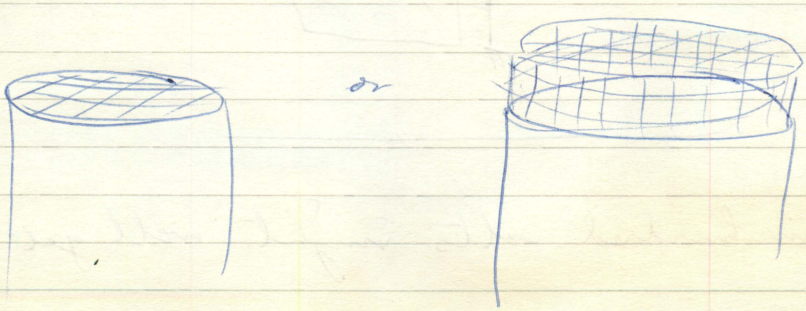
24 Jun 74

Inserting SS mesh into chamber to prevent
a) stray bodies dropping down into valve
b) stray ions existing from the depths & chewing the end off the tip (no rods shield fitted
∴ crystal has gone back to 4G.

Transparency of mesh :- ≈ 20 thou wire, 10 per inch
In 1 in^2, are $10 \times 1 \times 20$ thou = .2 sq ins
$+ 10 \times 20$th $\times (1 - 200$ thou$) = .2 \times .8$
$= 1.8 \times .2 = .36$ sq ins of wire.
≈ 75% transparency.

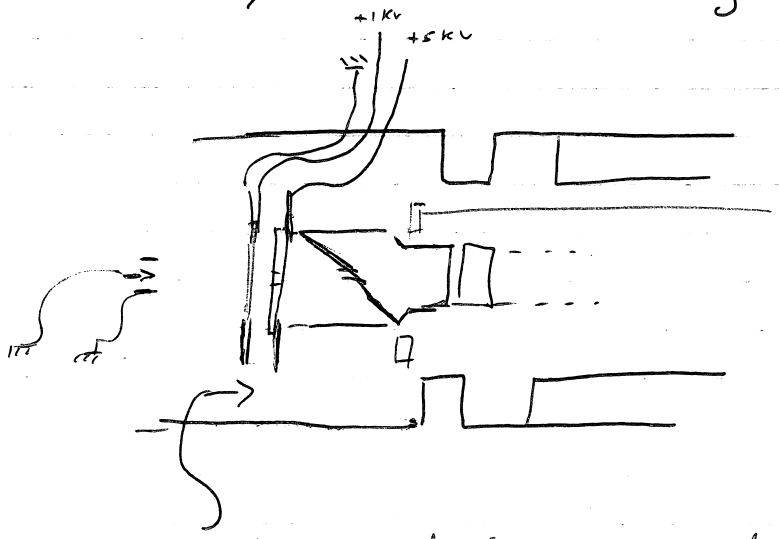
∴ To retain original pumping speed,
do not put mesh directly over ¼" tube, but bridge it up over top

ie



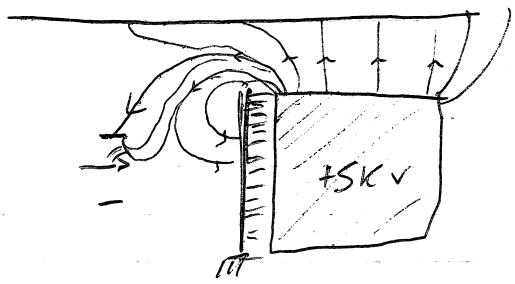
30th Jan '73 Since fitting the mesh has had no appreciable effect ? what other source of stray fields.

Chris the screen/mirror assembly.



1 1/2" gap at side of annulus.

? can field from mirror box penetrate tip vicinity, causing fe from tip & sputtering by gas ions.



Oops ? few hundred volts might well get to tip.

∴ put a "radn shield" on cryostat (cold finger)

Cold finger rebrazed on Monday 29 ∴ ~~take~~ let up to air at 11.10, pumping down by 13.20 !

VG (P. sales) phoned up Tues am to say that cryostat may take 4–5 weeks to fix as a new centre-section will have to be put in, & their insurance co. satisfied first.

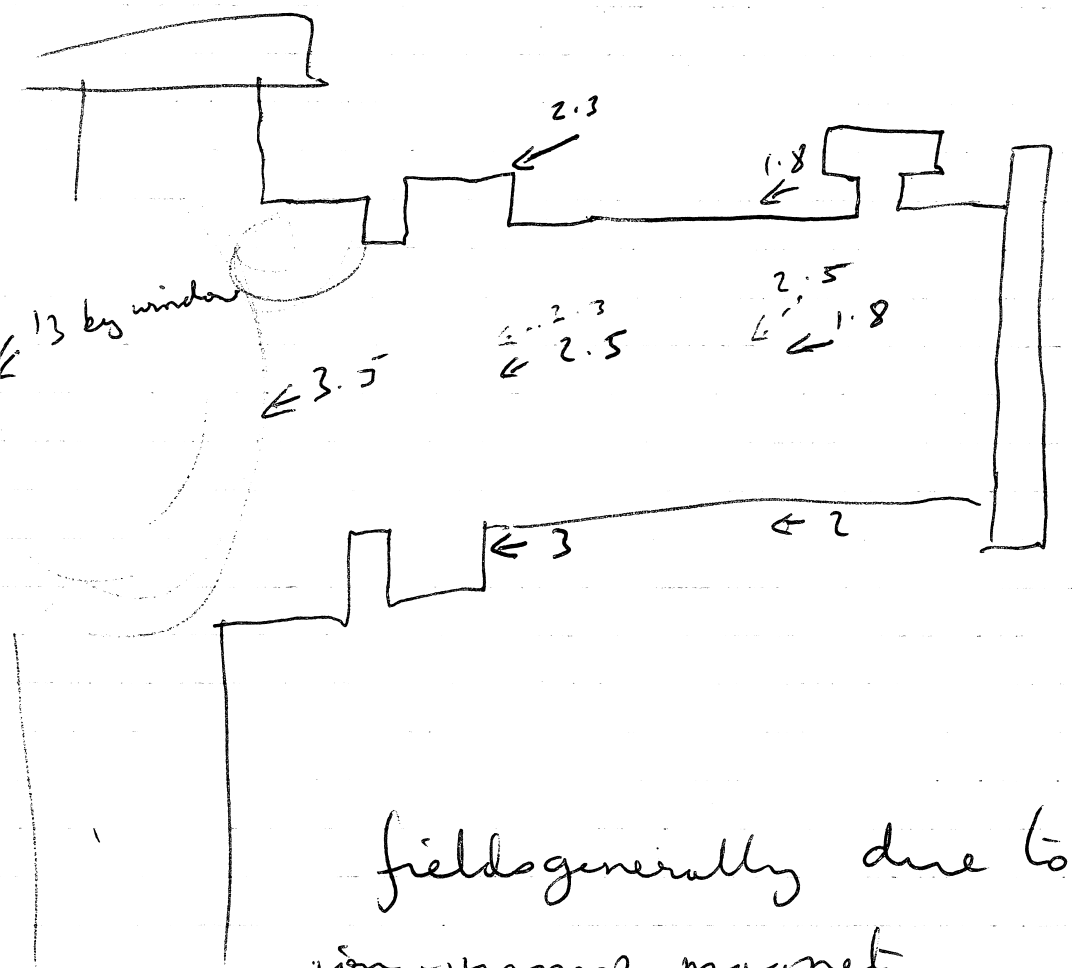
Investigns with a Keithley showed ≲ 2 pA tip current connected with the ion gauge (≲ independent of pressure, so ? electron from filament). Nothing from ion pump. Keithley reading not steady when connected on, few pA waves + occasional sharp flicks; readings not consistent between ranges so likely to be capacitative effects from HT to high impedance leads.

? are 2 pA enough to damage tip. Seems v. unlikely even if persistent & distributed over whole of tip, presumably.

27 Feb 72

Magnets

Investign of fields round microscope, (Varian Old ion pump



13 by window

fields in gun

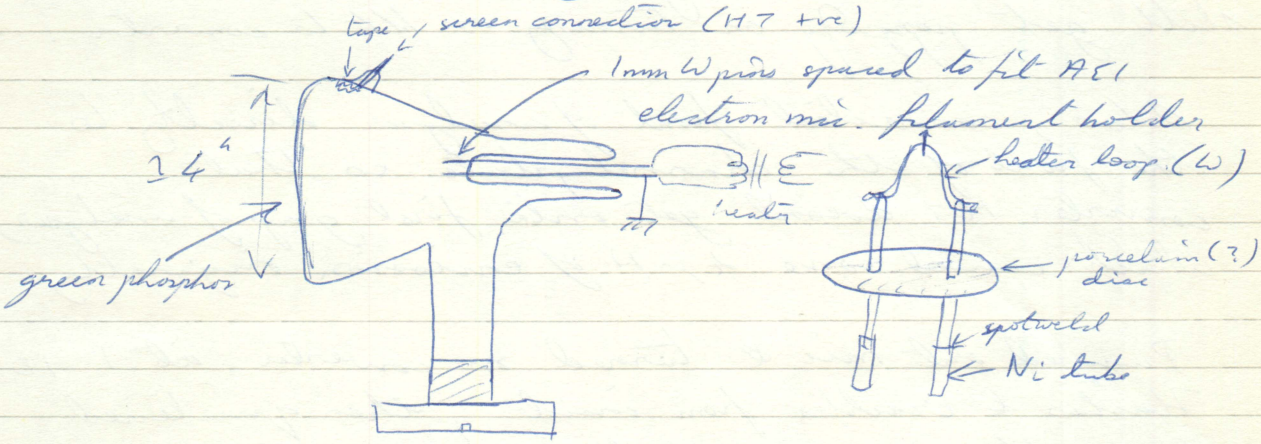
fields generally due to the ion-pump magnet.

- small local varns near windows.

Fields round a new Varian ion pump were investigated & found to be down by at least 10 over the old style, giving 1·5 gauss (mainly earths field) at 1 pos of analyser.

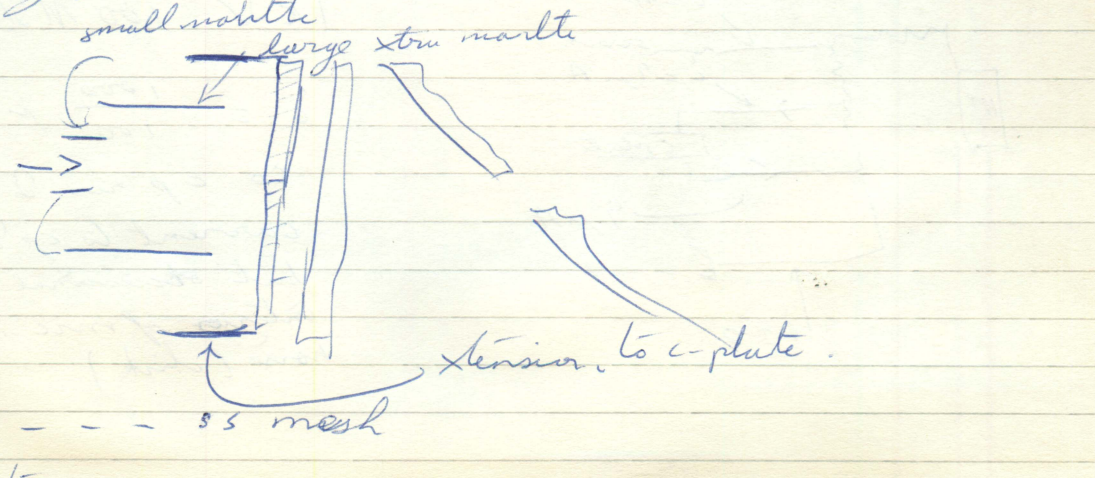
8 Feb

Today a tantalum tip put into field emission tube attached to the VG microscope (tube is thus :-



Scheme is to look at Ta oxide film as a field emitter as JB Swindon (who polished tips) thinks it shouldn't be affected by rubbish arriving on its surface.

Big Tesla converter/analyser section of flying pig to try to find out ~~what~~ why it makes sparking noises, & has bright flashes, & apparently shunts tips (11 failures to image below 6 kV in argon to date in spite of added shields to screen tips from fields of ion pumps & gauge & converter



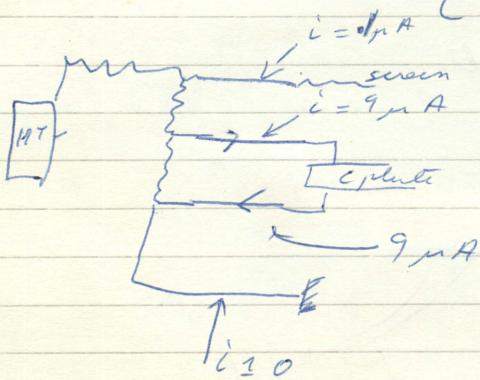
Found that mirror-box was not effectively connected to the screen: attempted a temporary fix by using a sprung bit of wire, but possibly came loose while inserting into mic as still get popping on turning on HT to converter.

Also, connected front of analyser directly to the front of the channel plate so that converter HT doesn't get onto first gap of analyser which caused some 4 μA of emission originally.

Pumped out mic & turned on converter at $1 \cdot 10^{-7}$. Flashes & crackles from inside, then quietened down with an occasional bright flash.
Front of cp was connected to annulus (checked while in piece, ~ 100 Ω from centre of plate to annulus)
Front of cp looks grotty — some blemishes of unknown origin + scratch acquired when extra mantle slipped + piece of metal embedded, believed to be remains of a flushed lip (spot appeared after lip flashed).

Some emission round edge of plate.

Current measured (→ 50 GΩ)



1 kV 100 MΩ

$i = \frac{1000}{100}\ \mu A = 10\ \mu A$

so cp res. to ∞.
Current to cp to ~ steady, but occasional waver when interior of mic makes sparkly noise (click)

Turned tips up in field emission ≥ 1.5 KV

Measure screen current as a function of picture brightness: 1 μA to bright, .5 μA ≥ equal to 'normal' TEM picture intensity & 2 μA to v bright.

FE picture looked reasonable for a v dirty tip: shadowy bright blobs, no structure apparent.

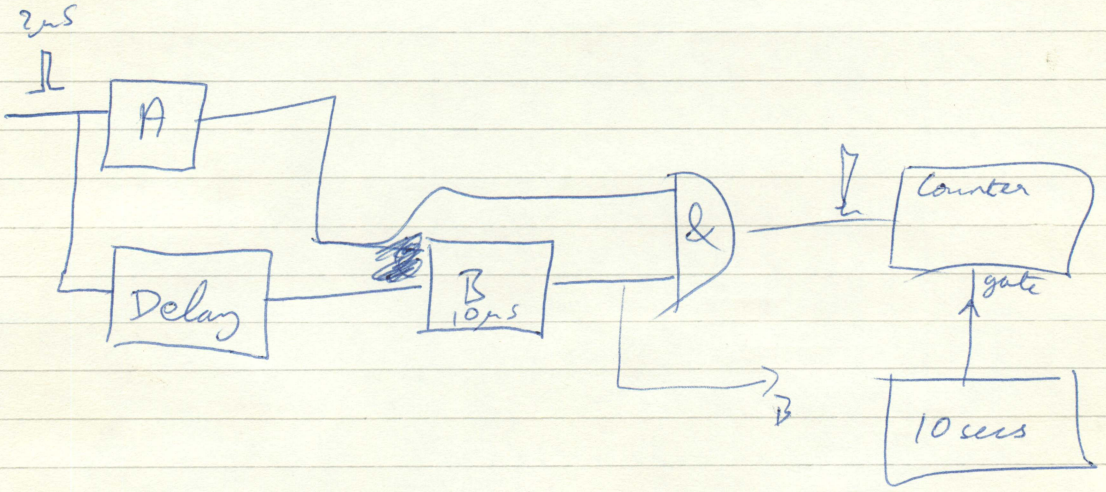
Tip was believed to be fairly blunt (RST estimated 10 KV in TEM) so will replaced with a sharper one before using TEM.

Rough

Experiments on time delay between pulses from W tip, 78K, 4×10^{-5} Hc to see if any dead ti
Gate width = 10 μS exists after emission of a field ion from a region o
the tip: rough expt only to test apparatus et

Delay, μS	Count in 100s					
10	1944					
20	1872					
	in 10s					
30	176	169				
40	201	190	194	12,693	12758	in 10 se
50	179	214	168	213		
60	174	189	206			
70	192	193				
100	184	165	197			
200	184	163	169			
300	150	134	147	9715	9776	
700	88	103	117	115	7184 (taken from B)	

Reducing delay to 0 puts count up to ~ 1/4000 again
so ? what goes on = correct ?



Delay ignores all pulses occurring when it is 'on'.
∴ count from B gives no of pulses not ignored by Delay.

~~[illegible]~~

. Need a count of number of times n that delay to trigger as well as " " " m that gated pulse to counted to be able to calculate the probability of a pulse occurring in an interval δt a time Δt after the first pulse.

Probability ~~[illegible]~~ no of pulses occurring in a time δt is $\bar{n}\delta t$
where $\bar{n}$ is no of pulses / sec.

$P(t)$ is probility of a pulse occurring time t after a previous pulse

Delay	n	m		$P(t)$	$P(t) \times 10^{-5}$
10	5171	317 326	$\frac{315.4}{5197.5}$	=	.06068
	5200	311 296,327			
	5129, 5290				
20	5088 5105	355 328 353			.0678
	5124 5111	357 344	5107		
30	4777 4834	339 337 348 356	4853		.07109
	4910 4890				
40	4707 4631	299 283 319 304	4658		.06467
	4663 4631				
50	4460 4508	286 282 289			
	4328 4387	284 269	4435		.0636
60	4225 4257	280 254 267 260 288	4246		.0626
	4215 4288				
70	4188 4098	234 270 244 270 223	4140		.0609
	4192 4085				
80	3926 4044	251 244 249 236 260	3943		.0628
	3843 3910				

90 3817 3791 259 248 233 .0632
3834 3835 230 246 3819

200 2748,2790 176 186 176 156 .0646
2762 2770 178 199 180 2767

300 2206 2201 147 170 122 .0659
2198 2258 127 155 155 2215

400 1861 1860 119 112 124 .0657
1861 1842 127 133 1856

500 1573 1583 1603 86 120 96 .0657
1594 1584 1568 107 98 114 119 1585

600 1386 1371 86 91 88 87 .0625
1375 1390 1367 87 90 76 88 1377
1371 1383

10 5276 5201 340 308 301 .0609
5260 5360 326 317 336 5274

4 5406 5304 254 268 265 .0470
5355 5244 242 244 236 5350
5365 5428

2μS pulse

50n Spube

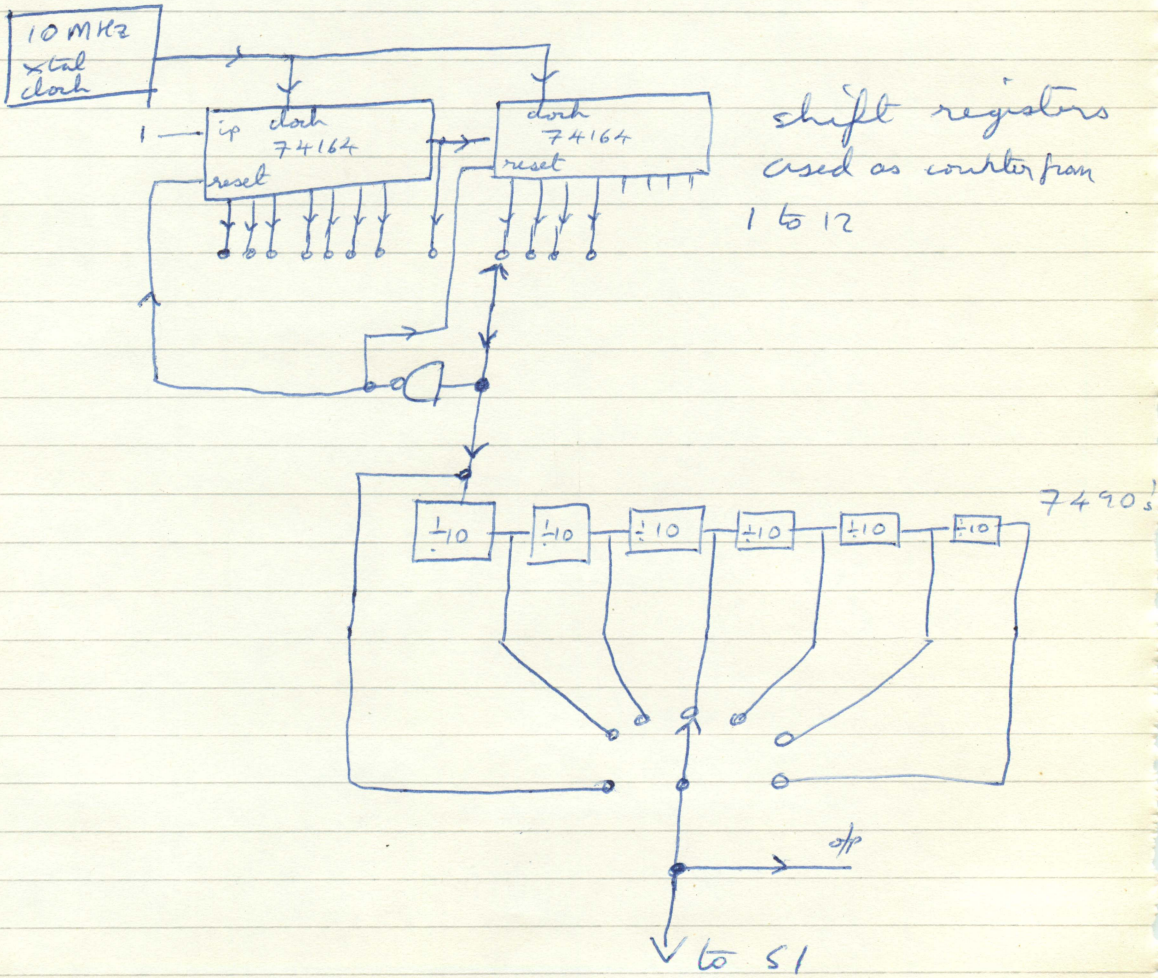
4 5170 5077 5242 230 233 240 .0447
5164 218 230 235 5163

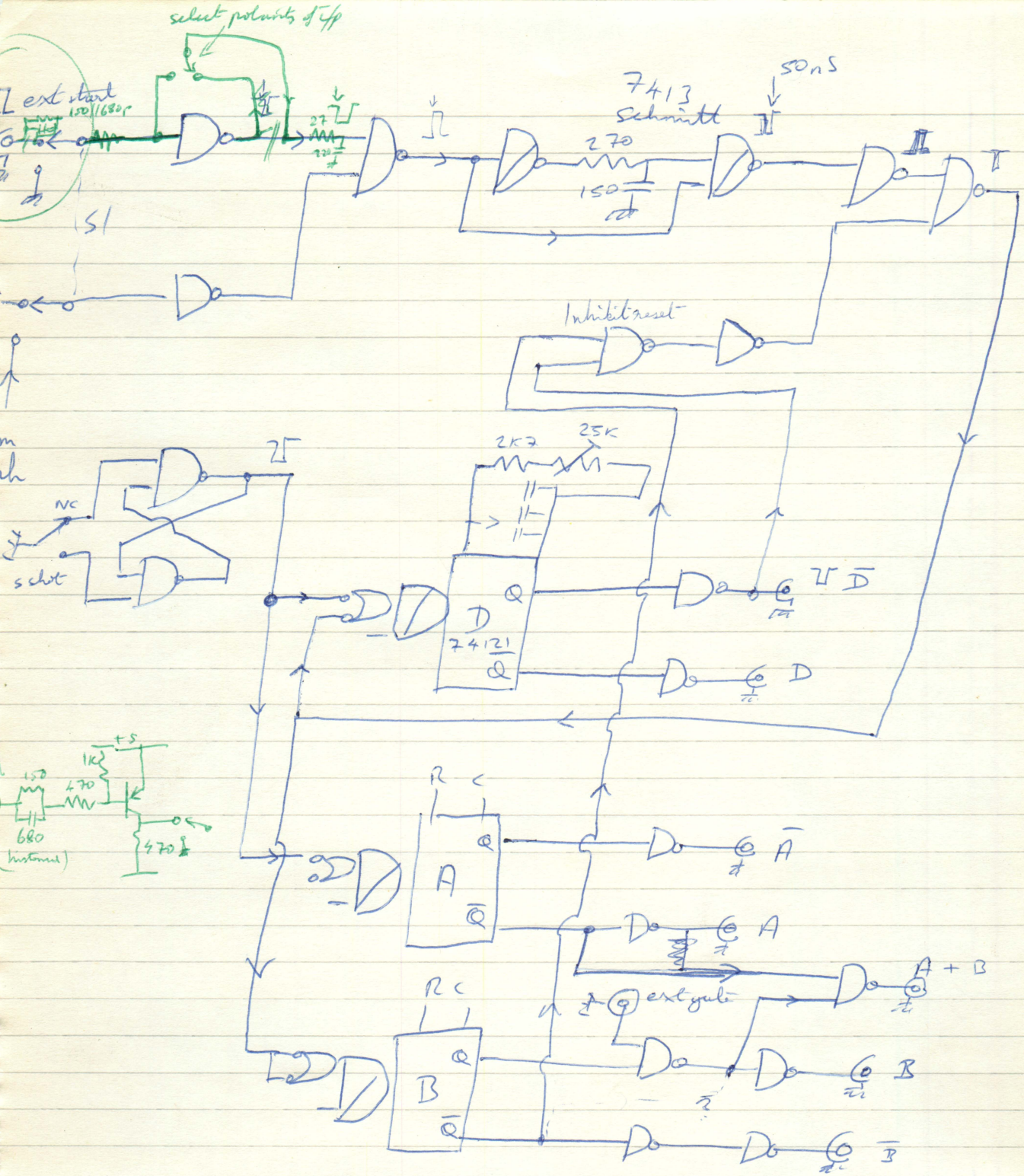
0 4930 4979 219 270 229
4907 4992 214 217 225

4867 .0477

Circuitry of delay/pulse generator.

This circuit produces an instaneous and as delayed pulse on receipt of an external triggering signal, or from an internal crystal clock or pushbutton for single shot.
Pulse widths are adjustable from 100nS to 1 sec in decade ~~slot~~ steps and fully variably within each decade.
Repetition rate is from 10MHz to ≥ 1Hz.
~~Manual~~ Delay is from 100nS to 1 sec.
The delayed pulse may be gated from an external source.





All ⊐D are 7400 4-NAND gates

74121 Monostable
7413 2-Schmitt
7490 Decade Counter
74164 8 bit shift register

26th Feb 73

He $3 10^{-5}$ He Mult 2.25 KV 78°K Tip 3.3 KV

Arbitrary point on tip

Ion current/sec 2309 2299 2278 2432 2370 2344
2389 2351 2386 2346 2360 2442
2333 2305 2341 2381

50 nS pulse from ratemeter

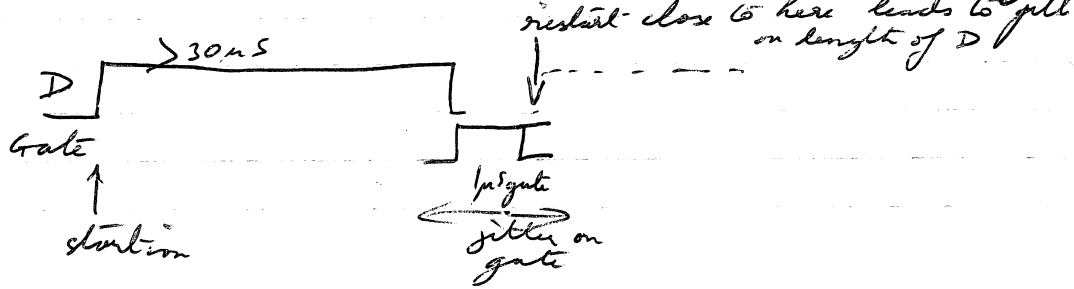
Gate width 1 μS

Ungated		Delay	
2544 2451 2452 2384 2459 2482	(2954.8)	1μ	6 14 8 8 8 3 8 8 11 8 5 9 8 6 8 9 5 132/17 = 7.76 → .002628
2423 2480 2456 2454 2423	(2447.2)	2	6 10 9 7 9 15 3 7 8 4 7 11 6 7 5 7 4 125/17 7.352 .0030046
2508 2576 2478 2482	(2511.0)	3	4 2 13 6 5 9 10 9 5 5 6 5 .002622
2522 2442 2519 2584	(2516.7)	4	6 8 5 6 8 6 3 7 3 3 7 8 9 5 8 .002437
2342 2328 2297 2307	(2318.5)	5	4 9 4 5 7 7 8 3 6 9 4 6 5 4 .00249

2248	2356	6	3	4	3	8	6	2	9	7	9	6 7
2403	2397	2351.0	6	13	8	9	11	5				.002903
2784	2845	7	7	11	8	5	8	9	7	8	8	4 6
2772	2745	2786.5	12	7	8	8	6					.002716
2806	2736	2760	8	5	11	2	10	6	6	8	11	8
2773	2725		6	4	7	5	10	9	11			.002694
2684	2774	9	11	5	23	31	35	28	34	21		
2703	2828											
4975	4893		25	28	23	30	30	24				
4804	4990											
4769	4936	10	20	28	37	26	35	27	34			
4856	4707											
4705	4652	20	28	26	26	29	24	29	26			
4647	4604											
4371	4374	30	40	24	23	27	34	23	28			
4449	4356											

step change in current

At this pt the jitter on the delayed pulse is getting large - this must be due to the delay monostable being retriggered too soon, as the leading edge from the delayed gate has become small compared to the width of the delayed pulse :-



Soln might be to use long wondelayed pulse A as the relo on restarting the delay monostable ~~— shorter A other pulsing~~

Also done today with DG Brandon — looking at a 10 volt anodised film of oxide deposited on a tungsten 4kV field emission shroyed tip (thermally cleaned to give clean ~~sp~~ picture in 4kV).

Field emission picture appeared at ≥ 4kV: picture was clearly related to substrate metal but not like normal 'dirty' W picture (data on which were collected on 23rd Feb, with & without the field on).

On warming up to a few hundred degrees (tip had been baked to ≥ 250 in base at 5 μm, for ≥ 30 hrs) (now red heat) the oxide apparently recrystallized). ~~On further heating~~ ⇒ & became more stable (less flicker: no trace of whiskers formation before or after) in ≥ 4 10^{-10} (screen outgassing: otherwise 4 10^{-11} Torr)

On further heating some sorts of whisker seemed to form: v bright spots: Heating to a dull red removed these. Structure of oxide changed further. Alternate heating & imaging carried out until ≥ clean W picture occurred.

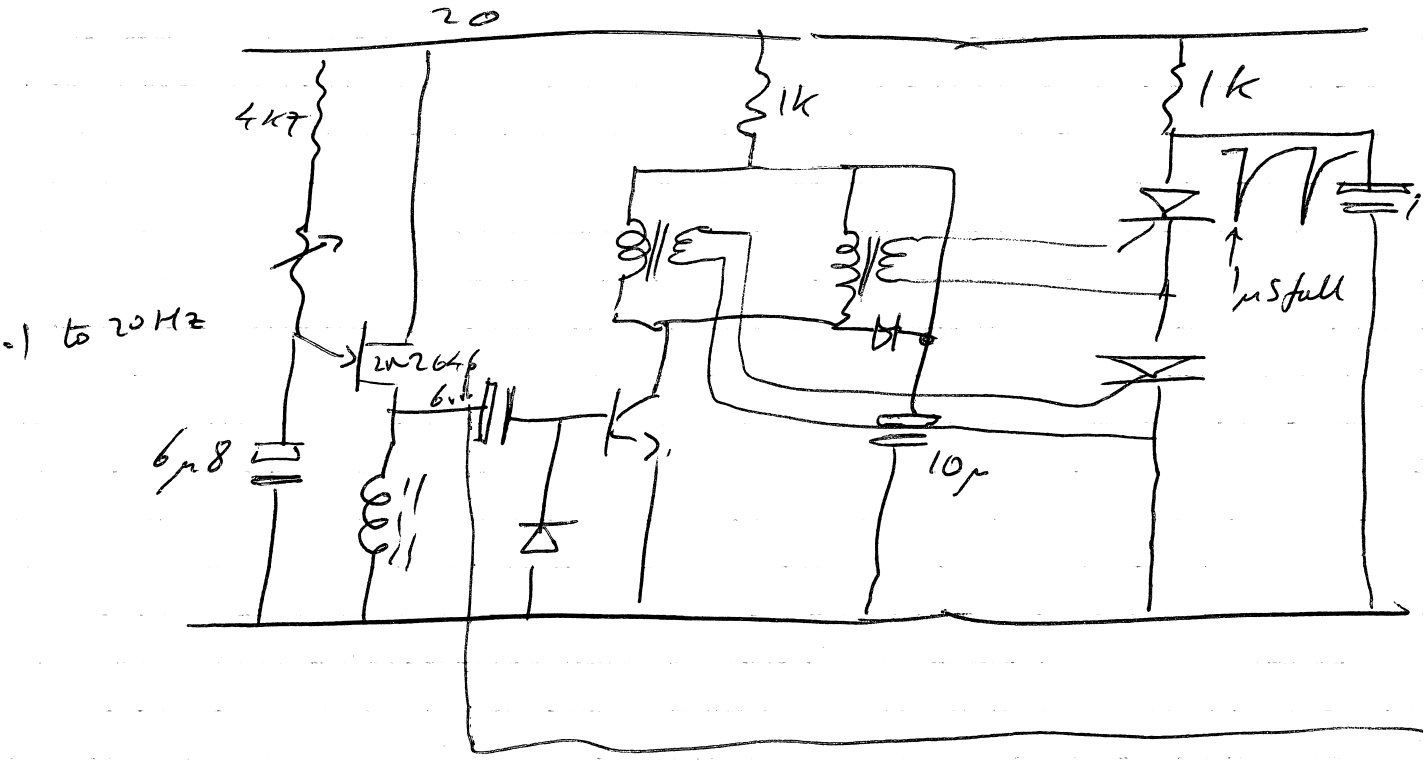
At this point the tip was heated with the field on: at a low temperature a film edge was observed to move towards

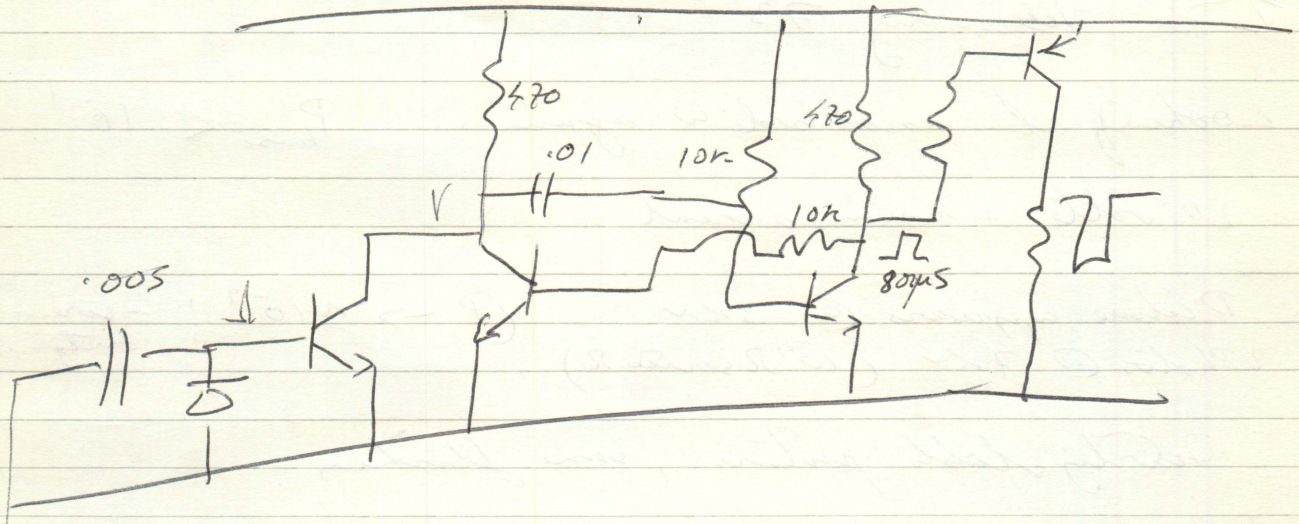
111
100 110 100
111

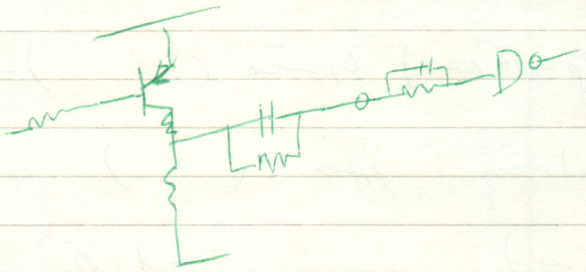
the 100 poles & could be stopped by removing the heat: heating was continued in bursts until a fully field/heat-built-up endform was obtained, pictures being taken. The the tip was cleaned & recycled, the film edge again being seen. Finally the tip was flushed white-hot to give a clean 4kV image, & removed. A 20 volt anodised film was applied by DB & the tip put back in the microscope & rebaked. 3 films of Trix taken, 1 sec exposures. Developed. Slightly underexposed.

Motorola MECL 10116 line receivers ordered to try to make a more stable & faster amplifier.

Continuing with high voltage pulse generator for ed boxes to evaporate aluminium with. Thus far:-




470
.01
10k
470
10k
80μs
.005



27th February '73

Looking at anodised W again. $P_{base} < 10^{-11}$.

20 volt + 4 min anneal.

Picture appears @ 3KV. ($P \rightarrow \simeq 10^{-9}$! - screen outgassing)
2 Photos @ 7KV ($10^{9}\Omega$ series R).

Fairly stable picture, some flicker.

Heat-
→ 10v 1 pic (heat-off)

12½ 1 pic (")

15 (→ 10^{-9} & down) 2 pics ( ) → 100 pole appearing dark.
2 for 10 secs

15 for 1 min 1 pic ( ) 100 pointer, some changes.

16 (15 secs) 1 pic $P \rightarrow 1.10^{-9}$
leave for ½ min.
2nd pic (dark band appearing).

17½ (10 secs) 2 pics picture changing.

19 (5 secs) 2 pics 1 after 10 secs. Big rings appeared. Picture not very stable, trying to form bright (whisker) spots.

19 for longer. Dull red (in dark) Similar. Unstable. 1 pic

20 Rings gone. 1 pic. III become very bright (? whisker growth).

20 for longer. 111 still v bright 1 pic

22½ 10 secs 1 pic. Pic flickering :. 111 v bright

22½ for longer Orange glow. 1 pic. Whiskers on 111.
Not at all stable.

23½ 5 secs 2 pictures. Similar. Flickering.

25 (p.s10⁻¹⁰) 5 secs. 1 pic. Holes appearing in 100 ;
~ hexagonal. 111 still v brite.

25 for longer 15 secs Stabler but still reverts to bright 111
1 pic

27½ Orbital glow in dark. 2 pics. 100 Now bright. Nature
still flickers but 111 does not take over.

27½ for longer time 20 secs 1 pic. Area between major poles becoming visible.

28½ 10 secs 1 pic. " " .

30 " 1 pic "

32½ 5 secs 1 pic. 111 becoming less prominent

35 ($p \sim 3 \times 10^{-10}$) 1 pic. Practically monolayer picture. Just a few random bright spots on 111

37½ 2 pics. Nice picture. Stabler but not totally stable.

40 White heat. 1 pic. $P \to 1 \times 10^{-9}$ with picture visible for 2 secs appears at ≈ 3 kV. Much stabler.

40 for longer ($p \to 2 \times 10^{-9}$) 1 pic. 310 bright & fairly stable.
10 secs 190 least stable (boiling) but only small amplitude fluctuations.

42½ 2 pics 17 secs apart, P 2×10^{-9}.
Pic → grainier.

45 5 secs (p 2×10^{-9}) New film (2nd) 100's holes.
1 pic. Fairly stable.

45 15 secs 2 pics 15 secs apart. P $1\frac{1}{2} \times 10^{-9}$.
Contaminating bombardment.

47½ 1 pic. Similar.

50 1 pic " .

End of Expt.

Phoned VG re Crystal which the Lave had since ~ Dec 24 : Psales "We are waiting for the insurance company to OK it before we start to fix it". !*!!!?

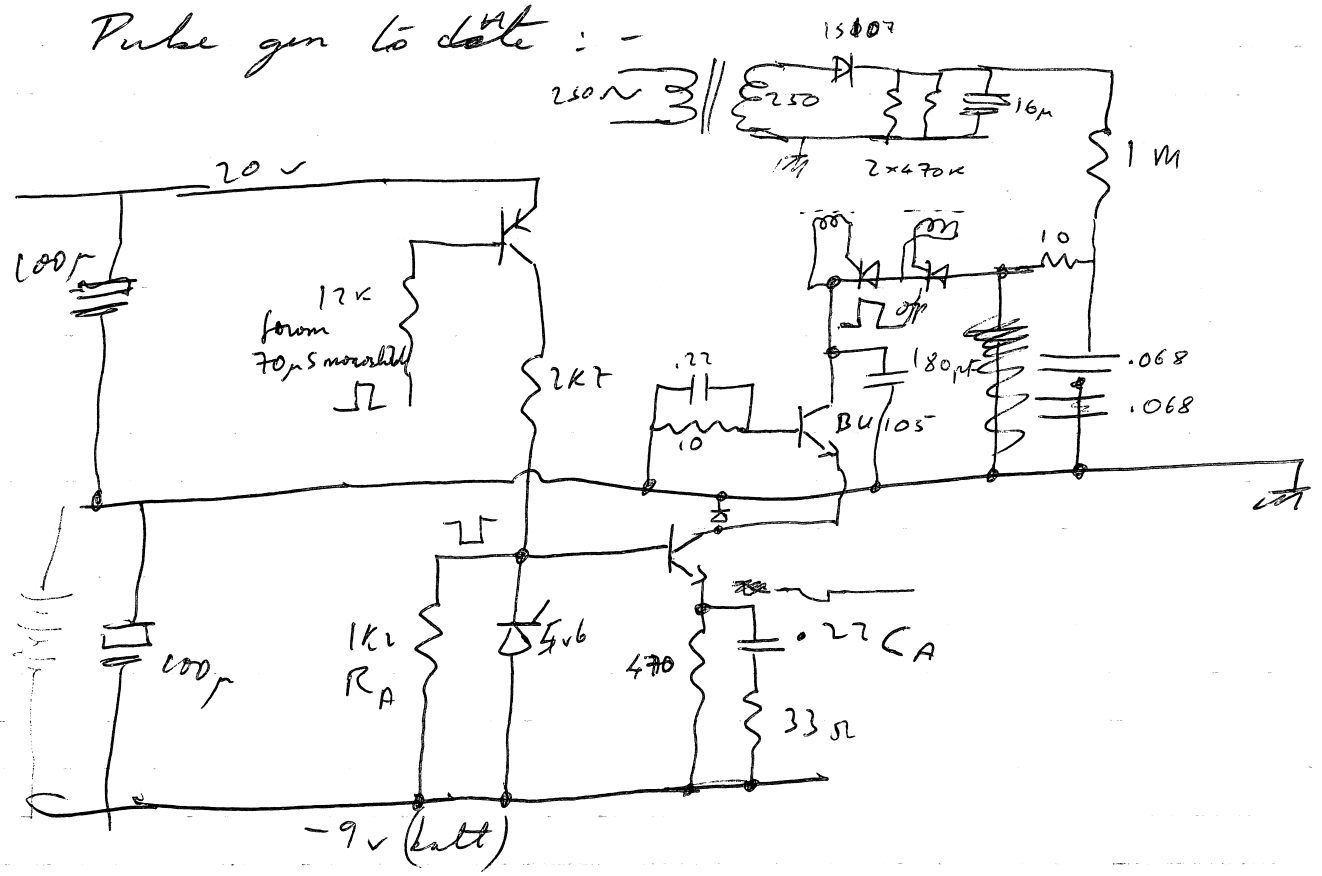
Emb pump filaments gone on flyaby jig.
Tip removed, so can wind up volts in argon to bury & remove whatever is causing the discharge.

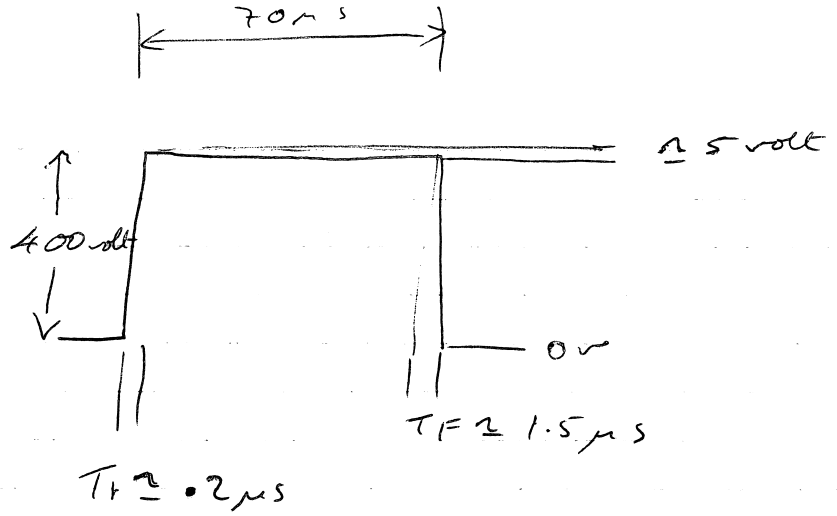
2 Mar 77 Phoned P Sales re crystal: say that should be finished by the end of next week. Shall believe it when I see it.

Printed pictures obtained from Langelia ~~the~~ FE on 27th. Look interesting — printed as contact print would make good xmas card ('snowflakes?!)

Continued with pulse generator for Ed (+ve KV pulses 0 (100 μs) long). Have thought of another use for it:- the Mk 2 analyser (// plate deflection of ions onto a channel plate as detector) would be improved if the c-plate to screen voltage was pulsed after the evapn pulse when looking at field evaporated ions, so that noise on plate should become insignificant.

Pulse gen to date:-





Output pulse looks v good.

≃ 1% slope & v good rise time.

R_A & pull-down resistor for current source. C_A + 33 Ω resistor provide a high initial discharging current, but allow the 470 Ω resistor to limit continuous current to ≃ 10 mA. Decreasing 33 Ω should decrease the pull time of the off pulse. (limiting factor is the ~~the~~ rate at which voltage may be applied to the thyristors without retriggering them.

DL 105's don't like > 1500 volts so replaced with a pair of pull-down thyristors.

March 12 Fri   On Monday Field Emission meeting at Imperial College. Lot of talk about carbon fibres as emitters stable in the $< 10^{-7}$ torr range: No crystallography is apparent & the current (total) is noisy, especially @ < 100 Hz ($\frac{1}{f}$ noise)

Tips are polished either by a corona discharge in air or by electroplating (W, Cu) & then polishing fibre in NaOH (dc).

Since carbon fibres have non-uniform properties, it seems a good idea to take a thermally rounded tungsten tip, coat it with amorphous carbon in an evaporator, & either use the film straight or graphitized, or diffused into the W as a carbide.

Tried expt & on Thursday a quasi-stable emission pattern from a tungsten carbide film was obtained! This was run at a dull red heat to remove contamination, in a vacuum of $1.5 \, 10^{-7}$, for 8 hrs. The pattern changed slowly as the C diffused inwards (?) but the pattern remained clean & well characterized: the 111 poles tended to give the brightest & most stable emission. On letting in air to worsen the vacuum, a limit was reached at $1-2 \, 10^{-6}$ torr above which irreversible changes tended to occur & extra heating was needed to keep off crud: pictures were obtained @ 10^{-5} Torr at which point changes were fairly rapid. Looks a v promising electron source.

20th March '71.

Tungsten coated with Carbon (? Pt)

P 6 10^{-11} with l_iN_2 in cryostat.
→ 2 10^{-11} — few 10^{-10} with screen outgassing.

Tip was one which had previously been carbon-coated & then 'cleaned' @ white heat in 2 10^{-7} vacuum. This was then put in the carbon evaporator & a thin film of carbon (easily transparent) applied in 1 10^{-4} vacuum. Baked overnight.

On turning up tip in field emission, many bright-spots, doublets & quads were seen: a smaller number of structured 'haloes' & rings were seen. On warming the tip with the field on these became blurred as if thermally agitated. ? should the resolution of a surface atom or molecule be diffraction limited, because the electron energy is likely to be different to the fermi energy of the metal (?) think about it. On further warming 'whiskers' were seen to grow & disintegrate. These occasionally had very 'sharp' edges to the emission pattern. One was seen to 'shadow' another in close proximity, presumably by screening the edge of it from the field.

On further warming, an emission pattern with poles was eventually found. Its crystallography was not obvious & was not simply related to the underlying tungsten (xtal orient. known from previous images) This structure was very resistant to change by heating, with or without the field on. Fuzzies effect was pronounced at all times & couldn't be totally eliminated by warming. After flashing to a medium white heat for several ~~after~~ seconds on a number of occasions with the field off, a pattern was obtained which was

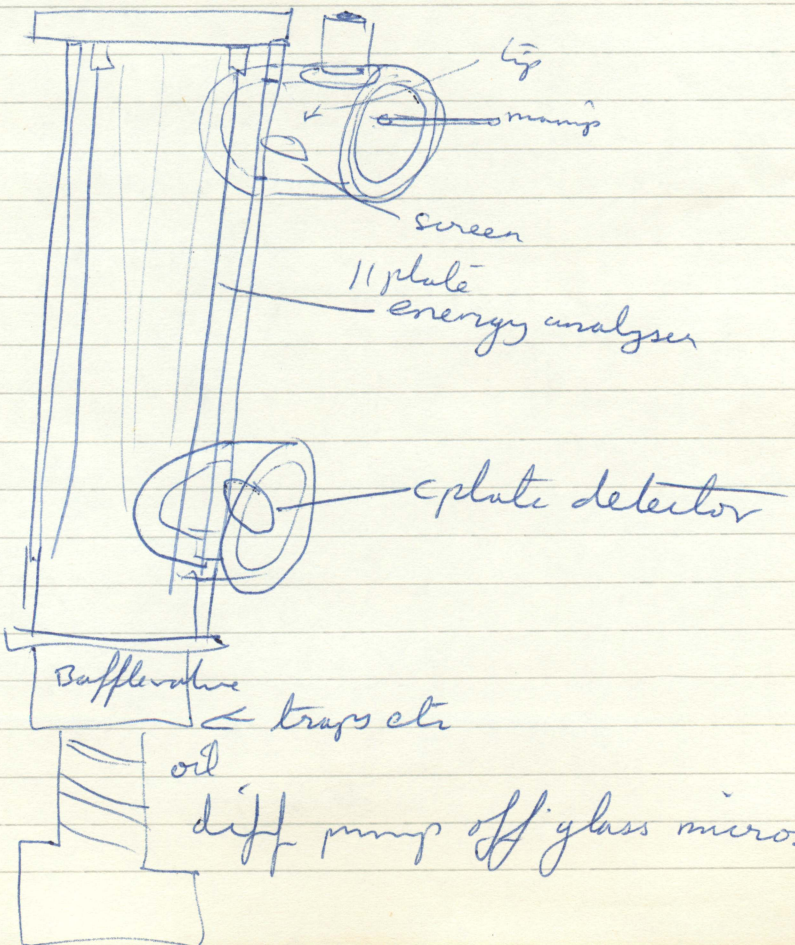
clearly related to the previous work & to the tungsten substrate, When the tip was raised to the same temperature @ which the previous layer had been stable, the emission pattern was drastically altered. Various ways of treating the tip with heating ± field & imaging ± heat were tried: emission was generally more stable than before, though apparently not more so than in the 10^{-7} run. Heating without the field gave a 'featureless' picture like clearish W, but reapplying heat with the field on led to marked changes, probably because of diffusion of C from solution in the metal towards the surface. Finally, after heating to ≳ 3000 K the loop broke (preserving the tip).

21st March (Wed) Cryostat for flyby pig returned from VG: Brazing on inner dewar is much better than before but none of the brazing looks perfect. Refitted it to mic & also added new sub-pump filaments. Pumped into low -7's rapidly after outgassing fils.

Put a tungsten tip into the VG mic & outgassed eln at $\sim$ 2500 – 3000 K in $\sim 10^{-7}$ ramum: looks at image which is moderately stable if kept at dull red heat (not clear W, oxide coated (guess). Took tip out & evaporated a carbon film on it: Put back into the microscope.

Developed 2 films from previous day & reloaded casettes.

Dural tubing for new Energy analyser arrived. Scheme of construction is:-



+ extra ports for gas lines & also for possible sub-pump (via a $\frac{1}{4}$ swing baffle valve).

13 Fri April He 78°K W tip few atoms on centre of 110

Background $7\ 10^{-10}$.

2.8 KV on mult for plateau.

P_{He} $3.8\ 10^{-5}$ ion gauge reading (Varian).

BIV ≃ 3.5 KV

Helipot	5sec counts			
1498	14181	14194	14285	14797
1458	14193	14207	14299	
143	13649	13484	13449	
141	12693	12796	12598	
139	11332	11472	11668	
137	10363	10144	10488	
134	8398	8563	8504	
132	7291	7327	7192	
130	5829	5734	5892	
128	4699	4672	4713	
126	3527	3689	3451	
124	2651	2539	2715	
122	1810	1806	1676	1899

120 1142 1220 1198 1237 1216 1183

118 865 858 830 802 830 836 805

116 469 510 540 528 511 528

114 318 334 308 341 383

112 186 204 188 184 198 205

110 133 125 120 120 107 107

149 17339 17311 17557 17461

145 16166 16183 16206

141 14144 13967 14192 $P = 3.8\ 10^{-5}$ Torr

$+ 10\ 10^{-7}$ Torr of Ne_{20000} ↓

~~147~~ 13534 13838 14087

145 13474 13584 13415

143 ~~13385~~ 12360 12240 12310

141 11075 10794 11144

139 10383 9800 9860 9988

137 8760 8750 8745

134 7118 7104 6986 7243 6997

132 5998 6122 6294 6305 6150

130	5323	5316	5201	5361	
128	~~5387~~	5	4244	4337	4356
126	3435	3442	3464		
124	2674	2682	2710		
122	1903	1874	1921		
120	1341	1376	1301		
118	1000	1001	999	990	(!)
116	669	635	680	660	
114	474	483	474	486	
112	337	326	327	333	
110	235	242	257	208	237
108	205	201	209	165	176
145	13942	14130	14304		
139	10898	10966	10815		

$4.2\ 10^{-5}$ overall p.
$6\text{-}8\ 10^{-7}$ Ne.

$4.5\,10^{-5}$ Ne

145 11626 11853 11732

143 11586 11534 11640

141 11520 11517 11306

139 11215 11379 11476 11334

137 11361 11197 11098

134 11113 11192 10948

132 10856 10829 10996

130 11009 10762 10575

128 10816 10740 10751

126 9525 9597 9037

124 8776 8777 8587 8535

122 8758 9457 8063 7402 9256 8569 10697 11370
15299 13667 13154

~~120~~ Dunno what went on here — ? some kind of rearrangement of the pile of atoms on 110 ?

130 11602 11331 11457

122 11886 11505 11510 11344

120 11644 11786 11859 11631

118 12212 12065 11954 12227

118 12319 12119 11972 12090

116 12434 12414 12321

114 12401 12447 12454

112 12123 12091 12093 28 KV
≃ BW

110 11907 11845 11606 11413

108 10985 10507 10523 10372

106 9249 9149

104 8290 8317 8221

102 7155 7232 7166

100 6436 6126 6644

98 5457 5406 5527

96 4441 4310 4299

94 3948 3285 3187

92 2570 2101 1902

90 ~~1267~~ 1157 1102 995 894

88 413 422 379

86 194 169 161 146

130 11740 11384 11500 11280 $4.4\,10^{-5}$ Ne

BIV ≃ 115 for Ne

No SRA image gas

86 1 5 0 1 4 0 2

$4\ 10^{-9}$ Background at end

15 April (Sunday) 110 211 ← W 78 K (same tip as before)

Background $2\ 10^{-10}$ with ion pump

$\geq 8\ 10^{-10}$ with diff " needs baking.

p He $3.95\ 10^{-5}$ 2.8KV on multipliers

132	15132	15220	15225
130	14249	14216	14053
128	12722	12505	12501
126	10611	10418	10514
124	8974	9002	8951
122	6521	6419	6530
120	4923	5136	4950
118	3401	3469	3482
116	2340	2186	2207
114	1497	1477	1558
112	863	874	822
110	484	458	509
108	319	302	292
106	169	188	191
104	126	102	82

5 sec counts

The extra mantle shifted when the orientation of the tip was changed from 110 so that only the pole used was visible : it had been intended (?!) to use (111). Need to take it to bits to fix it. Curses.

102	60	47	46	51
100	22	30	27	26
98	20	14	22	
132	16516	16483	16599	
130	15437	15578	15326	

P 3.3 10^{-5}
3.5 10^{-5}

3.4 10^{-5} Ne

130	7691	7573	7645
128	7646	7776	7543
126	7633	7691	7562
124	7367	7453	7402
122	7131	7256	7189
120	7220	7279	7227
118	7205	7216	7084	7162
116	7185	7265	7359	7203
114	7462	7284	7295	7270
112	7254	7291	7485	7336	7382
110	7346	7376	7454	
108	7377	7490	7361	

106	7435	7538	7332	
104	7210	7307	7227	
102	6990	6860	6987	
100	6393	6372	6605	6433
98	5770	5890	5963	
96	5026	5276	5107	
94	4085	4073	4178	
92	3848	3020	3147	3041
90	2021	1833	1811	
88	1077	1051	1138	
86	545	540	595	
84	254	268	252	
82	196	130	118	115
80	46	62	66	49
120	7637	7657	7656	

P_{Ne} $3.8\ 10^{-5}$ Torr

3. 8×10^{-7} He + Ne

4. 0×10^{-6} Ne

130	10524	10535	10510
128	9508	9330	9466
126	8005	7990	8175
124	6807	6467	6677
122	5094	5138	5239
120	4029	4055	4034
118	3124	3032	3017
116	2707	2361	2433	2241	2376
114	1781	1675	1847
112	1442	1376	1324
110	1149	1146	1214
108	1111	1045	1040
106	961	934	882
104	896	915	856
102	786	792	844
100	682	765	761
98	713	682	688
96	630	627	593

94 526 436 506

92 330 314 347

90 232 225 192

88 134 141 117 137

86 84 53 59 47 71

84 32 28 41 47 31 33

$3.7\ 10^{-5}$ Ne only

124 917 943 890

122 902 938 855

120 888 916 831

118 901 920 840 901

116 899 856 961 859

114 881 941 839

112 884 921 875 818

110 876 883 914

108 836 840 913 899

106 835 845 851

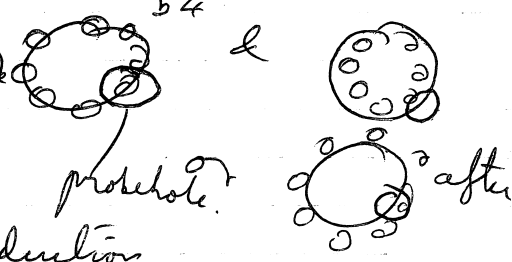
104 815 858 853

102	787	738	775		
100	742	728	771	776	
98	724	649	684	679	659
96	631	575	636	630	
94	507	497	530	436	409
92	353	281	278	266	
90	191	192	217	221	
88	142	117	128	142	
86	67	67	61	59	
84	38	28	26	35	
82	19	20	16	10	
80	7	11	5	11	
78	8	7	7	8	
120	820	897	935	850	

Drawing a rough graph for ion current curves of He, (He+Ne) and (He+Ne) − Ne seems to indicate that adding Ne actually reduces the ion current. Since this is unlikely there are 2 possibilities (1) the addition of Ne changes the ergon voltage so the endform changes and the resulting He current shifts in position and (2)

The alignment of the mix changes on adding Ne (ie the spots are in different posns eg.

Mouse appears to be 1) bigger & 2) careful realignment before every curve (or? measurement - does posn change actually during reduction of volts from He B.v towards Ne B.v)



Also do He + Ne curve first so that endform is stabilized - if you add Ne after looking at He curve the current tends to reduce after a few seconds at max volts presumably ∴ of rearrangement or evaporation.

April 17 Tues New W tip put in Δ 2.5KV He.

78°K $P_{background} = 3-4\ 10^{-8}$ Dynamic

$P_{He} = 3.4\ 10^{-5}$ ion g 4.5 Trig

He+Ne $3.6\ 10^{-5}$ 5.3 5 sec counts

110	39967	39787	42322	40564	40770
108	44337	42079	43875		
106	50342	48061	47964	49122	
104	50970	58214	58241	55404	
102	67454	68546	68602		
100	77286	81928	82176		
98	92689	92161	92521		
96	95851	99462	97382		
94	96134	99426	98834		
92	96285	93852	94060		
90	96715	100626	95623	89364	91917
88	94188	86615	82200	78971	
86	72324	75534	73624		
84	66657	69720	67598		

82 62432 56784 56947

80 45831 45747 43848

78 28850 29015 33571

76 16953 15006 18723

74 10851 10289 9836

72 5988 6543 6157

70 3288 2881 2500

68 760 508 429

66 133 57 65

64 98 150 4766 4233 3619 4966 4692 4639

5319 5305 4736 4253 3786 3196 1973

62 76 144 76 144 131 107 83

62 85 2367 4198 5519 5360 5361 4438

4238

64 70 8484 10199

72 557 447

90 93434 70478 93378

some current as before @ 71,
ie $\frac{71-64}{64} = \frac{7}{64} \simeq 10\%$
apparent increase in field

Shows arrival of a bright spot on the surface

× 30 in current

Ne Alone 3.1 10^{-6} ion gauge

110	375	387	383
108	377	385	370
106	390	381	385
104	358	354	378
102	404	403	383
100	385	404	396
98	447	408	405
96	401	411	447
94	358	330	325
92	315	370	403
90	403	411	356
88	231	259	349
86	437	244	263	236	240
84	227	206	255
82	168	151	171
80	146	179	146
78	173	167	
76	155	194	181

74 177 180 186

70 209 15> 120 66 $3.1\ 10^{-6}$ Ne

P_{He+Ne} $3.6\ 10^{-5}$

110 2 3888 24176 25455

$P_{He\ alone}$ $3.3\ 10^{-5}$ (Ne turned off from above set)

-110 Ne observed still to sit on the surface.

110 52467 51902 52422 52123 52584

100 56052

94 49239

88 49932

84 33267

80 23501

74 4946

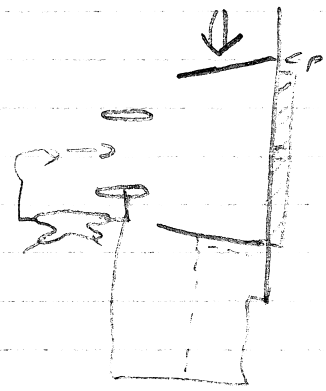
70 1536 195 171

100 61068 59029 64638

Clearly still a lot of Ne around. Looking at image can see hopping bright spots running round the rings below 2 kV. Turn off He & open out diff pump.

$P \rightarrow 2.5\ 10^{-8}$. Fire sub pump & wait for a while but still not possible to get rid of hopping bright spots. Will leave for a while.

Attempted to run mic in energy analysing mode, but applying -1 kV or more to the mantle the resulting (static) in enormous signals arriving at the detector. The image was very distorted & looks as if an extra large mantle will have to be fitted to exclude the field from the radn shield (or float this, as originally intended — ? whistler growth etc).



Thurs 27 April '70

W 111 78° ⊥ Background ~ few 10^{-10} ultimate.

1 sec counts He $3.6\ 10^{-5}$ Long gauge reading.

110	10631	10837	10928	
108	12252	12015	12103	
108	15768	15705	15859	
106	19535	19201	19126	
104	21765	22774	22955	22723
102	25497	25469	25319	
100	26712	26598	26669	
98	26763	26588	26703	
96	25509	25513	25450	
94	23749	23823	23727	
92	21117	21122	20208	21568
90	19477	19436	18973	
88	16568	16763	16729	
86	13933	13870	14049	
84	11638	11400	11646	

82 8433 8143 8357

80 5506 5439 5486

78 2694 2673 2622

76 7166 1080 1757 1853 2175, 1249 2363 2134
1124 1836 2176 1176

~~74~~

~~72~~ 110 14681 14451 12768 14004 14217
14368 14034 13575 13527

108 15960 15838 16079

106 20457 20738 20467

104 24691 24209 24131

102 27197 27103 26714

100 28544 28028 28038

98 28047 27970 27796

96 26223 26042 25356

94 23887 23714 24284

92 25760 21929 21644 21292

90 ~~92~~ 19200 19076 18968

88 16544 ~~16~~ 16667 17275

86 14537 14465 14163

84 11727 12009 11775

82 9192 7880 7980

80 5062 5031 6304 5009 5108 4940 4966

78 2854 3964 2123 2176 3232 4741 1981

~~76~~

110 13515 13212 12686

$1.3\,10^{-6}$ Ne 3.8 He+Ne 10^{-5}

106 13034 13465 13328 12699 13275

104 14217 13775 13415

102 15542 15826 16620

100 19207 17946 17678 17716

98 20803 20554 21409

96 22778 ~~22662~~ 23042 22754

94 23548 23574 23263

92 24169 24157 22467

90 22607 22577 23988

88 20815 20897 20920

86 17978 17744 17872

84	15130	15130	15233
82	11238	11253	11388
80	~~8[illegible]~~	7973	7709	7912
78	4242	4333	4345
76	2059	2043	1985	2017
74	977	1026	975

106	12004	12105	12520
104	12619	13214	13041
102	15780	15084	15472
100	18859	18781	18638
98	21710	20836	21311
96	23796	23885	23582
94	24427	24512	24867
92	24474	23811	24345
90	21798	22083	22004
88	19987	19884	20109
86	16930	16932	17282
84	14125	13963	14641

82 10831 10962 10906

80 7702 7525 7613

78 4021 4115 4036

76 1758 1731 1773

74 854 896 884

4×10^{-5} Ne c/g.

1 sec.

104 ~~1727 1652 1748 1662~~ 1677 1818 1784 1773 1785

Realign.

102 ~~1766 1665~~ 1667 Ne BIV 86. 1868 1881 1827

100 1912 1918 1854 1932

98 1991 2010 1874 1939 1967

96 2070 2078 1965 2071

94 2259 2374 2411 2339 2306

92 2596 2492 2569 2478

90 ~~4~~ 3037 2888 2870 2988 2969

88 3466 3509 3463 3648

86 4351 4305 4496 4511 4386 4509

84 6198 6070 6216 6267

82	9810	9374	9333	9128	9417
80	13727	13778	13779	13491	
78	16314	16445	16120		
76	~~18~~ 19158	19377	19059	18938	
74	19891	19960	20228	19762	
72	20074	19917	19727	16307	16349 16360
70	15075	15004	15300		
68	15536	13511	13770		
66	12345	13204	13402	13303	
64	8795	8291	9068	9005	
62	7896	6993	7219		
60	5464	5323	5365		
58	2454	2291	2339	2297	2372
56	534	542	506	499	468
54	87	79	97	89	
104	1513	1439	1428	1494	
102	1522	1514	1523		
100	1595	1594	1634		

98 1702 1796 1726

96 1914 1918 2034

94 2217 2156 2218

92 2545 2630 2592

90 2878 2820 3039 Div

88 3430 3429 3524 3504

86 4993 4753 4795

84 6576 6520 6474

82 9815 9795 9704

80 14225 14272 14229

78 17800 17256 17620

76 19595 19397 19310

74 20096 20141 20338

72 19665 19447 18597

70 18080 17104 17223

68 13965 14855 14714

66 10167 1004 8558 8837 9706 9787

64 8818 8887 8974

62 5974 5867 5765

60 4480 4702 4279

58 1601 1618 1633

56 5911 5520 494

54 113 96 78

180 1653 1670 1641

$3.9\ 10^{-5}$ Ne

Checking, 90 = BIV in Ne / $4-6\ 10^{-10}$ all gases on (Trig gauge reading)

$3.9\ 10^{-5}$ Ar u/g , (= $5.5\ 10^{-5}$ Trig)

90 208 237 219 207 228 229

88 194 164 206 201 207

86 190 185 183

84 173 165 167 163

82 178 172 159 156

80 166 156 163 162

78 176 151 148 140

76 140 157 147

74 145 143 155 139

72 179 121 143 121 116 145

$\frac{1.6}{3.5} \times 90 = \frac{144}{305}$

$= \frac{20}{.5} = 40$

70 117 154 152 157

68 111 144 132 134

66 137 124 107 131

64 117 106 125 116 121

62 [redacted] 137 122 144 135 153

60 140 154 168 122 132

58 143 144 155 137 128 174 169

56 174 161 142 165 169 162 163 136

54 157 152 158 148 153 160 168

52 188 186 218 214 195 186 201

50 297 286 263 309 275 304 303

48 935 832 609 680 683 696 638 706 679

46 1304 1395 1425 1440 1400 1298

44 2750 2937 2965 3026 2967 3127 2791 3263

42 5323 [redacted] 5712 6050 5608 5334 5049 5402

40 13012 12846 12025 11269 11162 11142

38 9873 12757 12764 13286 20496 27120 26524 24911
13172 12924 12807 13396 12890

36 6327 7203 6491 6038 6482 6189

8

54 2164084 4084 4067 4290 4008 1528 1396
1484 1421 1387 1386 1450 1607 1643
1552

32 1381 1238 1281 1227 1080

30 477 449 386 388 416 425 374 365

28 15 10 10 12 11 14

26 8 7 7 10

90 167 175

50 254 290 294 261 215

48 251 251 259 237 267

46 149 117 119 96 149 212 355 314 237

44 449 470 465 567 515

42 857 891 896 1310 1036 996 1172

40 2175 2775 3604 3857 3910 3876 4094

38 3527 3562 3604 3491 3087

36 1978 1806 1657 1366 1798

34 1041 1081 1098 1001 1058

32 1577 1888 1865 2086 2002

$1.3\,10^{-6}$ Ar + $3.6\,10^{-5}$ Ne

slightly different place Near 111.

104 1234 1273 1215 1173

102 1304 1287 1264 1185 1158

100 1107 1175 1181 1175

98 1188 1170 1187

96 1165 1232 1209 1253 1273

94 1260 1207 1221

92 1258 1362 1255

90 1232 1284 1268

88 1272 1217 1226

86 1120 1112 1199 1202

84 1149 1234 1120

82 1025 1084 1070 1086

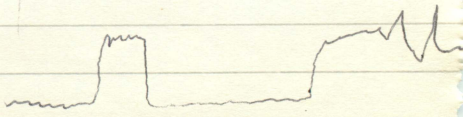
80 861 945 1009 956 925

78 747 794 787 600 711 647 775 781

76 499 555 568 491 503 515 1318 412 347

74 247 3346 2178 283 1651 447 813

looking on ratiometer shows trace



sort of.

72 133 882 671 748 1894 154 253

70 164 329 1430 1084 404

104 1316 1282 1297 1300

102 1287 1372 1413

100 1337 1318 1384

98 1358 1370 1316

96 1323 1408 1407 1421

94 1455 1472 1490 1403

92 1420 1436 1415 1487

90 1505 1578 1467 1586 1535 1418

88 1555 1488 1398 1513 1702 1588

86 1462 1520 1452 1576

84 1474 1499 1520 1528 1426

82 1544 1521 1364 1777 1256 1387 1316

80 1261 1288 1109 81115 1079

78 877 1028 924 976 882 964

76 694 885 740 748 782

74 730 635 551 565 558 432 531 579

72 327 242 2118 ~~1010~~ 1010 615 902 3285 35
1281 763 2638

Fri

W 111 Evapht. in He at solid N_2 temp.

$\sim 4\ 10^{-5}$ c/g He 1 sec counts.
few spots on center of 111 plane.

BIV ± 112.

114 10 100 10160 10142

112 11067 11112 11131

110 12575 12491 12384

108 13897 13607 13808

106 15207 15229 14889

104 16165 16252 16271

102 16137 16289 16488

100 15589 15669 14857 15253

98 14045 14022 13954

96 11733 12853 12389 12586

94 11245 11206 11077

92 8609 9120 9213 8530

90 7809 7781 7777

88 6653 6770 7529 6608

86 5691 5508 5624

84 4228 4032 4054

82 3147 3181 3158

80 2257 2290 2331

78 1728 1277 1315

76 693 681 721

74 301 342 251

72 111 88 79

114 10044 10714

112 10515 10636 11279

110 11241 12116 11676

108 12951 13101 12887

106 13533 14839 15030

104 16056 15435 14994 15461

102 18325 15672 14961 15253 15013

100 14926 14459 14815

98 17720 13596 13274

96 12750 12464 12507

94 11224 11137 10962

92 9326 9295 9418

90 7985 7970 7818

88 6546 6705 6646

86 6020 9855 5688 16308 5722 5519
5448 5563

84 4815 4916 4899

82 3922 7453 8533 3843 3878 11087

80 3609 2905 3399 3084

78 1773 1635 1718

76 2067 1663 1587

74 386 643 663 892 743 725

72 217 240 216

106 15737 16009 15837

9.8 10^{-7} Ne tbd 3.9 10^{-5} Ne+Ve 1 sec.

110 10499 11170 10905

108 12163 11009 11684

106 12552 12635 12097

104 14229 14532 14504

102 17164 15508 16831 16613 15738

100 17502 17454 16963

98 18029 17748 17190 17848

96 17744 18029 18028

94 16400 16584 16048

92 14482 14239 14553

90 12911 12708 12714

88 10739 10948 11156

86 9188 9115 9160

84 8035 8042 7968 8272 8206 8098

82 7206 7096 7040

80 5987 6011 5924

78 4332 4412 4423

76 2468 2437 2469

74 1086 1016 999

72 410 377 353

70 153 172 157

110 10495 10895 10764

108	10144	11460	11449
106	12160	17568	11630
104	13212	13803	13713
102	15220	15795	15134
100	R6	17486	17277	18232
98	18084	18088	16666
96	17047	17317	17834
94	16810	17064	16558
92	15057	14773	14851
90	13047	13092	13178
88	11141	11152	11117
86	9218	9270	9361
84	8317	8230	8234
82	6638	6679	6762
80	5609	5613	5647
78	3998	4152	4194
76	2382	2365	2444
74	1196	1174	1144
72	479	465	431
70	227	204	175

3.810^{-5} Ne. 1 sec

110	1727	1710	~~17~~	1666
108	1792	1750	1777	
106	1803	1713	1787	
104	1750	1709	1669	
102	1674	1672	1710	
100	1731	1729	1752	
98	1734	1765	1789	
96	1811	1823	1975	
94	1899	1972	2075	2007 1995
92	2168	2123	2120	
90	2441	2326	2329	
88	2689	2756	2685	
86	3137	3070	3028	
84	3670	3571	3722	
82	4596	4542	4588	
80	5413	5500	5349	
78	5923	5856	5863	

76 6121 6438 6443

74 6234 5832 6244

72 5448 5588 5646

70 5004 4811 4899

68 3871 4105 4038

66 3316 3226 3010

64 2706 1909 2463 2690 2768 2515 2418

62 1513 1413 1506

60 1491 1293 1047 945 931

58 636 575 492

10 1386 1460 1394

08 1388 1396 1368

06 1455 1468 1435

04 1497 1564 1452

02 1588 1567 1620

00 1683 1553 1566

98 1689 1698 1760

96 1826 1847 1749

94 1401 1945 1920

92 1976 2059 2168

90 2262 2327 2329

88 2607 2702 2688

86 2457 2442 2540

84 2869 2775 2823

82 4730 4576 4673

80 5572 5506 5415

78 5951 6010 5898

76 6191 6096 6037

74 5926 5818 5773

72 5293 5284 5102

70 4737 4568 4680

68 3937 3964 4033

66 2901 3126 3272

64 2892 1740 2908 2955 2865 2871 2845

62 2273 2070 2093

60 1859 1741 1408

58 913 967 876

DIV in Neon ± 91.

	$9.5\,10^{-7}$ Ar	$3.1\,10^{-5}$ Ar + Ne	
110	1437	1465	1418
108	1450	1528	1454
106	1573	1536	1453
104	1528	1509	1438
102	1582	1555	1572
100	1529	1590	1584
98	1630	1621	1502
96	1685	1769	1705
94	1841	1845	1826
92	1874	1995	1866
90	2128	2145	2157
88	2399	2500	2416
86	2886	2895	2916
84	3191	3288	3275
82	3976	3795	3661
80	3601	4175	4262	3615	4413

78 4731 4744 4823 3401 4571 3940

76 4009 1520 4605 2831 4410 3709

74 2811 3367 1552 2937 1275 2853 2278

72 500 1214 1075 1047 1290 616 289

70 315 334 376 459

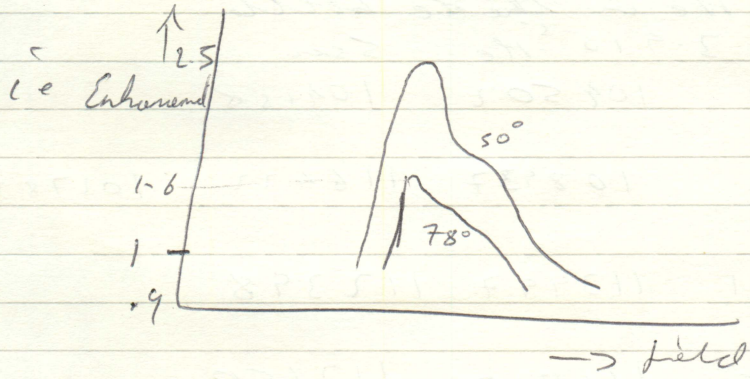
68 1844 4540 8076 7932 1284 1888

14867 4356

Studying the ratemeter at this point showed that the current varied between a relatively quiet low level and a much higher & noisier current, anything up to ~10 times larger: the transitions were generally abrupt. Examination of the image showed the presence of hopping very bright spots – presumably Ar atoms: the arrival of a bright spot ~~apparently~~ appeared to reduce the current from the region surrounding it, over quite a large portion of the image: the reduced current from Ne in the presence of a trace of Ar would appear to be due to the bright Ar spots siphoning off the current from sizeable areas of the image.

A graph showing $\frac{i_{He+Ne} - i_{Ne}}{i_{He}}$ vs voltage was plotted, where i_{Ne} = proportion of i_{He+Ne} current to be expected from the current obtained from Ne on its own. This curve was sharply peaked (height 2·5) at $\frac{78}{91} \times 100 = 86\%$ of Ne BIV. due to CWM, Ne produced image @ 70% of Ne BIV

For comparison the enhancement of the image at 78°K was plotted on the same graph. The enhancement peak at 50° is the same shape but diminished in size, height 1.63 & the width of the peak was reduced.

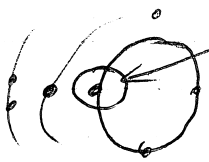


Had another look at Rendulic SS 71 & Janssen SS 72. (Rendulic 73 not available). " shows curves for W, Ir, Pt taken at 78° in grotty vacuum (few 10^{-8}) & Janssen has figures for W 78° in good vacuum. Rendulic considers studying linearity of i vs. P_{Ne} for Ne enhanced Ne current & vice versa for He: if gas promotes its own ionization lowering the field should cause the current to become noisy: similarly raising the temperature or decreasing the gas-pressure so that coverage is < 1. For Ne this coverage appears to go from few % to ≈ 100% in the 10^{-8} torr range. At a current of $2\,10^{-4}$ ips @ $4\,10^{-5}$ torr, current at $4\,10^{-8}$ is 20 ips: amplifier noise is ≈ 1 ips on good day, 10 ips on bad day, would need to fix amp to study this. Tricky anyhow to get meaningful statistics. If enhancement of say Ne by Ne is 2.5, are looking for currents of ≈ 20 ips alternating with currents of ≈ 1 ips. Much healthier to look at noise at higher pressures, Janssen-style.

Sat 29 April W 111 small cluster on centre again
Solid N2 cooling
Background 1.5×10^{-9} as before (trigger wasn't selecting right before)
He alone (some hopping bright spots already so)
probably some Ne in the He bottle
3.9×10^{-5} He 5 sec

~~112~~ 104	110048	104502	104158		
102	103839	108937	116422	102782	
100	108881	113997	112398		
98	120315	116830	112650		
96	123480	107961	112530		
94	81571	88288	106945	105602	101594
	83382	118797			
92	80424	89293	74879		
90	96113	97933	97697	97621	97803
	96276				
92	100664	108302			

Abandoned ∴ too much residual ? Neon — hopping bright spots v. persistent on 111 & surroundings. Try 110.



1 sec

110 10734 10813 12853 12967 12917 12666
11765 10587 10660

108 9160 9407 9418

106 7707 7595 7757

104 5774 5307 7003 5686 5748 6637 6774

102 4247 4292 4179 4244 4156 4267

100 3808 3023 3075 3019

98 2033 1958 2168 2036

96 1542 1520 1605 1550 1526

94 1414 1509 1264 1343 1353 1384 1344

92 1205 1177 1516 1214 1318

90 1204 1315 1515 1472 1418 1485
1427 1183 1215 1225 1312 1219 1317
1316 1273 1601 1494 1619 1314 1454
1513 1452

88 1320 1292 1314 1285

86 1294 1334 1225 1117

84 1086 1235 1224 1177

82 1137 1096 1033 1176

80 919 907 812 846 805

78 705 708 684 667 711 732 669

76 330 309 316 315

74 155 126 119 120

110 10926 12134 12063 11421 13321
13197 13072 12988

108 10815 10923 10431

106 8941 9225 10102

104 7686 7778 8884 7260

102 5514 5516 5631

100 4021 4021 4044

98 2835 3011 2982

96 2162 2104 2662

94 2039 2194 2189

92 1962 1585 1564

90 1354 1421 1485

88 1421 1172 1279

86 1190 1478 1472

84 1210 1236 1368

82 186 1050 1(8)

80 942 867 907 911

78 686 600 597

76 311 293 287

74 139 126 138 $3.6\ 10^{-5}$ No c/g.

Pump out $3\ 10^{-9}$ background.

Add ~~He~~ Ne = $8.9\ 10^{-9}$ total μ.

$3.6\ 10^{-5}$ He + Ne.

10 sec

106	81805	75598	
104	~~76408~~	64833	66086
102	47282	49975	
100	38162	35056	
98	27407	31286	
96	21044	20731	
94	13934	13813	
92	10198	9482	
90	9157	8899	
88	8607	8381	
86	7592	7621	
84	7474	7427	

82	7700	6742
80	5861	5892
78	4253	4727
76	2191	2247
74	1248	4545

3.6 He $2 10^{-8}$ Ne.

106	83890	80435
104	70605	65671
102	49457	47595
100	37788	35009
98	27700	25172
96	18133	17891
94	12440	12552
92	9978	10025
90	8607	8310
88	7412	7785
86	7615	7577
84	6922	6964

82	6279	~~6446~~ 6446	
80	5637	5551	
76	4353	3930	
74	2567	2140	$3.2\,10^{-5}$ total $2.1\,10^{-8}$ Ne
	$4.1\,10^{-8}$ Ne	$3.8\,10^{-5}$ Total	
06	80381	11326	129819
04	119461	75241	
02	51637	51672	
00	45501	39117	
98	27928	28696	
96	17959	17815	
94	13991	17102	
92	10532	10378	
90	10399	9910	
88	8938	8901	
86	8530	8576	
84	8280	8112	
82	7503	7793	

75
120
195
97

80	6426	6878
78	4335	4264
76	2560	2597
74	970	997

$3.65\ 10^{-5}$ total Kr/Ne
$4.05\ 10^{-8}$ Ne

$6.4\ 10^{-8}$ Ne $\quad 3.7\ 10^{-5}$ Ar

106	(73721)	122176	116245
104	91935	70942	
102	47920	60687	
100	61721	62472	
98	46094	28763	
96	18441	17294	
94	13154	12970	
92	10081	10008	
90	9136	9147	
88	8499	8295	
86	8044	7997	
84	7695	7734	
82	7248	7299	

80	6226	5963
78	5012	5008
76	2539	2539
74	1654	1193

$3.6\ 10^{-5}$ Tola
$6.4\ 10^{-8}$ N_e

10.8×10^{-8} N_e $\quad$ $3.7\ 10^{-5}$ ~~tola~~

106	131852	128506
104	92155	63372
102	48918	68383
100	82754	79113
98	24817	22622
96	17950	17467
94	12733	12147
92	10029	8934
90	8456	8481
88	7661	7375
86	8815	7504 7029
84	~~7029 6858~~	7029 7274
82	6858	
80	6433	5694 6268

78	4471	3950	
76	2727	2186	
74	1193	1006	$3.2\ 10^{-5}$ He/Ne $10.2\ 10^{-8}$ Ne

$4.5\ 10^{-7}$ Ne $3.65\ 10^{-5}$ He/Ne

106	132918	129200
104	125273	123959
102	99300	98611
100	77012	76860
98	51990	52241
96	32490	36153
94	28148	24210
92	9760	9295
90	8142	7934
88	7459	7480
86	7044	6894
84	6840	6889
82	6495	6422

80	5478	6260
78	4292	4415
76	2377	2198
74	1091	1062

3.310^{-5} ~~Ne~~/Ne
$3.6\,10^{-7}$ Ne

$10.1\ 10^{-7}$ Ne $3.6\ 10^{-5}$ Ne/Ne

106	128102	147702	
104	121174	93722	
102	~~[illegible]~~ 77411	94491	77699
100	77459	88883	
98	68587	66180	
96	43394	40971	
94	29411	28453	
92	22546	21984	
90	19832	18177	
88	12704	9211	
86	8403	8174	
~~84~~	8384	8401	
82	~~7593~~	7667	
80	6768	6478	
78	4891	4698	
76	2821	2736	
74	1316	1197	

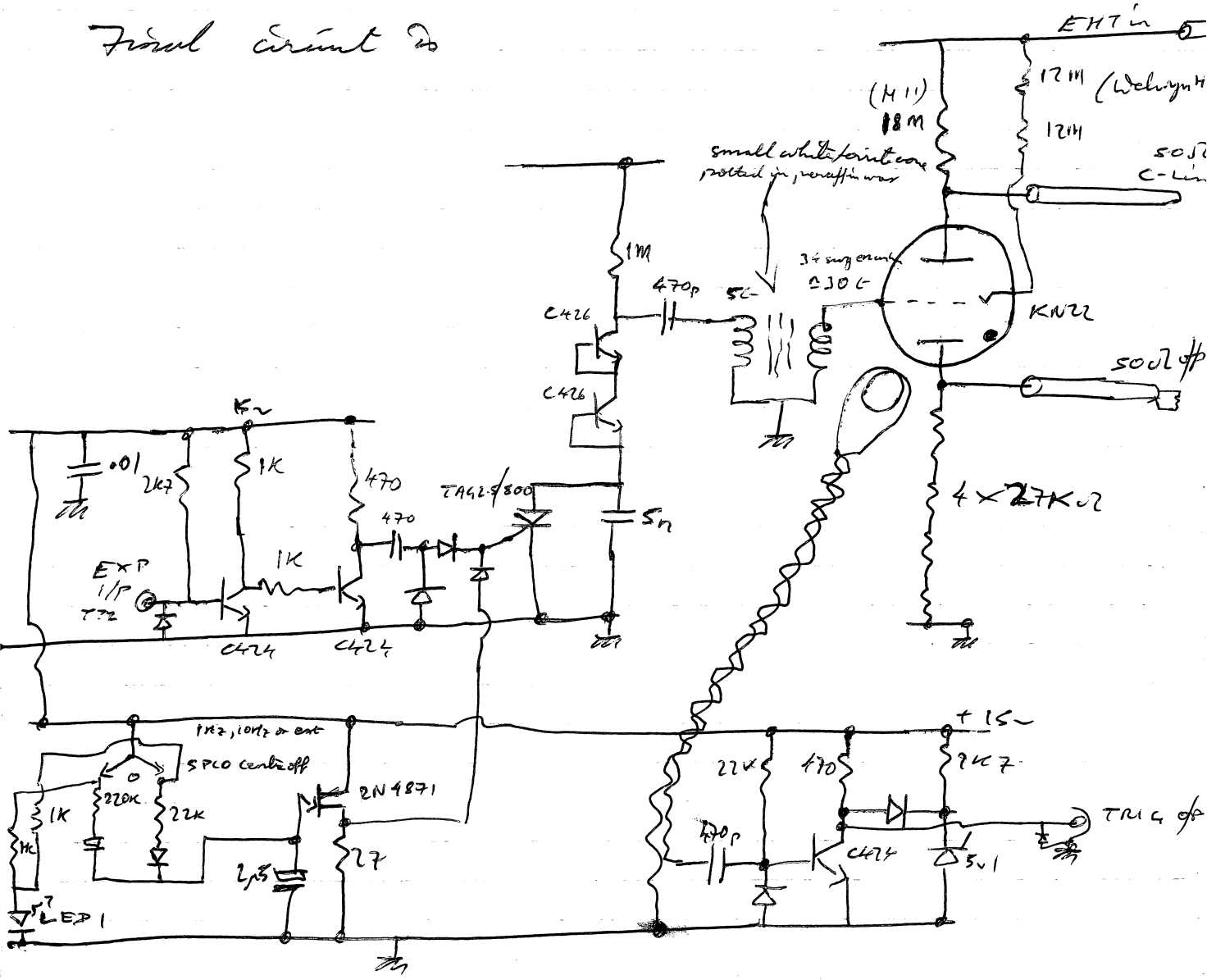
$3.6\ 10^{-5}$
$2\ 10.3\ 10^{-7}$ Ne

Tues May 1

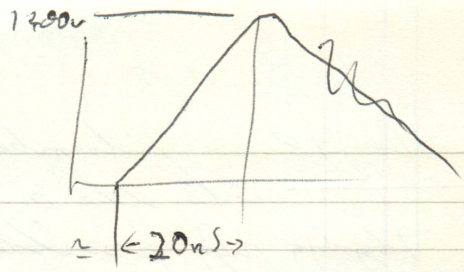
Put ASC mass spec onto nine after finding that system pressure decreased to $\sim 3 \times 10^{-10}$ on valve off the sub-pump. Some pressure @ 40 & 20 so possibly Ar & Ne leaking through leak valves. Tightened both up but with different. Bake system to eliminate hydrocarbons & will see what's left.

Wed Daddy nic. Experimenting with Krytron thyratron pulser as paddy's circuit doesn't appear to be working properly ($\sim$ 7ns rise & lots of jitter).

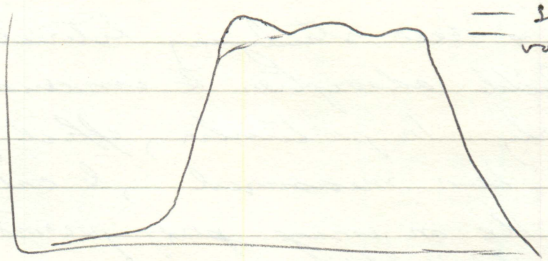
Final circuit :-



Trig pulse to krytron is



O/P pulse is

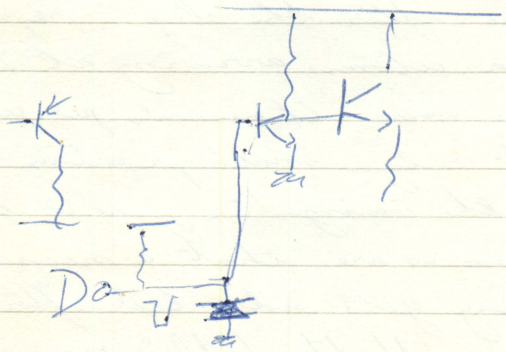


Is some fluctuation in amount of ripple so will try potting all ckt joints in silicone to try & eliminate.

≃ 15nS

— ~~that~~ Ckt fires thyristor to apply ≃ 400v ~~add~~ across 2 avalanche-connected transistors in ≃ 200nS : these break down with ≃ ~~5nS~~ 10nS full time & produce a 200v −ve pulse which is amplified & inverted by a pulse transformer & used to fire the krytron.

Later Modified.



$\frac{4\,kv}{25M}$

$\frac{4000}{25000} = 160\,\mu A.$

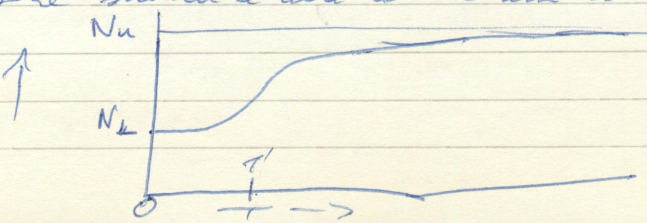
$18M \times 1000\,pF$
$= 18 \times 10^{6} \times 10^{-9}$
$= 18\,10^{-3}$

Fri May 18 Plumbers still putting 'cooling units' into the nic rooms so no exptl. work on flyaby proj possible since May 1st & continuing. Pissed off the

Have been studying literature (Janssen, Irwin, Rendulic e on field adsorption & conclude that is not understood properly. In particular, effect of He on He image hasn't been measured, & only the relative effect of Ne to He on image ~~proj~~ promotion has been measured, over a small field range (up to the point where gas supply limits the current). Present work has been the measurement of spot He currents with & without Ne (over only small temperature ranges) - measurement of adsorption times of Ne τ_1, τ_2 by Janssen which looks quite useful work - & some vaguely documented work by EWM using the atom probe to try & find the fields at which He & Ne turn up in the spectrum: this is a little dubious :^ ~~some of dodgy~~ ~~yes~~ poor statistics using destructive techniques.

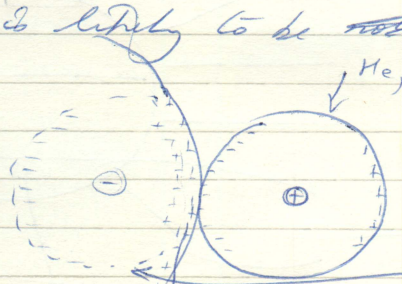
Best line of approach to He image promotion appears to be this:- raise tip ~~from~~ volts from 0, or much less than field needed to retain He on tip, ~~to~~ to $V + \Delta V$ suddenly (< 1 μs probably good enough). Keep tip volts steady for a while & measure ion current as a function of time after the step: repeat & average etc. The no. of gas atoms arriving at a site is given by MTS, EWM, etc as some thousands per sec at usual T, P (greater at low T) & only a small proportion ~~not~~ survive passage through the ionization zone to the tip (ingeniously studied - anyway, the chances are that a measureable current flows before anything gets adsorbed, after which a different current will flow. If the field is removed, only v der Waals forces hold on Ne/He, so desorb rapidly, < 1 ms.

Therefore should be able to obtain a curve something like

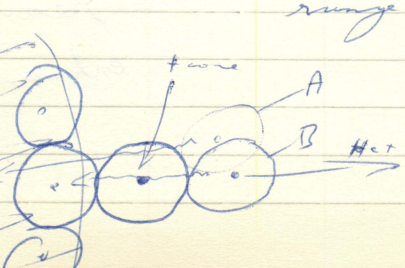


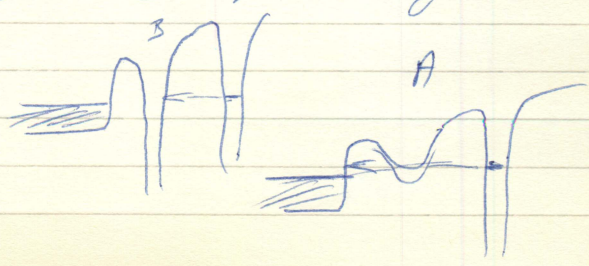
where N_L is ion current to surface without promoting gas atom & N_u is " " " " " with adsorbed gas atom. If A is not impossible that N_L is v small*, & if so this is a good reason for supposing that the field ion image is due solely to promoting effects of He, Ne adsorbed directly on the protruding surface atoms. Another possible piece of evidence for this is the fact that at 4°K the image spots have contracted to be very sharp indeed: Now, it is not obvious why this should be the case if ionization merely occurs where the field is highest: however, if tunneling is easiest when the metal atom & the promoting atom are directly in line with the gas ion, this might be explainable. ? uncertainty principle limits spot size to? What is apparent source size? See Richard Forbes Thesis. The adsorbed gas atom will move in a potential well governed by the field distribn across the surface & also by any local effects of the dipole moment of the gas atom — ie coupling with surface atoms' 'spare orbitals'. Evidence for this is the motion of Ne on a plane or ridge: it tends to run round a ridge or along a line of atoms & back again often at a slow speed — this shows that a binding potential well is likely to be ~~not~~ non-circular, but trough-shaped.

* at 81 K



'mirror image' of the polarized He or Ne in the metal, leading to a short-range binding force which might apparently be quite large at short-range.

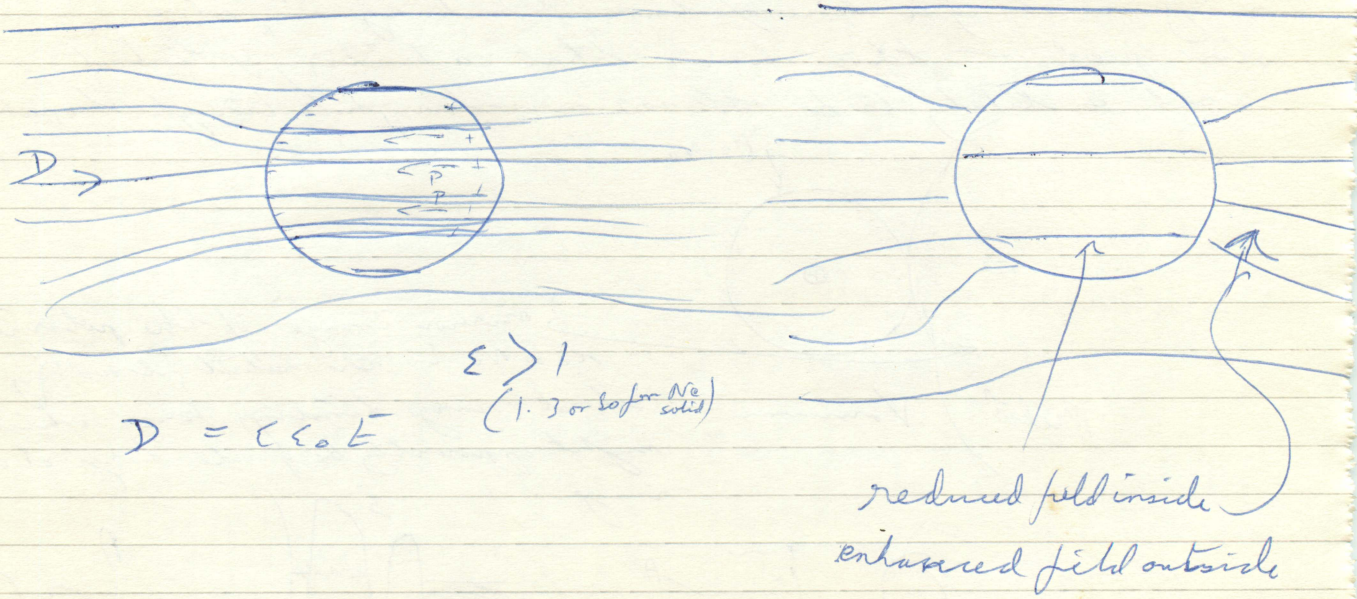




In case A the electron tunnels through a portion of the promoting atom in which the field of the core is screened partially by the ~~there~~ electrons. It has leads to a reduced energy 'core window' & so to a reduced tunnelling probability. Since the Ne/Ne ~~will~~ only be preferably absorbed, & fairly tightly, on the highest field regions above protruding atoms, & a 'sharpening' mechanism is probably operating to produce a sharper picture than would be the case if the promoted atoms were not present. I propose that this might be tested by using the pulsed field technique as above & gating a channel plate screen a short ~~at~~ while after to provide a 'stroboscopic' picture of the build-up of the ionization process. Could be enlightening!

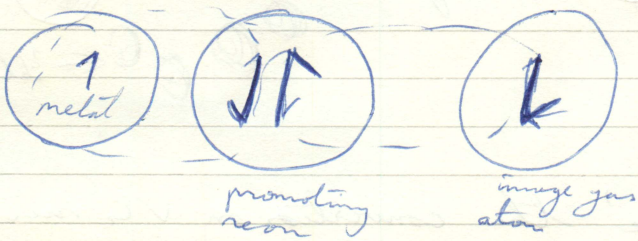
? what is the effect of the polarized gas atom on the field adjacent to it.

A dielectric sphere in a uniform field in vacuo tends to concentrate D & reduce E inside itself



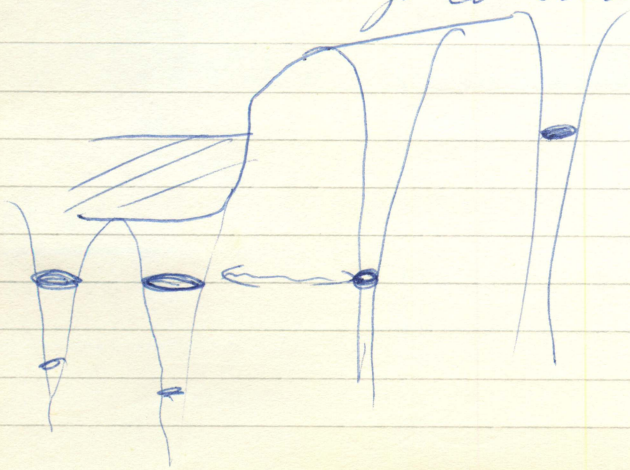
The effect of this will be a tendency to form chains like ball-bearings in a magnetic field — adjacent chains repel one another.
However, at sensible field strengths the second member of the chain will lie close to the optimum region for ionization and consequently will not survive long in the chain. The promoting atom therefore acts not merely as a 'window' into the tip for electrons, it also lures passing atoms, by virtue of the field enhancement, into a 'field ionization trap'. ? Use Pashley Howells ball-bearings to study the mechanism of chain formation.

The invisibility of various species in the field ion is likely to be related to the binding of the promoting atom to the surface; a 'resonance bond' of sorts might be possible — ie



Boolton papers of surfaces
see ~~field emission~~
~~Engng abstracts~~ or similar, circa '69
in library

This would tend to strengthen a chain.
? a possibility of energy levels of Ne & metal atom overlap to some extent



If second atom not there, effect of field in shifting electrons towards tip in adsorbed atom might be an inducement towards bond formation.

Done Constructing ±47 pulse gen for pulsing tip volts & for pulsing C-plate screen. See somewhere ahead for circuit diagram.

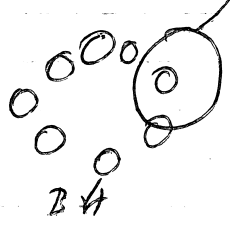
Constructing bits for E.A. Mk 2. Derek Stannell making analyser.

(black monster & also mine)

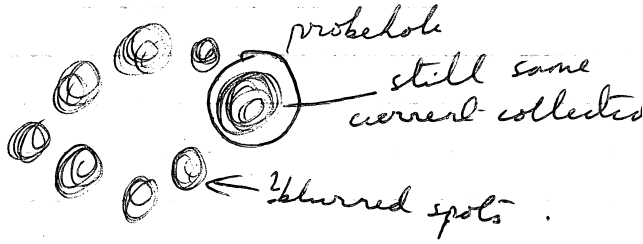
Tried pulsing on Flying Pig to see what does to image. Any crud in He bottle tends to stick to the tip on off-part of cycle. Trying to measure ion-currents as a function of time after replacing tip ±7 volts. Situation obscure as something obviously happening to the tip but no sensible results coming from counting system.

? Effect of pulse merely to blur a spot, so that all the ions from it are still spread only over area of less than probehole, thereby not altering the current measured

ie



after:



∴ Try & 'strobe' the counting on VG mic to see if any alteration in the picture can be recorded.

∴ Added converter to VG mic.

Mon 6th July

Pulsing tip volts & striking c plate. seems to work. 5 min exposures v faint 3 Hz I think. V ammm not good enough as sub-pump gone; so end of tip evaporates slowly thereby degrading picture. He gas-bottle grossly contaminated to throw away & replace. Pictures obtained of little value except to show that technique is possible.

Next week

Sub-pumps feeds broke when replacing external leads, so send back to VG. Borrow 8" flange with filament holder off eds microscope & send other back to be repaired with filament holder on new 2 3/4" port.

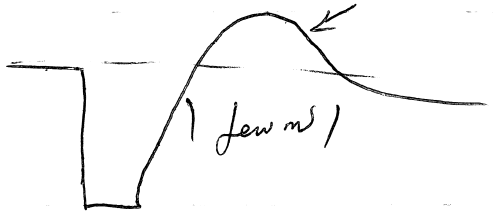
Converter on VG mic is V dim so dismantled it & added Al wire gaskets on either side of the c plate. Rebuilt. Brighter, but the screen, made by Astorin, is white & suspected of being inefficient as images is ~ 10 times too dim still (needs 1800V on c plate to give reasonably bright picture). Replace screen as soon as possible.

Sun 8th July W 78° 1.0^{-10} isolation

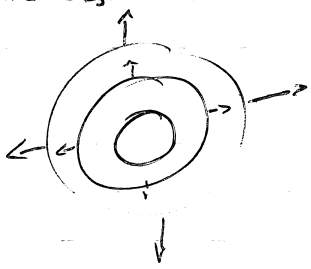
3.0^{-5} He

@ 490 nS off tip T pulse.

Pictures of better quality, but discovered nasty properties of trig Blach EHT pulse at pulse-lengths longer than ~ 200 pS: tend to drain some reservoir capacitor: on refilling it upsets EHT set which gives an overvoltage:-



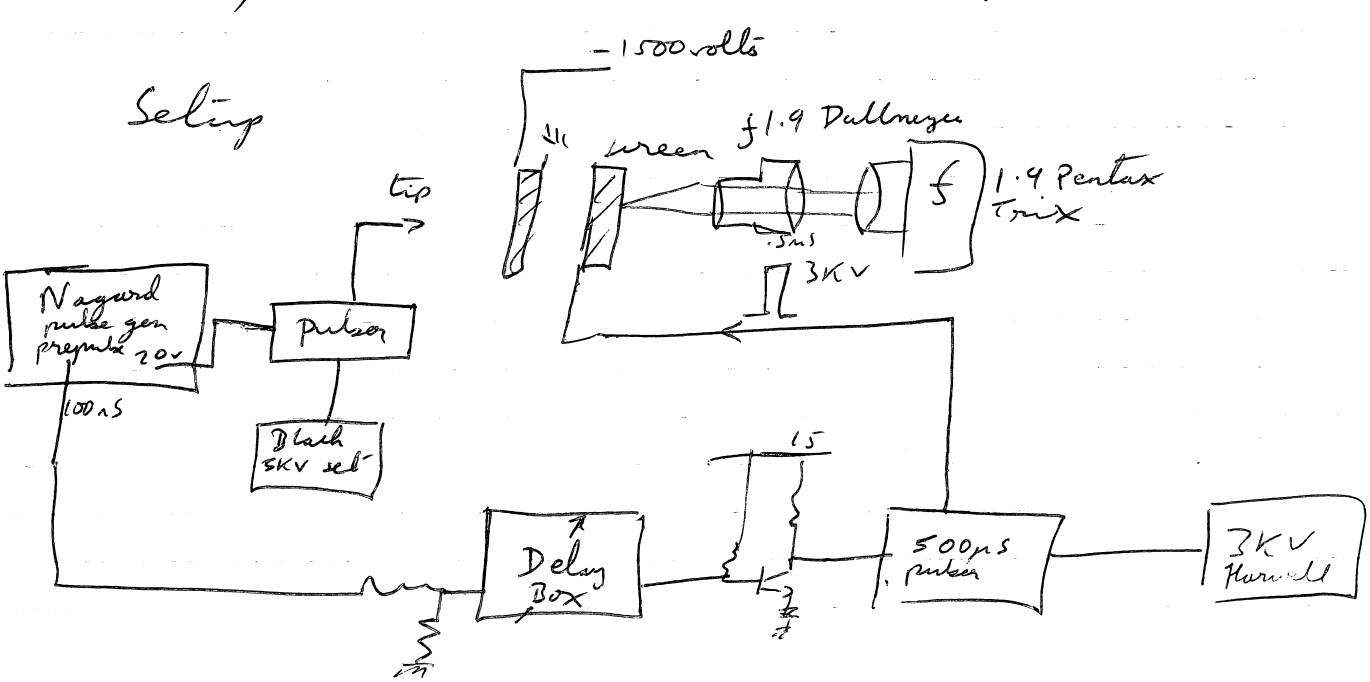
This produces misdelivery effects on the image which pulsates & expands thus



→ Picture brightness related to HT sets vagaries. not to image processes.

Total change in size of image ~ 10% (less in middle, of course). Normal use 200 pS or less pulses ($B\ t_{\frac{1}{2}} \sim 30$ pS)

Setup



Trouble with Vacuum as ed wanted FE tubes added to system
One leaked like a sieve, the other was dreadful! Eventually threw them off.
P —> 10^{-11}'s immediately. Thanks, Ed.

Fri 20th July

Continuing expts striking ~~Exp~~ screen after pulsing tip.

Background $3\,10^{-11}$ Dynamic, cold.
$3.5\,10^{-5}$ He
$1\ 10^{-7}$ Ne.

C-plate 1,500 volts Screen 3KV
⊓ 0.2 mS pulse on tip
7Hz 2.0KV 2.1KV BIV

BIV ≙ 2KV.

Film Test: 5mins pulsing screen only at ≙ 14Hz.

.8mS Delay	5mins exposure	Multiply times by
.8mS "	"	
5 mS	"	$\frac{6.8}{5} = 1.36\times$ as t-b unshielded
5 mS	"	
50 mS	7 "	
50 mS	5 "	
100 mS	5 "	
100 mS	5 "	

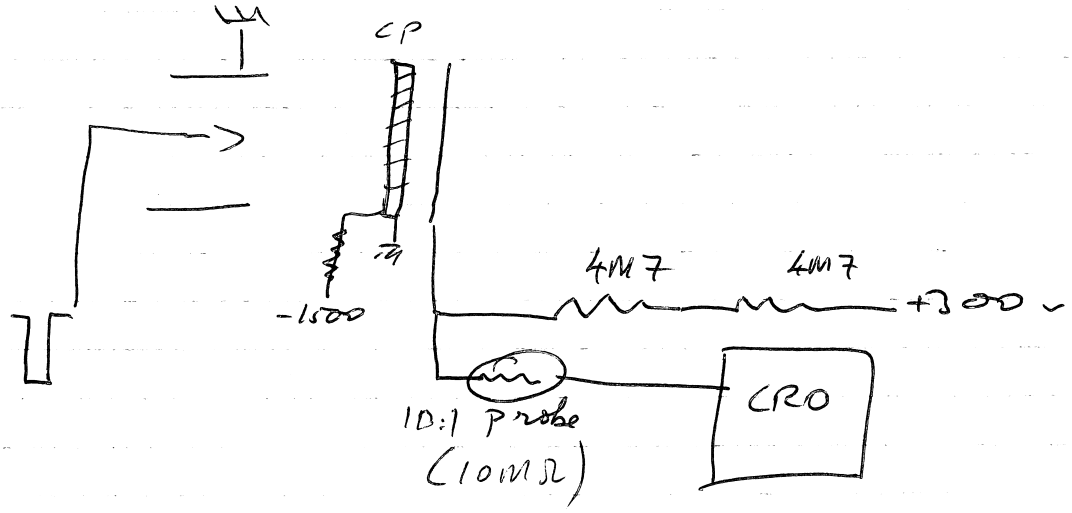
5mins screen only
1 blank frame (lights on)
1 sec screen on all de time.
Cool inner dewar by pumping
1 sec
Screen 5 mins
.5
5
50
100
1 sec

5mins exp = 300sec × 550 μs exposure × 14Hz
= 4200 × 550 ≙ 2,009000 μs = 2 sec

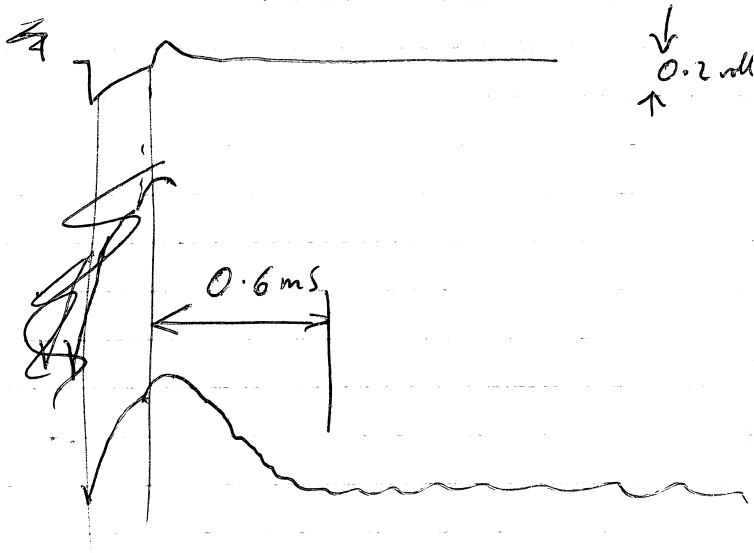
Sunday 22nd July. Background 3×10^{-7} dynamic

Evaporate tip at pumped nitrogen temp in 4×10^{-5} Ne
3×10^{-7} Ne

to 2.9 KV BIV.



Cplate off, 200μs pulse



Cplate on

∴ Same decay time for shorter pulse on tip

Try & take photos of screen

60 μS pulse 3 shots 0.2 mS/cm, different brightness
All at 0.2v/cm ↑ 100 Hz 1 sec exposure f4

" 2 shots c-plate off diff brightness 1 sec,

20 μS 2 shots c-plate on " " "

1 Blank

100 μS 3 shots " " "

200 μS 3 shots " " "

400 μS " " " " "

All above @ 2.7KV, 3.27×10^{-4} Torr He (3×10^{-4} Ne)

reducing tip HT made pin smaller but shapes same.

Reduce gas pressure to 1×10^{-5} Hg.
3 pins at 0.2 v/cm 200 μS diff brightness

3 pins at 0.1 v/cm " " "

Reduce gas pressure to 3×10^{-6} Hg
0μS 3 pins at 0.2 mS/cm, .05 v/cm " "
3 pins at 0.5 mS/cm .05 v/cm " "

1 pin of scope ↑s f4 ambient lighting

2 pins of " c-plate off .2 mS/cm .05 v/cm " "
2 pins .5 " " " "

1 pin 0.5 cm/μS 0.2 v/cm 4×10^{-5} He c-plate on.

. end of film.

Object of above exercise was to see 1) If screen of cylinder could be used directly to measure H^+ current & what sort of H^+ current might arise there.

2) see if a time occurred after raising tip volts from 0 during which H^+ current rises to 3 V level. This time should $\propto$ (gas pressure)$^{-1}$ if it is time for adsorbed layer to form on tip.

Some trouble from picking up pulse by probe — answer is to increase efficiency of H screening (wax only used for part of H line so as not to strain glass/metal 'H' feedthro'.)

Analysis of results indicates the following

Signal is $\pm$ .4 volt high at $4 0^{-5}$ Hz.

5 MΩ load, so $\Delta i = \frac{.4}{5}\,\mu A = .08\,\mu A$ approx.

Time constant of system is observed as 0.2 ms

$$C = \frac{2.0^{-4}}{4\,10^{6}} = 50\,pF$$

Timescale of decay is $\pm$ 1 ms @ 3.0^{-6} Torr

so $\pm$ 100 μs @ 3.0^{-5} Torr.

So want $\pm$ 10 μs time-constant of system @ maximum

$\therefore$ Need input resistor of $\frac{10^{-5}}{50\,10^{-12}} = \frac{10^{7}}{50} = 200\,K\Omega$.

Current is .08 μA $\quad V = .013\,V_{max} = 1.3\,mV_{min}$

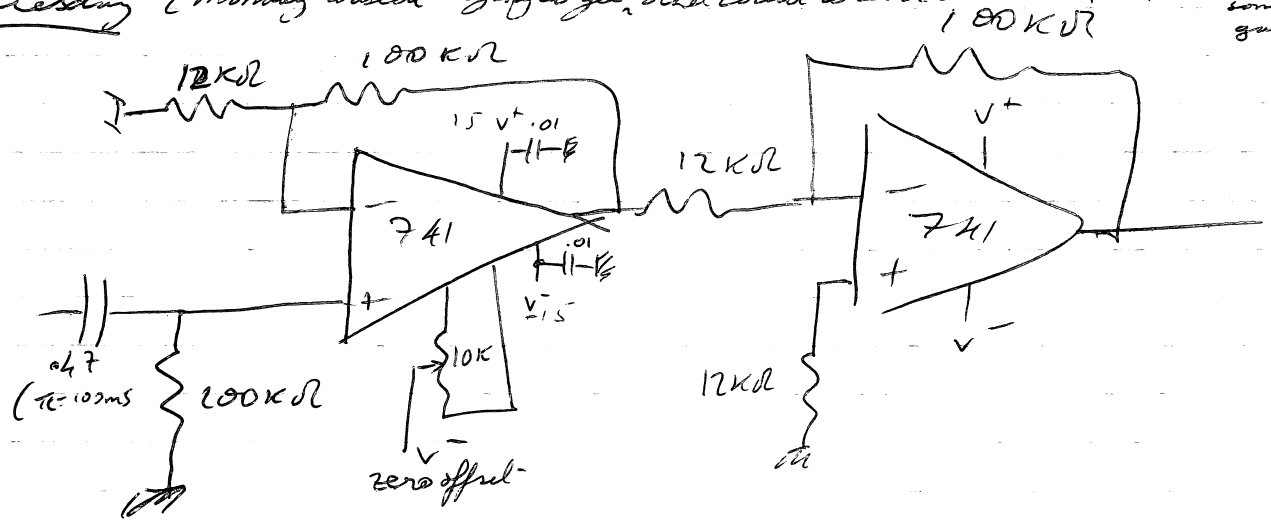
Scope has 50mV/cm gain using probe (5mV/cm without)

∴ ×100 gain with ≃ 5μS risetime would be useful.

Type 741 (perhaps 20dB gain @ 100KHz (⇒ 3.3μS τ_r)
& Z_{in} 2MΩ.

∴ Constructed this circuit :—

Tuesday (Monday wasted trying to get an older circuit to work (published, too! & totally wrong somewhere) gave up on it

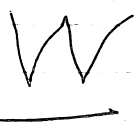


Measure gain ≃ 100, τ_r = 10μS.

Measured τ_r of EHT pulse gen : ≃ 100μS top (flat)

@ 4KHz, 30μS pulse get-

2KHz gives 300μS top.
Some tendency not to "bottom"
completely at high volts & fast rep rates - so care needed.



If Timescale is $\sim O(100\,\mu s)$ @ $\sim 10^{-5}$ Torr,
& $\sim O(200\,\mu s)$ @ $\sim 10^{-5}$ Torr.

If we run the ehl pulse gen @ 4 kHz, we can cut down the length of time spent at the full ekt by $\frac{1}{2}$. However, as the recovery time of the signal appears to be of order 100 μs, any photograph taken during this time (continuous exposure) should have intensity $< \frac{1}{2}$ & should be largely of a surface uncoated with surface gas eh.
? What would it look like — try it.

Also, If Ve was present, no chance of it being adsorbed in this time, so picture should be different. If only 300 μs flat top was allowed rather than using 30 ms Gross changes in picture might be observable visually.
? Would tip fall to bits.
? Mullers expts once tip fatiguing took ehl right off, I think almost certainly in lousy vacuum, therefore the pictures of a distorted endform are almost certainly of a grossly etched endform from residual H_2O & H_2.

Also spending time organizing trip to FE symposium @ Penn State & Summer institute on surface studies @ Milwaukee.

// plate

Aug 2nd The energy analysis works!

W, 78°K, He $4 \cdot 10^{-5}$ ig. gave image at 3KV, then 5KV after a slight flash. Spectrum finally located at 6 ev.

Aug 3rd. Optical bench rigged-up for f 1.9 dallmeyer & 1.9 Pentax for EAM 2. New d'Bury HT set used as some jitter yesterday (50 volts on 5KV)

Image appeared at DIV 6.2 KV (? 5.8KV) in He 78K. Analyser voltage 2.38 KV. Less jitter than yesterday (poly sheet added to screen HT feed from water vapours).
Background $1-2 \cdot 10^{-6}$ T cold.

Pictures taken with $4 \cdot 10^{-5}$ He. (image viewed at 10^{-4} ig reading) & diff pump wide open.
Picture of screen
1, 10 secs of spectrum
" no image gas.
Then series of pics changing (increasing) analyser volts " " " " (decreasing) top volts.
Then attempt to focus better by moving (screen + top) → spectrum became sharper but difficult to see if it was focussed or not. Exposures of ≥10 secs usually (last pic (60 secs) on reel)

Source of ions on hi-field region near III
C-P volts initially 1200 then 1KV in attempt to reduce high background noise (? scattered ions ? effect of only system)
C-P has developed several bit up channels since being used in the steam engine. Same just like phosphor

"Rough" Calibration of analyser

Mon Aug 13th U 78° He.

BIV [[3.468]] 3·3 KV (125 Helipot ½ (α series))

Centred on detector at 1·200 KV.

Top of detector @ 1·243 KV

Bottom of detector @ 1·175 KV.

(With series safety resistor of MΩ in series with 14 MΩ dividers).

1·231 KV =	125 Helipot
1 217	123
1 200	121
1 176	119
1 161	117
1 142	115
1 124	113
1 106	111
1088	109
1065	107
1048	105
1029	103
1013	101
999	99

-2KV

-1KV ->

lining up edge of spectrum with a bit-up channel.

Analyser set to 1KV on 1-2KV scale. Top of plate = 098

Bottom of plate = 105 ≈ 2·8 KV (2·955)

	Top	Bottom	
1·05	104	111	≈ 3KV
1·100	109	116	
1·150	1145	122	
1 200	120	127·5	

Set analyser to 1478 KV

screen 3.5KV
C-plate to 1.7 KV,

1 15 sec photo @ 125 — ×11.67 mm

measurements on film, projected on screen & measured with a vernier caliper

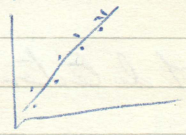
1 " " - 123 — 8.62

1 " " - 121 — 4.11

" " 119 — 0

" " 117 — ×-ve

Plot of displacement vs. tip volts is straight line



" " 118 — -2.41

" " 120 — 1.16

" " 122 — 5.44

" " 124 — 10.59

1 Blank.

1 15 sec pic & no tip HT.

If 111 = 3KV, ~~$\frac{2}{3} \times \frac{22.7}{3} = 74$, for a +1KV pulse.~~

If 110 = 3KV & 130 is even volts,

$$130 = \frac{13}{11} \times 3KV = \frac{39}{11} = 3.54\ KV.$$

$$\& \ 2.54KV = \frac{2.54}{3} \times 110 = 0.846 \times 110$$

$$= 103.$$

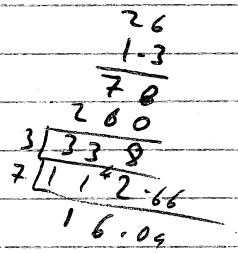
∴ for 1KV pulse require HT ≈ 103.

8466
11
10306
5.

Measurement of width of peak on film gives width as $\frac{1.7}{2.1} \times 26$ volts

$= 16$ volts

∴ likely that analyser was not perfectly focussed.


26
1.3
78
260
3
338
7
112.66
16.09

14 Sept '73

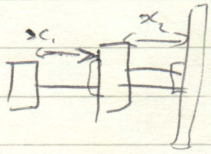
Calibration of X-series 807R Brandenburg 30KV HT set.
2 Hrs warmup. Measured with CPS 50KV probe & Fluke 895A Diff. voltmeter
1000:1

Helipot	KV				
0	.034		180	4.864	
25	.75271		185	4.981	
40	1.192		190	5.112	
45	1.332		195	5.235	
50	1.480	1.473	200	5.349	5.376
55	1.620		210	5.600	
60	1.756		220	5.840	
65	1.894		230	6.070	
70	2.031		240	6.317	
75	2.164		250	6.562	6.545
80	2.302		260	6.866	
85	2.432		270	7.030	
90	2.566		280	7.267	
95	2.699		290	7.512	
100	2.824	2.821	300	7.732	7.729
105	2.955		350	8.905	
110	3.084		400	10.10	10.08
115	3.217		450	11.260	
120	3.342		500	12.50	12.50
125	3.468		550	13.79	
130	3.604		600	15.10	
135	3.727		650	16.49	
140	3.860		700	17.89	17.92
145	3.989		750	19.57	
150	4.117	4.103	800	21.19	
155	4.240		850	23.01	
160	4.366		900	25.01	
165	4.487		950	27.22	
170	4.615		1000	29.68	29.71
175	4.745				

	3:12 pm	3·35	4·50	6·10
200	5·3605	5·365	5·363	5358

16 Sept.

Freeness of elm 2 manipulator



$x_1 = 2.2$mm $\quad x_2 = 2.45$ [initial settings as found]

x_2 max $= 3.1$ cm

x_2 min $= 2.05$

17 Sept

2 pics ~10 secs @ 210, analyser 1972 volts.
1200v, 1300v cyclute $\quad 2.45$cm x_2

3 or 4 10sec pics rotating tip: pair of lines, intensity lights between them running across 110 zone dec near 110 $\quad x_2 = 2.15$?
1 blank

1935v volts 10sec $x_2 = 2.15$

@ $x_2 = 2.1$ lose picture.
1 pic nearest ↑.
" $= 2.17$. forming clearly strong fm of x_2 in these pics
1957, 2.54 10sec
1 pic: not stably intensity, ? tip altering.
1 blank

With Helpist 212, pictured at 2123 analyser volts when dc is applied from battery pack. 1 10 sec picture.

Set Hel to 215 + pulse, analyser to 2140. 1 pic.

1 pic at 2kv, 215 on Helpist.

1 pic at 2kv " " no gas 20 secs.

" " 2140, " + pulse " . " .

2145 218 20 secs.
20 secs no pulse
20 secs pulse.

2150 221

Put gas back in, analyser should have been at 2200 to catch ions from 221.
1 10 sec pic at 221, 2200.

224, 2230 10 sec.
1 blank

227 2260

230 2290

233 2320 10 sec

" " " + charge gas.

236 2350 " " " "

239 2380

242 2410

24 8 2570 nogas

" " 4.0 $^{-5}$ 20 sec.

" " 1.0 $^{-5}$ 50.

248 ± BIV. tip surviving.

Naftha

± 262 BIV 2296 analyses 10 secs. 110 zone dec.
x_2 2.49 ish x_1 2.3 ish

" 2.25 20 secs

much pissing around trying to form.
eventually settle for ~~x~~ x_2 2.30, x_1 2.3 ish.
suspect loss spec wand ∴ hysteresis etc.
1 pin 20 secs.

Add pulse analyses at 2640

Helium 265 → " at 2672. so add 30 v / 3 on helium.
20 sec pin.

271	2730	20 sec pin nogas.	
274	2760	10 " " "	
277	2790	"	
280	2820	"	
283	2850	"	
286	2880	20	small flush
289	2910	30	
292	2940	20	
295	2970	20	
298	3000		

Tip on 1270 DIV. Run out of volts on analyser (>5KV only).

Wed 19 sept- Newelsing CD3s 5KV VG H7 set. (50 analyser volts real × scale factor
(Otherwise Harwell unit, unsatisfactory as voltage source

for analyser.

230 10sec analyser 230 volts.

+DC pulse -> " 2380 volts 1pi 10sec (2)

251 $\frac{21}{3} \times 10 = 210$ volts -> 2510 10secs.
1 blank

257 2650 15secs.

260 2680 10 "

263 2710 10

266 2740 15

269 2770 15

272 2800 15

275 2830 10

278 2860 15

281	2890	20
284	2920	20
287	2950	10
290	2980	20
296	3040	20
302	3100	25
308	3160	15
314	3220	10

+ gus 10 (but no ~~spike~~ real one).

spectrum found @ 314 + probe -> 3100.

Typ still there.

230 2380
314 3100

84 720 ~~360~~ 60 ~~180~~
~~720~~
1 ~~84~~ ~~42~~ 8 4/7 , 3 => 26..
~~21~~ 7

∴ Should add ≥ 8 4/7 volts per kelvin unit in this range,

Replace 3 grotty batteries in de supply -> now ≥ 730 volts
(≥ 300 BV : Hi-Z)

19 (Thurs) Sept

Nu tip

BIV ≈ 148 . 131 + pulse = evaps killed .

x_2 2·1 x_1 2·51 initially out of focus .

1250 analyser volts .

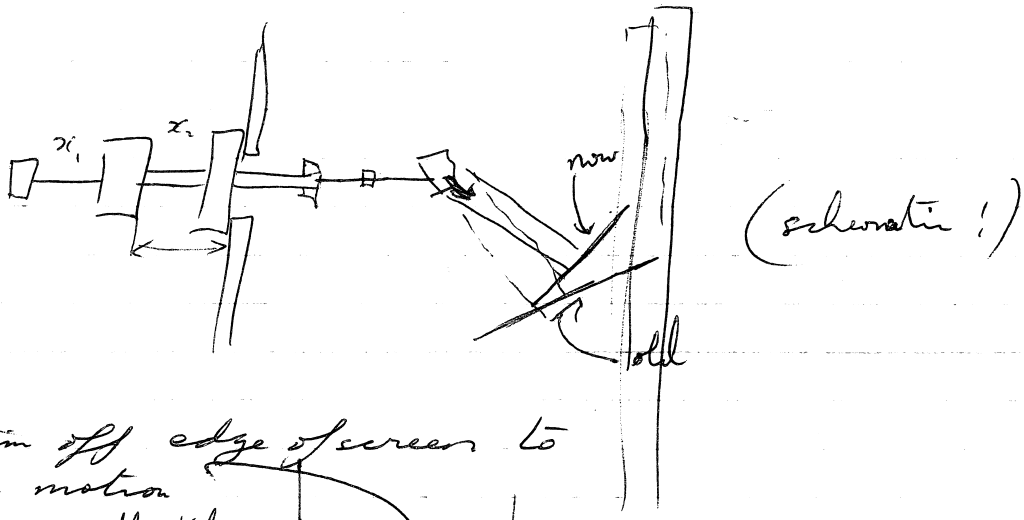
Tip flashed when manipulator shorted onto HT .

Nothing at 2 3kv .

Yesterdays pics were unfocussed : entrance ℄ of analyser was set to 35–45° : way off, anyhow .

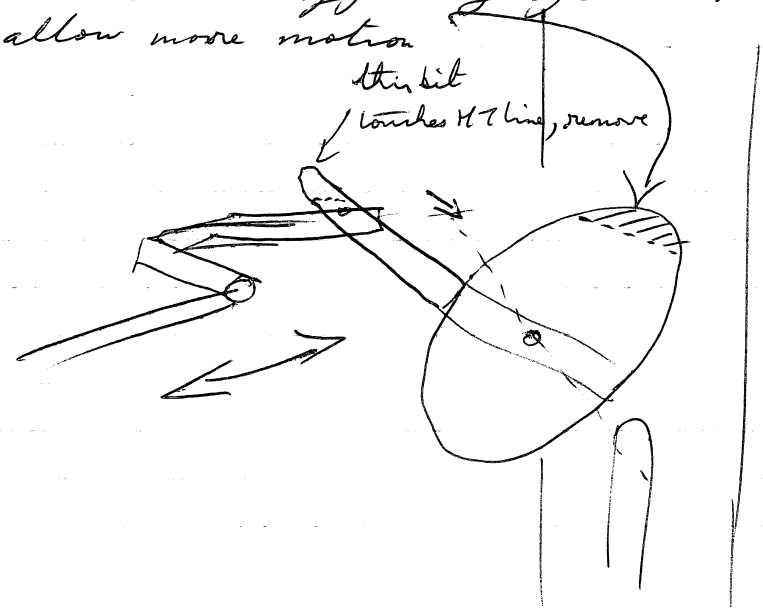
Todays looked ≈ in focus just before flashing , with $x_1 = 2·5$, $x_2 \approx 1·7$ (effect of screen being misaligned was to prevent x_2 being decreased enough

ie



(schematic !)

could trim off edge of screen to allow more motion



Fri 20 BIV 203 evapn at DC pulse + 184

1.82	2.55	10 sec	1710 volts anode
1.95	2.55	"	
2.08	2.50	15	
"	"	60	
"	"	20	184 pulse 1960
		20	183 " "
		20	190 2020
pause for evapn →		20	" "
20 sec "		20	196 2080
	→	20	196 "
20 sec	209	1900 volts.	
1.95	2.05		
15	2.00	2.5	"
20	2.05	2.5	1910

Mon 24 Sept   Same W tip   765 + pulse = 785 energy volts
BIV ≃ 4½ KV.
165 regular 1530 analyser.
? Enfocus. Noisy spectrum.
10 secs } 4 10^{-5} He
20

10 } 2 10^{-5} He } Off reading
20   2 2 10^{-5} H_2
40   same site.

50   < 1 4 10^{-5} H_2 only.
↓
1 Blank.

50   Analyser volts 1500.

20   1470   apparently spectrum to brighter
45   at bottom of c-plate (lo field).
? Why.

151	20	1370	"
"	70	1380	
	30	1380	2 10^{-5} He 2 10^{-5} Ne
	30	1360	
	30	1420	He peak.
	30	1400	
139	30	1300	He peak.
	30	1310	"
	30	1290	He + H_2
	30	1280	H_2
	30	1270	"
	30	1260	"

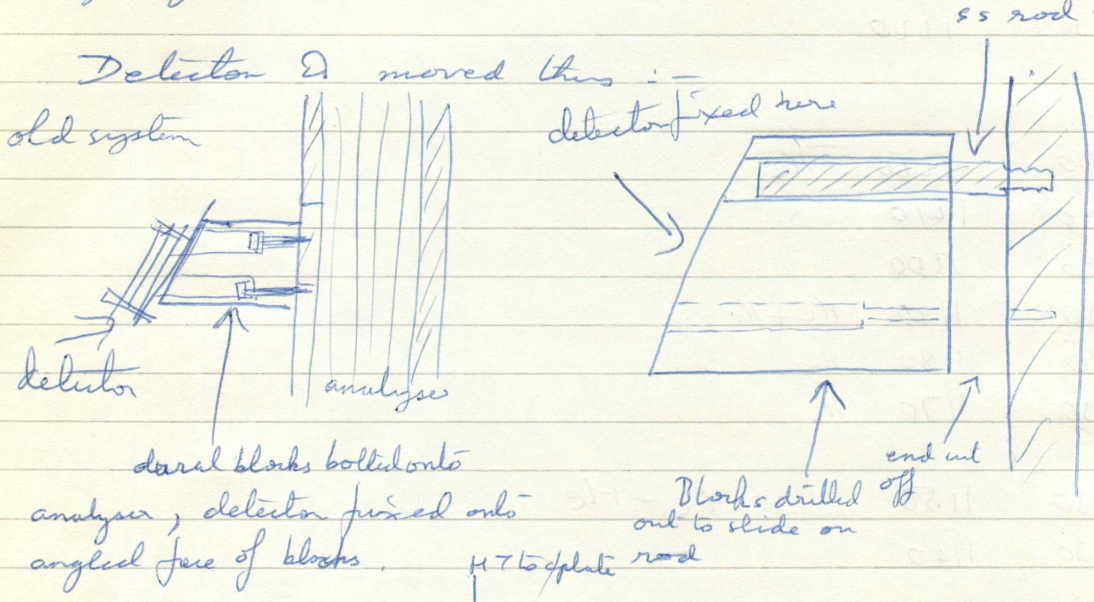
133.5	30	1260	He
	30	1250	He H_2
	30	1240	H_2
	30	1230	"
	30	1220	"
127.5	30	1220	He
	30	1210	"
	30	1200	
	30	1190	H_2 + He
	30	1180	H_2
	30	1170	H_2
~122	30	1150	H_2 + He
	30	1140	"
118.5	40	1120	He + ?
	40	1110	? + H_2

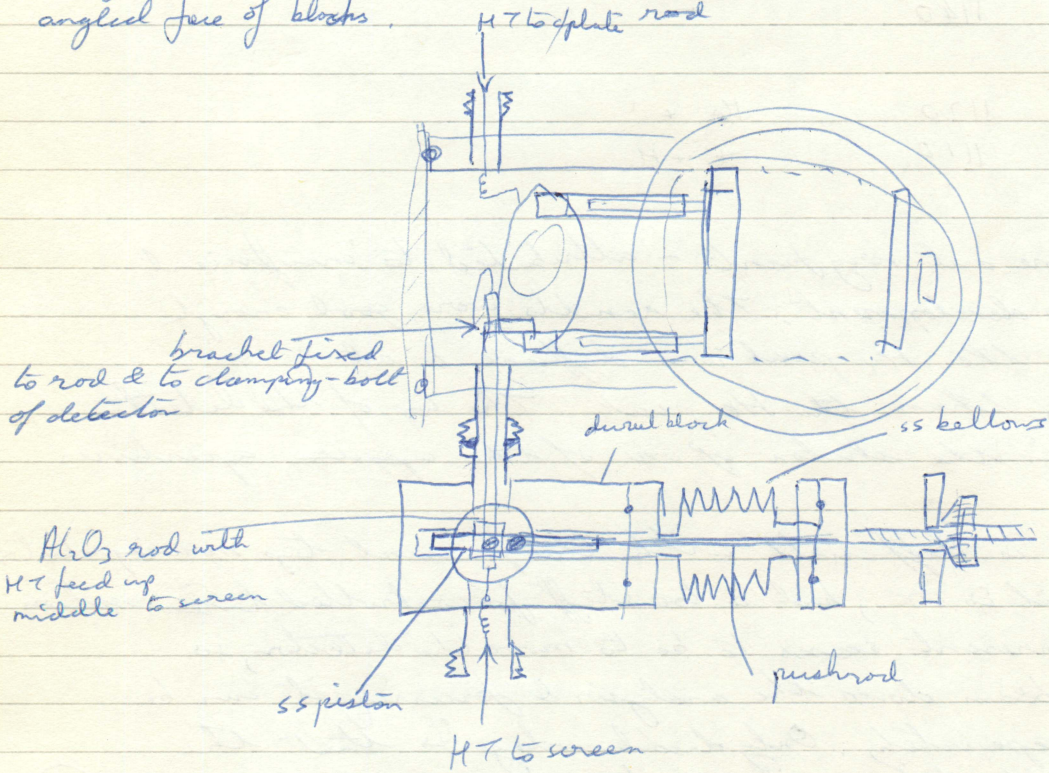
This film came out very faint - attributed to insufficient agitation during development. The results were good enough to show that the H_2 peak was diffuse & at a lower energy than the He peak. The top of the detector is apparently in the shadow of one of the ~~upper~~ apertures.

Focussing is difficult with the present tip manipulator - the rotary seal is OK, but is too stiff for controlled linear motion. Best solution at present seems to be to move the detector, so that getting a beam down the analyser & focussing it can be accomplished separately. Only disadvantage is that the low depth of focus of the f0.9 lens will mean refocussing the camera after focussing the detector, & this means losing dark adaptation.

25 Sept – 12 October: this period spent building movable detector, enriching the motor trade, attending FE discussion groups (at Cambridge), & preparing & giving a postgraduate lecture.

Detector is moved thus :–





Moving pushrod connected to bellows moves the piston in the dural block: an alumina rod passes through this at 90° & is held rigidly to it with a clamping-piece. This alumina rod passes through the ¼" hole ~~formerly on~~ formerly used by the screen HT feed

and produces ~ 8 mm travel for the detector. The screen 47 is taken up the centre of the rod. The drive the the screen is on the stiff side as the detector tends to go askew on its rails, but the motion obtained is apparently useable.

Mon 15 Oct He, H_2 @ 78° K ~ 10^{-6}

$2 \cdot 10^{-5}$ He DIV ≃ 137 (~~138~~) 6 secs 1300 analyser cp 1300

" 6 secs " 1400

picture brightens & dims.
looks quite well focused

" 6 secs 1310 "

" 35 secs " "

" 35 secs " 1300 volts

$2 \cdot 10^{-5}$ He 35 1490

" " 20 " "

Ne He " 35 " "

$4 \cdot 10^{-5}$ H_2 " 35 " 1400

" " 1280 "

" " 20 " "

" 130 20 1220 "

125 35 1180 "

120 20 1140 "

" 35 1140 "

1 B Link

115	30 sec	1090	1400
110	30	1050	〃
105	35	1010	1400
100	35	970	〃
95	35	930	〃
90	35	890	〃
85	35	850	〃
85	35	840	
80	〃	790	
	1 Blank		
100	35	970	〃
〃	20	〃	〃
〃	10	〃	〃
1.10^{-5}	〃	60	〃
2.10^{-5} He/H_2 2.10^{-5}	29	970	〃
137	17	1300	〃
	25	1290	
	30	1280	
	25	1290	

Thurs 18 Same Cup.

162	1540	40secs	1400 v.	$4 10^{-5}$ He
"	1550	"	"	
"	1560	"	"	
"	1570	"	"	
"	1580	"	"	
"	1590	"	"	
"	1530	"	"	
"	1520	"	"	
"	1540	"	"	

$2 10^{-5}$ He $2 10^{-5}$ H_2 Eq.

162	1540	40	"	He + ? H_2.
"	"	60	"	
"	1510	40	"	H_2 push
	"	"	"	
"	1530	"	"	He + H_2
	1 diff short			
"	1530	"	"	diff. location.
	1 blank.			
157	1490	40	"	"
"	"	45	"	
152	1450	40	"	
"	"	"	"	
147	1480	40	"	
"	1 diff		"	
"	"	"	"	
142	1360	"	"	
"	"	"	"	
2 "				
	1 blank			
137	1510	40	"	
"	"		"	
132	1270	"	"	"

132	1270	duff	"	
"	"	40		
122	1180	40	"	
"	"			
113	1100	60	"	"
"	"	"	"	No gas.

Mon 22 Oct W ~60%

167	1 blank	1580	1400 cp	$4 10^{-5}$ He
	10			
	20			
101	10	990	1400	$4 10^{-5}$ He
	30			
	30	1990		
"	30	990	"	"
	30			
	30	"		
	30	-		
	40			
	30			
	1 blank			
	30			
	35			
	30			
	30			

readjust screen angle as well as tip/screen angle

	230			
	30			
	30			
	30			
	30			
	30			
	1 blank			

101

30

20

30 edge of picture

30

? extra 30

30

20

30 Crop on edge of picture, not a stable

Mon 29 Oct Same tip.

Small flush -> 297 b/v. v Bright picture.

He, H_2, Ne solid N_2 temp.

$\frac{297}{2} \simeq 150$, analyser $\simeq 2 \times 1400 \simeq 2800$.

Actually, $n = 2650$ middetector.

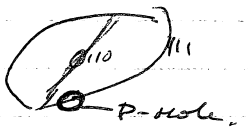
4×10^{-5} He

297 1×10 sec. 2650 1290 cp.

1×20 sec

Apparently several peaks present.

1×40 sec.



2×10^{-5} He, " Ne (b/g)

10 sec ≃ same site

20 sec 2650

2×10^{-5} Ne only

12

290 10 2580

30

1 blank

280 20 2500

20

270 20 2420

20

260 20 2340

20

250 20 2260

20

1 blank

240 20 2180

20

40

230 25 2190

25

220	20 sec	2020
	20	
210	20	1940
	20	
200	20	1860
	20	
190	20	1780
	20	
180	20	1690
	20	
170	30	1590
	230	

1.10^{-5} Ne, $3 10^{-5}$ He

230	20	2100	(230 looks like Ne-enhanced image onset (bright-hifield regions))
	30		

$3 10^{-5}$ He alone 20 ~ much dimmer

20

end of film -

N film

230	30	2100	$3 10^{-5}$ He
240	12	2580	
	12		highly variable spectrum.
280	20	2490	? above BW
	10		
270	10	2420	
	10		
	25		
260	10	2340	
	10		
~~X5~~	20		
250	10	2260	
	10		
	20		

240 10 2180
10
20
230 10 2090
10
20
220 10 2000
1
10
210 16 1930
10
200 20 1850
10
190 20 1770
20
Reforms flaming analyser (moving tip).
240 15 2200

all previous film(s) out of focus.
— tip moving slowly striking in.

240 20 2200
20
$3 10^{-6}$ Ne $3 10^{-5}$ He

240 30 "
23 1

210 30 1950
30
Ne Ne
210 30 " 2370
30
260

BIV ≙ 245²

4.10^{-5} He.

245	10	2250	1490
	20		

$1\,10^{-5}$ He $3\,10^{-5}$ Ne

245	10	2250
	20	
	30	
235	20	2130
	20	
225	25	2080
	25	
215	25	2000
	25	
205	25	1920
	25	
195	25	1830
	25	
185	25	1750
	25	
175	30	1670
	30	
165	30	1570
	30	
155	30	1490
	30	

16 blanks

185	30	1750
Remove He.		
185	30	1750
	30	
245	30	2250
	30	
	1 blank	
235	30	2170
	30	
225	30	2090
	30	2
215	30	2000
	30	
205	30	1900
	New film	
205	30	1900
195	30	1820
	30	
	1 blank	
185	30	1740
	30	
175	30	1660
	30	
165	30	1570
	30	
155	30	1480
	30	

145	30	1390
	30	
225	60	2030
	60	
	$3\,10^{-5}$ Ne + $1\,10^{-5}$ He	
220	60	2030
	60	
205	60	1900
	60	
	Remove He	
205	60	1400
	60	

2 Nov 73 W Solid Ne Background $1 10^{-6}$

B I V 210

$4 10^{-5}$ He

209 1960 30 sec 1400

60 sec

$2 10^{-5}$ Ne

204 1960 30 sec

60

200 1870 40

40

190 1790 40

40

180 1690 40

40

170 1610 40

40

160 1520 40

?40

150 1430 40

40

140 210 1940 40

1 dmd

$2 10^{-5}$ Ne $1 10^{-5}$ H_2

210 1940 40

40

200 1870 40

40

Looking for Ne from surface in presence of H

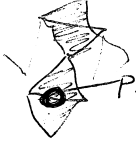
190	1790	40
		40
180	1710	40
		40
170	1620	40
		40
160	1530	40
		40
150	1440	40
		40
140	1350	40
		40
		40
130	1260	40

Mon 5th Nov Ruddock of AEI came

to give a quote for the CAM 2 UHV version can.

Wed 7 Nov Mo 78°K

All in He.



Looking for field evaporated ions.

3/4 = 3220

302 = 3100

12 → 120

334 − 314 = 20, $\frac{220}{12}$ × 120 = 200 = 3420

332 2900 bottom
2970 middle
3040 top

340 + DC pulse 3220 bolt

340 no pulse 3000

∴ Pulse adds 220 v to analyser

$3\ 10^{-5}$ He

340 3000 5 secs ≈ 1490 ep
10
20

$2\ 10^{-6}$ He

340 3000 30 sec
60

340 + P 3240 40

345 3020 40

345 + P 3260 20
20

350 3070

350 + P 3240 20
350 20
350 + P 20

360	3170	40
360+P	3290	25
+P	3	25
370	3250	40
370+P	3470	25
+P		25
380	3330	40
380+P	3550	30
+P		30
390	3410	~~25~~ 40
		~~25~~
390+P	3630	35
+P		35
400	3490	40
400+P	3710	30
+P		30
415	3610	40
415+P	3830	35
		35
435	3770	30
435+P	3990	30
+P		30
nop		30

No ions seen in this film,
? : analyser aperture reduced in efforts to focus (beam probably hitting entrance/exit slits of analyser).

2nd filter

307	2770	5	1400 up
		10	
		20	
		1	

Analyser reformissed (tip/screen & tip/analyser) to give better transmission & reasonable forms.

310	2770	5	
300	4	5	
	$2\,10^{-6}$		
310	2810	30	
310 +P	3030	10	
		30	
320	2890	30	1400
			1450
320 +P	3110	20	1450
+P		30	"
330	2970	30	
330+P	3190	20	
+P		30	
340	3050	30	
+P	3270	20	
+P		30	
355	3170	30	
+P	3390	20	
+P		30	
370	3290	30	
P	3520	20	
P		30	

385	3420	30	1500 gp
	3630	20	"
		30	
405	3580	30	
	3810	20	
		30	
425	$2\,10^{-7}$ He 3740	30	
	3960	20	
		30	
445 + p	~~3438~~	20	1600
+ p		20	"
no p	3900	30	"
435 no p	3900		1560

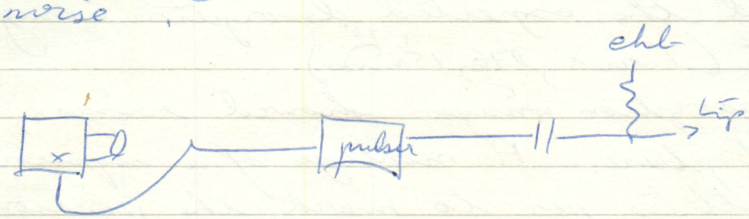
Mo 78

Thur 8 Nov → 2740 and 304		1	1450 cp,
		1	
		5	
		5	
		20	
302	2960	5	(no pic, noise only.
302+P		5	
	≃ $1\,10^{-7}$ Mc		
302+P	2960	? 20 sec	
"		20 sec	
310	2830	20	
		5	
10+P	3050	20	
P		20	
no P		20	
30	3000	20	
30+P	3200	20	
+P		20	
50	3150	30	
	3150		no gas
0+P	3370	20	Camera shot when switch pulled
		20	
		30	$1\,10^{-7}$ Mc.
70	3300	30	" no gas
+P	3520	20	Camera open when switch pulled → desorbed gas.
+P		20	
+P		25	$1\,10^{-7}$ Mc background $4\,c\,0^{-7}$

78 Mo 2475 film.

Oct 14	340	3060	1 sec	1500 gf
.	310 + P	"	1 sec	
310	310 + P	"	1/60	Screen v noisy.
	"	3120	"	
	? "	"	"	
320 + P		3170	1/60	1KV pulse
"			1/60	
320 + P		3260	"	
+ P			"	
"			"	
"			"	
"			"	No gas.
			Blank	
340 + P		3360	1/60	
"			1/60	
"			1/60	
350 "		3430	1/60	
"			"	
"			"	
360	3650		1/60	
	((3530 would have been better))		"	
370 + 1500v pulse		3780	1/60	1500v pulse
"			1/60	
380	3870		1/60	
			1/60	
			1/60	
400	4050		1/60	Isotopes seen on detector.
			1/60	
			1/60	
420	4210		1/60	Flash from lip, but it survived.
			1	
			1 (but lip surviving.)	

Since Tuesdays expt was not completely successful (although the sensitivity to single ions was apparently greater with 24Ts than Tri X, the background noise from the channel plate & various discharges on its annuli obscured evaporations to a large degree) the X-contacts on the pentax were used to trigger the pulser, so that the 550μs evapn pulse should occur during the $\frac{1}{60}$ sec = 18 ms exposure, thereby reducing by a factor of 60 upwards the background noise.



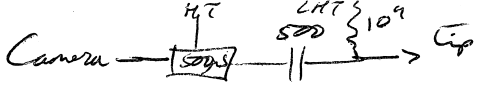
The converter/detector in the analyser was v. noisy & a discharge could be seen across one of the insulators in it ?? why should this break down suddenly, long path over porcelain, should be good to 25 KV +

— will have to rebuild converter so that screen volts can be run at 5 KV without discharges; all brightness of screen is required to record single ions

— though today ~~was~~ fused up mounting arrangements for using Dallmeyer 1.9 into f/1 Wray lens on a Leonard Tompson-body to give large aperture. Trouble is, only crude shutter, no chance of triggering pulser reliably so need ~ 2 sec exposure with consequent background noise problems — ? Add a separate shutter mechanism with a flash contact, or use another pulser to gate the channelplate or the screen voltage.

Anyway first problem is to operate detector screen voltage.

Some evaporated ions were definitely identified on the todays film.



Thurs 15 Experimenting with a field desorption mic based on 2" VG system, with EDB & D. Cowley. Using 2 f 2 pentax lenses nose to nose, 1500 v. on c-plate. Poor vacuum ≥ 2.10⁻⁸ background. The 500μs pulser was run from the camera flash contacts, as with the EAM 2. The resulting desorbed ions could be clearly seen on the microscope screen. Photographs were taken at various pulse/DV ratios and showed the expected desorption images on developement (Tri X, D76, 1:1 15 mins 20°). photos

The desorption images showed rings, some with a central net plane. A montage of a sequence was made, by using a felt tip pen to mark the positions of the spots on a bit of paper under the enlarger; bit-up channels were used to register adjacent frames. As expected, the (110) regions were heavily spotted: the (111) plane was almost entirely free of ion spots, as expected: clearly, resolving a (111) net plane by desorbing the atoms is non trivial, especially if image gas or crud may be adsorbed on the surface.

A Dallmeyer + Canon combination would be an improvement over the Pentax, as vignetting was apparent, & only about ½ the screen registered on the photograph (? or 1" c-plate). A (111) oriented tip would also be an advantage (A (111) iron tip would be interesting as the plane is invisible normally, surrounded by 3 dark rays Y, so no adsorbed gas to obscure the desorption image.

Fri 16 Nov No 78

249	2300	1 sec	1500 Canonf 95 $1 \cdot 10^{-5}$ He.
		5	
249+p	2600	1/60	P = 1kV
2		1/60	
255+p	2650	"	
"		" ← realign 6110	
"	"	"	
"		"	

Stabilising with alignment, typ electron

350+p	3460	1/60	(
		1/60	
360+p	3650	"	$2 \cdot 10^{-5}$ He
NB →	3550	"	
	3550	"	
~~370~~	~~3780~~		lots of ions
360+p	3670	1/60	P = 1500
		1/60	
370	3780	"	No gas lots of ion
3		"	
		"	
380	3870	"	" "
		"	
		"	
370	3960	"	
		"	
		"	
400	4050	"	
		"	
		"	
		"	4
410	4140	"	
		"	
		"	

4260 1/60

425+P " "

440 4400 " "

Above film was v. out-of-focus & was useless & abandoned.
(Camera o.o.f., not analyser)

Try again.

400 stable. 78° Hg

380+P 3870 1/60 lots No gas. 1500, rubbish 1500 cps.

" " " 5 shots.

390+P 3960 " "

400+P 4050 " "

410+P 4140 " "

" " " 4

425+P 4250 " "

" " " 3

90 135

440	4400	7	
		4	
		4	
455	4520	4	
		4	
		4	
470	4600	4	
		4	
		4	
485	4790	2	
		1	
500	4820	1	flash. Tip ox
		4	
		4	
		2	4
510	4930	1	
		4	
		4	3

At this pt the bloody camera was discovered not to be winding on. Oh happy day.

New Mo tip inserted in mic : Only 5kV available to work the energy analyser. The above spectra were (not) taken with the probe hole over the (110) environs, since these provide more ions per pulse than (111) or (100) regions ((100) was the previous site for moly. spectra : bright & accessible). Plenty of ions were seen on the channel plate, in a moderately narrow band (≥ 1 cm), possibly with individual lines in it. No photos, so can't tell. Bloody 'ell.

Today the Canon 7 with f: 0·95 lens fed by Dallmeyer f 1·9 was used, with 2475 film, to try to record desorbed ions with maximum efficiency.

Sat 17 New Mo Tip (imaged last nite, ≃ 10KV, etched back to ≃ 5KV). 78° 2475 film.

282 2570 x $2 10^{-5}$ He (100) 1500 cps.

4

blank — checking of film winding on.

1

260 ±? (1KV)	2700	x	no ions seen
		x	
270 "	2800	x	
280 "	2900	x	
290 "	2970	x	
	"	x	
300 "	3040	x	
		? x	

realign between 111, 100. No gas.

310 "	3130		
320 "	3170		Ions seen at bottom of screen
330 "	3270		middle
340	3360		
350 "	3440		
360	3530		
370 "	3780	x	
		x	
380 "	3870	x	(1500 pulses)
390 "	3960	x	
400 "	4050	x	
		x	
410 "	4140	x	
425 "	4250	x	no ions seen
440	4400	x	
455	4510	x	
~~470~~	"	x	
		x	
470	4680	x	
		x	

485 4700 ×

×

×

× 41 turns

Background 4–6 10^{-7} cold

Prints made of ≃ 15cm diam (of screen) : a perspex sheet was scribed with arcs 2mm apart, rad. = rad of curvature of a helium peak. Counts made from prints in the 2mm bins.

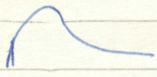
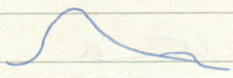
Helipot

440	1, 0, 1, 0, 12, 10, 15, 14, 8, 4, 1, 2, 2, 1, 0, 1
410	1, 1, 0, 1, 10, 6, 5, 2, 5, 2, 0, 0, 1
455	1, 13, 20, 20, 8, 7, 2, 7, 2, 1, 1, 1
485	1, 3, 5, 17, 19, 0, 3, 2, 4, 3, 1, 1, 1
470	12, 23, 7, 15, 6, 6, 3, 2, 3, 1
w16	1, 2, 9, 6, 6, 5, 1, 0, 0, 1, 1, 0, 4, 2, 1, 2, 0, 3, 1

Dispersion = $\frac{\sqrt{7}}{E}$ mm/v $\Rightarrow \frac{E}{\sqrt{7}}$ v/mm $E = \frac{V_{an}}{70} \times k$, $D' = \frac{V}{70\sqrt{7}} \times k$ $(k \leq 1)$

	V_{an}	$4700/V_{an}$	
440	4400	1.068	
410	4140	1.135	14.93 v/mm
455	4510	1.042	
485	4700	1	22.62 v/mm or plate
470	4690	1.022	

The peaks obtained from the data above were between 120 and 200 volts in extent,

either  or  shaped.

(2 secondary peaks)

$\sim$ 80 ions per peak.

? Do the wide spread of ions 1) due to energy loss processes 2) due to slope on the top of the pulse 3) due to evaporation on the leading edge of the pulse. Slope of top should be $\sim$ 20 volts or so Risetime $\sim$ 200 nS – 400 nS.

Test for 3) by looking at output from detector as a function of time after the start of every pulse. Spread of time due to different ~~masses~~ energies should be $\sim$ 100 nS, to different charge states several μS, to different masses (if not M_0 but He, H_2, etc again several μS.

? amp fixed to screen resistor

or photomult registering from screen.

Mon 19 Nov Monolip 78° Zeiss (no 2475) Canon

310 2830 5 $1\ 10^{-5}$ He 1500 cp.

10

300 3040 x 1 KV pulse

x

310 3130 x

x ?

320 3220 x

x

330 3270 x

x

340 3360 x

x

355 3500 x

x

3620

370 ~~3780~~ x 1 KV pulse

x

370 3780 x 1500 ~ ~

x

x

385 3870 x

x

x

390 3960 x

x

x

490 4050 x

x

410 4140 x Navel seen

x side moved downward 110

425 4250 x

440 4400 flash, lip OK

455 4510 x

x

x

x

x

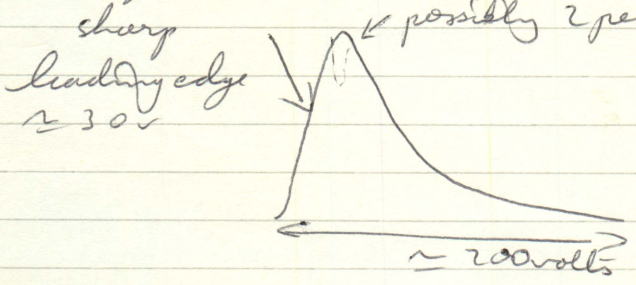
470	4600	x
		x
		x
Nyfilm 470	〃	x
Trix		x
		x
		x
		x Nogus.
		x
		x
485	4700	x
		x
		x
		x
		x
~~500~~	4820	x
		x
		x
		x
		x
515	4950	x
		x
		x
520	5000	x flash Gp 0r.
		x ?

430	3780	5	$2 10^{-5}$ He
420	〃	5	
455	3960	5	
425	〃	5	
475	4140	5	
465		5	
505	4400	5	
500		5	
495		5	
〃	〃	30	to get pic of screen readings

analyser can't be in focus only near bottom of screen

Tip etched back to ≃ 5 KV in deliberately worsened manner.

The data for 500 & 575 showed features which might be due to a) two spectra lines ≃ 20v apart or b) 1 line defocussed to produce 2 lines. Have to repeat expt to find out which. Expt shows a) the recording efficiency of Tri-X using the Canon f 0.85 lens is reasonably near unity b) the peaks produced by 500 & 575 were analysed by placing a 2mm graticule rad of curve = 20.0 (?) think on prints which gave a screen diam of 20cm (i.e. × 10 mag). The peaks produced were like



Points to check a) shape of pulse actually reaching the tip b) effect of properly focussing the analyser c) whether the ions have a wide spread in energy due to on the leading edge of the pulse. Eliminate this effect by gating analyser 1) by gating the screen voltage (requires 2nd pulser) or 2) putting an x-y deflector system immediately after the probe-hole, to deflect ions away from the detector except when the energy pulse is flat-topped. This seems to be the best soln (reduced chance of getting interference from converter & noise produced by charging currents, though this should be negligible with a good design anyway.

Tues demonstrating.
Wed Mutually slides for gp seminar in am. given 1 on.
pm fixed D'burg H.T. set for D Copley, imaged Mo tip in
CBM2 by but found it too blunt to repeat-mondays exp-
put in new tip (Mo) in evening.

							$\Lambda + \Sigma I_j - n\Phi$			
	Λ	Φ	I_1	I_2	I_3	I_4	$n=1$	2	3	4
	7.4	4.34	11 3	35 6	83.4	137 8	14 16	34 39	77 92	138 1
	6.87	4 30	7 1	23.2	50 3	96 7	9.67	21.52	44.35	86.45
	3 33	4.20	6.0	24.8	63.2		5 11	19.73	43 95	—
	3.44	3.92	4 32	27.5			8 84	23.13		
	4.45	5.01	7.6	23.78	58 8		7 07	20 21	50 36	
	8.8	4.52	7 92	25.7	49 7	84.7	12 26	25.44	44 92	75.40
	6.94	5.0	9	26	5 3	92	10 94	22 94	44.54	78.94
	3 92	4.82	9.2	24.7	59.7		7.86	20.51	49.6	
	4.40	4 40	7 86				7.51	16.91	40.21	
	4.86	4.17								