The following Hamamatsu pre-series detectors have been irradiated in the PS since April:

Type	Orientation	Thickness	Number	Configuration during irradiation	Assembled at
Barrel B2	<111>	285 µm	5	Biased, metal strips grounded	Cambridge
Barrel B2	<100>	285 µm	5	Biased, metal strips grounded	Cambridge
Barrel B2	<100>	285 µm	8	Unbiased, for module making	Cambridge
W12	<111>	285 µm	4	Biased, metal strips grounded	Cambridge
W12	<111>	260 µm	2	Biased, metal strips grounded	Cambridge
W12	<100>	285 µm	2	Biased, metal strips grounded	Cambridge
W12	<100>	260 µm	4	Biased, metal strips grounded	Cambridge
W31 # 70	**<111>**	**285 µm**	**1**	**Biased, metal strips floating**	**Cambridge**
W31 #56	**<100>**	**285 µm**	**1**	**Biased, metal strips floating**	**Cambridge**
W31 #53,55	<100>	285 µm	2	Biased, metal strips grounded	Liverpool
W32 # 16	<111>	285 µm	1	Biased, metal strips grounded	Liverpool
W32	<111>	285 µm	1	Biased, metal strips grounded	Geneva
W32 # 17	**<111>**	**285 µm**	**1**	**Biased, metal strips floating**	**Cambridge**
W21 # 7	**<111>**	**285 µm**	**1**	**Biased, metal strips floating**	**Cambridge**
W21 # 1	<111>	285 µm	1	Biased, metal strips grounded	Liverpool
W22 # 1	**<111>**	**285 µm**	**1**	**Biased, metal strips floating**	**Cambridge**
W22 # 14	<111>	285 µm	1	Biased, metal strips grounded	Liverpool

The 5 highlighted detectors were put in the PS with their metal strips floating (ie not bonded out to the pitch adapter) because the Cambridge bonding machine developed a problem just before the irradiation and no alternative solution could be found on the necessary timescale.

All detectors except that assembled in Geneva have been annealed at Cambridge (7 days, 25°C equivalent), and all measurements so far have been done in Cambridge following the anneal.

Post-irradiation I-V Measurements:

- All barrel detectors (<111> and <100>) look fine – see attached plot
- All W12 detectors (<111>, <100>, thick and thin) look fine – see attached plot
- All W21, W22, W31, W32 detectors assembled with strips grounded at Liverpool look fine (3 <111>, 2 <100> detectors) – see attached plot
- All the <111> wedge detectors assembled at Cambridge with strips floating have bad IV curves. The IV curve of the <100> wedge detector with strips floating is fine – see attached plot.

- Note the adjacent serial numbers of the Liverpool/Cambridge (good/bad) W32 detectors. Note also that one of the good barrel detectors had the same Hamamatsu substrate number as the bad W32 detector.

Bonding and Soak Test

- The metal strips of the bad W32 detector were bonded out and grounded. This improved the I-V curve, but there is still substantial upturn above 350V.

- This W32 detector was left first for 15 hours at 450V bias and then for 64 hours at 470V. In each case there was some further improvement in the I-V curve, but some of the improvement was lost when the detector was switched off for 24 hours and switched on again.

Noise Measurement

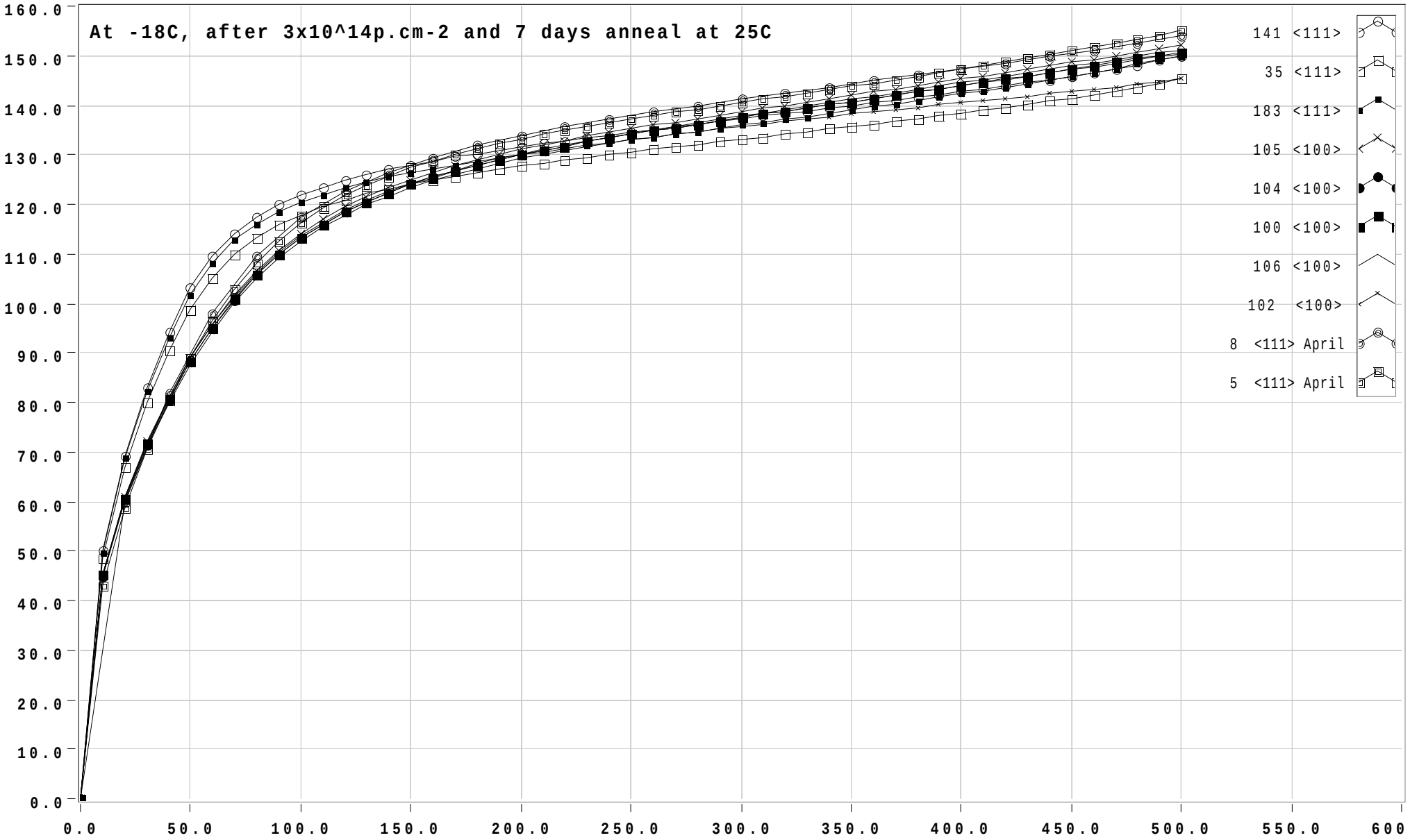
- The bad W32 detector has been connected to the SCT128A (~12cm region of pitch adapter bussing). The current lift-off is indeed associated with high noise. See attached plot. Also the overall noise level reduced after the 64 hour soak test. Note that S/N is 4 fC calibrate/noise in this plot (not a source run).

Tentative Conclusion

The 4 <111> wedge detectors irradiated with floating strips show microdischarge. The <100> detector does not. The detectors have been visually inspected and there is no obvious physical cause for the problem. The 3 <111> wedge detectors irradiated with grounded strips do not show microdischarge. We tentatively conclude that the problem is not with the wedge designs, nor the substrate or processing, but correlated with the floating strips. We presume that the different surface state of <100> has led to the different result in this case?

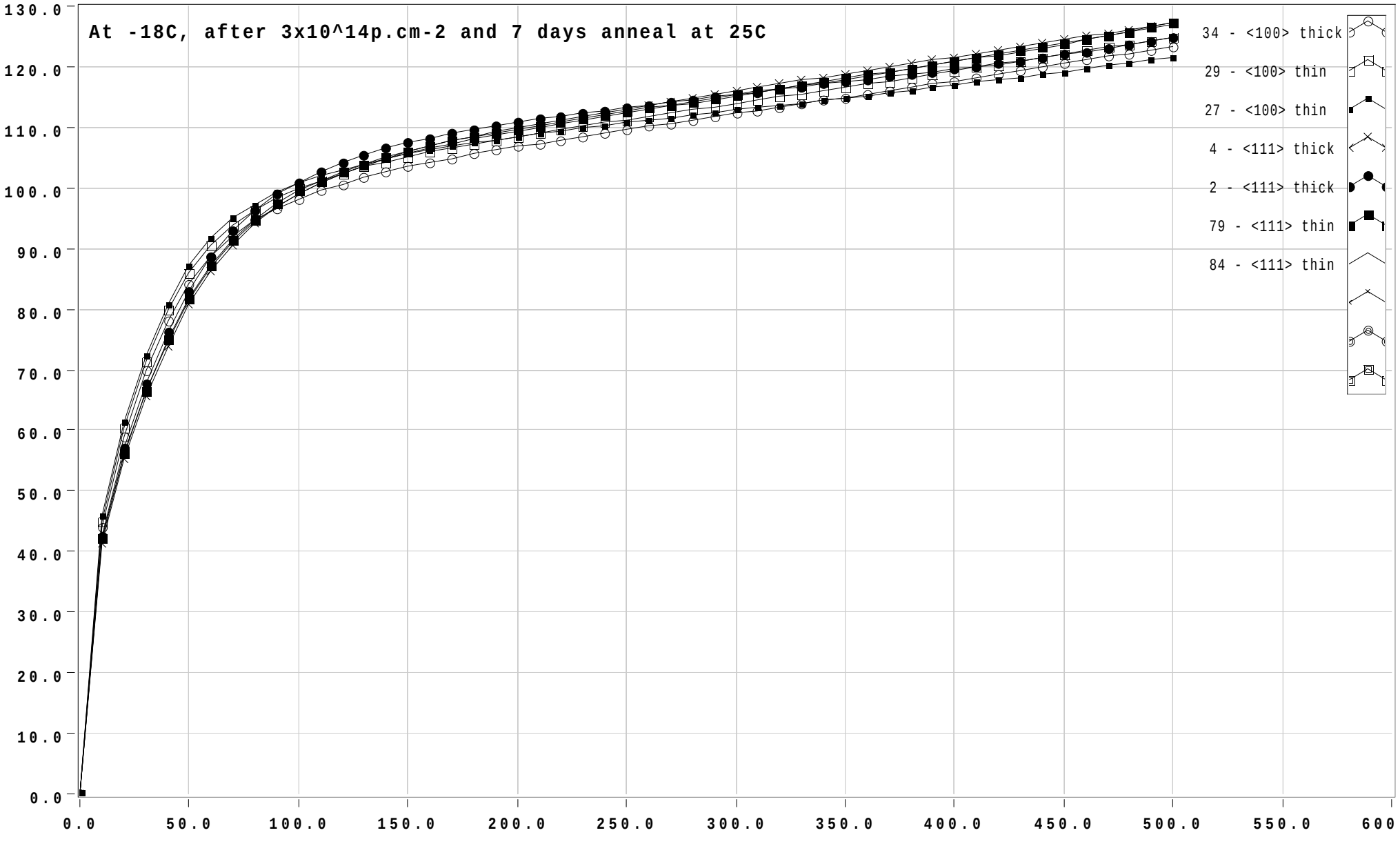
Current(uA) vs Bias(V) - Irradiated Hamamatsu Barrels

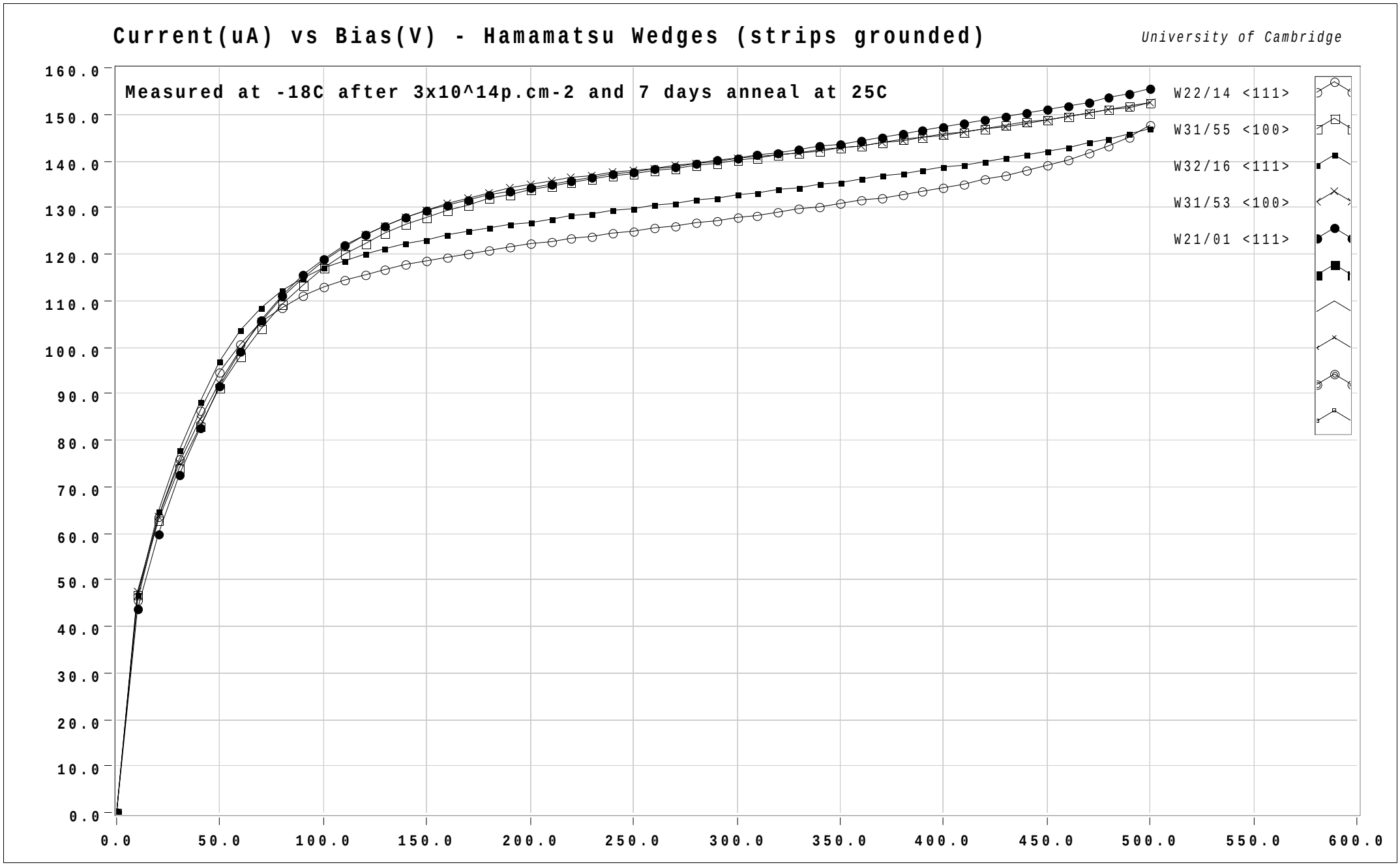
University of Cambridge



Current(uA) vs Bias(V) - Irradiated Hamamatsu W12s

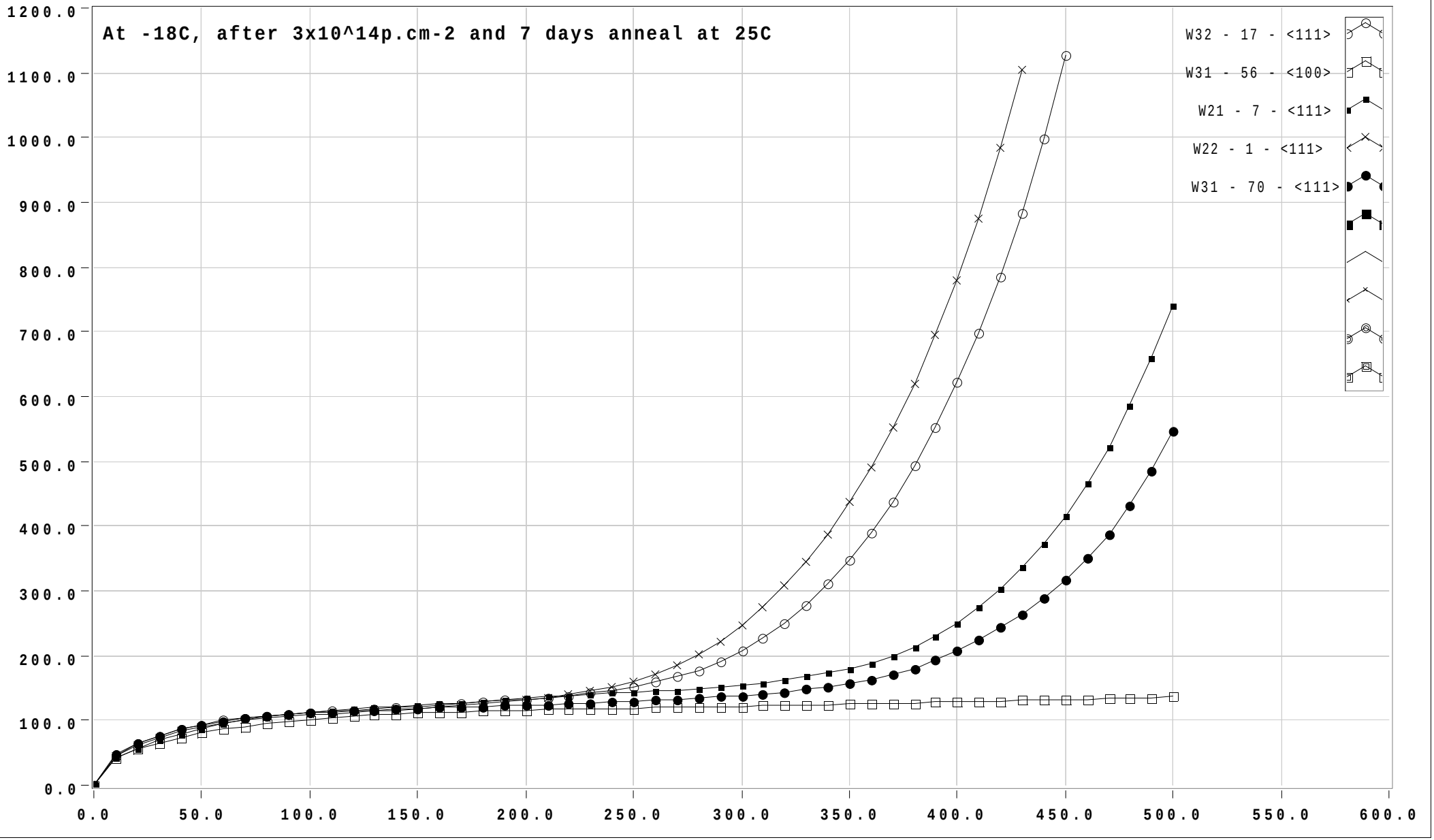
University of Cambridge

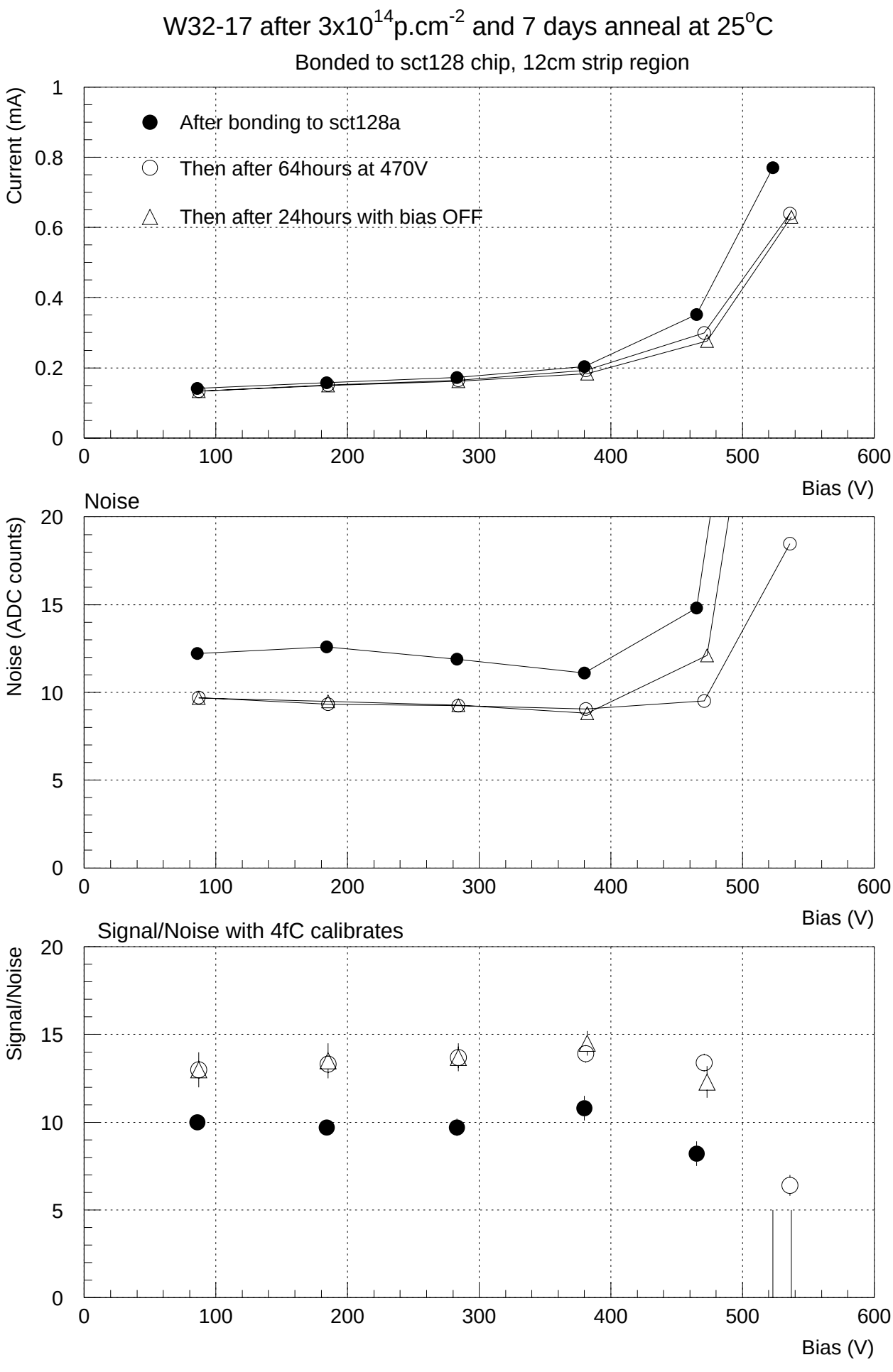



Current(uA) vs Bias(V) - Hamamatsu Wedges (strips grounded)
University of Cambridge
Measured at -18C after 3x10^14p.cm-2 and 7 days anneal at 25C
W22/14 <111>
W31/55 <100>
W32/16 <111>
W31/53 <100>
W21/01 <111>
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0

Current(uA) vs Bias(V) - Irradiated Hamamatsu Wedges (strips floating)

University of Cambridge




W32-17 after 3x10^14 p.cm^-2 and 7 days anneal at 25°C
Bonded to sct128 chip, 12cm strip region
Current (mA)
After bonding to sct128a
Then after 64hours at 470V
Then after 24hours with bias OFF
Bias (V)
Noise
Noise (ADC counts)
Bias (V)
Signal/Noise with 4fC calibrates
Signal/Noise
Bias (V)