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9.8 TURBULENT SMALL-SCALE NEUTRAL AND ION DENSITY FLUCTUATIONS AS MEASURED DURING MAC/EPSILON

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During the MAC/Epsilon campaign (Fall 1987, from Andoya, Northern Norway, 69°N, 16°E) a total of four altitude profiles of neutral gas number densities and six profiles of ion number densities were measured with high spatial resolution in the height range from 60 to 120 km. First results of these rocket-borne experiments will be presented with emphasis on small-scale turbulent density variations and related turbulent parameter as structure function constants and energy dissipation rates.

Raw-Data: $n(z)$; $n_{N2}(z)$; $I(z)$

Relative Fluctuations: (data-fit)/fit

Spectral Analysis:

1. Power spectral density (PSD)
2. Spectral index ξ: PSD ~ K_z^{ξ}
3. Structure function constant C_n^2:

$$PSD(k_z) = 0.125 * C_n^2 * k_z^{-5/3}$$

Turbulent vertical velocity:

$$w^2 = 1.1 * \{g/4M\}^{3/2} * \{C_n^2\}^{3/2}/\omega_B$$

with

$$M = (1/n) * (dn_{pot}/dz) = 1/H_n - 1/\gamma H_p$$

Energy dissipation rate: $\varepsilon = 0.4\, w^2\, \omega_B$

Eddy diffusion coefficient: $k = 0.8\, \varepsilon/\omega_B^2$

3 Instruments:

*Mass-spectrometer ("BUGATTI") n_{N2}, (n_{Ar}, n_{He}, n_{kr})
*Ionization-gauge ("TOTAL") n_{tot}; Δn
*Positive ion probe ("PIP") I_i

Background temperature and –density from:

*BUGATTI and TOTAL: $90 \le z \le 125$ km
*Passive falling sphere: $45 \le z \le 90$ km
* LIDAR (MAC-E-T3 only): $82 \le z \le 97$ km

Small Scale Turbulence Measurements with BUGATTI PIP and TOTAL durch MAC/EPSILON

MAC-E-T	Salvo	Launch	Apogee	BUGATTI	PIP	TOTAL
1	Day	Oct. 15, 1987 10:52:00 UT	127.0 km	Apogee - 94.0	63.4-120.0 km	117.-66,9 km
2	Night A	Oct. 21, 1987 21:33:00 UT	126.0 km	/	64.3-120.0 km	/
3	"	" + 20 sec	125.6 km	/	61.9-120.0 km	117.-64,2 km
4	Night B	Nov. 21, 1987 00:21:00 UT	126.0 km	/	64,9-120.0 km	/
5	"	" + 20 sec	124.2 km	/	67,0-120.0 km	117.-60,9 km

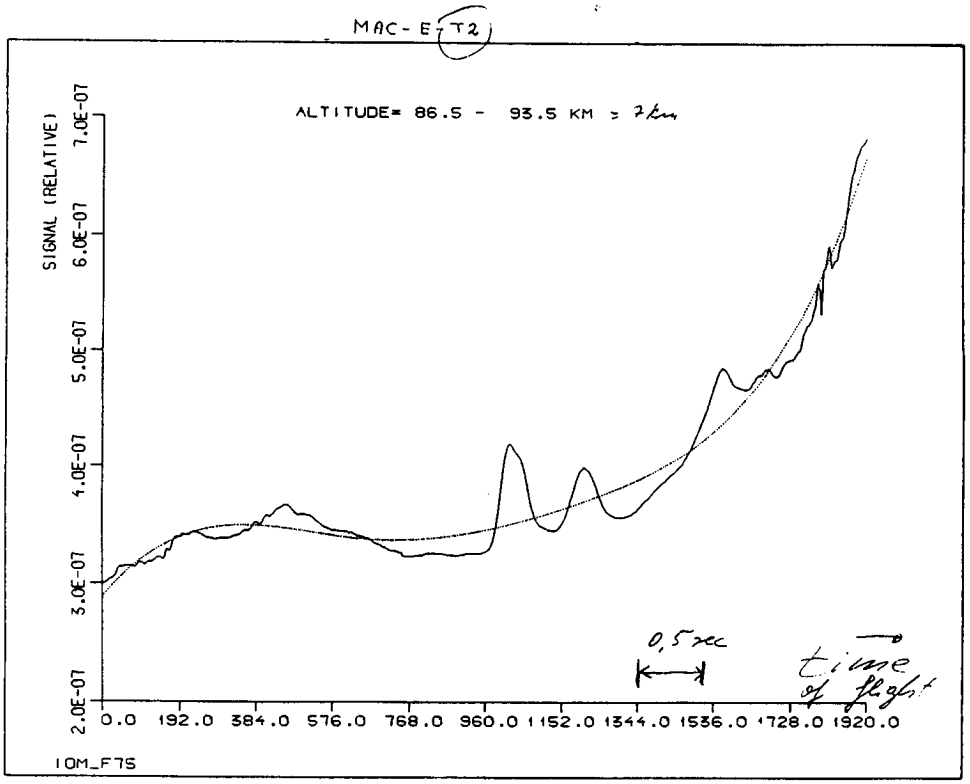

Figure 1.

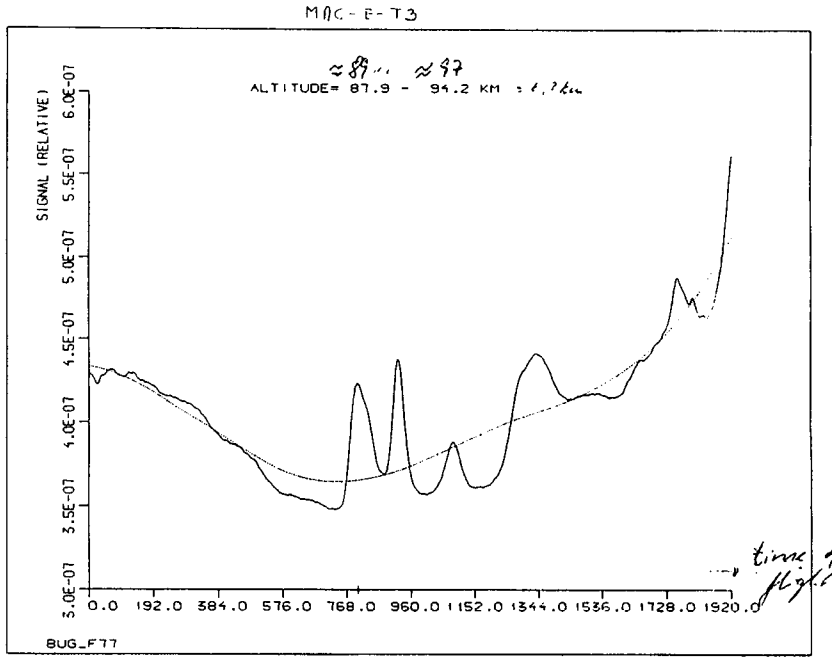

Figure 2.

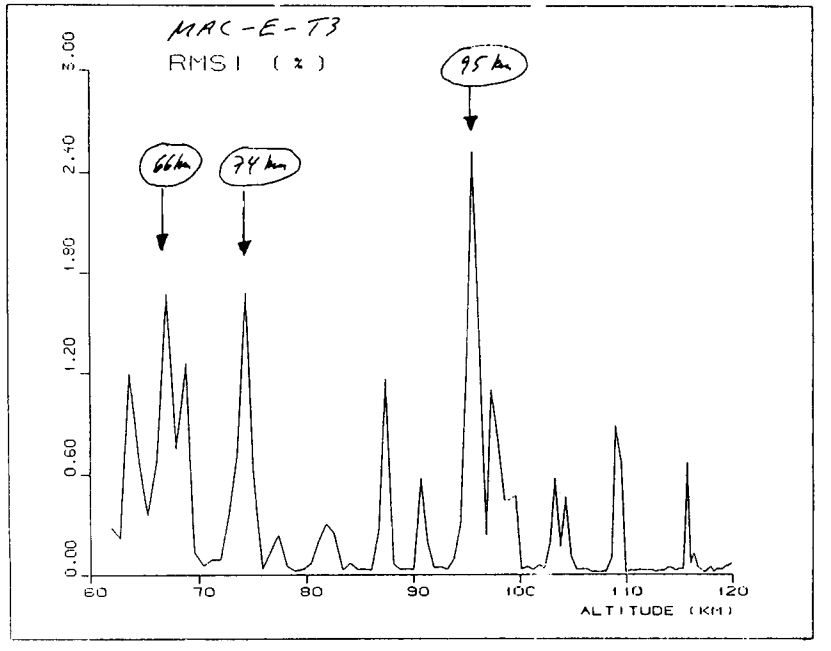

Figure 3.

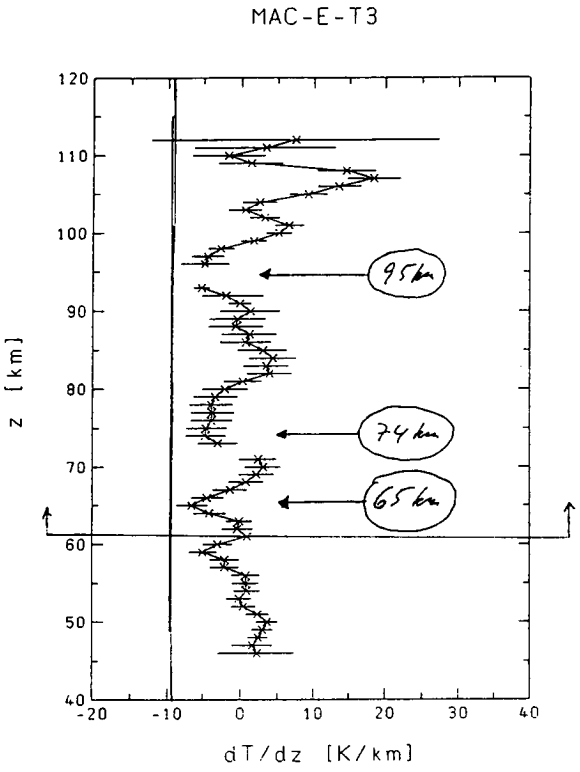

Figure 4.

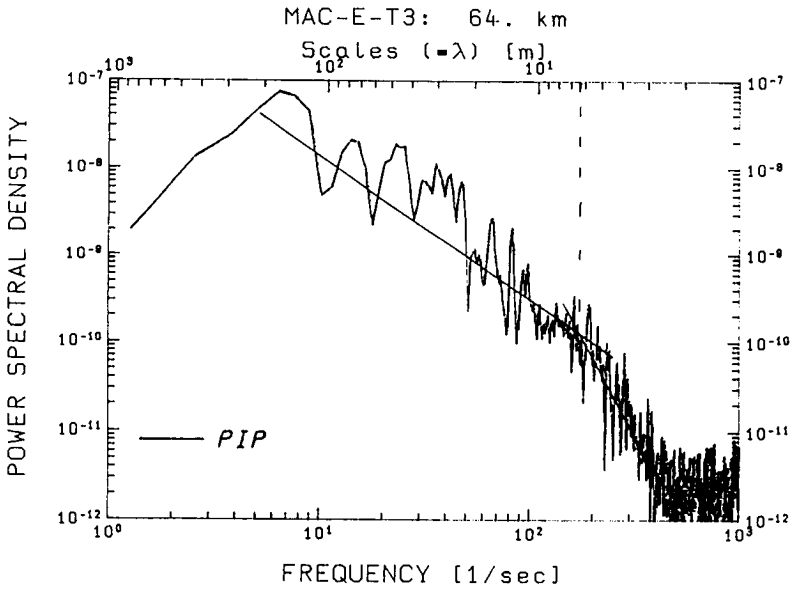

Figure 5.

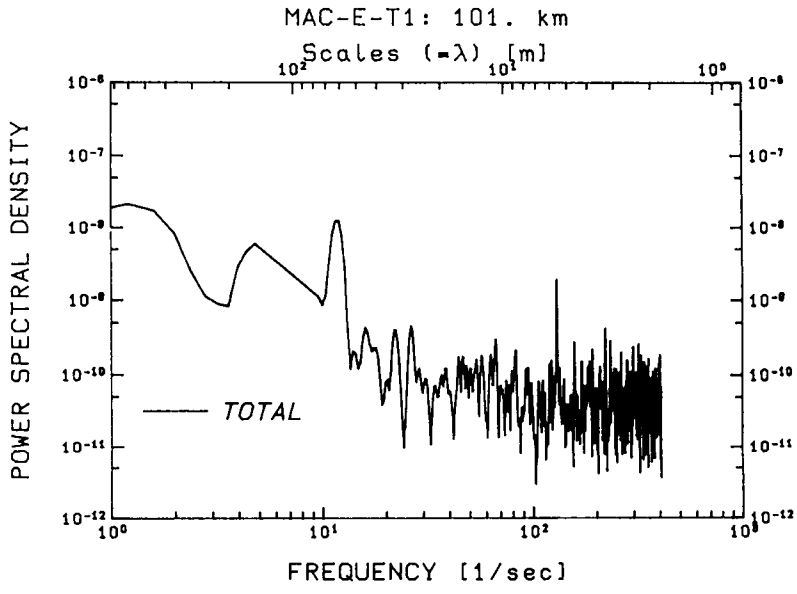

Figure 6.

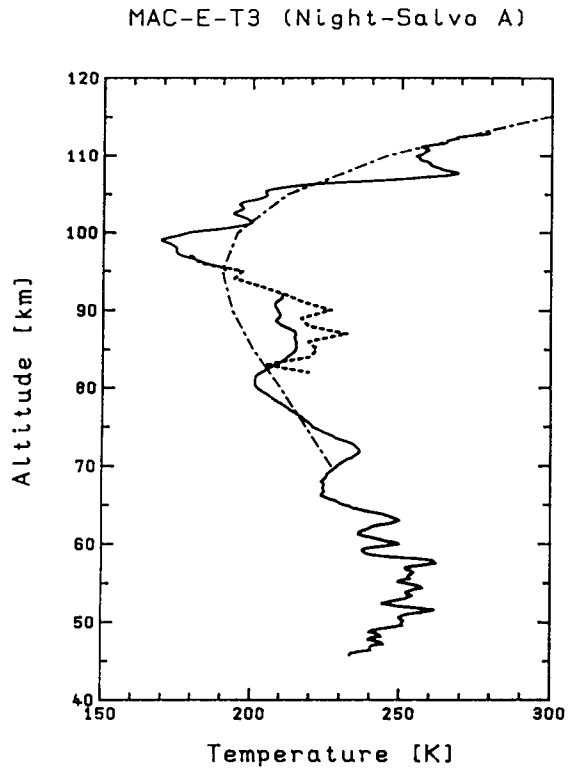

Figure 7.

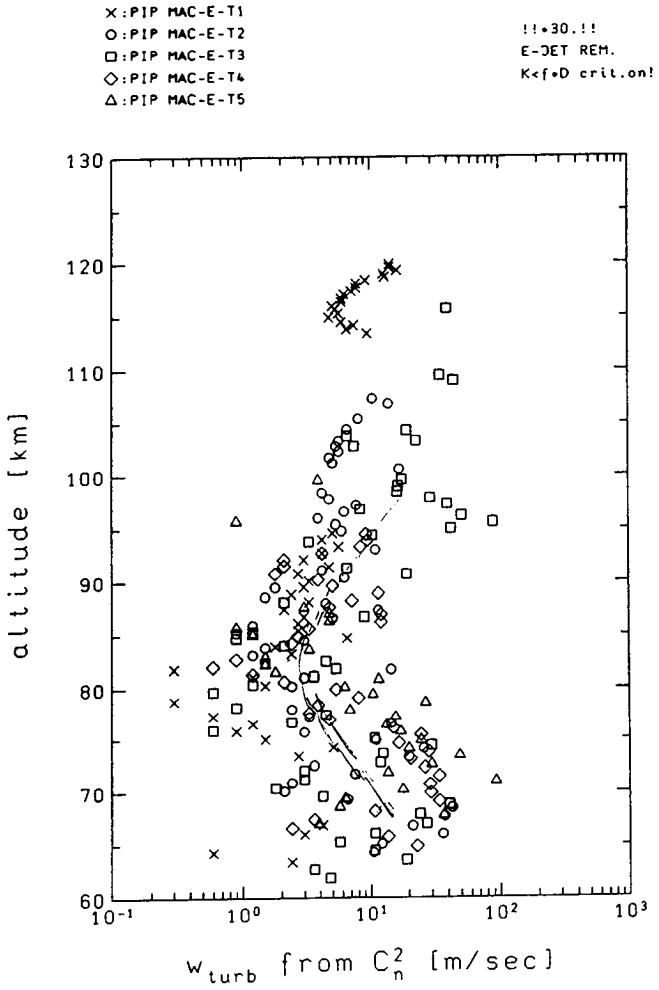
×:PIP MAC-E-T1
○:PIP MAC-E-T2
□:PIP MAC-E-T3
◇:PIP MAC-E-T4
△:PIP MAC-E-T5
!!•30.!!
E-JET REM.
K<f•D crit.on!
altitude [km]
130
120
110
100
90
80
70
60
10⁻¹
10⁰
10¹
10²
10³
w turb from C²n [m/sec]

Figure 8.