All poster material
TA # 208144

DETECTION OF EXPLOSIVES, NERVE AGENTS, AND OTHER ILLICIT SUBSTANCES BY ZERO-ENERGY ELECTRON ATTACHMENT

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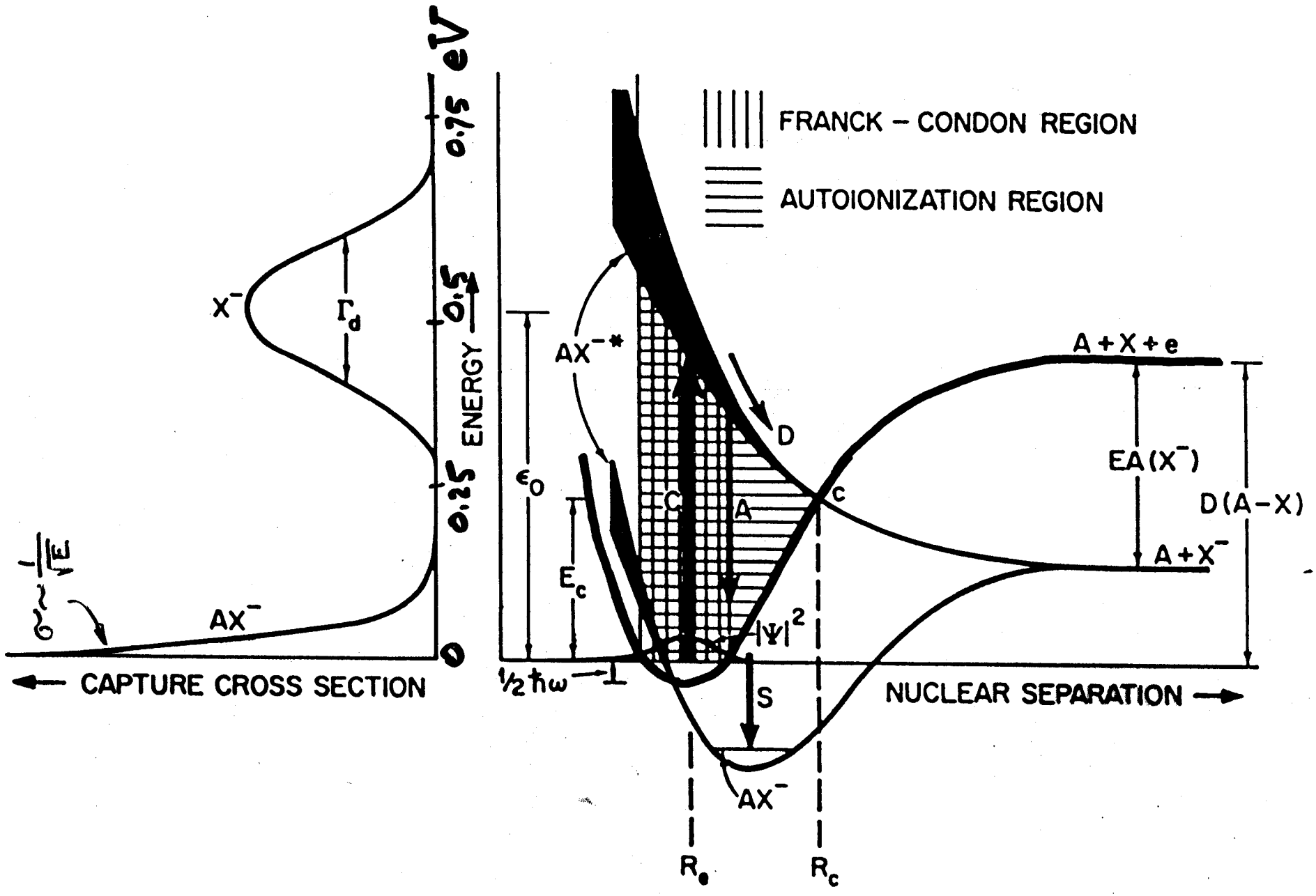
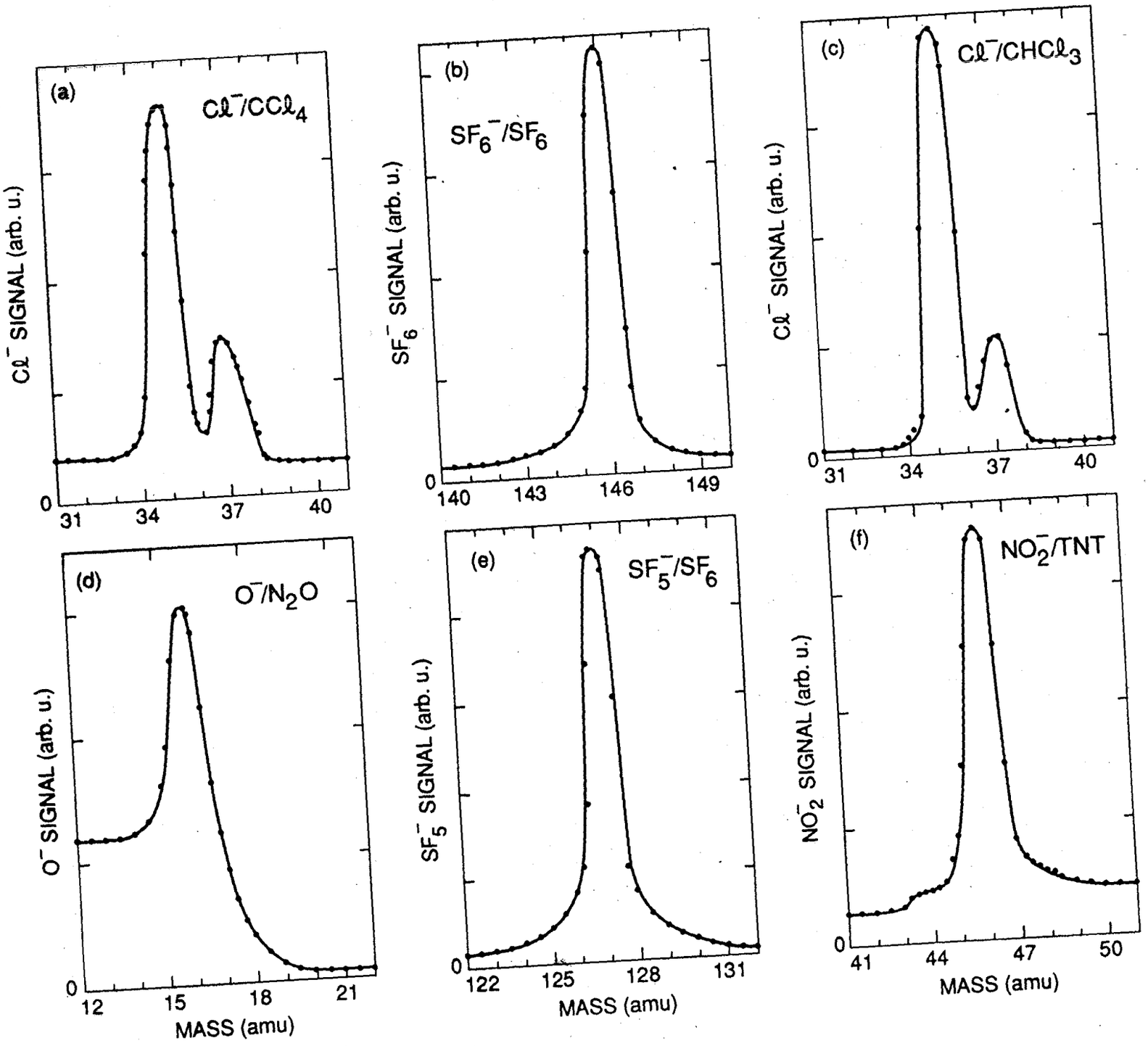
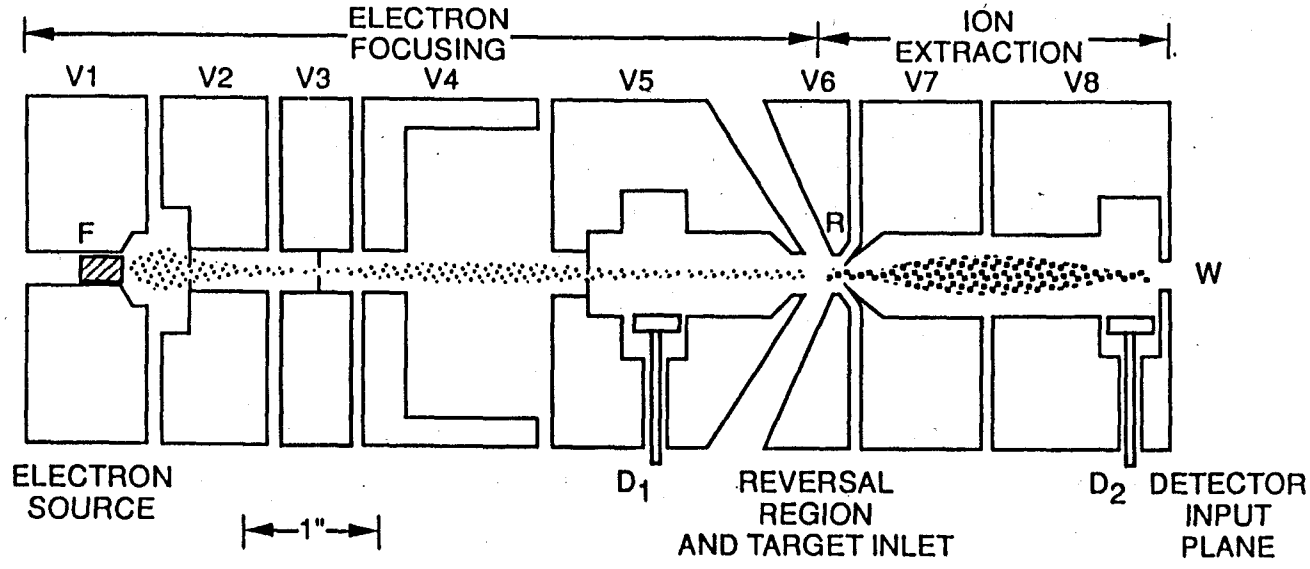
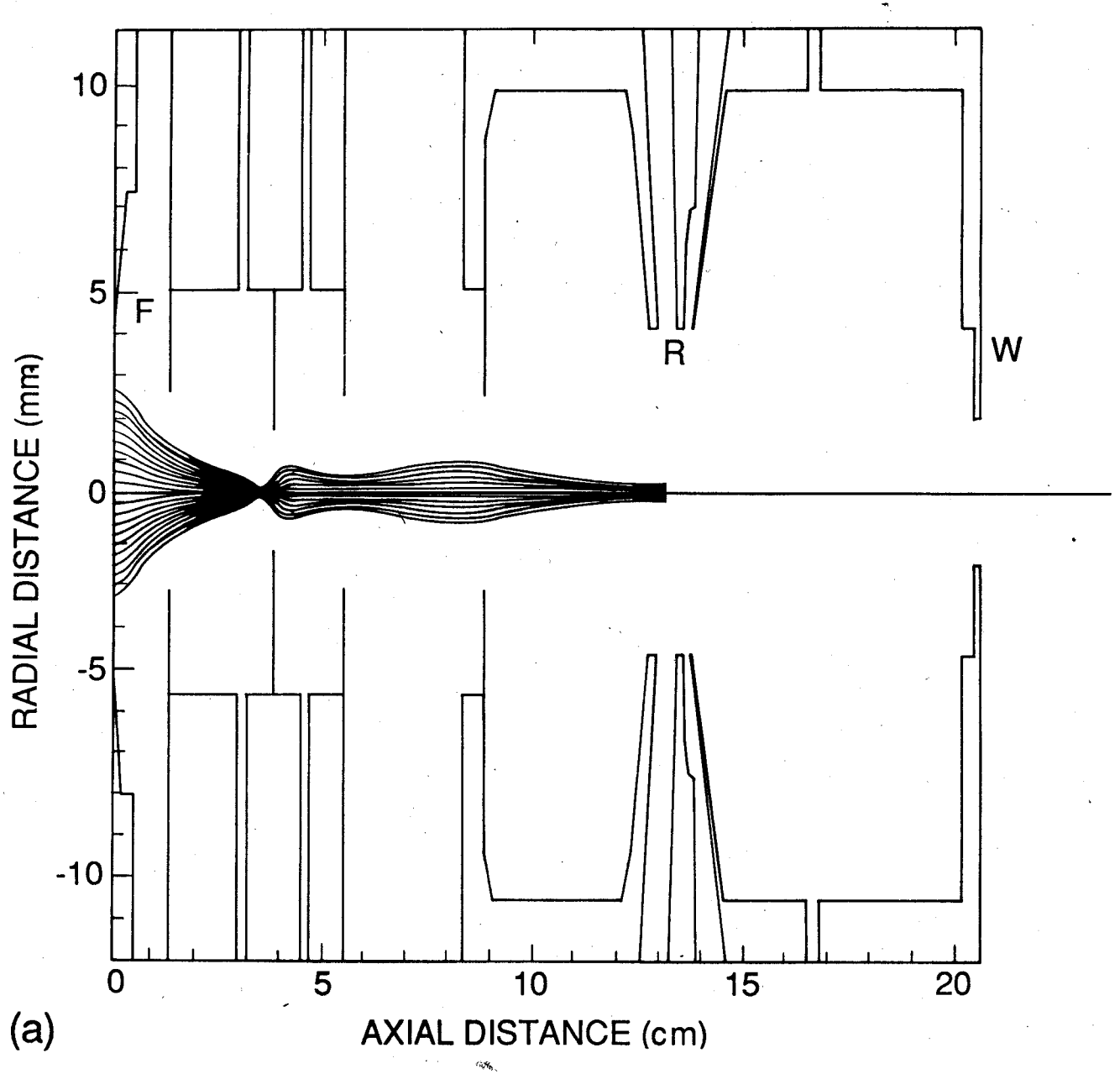
MOLECULAR POTENTIAL-ENERGY CURVES FOR ELECTRON ATTACHMENT

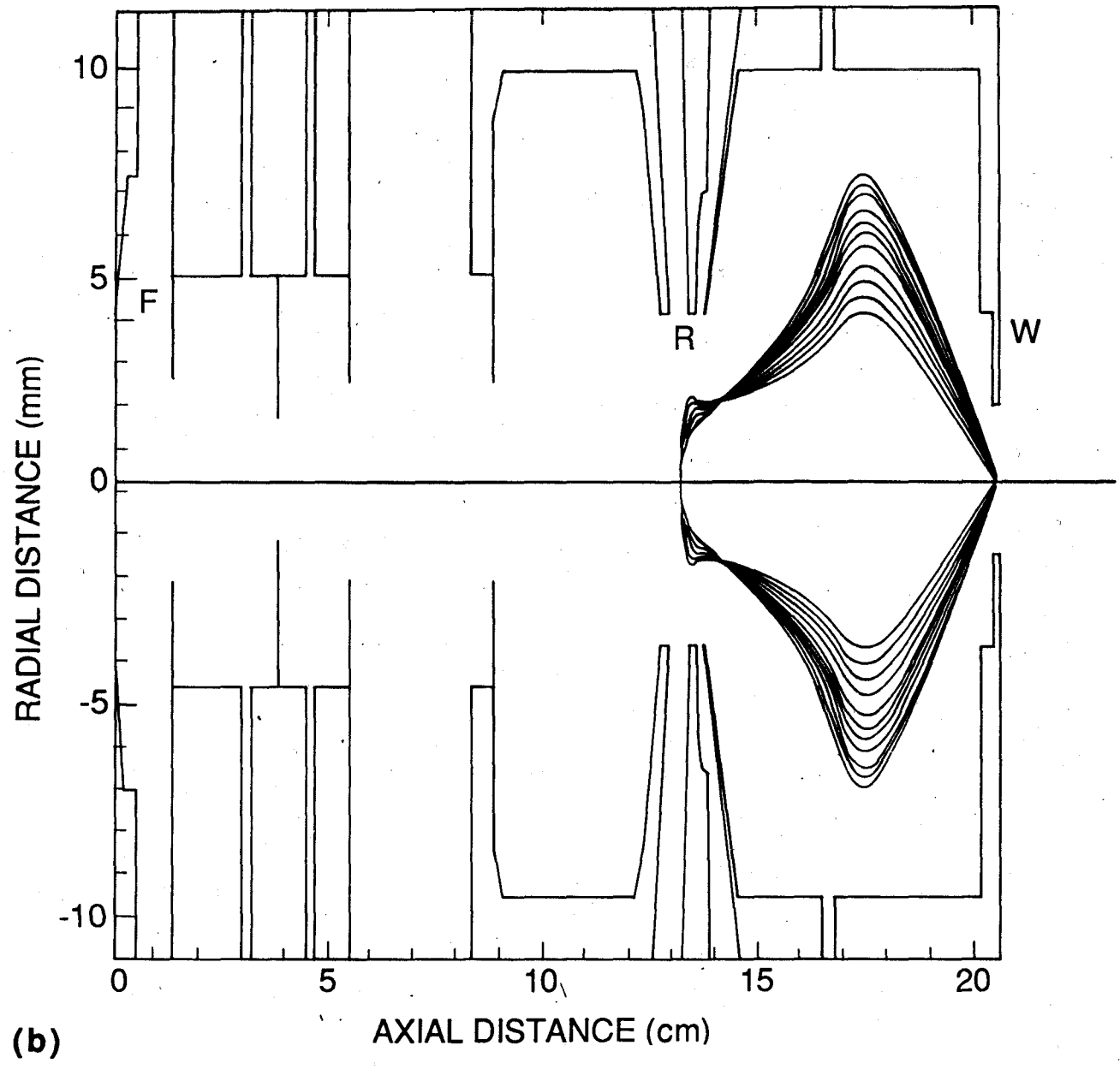



(a)
Cl^-/CCl_4
Cl^- SIGNAL (arb. u.)
0
31
34
37
40
(b)
SF_6^-/SF_6
SF_6^- SIGNAL (arb. u.)
0
140
143
146
149
(c)
$Cl^-/CHCl_3$
Cl^- SIGNAL (arb. u.)
0
31
34
37
40
(d)
O^-/N_2O
O^- SIGNAL (arb. u.)
0
12
15
18
21
MASS (amu)
(e)
SF_5^-/SF_6
SF_5^- SIGNAL (arb. u.)
0
122
125
128
131
MASS (amu)
(f)
NO_2^-/TNT
NO_2^- SIGNAL (arb. u.)
0
41
44
47
50
MASS (amu)

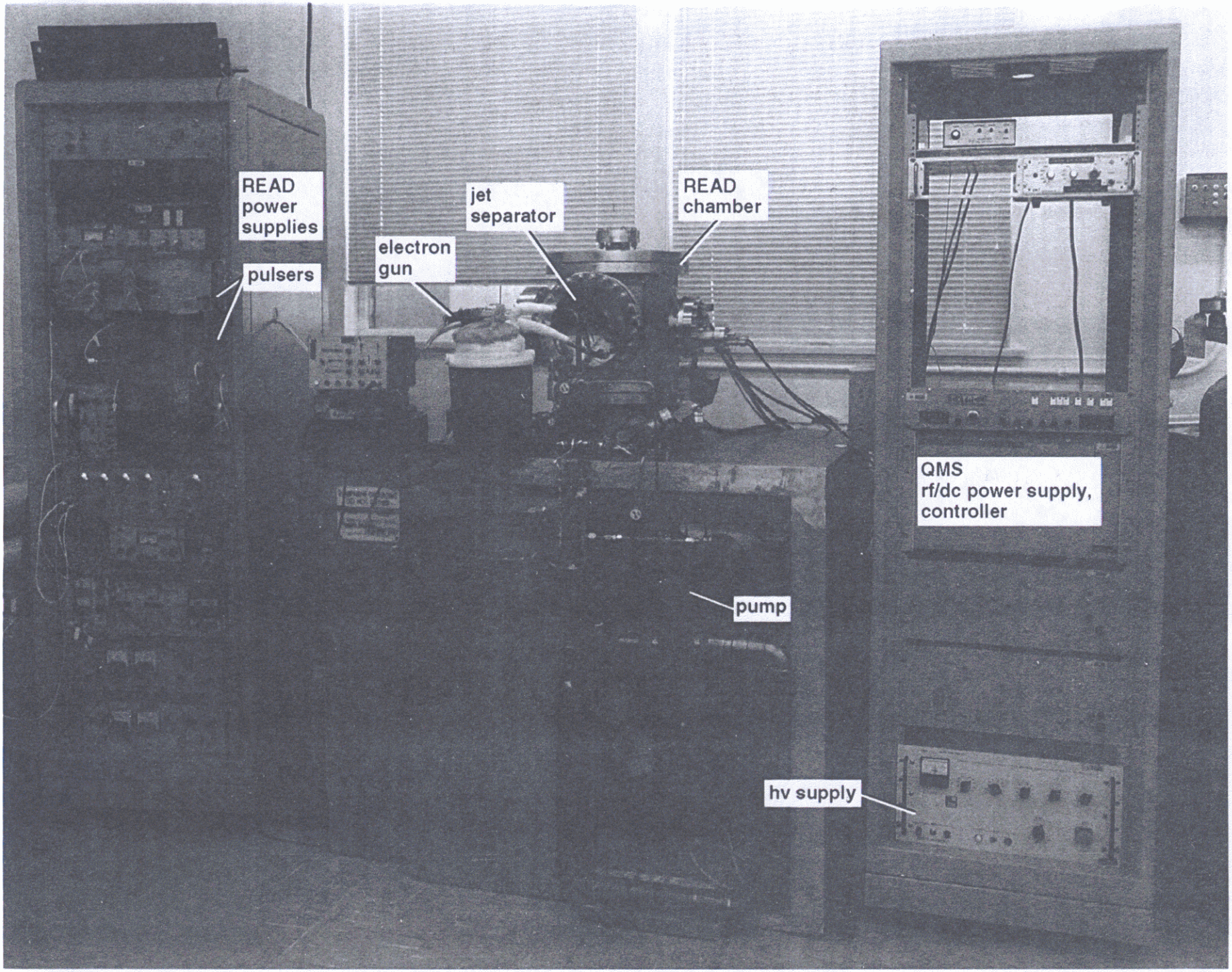


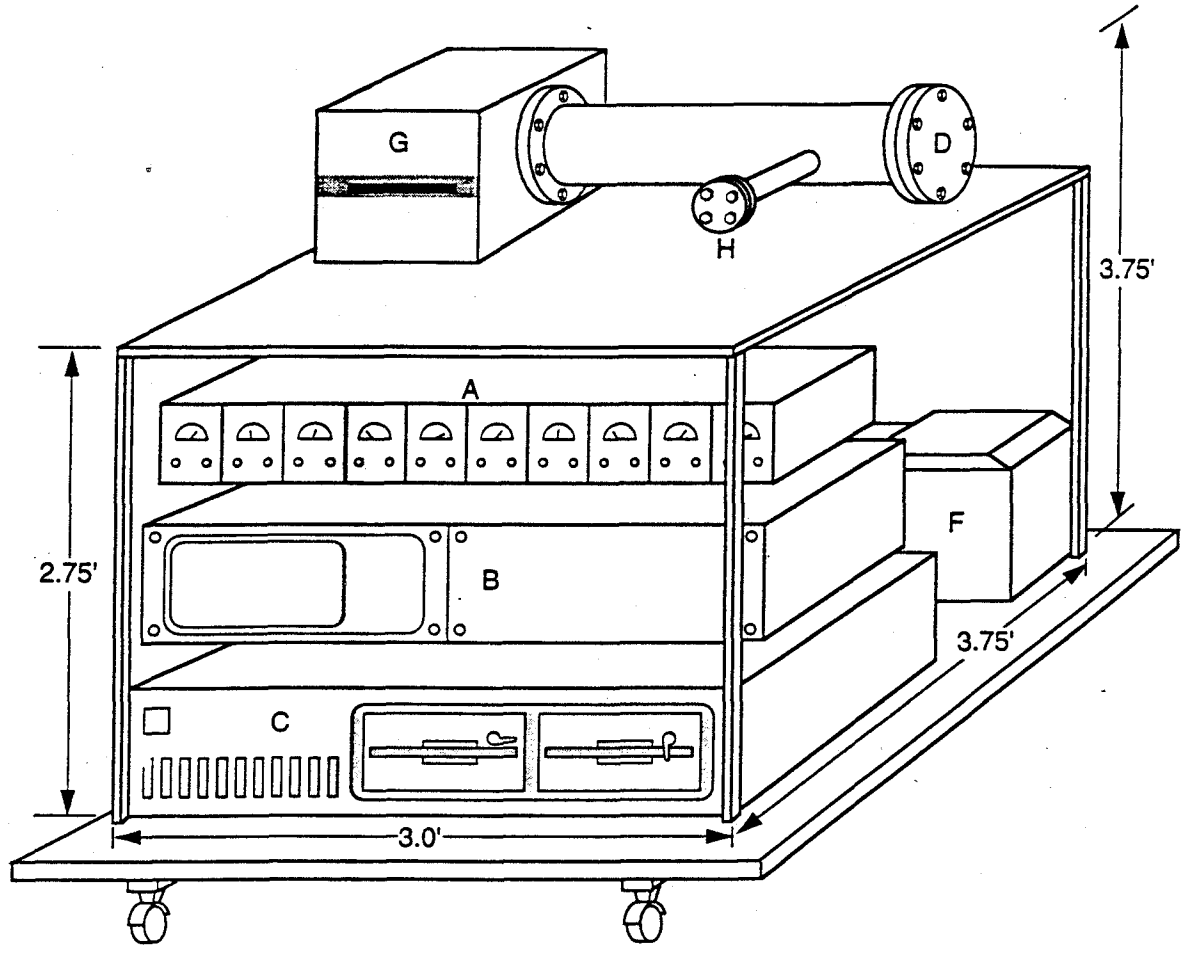
The Reversal Electron Attachment Detector (*READ*) used for generating low-energy electrons and extracting the product negative ions (Bernius and Chutjian, 1989; Boumsellek and Chutjian, 1992).


10
5
0
-5
-10
F
R
W
RADIAL DISTANCE (mm)
0
5
10
15
20
AXIAL DISTANCE (cm)
(a)

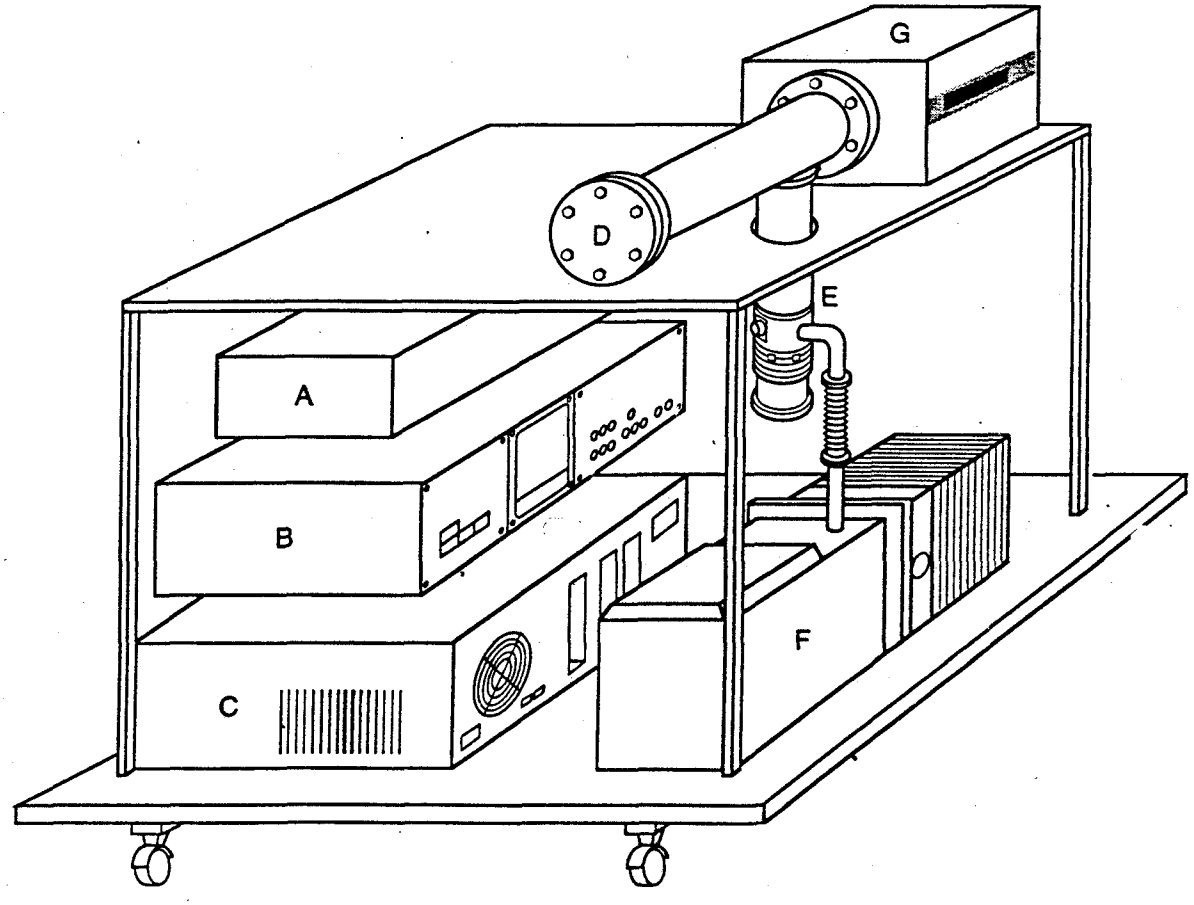


(b)


READ
power
supplies
pulsers
electron
gun
jet
separator
READ
chamber
QMS
rf/dc power supply,
controller
pump
hv supply



FRONT VIEW



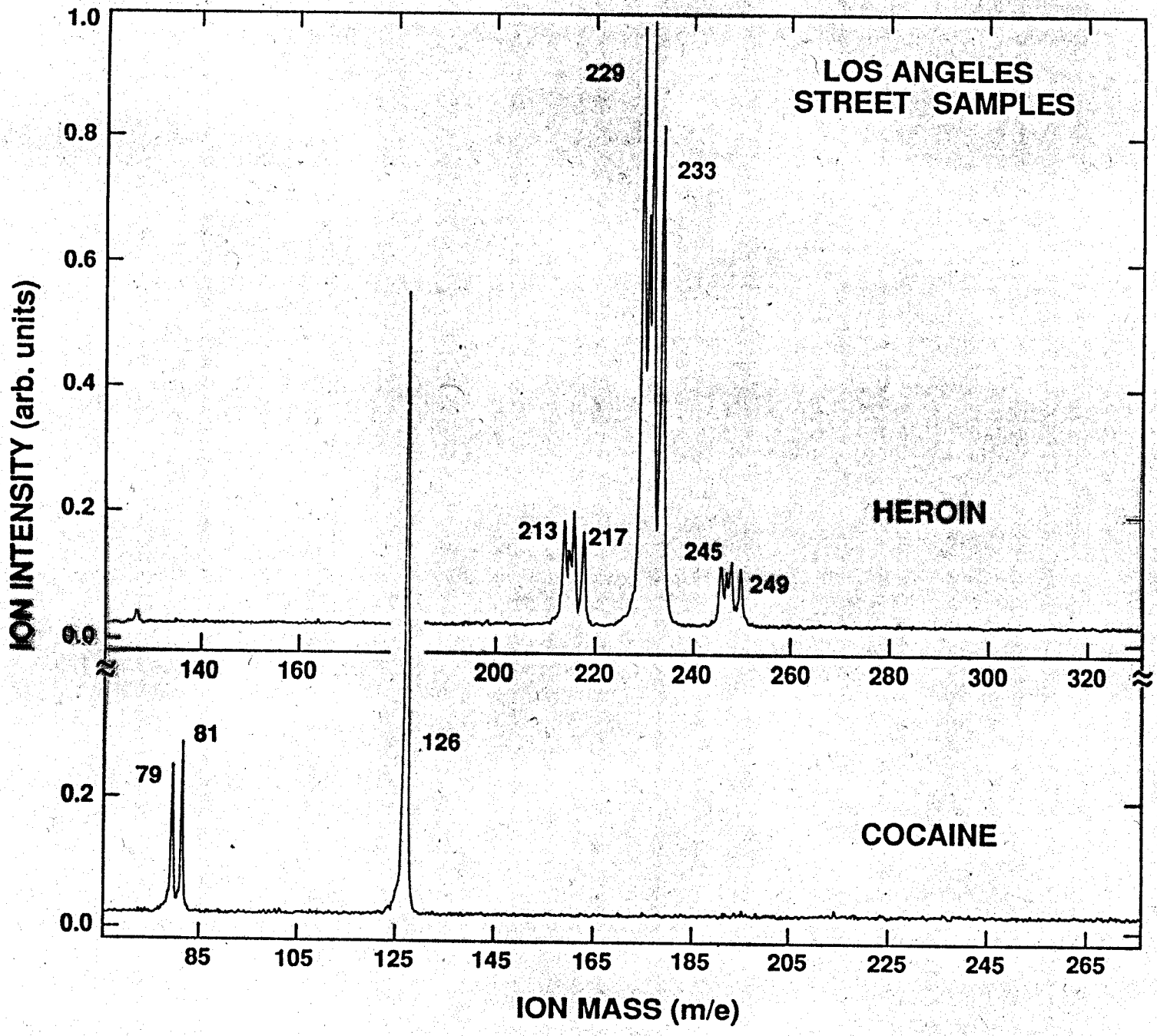
REAR VIEW

PRESENT *READ* SENSITIVITIES

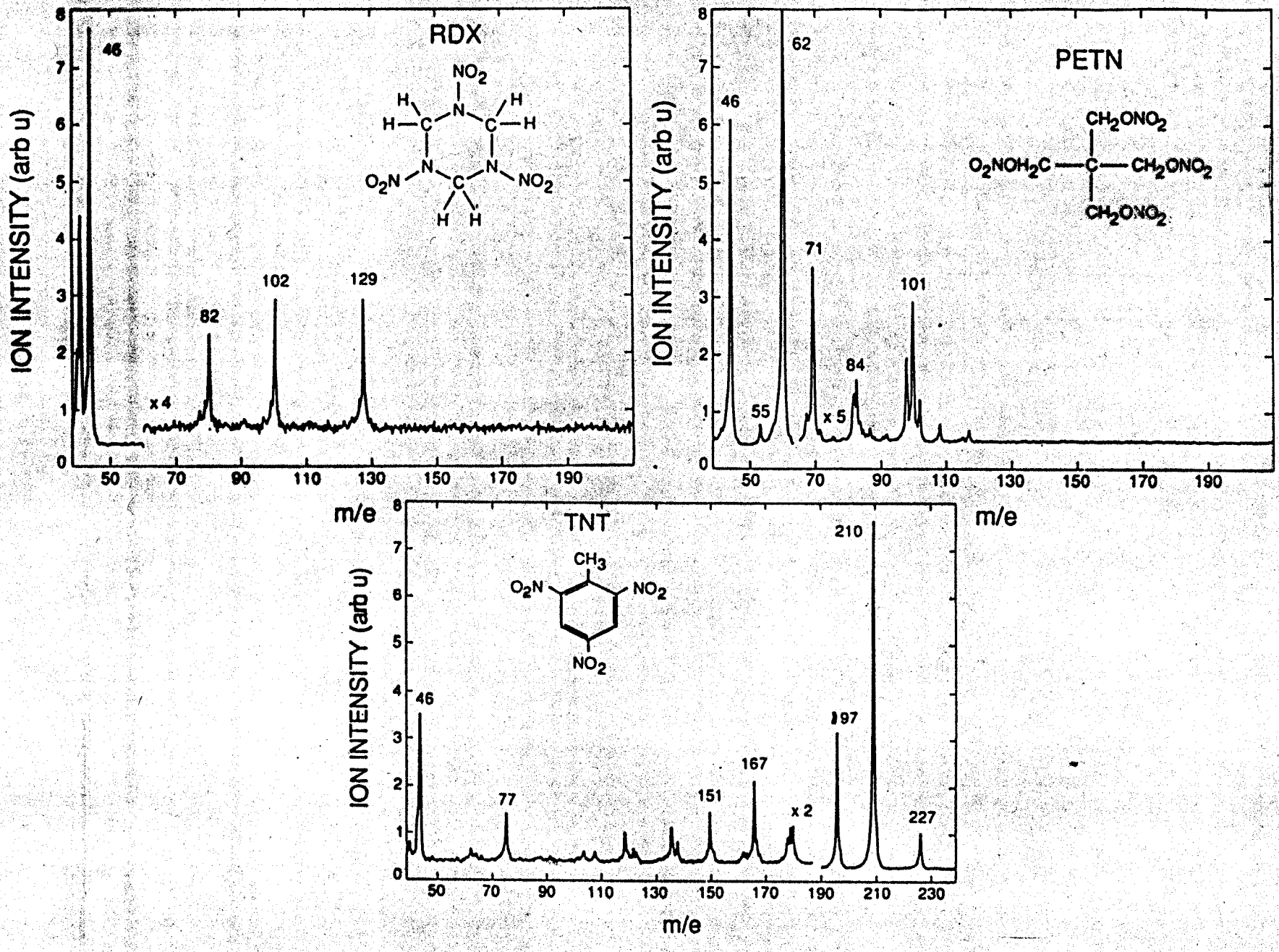
molecule	molecular weight (g/mole)	headspace vapor density (g/cm^3)	mole fraction at 760 torr (VP/760)	moles n_A/10 sec	grams M_A/10 sec	signal rate (counts/sec)
DNT	182	1.4×10^{-9}	184 ppb	1×10^{-12}	182 picogram	65,000 [b]
2,4,6-TNT	227	1.2×10^{-10}	13 ppb	8×10^{-14}	1.8 picogram[a]	9,000
PETN	316	1.2×10^{-13}	26 pptr	2×10^{-16}	63 femtogram	300
RDX	222	7.6×10^{-14}	8.4 pptr	6×10^{-17}	13 femtogram	100

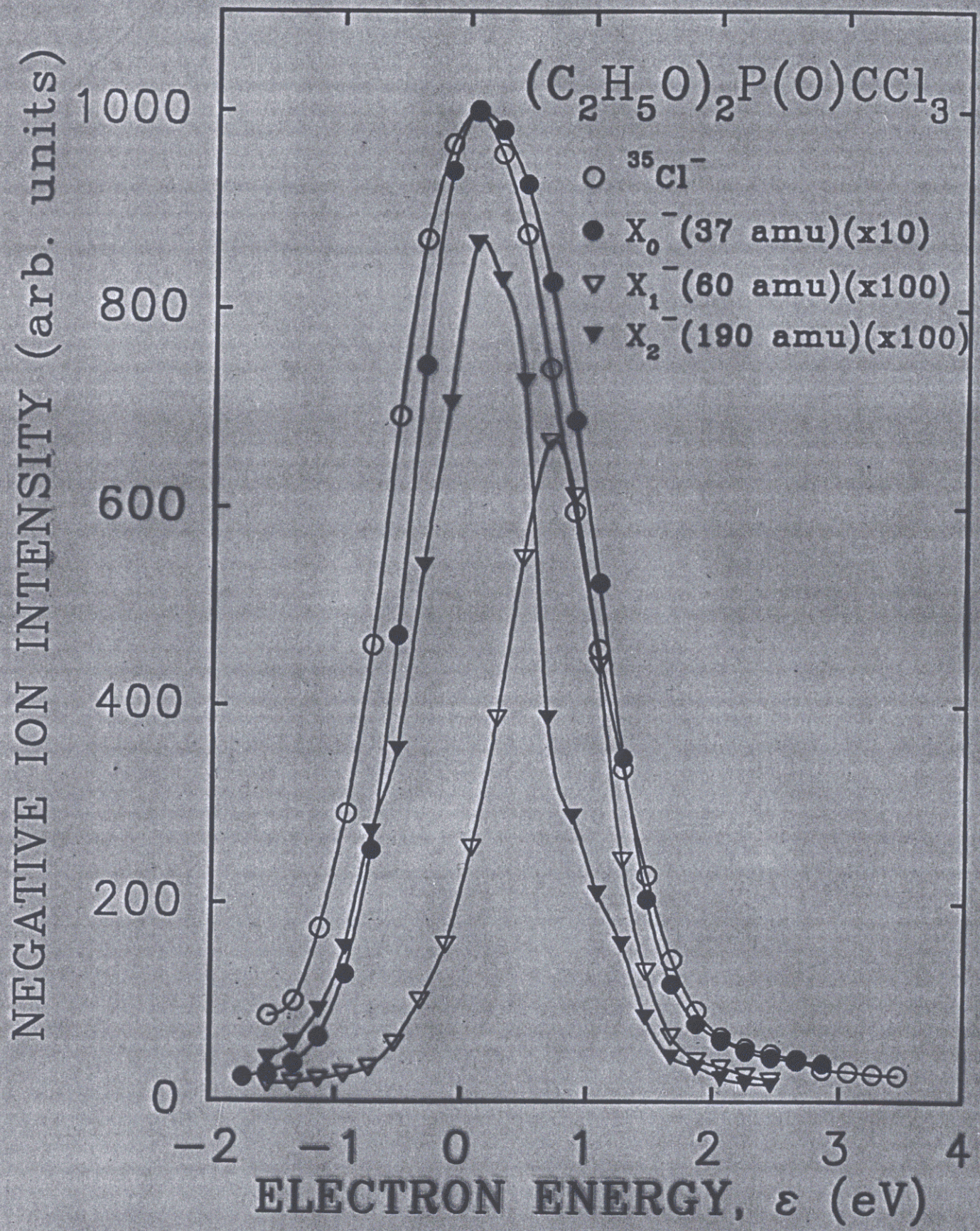
[a] to be compared to 300 picogram for the Barringer *Ionscan*, at an unspecified SNR [see F. Garofolo, *et al.*, *Rapid Commun. Mass Spectrom. 10,* 1321 (1996)]

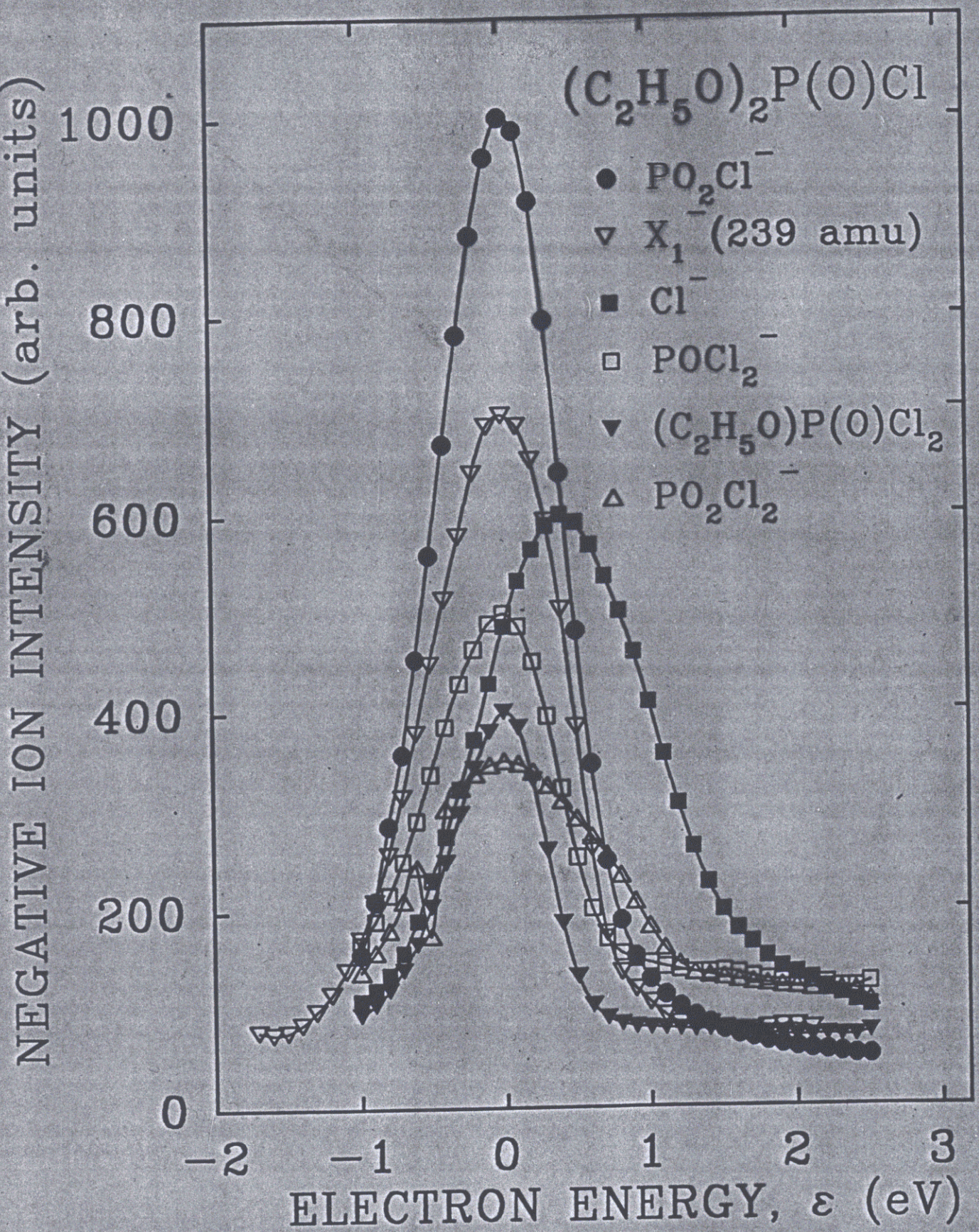
b 4×10^6 c/s effective count rate with new ionizer


LOS ANGELES
STREET SAMPLES
HEROIN
COCAINE
229
233
213
217
245
249
126
81
79
ION INTENSITY (arb. units)
ION MASS (m/e)
1.0
0.8
0.6
0.4
0.2
0.0
140
160
200
220
240
260
280
300
320
85
105
125
145
165
185
205
225
245
265

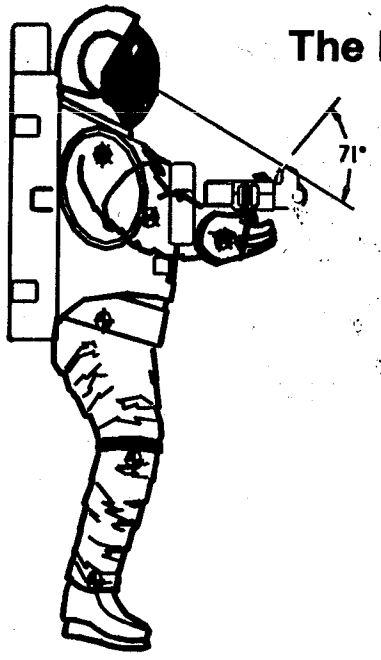
NEGATIVE-ION MASS SPECTRAL "SIGNATURES" OF THE EXPLOSIVES

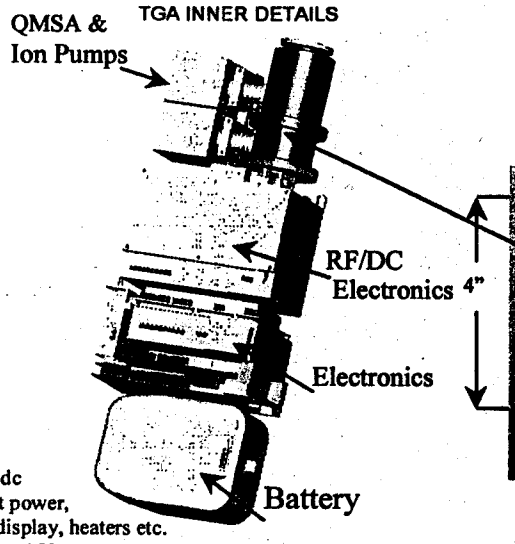


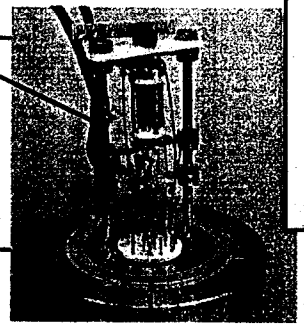

$(C_2H_5O)_2P(O)CCl_3$
$^{35}Cl^-$
X_0^-(37 amu)(x10)
X_1^-(60 amu)(x100)
X_2^-(190 amu)(x100)
NEGATIVE ION INTENSITY (arb. units)
0
200
400
600
800
1000
−2
−1
0
1
2
3
4
ELECTRON ENERGY, ε (eV)


$(C_2H_5O)_2P(O)Cl$
PO_2Cl^-
X_1^- (239 amu)
Cl^-
$POCl_2^-$
$(C_2H_5O)P(O)Cl_2$
$PO_2Cl_2^-$
NEGATIVE ION INTENSITY (arb. units)
0
200
400
600
800
1000
−2
−1
0
1
2
3
ELECTRON ENERGY, ε (eV)

The Miniature Quadrupole Mass Spectrometer Array (QMSA) for the Trace Gas Analyzer (TGA)







The Miniature Quadrupole Mass Spectrometer Array (QMSA) has been developed at JPL to reduce sensor size while maintaining the same performance as the large commercial units. The system maintains a mass range, resolution, precision, and stability comparable to larger units, with a sensitivity corresponding to ~ 500 ppb.

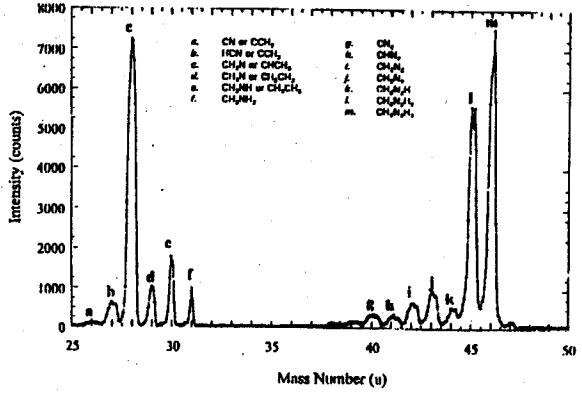
Currently slated for International Space Station (ISS) application for detection of leaks and contamination.

Other applications are: Planetary geology, isotopic analysis, surface-evolved gases(Europa), comets and asteroids; and ion composition in the Io torus and other planetary magnetospheres and ionospheres.

Battery Voltage	28 to 45 Vdc
Power Consumption	Total input power, including display, heaters etc. NTE 60W at 150 amu.
TGA envelope dimens.	6.5" X 7.1" X 17.5"
Weight	TGA without battery NTE 12lb

Spectrometer Type	Quadrupole Mass Spectrometer Array. Consisting of 9 parallel analyzers
Mass Range	1-600 amu (a 1-150 amu @ rf=10Mhz version is being deliverer to ISS)
Mass resolution	0.5 amu (FWHM)
Sensitivity	$2x10^{12}$ counts/torr-sec (neutrals). ~ 10^{14} counts/torr-sec (ions)
Dynamic range	10^7
Mass crosstalk	better than $1:10^4$
Detector type	Channel multiplier OR Microchnnel plate
Power Consumption	15W at 150amu (including electronics and pumps)
Weight	1400 gr. (including electronics and pumps)
Front ends	Straight-thru OR gas chromatographic input
Envelope dimensions	4" (height) x 6" (width) x 12" (length)

MMH QMSA SPECTRUM



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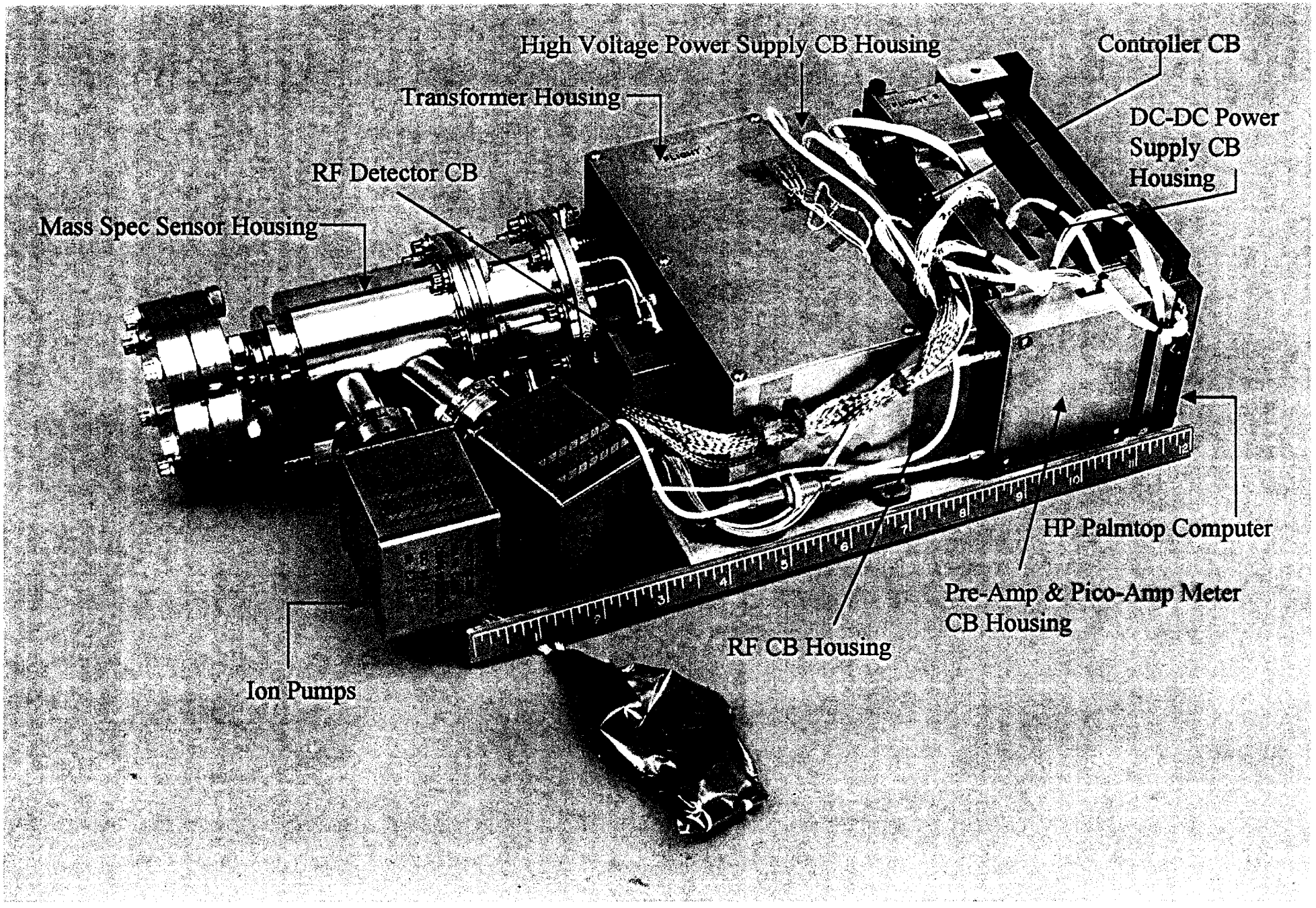
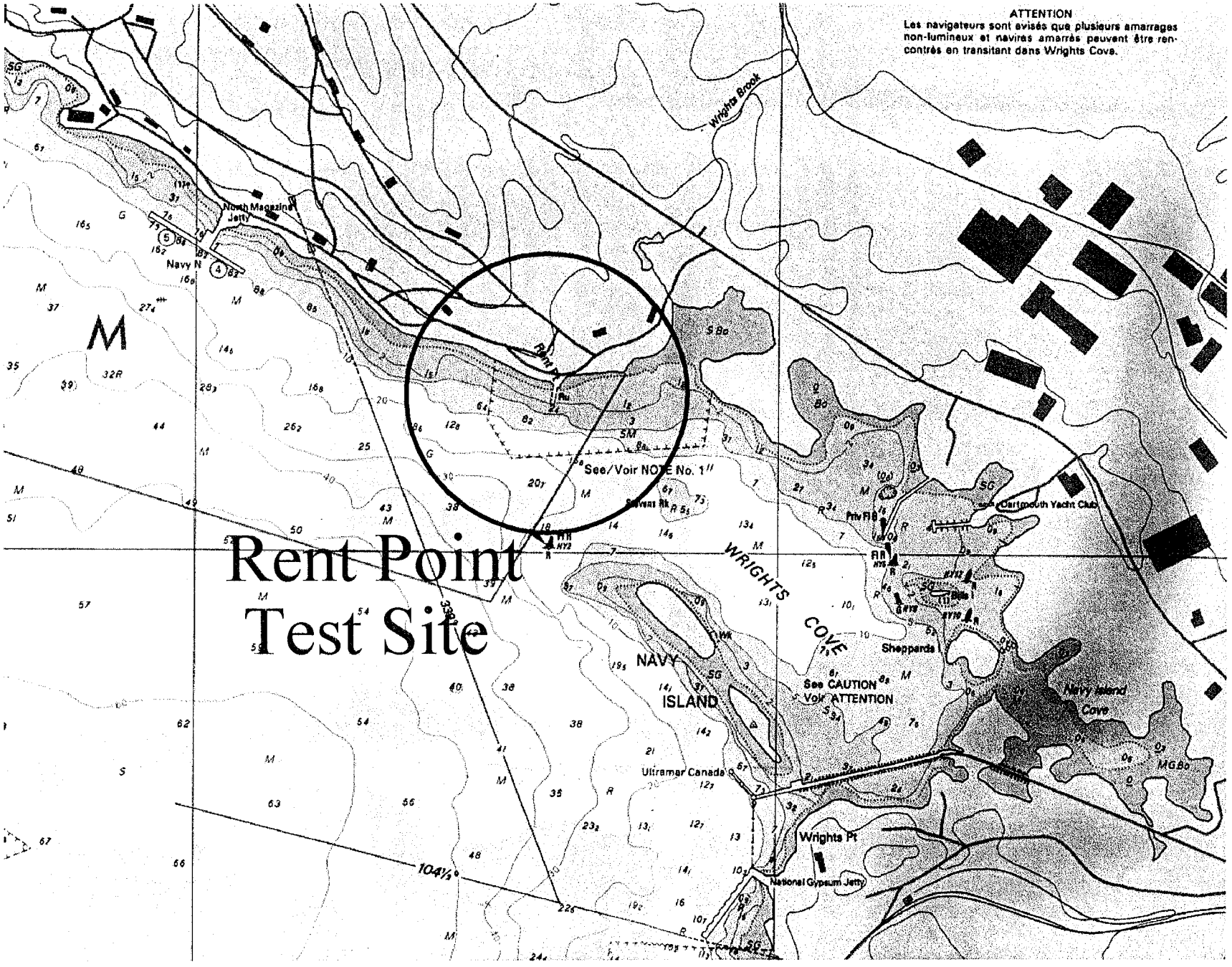
File: QUAD_chart..PPT


High Voltage Power Supply CB Housing
Controller CB
Transformer Housing
DC-DC Power Supply CB Housing
RF Detector CB
Mass Spec Sensor Housing
HP Palmtop Computer
Pre-Amp & Pico-Amp Meter CB Housing
RF CB Housing
Ion Pumps

63° 38'

63° 37'

44° 42'