

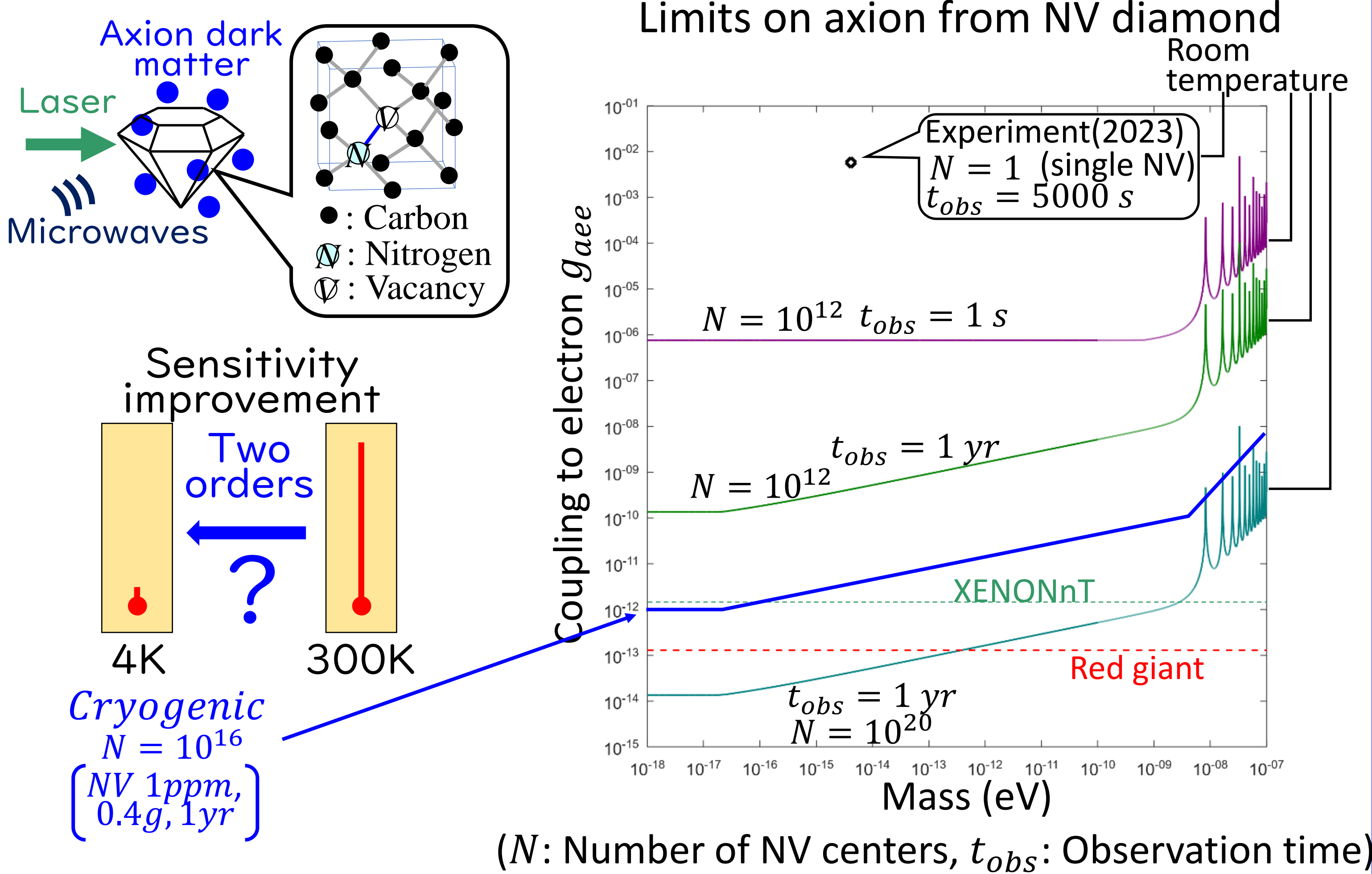
QUP Quantum Cluster - NV diamond and Casimir forces - Atsuhiro Umemoto and Hideo Iizuka

Objective: New quantum field search via NV diamond and Casimir forces

Cryogenic NV diamond

Nitrogen-Vacancy (NV) centers in diamond are illuminated by laser and microwaves. The spin-state control allows axion dark matter search via electron coupling in NV diamond.

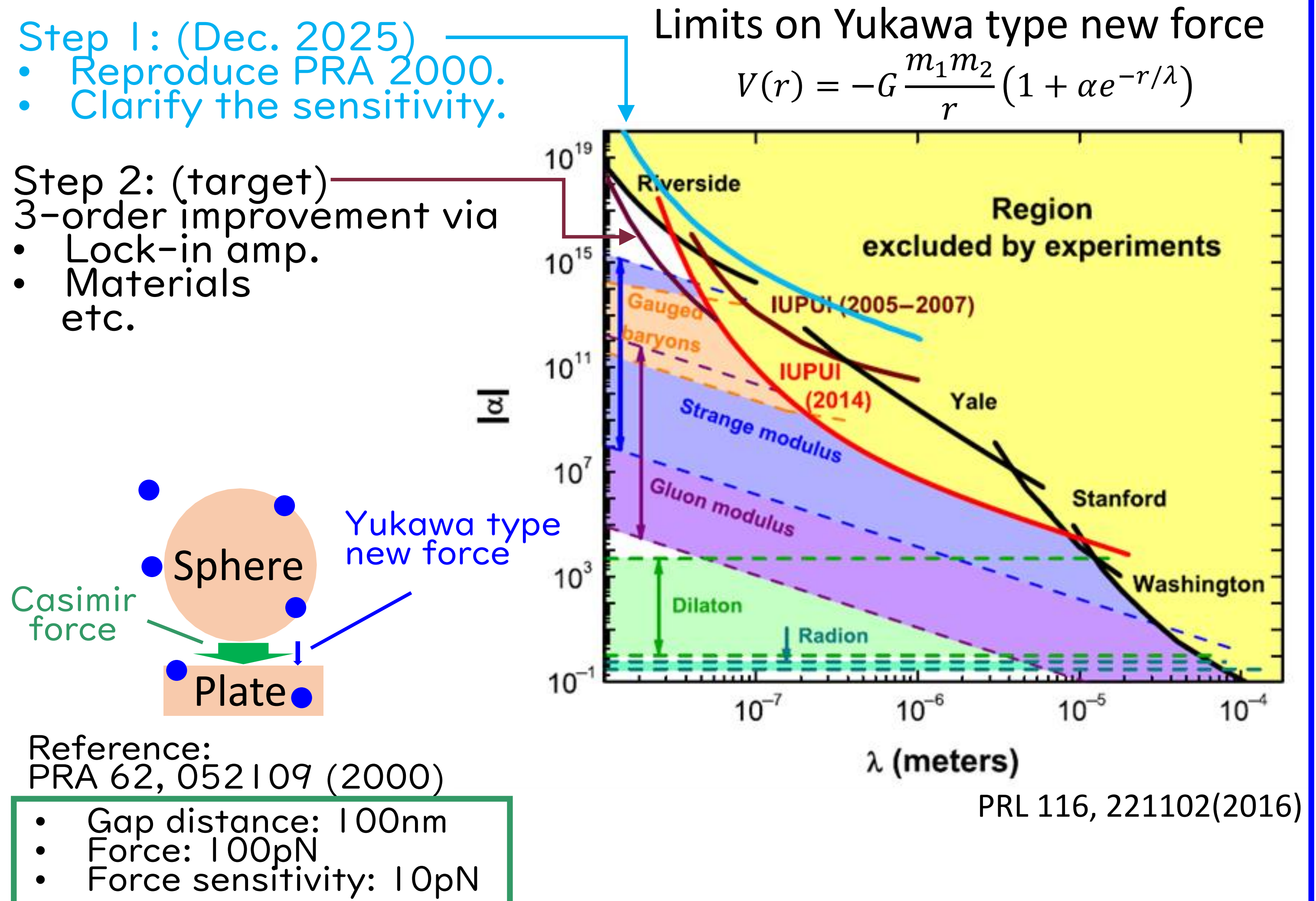
We want to explore the cryogenic sensitivity.



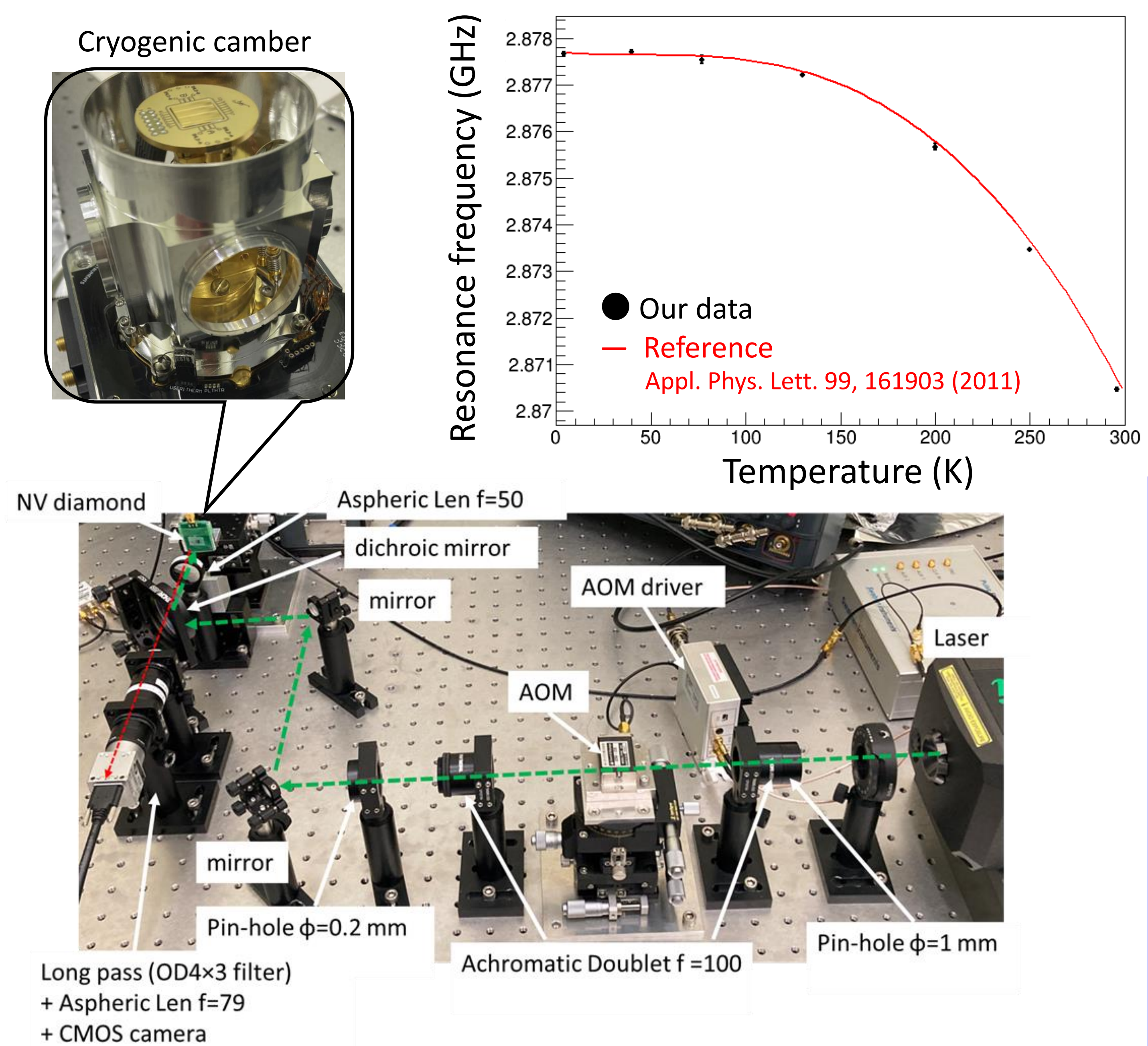
Casimir forces

Casimir forces arise from quantum and thermal fluctuations for closely placed bodies, which allow the search for Yukawa type new force.

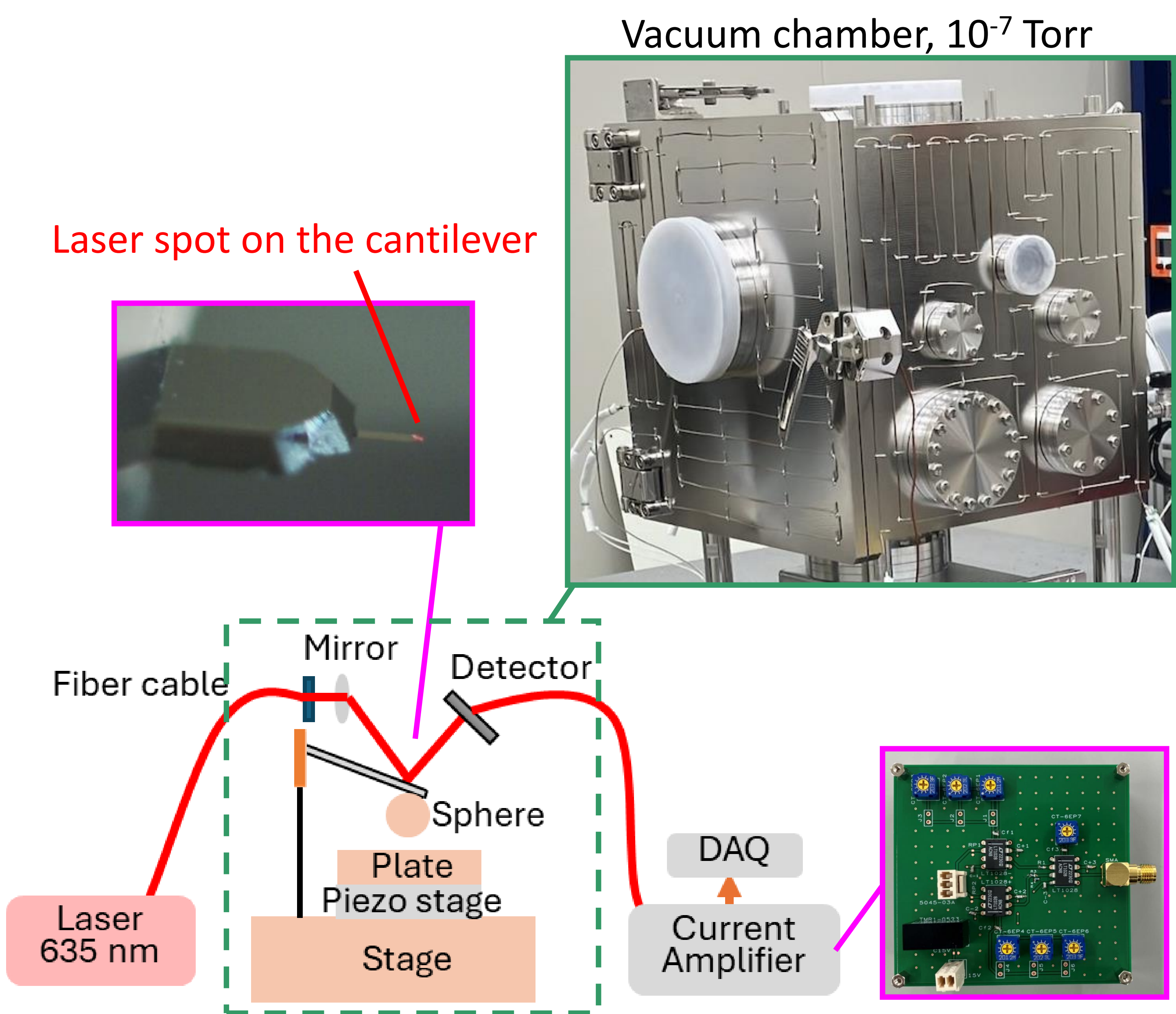
We want to clarify the sensitivity in the standard experimental setup and then improve it.



The cryogenic setup for ensemble NV diamond is going on at Fuji building, KEK. Measurement results have verified that the microwave resonance in a NV diamond sample increases with decreasing the temperature.



The experimental setup for Casimir forces is going on in the QUP satellite of Toyota Central R&D Labs.



FY2025			FY2026		After2027
Apr.	Jul.	Oct.	Jan.		
Measurement setup for T1	Sensitivity improvement	Measurement setup for T2	Sensitivity improvement		Higher sensitivity measurement (Axion)
T1 measurement of cryogenic NV diamond			Quantum field measurement (Axion)		Higher sensitivity measurement (Axion)
Microwave antennas		Performance improvement			

Collaborators
Prof. Norikazu Mizuochi (Kyoto Univ.)
Dr. Kenichi Yatsugi (Toyota Central R&D Labs)

FY2025				FY2026		After2027
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Measurement setup	Force-component separation	Sensitivity improvement	Sensitivity improvement		Quantum field measurement (B-L boson, etc)	Higher sensitivity measurement (B-L boson, etc)
Measured signals of Casimir forces (noise included)			100nm gap 100pN force Sensitivity?		Quantum field measurement (B-L boson, etc)	Higher sensitivity measurement (B-L boson, etc)

Collaborators
Prof. Pramod Reddy (Univ. Michigan)
Dr. Shrinathan E. M. Pandara Kone (Toyota Central R&D Labs)