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SOME COMMENTS ON THE AGS VACUUM SYSTEM

K. Welch

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Collider Accelerator Department

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Accelerator Division
Technical Note

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October 27, 1987

SOME COMMENTS ON THE
AGS VACUUM SYSTEM

AGS Machine Physics Meeting
October 16, 1987

Kimo M. Welch
Hsiao-Chaun Hseuh
Joseph E. Tuozzolo

THE AGS VACUUM SYSTEM
October 16, 1987

1) HISTORY OF VACUUM PERFORMANCE.

2) OUR OBJECTIVE FOR THE FUTURE.

3) THE GLOBAL APPROACH TO MEETING THE OBJECTIVE.

4) SINKS AND SOURCES OF GAS IN THE AGS.

5) THE BEAM CHAMBER.

6) CHAMBER SIZE VS SPUTTER-ION PUMP SPEED.

7) A LITTLE ON SPUTTER-ION PUMPS.

8) BEAM CHAMBER OUTGASSING "NUMBERS".

9) EXAMPLES OF OTHER SOURCES OF GAS IN THE AGS.

10) THE IMPACT OF LOCAL SOURCES - THE "PRESSURE BUMP".

11) SOLUTIONS TO MEETING OUR OBJECTIVES.

12) THE SPECIFIC APPROACH AND OUR PROGRESS.

Kimo M. Welch
October 16, 1987

HISTORICAL SUMMARY OF THE AGS OPERATING PRESSURES

DATE	PRESSURE (Torr)(1)	AGS STATUS
6/27/77	2.4×10^{-7}	PROTON BEAM
3/27/79	3.1×10^{-7}	" "
4/30/82	2.4×10^{-7}	" "
11/14/83	1.1×10^{-6}	" "
4/16/84	5.1×10^{-7}	" "
10/31/84	2.9×10^{-7}	" "
10/21/85	4.2×10^{-7}	" "
1/21/87	1.6×10^{-7}	" "
4/24/87	9.6×10^{-8}	HEAVY IONS
≈ 8/30/87	1.8×10^{-7}	NO BEAM(2)

(1) All data, except 8/30/87 entry, are from average of super-period sputter-ion pump current.

(2) Data taken using PIG's (mean, w/ sd = $\pm 1.2 \times 10^{-7}$).

Kimo M. Welch
10/13/87

AGS VACUUM SYSTEM
AIP ACTIVITIES

October 16, 1987

I. OBJECTIVES

1) ACHIEVE AN AGS OPERATING PRESSURE OF $<10^{-8}$ TORR WITH PROTON BEAM INTENSITIES OF 5×10^{13} PROTONS PER PULSE.

   (If we achieve this for protons, we'll do better for Heavy Ion operation.)

2) MAKE THE MACHINE CONFIGURATION MORE SERVICEABLE AND RELIABLE SO AS TO ...

3) MINIMIZE DOWNTIME, AND PERSONNEL EXPOSURE TO RADIATION.

II. WHO'S OBJECTIVE and WHY ???

III. SOLUTIONS / PROBLEMS

A. RECOGNIZE THERE ARE NO "SILVER BULLET" SOLUTIONS.

B. REDUCE THE PROBLEM TO IDENTIFYING GAS "SOURCES" AND "SINKS", AND EITHER DECREASE THE FORMER OR INCREASE THE LATTER.

C. PRIMARY "SINKS" OF GAS IN THE AGS:

1) SPUTTER-ION PUMPS,

2) CRYOPUMPS,

3) TURBO-PUMPS (also a major source),

4) NEG PUMPS.

D. PRIMARY "SOURCES" OF GAS IN THE AGS:

1) LEAKS IN VACUUM JOINTS DUE TO:
   - i) MARGINAL FLANGE CLAMP DESIGN.
   - ii) THE "POTPOURRI" OF VACUUM GASKETS.
   - iii) "HODGEPODGE" OF FLANGES AND TRANSITION JOINTS.

2) LEAKS IN WELD JOINTS AND VACUUM WALL:
   - i) ION PUMP BODY FAILURES (ion holes).
   - ii) "WANDERING" PROTON BEAMS.

3) LEAKS IN CERAMIC-TO-METAL SEALS:
   - i) ION PUMP HV FEEDTHROUGHS.
   - ii) BEAM COMPONENT H.V. FEEDTHROUGHS.
   - iii) PUE FEEDTHROUGHS.

4) SYSTEM CONTAMINATION:

- i) HYDROCARBON CONTAMINATION FROM "TURBO'S".
- ii) HYDROCARBON CONTAMINATION FROM LEAKS IN HIGH VOLTAGE FEEDTHROUGH INSULATORS.
- iii) HYDROCARBON AND WATER CONTAMINATION FROM MATERIALS PLASTICS USED IN BEAM COMPONENTS AND INSTRUMENT CHAMBERS.
    - a. PLASTICS.
    - b. FERRITES.
    - c. ADHESIVES.
    - d. EPOXIES.

5) OUTGASSING OF WALLS AND SPECIAL MATERIALS:

- i) BEAM CHAMBER WALLS.
- ii) AL VALVE BODIES.
- iii) USE OF "SPECIAL" MATERIALS.
- iv) ETC., ETC...

A BRIEF LOOK AT BEAM CHAMBER OUTGASSING NUMBERS

TEST CONDITIONS	TOTAL OUTGASSING RATE vs TIME Torr-L/sec-cm² 24 hrs	550 hrs
Unbaked Chamber w/ PUE.	7.2×10^{-10} (1)	4.3×10^{-11} (2)
Air Baked Chamber w/ PUE.	2.0×10^{-10} (1)	1.2×10^{-11} (2)
Air Baked Chamber, No PUE.	6.0×10^{-11} (1)	3.5×10^{-12} (2)
Unbaked, 50 m stn.stl. Tube.	No Data	2.5×10^{-11} (3)
Air Baked stn. stl Chamber.	No Data	"few" $\times 10^{-11}$ (4)

Notes:

1) Data taken by H-C Hseuh. Chambers were baked in air at ≈ 145 °C for 24 hours. After baking, they were first pumped down, and then vented to air for 24 hours prior conducting measurements.

2) Data is an extrapolation of Hseuh data using:

$$q_f = q_i (t_i / t_f)^{-m}, \quad m = -0.903.$$

3) K. M. Welch, Vacuum, 23, 1973, 271.

4) Hartmut Wahl, CERN SPS; data obtained in discussions with Hartmut during Welch visit April 1987. Chambers were air baked at ≈ 150°C for 24 hours.

Kimo M. Welch

OUTGASSING RATE DEPENDENCE OF STEAM CLEANED STAINLESS STEEL BEAM TUBE ON TEMPERATURE*

TOTAL HOURS	TEMP. °C	OUTGASSING RATE Torr-L/sec-cm^2	RATIO TO H_2			
			H_2	H_2O	CO	CO_2
500	27	2.5 X 10^{-11}	1	1.5	0.5	0.3
760	35	8.3 X 10^{-11}	1	5.0	0.4	0.3
910	100	$\approx$ 2.2 X 10^{-9}	First Bakeout of Tube.			
1100	23	8.2 X 10^{-12}	1	0.041	0.045	0.008
1420	23	5.5 X 10^{-12}	1	0.03	0.07	0.02
1450	42	2.3 X 10^{-11}	1	0.02	0.02	0.01
1480	90	1.2 X 10^{-10}	1	0.01	0.01	0.005
1500	120	4.6 X 10^{-10}	1	0.007	0.004	0.005

* Though eddy-current heating may not be a factor in AGS, the issue of temperature dependence may be important as it relates to minor chamber temperature increases due to beam losses and surface gas desorption.

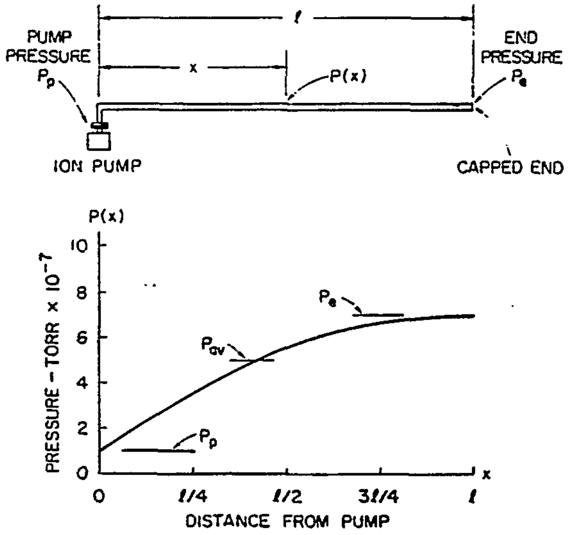
Kimo M. Welch
October 15, 1987

PRESSURE IN BEAM CHAMBER DUE TO OUTGASSING OF CHAMBER WALLS

Neglecting outgassing of other AGS equipment, and assuming the chamber is not contaminated, the pressure profile in the chamber is:

$$P(x) = P_p + (\pi q/2kD^2)(2x\ell - x^2),$$

a simple parabolic function.



The average pressure in a section of the chamber is:

$$P_{av} = (1/\ell)\int P(x)dx$$

$$= P_p + 2/3\ (\pi q\ell^2/2kD^2).$$

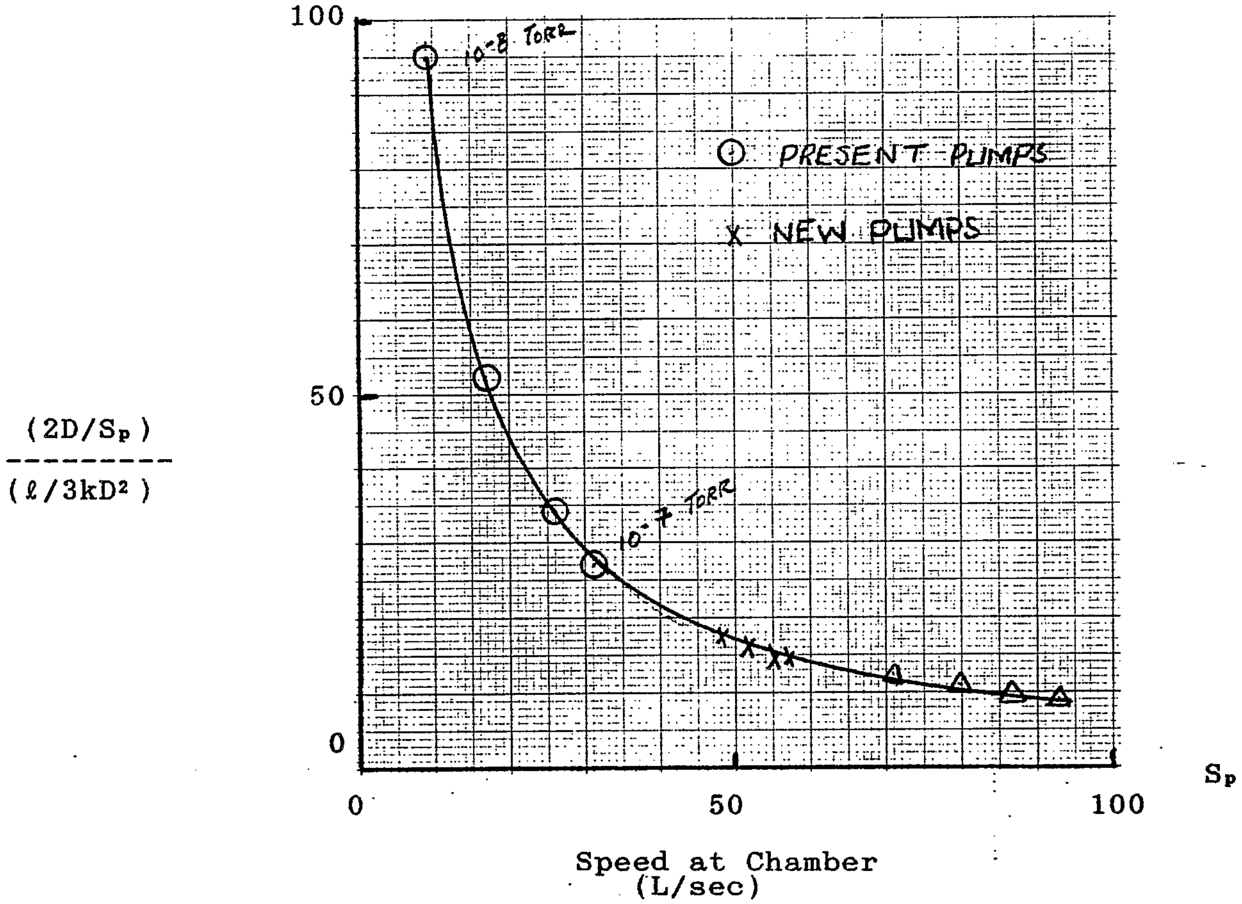
One pump pumps two half-chambers. Therefore, the pump pressure may be expressed by:

$$P_p = 2(A)q/S_p$$

$$= 2(\pi D\ell)q/S_p.$$

Then the average pressure in the AGS due to chamber outgassing is simply:

$$P_{av} = \pi q\ell(2D/S_p + \ell/3kD^2).$$



OPTIMUM CHAMBER-PUMP SPEED MATCH

Setting $dP_{av} / dD = 0$,

Yields $D = (S_e \ell / 3k)^{1/3}$

For $S_e = 50$ L/sec

$D \approx 14.5$ cm.

For $S_e = 10$ L/sec

$D \approx 6.6$ cm.

Our present beam chamber has the equivalent:

$D \approx 12.2$ cm.

It appears we wont have to reduce the diameter of the beam chamber, (joke!) but, for the optimum system (i.e. lowest avarage pressure possible for the given geometry) we should increase our pump speed to 50L/sec.

SOME COMMENTS ON
SPUTTER-ION PUMPS

1) Diode and Triode Sputter-ion Pumps comprise an ensemble of Penning cells which store space charge.

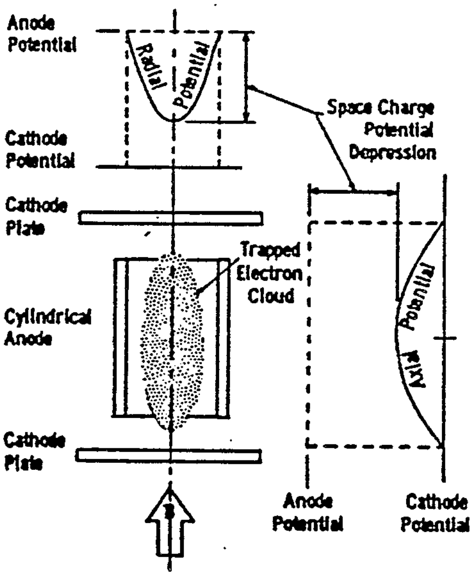
2) The the relative magnitude of ion current created and impinging on the cathodes of the cell, is termed the "sensitivity" Θ, of the device and is defined by:

$$I^{+} = \Theta P,$$

or,

$$\Theta = I^{+}/P. \quad \text{(units are Amps/Torr).}$$

3) I^{+}/P is dependent on the amount of electron space charge which is "stored" in the Penning cell. This is approximated using smooth-bore magnetron theory.



Configuration of a Penning discharge.

$$q_{max} = \frac{-4\pi\epsilon_0 L(V_a - V_k)(x^2 - 1)}{[x^2 - 1 + (2/x^2)\ell n\, x]}$$

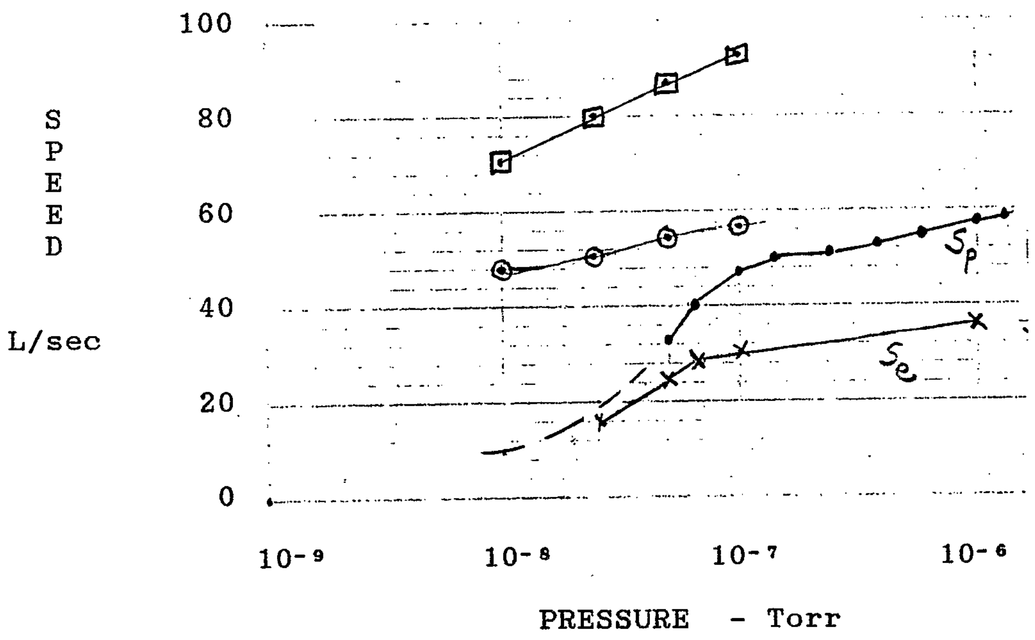
$$x = r_a/r_k.$$

$$q_{max} \approx -4\pi\epsilon_0 L(V_a - V_0)$$

4) Variables which alter I^+/P include:

- A. Magnetic field
- B. Anode voltage
- C. Anode length
- D. Surface condition of the cathodes.
- F. Cell diameter (not fully understood).

5) The "bottom line" is that pump speed is directly proportional to I^+/P and it is <u>not</u> a constant in pressure.



S_p : Present AGS pump speed.

S_e : Effective speed delivered to the chamber.

⊙ : S_e with new pumps.

⊡ : S_e with new pumps and larger pumpout manifold.

WHAT DO ALL OF THESE NUMBERS MEAN?

1) From the data given, we may assume the beam chambers have a surface outgassing rate of:

$$q \approx 2 \times 10^{-11} \text{ Torr-L/sec-cm}^2,$$

2) Another approximation we may make is that A_t, the total AGS vacuum surface area is:

$$A_t \approx 2 \times A_c,$$

where A_c, $\approx 3.4 \times 10^6$ cm², is the vacuum surface area of the beam chambers and pipes.

Then the total AGS gas load Q_t, assuming uniform outgassing throughout the AGS, should be on the order of:

$$Q_t \approx q A_t$$

or calculated: $\underline{Q_t \approx 1.4 \times 10^{-4} \text{ Torr-L/sec.}}$

How does this number "square" with observed <u>pump</u> pressures?

1) Assume the average pump speed, S_{pav} is 50 L/sec.

2) Assume the average pump pressure, P_p, is 2×10^{-7} Torr.

3) Assume there are 260 pumps in the AGS.

Then: $Q_t \approx 260 \times S_{pav} \times P_p$.

Or measured: $\underline{Q_t \approx 2.6\ 10^{-3} \text{ Torr-L/sec.}}$

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October 15, 1987

EXAMPLES OF AGS APPROXIMATE OUTGASSING LOADS FROM BEAM INSTRUMENTS AND COMPONENTS UNDER STATIC AND DYNAMIC CONDITIONS(4)

COMPONENT/ INSTRUMENT	STATIC(2) OUTGASSING (Torr-L/sec)	DYNAMIC(3) OUTGASSING (Torr-L/sec)
A-13 Bump Coil	No Data	3×10^{-5} (45 min)
B-7 Bump Coil	No Data	3×10^{-5} (45 min)
B-5 I Xformer	7×10^{-5} (150 hr)(1)	No Data
C-20 Wire Septum	5×10^{-5} (300 hr)(1)	9×10^{-5} (36 min)
D-17 Flag Drive	3×10^{-5} (≈72 hr)	0.05 (leak problem)
F-10 Magnet	3×10^{-5} (≈70 hr)(1)	No Data
G-10 Polarimeter	2×10^{-3} (25 hr)	No Data
E-5/H-5 Kicker	3×10^{-5} (360 hr)(1)	No Data
H-20 ES Septum	No Data	2×10^{-4} (45 min)
F-5 Kicker	2×10^{-4} (5) (24 hr)	No Data
J-5 Flip Target	3×10^{-5} (1) (≈170 hr)	1×10^{-3} (<15 min)
J-19 Flip Target	3×10^{-5} (1) (≈170 hr)	8×10^{-4} (<15 min)

Notes: 1) Data from studies by H-C Hseuh.

2) "Static": outgassing component, after extended pumping, while equipment is not being energized or actuated.

3) "Dynamic": outgassing component due to actuation or energizing.

4) No beam present in the AGS during tests.

5) Joe Schuchman, 1978.

$Q_c \sim 10^{-5}$ Torr-L/sec

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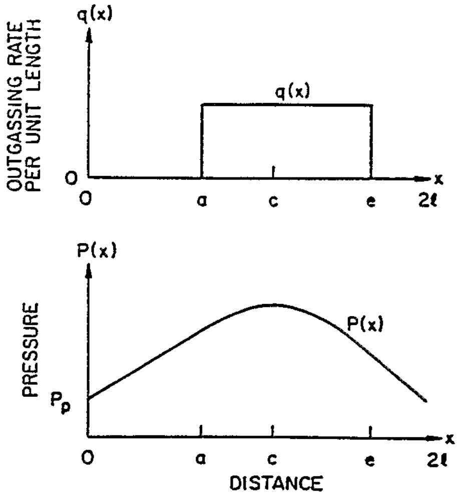
10/13/87

SUPER-PERIOD PRESSURE "BUMPS"
ESTABLISHING AN AGS MODEL

1) A pressure "bump" in the AGS is a local high pressure area stemming from outgassing of a component or a leak.

2) Outgassing from an AGS component may be represented by a spacial "square wave" or some other q(x) along the beam pipe.



"SQUARE WAVE" OUTGASSING FROM BEAM COMPONENT BOX OF LENGTH (e - a).

3) The outgassing may be interpreted as resulting from "n" little delta functions, of amplitude Q_d, outgassing within the box, where one of these functions is defined by:

$$\int_0^{2\ell} Q_\delta \delta(b-x)\mathrm{d}x = Q_\delta.$$

a source at "b".

Where
$$\lim_{\Delta x\to 0}\int_{b-\Delta x}^{b+\Delta x} \delta(b-x) = 1.$$

Figure 3. The average pressure for interval $(0,2\ell)$ will be calculated using delta functions distributed along the length $(e - a)$, as shown in Figure 3. Using the long tube formula it can be shown that pressure along the tubing with a single 'leak' at b and of magnitude Q_δ is given by:

$$P(x) = P_p + \frac{Q_\delta(2\ell - b)}{2kD^3\ell}\,x \qquad 0 \le x \le b \tag{7a}$$

$$P(x) = P_p + \frac{Q_\delta(2\ell - x)}{2kD^3\ell}\,b \qquad b \le x \le 2\ell \tag{7b}$$

Assume that the length $(e - a)$ is divided into integer n equal sections. Subtending each section let there be an outgassing function of magnitude Q_δ, where

$$Q_\delta = \left(\int_a^e q(x)\mathrm{d}x\right)/(n+1).$$

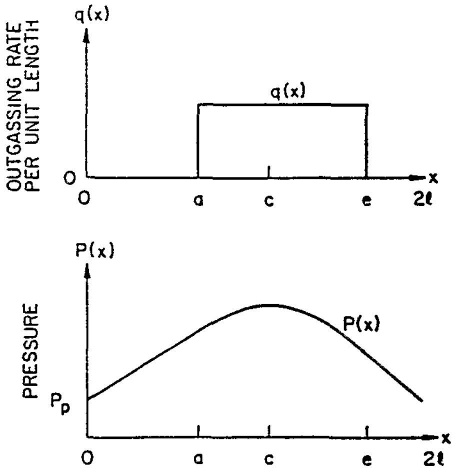


Figure 3. Pressure and nonuniform outgassing functions appearing between pumps separated a distance $2l$.

Define the following functions:

$$u(x) = u = 1, \qquad 0 < x \le 2\ell \tag{8a}$$

$$u(x - b_i) = u_i = 0, \qquad 0 \le x < b_i \tag{8b}$$

$$= 1, \qquad x \ge b_i$$

$$b_i = a + \frac{(i - \ell)(e - a)}{n}. \tag{8c}$$

Equation (8c) gives the location of one of the $(n + 1)$ delta functions. Note also that for some analytic $f(x)$ in the interval $(0,2\ell)$, equation (8) implies that

$$\int_0^{2\ell} u_i f(x)\,\mathrm{d}x = \int_{b_i}^{2\ell} f(x)\,\mathrm{d}x.$$

Using equations (7) and (8), $P_i(x)$, the pressure as a function of x as a consequence of the delta function located at b_i, is:

$$P_i = P_{p_i} + \frac{Q_\delta}{2kD^3\ell}\left[(2\ell - b_i)x(u - u_i) + (2\ell - x)b_i u_i\right]. \tag{9}$$

$$P_t(x) \approx \sum_{i=1}^{n+1} P_i(x),$$

or

$$P_t(x) \approx P_p + \frac{Q_p}{2kD^3\ell(n+1)}\{[2\ell(n+1) -$$
$$(b_1 + b_2 + \ldots + b_{n+1})]\,xu +$$
$$2\ell[(b_1u_1 + b_2u_2 + \ldots + b_{n+1}u_{n+1}) -$$
$$x(u_1 + u_2 + \ldots + u_{n+1})]\}. \tag{10}$$

The exact expression for average pressure is then:

$$P_{av} = \lim_{n\to\infty} \frac{1}{2\ell}\int_0^{2\ell} \sum_{i=1}^{n+1} P_i(x)\mathrm{d}x \tag{11}$$

which is:

SEVERAL PUMPS

$$P_{av} = P_p + \frac{Q_p}{4kD^3\ell}\left[\ell(e + a) - \frac{1}{3}(e^2 + a^2 + ea)\right] \tag{12}$$

Analytic expression for pressures

Where on the one hand particle beam physicists may be primarily interested in average pressure values, on the other hand there may be those interested in pressure values at specific locations. For example, should an rf cavity exist somewhere in interval $(0,2\ell)$, would there be problems of electrical breakdown? For this reason analytic expressions of $P(x)$ for a 'square wave' outgassing function similar to that shown in Figure 3 were developed. These expressions were derived using the long tube formula and equations similar to equation (5) for appropriate intervals. Due to the lengthy development only the results will be given, which are:

"Turbo" pumping
of r.f.c.

$$P(x) = P_p\left[1 + \frac{S_p}{kD^3(e - a)}(c - a)x\right], \qquad 0 \le x \le a \tag{13a}$$

$$P(x) = P_p\left[1 + \frac{S_p}{2kD^3(e - a)}(2cx - x^2 - a^2)\right], \qquad a \le x \le c \tag{13b}$$

$$P(x) = P_p\left[1 + \frac{S_p}{2kD^3(e - a)}((2c - x)x - e^2 + 4\ell(e - c))\right] \qquad c \le x \le e \tag{13c}$$

$$P(x) = P_p\left[1 + \frac{S_p}{kD^3(e - a)}(e - c)(2\ell - x)\right], \qquad e \le x \le 2\ell \tag{13d}$$

The value c is that point at which $\mathrm{d}P(x)/\mathrm{d}x$ vanishes and is given by:

$$c = \frac{(a + e)(a - e)}{4\ell} + e \tag{14}$$

AGS PRESSURE PROFILE FROM OUTGASSING EFFECTS OF G-10 POLARIMETER **

IF:

1) Static outgassing of the device is 2 X 10^{-4} Torr-L/sec, (i.e. X10 less than observed in tests after pumping 25 hours).

2) Outgassing from the Al box, valves and tubing adjoining the box is << 2 X 10^{-4} Torr-L/sec (it's probably on the order of 10^{-5} Torr-L/sec).

3) There are no leaks and beam chamber outgassing is negligible.

4) There is no increase in outgassing as the result of activation of the "fishline", with beam.

5) Only six sputter-ion pumps, on each side of the "box", pump on the static gas load (50 L/sec at each pump flange).

** This is not meant as a criticism of any particular component, but is given as an example to give people a "feel" for the super-period pressure profiles with outgassing.

THEN:

1) Total pumping on the box is ≈ 180 L/sec.

2) Pressure in the box is ≈ 1.1×10^{-6} Torr.

3) Note that because of sizing of tubing, the box is essentially 2 meters long (1/4 of AGS at 10^{-6} Torr).

4) The pressure at the 6th pump removed on each side of box would be:

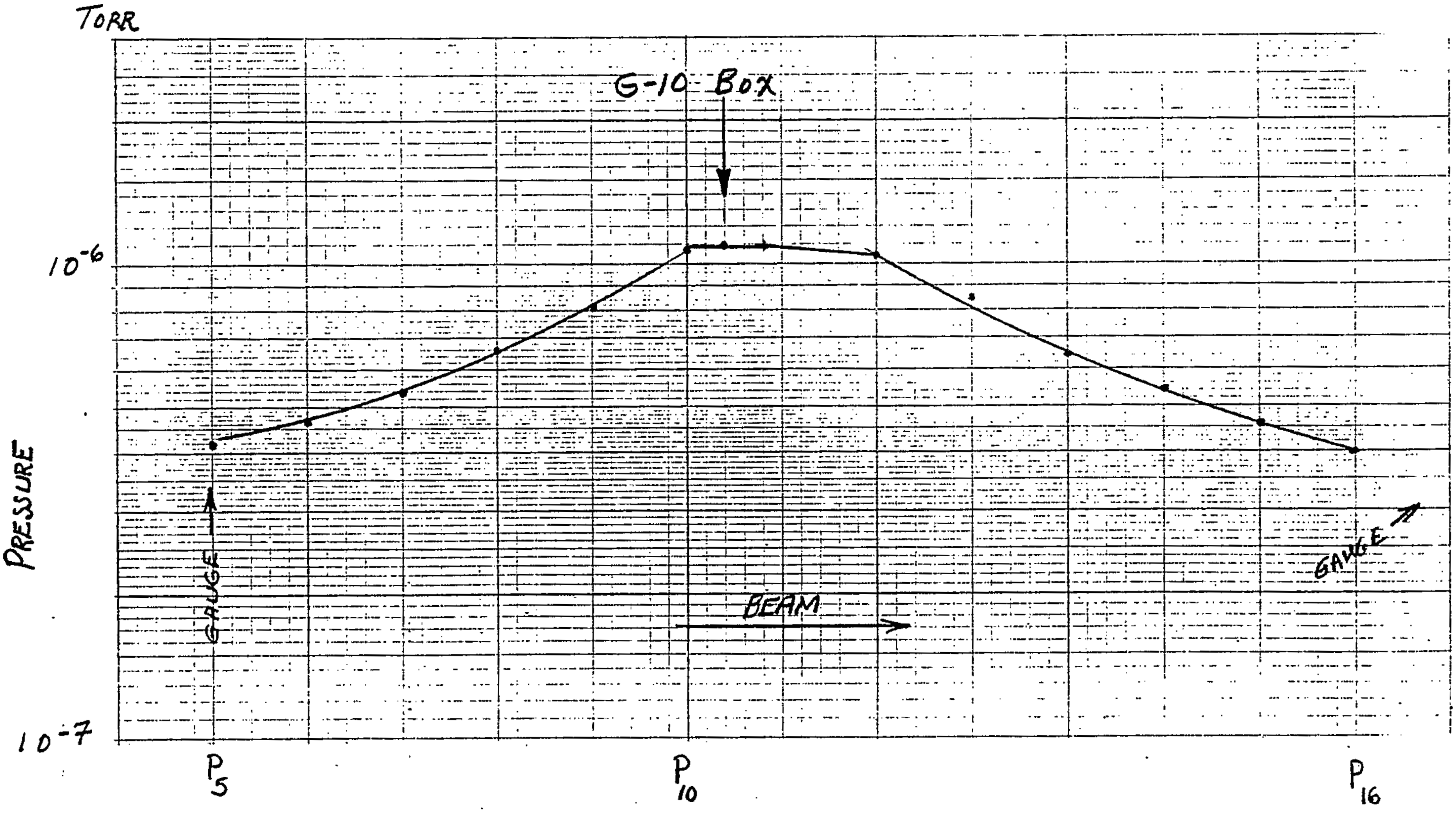
$$P_5 \approx 4.2 \times 10^{-7} \text{ Torr.}$$

$$P_{16} \approx 4.0 \times 10^{-7} \text{ Torr.}$$

5) The average pressure, P_{av}, for the total 12-pump section would be:

$$P_{av} \approx 6.9 \times 10^{-7} \text{ Torr.}$$

6) The pressure profile, dispelling the notion of a "local pressure bump", is:



IV. SOLUTIONS TO THESE PROBLEMS

1) FIX THE LEAKS.

2) IMPROVE OUR DESIGN PRACTICES:

    i) JOINT DESIGNS PRACTICES (E.G. WELDING, BRAZING, SEALOGRAPHY).

    ii) ESTABLISH "STANDARD" SEALING GASKETS FOR USE THROUGHOUT THE AGS.

    iii) IMPROVE OUR CLEANING PRACTICES.

    iii) IMPROVE OUR "CLEANROOM" ASSEMBLY PRACTICES.

3) SYSTEMATICALLY REFURBISH EXISTING BEAM COMPONENTS AND INSTRUMENTATION INCORPORATING NEW MATERIALS, JOINT DESIGNS AND MATERIALS.

4) WHERE REQUIRED, ADD ADDITIONAL GAS "SINKS".

5) WHERE GREATER "SINKS" WONT HELP, DECREASE THE "SOURCES" (our only option).

AGS DEPARTMENT ACCELERATOR IMPROVEMENT PROGRAMS
VACUUM RELATED PROJECTS

Kimo M. Welch, Joseph Tuozzolo
September 25, 1987

TABLE 3A, REV. A

PRIORITY NUMBER	ACTIVITY OR ITEM	TECHNICAL JUSTIFICATION	COGNIZANT STAFF		TENTATIVE SCHEDULE		COMMENTS	K$ (1)
			ENGINEER	PHYSICIST	COMMITTEE TO MEET	AIP WORK COMPLETE		
1	OBTAIN & INSTALL ALL 9-1/2" VACUUM CLAMPS	MECHANICAL DESIGN WEAK; PARTS FATIGUED.	VACUUM	N.A.	N.A.	SUMMER'88	AIP ESTIMATE -->	169
2	DEFINE, OBTAIN & INSTALL ALL 9-1/2" STANDARD VAC SEALS	NO RELIABLE STANDARD SEAL	VACUUM	N.A.	N.A.	SUMMER'88	(TEST FIX. $2.5K)	32.5
3	FLANGE RC NETWORKS: DEFINE, OBTAIN & INSTALL HYBRID CIRCUITS	PRESENT DESIGN CONFIGURATION, EMI, INDUCTANCE, ETC.	VACUUM	BRENNAN		SUMMER'88		25
4	FLANGE SUPPORT POSTS (RC NETWORKS): ELIMINATE.	NOT NEEDED; UNSIGHTLY; TAKES SPACE.	VACUUM	BRENNAN		SUMMER'88		0
5	D-17 FLAG: LIN.FD.DRIVE & FLAG MATERIAL MOD.	SEAL & FLAGS ARE MAJOR GAS LOAD	REPETA	Y.Y.LEE		SUMMER'88		15
6	STUPAKOFF FEEDTHROUGHS: DEFINE, OBTAIN & INSTALL ALTERNATE.	UNRELIABLE, HIGH MAINTENANCE ITEM.	BRENNAN	AHRENS		SUMMER'89		
7	SECTOR VALVES & ASSOCIATED CHAMBERS/TRANSITIONS.	CAST Al VALVES; ELASTOMER TRANSITIONS.	VACUUM	VANASSELT		SUMMER'89	DETAILED ESTIMATE	134
8	TACK WELD PUMP MOUNTING STAND SAFETY PLATES.	SAFETY.	VACUUM	N.A.		WIN'87		2
9	AUTO-VENT ALL AGS TURBOS.	OIL CONTAMINATION OF AGS.	VACUUM	N.A.		WIN'87		
10	SUPER-PERIOD ROUGHING VALVES: DEFINE, OBTAIN & INSTALL.	CAST Al VALVE; ELASTOMERS; OIL CONTAMINATION.	VACUUM	VANASSELT		SUMMER'89	DETAILED ESTIMATE	89
11	J-5/J-19 FLIP TARGETS, OLD DESIGN TO BE REPLACED IN '88.	HIGH AMBIENT & DYNAMIC GAS LOAD.	REPETA	THERN		SUMMER'88		
12	CHAMBER REWORK; COMPLETE NEW BELLOWS/FLANGE INSTALLATION.	RUSTING & "EDM" OF OLD BELLOWS.	VACUUM	N.A.		SUMMER'89	PRIMARILY G & GH.	
13	OVAL SEAL: DEFINE & OBTAIN NEW SEALS.	PRESENT SEAL UNREALIABLE.	VACUUM	N.A.		SUMMER'88		4
14	SKIM CUT OVAL SEAL FLANGES & INSTALL NEW SEALS.	ROUGH SURFACE FROM AIR FIRING CERAMIC COATING.	VACUUM	N.A.		SUMMER'89		
15	CHAMBER "SCRUBBING" DEVICE (EQUIPMENT).	OIL CONTAMINATION PROBLEM.	VACUUM	N.A.		SUMMER'88		
16	SPUTTER-ION PUMPS: DEFINE, OBTAIN & INSTALL.	NEED GREATER SPEED AT LOWER PRESSURES.	VACUUM	BLESSER		SUMMER'89		
17	SPUTTER-ION PUMP SEALS & EMI SCREEN.	RELIABLE SEAL; EMI & POSSIBLE RESONANCES.	VACUUM	BLESSER		SUMMER'89		
18	ESTABLISH PROTOCOL FOR VACUUM EQUIPMENT INSTALLATION IN AGS.	NONE EXISTS; REQUIRED TO PRESERVE VACUUM INTEGRITY.	VACUUM	JABLONSKI		FALL'87		
19	E-10 EXTRACTION MAGNET W/ WATER COOLED SEPTUM: REPLACE IN '88.	"IN THE WORKS."	ROGERS	BLESSER		SUMMER'88		
20	PUE's IN 5' STRAIGHT SECTIONS: MODIFY.	PLASTIC-->CERAMIC; ELIMINATE FLANGE F/T VIRTUALS.	BRENNAN	AHRENS		SUMMER'89		18

AGS DEPARTMENT ACCELERATOR IMPROVEMENT PROGRAMS
VACUUM RELATED PROJECTS

Kimo M. Welch, Joseph Tuozzolo
September 25, 1987

TABLE 3B, REV. A

PRIORITY NUMBER	ACTIVITY OR ITEM	TECHNICAL JUSTIFICATION	COGNIZANT STAFF		TENTATIVE SCHEDULE		COMMENTS	E$
			ENGINEER	PHYSICIST	COMMITTEE TO MEET	AIP WORK COMPLETE		
21	F-20: CLEAN UP & INSTALL STD. CHAMBER IN F-20.	UNNECESSARY SEALS; USE OF EPOXIES & PHENOLIC.	GILL	AHRENS		SUMMER'88		
22	F-5: FIX WATER LEAKS AND ADD PUMPING IF REQUIRED.	WATER FEEDTHROUGH "GLYPTOLED."	ROGERS	BLESSER		WIN'87		
23	B-1 CARBON FOIL: ALTERNATE ROUGHING.	HYDROCARBON CONTAMINATION PROBLEM.	VACUUM	N.A.		SUMMER'88		
24	B-5 CURRENT XFORMER; REMOVE OR REDESIGN.	INCOMPATIBLE UHV MATERIALS.	SIMS	WHITKOVER		SUMMER'89		
25	B-1 CARBON FOIL: NEW ISOLATION VALVE & CHAMBER.	OIL CONTAMINATION PROBLEM.	VACUUM	N.A.		SUMMER'89		
26	ELIMINATE 5' SS OVAL CHAMBERS WHERE NOT REQUIRED.	NUMEROUS SUPERFLUOUS FLANGES.	VACUUM	VANASSELT		SUMMER'89		
27	H-20 WIRE SEPTUM: OIL FEEDTHROUGH, OLD DRIVES & VACUUM BOX; RTV!	HIGH AMBIENT & DYNAMIC GAS LOAD; ADHESIVES.	REPETA	BLESSER		SUMMER'89		
28	FAST QUAD BEAM "PIPES": REPLACE WITH NEW DESIGN.	CERAMIC-TO-METAL JOINT; LIBERAL USE OF "SPRAY."	LEONHARDT	RATNER		SUMMER'90		
29	C-20 WIRE SEPTUM: ELECTROSTATIC INFLECTOR; AUGMENT PUMING.	DYNAMIC GAS LOAD.	REPETA	BLESSER		SUMMER'88		
30	G-10 POLARIMETER, "FISHLINE BOX;" AUGMENT PUMPING.	HIGH AMBIENT & DYNAMIC GAS LOAD.	Univ.Mich	RATNER		SUMMER'89		
31	A-20 LINAC/AGS INJECTION: CAN BE REPLACED W/ STRAIGHT PIPE.	NUMEROUS UNNEEDED FLANGES & JOINTS.	JABLONSKI	BARTON		SUMMER'88		
32	A-10 BEAM TUNER: FERRITES IN VAC. REQUIRE LONG BAKEOUT, OLD "BOX".	ISOLATION VALVES TO PRESERVE NEIGHBOR VACUUM.	VACUUM	Y.Y.LEE		SUMMER'89		
33	BUMP COILS: ASSEMBLY & STORAGE PROCEDURES.	METHODS & PROCEDURES.	CAMERON	Y.Y.LEE		WIN'88		
34	ISOLATION VALVE BETWEEN "SPLITTERS" & SECONDARY EM. MON.	MINIMIZE AMOUNT OF SYSTEM VENTED.	VACUUM	BLESSER		SUMMER'88		
35	H-5/E-5 SINGLE BUNCH EXTRACTIONM KICKER MAGNET; MEASURE THROUGHPUT.	DON'T YET KNOW IF PROBLEM EXISTS.	VACUUM	BLESSER		FALL'89		
36	L-20 BEAM CURRENT MONITOR: MODIFY.	REDUCE VACUUM JOINTS & USE METAL SEALS.	VACUUM	AHRENS		WIN'88		
37	CLAMPS, 13" & 15" O.D.: ASSESS MECHANICAL INTEGRITY.	MAY NOT BE PROBLEM.	VACUUM	N.A.		SUMMER'89		
38								
39								
40								
41								
42							FY'88 PROPOSED --)	55