BNL-104081-2014-TECH

AGS.SN205;BNL-104081-2014-IR

Pressure Bump Effects on the High Intensity Beam

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April 1986

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U.S. Department of Energy

USDOE Office of Science (SC)

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5/20/86

Number 205

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* AGS Studies Report *
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Date: 24-April-86 Time: 15:30 - 16:30

Experimented and reported by :

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Subject : Pressure Bump Effects on the High Intensity Beam

**** AGS Studies ****

$ Introduction

Whenever we experience a large beam loss at extraction or a so-called bunch tearing, we usually suspect the poor vacuum for it even if the VSCAN reveals no poor vacuum sectors. It is generally assumed that poor vacuum sector(s) (e.g., Press. > 5.*10**-6 Torr) may cause an extra beam loss and/or lead to growth of the beam size or emittance (i.e. beam blowup) during the acceleration period due to beam-gas interactions.

This report presents results of a study of effects of a vacuum pressure bump on the high intensity circulating beam by utilizing the Ionization Profile Monitor Controlled Vacuum Leak (IPM_LK) at E-10.

$ Experimental Procedure

@ The machine was set up for the normal FEB run.
@ The maximum pressure limit for the IPM was increased from 6.*10**-6 Torr to 5.*10**-5 Torr in order to make a stronger vacuum pressure bump around E-10.
@ The HOLD system for the E vacuum sector was replaced with one of three available start-supply systems.
@ The vertical flip target at J-19 was set up at 450 msec and was moved to close to the edge of the beam.
@ The beam current,timing of the flip target and radiation loss at J-19 were monitored on a scope.

After establishing an reasonable stable running condition, the data from VSCAN,RLRM and IPM were collected.

CBM = 1.2 to 1.4 *10**13 ppp
Transition Loss = 80 to 85 %
Average Ring Vacuum Press. <P> = 1.1 *10**-7 Torr
H-05_Loss = 0.4 to 0.5 %
H-10_Loss = 0.5 to 0.6 %

@ Then ion pumps around the E-10 box (E-8,9,11 &12) were disconnected to produce a broader pressure bump.
@ A pressure bump at E-10 was created by turning on IPMLK at 2500,

Pressure [10**-07 Torr]

Bump	E-10	E-06	E-05	E-04
Off	1.0	1.3	0.5	0.4
ON	185.	20.	10.	4.0

Again the relevant data were collected without changing any machine parameters and were compared to the previous data.

$ Results and Conclusion

Results with and without the pressure bump are summarized in summarized in the attached figures.

Fig.1 (VSCAN) shows the vacuum pressure distributions around the ring, which were rather uniform. The bump created at E-10 is illustrated by the dotted lines. It should be noted that the pressure reading at the E vacuum sector with the bump (7.5 * 10**-7 Torr), was an average value for E-04,E-05 and E-06 pumps but not for the whole E sector.

Fig.2-a and 2-b (RLRM) show the radiation loss distributions around the ring.

Fig.3-H and 3-V (IPMPL) show the circulating beam size, emittance and centroid as a function of acceleration time in the horizontal and vertical planes, respectively. The circulating beam intensity (L20) is shown in Fig. 3-L.

Fig. 4 (IPMPL) shows a blow-up of Fig.3-L for the early acceleration period (< 200 msec).

Fig.5-a and 5-b show photos for the beam current,the flip target timing and the radiation loss at J-19 on scope.

Radiation levels at H-05 and H-10 at the extraction time remained the same at a level of 0.4 to 0.6 %.

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Despite of our expectations, the pressure bump created at E-10 made no significant effects on beam conditions of the FEB run. However it appears that during the early acceleration period (< 100 msec);

@ the vertical beam size reduced more slowly while the vertical emittance increase more rapidly (Fig.3-V-(3) and (4)).

@ the beam intensity (L20) reduced more sharply (Fig.4).

@ there are some shifts (3 mm) in both horizontal and vertical beam centroids (Fig.4-H (2) and V (2)).

$ Open Questions

-> Was the E-10 pressure bump too localized (narrow) to make effects on the beam conditions even if the pressure at E-10 was > 1.8 *10 **-5 Torr ?

-> Do effects on beam conditions depend on the location of the pressure bump ?

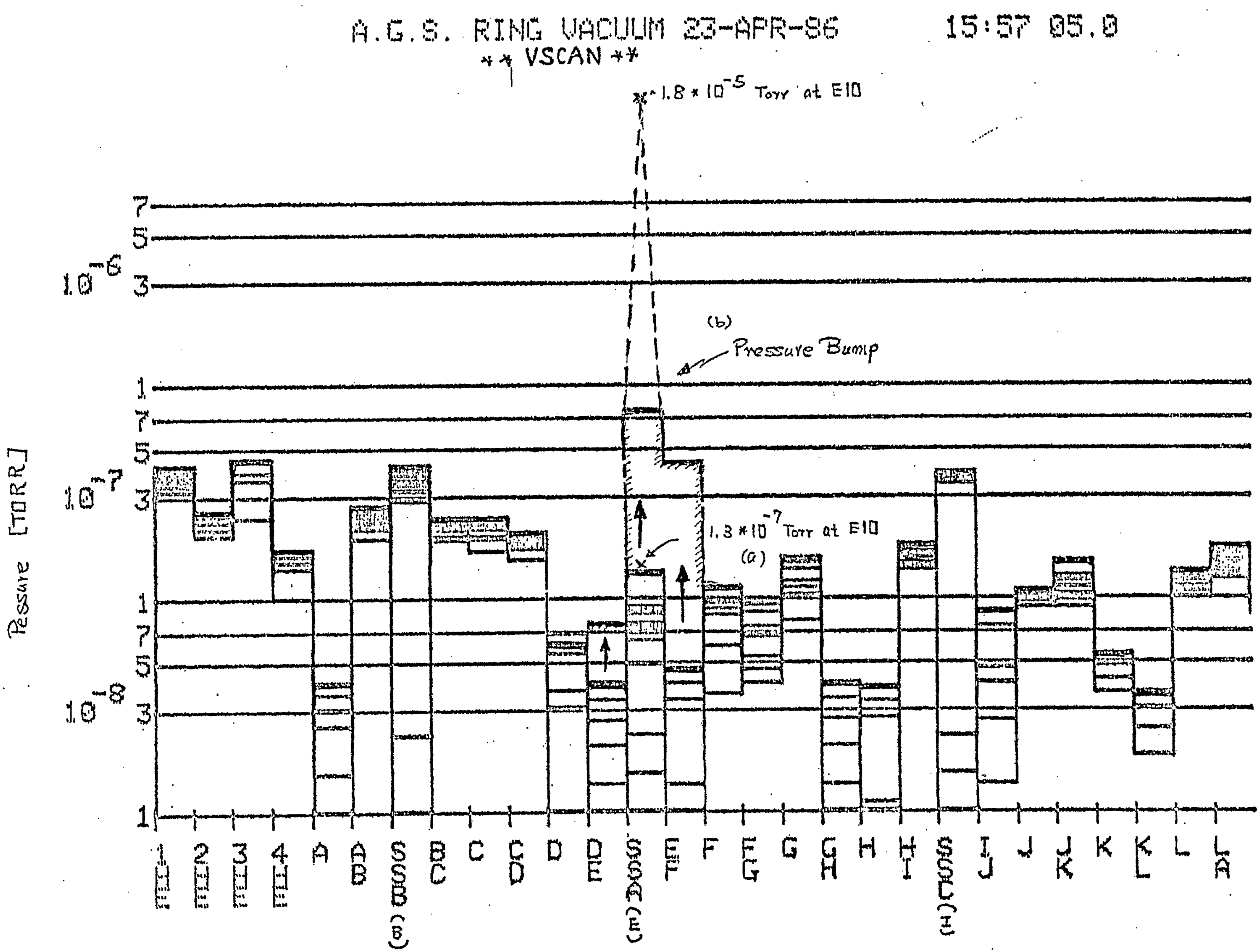
-> Was the beam intensity of 1.4 * 10 **13 ppp still too low to observe any clear effects ?

-> Can we take IPM measurements at face value?
or How are we sure that the observed differences by IPM are real , not due to apparatus effects ?

$ Recommendation

In order to study vacuum-related effects on beam conditions quantitatively, a vacuum leak control facility which is independent of the IPM (measuring device) will be needed.

*** end ***



A.G.S. RING VACUUM 23-APR-86 15:57 05.0
** VSCAN **
1.8 * 10^-5 Torr at E10
(b)
Pressure Bump
1.3 * 10^-7 Torr at E10
(a)
Pressure [TORR]
10^-6
10^-7
10^-8
1 2 3 4 A A B S S B B C C C D D D E S S D E E F F F G G G H H H I S S L I J J J K K K L L L A

Fig.1 VSCAN

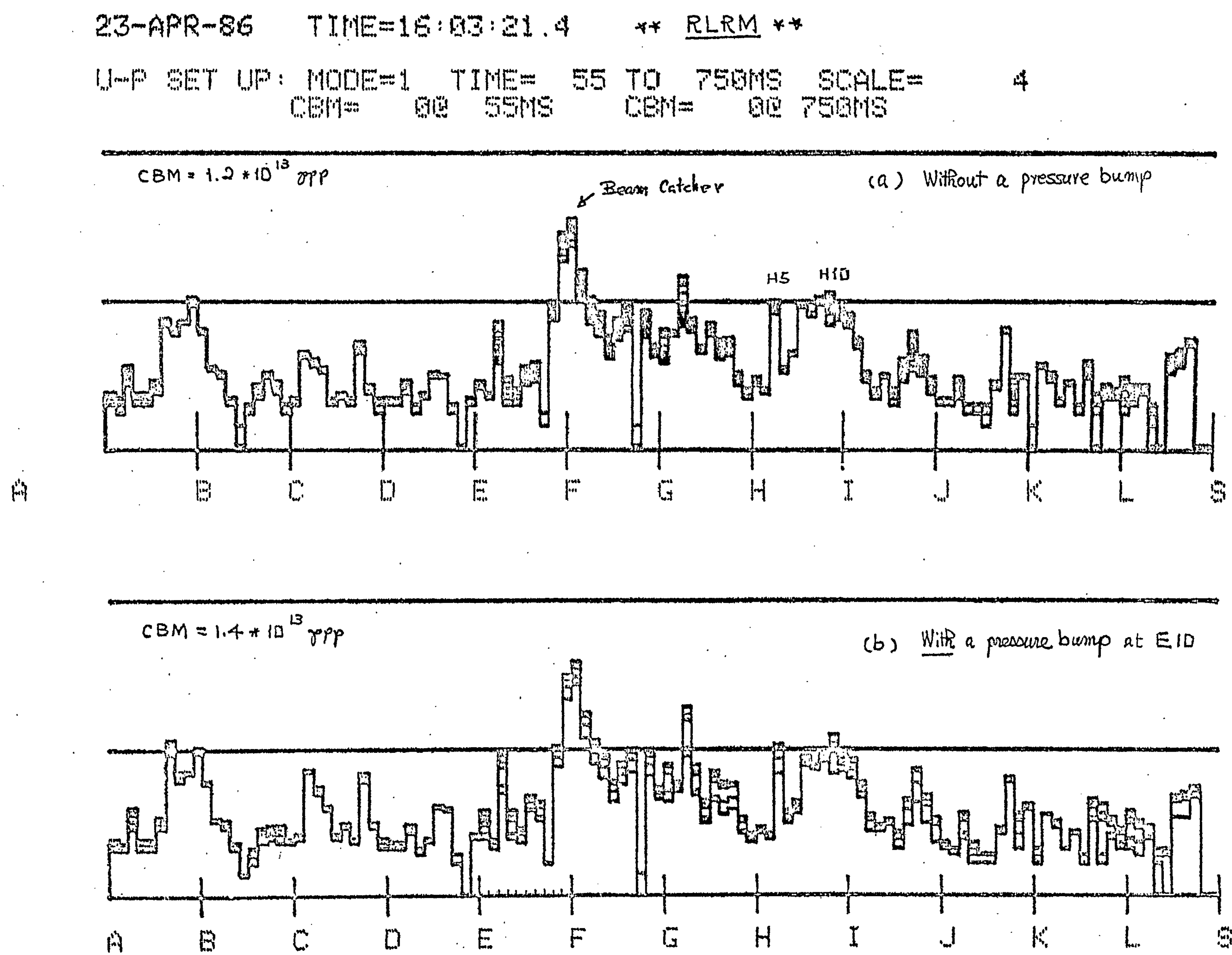
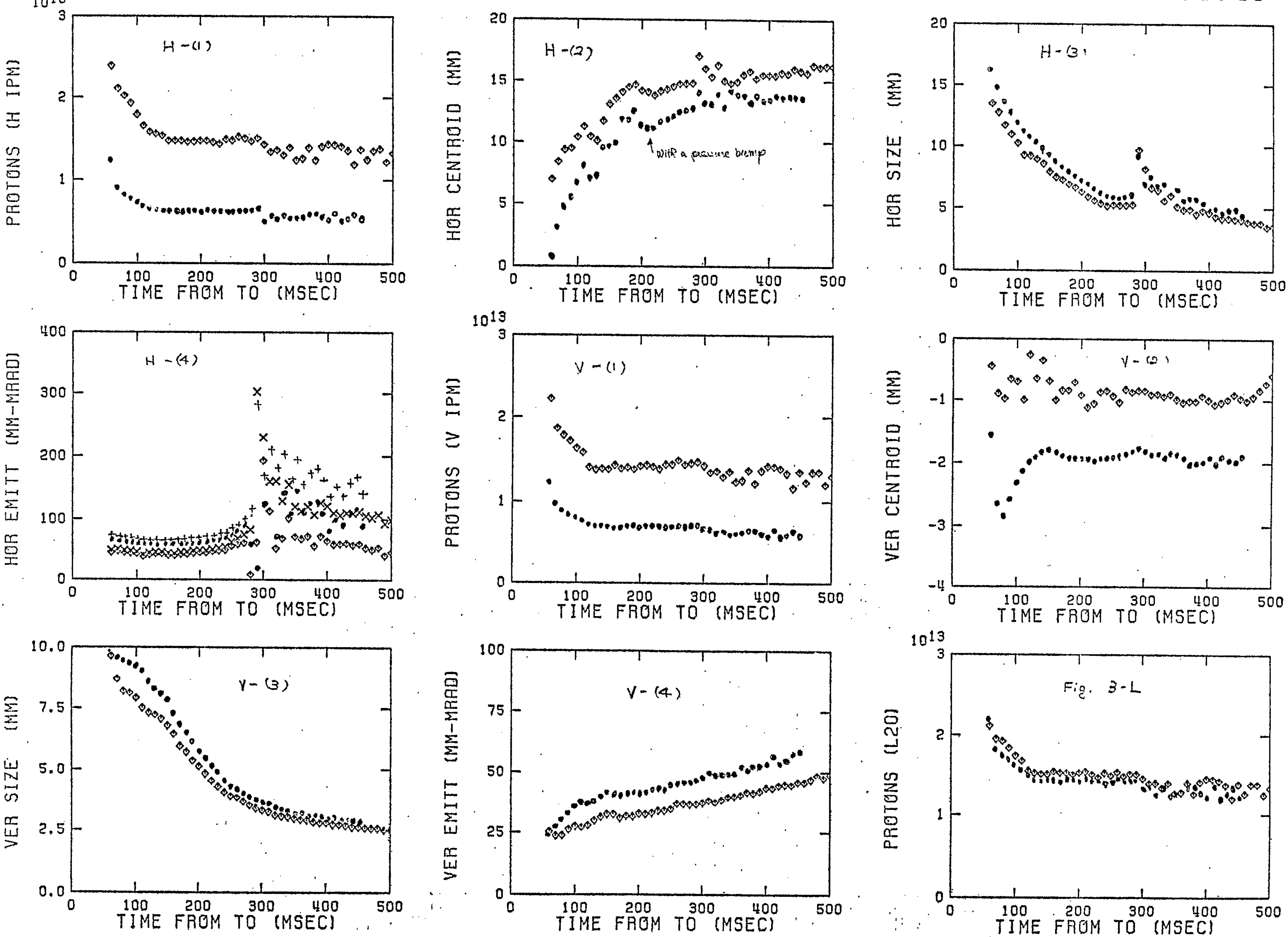

23-APR-86 TIME=16:03:21.4 ** RLRM **
U-P SET UP: MODE=1 TIME= 55 TO 750MS SCALE= 4
CBM= 00 55MS CBM= 00 750MS
CBM = 1.2 * 10^13 ppp
Beam Catcher
(a) Without a pressure bump
H5
H10
A B C D E F G H I J K L S
CBM = 1.4 * 10^13 ppp
(b) With a pressure bump at E10
A B C D E F G H I J K L S

Fig.2 RLRM

3-APR-86 16:17 VACA .IPD IPMPL:05/08/86 13-MAY-86 16:35:43



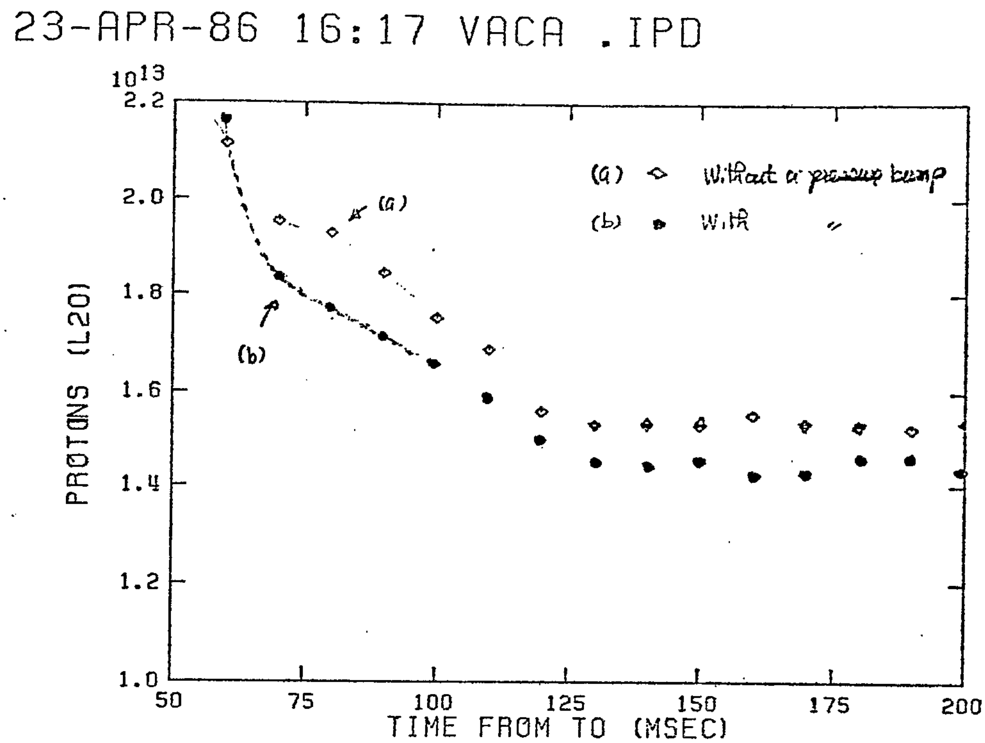


Fig.4 IPMPL (CBM)

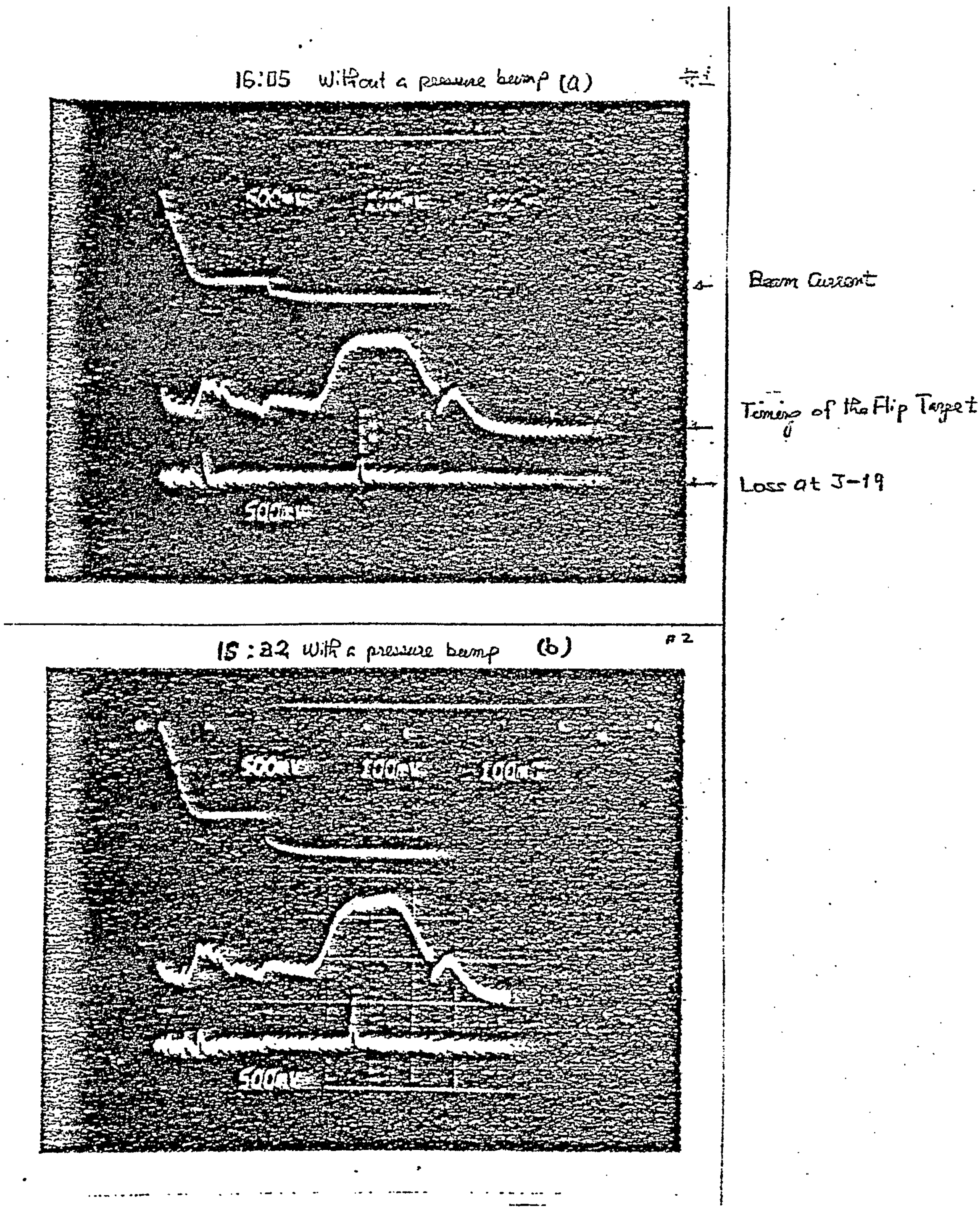


Fig.5 SCOPE (CBM,Timing,Loss)