An advanced transducer for ALLEGRO

Ho Jung Paik, M. Vol Moody, and Andrew Weber
Department of Physics
University of Maryland, College Park

- Two-mode superconducting inductive transducer
- Integrated with two-stage Quantum Design dc SQUID

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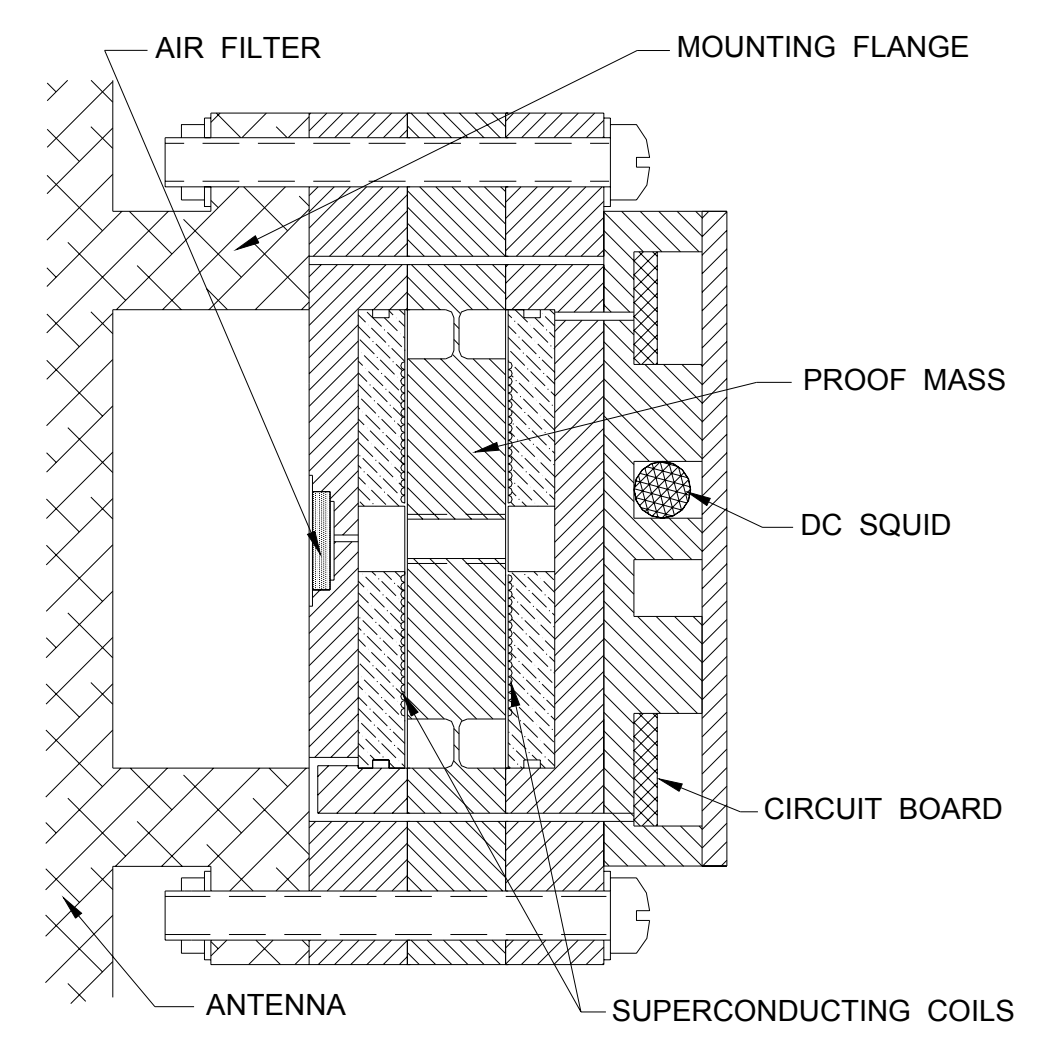
Amaldi 5, Pisa, Italy

Present single-mode Maryland transducer



Specifications and expected performance

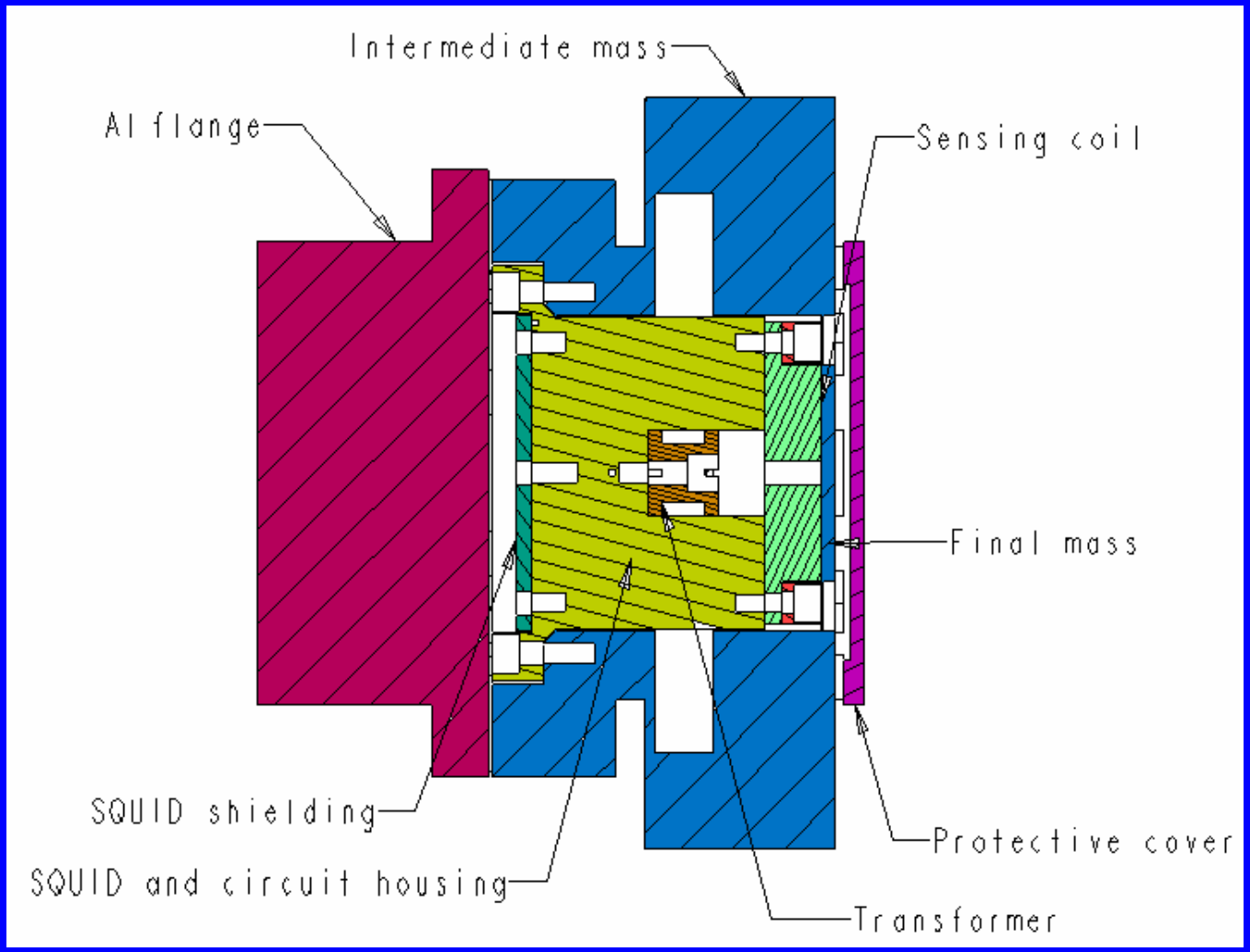
Specs or measured parameters

- Antenna (Al): @ 4.4 K,
  m_1 = 1150 kg, Q_1 = 9 x 10^6
- Transducer mass (Nb):
  m_2 = 0.62 kg, Q_2 = 2 x 10^6
- Measured parameters:
  coil spacing = 25 μm,
  β = 0.10 (with I_0 = 16 A)
  Q_M = 2 x 10^6, $Q_E \approx 10^5$
- SQUID noise: 5000 $\hbar\omega_0/k_B$
  (Quantum Design dc SQUID)

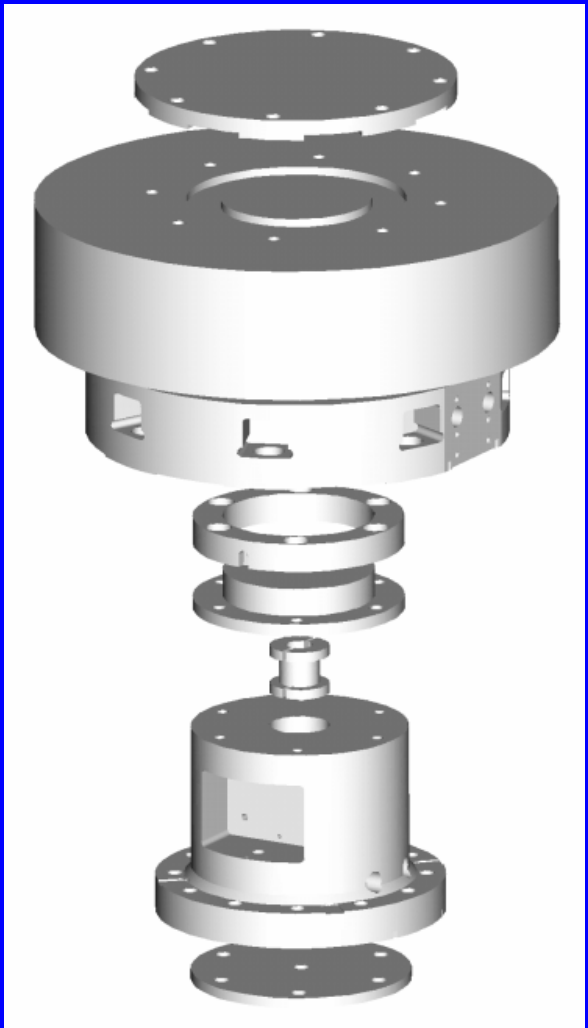
Calculated performance

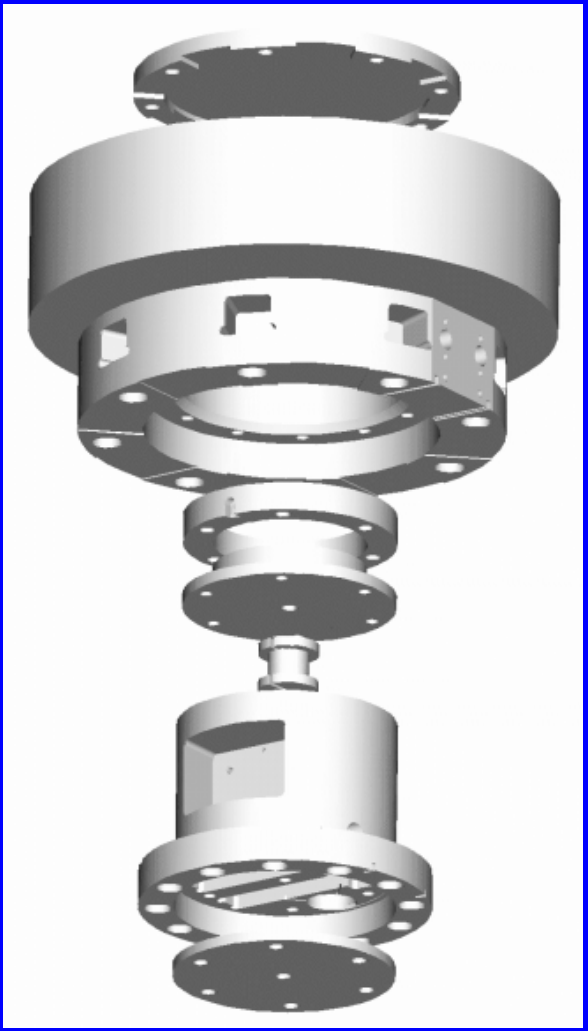
- Bandwidth: 34 Hz
- Strain sensitivity: h = 1.7 x 10^{-19}
- Detector noise temperature:
  T_N = 3.3 x 10^{-4} K
- Overall efficiency = 36000 $\hbar\omega_0$

New two-mode Maryland transducer



Exploded views showing components





Specifications and expected performance

Specifications

- Antenna (Al): @ 4.4 K,
  m_1 = 1150 kg, Q_1 = 9 x 10^6
- Intermediate mass (Nb):
  m_2 = 5.35 kg, Q_2 = 3 x 10^6
- Final mass (Nb):
  m_3 = 0.050 kg, Q_3 = 3 x 10^6

  (4.8 cm in diameter, 0.30 cm thick, coil spacing = 50 μm)
- SQUID noise: 300 $\hbar\omega_0/k_B$
  (two-stage QD dc SQUID)

Calculated performance

- Bandwidth: 100 Hz
- Strain sensitivity: h = 7.6 x 10^{-20}
- Detector noise temperature:
  T_N = 1.3 x 10^{-5} K
- Overall efficiency = 1430 $\hbar\omega_0$

Modal analysis

653 Hz	M2 rocking
823 Hz	Axial (common)
930 Hz	Axial (differential)
1443 Hz	M3 rocking
2055 Hz	M2 torsional
2970 Hz	Mass cover

Comparison with other transducers