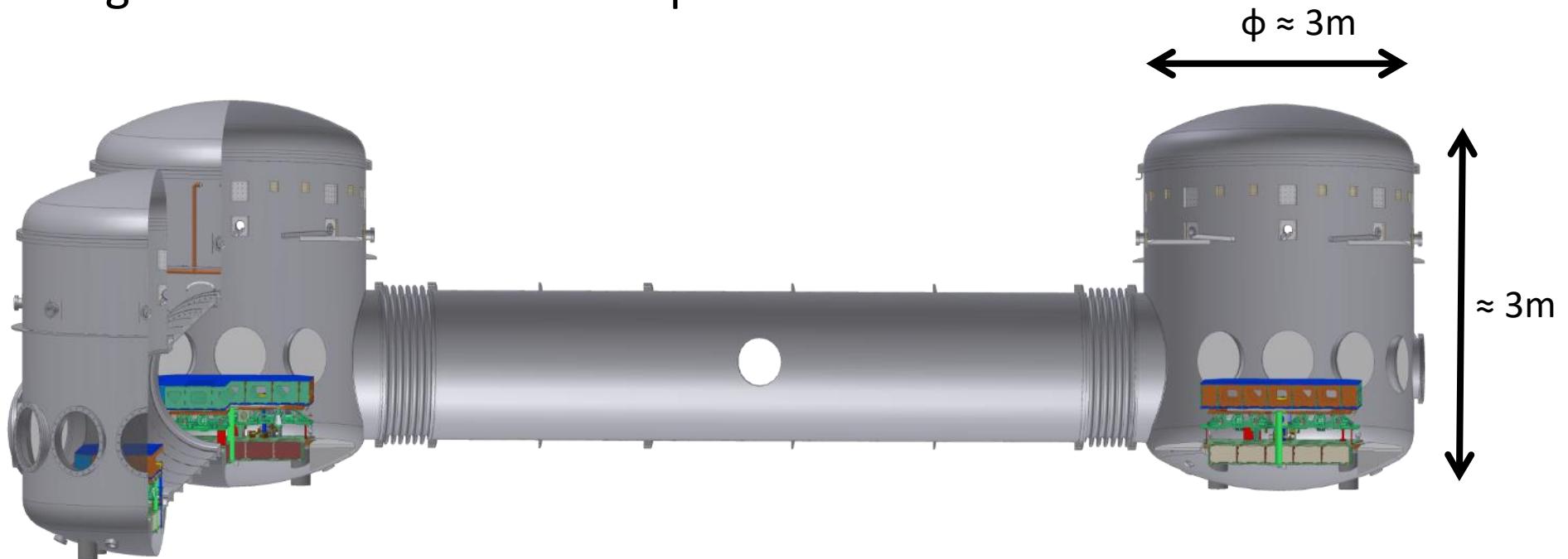
21.05.2019, LIGO-G1900990





AEI 10 m Prototype

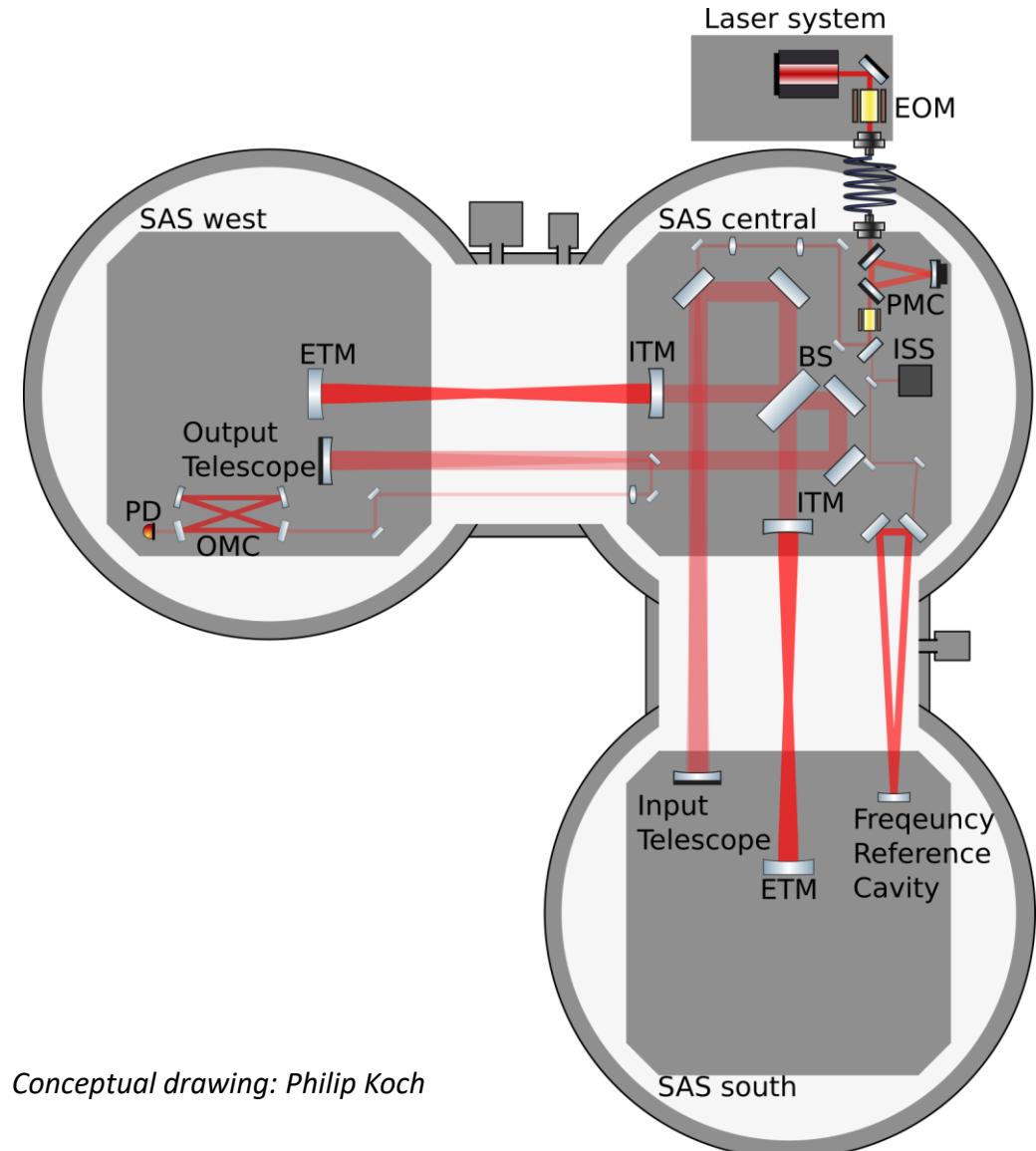
- Provide a prototyping facility closely resembling a gravitational wave detector to study methods to overcome the standard quantum limit (SQL)
 - High vacuum $O(10^{-7})$ mbar within a week
 - Seismically isolated optical tables
 - Flexible configurations for additional experiments





The Sub-SQL Interferometer

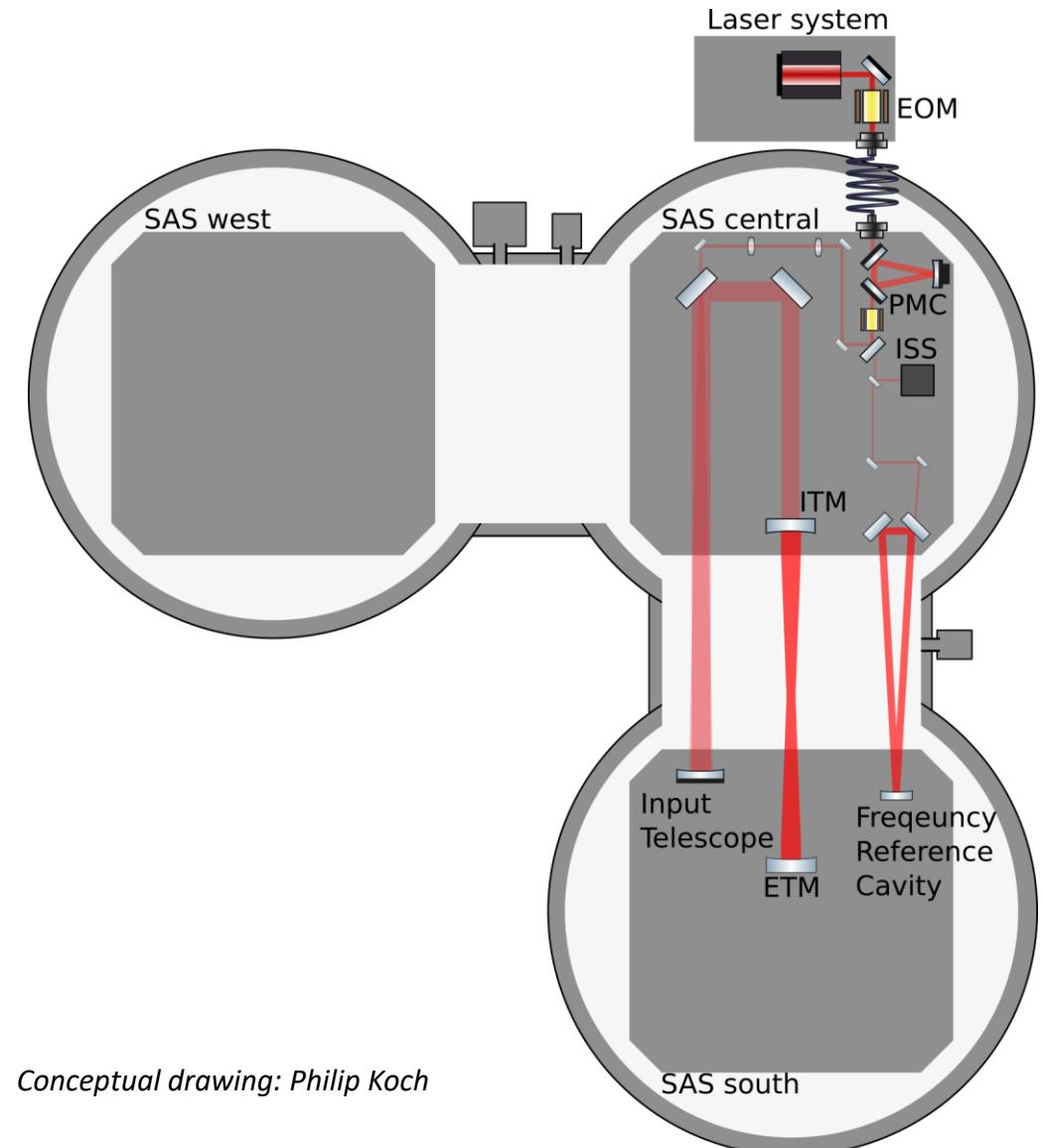
- Small 100 g test masses to enhance the SQL
- Aiming to be limited by the SQL between approx. 50 and 500 Hz
- Coating thermal noise is dominant classical source
 - Large g-factor 0.99 (cf. aLIGO 0.83)
 - Crystalline coatings (AlGaAs/GaAs)



Conceptual drawing: Philip Koch

Current Status

- Seismic Attenuation System (AEI-SAS)
 - Suspension platform interferometer (SPI)
 - Optical levers
- Pre-Stabilised Laser
 - Power stabilisation (aLIGO style PD array)
 - Frequency stabilisation (10 m suspended reference cavity)
- Single Arm Test
 - 100 g pilot optics (wire suspension)
- Control and Data System (CDS)

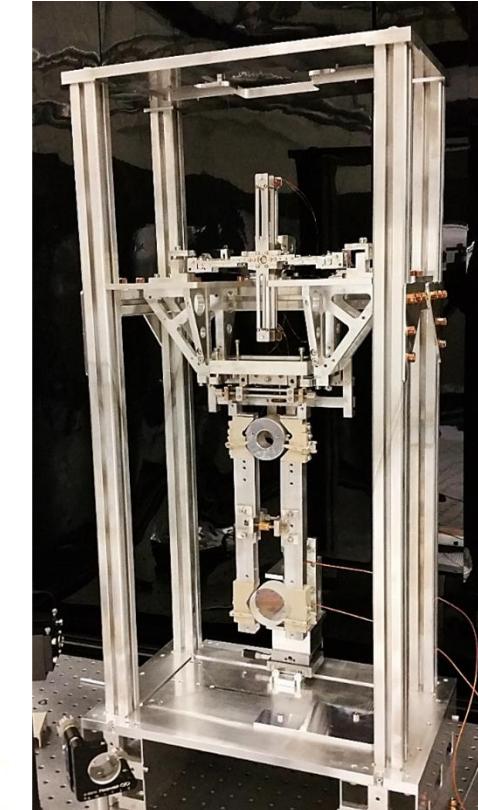


Conceptual drawing: Philip Koch



Milestones Towards the Sub-SQL Interferometer

- Core optics
 - Beam splitter
 - 100 g test mass mirrors
 - Substrates for AlGaAs damaged
 - Damaged substrates will be IBS coated
 - New substrates to be acquired for AlGaAs coatings
- Interferometer readout
 - Balanced homodyne readout planned
 - Starting on a BHD compatible OMC design
- Implementing a control scheme
- Plenty of other tasks!!





Synergy

Synergies	Discords
Low noise test facility - eg. thermal noise interferometer	No immediate plans for signal or power recycling
Seismic isolation techniques - Huddle tests for inertial sensors - Global control scheme	High power testing - Limited power into photonic crystal fibre - No power recycling
Crystalline coatings - Still low noise with large spot sizes? (Penn, G1900684)	Filter cavities - 10 m cavity needs of order 100,000 finesse
Quantum correlation measurement (Martynov <i>et al.</i> 2017) - Measure limiting classical noise	Cryogenics
Balanced homodyne readout/OMC	
Squeezed light application and testing	

D. Martynov *et al.*, Phys. Rev. A **95**, 04383 (2017)



The End