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This grant provided equipment that would allow us to explore the limits and applicability of high precision ICR techniques for use in a variety of situations. In fact, we were able4 to get signals from portable ICR devices. We tried a number of electrode configurations to determine which was the optimum. We learned about some stability challenges that we are still thinking about the trying to devise solutions to. The nature of this grant was to provide equipment that would allow us to do such diagnostics on a continuing basis, at the same time as we were pursuing more fundamental research topics.

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Final Performance Report

AFOSR F49620-00-1-0271
"Exploring the Limits and Applicability of High Precision ICR Techniques
for Use in Portable Gas Sensors

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This grant provided equipment that would allow us to explore the limits and applicability of high precision ICR techniques for use in a variety of situations. In fact, we were able to get signals from portable ICR devices. We tried a number of electrode configurations to determine which was the optimum. We learned about some stability challenges that we are still thinking about and trying to devise solutions to.

The nature of this grant was to provide equipment that would allow us to do such diagnostics on a continuing basis, at the same time as we were pursuing more fundamental research topics. This work is now going on and will continue for some time.

Equipment items are listed with manufacturers, model numbers and prices. Web references are given where this is possible. The nature of the research includes apparatus development. Some equipment items must be custom built because there is yet no commercial supplier. We provided the designs and the construction was done in the Harvard machine shop.

Oscilloscopes (2) $13,756

HP 54616C 2 GSa/s 500 MHz 2 Channel Color Oscilloscope
with HP 54650A HPIB interface (including shipping and 10% discount)

Verdi V8 Pump Laser with PE cooler plate option, Coherent Laser Group $80,000

PTS D620-R-H-0-2-A-G dual channel frequency synthesizer $14,051
620 MHz, 0.1/0.2 Hz resolution, rackmount, OXCO standard,
R01240V line, step attenuator, GPIB interface

Magnetic Trap and Dewar System $106,622

Hewlett Packard HP 6680A DC power supply, with GPIB, rack mount,
bus bars, meter and shipping, with 10% discount.
See www.agilent.com. $ 5700

Ioffee Field Coils: we may need to build these ourselves, but it would be much better to have these built by an experienced manufacturer. American Magnetics Incorporated has just built Ioffee coils for the first time (working with my colleague Prof. John Doyle). Estimated pricing per set of coils is $15,000. We need 2 sets of coils. $30,000

Helium temperature dewar system: Because of tight space constraints we

will need to build and assemble this system. Two refrigerator systems (listed below) were purchased as part of this system.

Cryomech: PT405 dual stage pulse tube cryorefrigerator (with shipping) $30,100
PT60 single stage pulse tube cryorefrigerator (with shipping)
See www.cryomech.com. $12,872

The support and dewar system will be custom designed by us and built for us in the Harvard machine shop. $27,950

Stanford Research Systems, ICR Electronics $ 9,401
Digital delay/pulse generator
P01622

Vacuum and Gas Handling System $75,634
A complete pumping station wasconstructed by us. Major components are listed.

The following components were purchased at Kurt J. Lesker

ED-B75302000 Edwards Turbo pump EXT255H DN100 CF	$5431
ED-A71002909 Scroll Pump, ESDP12, 8.8 CFM	$4777
ED-B58053160 ACX250H, 24V Air coolers	$ 212
ED D3916000 EXC120 turbo controller	$1292
ED D39618030 3 M, Ext to Exc Cable	$ 191
ED-B580066020 Vent valve, TAV6	$ 253
A46226000 EMF10 Filter ET EMF10	$ 190
Total:	$ 12,346

The following components were purchased at Granville-Phillips.
358001-T3 Controller for MICRO-ION Gauge (2 units @ $950)
358002 Dual CONVECTRON Gauge module (2 units @ $395)
358003 Process control module with 6-relays, 2 relays per channel (2 units at $360)
358008 3 M long microion cable (2 @ $100)
350009 8 M long microion cable (1 @ $145)
303030 Dual convection gauge cable, 3 m (1 at $85)
303031 Dual convection gauge cable, 7.5 m (1 at $115)
275196 Convection gauge on NW 25 (4 at $150)
370021 Mount for controllers (1 @ $50)
355001 Micro-ion gauge on 2 ¾" conflat (1 @ 235)
Total $4840

The following components are made by Granville-Phillips. See www.helixtechnology.com. Shipping is added.
358001-T5 Granville Phillips Series 358 Micro-Ion Vacuum Measurement system (ion gauge, controller, Power cord (1 @ $950)
355001-YG Micro-Ion gauge (NW35 CF, 2.75 in.) metric (1 @ $235)
275196 Convection gauges (NW25KF-welded (2 @ $150)
358002 Dual convection gauge module (plugs into ion gauge controller above)

(1 @ $395)
370010 Rack mount on right (1 @ $50)
303031 25 ft cable (controller → convection (1 @$115)
358009 25 ft cable (controller → ion gauge (1 @$145)
358003 Process control option (6 set points) (1 @ $360)
Total $2550

Kepco, Inc.
BHK1000-0.2 MG power supply (2 @$1309) $2618

The remaining items must be constructed by us. Included are the valves, plumbing and cart for the vacuum system. Also included are the high pressure gas handling system, with regulators, gauges, etc. The estimated cost comes from comparing costs for comparable vacuum systems.

Valves, conflat flanges, bolts, tees, etc. and gas handling system $22,452

Trap electrodes: The Penning trap is the heart of the measurements. One goal is to make Penning trap designs which allow the most robust trap performance. We will design the electrodes, and will get the pieces constructed in our shop.

Penning trap electrodes and enclosure system $30,828

Computer Workstations $ 9731
MicroElectronics – CFG10631735 Millenia Max 65133 PC
Pentium III 866 MHz, 256 MB RAM, 45 and 30 Gb hard drives,
Promise Ultra, ATA100 Controller, GEFORCE@ GTS AGP
Graphics card, 19" Trinitron display, MS Office 2000, MS Windows NT,
ACS 33 speakers, 3 COM 3C900 PCI combo network card
Ref #50560700 $3161
Ref 50561185 $2970

Dell Computer Corp. – Dell Precision Workstation 330 @ $3600

RF Amplifiers (we built ourselves from smaller components, and available integrated circuits) $12,852

AD Interface $ 9,447

GigaOptics Fentosecond Laser $49,468
GigaJet 30 – 3GHz repetition rate unidirectional Femtosecond
Ti:sapphire ring laser kit for user self assembly

Miteq – Low-Noise Amplifiers Au-2A-0110-BNC (20@$310) $ 6,203

Berkeley Nucleonics – 4-channel pulse generator w/GPIB, rack mount $ 2,835
110/220V compatible 555-2126

Total **$390,000**