

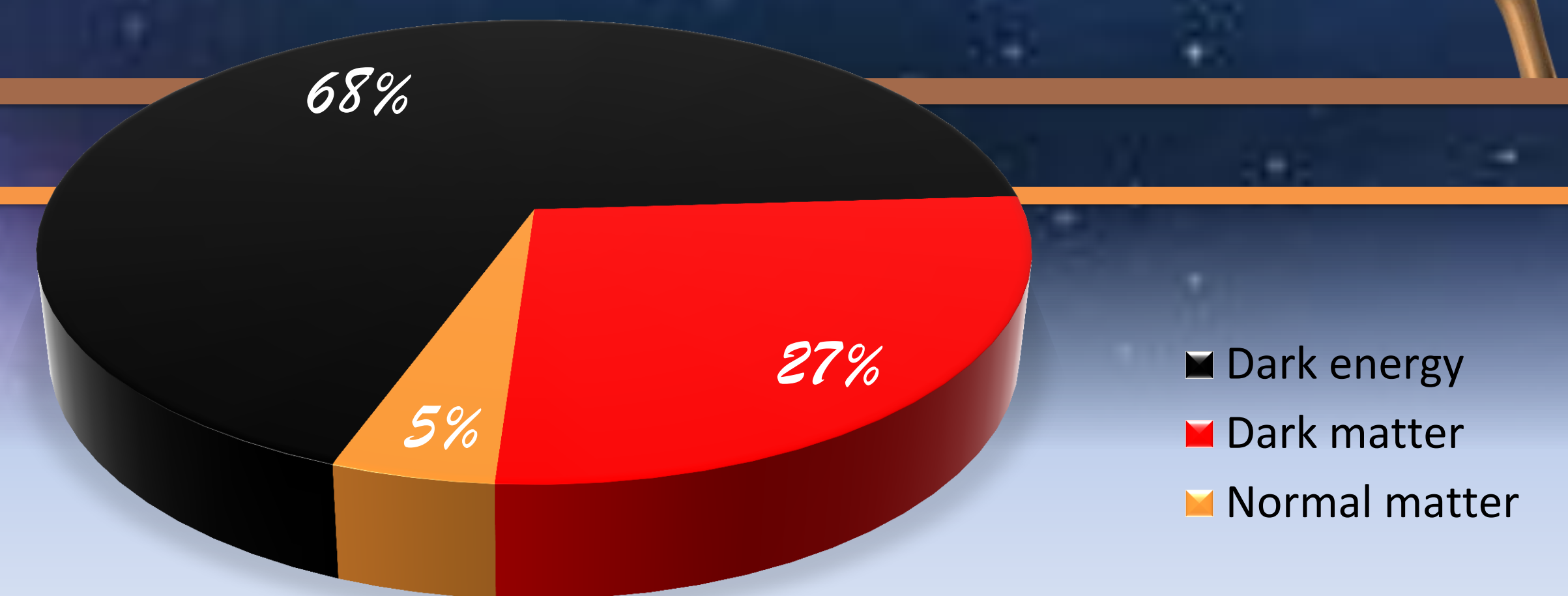
Hunting for the chameleon particle: an update on an ambitious experiment on dark energy

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Introduction

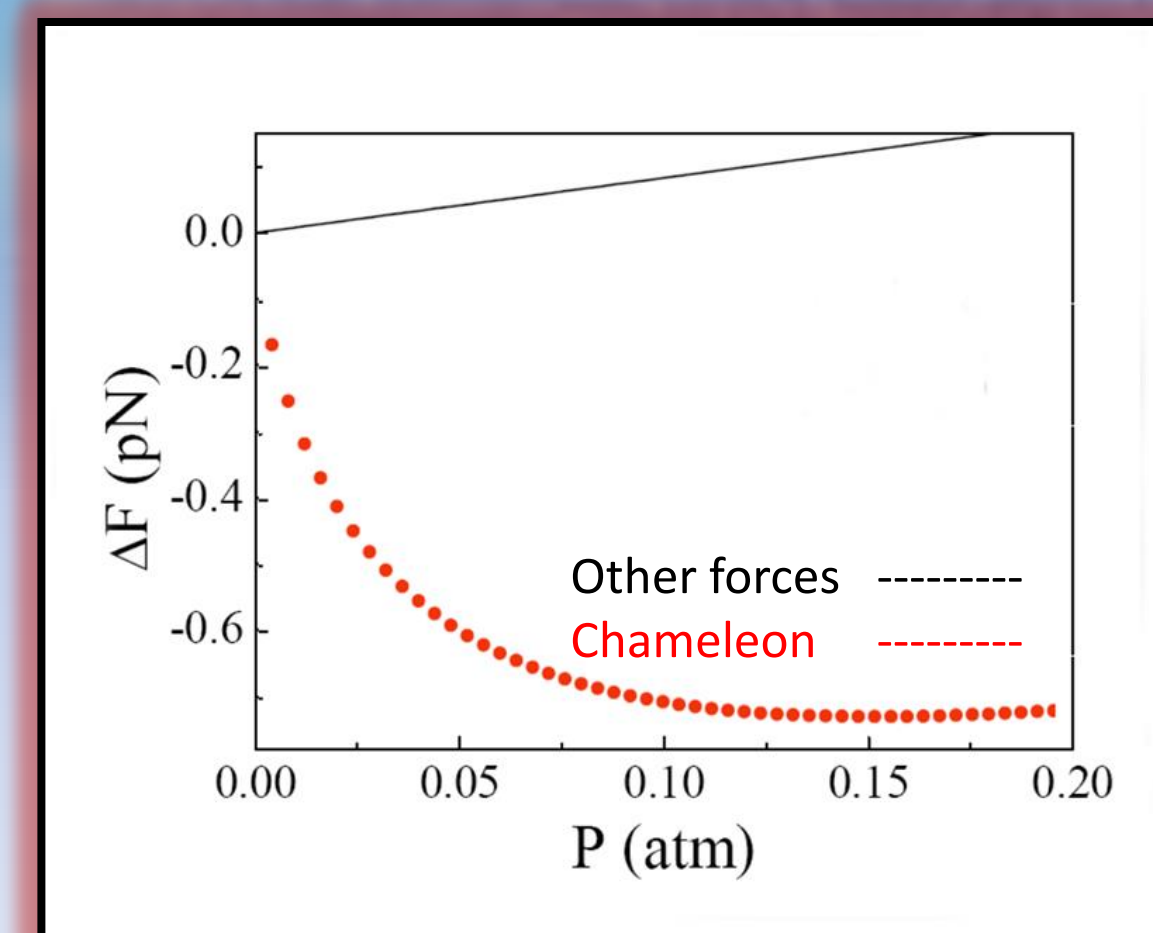
The hypothetical chameleon interaction could be a possible explanation for dark energy accounting for 68 % of the total energy in our universe. We are following a novel idea [2] to measure this interaction in a table-top setup - the CANNEX experiment.



Concept

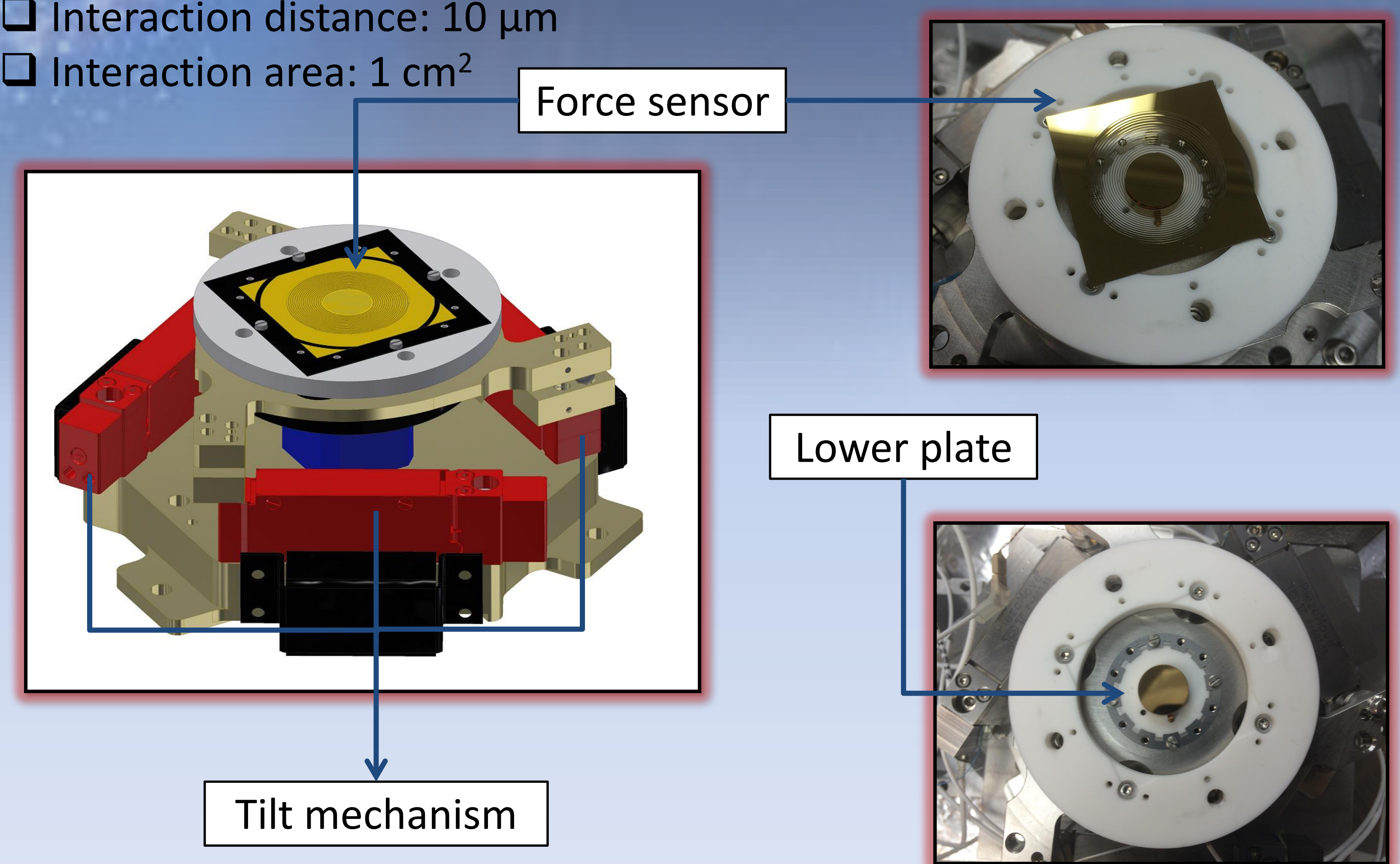
- Measure forces between two parallel plates
- Inject gas and vary pressure p
- If the Chameleon exists, the force decreases, otherwise it increases with p

Aim: limit to the interaction strength or proof of existence



2nd hurdle: force sensitivity

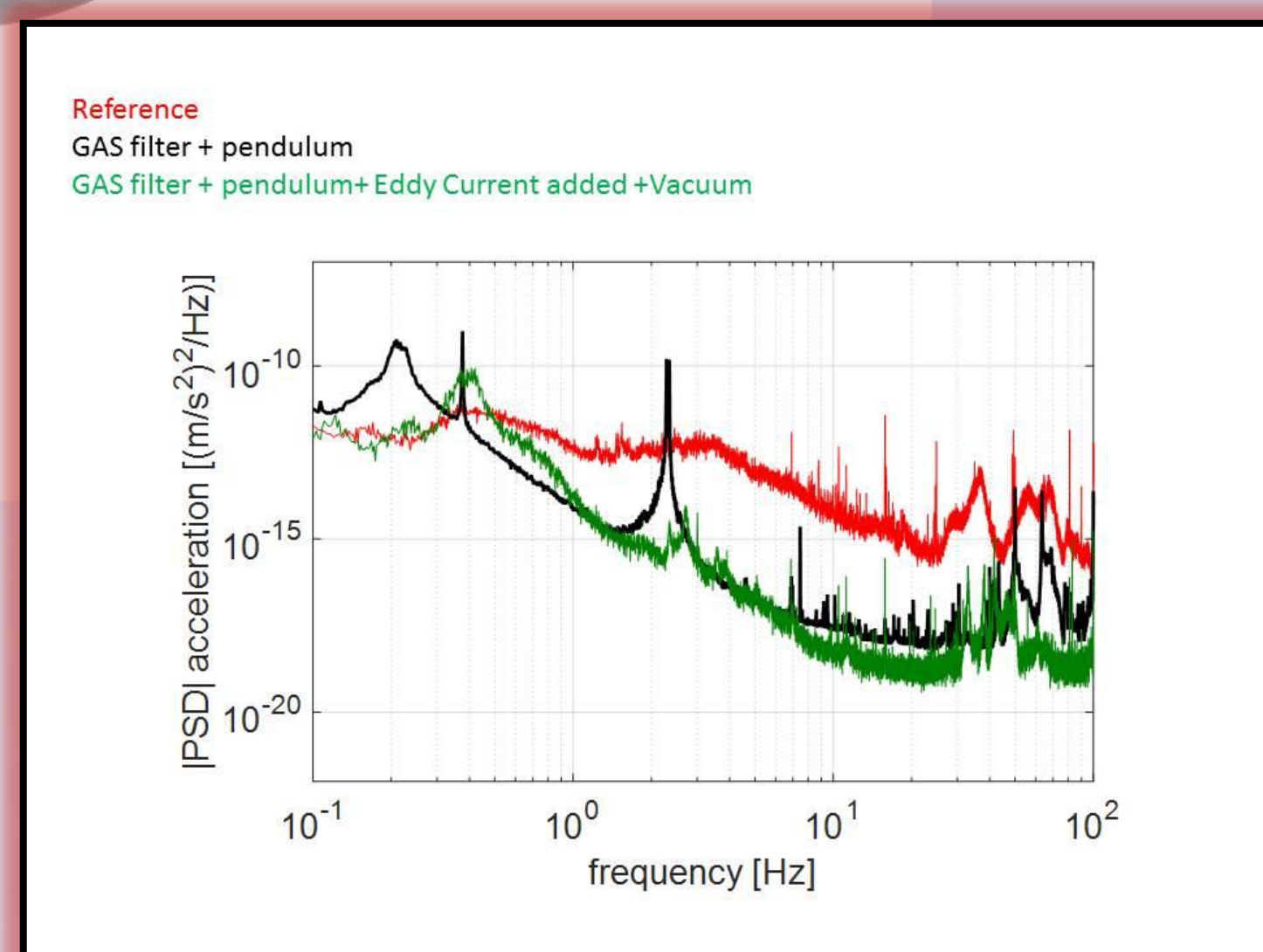
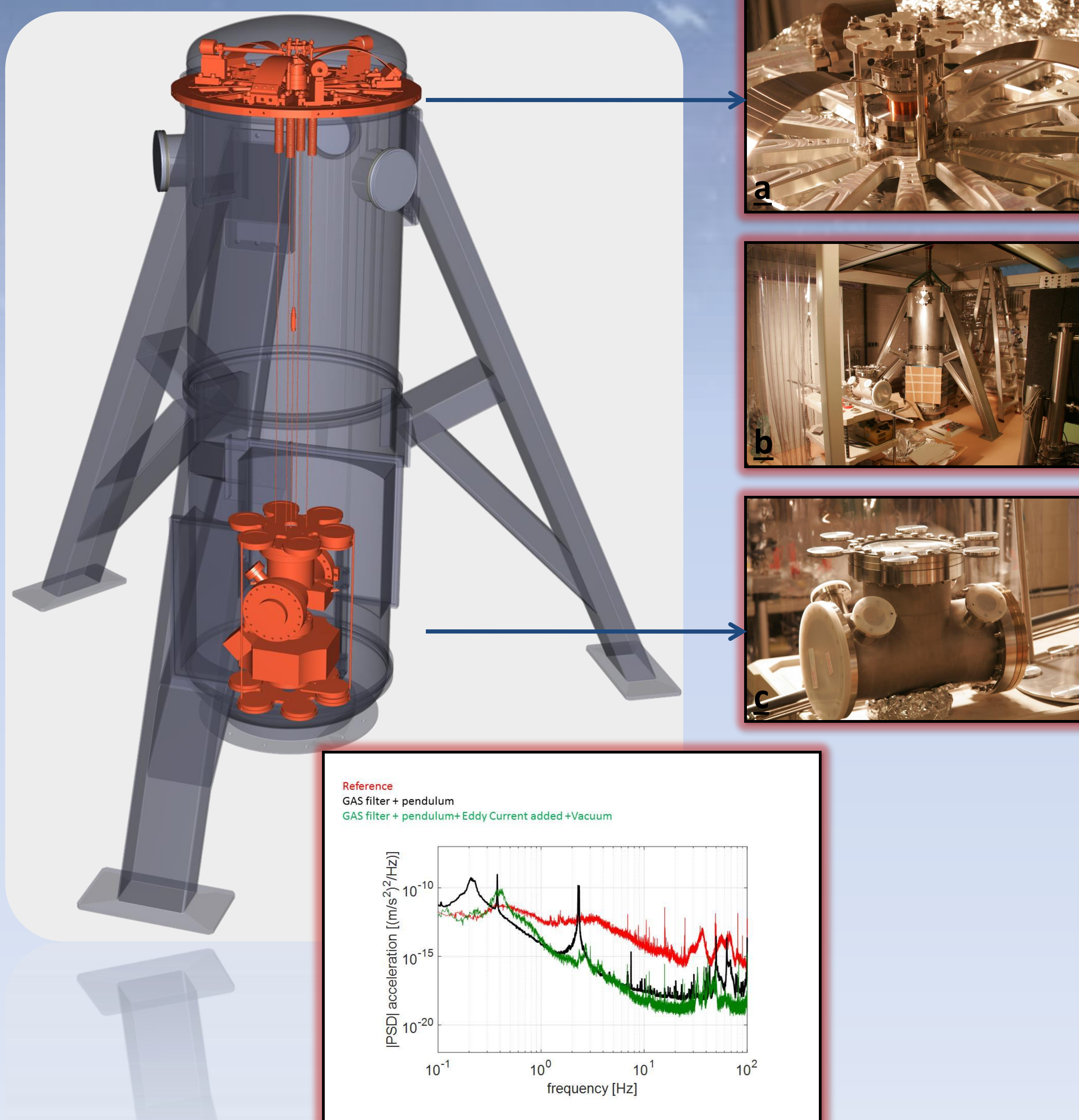
- Required sensitivity: 0.1 pN
- Interaction distance: 10 μm
- Interaction area: 1 cm^2



1st hurdle: vibrations

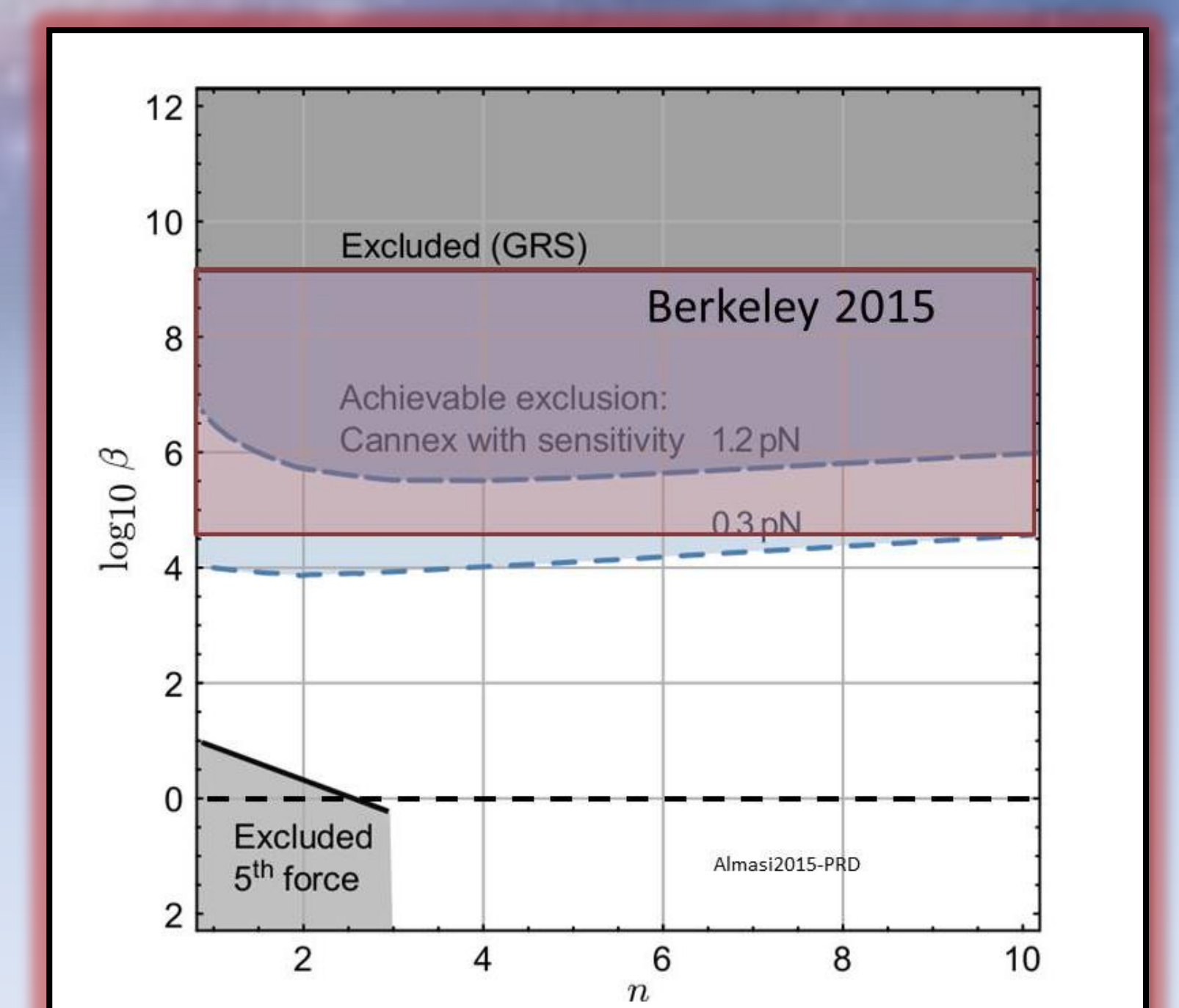
Problem: required force sensitivity of 0.1 pN between DC and 1 Hz requires excellent damping of seismic and acoustic vibrations.

Solution: two-directional anti-vibration stage consisting of a geometrical anti-spring (GAS) filter (Fig.a) [3], a double pendulum (Fig.b), eddy current dampers, and a two-stage vacuum chamber (Fig.c).



Achievable sensitivity

- First sensitivity 1.5 pN**
 - Achievable with current setup
- Second sensitivity 0.3 pN**
 - Upgrading the detection system
- Third sensitivity 0.1 pN**
 - Upgrading the force sensor design



... to the next hurdles

- Augment the passive anti-vibration stage by active H_∞ feedback
- Demonstrate capability to keep parallelism between three surfaces
- Demonstrate force sensitivity

Interested? Stay tuned on cannex.vu.nl!

[1] J. Khouty, A. Weltman. Chameleon Cosmology, Phys. Rev. D, 69, 044026, 2004.

[2] Ph. Brax, C. van de .Bruck, A. C. Davis, D. J. Shaw and D. Iannuzzi. Tuning the Mass of Chameleon Fields in Casimir Force Experiments, Phys. Rev. letter, 104, 241101, 2010.

[3] A. Stochino, B. Abbot, Y. Aso, M. Barton and A. Bertolini. The Seismic Attenuation System (SAS) for the Advanced LIGO gravitational wave interferometric detectors, Nucl. Instrum. Meth. A, 598, 737, 2009.