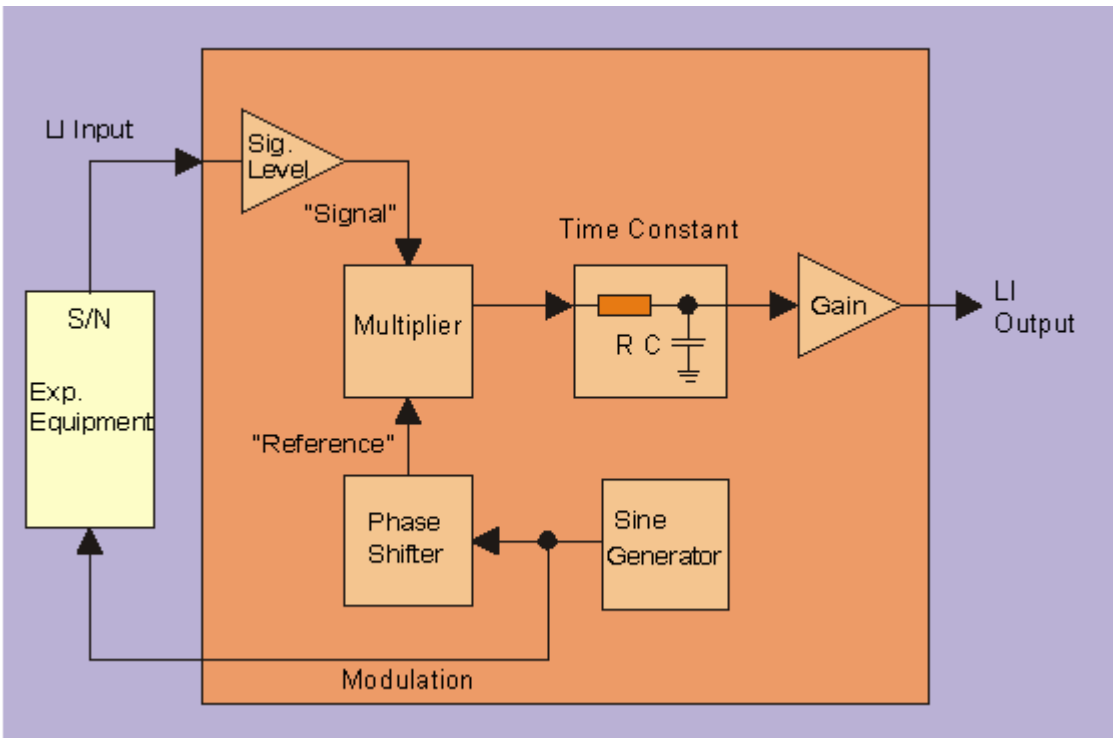
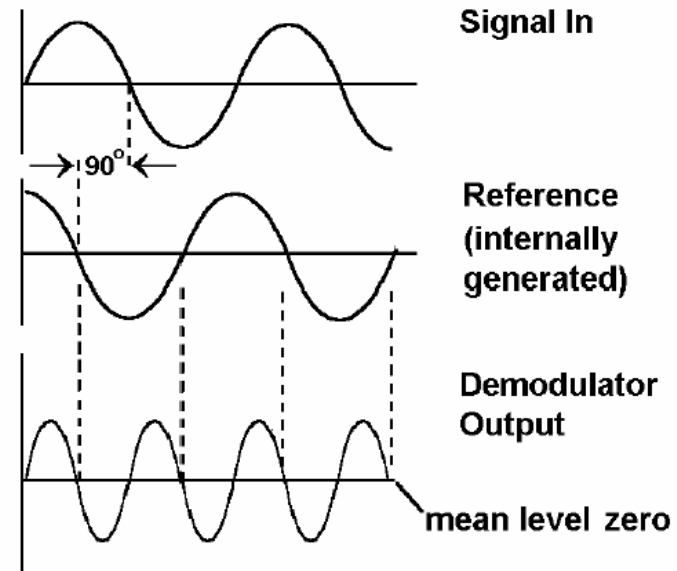
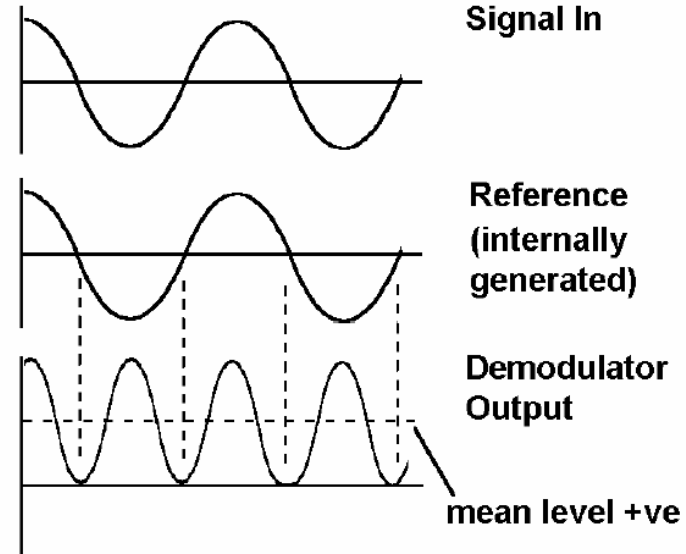
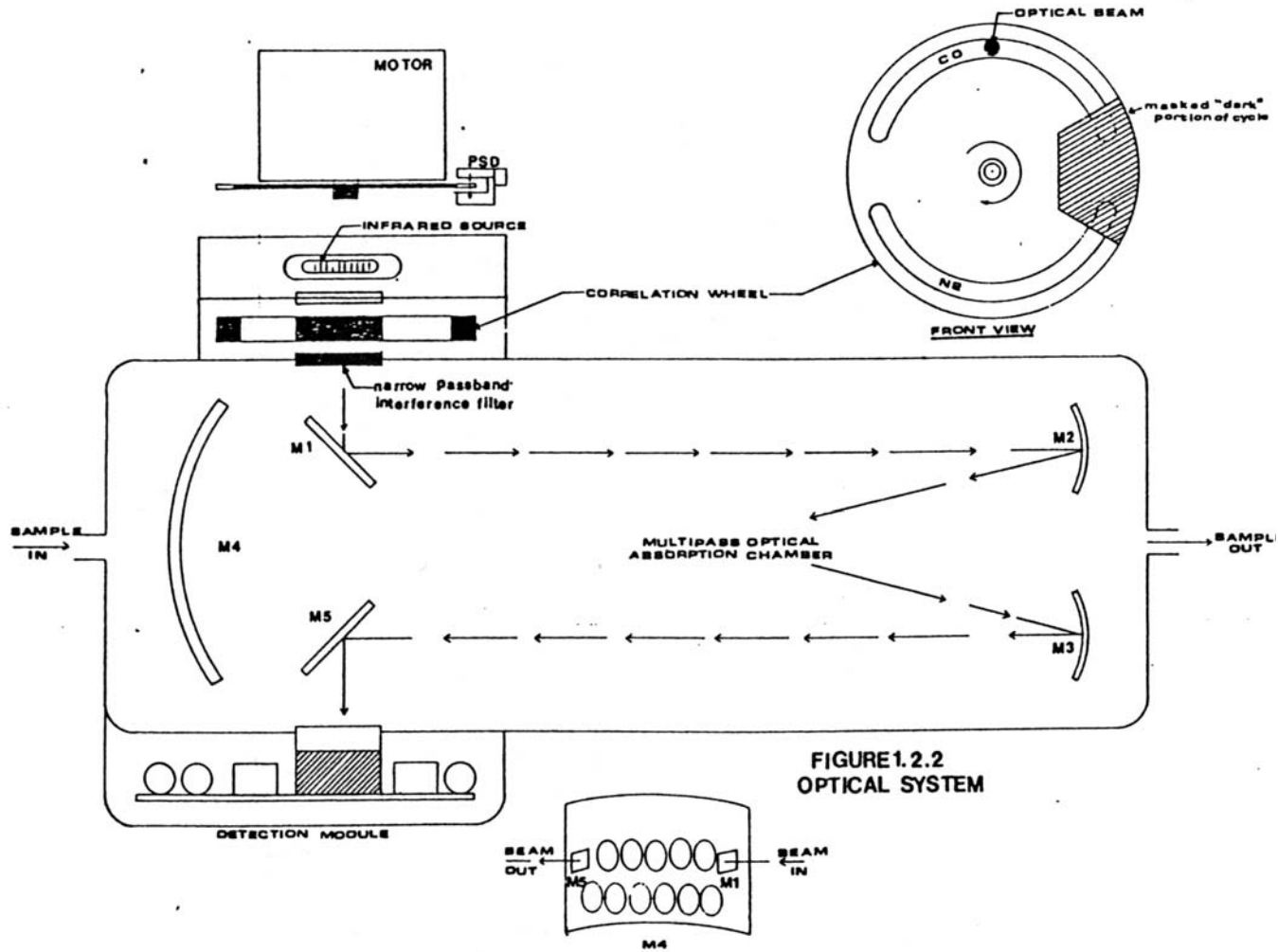


Lock-In-Verstärker

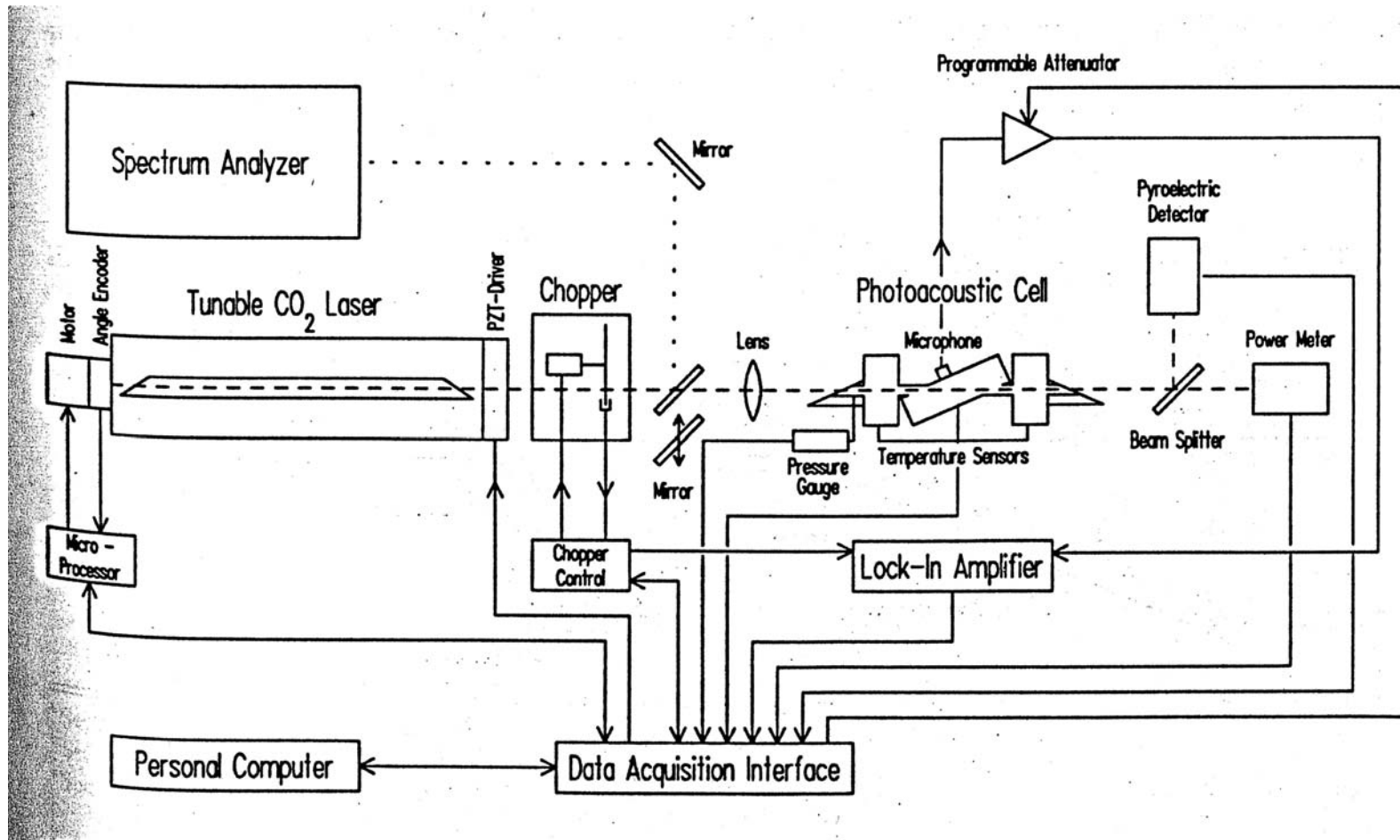
$$U_{out} = U(\Delta) = \frac{ab}{2} \cos(\Delta)$$



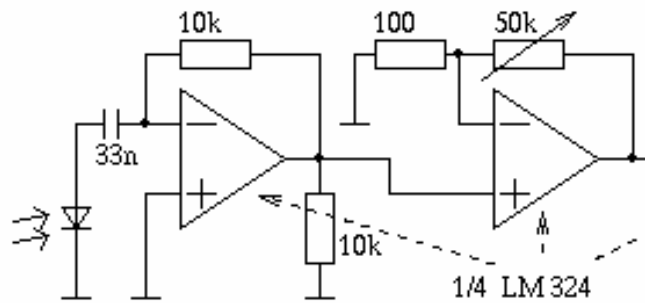
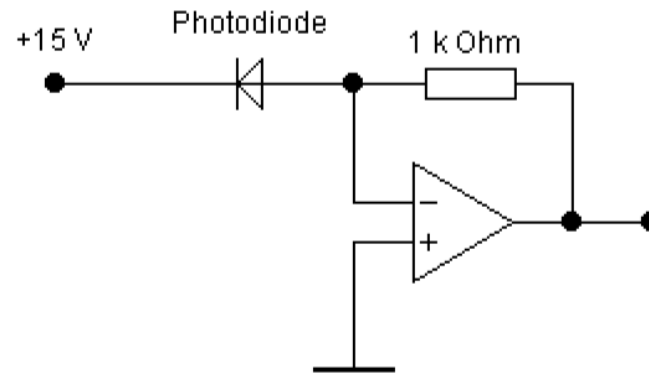
CO-Gerät



PAS: Photoacoustic Spectroscopy



Transimpedanzverstärker



Matrix Isolation (FTIR und ESR)

- Jedes Molekül befindet sich in einer chemisch stabilen Umgebung
- Reaktive Spezies können in der gleichen Matrix gemessen werden, ohne sich zu beeinflussen
- Wird die Luft in einer Matrix oberhalb von 77K gesammelt, führt dies zu einer grossen Aufkonzentration, weil weder O_2 noch N_2 noch Ar gesammelt wird
- Rotationsbanden fehlen im Spektrum, was die Interpretation der Spektren erleichtert

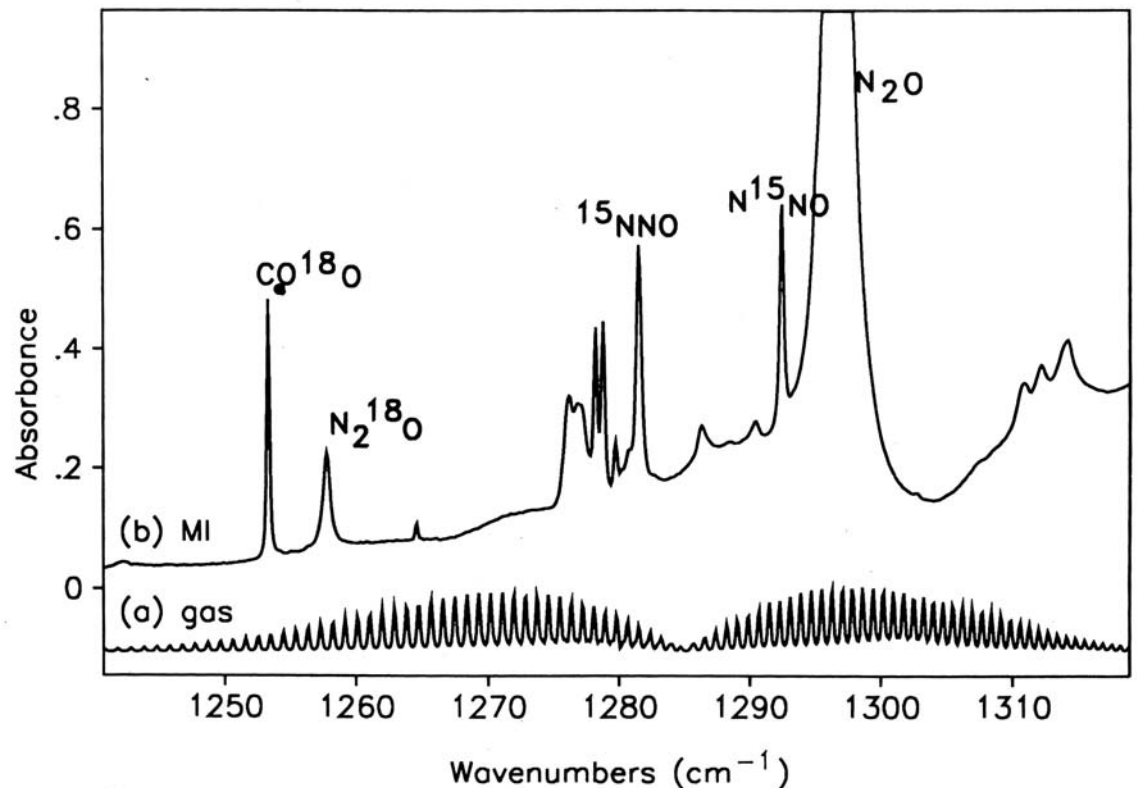


Figure 7.1. (a) Gas phase spectrum of N_2O near the ν_1 band at 1284 cm^{-1} . (b) Matrix isolation spectrum of 1:1000 N_2O in CO_2 in the same region. See text for discussion.

Massenspektroskopie MS

TABLE 11.4 Some Species Measured by Mass Spectrometry in the Atmosphere up to about 1990^a

Species	Altitude (km)	Detect by + / - Ion	Concentration range
C ₅ H ₅ N, pyridine	0-4	+	1-10 pptv
CH ₃ COCH ₃ , acetone	6-14	+	1-100 pptv
CH ₃ CN, acetonitrile	10-45	+	0.1-10 pptv
NH ₃ , ammonia	0-10	+	0.1-10 ³ pptv
HOCl, hypochlorous acid	35-39	-	0.1-1 ppbv
SO ₂ , sulfur dioxide	0-11	-	1 ppbv
HNO ₃ , nitric acid	4-50	-	1-10 ⁴ pptv
H ₂ SO ₄ , sulfuric acid	0-45	-	0.01-10 pptv
H ₂ O	38-40	+	1-10 ppmv
NO, nitric oxide	10	-	1 ppmv
NO ₂ , nitrogen dioxide	10	-	0.1 ppmv
HONO, nitrous acid	10	-	1 ppbv
CH ₃ SO ₃ H, methanesulfonic acid	0	-	<< 1 pptv
C ₆ H ₇ N, picoline	0	+	1 pptv
C ₇ H ₉ N, lutidine	0	+	1 pptv
C ₃ H ₄ O ₄ , malonic acid	0	-	0.1-10 pptv
CH ₃ SCH ₃ , dimethyl sulfide	0	+	1-100 pptv
C ₁₅ H ₂₄ , β-caryophyllene	0	+	1-10 pptv
CH ₃ SOCH ₃ , dimethyl sulfoxide	0	+	1 pptv

^a Adapted from Viggiano (1993); see references therein for original literature.

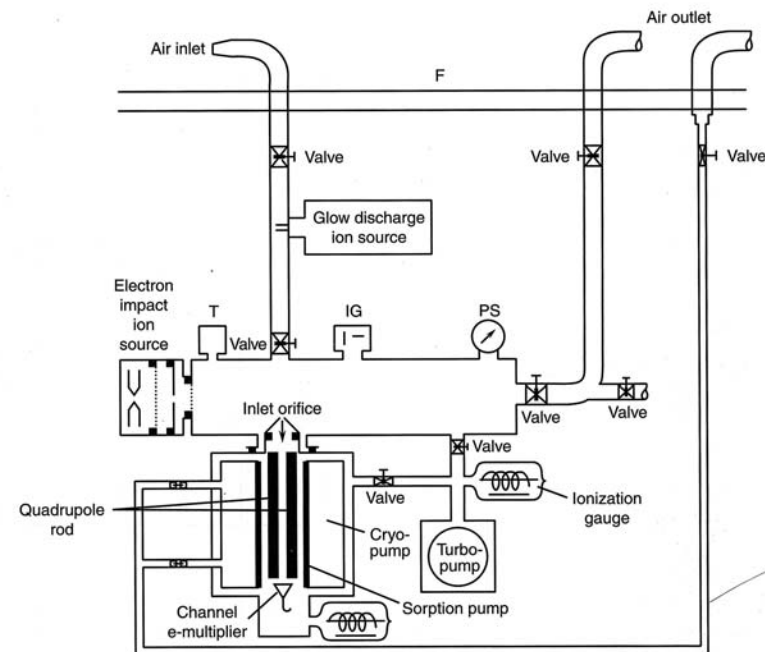
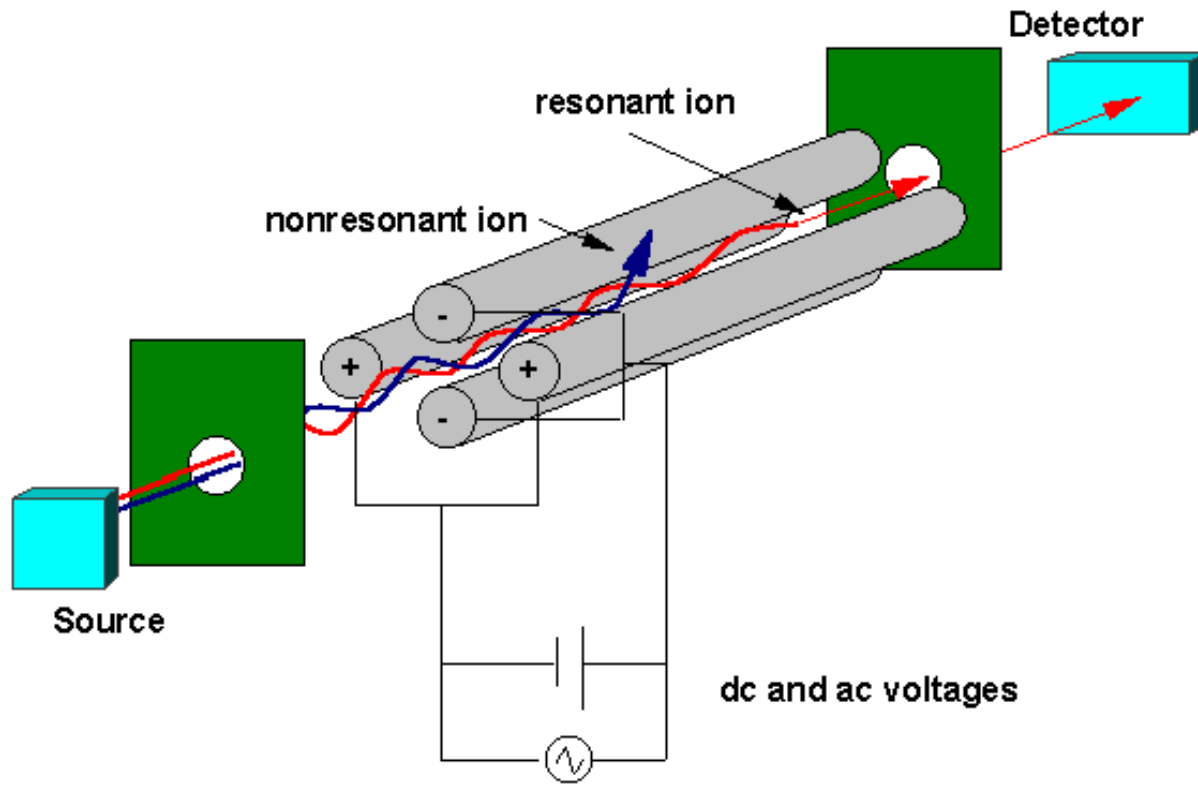


FIGURE 11.17 Schematic of mass spectrometer used for stratospheric measurements (IG = ion getter pump, PS = pressure sensor) (adapted from Arnold and Hauck, 1985).



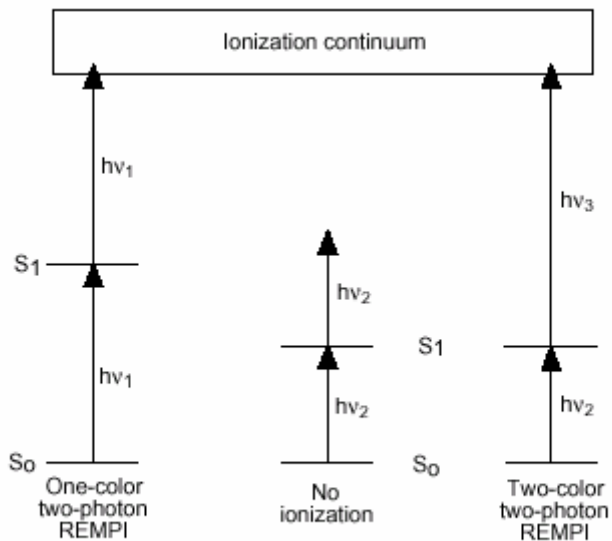


Figure 2. Resonance enhanced multiphoton ionization (REMPI) schemes.

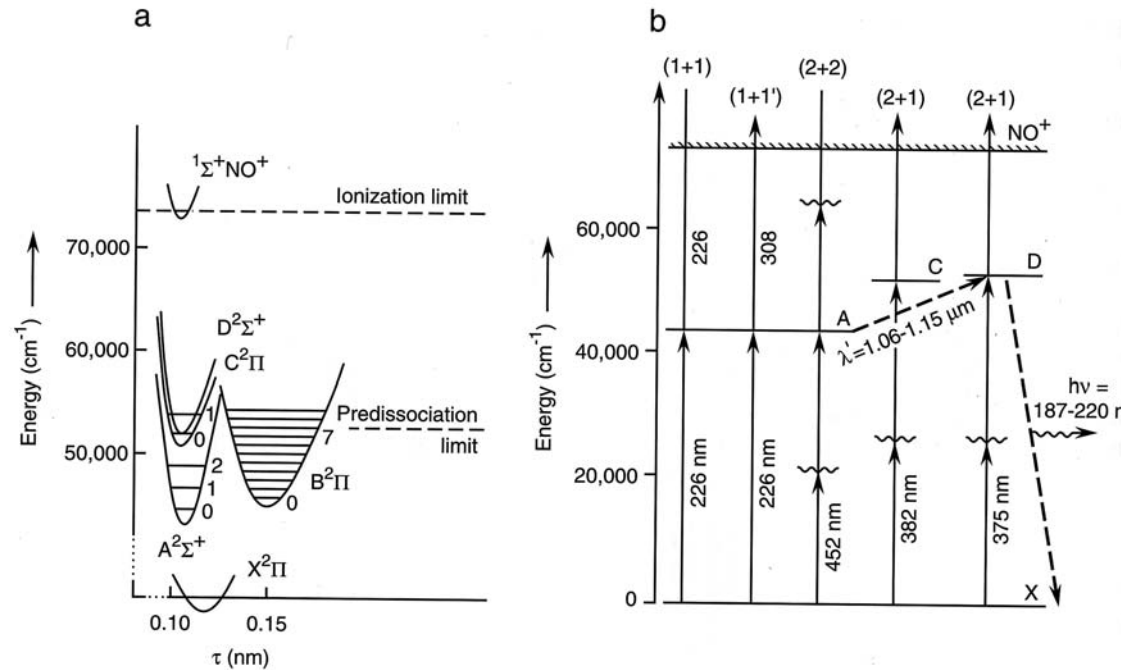


FIGURE 11.18 (a) Potential energy diagram and (b) REMPI schemes for the excitation and ionization of NO (adapted from Pfab, 1995). The \sim indicates a virtual state. The dashed arrows show other transitions used to detect NO in the atmosphere by laser-induced fluorescence (see Section A.4.a(1)).

Massenspektroskopie MS

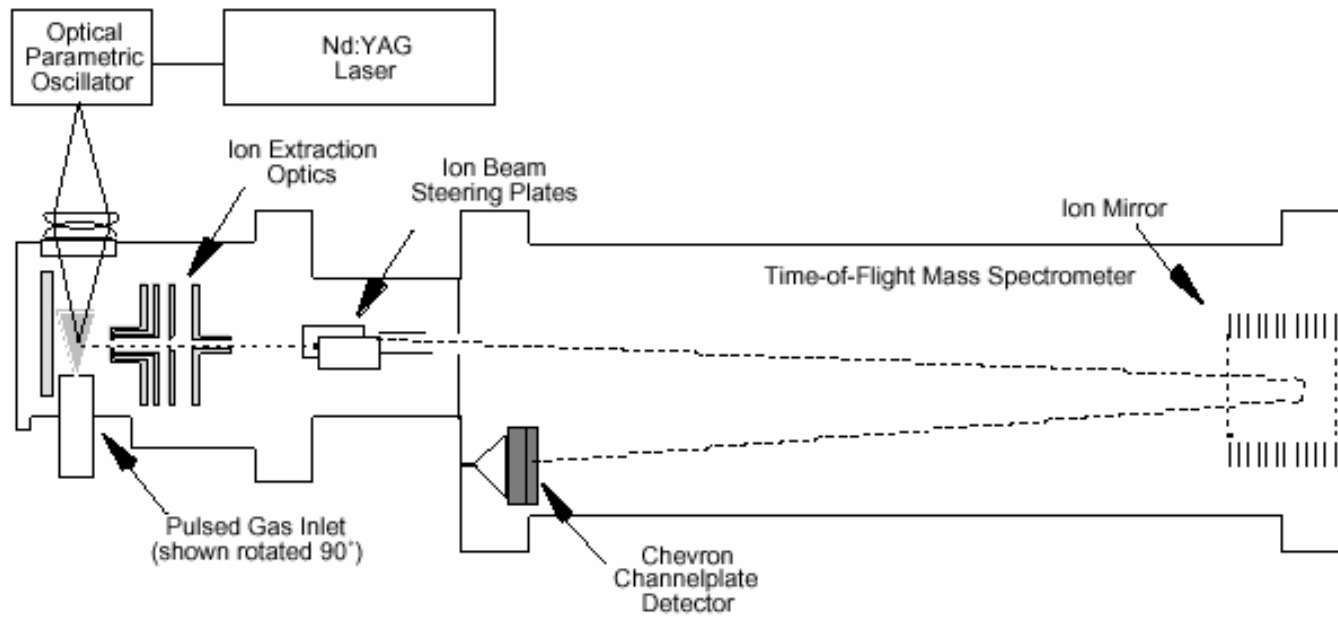


Figure 1. Schematic of the laboratory prototype jet-REMPI apparatus.

Massenspektroskopie MS

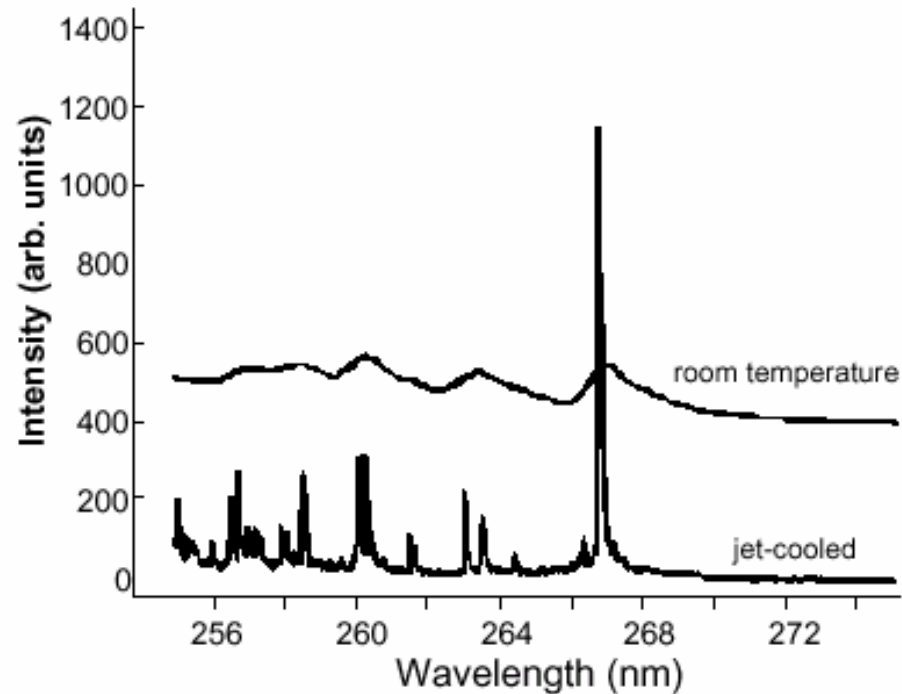
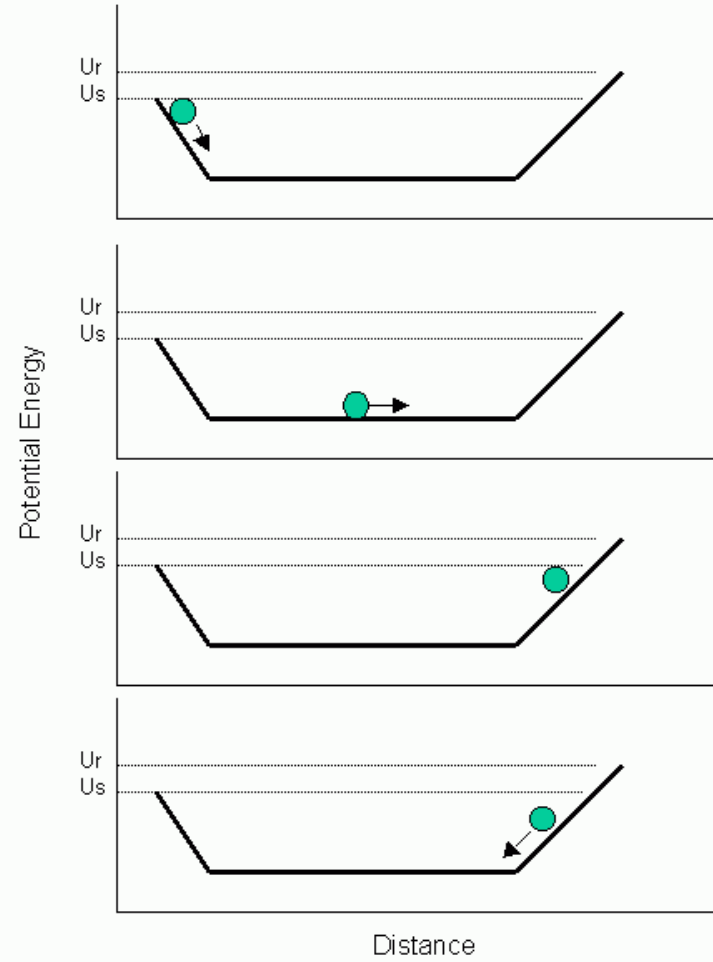
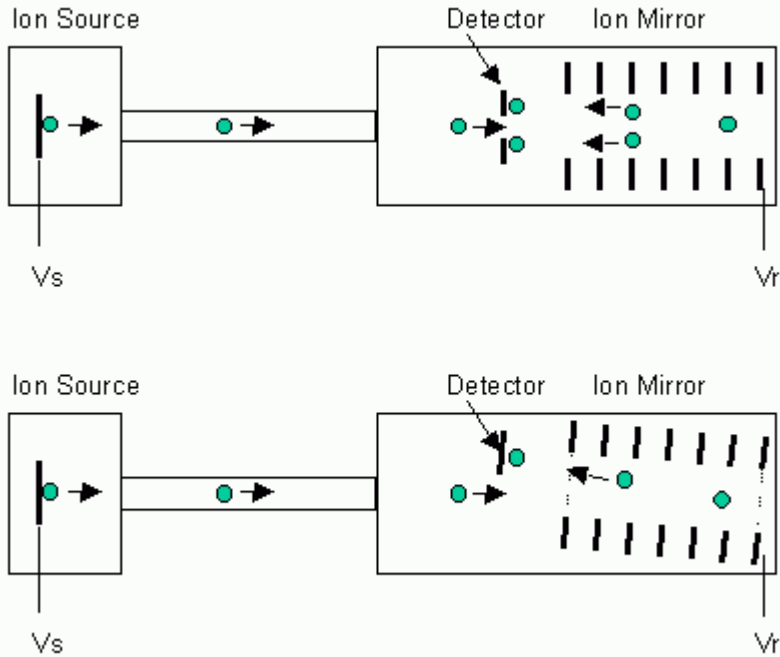


Figure 3. REMPI wavelength dependence for toluene measured in a jet-cooled adiabatic expansion as compared with room temperature absorption. The room temperature data has been multiplied by 20 and shifted vertically.

Massenspektroskopie MS

Ionen Spiegel



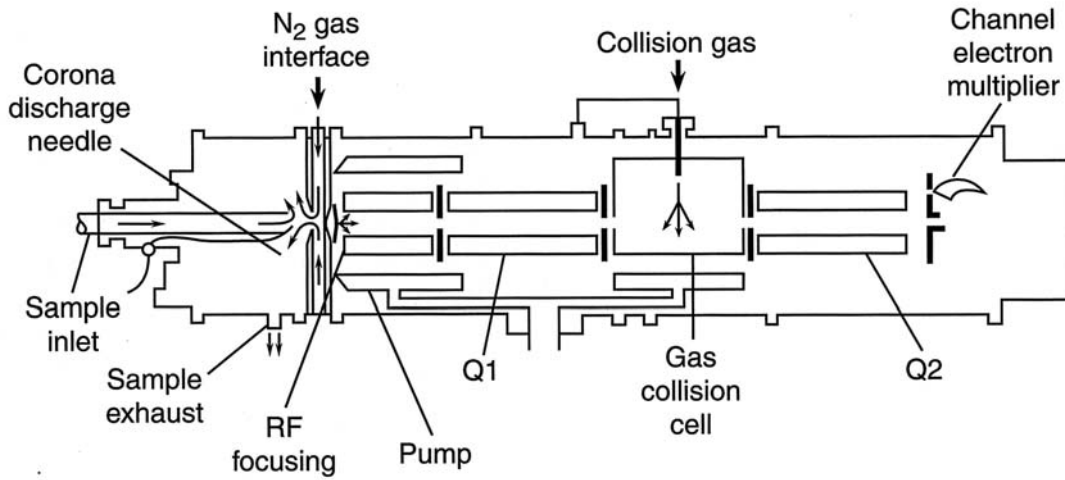


FIGURE 11.20 Schematic diagram of tandem mass spectrometer (adapted Spicer *et al.*, 1994a).

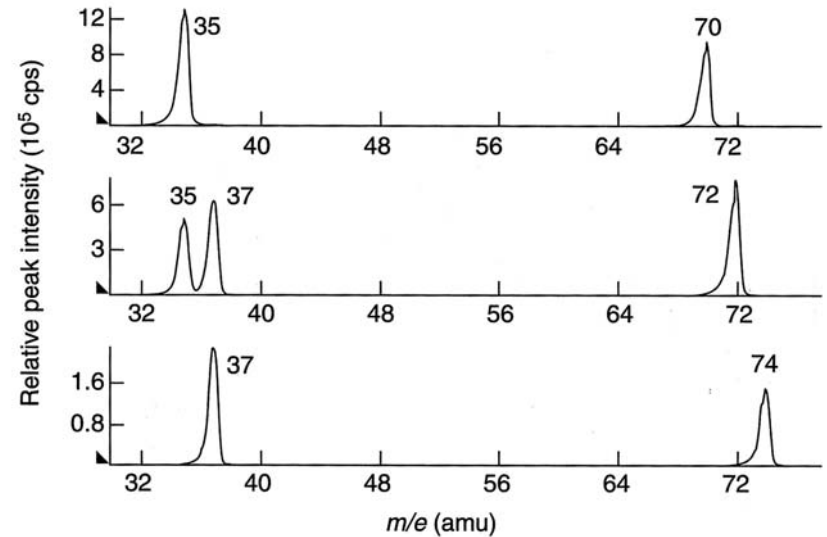
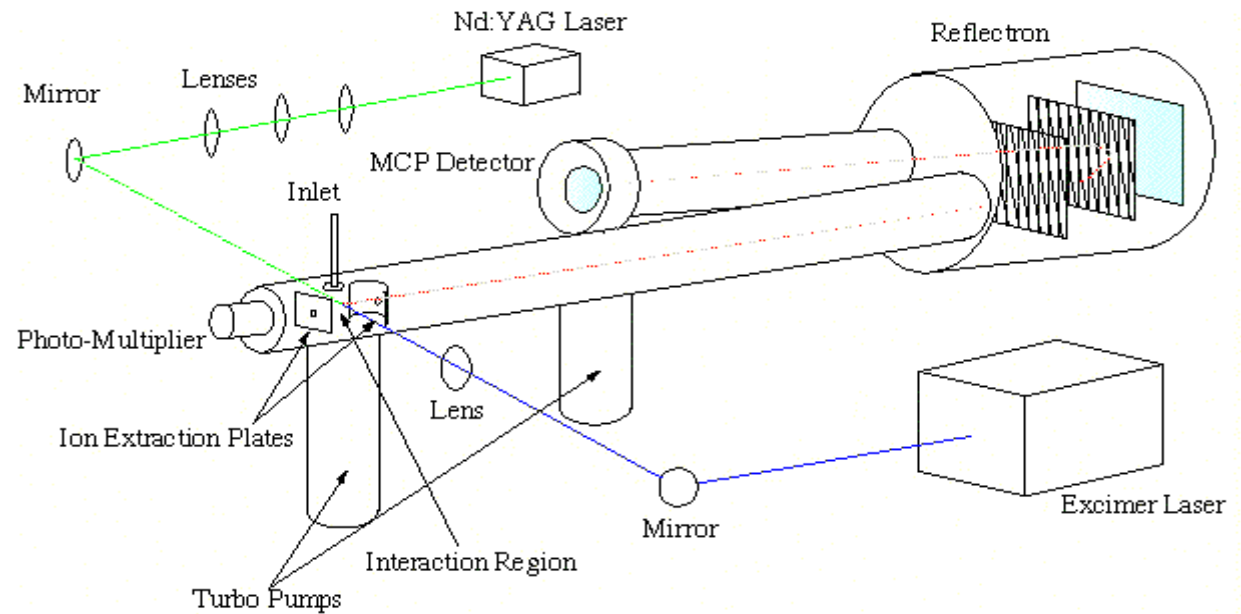


FIGURE 11.21 MS-MS of peaks at m/e 70, 72, and 74 due to Cl_2 (spectra taken by K. Oum).

PALMS (Particle Analysis by Mass Spectrometry)

<http://www.esrl.noaa.gov/csd/palms/>

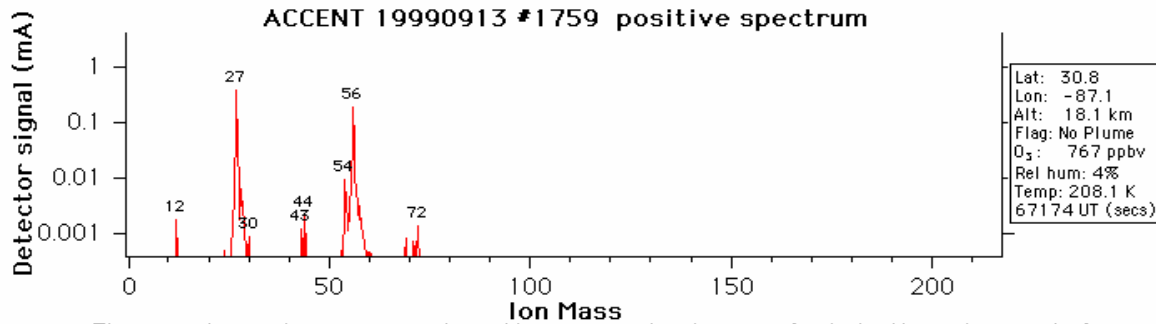
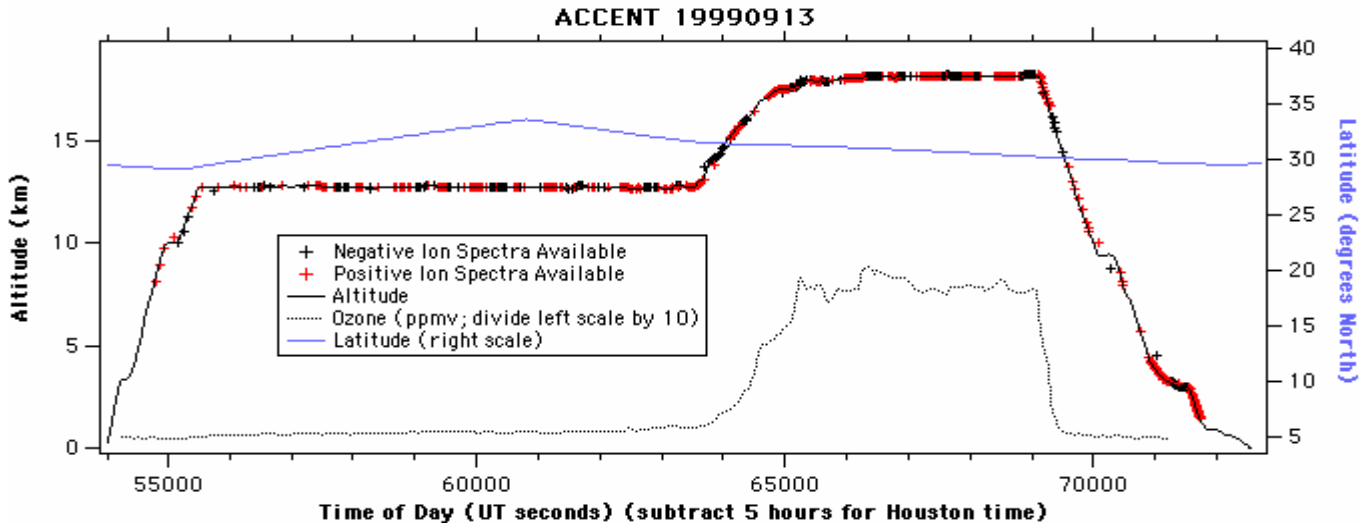


The probe on the nose of the WB-57 aircraft is the inlet for the PALMS instrument

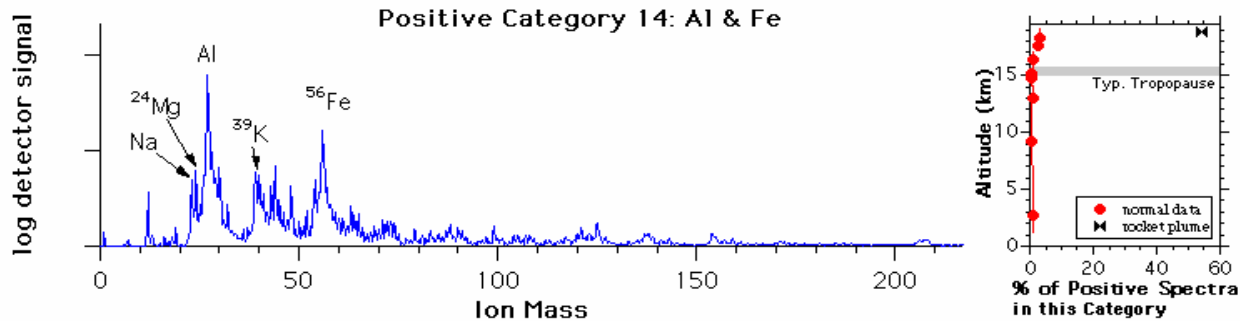


PALMS (Particle Analysis by Mass Spectrometry)

<http://www.esrl.noaa.gov/csd/palms/>

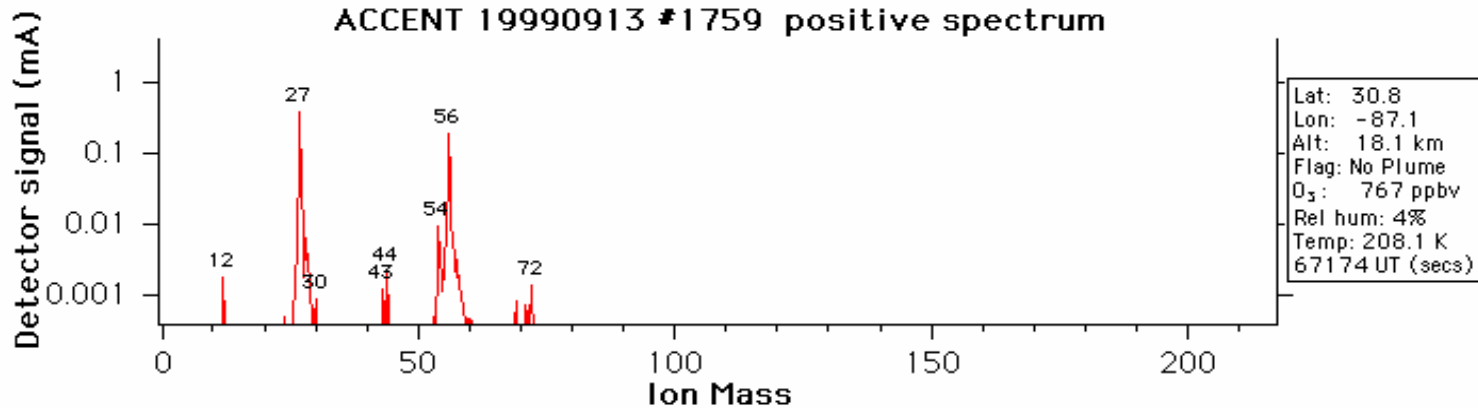


The spectrum above was assigned by regression tree analysis to the category below.

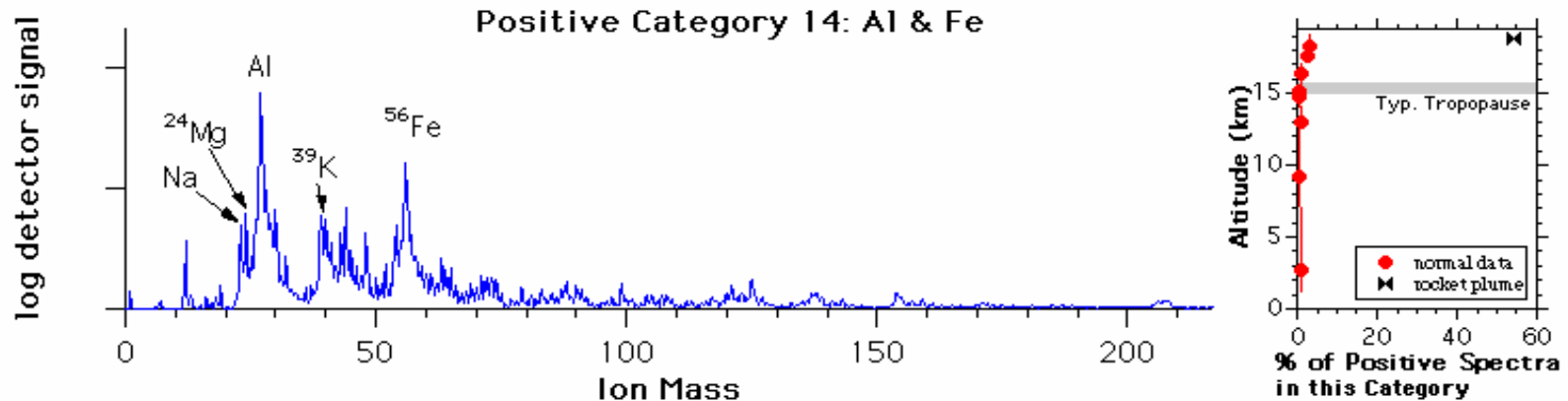


PALMS (Particle Analysis by Mass Spectroscopy)

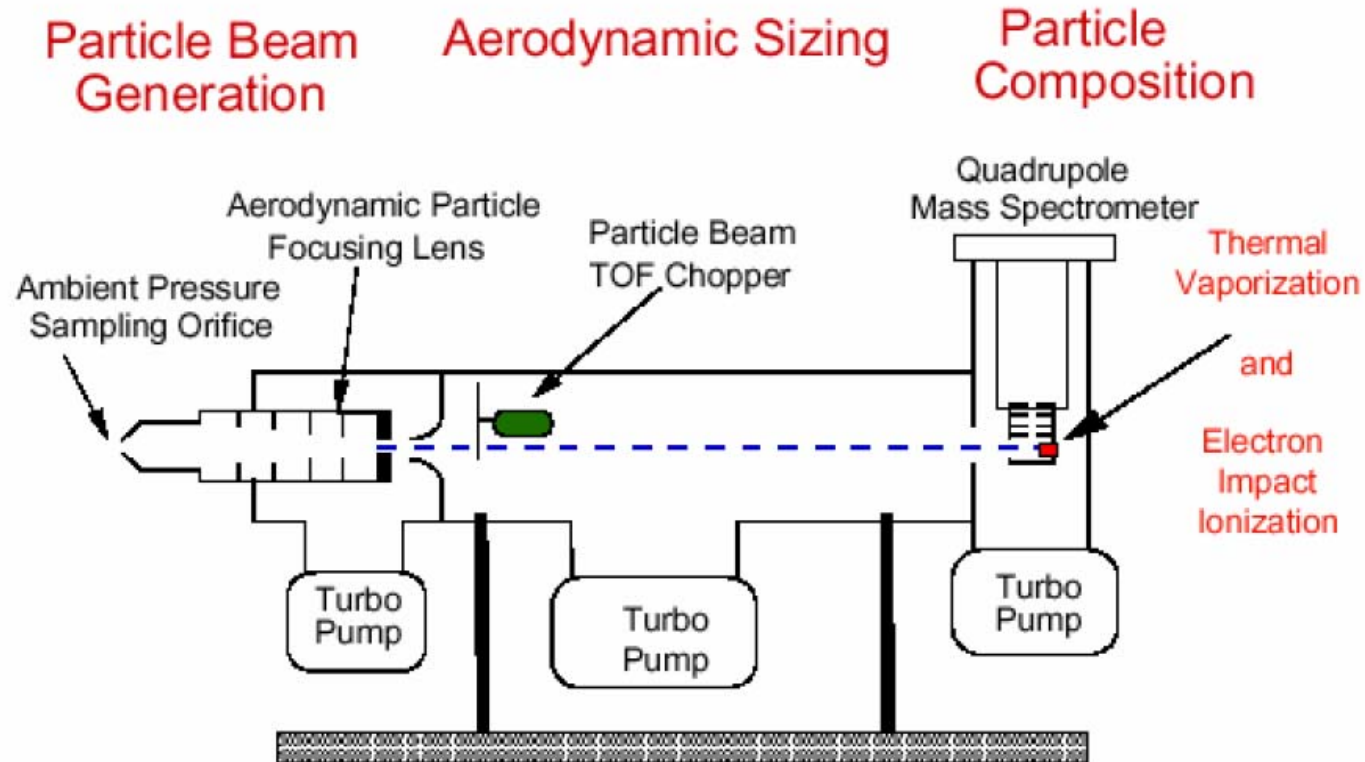
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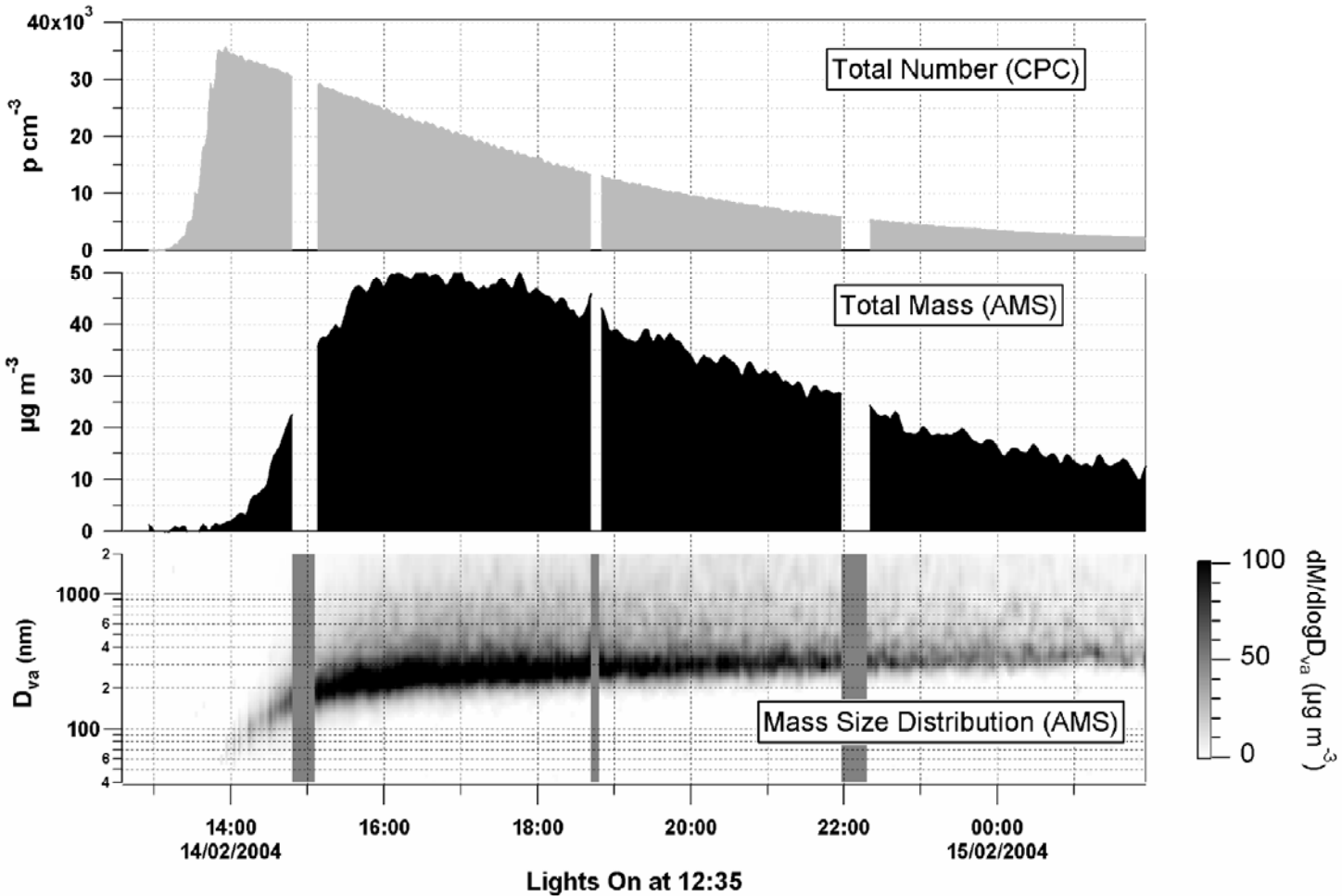
The spectrum above was assigned by regression tree analysis to the category below.



Aerodyne Aerosol Mass Spectrometer



Aerodyne Aerosol Mass Spectrometer



Aerodyne Aerosol Mass Spectrometer

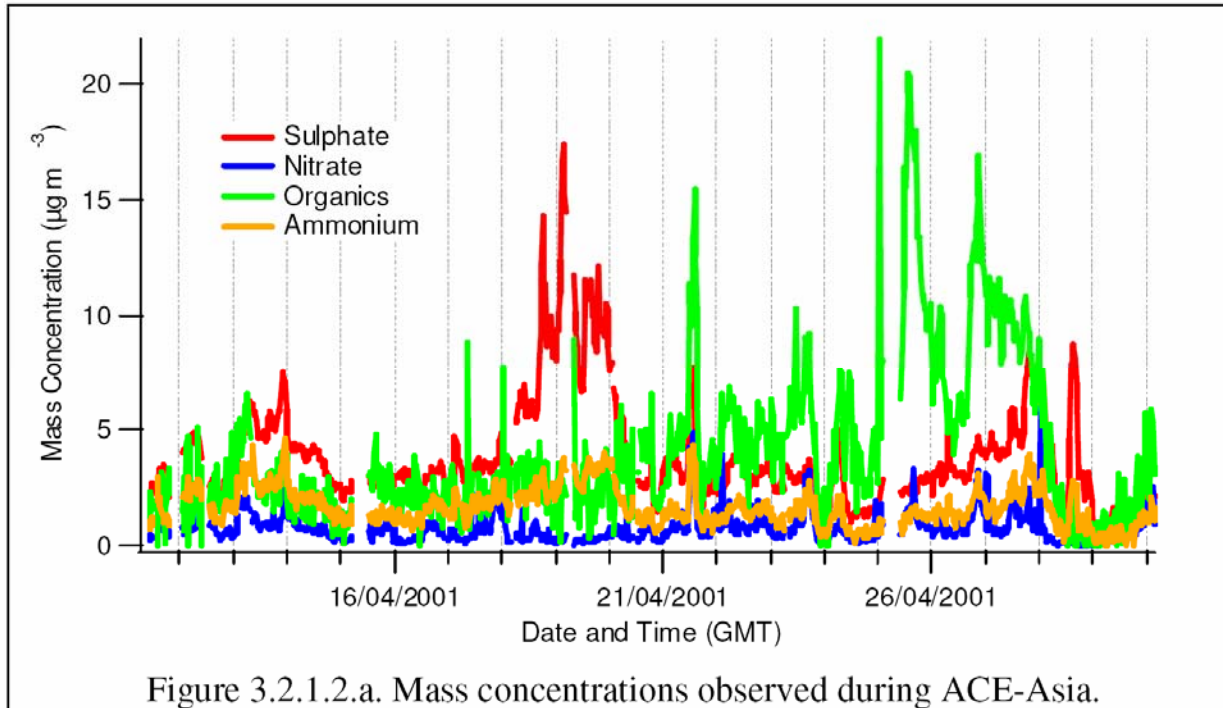


Figure 3.2.1.2.a. Mass concentrations observed during ACE-Asia.

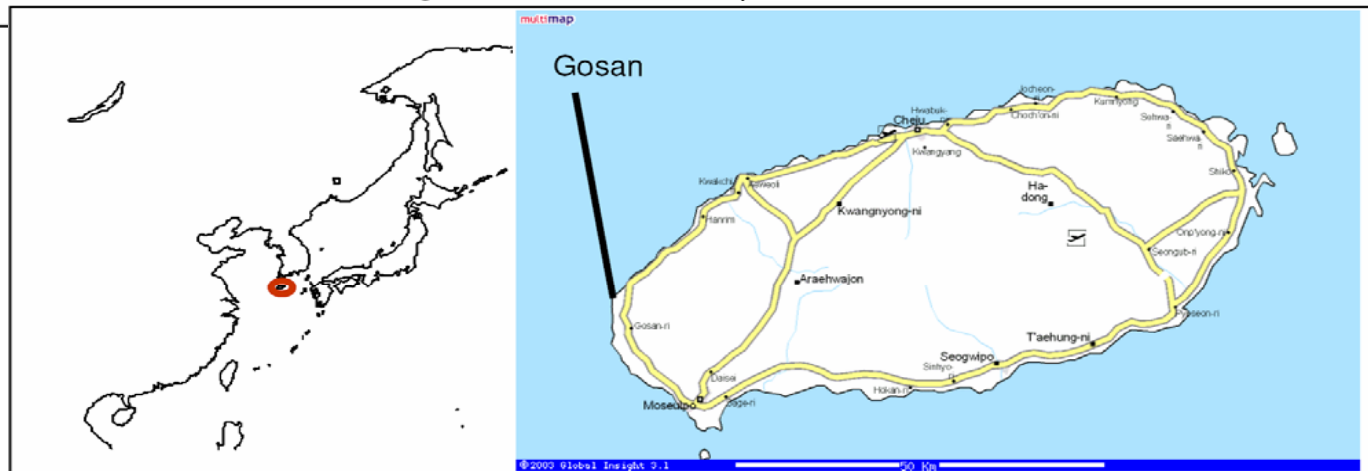


Figure 3.2.1.1.a. Location of the measurement site during ACE-Asia.