APPENDIX B:
Point Source SNR Plots

In This Appendix...

B.1 Plots for Estimating Point Source SNR

In this section we present plots which may be used to rapidly estimate signal-to-noise ratio (SNR) for point sources with stellar spectra observed through popular WFPC2 filters. Plots are given for filters F160BW, F218W, F255W, F300W, F336W, F410M, F439W, F502N, F547M, F555W, F606W, F675W, F702W, and F814W. These plots assume that the data will be analyzed by PSF fitting, which optimizes the SNR in the background noise limited case. They also assume an average sky background of V=22.9 mag arcsec^{-2}. These plots do not explicitly include SNR reduction due to CR-SPLITing when the read noise dominates, but this effect is easily included as described below.

In situations requiring more detailed calculations (non-stellar spectra, extended sources, other sky background levels, don't know target V magnitude, etc.), the WFPC2 Exposure Time Calculator tool, located on the WFPC2 WWW pages, should be used instead.

One uses these plots as follows:

1. Examine Table B.1 and find the spectral type and wavelength of the desired filter (e.g. F555W ≈5500Å). Interpolate in the Table to get AB_V.
2. Sum the V magnitude of the target and AB_V derived from the Table.
3. Find the appropriate plot for the filter in question, and locate $V+AB_V$ on the horizontal axis. Then read off the SNR for the desired exposure time, or vice-versa.
4. To get accurate values for CR-SPLIT exposures, one should use the sub-exposure time when consulting the plot, and then multiply the resulting SNR by $\sqrt{N}$, where N is the number of sub-exposures to be averaged.

There are separate lines for PC1 (light lines) and the WFC (heavy lines), as well as for ATD-GAIN=7 (default, solid lines), and ATD-GAIN=15 (dashed lines).

Dotted lines across the top of each plot indicate the onset of saturation. There are lines for saturation of the ATD-GAIN=7 setting (G=7), saturation of the ATD-GAIN=15 setting (G=15), and finally a line where blooming starts (top-most line for given camera).

We now give a sample SNR calculation using these plots. Consider a V=20 star of spectral class G0, for which we want to derive the SNR for 1200s CR-SPLIT exposure in F555W on PC1. We look up the G0 spectral class and F555W filter (5500Å) in Table B.1, and obtain AB_ν=0.02. We thus have V+AB_ν=20.02. We look at Figure B.10 and find this value on the horizontal axis. We locate exposure time 600s (one-half of the total 1200s CR-SPLIT exposure), and find SNR~200. For the total 1200s exposure the SNR would be $200\sqrt{2} = 280$. This exposure is well below the saturation lines in the plot, so saturation is not a concern. If instead, the star had V=19, we would be approaching the "Saturate G=7 PC" line indicating A-to-D converter saturation at gain 7, and so would want to specify ATD-GAIN=15.

Table B.1: AB_ν as a Function of Wavelength. AB_ν is defined as a color-dependent correction from V magnitude to AB magnitude at frequency ν. Wavelength (Å) runs along the top; spectral classes run down the leftmost column. The second column contains B-V. See Section 6.3.

	B-V	1500	2000	2500	3000	3500	4000	4500	5000	6000	7000	8000	9000	10000
sky	1.10	2.45	5.46	5.46	3.12	2.00	1.03	0.55	0.18	-0.11	-0.33	-0.55	-0.65	-0.75
B0	-0.31	-1.60	-1.50	-1.20	-0.78	-0.62	-0.46	-0.36	-0.22	0.16	0.46	0.76	0.96	1.17
A0	0.00	2.22	1.35	1.11	1.21	1.00	-0.23	-0.16	-0.09	0.11	0.22	0.33	0.36	0.4
F0	0.27	7.22	4.10	3.11	1.99	1.38	0.29	0.06	0.03	0.03	0.05	0.08	0.09	0.1
G0	0.58	8.9	6.35	4.61	2.46	1.63	0.67	0.26	0.08	-0.04	-0.12	-0.21	-0.23	-0.25
K0III	1.07	13	10.3	8.11	5.46	2.13	1.16	0.46	0.2	-0.24	-0.42	-0.61	-0.66	-0.72
M0III	1.60	15	12.3	9.36	6.21	4.63	2.26	0.96	0.51	-0.46	-0.76	-1.06	-1.12	-1.19
gE	1.00	6.82	6.41	5.43	3.63	2.49	1.40	0.55	0.21	-0.19	-0.52	-0.81	-1.07	-1.29
Sa	0.80	5.40	4.80	4.10	3.00	2.01	1.12	0.44	0.19	-0.17	-0.44	-0.7	-0.95	-1.16
Sbc	0.60	4.03	3.18	2.86	2.46	1.54	0.84	0.34	0.17	-0.14	-0.37	-0.6	-0.84	-1.04
Scd	0.45	2.67	2.29	2.15	1.76	1.35	0.65	0.28	0.13	-0.11	-0.26	-0.39	-0.47	-0.58
Ir I	0.30	1.77	1.40	1.36	1.24	0.94	0.43	0.34	0.17	0.13	-0.04	-0.21	-0.33	-0.45

Figure B.1: Point Source SNR vs. V+AB$_{\nu}$ for F160BW Filter.

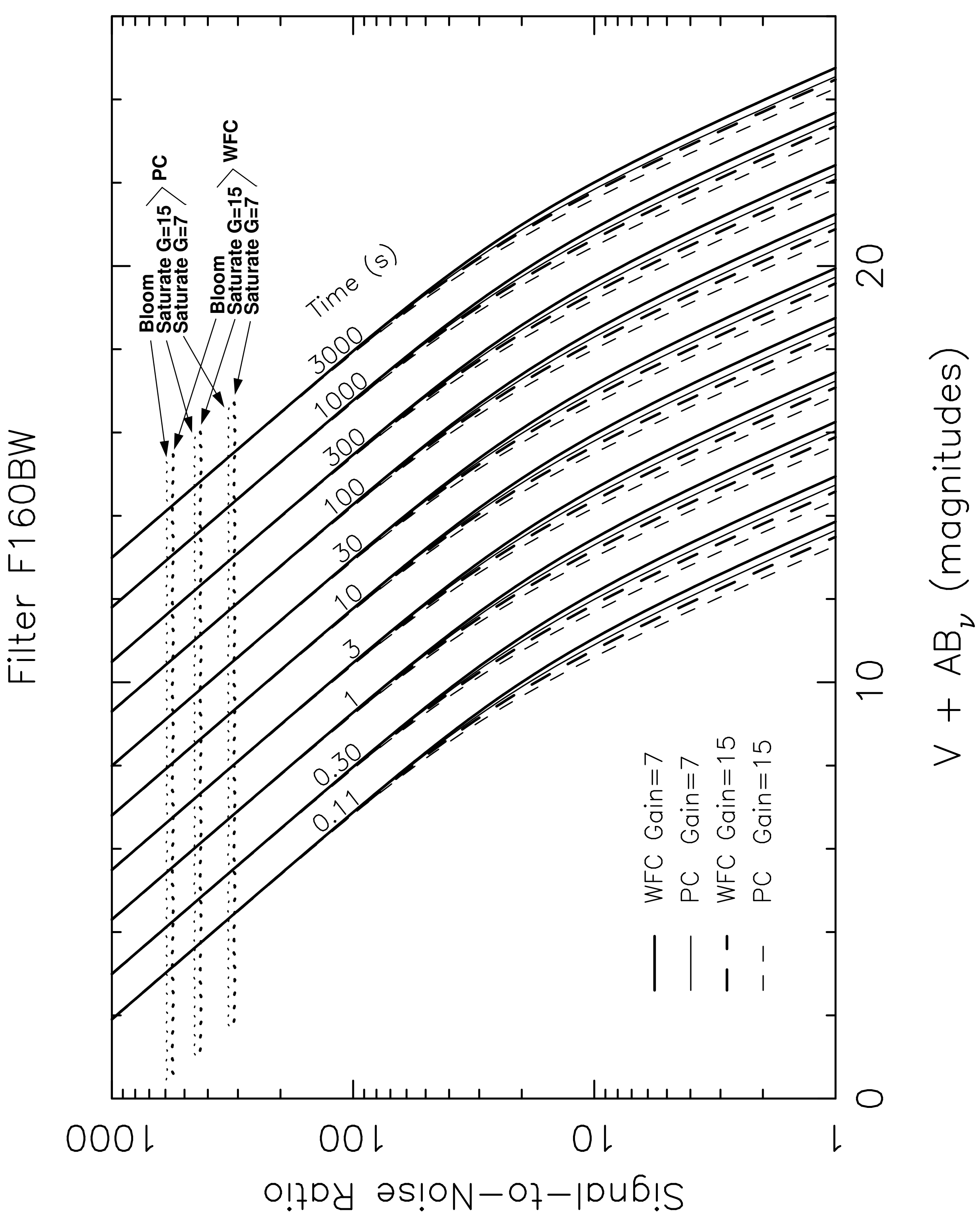

Figure B.2: Point Source SNR vs. V+AB$_\nu$ for F218W Filter.

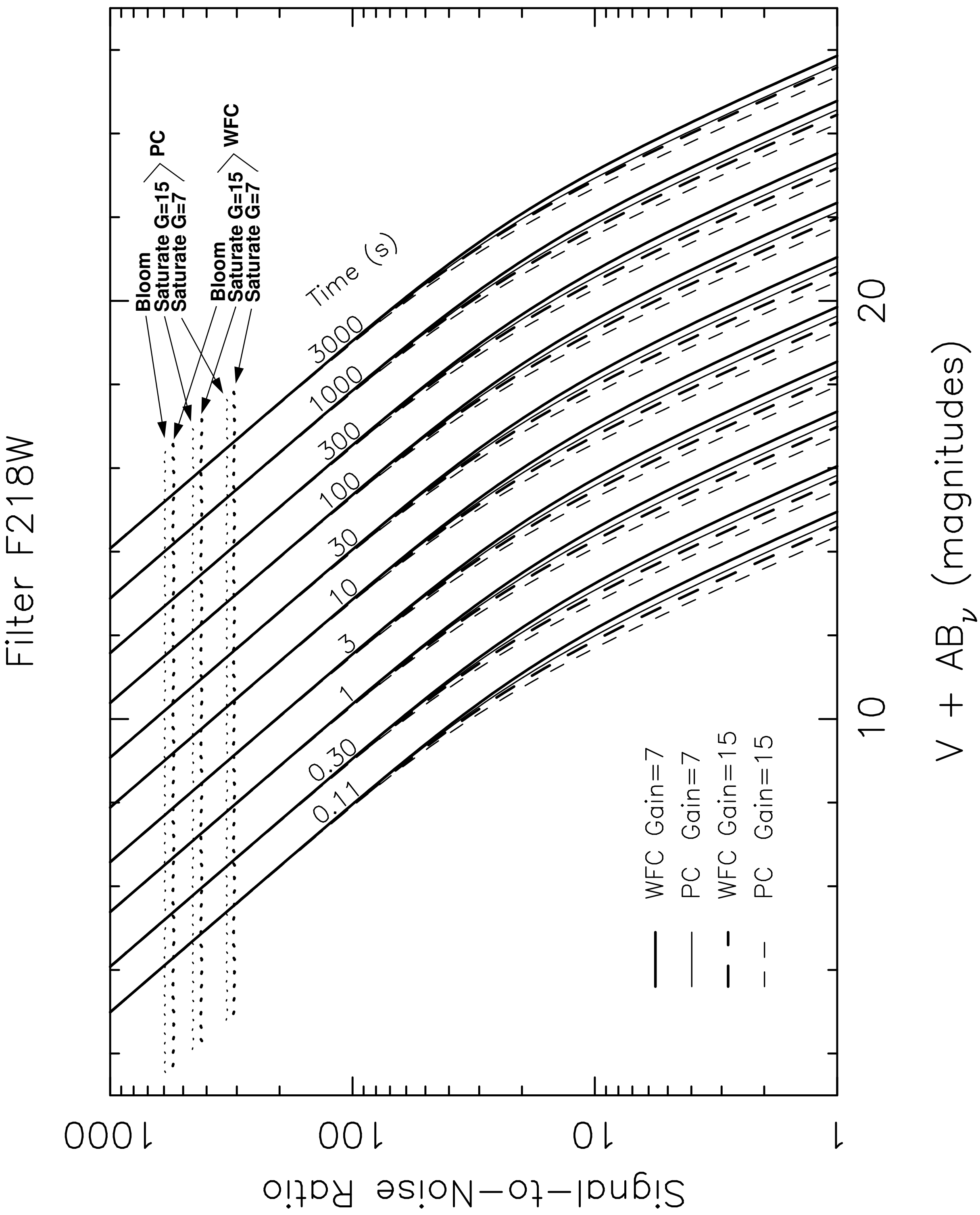

Figure B.3: Point Source SNR vs. V+AB$_{\nu}$ for F255W Filter.

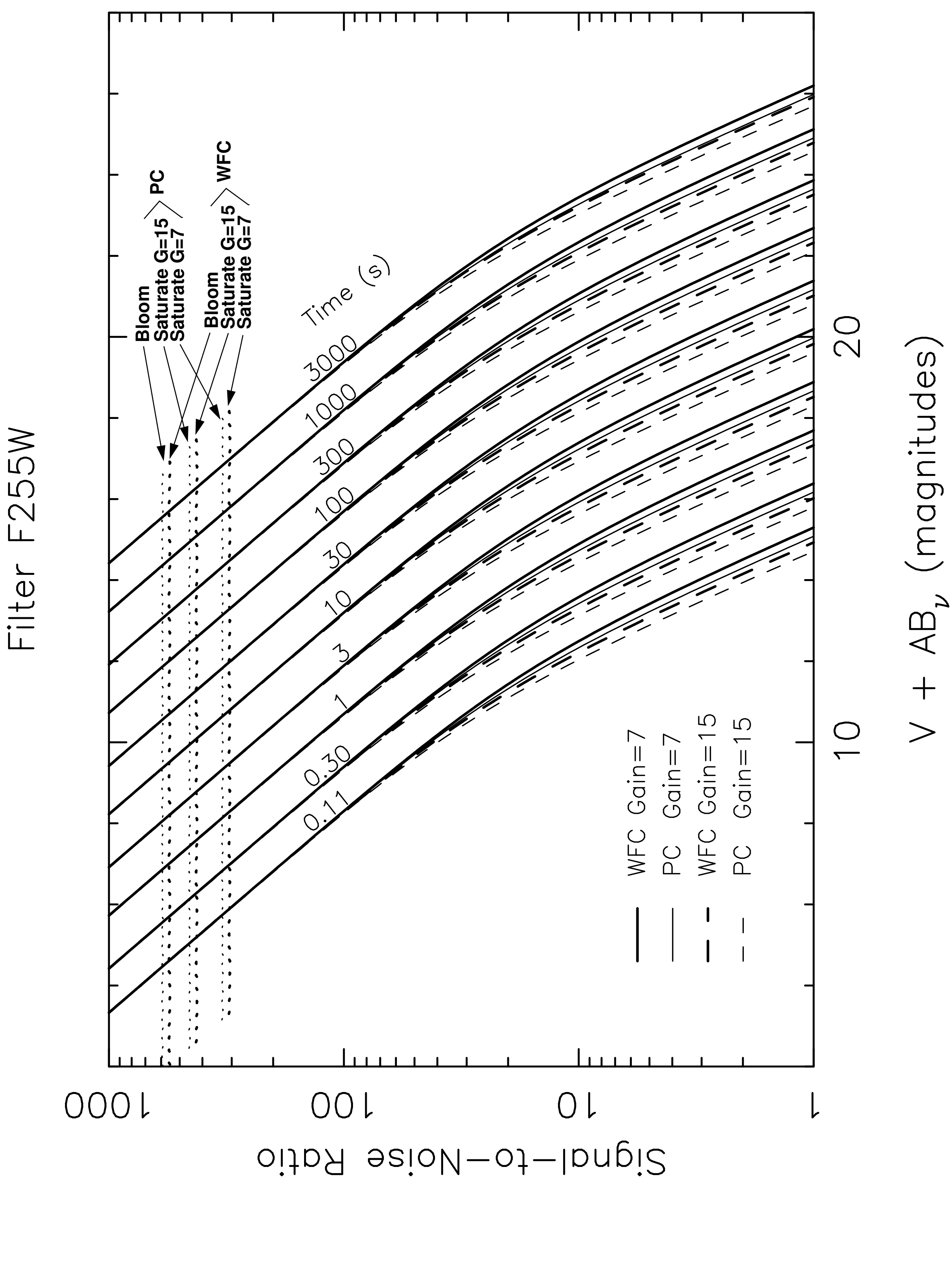

Figure B.4: Point Source SNR vs. V+AB$_\nu$ for F300W Filter.

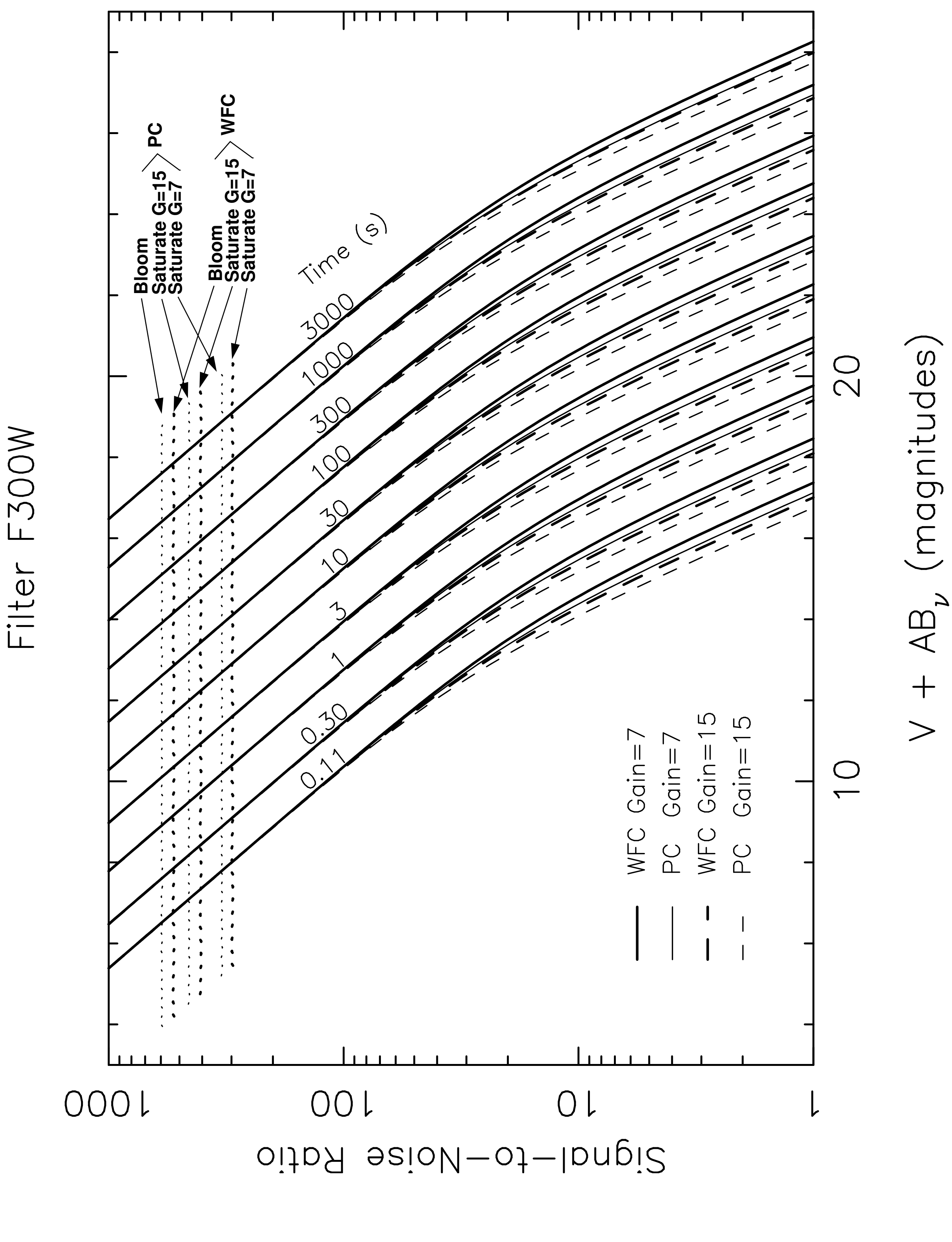

Figure B.5: Point Source SNR vs. V+AB$_\nu$ for F336W Filter.

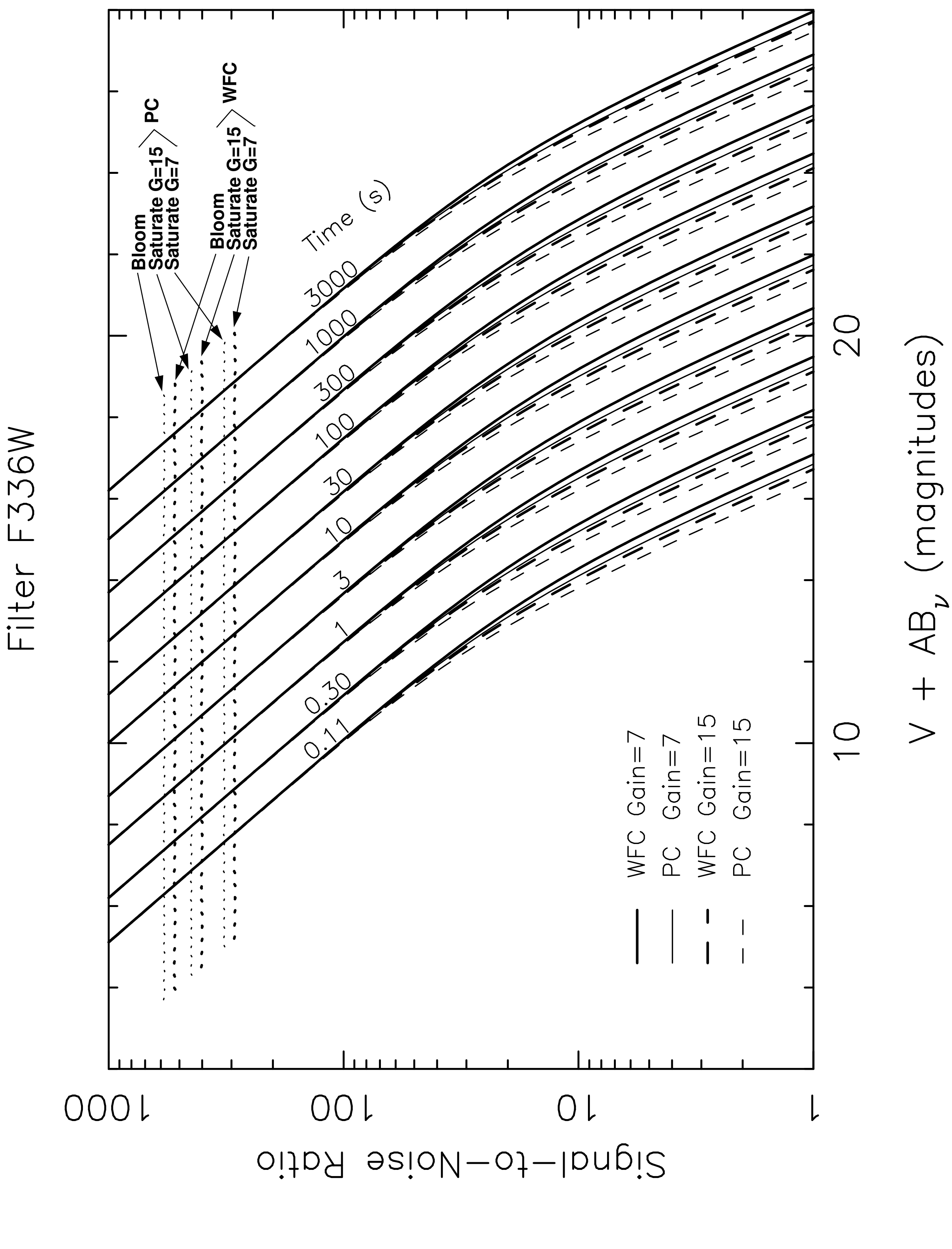

Figure B.6: Point Source SNR vs. V+AB$_\nu$ for F410M Filter.

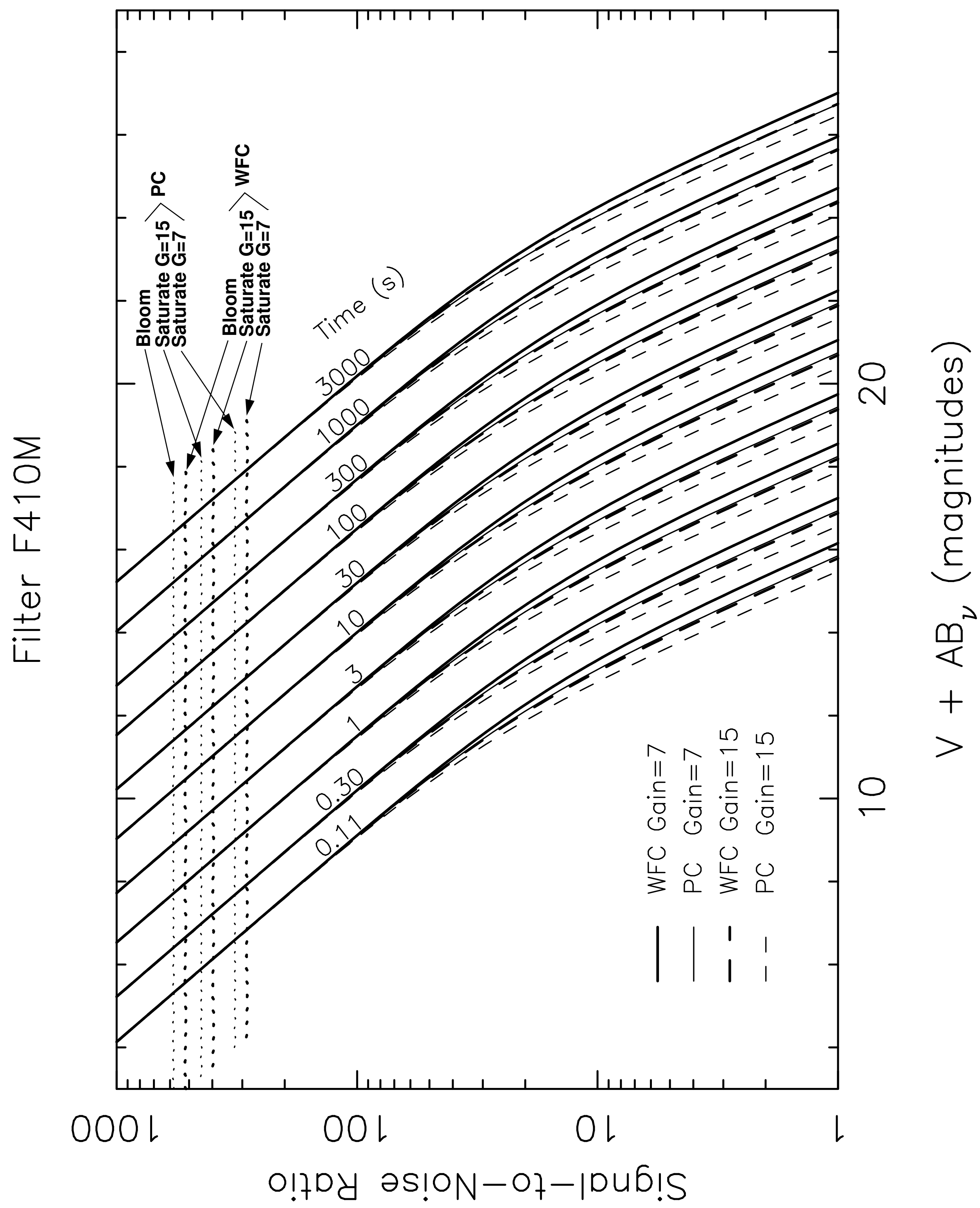

Figure B.7: Point Source SNR vs. V+AB$_\nu$ for F439W Filter.

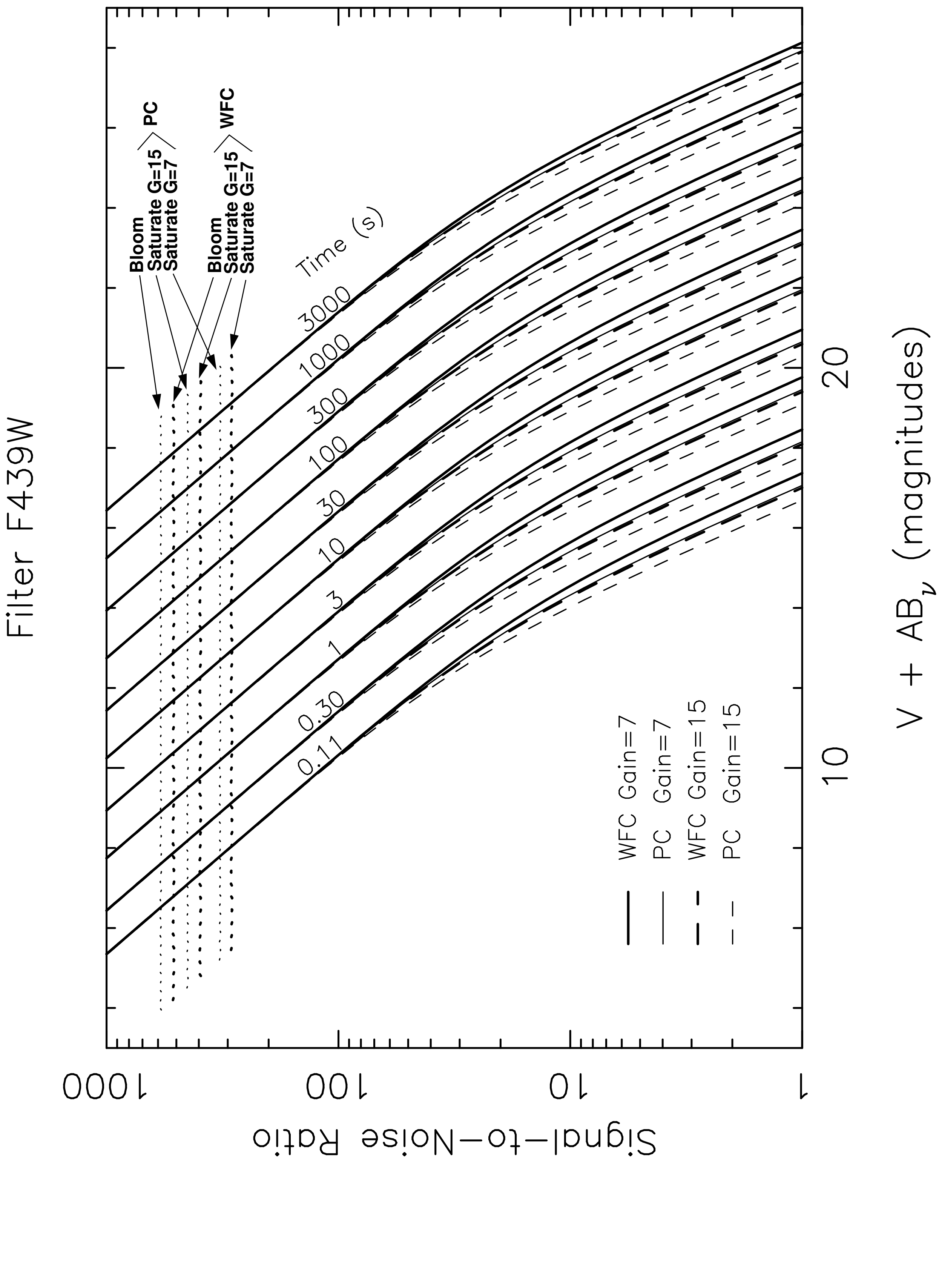

Figure B.8: Point Source SNR vs. V+AB$_{\nu}$ for F502N Filter.

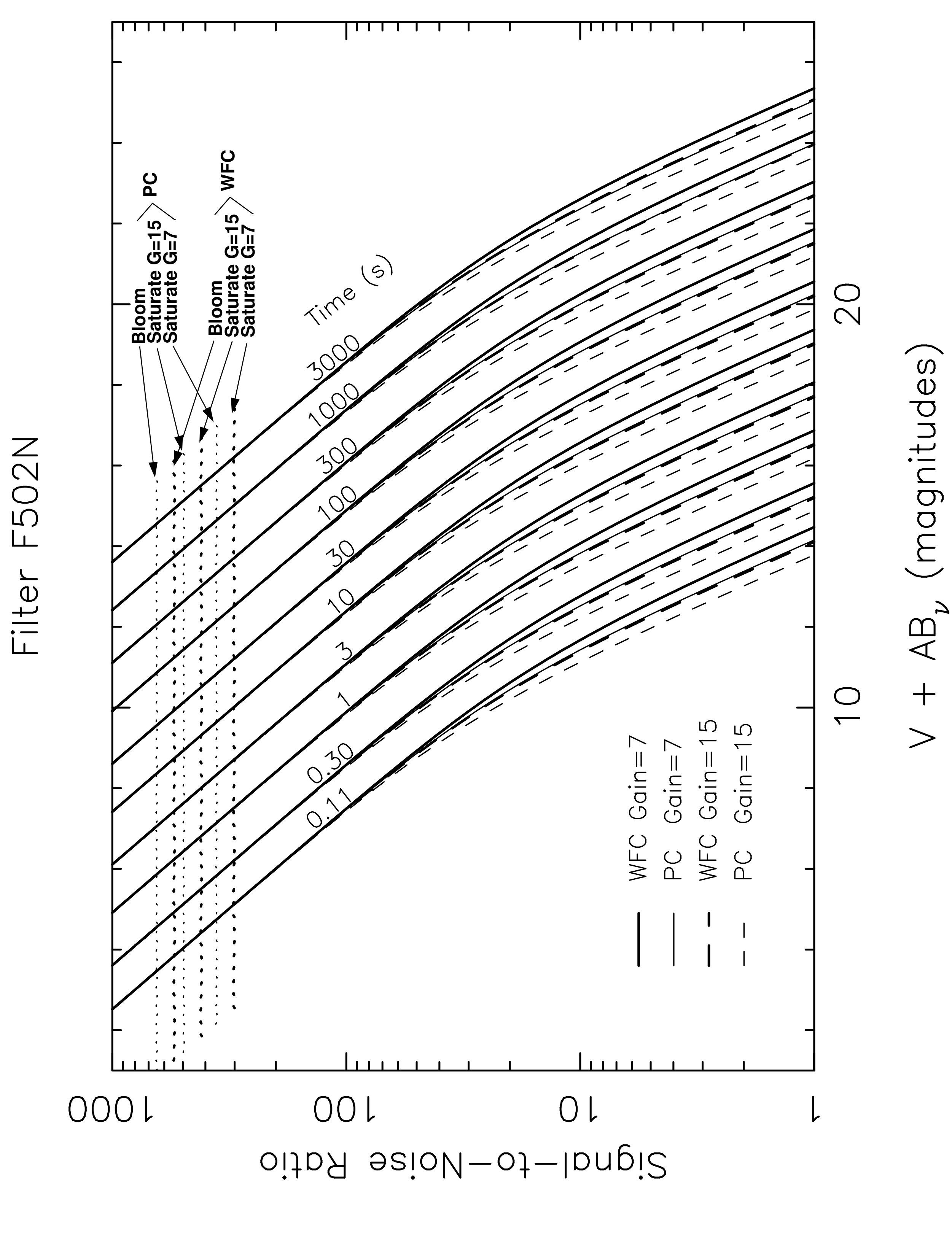

Figure B.9: Point Source SNR vs. V+AB$_\nu$ for F547M Filter.

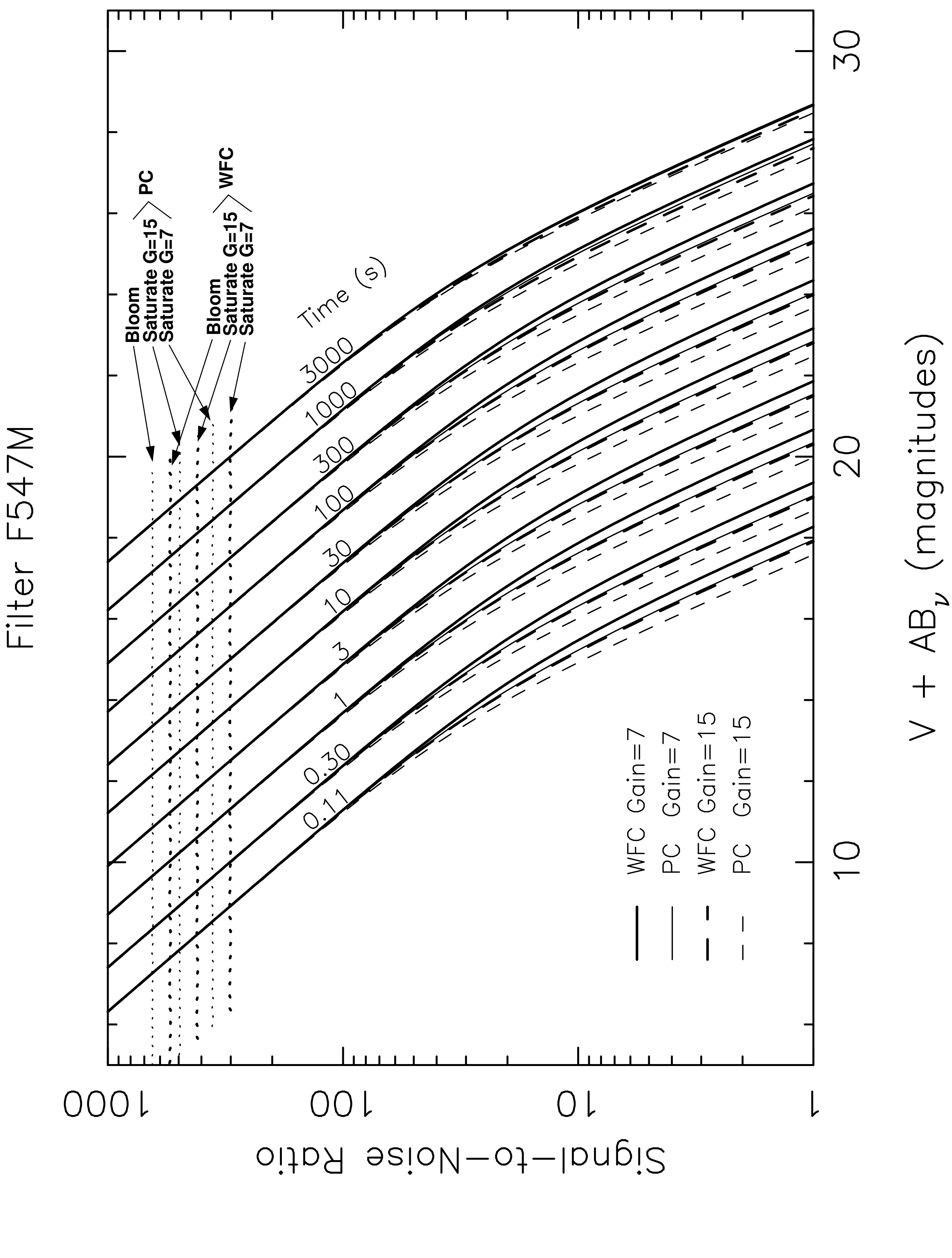

Figure B.10: Point Source SNR vs. V+AB$_\nu$ for F555W Filter.

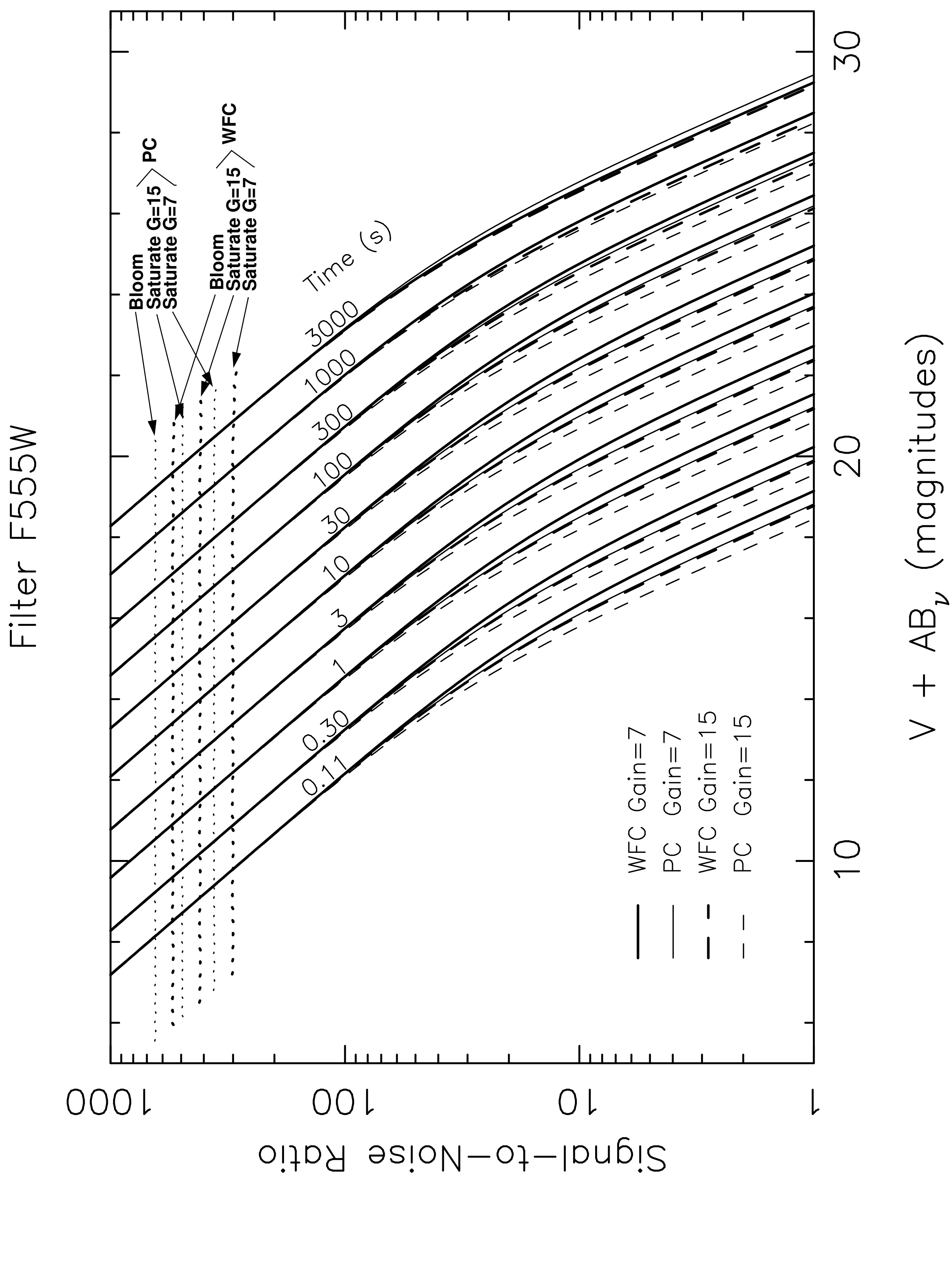

Figure B.11: Point Source SNR vs. V+AB$_\nu$ for F606W Filter.

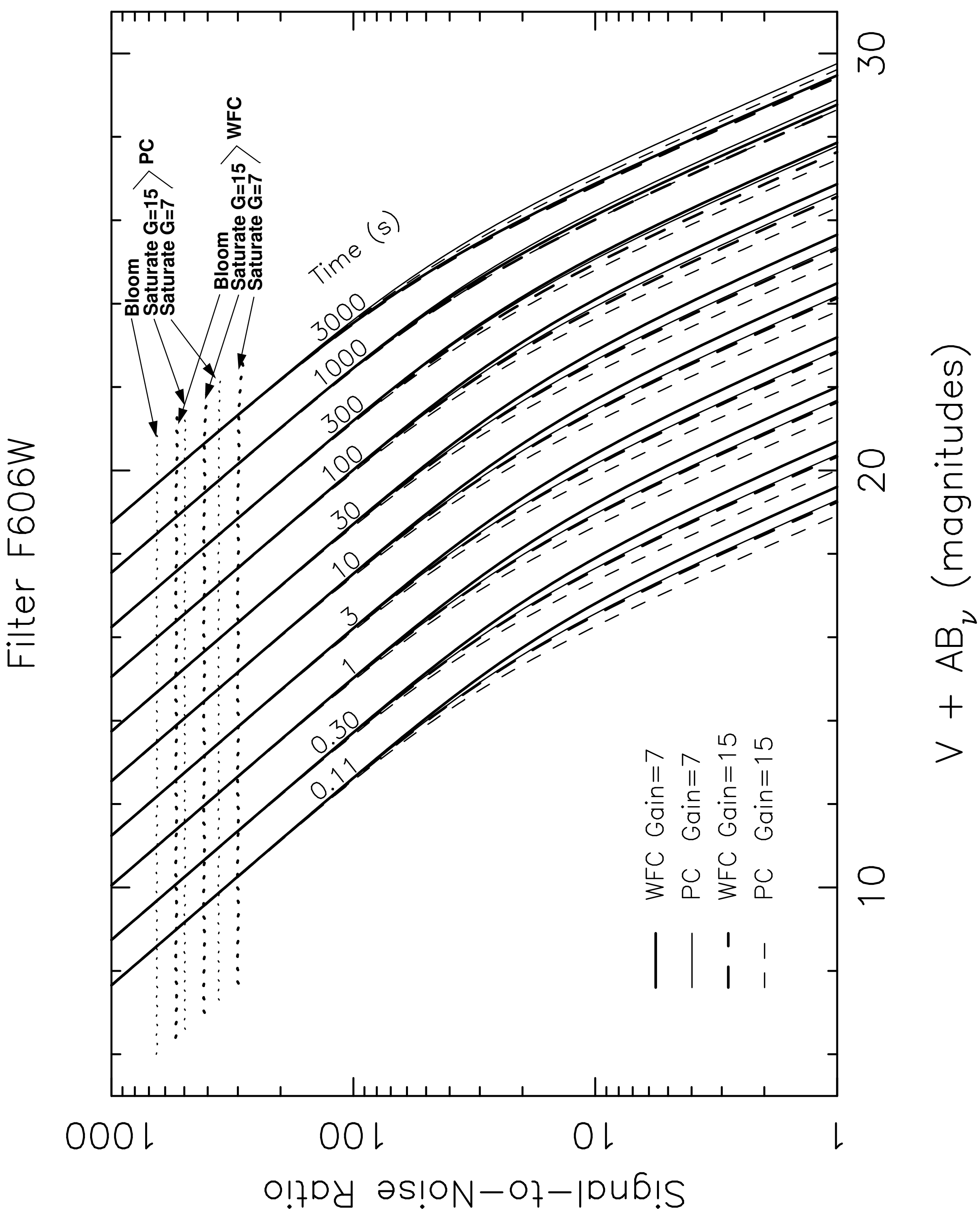

Figure B.12: Point Source SNR vs. V+AB$_\nu$ for F675W Filter.

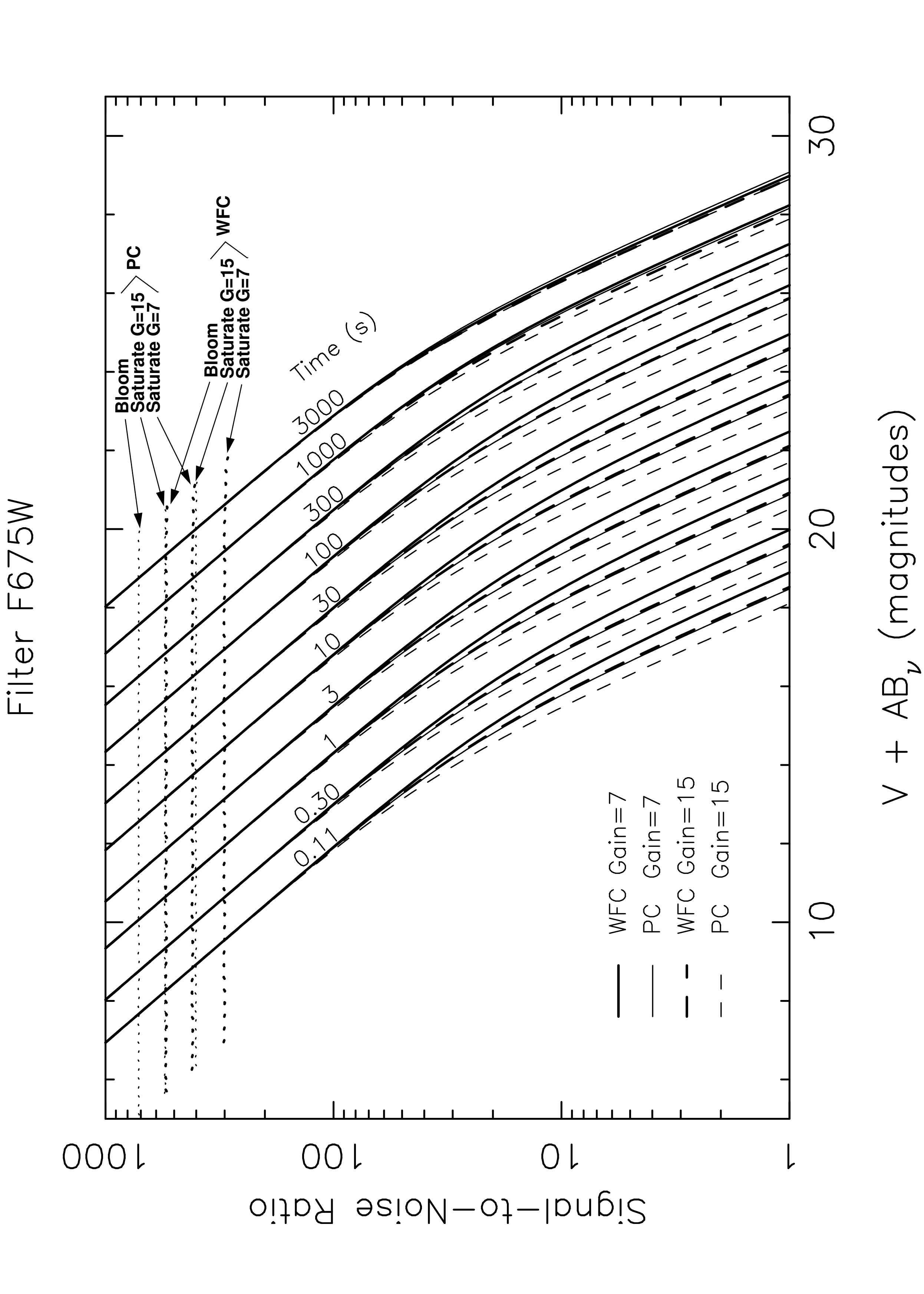

Figure B.13: Point Source SNR vs. V+AB$_\nu$ for F702W Filter.

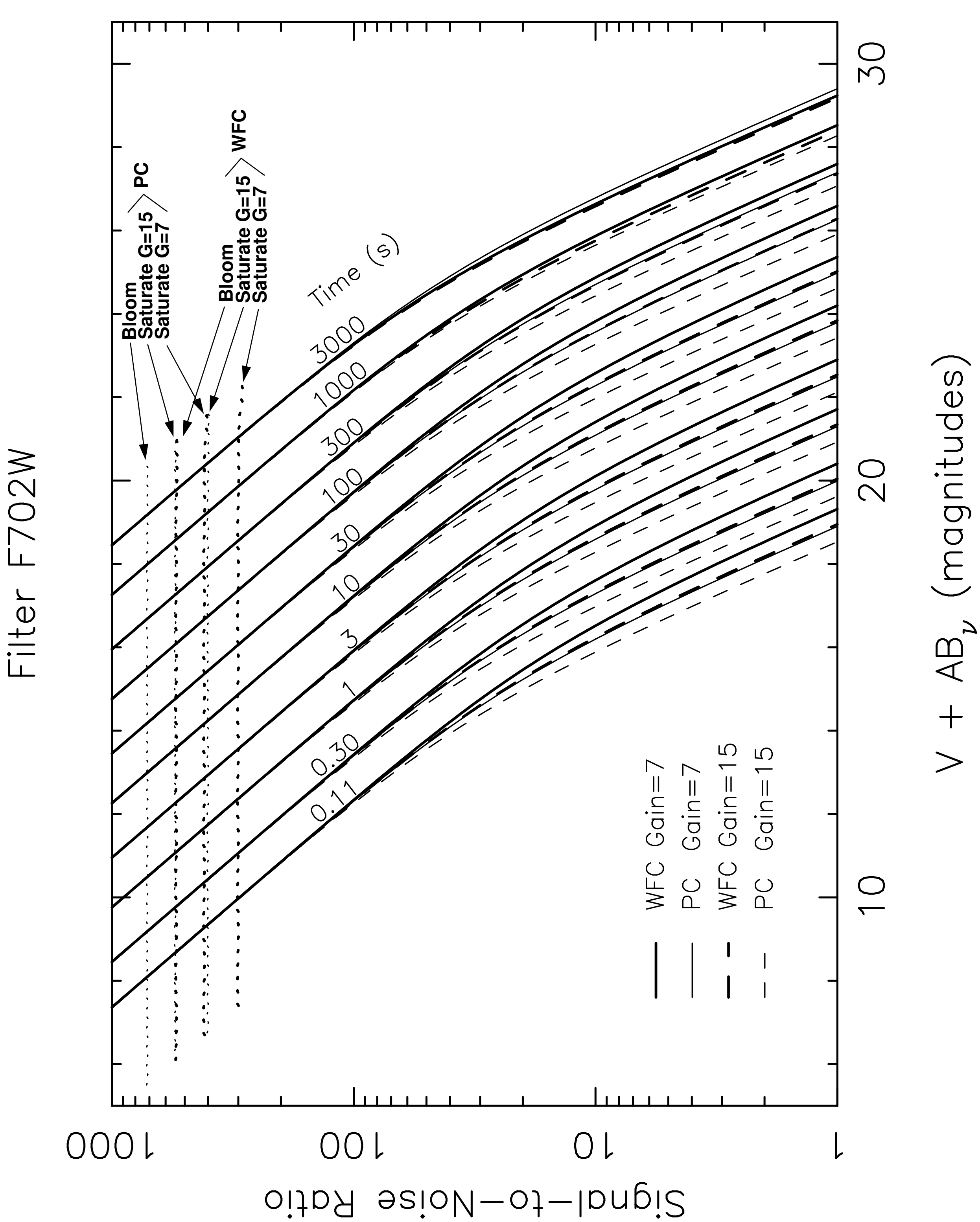

Figure B.14: Point Source SNR vs. V+AB$_\nu$ for F814W Filter.