



**Fermi National Accelerator Laboratory**

TM-1565

**Measurements of the Gas Pressure  
and the Residual Gas Composition  
in the Main Ring**

Dejan Trbojevic and Nicholas Pastore  
Fermi National Accelerator Laboratory  
P.O. Box 500, Batavia, Illinois

February 14, 1989



Operated by Universities Research Association, Inc., under contract with the United States Department of Energy

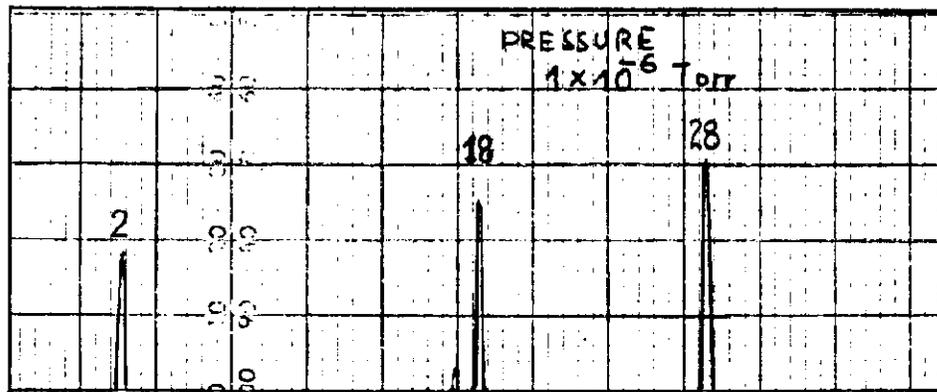
Technical Memo

February 14, 1989

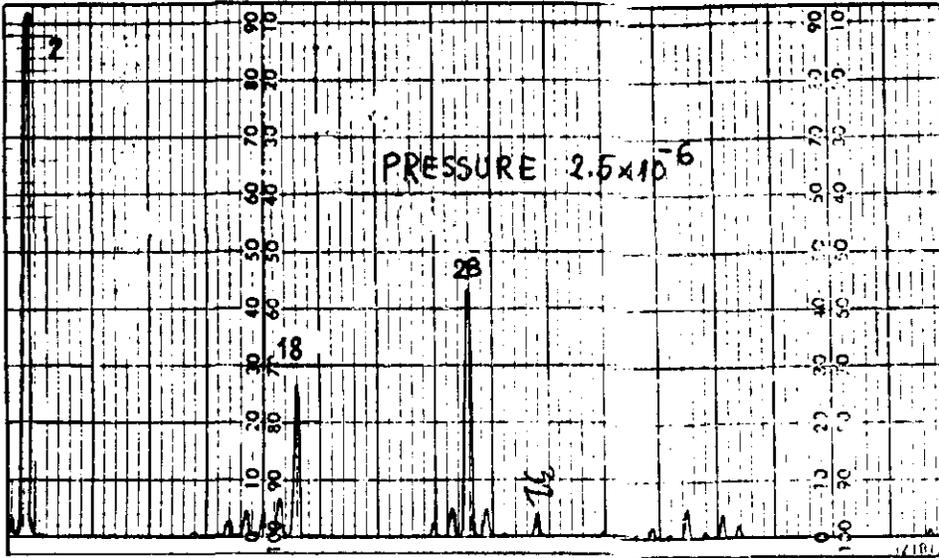
Dejan Trbojevic and Nicholas Pastore

MEASUREMENTS OF THE GAS PRESSURE AND THE  
RESIDUAL GAS COMPOSITION IN THE MAIN RING

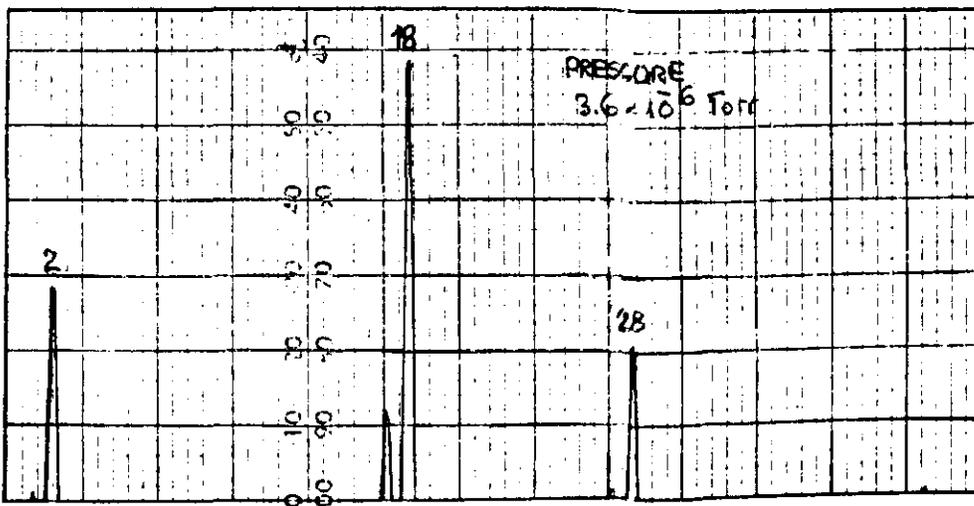
The residual gas composition as well as the value of the pressure in the Main Ring were measured on November 11, 1988. A clean small vacuum chamber (with all stainless steel parts previously baked at above 300°C) with a quadrupole mass analyzer, turbomolecular pump and a Bayard-Alpert gauge were connected to the main ring vacuum chamber at the existing vacuum valve at the A-17 mini straight. The chamber was first pumped down with the turbomolecular pump to a pressure of  $1.35 \times 10^{-6}$  Torr without being connected to the Main Ring Vacuum. This pressure was measured with the degassed ion gauge. The chamber was then baked for 90 minutes at 150°C. During this bakeout the pressure in the chamber rose to  $1 \times 10^{-5}$  Torr. Half an hour after the bakeout the pressure in the chamber, still separated from the Main Ring, measured  $2.5 \times 10^{-6}$ . Figure 1 shows the spectrum of the residual gases in the chamber before the bakeout while fig. 2 shows the gas spectrum in the separated chamber after the bakeout.



- Figure 1 -



- Figure 2 -



- Figure 3 -

When the valve of the Main Ring vacuum chamber was opened the pressure in the small chamber rose to  $6 \times 10^{-6}$  Torr. With a help of the turbomolecular pump the pressure in the small chamber stabilized at  $3.6 \times 10^{-6}$  Torr which showed that the pressure in the Main Ring was worse than  $3.6 \times 10^{-6}$  Torr. Figure 3 shows the residual gas composition in the Main Ring.

The quadrupole mass spectrometer (Varian AGA-100, model 981-9800) consists of an ionizer, a quadrupole mass filter, and a Faraday cup detector. The ionizer is very similar to the Bayard-Alpert ionization gauge. The sensitivity of the analyzer in respect to different gases is mostly dependent on the ionizers sensitivity (effects as the transmittion dependence on the gas mass and others can be neglected). The signals of in the residual gas spectrum have to be corrected by:

$$S_a = \text{Signal}_a / \text{IP}_a,$$

where the  $S_a$  is the corrected value of the signal for the gas 'a', while  $\text{IP}_a$  is the ionization probability or relative yield of ions from the gas 'a' in respect to nitrogen. The partial pressure of the gas 'a' can be calculated from the total pressure by:

$$\text{PP}_a = S_a / \text{TS} * \text{TP},$$

where the TS is the sumation of all corected signals while the TP is the total pressure measured by the ion gauge calibrated in respect to nitrogen. The table 1 presents the ionization probability or sensitivity of the ionizer in respect to nitrogen(1).

TABLE 1  
IONIZATION PROBABILITY

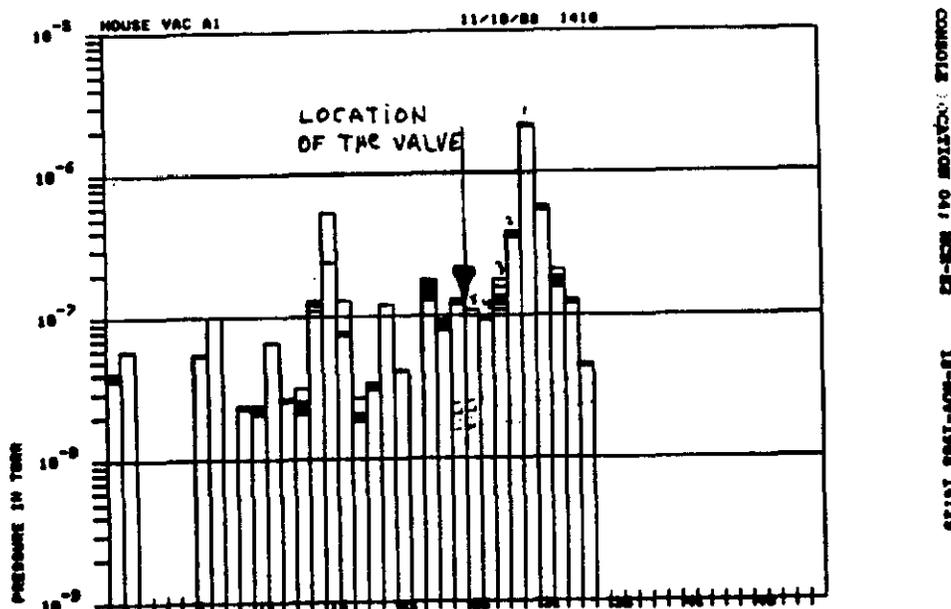
GAS	MASS	SENSITIVITY
HYDROGEN	2	0.44
METHANE	16	1.6
WATER	18	1.0
N <sub>2</sub> /CO	28	1.0
CO <sub>2</sub>	44	1.4

The partial pressures measured in this experiment are presented in table 2.

TABLE 2

MASS	GAS	CORRECTED SIGNAL	PARTIAL PRESSURE
2	HYDROGEN	63.6	$1.5 \times 10^{-6}$ Torr
17	OH	12	$2.7 \times 10^{-7}$ Torr
18	WATER VAPOR	58.5	$1.3 \times 10^{-6}$ Torr
28	CO / N <sub>2</sub>	21	$4.9 \times 10^{-7}$ Torr

It is interesting to note that the pressure readings obtained from the ion pumps around the location where the chamber was connected, showed quite different values. This is presented in figure 4.



- Figure 4 -

(1) J. F. Hanlon, "User's Guide to Vacuum Technology", Willey-Interscience, New York (1980) 106-116 pp.