Initial Attempt at the Observation Sequence Optimization of High-Redshift HST Search
Addendum A

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1 Introduction

This is an addendum to the note of October 17. The goal is to answer Saul's questions of October 18.
Technically, there have been some changes compared to the previous note:

- Rachel regenerated S/N tables with better assumptions regarding the galaxy light contamination and exposure timing.
- The counting of the orbits is more precise now.
- The range of the redshift has been extended to include z=1.5 .

There are four types of the observation sequences considered in this note:

- Groups of observations spaced by about 1 week apart (baseline).
- Example with the total number of orbits reduced to 6.
- Example with observation time range extended beyond 45 days.
- Example with shortened observations time range.

There was an attempt to include the 3/4 of the orbit from the preceeding GOODs observation of the field, but it did not work out due to the software crashes. It seems that SNminuit is not happy with inclusion of a "deeply negative" point.

2 Conclusions

We can make the following conclutions:

- The strong dependence of the stretch error on the SN discovery date claimed in the previous note is a bit reduced. This is especially apparent for z=1.2 case. We attribute the change to the improvements in the S/N tables. The dependence of the error on the max magnitude did not change compared to the previous note. The dependence of both errors on the discovery date becomes stronger at higher redshift.
- Reduction of the number of orbits from 11 to 6 results in the increase of the error of the stretch by 12-25% for the examples considered. The error on the magnitude does not seem to be sensetive to the change. Note that we included in the estimates the 3/4 of the orbits at times 0 (discovery) and 45, but did not count them in the budget of orbits.

- Extending the observation sequence beyond the first 45 days after the discovery seems advantages for late-time discovery at z=1.5 and (maybe) z=1.4, where it improves the error on the stretch by 25%.
- Shortening the observation sequence results in the increased error on the stretch. This effect is also dependent on the redshift and the SN discovery time. In the example chosen this effect is up to ≈ 20%.
- We note that there seem to be numerical inconsistencies for z=1.4 and 1.5 for the last two types of the observation sequence. We suspect that the problem is with MINUIT convergence, but this would have to be verified.

Z	N orbits	Observation Sequence wrt to Day of Maximum	*Stretch*	*m_Z*	*m_B_corr*
Equidistant observation sequence					
1.2	11	-7,0,0.1,0.2,8,8.1,15,15.1,22,22.1,29,29.1,38	1.004 ± 0.054	23.88 ± 0.02	25.37 ± 0.10
1.2	11	-5,2,2.1,2.2,10,10.1,17,17.1,24,24.1,31,31.1,40	1.004 ± 0.056	23.88 ± 0.02	25.37 ± 0.10
1.2	11	-3,4,4.1,4.2,12,12.1,19,19.1,26,26.1,33,33.1,42	1.000 ± 0.060	23.88 ± 0.03	25.36 ± 0.10
1.2	11	-1,6,6.1,6.2,14,14.1,21,21.1,28,28.1,35,35.1,44	0.996 ± 0.062	23.88 ± 0.04	25.36 ± 0.09
1.2	11	1,8,8.1,8.2,16,16.1,23,23.1,30,30.1,37,37.1,46	0.999 ± 0.065	23.88 ± 0.05	25.36 ± 0.09
1.2	11	3,10,10.1,10.2,18,18.1,25,25.1,32,32.1,39,39.1,48	0.999 ± 0.067	23.88 ± 0.06	25.36 ± 0.09
1.2	11	5,12,12.1,12.2,20,20.1,27,27.1,34,34.1,41,41.1,50	0.998 ± 0.079	23.88 ± 0.10	25.36 ± 0.08
Reduced number of orbits					
1.2	6	-7,0,0.1,8,15,22,29,38	1.003 ± 0.061	23.88 ± 0.02	25.37 ± 0.12
1.2	6	-5,2,2.1,10,17,24,31,40	1.003 ± 0.068	23.88 ± 0.02	25.37 ± 0.12
1.2	6	-3,4,4.1,12,19,26,33,42	0.998 ± 0.072	23.88 ± 0.03	25.36 ± 0.12
1.2	6	-1,6,6.1,14,21,28,35,44	0.997 ± 0.074	23.88 ± 0.04	25.36 ± 0.12
1.2	6	1,8,8.1,16,23,30,37,46	1.000 ± 0.077	23.88 ± 0.05	25.36 ± 0.11
1.2	6	3,10,10.1,18,25,32,39,48	1.001 ± 0.080	23.88 ± 0.07	25.36 ± 0.11
1.2	6	5,12,12.1,20,27,34,41,50	1.000 ± 0.094	23.88 ± 0.10	25.36 ± 0.10
Observations sequence extended beyond 1st 45 days					
1.2	11	-7,0,0.1,15,15.1,29,29.1,38,52,52.1,56,56.1,56.2	1.001 ± 0.051	23.88 ± 0.02	25.36 ± 0.10
1.2	11	-5,2,2.1,17,17.1,31,31.1,40,54,54.1,58,58.1,58.2	1.002 ± 0.056	23.88 ± 0.02	25.37 ± 0.10
1.2	11	-3,4,4.1,19,19.1,33,33.1,42,56,56.1,60,60.1,60.2	1.002 ± 0.061	23.88 ± 0.03	25.37 ± 0.10
1.2	11	-1,6,6.1,21,21.1,35,35.1,44,58,58.1,62,62.1,62.2	1.002 ± 0.062	23.88 ± 0.03	25.37 ± 0.10
1.2	11	1,8,8.1,23,23.1,37,37.1,46,60,60.1,64,64.1,64.2	1.003 ± 0.063	23.88 ± 0.05	25.36 ± 0.09
1.2	11	3,10,10.1,25,25.1,39,39.1,48,62,62.1,66,66.1,66.2	1.001 ± 0.063	23.88 ± 0.06	25.36 ± 0.09
1.2	11	5,12,12.1,27,27.1,41,41.1,50,64,64.1,68,68.1,68.2	0.998 ± 0.067	23.88 ± 0.08	25.36 ± 0.09
Observations sequence with shortened duration					
1.2	11	-7,0,0.1,0.2,8.1,8.2,8.3,15,15.1,15.3,22,22.1,38	1.003 ± 0.061	23.88 ± 0.02	25.37 ± 0.11
1.2	11	-5,2,2.1,2.2,10.1,10.2,10.3,17,17.1,17.3,24,24.1,40	1.003 ± 0.064	23.88 ± 0.02	25.37 ± 0.11
1.2	11	-3,4,4.1,4.2,12.1,12.2,12.3,19,19.1,19.3,26,26.1,42	1.001 ± 0.070	23.88 ± 0.03	25.36 ± 0.12
1.2	11	-1,6,6.1,6.2,14.1,14.2,14.3,21,21.1,21.3,28,28.1,44	0.995 ± 0.072	23.88 ± 0.04	25.36 ± 0.11
1.2	11	1,8,8.1,8.2,16.1,16.2,16.3,23,23.1,23.3,30,30.1,46	0.997 ± 0.075	23.88 ± 0.05	25.36 ± 0.11
1.2	11	3,10,10.1,10.2,18.1,18.2,18.3,25,25.1,25.3,32,32.1,48	0.999 ± 0.080	23.88 ± 0.07	25.36 ± 0.11
1.2	11	5,12,12.1,12.2,20.1,20.2,20.3,27,27.1,27.3,34,34.1,50	1.002 ± 0.096	23.88 ± 0.10	25.36 ± 0.10

Z	N orbits	Observation Sequence wrt to Day of Maximum	Stretch	m_Z	m_B_corr
Equidistant observation sequence					
1.3	11	-7,0,0.1,0.2,8,8.1,15,15.1,22,22.1,29,29.1,38	0.994 ± 0.072	24.18 ± 0.02	25.57 ± 0.13
1.3	11	-5,2,2.1,2.2,10,10.1,17,17.1,24,24.1,31,31.1,40	0.998 ± 0.073	24.18 ± 0.03	25.57 ± 0.13
1.3	11	-3,4,4.1,4.2,12,12.1,19,19.1,26,26.1,33,33.1,42	1.004 ± 0.073	24.19 ± 0.03	25.58 ± 0.12
1.3	11	-1,6,6.1,6.2,14,14.1,21,21.1,28,28.1,35,35.1,44	1.003 ± 0.080	24.19 ± 0.04	25.58 ± 0.12
1.3	11	1,8,8.1,8.2,16,16.1,23,23.1,30,30.1,37,37.1,46	1.005 ± 0.084	24.18 ± 0.06	25.58 ± 0.12
1.3	11	3,10,10.1,10.2,18,18.1,25,25.1,32,32.1,39,39.1,48	0.997 ± 0.089	24.18 ± 0.08	25.57 ± 0.11
1.3	11	5,12,12.1,12.2,20,20.1,27,27.1,34,34.1,41,41.1,50	0.999 ± 0.106	24.18 ± 0.13	25.57 ± 0.11
Reduced number of orbits					
1.3	6	-7,0,0.1,8,15,22,29,38	0.991 ± 0.083	24.18 ± 0.03	25.56 ± 0.16
1.3	6	-5,2,2.1,10,17,24,31,40	1.004 ± 0.089	24.18 ± 0.03	25.58 ± 0.16
1.3	6	-3,4,4.1,12,19,26,33,42	1.003 ± 0.089	24.19 ± 0.03	25.58 ± 0.15
1.3	6	-1,6,6.1,14,21,28,35,44	1.003 ± 0.096	24.19 ± 0.05	25.58 ± 0.15
1.3	6	1,8,8.1,16,23,30,37,46	1.003 ± 0.102	24.18 ± 0.06	25.58 ± 0.15
1.3	6	3,10,10.1,18,25,32,39,48	0.997 ± 0.106	24.18 ± 0.08	25.57 ± 0.15
1.3	6	5,12,12.1,20,27,34,41,50	0.998 ± 0.127	24.18 ± 0.14	25.57 ± 0.14
Observations sequence extended beyond 1st 45 days					
1.3	11	-7,0,0.1,15,15.1,29,29.1,38,52,52.1,56,56.1,56.2	0.999 ± 0.068	24.18 ± 0.03	25.58 ± 0.13
1.3	11	-5,2,2.1,17,17.1,31,31.1,40,54,54.1,58,58.1,58.2	0.997 ± 0.073	24.18 ± 0.03	25.57 ± 0.13
1.3	11	-3,4,4.1,19,19.1,33,33.1,42,56,56.1,60,60.1,60.2	1.001 ± 0.075	24.19 ± 0.03	25.58 ± 0.13
1.3	11	-1,6,6.1,21,21.1,35,35.1,44,58,58.1,62,62.1,62.2	1.002 ± 0.077	24.19 ± 0.04	25.58 ± 0.12
1.3	11	1,8,8.1,23,23.1,37,37.1,46,60,60.1,64,64.1,64.2	1.002 ± 0.077	24.18 ± 0.06	25.58 ± 0.11
1.3	11	3,10,10.1,25,25.1,39,39.1,48,62,62.1,66,66.1,66.2	0.997 ± 0.078	24.18 ± 0.07	25.57 ± 0.11
1.3	11	5,12,12.1,27,27.1,41,41.1,50,64,64.1,68,68.1,68.2	0.998 ± 0.087	24.18 ± 0.11	25.57 ± 0.11
Observations sequence with shortened duration					
1.3	11	-7,0,0.1,0.2,8.1,8.2,8.3,15,15.1,15.3,22,22.1,38	0.997 ± 0.079	24.18 ± 0.02	25.57 ± 0.15
1.3	11	-5,2,2.1,2.2,10.1,10.2,10.3,17,17.1,17.3,24,24.1,40	1.002 ± 0.085	24.18 ± 0.03	25.58 ± 0.15
1.3	11	-3,4,4.1,4.2,12.1,12.2,12.3,19,19.1,19.3,26,26.1,42	1.002 ± 0.090	24.19 ± 0.03	25.58 ± 0.15
1.3	11	-1,6,6.1,6.2,14.1,14.2,14.3,21,21.1,21.3,28,28.1,44	1.003 ± 0.095	24.19 ± 0.04	25.58 ± 0.15
1.3	11	1,8,8.1,8.2,16.1,16.2,16.3,23,23.1,23.3,30,30.1,46	1.005 ± 0.100	24.18 ± 0.06	25.58 ± 0.14
1.3	11	3,10,10.1,10.2,18.1,18.2,18.3,25,25.1,25.3,32,32.1,48	0.995 ± 0.104	24.18 ± 0.08	25.57 ± 0.14
1.3	11	5,12,12.1,12.2,20.1,20.2,20.3,27,27.1,27.3,34,34.1,50	0.996 ± 0.129	24.18 ± 0.14	25.57 ± 0.14

Z	N orbits	Observation Sequence wrt to Day of Maximum	Stretch	m_Z	m_B_corr
Equidistant observation sequence					
1.4	11	-7,0,0.1,0.2,8,8.1,15,15.1,22,22.1,29,29.1,38	0.994 ± 0.087	24.40 ± 0.03	25.76 ± 0.17
1.4	11	-5,2,2.1,2.2,10,10.1,17,17.1,24,24.1,31,31.1,40	0.994 ± 0.093	24.40 ± 0.03	25.77 ± 0.17
1.4	11	-3,4,4.1,4.2,12,12.1,19,19.1,26,26.1,33,33.1,42	0.994 ± 0.100	24.41 ± 0.04	25.77 ± 0.16
1.4	11	-1,6,6.1,6.2,14,14.1,21,21.1,28,28.1,35,35.1,44	0.996 ± 0.103	24.41 ± 0.06	25.78 ± 0.15
1.4	11	1,8,8.1,8.2,16,16.1,23,23.1,30,30.1,37,37.1,46	1.000 ± 0.106	24.39 ± 0.08	25.76 ± 0.15
1.4	11	3,10,10.1,10.2,18,18.1,25,25.1,32,32.1,39,39.1,48	1.011 ± 0.118	24.40 ± 0.12	25.79 ± 0.15
1.4	11	5,12,12.1,12.2,20,20.1,27,27.1,34,34.1,41,41.1,50	0.997 ± 0.116	24.41 ± 0.11	25.78 ± 0.16
Reduced number of orbits					
1.4	6	-7,0,0.1,8,15,22,29,38	0.994 ± 0.106	24.40 ± 0.03	25.76 ± 0.21
1.4	6	-5,2,2.1,10,17,24,31,40	0.995 ± 0.115	24.40 ± 0.04	25.77 ± 0.21
1.4	6	-3,4,4.1,12,19,26,33,42	0.996 ± 0.123	24.41 ± 0.05	25.77 ± 0.20
1.4	6	-1,6,6.1,14,21,28,35,44	0.999 ± 0.124	24.41 ± 0.06	25.78 ± 0.19
1.4	6	1,8,8.1,16,23,30,37,46	0.997 ± 0.128	24.39 ± 0.09	25.76 ± 0.19
1.4	6	3,10,10.1,18,25,32,39,48	1.009 ± 0.141	24.40 ± 0.12	25.78 ± 0.19
1.4	6	5,12,12.1,20,27,34,41,50	0.999 ± 0.143	24.41 ± 0.12	25.78 ± 0.21
Observations sequence extended beyond 1st 45 days					
1.4	11	-7,0,0.1,15,15.1,29,29.1,38,52,52.1,56,56.1,56.2	0.996 ± 0.093	24.40 ± 0.04	25.77 ± 0.17
1.4	11	-5,2,2.1,17,17.1,31,31.1,40,54,54.1,58,58.1,58.2	0.997 ± 0.095	24.40 ± 0.04	25.77 ± 0.17
1.4	11	-3,4,4.1,19,19.1,33,33.1,42,56,56.1,60,60.1,60.2	0.999 ± 0.101	24.41 ± 0.05	25.78 ± 0.16
1.4	11	-1,6,6.1,21,21.1,35,35.1,44,58,58.1,62,62.1,62.2	1.003 ± 0.096	24.41 ± 0.06	25.78 ± 0.15
1.4	11	1,8,8.1,23,23.1,37,37.1,46,60,60.1,64,64.1,64.2	1.002 ± 0.103	24.39 ± 0.08	25.77 ± 0.15
1.4	11	3,10,10.1,25,25.1,39,39.1,48,62,62.1,66,66.1,66.2	0.998 ± 0.106	24.40 ± 0.11	25.77 ± 0.15
1.4	11	5,12,12.1,27,27.1,41,41.1,50,64,64.1,68,68.1,68.2	1.000 ± 0.044	24.41 ± 0.04	25.78 ± 0.32
Observations sequence with shortened duration					
1.4	11	-7,0,0.1,0.2,8.1,8.2,8.3,15,15.1,15.3,22,22.1,38	0.992 ± 0.102	24.40 ± 0.03	25.76 ± 0.19
1.4	11	-5,2,2.1,2.2,10.1,10.2,10.3,17,17.1,17.3,24,24.1,40	0.993 ± 0.111	24.40 ± 0.03	25.76 ± 0.20
1.4	11	-3,4,4.1,4.2,12.1,12.2,12.3,19,19.1,19.3,26,26.1,42	0.994 ± 0.118	24.41 ± 0.04	25.77 ± 0.19
1.4	11	-1,6,6.1,6.2,14.1,14.2,14.3,21,21.1,21.3,28,28.1,44	0.998 ± 0.121	24.41 ± 0.06	25.78 ± 0.18
1.4	11	1,8,8.1,8.2,16.1,16.2,16.3,23,23.1,23.3,30,30.1,46	0.983 ± 0.123	24.40 ± 0.09	25.74 ± 0.18
1.4	11	3,10,10.1,10.2,18.1,18.2,18.3,25,25.1,25.3,32,32.1,48	1.013 ± 0.140	24.39 ± 0.12	25.79 ± 0.19
1.4	11	5,12,12.1,12.2,20.1,20.2,20.3,27,27.1,27.3,34,34.1,50	0.999 ± 0.138	24.41 ± 0.12	25.78 ± 0.19

Z	N orbits	Observation Sequence wrt to Day of Maximum	Stretch	m_Z	m_B_corr
Equidistant observation sequence					
1.5	11	-7,0,0.1,0.2,8,8.1,15,15.1,22,22.1,29,29.1,38	0.985 ± 0.126	24.72 ± 0.05	25.93 ± 0.22
1.5	11	-5,2,2.1,2.2,10,10.1,17,17.1,24,24.1,31,31.1,40	1.007 ± 0.139	24.72 ± 0.06	25.97 ± 0.21
1.5	11	-3,4,4.1,4.2,12,12.1,19,19.1,26,26.1,33,33.1,42	1.019 ± 0.147	24.73 ± 0.08	26.00 ± 0.21
1.5	11	-1,6,6.1,6.2,14,14.1,21,21.1,28,28.1,35,35.1,44	0.988 ± 0.142	24.73 ± 0.10	25.95 ± 0.20
1.5	11	1,8,8.1,8.2,16,16.1,23,23.1,30,30.1,37,37.1,46	0.993 ± 0.144	24.71 ± 0.14	25.94 ± 0.18
1.5	11	3,10,10.1,10.2,18,18.1,25,25.1,32,32.1,39,39.1,48	0.989 ± 0.181	24.72 ± 0.19	25.94 ± 0.18
1.5	11	5,12,12.1,12.2,20,20.1,27,27.1,34,34.1,41,41.1,50	1.002 ± 0.219	24.72 ± 0.29	25.96 ± 0.18
Reduced number of orbits					
1.5	6	-7,0,0.1,8,15,22,29,38	0.990 ± 0.154	24.72 ± 0.05	25.94 ± 0.27
1.5	6	-5,2,2.1,10,17,24,31,40	1.007 ± 0.173	24.72 ± 0.07	25.97 ± 0.27
1.5	6	-3,4,4.1,12,19,26,33,42	1.017 ± 0.178	24.73 ± 0.08	25.99 ± 0.27
1.5	6	-1,6,6.1,14,21,28,35,44	0.984 ± 0.168	24.73 ± 0.11	25.94 ± 0.25
1.5	6	1,8,8.1,16,23,30,37,46	0.995 ± 0.169	24.71 ± 0.14	25.94 ± 0.24
1.5	6	3,10,10.1,18,25,32,39,48	0.995 ± 0.190	24.72 ± 0.20	25.95 ± 0.25
1.5	6	5,12,12.1,20,27,34,41,50	1.004 ± 0.274	24.71 ± 0.34	25.96 ± 0.22
Observations sequence extended beyond 1st 45 days					
1.5	11	-7,0,0.1,15,15.1,29,29.1,38,52,52.1,56,56.1,56.2	0.997 ± 0.123	24.72 ± 0.05	25.95 ± 0.21
1.5	11	-5,2,2.1,17,17.1,31,31.1,40,54,54.1,58,58.1,58.2	1.012 ± 0.142	24.72 ± 0.07	25.98 ± 0.21
1.5	11	-3,4,4.1,19,19.1,33,33.1,42,56,56.1,60,60.1,60.2	1.013 ± 0.133	24.73 ± 0.07	25.99 ± 0.19
1.5	11	-1,6,6.1,21,21.1,35,35.1,44,58,58.1,62,62.1,62.2	0.981 ± 0.122	24.73 ± 0.10	25.94 ± 0.18
1.5	11	1,8,8.1,23,23.1,37,37.1,46,60,60.1,64,64.1,64.2	0.995 ± 0.130	24.71 ± 0.13	25.94 ± 0.18
1.5	11	3,10,10.1,25,25.1,39,39.1,48,62,62.1,66,66.1,66.2	0.998 ± 0.135	24.71 ± 0.16	25.95 ± 0.18
1.5	11	5,12,12.1,27,27.1,41,41.1,50,64,64.1,68,68.1,68.2	1.009 ± 0.164	24.71 ± 0.24	25.96 ± 0.20
Observations sequence with shortened duration					
1.5	11	-7,0,0.1,0.2,8.1,8.2,8.3,15,15.1,15.3,22,22.1,38	0.986 ± 0.153	24.72 ± 0.05	25.94 ± 0.27
1.5	11	-5,2,2.1,2.2,10.1,10.2,10.3,17,17.1,17.3,24,24.1,40	0.988 ± 0.145	24.72 ± 0.05	25.94 ± 0.26
1.5	11	-3,4,4.1,4.2,12.1,12.2,12.3,19,19.1,19.3,26,26.1,42	1.019 ± 0.176	24.73 ± 0.08	26.00 ± 0.26
1.5	11	-1,6,6.1,6.2,14.1,14.2,14.3,21,21.1,21.3,28,28.1,44	0.990 ± 0.169	24.73 ± 0.10	25.95 ± 0.24
1.5	11	1,8,8.1,8.2,16.1,16.2,16.3,23,23.1,23.3,30,30.1,46	1.001 ± 0.167	24.71 ± 0.14	25.95 ± 0.23
1.5	11	3,10,10.1,10.2,18.1,18.2,18.3,25,25.1,25.3,32,32.1,48	0.988 ± 0.222	24.73 ± 0.21	25.95 ± 0.23
1.5	11	5,12,12.1,12.2,20.1,20.2,20.3,27,27.1,27.3,34,34.1,50	0.990 ± 0.198	24.73 ± 0.20	25.95 ± 0.25