Cosmological Calibrators in the Magellanic Clouds and Stars in the Solar Neighborhood; Revealing Binarity

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Scientific keywords: LOW-MASS AND COOL STARS, WHITE DWARFS, MASSIVE STARS
Instruments: FGS Proprietary period: 0
Number of targets: 287

Abstract

We propose to use BEA time during SMOV3a to conduct a high angular resolution survey with FGS1r to detect binarity among luminous objects in the Magellanic Clouds and nearby M dwarfs and white dwarfs. By making use of a capability not available from any other observatory to address important and ongoing scientific investigations, these observations will be a valuable service to the community and an important addition to the HST archives.

An FGS survey of local dwarf stars will detect binaries with separations as small as $0''.007$ (∼0.3 AU at 50 pc). This will identify systems with periods as short as one year (or less), ideal candidates for follow up studies to determine stellar masses. This is especially important for white dwarf stars, for which only three have dynamically determined masses.

A survey of stars in the LMC and SMC at $0''.007$ resolution will detect binaries down to ∼400 AU, more than an order of magnitude improvement over WFPC2. Our targets have all been observed by HST's cameras and spectrographs (including HDE 269810, suspected to have a mass $\sim 200 M_\odot$) to calibrate the UV spectra of massive stars for cosmological investigations. Unrecognized binarity in these objects cause those observations to be misinterpreted, thereby contaminating the cosmological calibrations.

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Number of ESA investigators: 2 (indicated by * after name)

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
RMC 71	05 02 07.39	-71 20 13.1	9.8	FGS TRANS 1 F583W	1	BEA
RMC 84	05 13 53.65	-69 31 46.5	11.7	FGS TRANS 1 F583W	1	BEA
S DOR	05 18 17.87	-69 15 25.95	9.9	FGS TRANS 1 F583W	1	BEA
RMC 99	05 22 54.92	-68 01 41.95	11.4	FGS TRANS 1 F583W	1	BEA
HDE 269582	05 27 52.75	-68 59 08.60	11.3	FGS TRANS 1 F583W	1	BEA
RMC 110	05 30 51.48	-69 02 58.6	10.2	FGS TRANS 1 F583W	1	BEA
S 119	05 31 25.60	-69 05 38.00	11.9	FGS TRANS 1 F583W	1	BEA
BE 381	05 35 54.61	-68 59 08.4	9.8	FGS TRANS 1 F583W	1	BEA
RMC 127	05 36 43.40	-69 29 46.0	11.2	FGS TRANS 1 F583W	1	BEA
RMC 143	05 38 46.26	-69 08 03.71	12.2	FGS TRANS 1 F583W	1	BEA
HDE 269810	05 35 13.93	-67 33 26.70	12.2	FGS TRANS 1 F583W	1	BEA
R126	05 36 25.50	-69 23 01.0	10.9	FGS TRANS 1 F583W	1	BEA
S61	05 45 47.06	-67 14 22.62	12.0	FGS TRANS 1 F583W	1	BEA
SK-68°137	05 38 24.78	-68 52 32.81	13.3	FGS TRANS 1 F583W	1	BEA
SK-66°172	05 37 05.59	-66 21 35.94	13.1	FGS TRANS 1 F583W	1	BEA
SK-67°166	05 31 44.30	-67 38 01.02	12.3	FGS TRANS 1 F583W	1	BEA
SK-67°167	05 31 51.98	-67 39 41.14	12.5	FGS TRANS 1 F583W	1	BEA
SK-70°69	05 05 18.77	-70 25 49.91	13.9	FGS TRANS 1 F583W	1	BEA
SK-66°100*	05 27 45.49	-66 55 14.64	13.1	FGS TRANS 1 F583W	1	BEA
SK-65°21	05 01 22.33	-65 41 48.14	12.0	FGS TRANS 1 F583W	1	BEA
SK-68°41	05 05 27.20	-68 10 02.79	12.0	FGS TRANS 1 F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
NGC 346#3	00 58 59.20	-72 10 31.0	13.50	FGS TRANS F583W	1	BEA
MPG 324	00 58 57.59	-72 10 35.4	14.02	FGS TRANS F583W	1	BEA
NGC 346#4	00 58 58.9	-72 10 39.0	13.66	FGS TRANS F583W	1	BEA
NGC 346#1	00 59 03.2	-72 10 27.0	12.57	FGS TRANS F583W	1	BEA
AV388	01 05 39.62	-72 29 26.80	14.12	FGS TRANS F583W	1	BEA
AV243	01 00 07	-72 47 12	13.87	FGS TRANS F583W	1	BEA
AV238	00 59 56	-72 13 30	13.77	FGS TRANS F583W	1	BEA
AV232	00 59 32.19	-72 10 46.22	12.36	FGS TRANS F583W	1	BEA
AV488	01 15 58.84	-73 21 24.14	11.90	FGS TRANS F583W	1	BEA
NGC 346-355	00 59 00.94	-72 10 30.3	13.50	FGS TRANS F583W	1	BEA
NGC 346-324	00 58 57.56	-72 10 35.7	14.02	FGS TRANS F583W	1	BEA
NGC 346-368	00 59 02.00	-72 10 33.3	14.18	FGS TRANS F583W	1	BEA
NGC 346-342	00 59 00.21	-72 10 20.6	13.66	FGS TRANS F583W	1	BEA
NGC 346-655	00 59 15.63	-72 11 13.5	14.82	FGS TRANS F583W	1	BEA
NGC 346-396	00 59 03.10	-72 10 36.9	14.39	FGS TRANS F583W	1	BEA
NGC 346-487	00 59 06.88	-72 10 43.1	14.53	FGS TRANS F583W	1	BEA
NGC 346-113	00 58 31.84	-72 11 00.1	14.93	FGS TRANS F583W	1	BEA
NGC 346-435	00 59 04.68	-72 10 26.6	12.57	FGS TRANS F583W	1	BEA
NGC 346-682	00 59 18.73	-72 11 11.7	14.87	FGS TRANS F583W	1	BEA
NGC 346-12	00 58 14.17	-72 10 46.3	14.87	FGS TRANS F583W	1	BEA
AV75	00 50 32.37	-72 52 35.8	12.79	FGS TRANS F583W	1	BEA
AV80	00 50 43.79	-72 47 41.0	13.33	FGS TRANS F583W	1	BEA
AV69	00 50 17.27	-72 53 29.6	13.35	FGS TRANS F583W	1	BEA
AV15	00 46 42.16	-73 24 55.2	13.20	FGS TRANS F583W	1	BEA
AV83	00 50 52.01	-72 42 14.5	13.38	FGS TRANS F583W	1	BEA
AV47	00 48 51.52	-73 25 58.5	13.38	FGS TRANS F583W	1	BEA
AV95	00 51 21.55	-72 44 14.5	13.91	FGS TRANS F583W	1	BEA
AV423	01 07 40.43	-72 50 59.6	13.3	FGS TRANS F583W	1	BEA
AV170	00 55 42.40	-73 17 30.0	14.09	FGS TRANS F583W	1	BEA
AV220	00 59 09.98	-72 05 48.2	14.50	FGS TRANS F583W	1	BEA
AV327	01 03 10.58	-72 02 13.8	13.25	FGS TRANS F583W	1	BEA
AV2A	00 44 41.19	-72 20 43.1	11.4	FGS TRANS F583W	1	BEA
AV39	00 48 30	-73 27 00.0	13.02	FGS TRANS F583W	1	BEA
AV60A	00 50 00	-73 22 06	13.50	FGS TRANS F583W	1	BEA
AV81	00 50 36	-72 27	13.50	FGS TRANS F583W	1	BEA
AV332	01 03 08.6	-72 06 09	12.11	FGS TRANS F583W	1	BEA
HD5980	00 59 26.57	-72 09 53.9	10.8	FGS TRANS F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
SK188	01 31 05.10	-73 25 31.52	12.90	FGS TRANS F583W	1	BEA
RMC4	00 46 54.00	-73 09 00.0	13.19	FGS TRANS F583W	1	BEA
RMC50	01 44 03.88	-74 40 49.8	11.56	FGS TRANS F583W	1	BEA
S18	00 54 07.90	-72 41 44.0	13.55	FGS TRANS F583W	1	BEA
AV172	00 55 55.00	-72 08 54.0	13.37	FGS TRANS F583W	1	BEA
HD6884	01 07 18.21	-72 28 03.7	10.23	FGS TRANS F583W	1	BEA
HD7099	01 09 03.95	-72 32 17.6	10.9	FGS TRANS F583W	1	BEA
HD7583	01 13 30.50	-72 20 10.3	10.20	FGS TRANS F583W	1	BEA
N81	01 09 08	-73 12 06	11.3	FGS TRANS F583W	1	BEA
SMC X-1	01 17 05.2	-73 25 35.0	13.30	FGS TRANS F583W	1	BEA
AV 260	01 00 52.0	-72 13 32	13.28	FGS TRANS F583W	1	BEA
AV 137	00 52 53.0	-72 44 04	12.33	FGS TRANS F583W	1	BEA
AV 56	00 49 51.7	-72 55 39	11.17	FGS TRANS F583W	1	BEA
AV 23	00 47 40.1	-73 22 43	12.25	FGS TRANS F583W	1	BEA
AV 48	00 49 03.4	-73 21 32	11.03	FGS TRANS F583W	1	BEA
AV 65	00 50 06.9	-73 07 39	11.13	FGS TRANS F583W	1	BEA
AV 263	01 01 06.9	-72 12 57	12.85	FGS TRANS F583W	1	BEA
AV 270	01 01 17.5	-72 17 27	11.42	FGS TRANS F583W	1	BEA
AV 136	00 52 51.2	-73 06 53.6	10.64	FGS TRANS F583W	1	BEA
AV 478	01 14 21.65	-73 12 44.8	12.0	FGS TRANS F583W	1	BEA
AV 254	01 00 40.76	-71 32 30.3	11.6	FGS TRANS F583W	1	BEA
AV 442	01 08 56.85	-73 02 34.3	11.2	FGS TRANS F583W	1	BEA
WD MS538	09 35 46.0	-58 56.5	15.46	FGS TRANS F583W	1	BEA
WD MS535	09 29 05.0	-71 33.0	15.44	FGS TRANS F583W	1	BEA
WD MS496	08 51 01.0	-61 54.3	14.73	FGS TRANS F583W	1	BEA
WD MS495	08 47 55.0	-73 13.1	15.30	FGS TRANS F583W	1	BEA
WD MS476	08 31 51.0	-53 40.5	14.46	FGS TRANS F583W	1	BEA
WD MS454	08 09 32.0	-72 59.3	15.15	FGS TRANS F583W	1	BEA
WD MS452	08 06 52.0	-66 18.0	13.92	FGS TRANS F583W	1	BEA
WD MS441	08 01 59.0	-53 27.4	15.76	FGS TRANS F583W	1	BEA
WD MS436	07 53 11.0	-67 47.1	14.08	FGS TRANS F583W	1	BEA
WD MS427	07 41 48.0	-57 09.1	15.06	FGS TRANS F583W	1	BEA
WD MS395	07 02 17.0	-58 50.3	14.46	FGS TRANS F583W	1	BEA
WD MS369	06 22 38.0	-75 41.6	15.38	FGS TRANS F583W	1	BEA
WD MS367	06 16 18.0	-59 12.6	14.09	FGS TRANS F583W	1	BEA
WD MS299	04 43 41.0	-78 51.6	13.47	FGS TRANS F583W	1	BEA
WD MS262	04 19 37.0	-73 03.6	15.49	FGS TRANS F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
WD MS260	04 21 01.0	-48 39.4	14.36	FGS TRANS F583W	1	BEA
WD MS259	04 19 17.0	-53 50.9	15.32	FGS TRANS F583W	1	BEA
WD MS221	03 42 23.0	-67 09.5	15.74	FGS TRANS F583W	1	BEA
WD MS201	03 22 14.0	-53 45.2	14.99	FGS TRANS F583W	1	BEA
WD MS198	03 12 43.0	-54 06.9	14.75	FGS TRANS F583W	1	BEA
WD MS196	03 10 28.0	-68 36.8	11.40	FGS TRANS F583W	1	BEA
WD MS195	03 09 50.0	-56 22.6	14.07	FGS TRANS F583W	1	BEA
WD MS184	02 56 18.0	-70 22.1	14.08	FGS TRANS F583W	1	BEA
WD MS123	01 46 11.0	-70 20.2	15.31	FGS TRANS F583W	1	BEA
WD MS118	01 42 58.0	-67 17.8	13.90	FGS TRANS F583W	1	BEA
WD MS117	01 40 35.0	-55 42.9	14.86	FGS TRANS F583W	1	BEA
WD MS97 0	01 28 08.0	-53 01.5	14.48	FGS TRANS F583W	1	BEA
WD MS55 0	00 51 09.0	-54 12.6	15.29	FGS TRANS F583W	1	BEA
WD MS54 0	00 50 04.0	-52 08.7	14.20	FGS TRANS F583W	1	BEA
WD MS30 0	00 29 56.0	-63 24.9	15.29	FGS TRANS F583W	1	BEA
WD MS29 0	00 29 50.0	-54 41.6	15.80	FGS TRANS F583W	1	BEA
WD MS27 0	00 26 38.0	-55 25.4	15.21	FGS TRANS F583W	1	BEA
WD MS1341	23 40 37.0	-75 46.5	14.66	FGS TRANS F583W	1	BEA
WD MS1314	23 24 31.0	-54 41.6	15.19	FGS TRANS F583W	1	BEA
CD-78 383	09 45 40.63	-78 36 28.4	10.39	FGS TRANS F583W	1	BEA
HD 309776	09 45 13.62	-66 14 28.9	9.33	FGS TRANS F583W	1	BEA
HD 300142	09 34 15.94	-56 12 33.5	9.05	FGS TRANS F583W	1	BEA
HD 311282	09 26 47.46	-70 14 59.0	9.40	FGS TRANS F583W	1	BEA
HD 300099	09 26 05.25	-56 20 41.2	9.33	FGS TRANS F583W	1	BEA
L 99 -35	09 21 36	-66 29.2	12.75	FGS TRANS F583W	1	BEA
V* QV CAR	09 21 18.06	-58 40 57.7	8.63	FGS TRANS F583W	1	BEA
HD 298314	09 16 26.48	-51 35 08.3	9.30	FGS TRANS F583W	1	BEA
CD-80 320	09 15 21.27	-81 24 37.9	9.96	FGS TRANS F583W	1	BEA
V* GH VEL	09 13 43.93	-48 39 05.4	9.30	FGS TRANS F583W	1	BEA
HD 79672	09 12 48.80	-60 40 48.0	9.48	FGS TRANS F583W	1	BEA
HD 309590	09 05 16.25	-64 10 22.4	9.50	FGS TRANS F583W	1	BEA
V* V475 CAR	09 00 51.31	-57 55 01.2	8.25	FGS TRANS F583W	1	BEA
CD-50 3737	08 59 09.18	-50 41 40.7	9.22	FGS TRANS F583W	1	BEA
J08488-5729AB	08 48 46.86	-57 29 13.7	8.30	FGS TRANS F583W	1	BEA
HD 74584	08 41 07.97	-64 36 08.6	8.40	FGS TRANS F583W	1	BEA
SON 6183	08 35 32.4	-69 14 43	13.06	FGS TRANS F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
CD-61 1941	08 27 16.66	-62 05 15.4	9.29	FGS TRANS F583W	1	BEA
CD-53 2213	08 16 52.97	-53 37 34.9	7.38	FGS TRANS F583W	1	BEA
HD 69802	08 15 45.72	-56 43 16.7	9.09	FGS TRANS F583W	1	BEA
V* BN VEL	08 13 05.59	-48 07 56.0	8.60	FGS TRANS F583W	1	BEA
CD-77 321	08 10 21.76	-78 22 20.3	9.12	FGS TRANS F583W	1	BEA
V464 CAR	08 08 48.91	-61 34 07.6	9.14	FGS TRANS F583W	1	BEA
CD-62 329	08 04 30.54	-62 50 27.0	7.70	FGS TRANS F583W	1	BEA
CD-73 398	08 02 57.99	-74 07 42.7	9.60	FGS TRANS F583W	1	BEA
HD 66424	07 55 21.38	-76 29 52.4	8.63	FGS TRANS F583W	1	BEA
J0749-76.6	07 49 22.50	-76 41 50.0	12.30	FGS TRANS F583W	1	BEA
HD 63491	07 46 18.52	-54 33 49.6	9.62	FGS TRANS F583W	1	BEA
CD-60 1845	07 42 40.63	-60 18 11.8	9.23	FGS TRANS F583W	1	BEA
CPD-66 735	07 42 21.99	-66 52 54.4	8.53	FGS TRANS F583W	1	BEA
CD-49 2885	07 30 34.32	-50 07 40.9	9.73	FGS TRANS F583W	1	BEA
CD-79 290	07 24 31.09	-80 11 07.3	10.03	FGS TRANS F583W	1	BEA
SV BV 1589	07 21 45.65	-56 15 11.4	7.97	FGS TRANS F583W	1	BEA
HD 58803	07 20 54.89	-71 31 56.4	7.87	FGS TRANS F583W	1	BEA
CI 20 416	07 11 19.72	-67 07 21.9	11.15	FGS TRANS F583W	1	BEA
V* VZ VOL	07 04 35.11	-68 14 54.8	8.39	FGS TRANS F583W	1	BEA
HD 54450	07 03 58.57	-66 27 28.0	10.34	FGS TRANS F583W	1	BEA
V* T VOL	06 57 47.94	-67 07 25.8	9.45	FGS TRANS F583W	1	BEA
V* S MEN	06 57 20.31	-75 59 16.2	10.30	FGS TRANS F583W	1	BEA
HD 51706	06 55 53.68	-50 05 09.2	8.22	FGS TRANS F583W	1	BEA
V* VX VOL	06 53 44.29	-65 54 50.0	8.25	FGS TRANS F583W	1	BEA
L 238 -28	06 53 13	-53 08.4	12.43	FGS TRANS F583W	1	BEA
V* AP MEN	06 37 41.73	-77 32 18.8	8.11	FGS TRANS F583W	1	BEA
CPD-75 383	06 27 17.83	-75 49 26.3	10.60	FGS TRANS F583W	1	BEA
SV* BV 436	06 23 58.32	-68 36 03.2	8.42	FGS TRANS F583W	1	BEA
HD 45078	06 21 06.94	-62 11 21.6	8.41	FGS TRANS F583W	1	BEA
CD-81 202	06 09 42.64	-81 47 26.1	10.80	FGS TRANS F583W	1	BEA
CD-80 211	06 06 20.46	-80 25 11.1	10.01	FGS TRANS F583W	1	BEA
V* RU MEN	06 01 50.11	-70 35 36.1	10.40	FGS TRANS F583W	1	BEA
L 235 -35	05 52 22	-55 07.4	12.65	FGS TRANS F583W	1	BEA
HD 38922	05 43 28.15	-68 28 10.4	10.20	FGS TRANS F583W	1	BEA
V* SX PIC	05 43 03	-50 58.2	12.00	FGS TRANS F583W	1	BEA
HD 270023	05 42 13	-68 41.5	10.64	FGS TRANS F583W	1	BEA
[ST92] 4- 72	05 40 03.00	-69 22 48.9	13.36	FGS TRANS F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
MH 24	05 39 42.5	-69 11 35	14.40	FGS TRANS F583W	1	BEA
MH 23	05 39 40.3	-69 11 56	14.06	FGS TRANS F583W	1	BEA
RM 1-536	05 31 29	-69 10.4	13.50	FGS TRANS F583W	1	BEA
RM 1-522	05 31 13	-69 03.9	13.10	FGS TRANS F583W	1	BEA
RM 1-517	05 31 03	-68 59.9	13.30	FGS TRANS F583W	1	BEA
HD 274960	05 31 04.75	-49 04 23.2	10.90	FGS TRANS F583W	1	BEA
CD-81 173	05 28 18.32	-81 46 31.4	9.90	FGS TRANS F583W	1	BEA
RM 1-420	05 28 43	-68 57.9	12.10	FGS TRANS F583W	1	BEA
RM 1-412	05 28 29	-69 08.8	13.80	FGS TRANS F583W	1	BEA
RM 1-385	05 27 25	-69 00.5	12.60	FGS TRANS F583W	1	BEA
[GMP94] 301	05 26 33	-68 51.8	11.90	FGS TRANS F583W	1	BEA
CD-79 214	05 23 41.72	-79 41 30.2	9.31	FGS TRANS F583W	1	BEA
IRAS 05208-6459	05 21 03.6	-64 56 43	12.50	FGS TRANS F583W	1	BEA
IRAS 05099-6740	05 09 53.1	-67 36 37	15.41	FGS TRANS F583W	1	BEA
RM 1-93	04 58 58	-65 41.1	13.20	FGS TRANS F583W	1	BEA
SV* HV 12420	04 57 31.0	-70 09 00	13.30	FGS TRANS F583W	1	BEA
RM 1-80	04 57 24	-66 23.5	13.10	FGS TRANS F583W	1	BEA
RM 1-78	04 56 53.2	-69 24 02	13.00	FGS TRANS F583W	1	BEA
PGMW 3160	04 56 51.2	-66 24 44	13.09	FGS TRANS F583W	1	BEA
RM 1-76	04 56 48.4	-69 39 54	12.10	FGS TRANS F583W	1	BEA
RM 1-77	04 56 46.4	-69 48 32	11.90	FGS TRANS F583W	1	BEA
RM 1-72	04 56 28.3	-69 40 36	12.70	FGS TRANS F583W	1	BEA
RM 1-71	04 56 23.6	-69 42 10	12.60	FGS TRANS F583W	1	BEA
[L72] LH 9- 77	04 56 23.4	-66 27 15	12.20	FGS TRANS F583W	1	BEA
[L72] LH 9- 82	04 56 17.6	-66 27 32	12.20	FGS TRANS F583W	1	BEA
CPD-80 138	04 56 33.33	-79 54 26.2	10.26	FGS TRANS F583W	1	BEA
HD 272915	04 56 11.44	-50 03 23.1	10.00	FGS TRANS F583W	1	BEA
SV* HV 5498	04 56 01.0	-66 30 37	12.70	FGS TRANS F583W	1	BEA
SV* HV 5510	04 55 48.3	-69 24 06	12.80	FGS TRANS F583W	1	BEA
RM 1-58	04 55 35	-67 08.1	13.70	FGS TRANS F583W	1	BEA
SV* HV 2239	04 55 32.3	-66 50 40	12.40	FGS TRANS F583W	1	BEA
RM 1-54	04 55 12	-69 19.1	12.60	FGS TRANS F583W	1	BEA
RM 1-50	04 55 01	-66 35.6	13.40	FGS TRANS F583W	1	BEA
RM 1-49	04 54 41	-69 21.5	13.70	FGS TRANS F583W	1	BEA
RM 1-46	04 54 40	-66 33.8	13.60	FGS TRANS F583W	1	BEA
SV* HV 12495	04 54 39.3	-69 04 37	13.00	FGS TRANS F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
RM 1-44	04 54 25	-67 22.8	13.20	FGS TRANS F583W	1	BEA
RM 1-40	04 54 14	-66 32.4	13.20	FGS TRANS F583W	1	BEA
RM 1-43	04 54 12.5	-70 17 06	13.00	FGS TRANS F583W	1	BEA
RM 1-42	04 54 07.9	-70 06 23	12.90	FGS TRANS F583W	1	BEA
RM 1-39	04 54 07	-66 36.1	13.50	FGS TRANS F583W	1	BEA
RM 1-38	04 53 45.9	-68 52 37	12.90	FGS TRANS F583W	1	BEA
RM 1-37	04 53 43	-67 13.6	13.30	FGS TRANS F583W	1	BEA
RM 1-33	04 53 34	-66 48.5	13.30	FGS TRANS F583W	1	BEA
H 0449-55	04 53 30.7	-55 51 38	11.10	FGS TRANS F583W	1	BEA
RM 1-24	04 52 53.8	-66 55 54	11.50	FGS TRANS F583W	1	BEA
RM 1-27	04 52 47.0	-70 46 41	13.00	FGS TRANS F583W	1	BEA
RM 1-23	04 52 34.0	-69 46 17	12.70	FGS TRANS F583W	1	BEA
RM 1-20	04 51 54.0	-70 11 57	12.70	FGS TRANS F583W	1	BEA
RM 1-15	04 51 18	-69 29.3	12.90	FGS TRANS F583W	1	BEA
RM 1-11	04 50 58.6	-69 14 01	13.00	FGS TRANS F583W	1	BEA
RM 1-7	04 49 47	-69 55.7	13.30	FGS TRANS F583W	1	BEA
SV* HV 12449	04 49 46	-68 42.5	13.40	FGS TRANS F583W	1	BEA
RM 1-5	04 49 24	-68 45.0	13.30	FGS TRANS F583W	1	BEA
RM 1-1	04 47 16	-69 42.4	13.40	FGS TRANS F583W	1	BEA
V* T DOR	04 45 49.64	-59 47 12.9	9.90	FGS TRANS F583W	1	BEA
SV* HV 12463	04 44 35.4	-70 43 01	14.19	FGS TRANS F583W	1	BEA
CD-61 904	04 34 33.56	-60 48 10.0	9.58	FGS TRANS F583W	1	BEA
CD-82 90	04 33 37.08	-81 56 05.2	9.90	FGS TRANS F583W	1	BEA
V* R RET	04 33 32.83	-63 01 45.0	9.23	FGS TRANS F583W	1	BEA
L 302 -104	04 30 13	-48 35.5	14.35	FGS TRANS F583W	1	BEA
CD-74 195	04 20 00.43	-74 19 10.2	9.65	FGS TRANS F583W	1	BEA
GEN +9.8617	04 18 47	-57 15.3	13.30	FGS TRANS F583W	1	BEA
L 92 -38	04 21 52	-67 39.8	12.90	FGS TRANS F583W	1	BEA
V* WX DOR	04 15 05.40	-53 00 32.6	8.90	FGS TRANS F583W	1	BEA
V* WW MEN	04 02 57.28	-79 50 42.9	9.69	FGS TRANS F583W	1	BEA
V* RY RET	03 50 03.38	-57 21 13.7	9.54	FGS TRANS F583W	1	BEA
CD-78 139	03 48 05.91	-78 04 22.3	10.11	FGS TRANS F583W	1	BEA
V* CS HYI	03 35 53.00	-69 11 34.8	8.74	FGS TRANS F583W	1	BEA
CD-78 129	03 32 34.74	-78 32 52.6	9.62	FGS TRANS F583W	1	BEA
CD-55 704	03 29 30.63	-54 46 55.5	8.97	FGS TRANS F583W	1	BEA
CD-80 105	03 25 12.21	-80 07 56.4	9.70	FGS TRANS F583W	1	BEA
CD-72 156	03 22 54.71	-71 40 56.8	9.55	FGS TRANS F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
CD-49 877	03 09 22.64	-49 01 05.3	8.91	FGS TRANS F583W	1	BEA
CD-81 98	03 04 38.68	-81 13 58.4	10.10	FGS TRANS F583W	1	BEA
V* V HOR	03 03 28.37	-58 55 59.0	7.27	FGS TRANS F583W	1	BEA
V* T HOR	03 00 52.12	-50 38 31.9	8.69	FGS TRANS F583W	1	BEA
NSV 992	02 56 18.18	-50 12 31.0	9.62	FGS TRANS F583W	1	BEA
CD-50 869	02 56 16.43	-50 11 26.6	9.72	FGS TRANS F583W	1	BEA
CD-51 684	02 54 09.78	-50 50 46.7	7.81	FGS TRANS F583W	1	BEA
V* W HOR	02 44 14.75	-54 18 04.1	8.84	FGS TRANS F583W	1	BEA
V* TZ HOR	02 25 26.45	-66 29 38.5	6.44	FGS TRANS F583W	1	BEA
CD-80 69	02 24 02.44	-80 02 43.7	9.44	FGS TRANS F583W	1	BEA
L 89 -33	02 18 17	-66 57.3	14.35	FGS TRANS F583W	1	BEA
BTR99	02 12 58.1	-58 51 17	13.70	FGS TRANS F583W	1	BEA
SV* ZI 121	02 08 54.96	-80 06 15.8	9.83	FGS TRANS F583W	1	BEA
L 52 -112	02 12 42	-74 45.7	12.70	FGS TRANS F583W	1	BEA
V* CH HYI	02 01 52.33	-74 26 44.6	6.86	FGS TRANS F583W	1	BEA
L 223 -3	01 50 23	-49 36.3	13.50	FGS TRANS F583W	1	BEA
V* VZ HYI	01 44 58.35	-80 11 07.8	9.26	FGS TRANS F583W	1	BEA
CPD-68 77B	01 41 10.7	-67 40 36	13.50	FGS TRANS F583W	1	BEA
V* RY HYI	01 33 34.06	-75 12 27.1	9.80	FGS TRANS F583W	1	BEA
V* W PHE	01 19 52.59	-55 55 04.2	10.30	FGS TRANS F583W	1	BEA
CD-68 49	01 11 16.91	-68 02 54.7	9.53	FGS TRANS F583W	1	BEA
CD-82 21	01 10 02.66	-81 55 14.6	10.18	FGS TRANS F583W	1	BEA
CD-81 27	01 05 02.99	-80 31 22.5	10.10	FGS TRANS F583W	1	BEA
PMMR 97A	00 58.9	-72 12	13.39	FGS TRANS F583W	1	BEA
V* U TUC	00 57 13.14	-75 00 00.4	9.48	FGS TRANS F583W	1	BEA
NSV 351	00 56 29.38	-59 40 23.4	9.37	FGS TRANS F583W	1	BEA
L 220 -27	00 54 10	-50 36.4	12.60	FGS TRANS F583W	1	BEA
SV* SON 5342	00 51 23.73	-59 37 46.0	9.84	FGS TRANS F583W	1	BEA
[S78D] 21	00 50 44.1	-72 34 11	13.20	FGS TRANS F583W	1	BEA
L 171 -3	00 50 02	-54 32.8	12.65	FGS TRANS F583W	1	BEA
CD-69 24	00 38 11.93	-68 59 04.7	10.34	FGS TRANS F583W	1	BEA
CD-69 16	00 27 16.79	-68 19 45.6	9.95	FGS TRANS F583W	1	BEA
NGC 104 3	00 25.2	-72 03	11.40	FGS TRANS F583W	1	BEA
NGC 104 2	00 24.2	-72 07	11.60	FGS TRANS F583W	1	BEA
NGC 104 1	00 24.1	-72 06	11.30	FGS TRANS F583W	1	BEA
GJ 3018A	00 15 55	-67 59.9	10.95	FGS TRANS F583W	1	BEA
GJ 3019B	00 15 46	-67 59.5	12.50	FGS TRANS F583W	1	BEA

Observing Summary:

Target	RA	DEC	V	Configuration,mode,aperture spectral elements	Total orbits	Flags
GJ 3005	00 05 26	-50 03.3	11.95	FGS TRANS F583W	1	BEA
CD-81 894	00 03 37.43	-80 30 40.7	9.73	FGS TRANS F583W	1	BEA
L 169 -40	00 06 03	-61 04.6	14.65	FGS TRANS F583W	1	BEA
HD 224585	23 59 08.30	-68 56 25.7	9.73	FGS TRANS F583W	1	BEA
V* R TUC	23 57 26.2	-65 23 05	9.00	FGS TRANS F583W	1	BEA
HD 223889	23 53 50.11	-75 37 57.1	10.50	FGS TRANS F583W	1	BEA
V* DU TUC	23 49 58.21	-61 08 07.2	7.57	FGS TRANS F583W	1	BEA
L 168 -15	23 34 28	-60 19.2	12.95	FGS TRANS F583W	1	BEA
L 26 -87	23 27 27	-78 02.0	13.30	FGS TRANS F583W	1	BEA
				Grand total orbit request	287	

Scientific Justification

1 Introduction

During the first 12 days of SMOV3a the normal HST science program will be suspended. The pointing of the telescope will be restricted to a zone of bright earth avoidance (BEA) and a large amount of observing time may be available. For a Dec 2 launch of STS-103 (the servicing mission), the Large Magellanic Cloud will fall within the BEA. In the last 2 days of the BEA, or if launch is delayed a few days, the Small Magellanic Cloud becomes available.

We propose to use FGS1r in its high angular resolution observing mode to survey some of the most interesting objects in the LMC and SMC as well as nearby M dwarfs and white dwarf stars to detect binary and multiple systems at an unprecedented angular resolution of $0''.007$ (corresponding to 350 A.U. at the LMC, 460 A.U. at the SMC, and 0.3 A.U. at 50 pc). These observations will be a valuable service to the community both as an important addition to the HST archives (LMC and SMC) and for providing the quickest (and perhaps only) means available for the identification of nearby binary stars for follow up studies. This proposal is also an opportunity for STScI to demonstrate the unsurpassed angular resolution of HST/FGS1r and the benefits of interferometry from space.

Our target list includes 21 objects in the LMC, 59 objects in the SMC, 34 white dwarf stars, and 73 M dwarfs. All of these objects will be within the BEA at one time or another during the 12 day interval. To constrain the HST scheduling system so that all targets are observed inside the BEA, we will employ the "BETWEEN" special requirement. This maximizes the target viewing zone and the potential scientific return of the proposal. We recognize that only a subset of our targets can be observed. If this proposal is accepted, we will prioritize the list subject to target availability (*i.e.*BEA restrictions) and importance.

2 Magellanic Clouds

Because of their proximity, the Magellanic Clouds provide astronomers with an unprecedented opportunity for a spectroscopic study of low metallicity, extragalactic star forming regions at high angular resolution. The LMC's and SMC's most massive O-stars stars are especially applicable for our understanding of the upper IMF and the upper mass cutoff at metallicites similar to values observed in galaxies at redshifts of $z = 1 - 3$. The UV spectra of the massive stars provide an important means by which to properly interpret the ground based observations of high redshift galaxies with rest frame UV luminosities presumably dominanted by early type stars (e.g., Pettini et al, 1997). The O through A supergiants in the Clouds are being observed (Lennon 1997) to calibrate the wind momentum-luminosity relation (WLR), known to be a function of metalicity (Puls et al 1996), so that the relation can be used as a standard candle and applied to resolved galaxies as far away as the Virgo cluster. The SMC's Wolf-Rayet (WR) stars, which Dalton & Sarazin (1995) suggest are all members of binary systems, can be used to calibrate our interpretation of more distant, so called WR starburst regions.

Clearly the bright, high mass stars in the Clouds take on a cosmological significance as astronomers apply models, calibrated by these objects, to more distant starburst galaxies and high redshift objects. But the fidelity of these calibrations will be degraded if, in fact, some of the objects are multiple stars systems, or even isolated stars with small line of sight projections.

But the propensity of massive stars to form as multiple systems (*e.g.,*Mason *et al.*, 1997) underscores the need for caution. If we want to guarantee the reliability of the spectroscopic calibrators, *we have to guarantee that the selected stars are single.* While this can be done with spectroscopy for sufficiently close binary systems and/or for systems containing stars with very different spectral characteristics, the case for spectroscopic detection of physically wide binaries at great distances and/or small aggregates of almost identical stars is *hopeless.* If multiplicity remains unresolved or unrecognized, particular objects will be misinterpreted and systematic errors will contaminate our determination of the upper IMF. Specifically, if high mass multiple systems are not properly accounted for, an IMF model leads to an estimate of the upper mass cutoff which is too high. Furthermore, the number of high mass stars will be underestimated, while their intrinsic luminosities will be overestimated.

We anticipate that the LMC or SMC will be within the restricted BEA (for an early Dec launch date). Therefore, we have identified a list for the FGS1r survey of 21 LBVs, O3 and O4 supergiants, and OB stars in the LMC and 59 high mass objects in the SMC that have been observed by HST's spectrographs and/or cameras. The spectroscopic data (*e.g.,*proposals 4110, 6078, 6530, 7437, 7749) are being used to precisely determine the intrinsic stellar parameters of luminosity, effective temperature, gravity, mass, and chemical composition and the stellar wind parameters of mass-loss rate and velocity structure for low metallicity massive stars (*e.g.,*Walborn *et al.*, 1994). The imaging data (*e.g.,*proposal 6133) surveyed objects to establish whether or not the stars are single (down to $0\farcs100$). One object, HDE 269810, is thought to have a mass of about 170 $M_{\odot}$(Puls *et al.*, 1996), making it a candidate for the most massive star known. FGS1r observations of these targets offer an opportunity to inspect them for multiplicity down to an unprecedented $0\farcs007$, or 300 to 400 A.U., nearly an order of magnitude improvement over WFPC2. Our observations will either confirm the reliability of the previous results or will discover multiplicity among these objects.

3 Relevance of Binarity in Nearby Stars

The low and intermediate mass nearby stars, those within approximately 50 pc, contribute as fundamental calibrators for our understanding of the local universe. With accurate trigonometric parallaxes we can determine the relationship between spectral type and absolute luminosity. The nearby stars can be observed to determine a given object's metalicity, age, and kinematic properties. The relationship between age and chromospheric activity for a variety of spectral types and metallicities can be investigated. But a full understanding of stellar astrophysics requires a precise determination of a star's mass. For this reason, binary systems are important astrophysical laboratories; by determining a system's visual orbit, in combination with either its parallax or radial velocity observations (for double lined spectroscopic binaries), the mass and luminosity of each star can be derived.

4 Detecting Binary Systems, low mass MS stars

Several groups are conducting spectroscopic investigations of nearby stars of spectral types M through F with the goal of discovering binary systems (*e.g.,*, Delfosse *et al.*, 1999, Stefanik *et al.*, 1994). Radial velocity (RV) observations of F through early K spectral types have discovered systems with Periods < 8 years (Mayor *et al.*, 1997). For a 2 $M_{\odot}$system this corresponds to a semimajor axis of approximately 5 A.U., which at 50 pc subtends 0$''$.100. A ground based imaging survey with adaptive optics *might* detect binarity for systems with separations as small as 0$''$.100, while speckle interferometry can push that limit to about 0$''$.040. On the basis of this, one might conclude that there is no detectability gap for binaries among the nearby stars. But for isolated systems fainter than about V=10 speckle is not a option, and the overlap between spectroscopy and direct imaging is *extremely tenuous*, especially for systems whose components have even a small magnitude difference.

The detectability gap for M-dwarfs is more pronounced. Combining IR adaptive optics and RV spectroscopy in a survey of 127 nearby (within 9 pc) M dwarfs, Delfosse *et al.*(1999) detected 13 new companions. Of these, the A.O. observations failed to discover any systems with projected angular separations less than 0$''$.180, and all but two of the RV detections have periods less than 1 year (most have periods less than 50 days). For more distant systems the detectability gap widens since only stars with increasingly large physical separations can be resolved by direct imaging while RV detection selects for even shorter period systems in order to achieve adequate S/N in the observations of these faint stars.

FGS1r has demonstrated the ability to detect binary systems with separations as small as 0$''$.007. At 50 pc this corresponds to a separation of only 0.3 A.U. And at this distance an M5 dwarf star is still sufficiently bright for HST/FGS. Aside from closing the detectability gap out to 50 pc (provided the magnitude difference is less than about 2.5 for the smallest separations), FGS1r can detect multiplicity in an object in just one HST orbit, in contrast to a long term, patient spectroscopic program. But just as important as discovering binary systems, follow up observations with FGS1r, complemented by either FGS astrometry or radial velocity observations made from the ground, will yield the stellar masses.

5 Detecting Binary Systems, White Dwarfs

White dwarf stars are an interesting subset of the sun's nearest neighbors since they represent the end state for the vast majority of all stellar objects. Given the widely accepted notion that as many as 60% or more of the field stars are binary systems, it is reasonable to expect that many isolated white dwarfs are infact white dwarf binary systems. But spectroscopic detection of WD binaries, or double degenerates (DDs), becomes increasing difficult for systems with periods greater than 10 days (the hydrogen lines are too broad). Furthermore, ground based imaging cannot detect systems with separations less than about 0$''$.300. (Adaptive optics is not an option since these objects tend to be too faint to be used as a guide star and are generally more than 20" from a sufficiently bright guide star.) Another difficulty is introduced by the expected large magnitude difference between the components arising as a result of the WD cooling curve. But simulations of the FGS1r photometric response convolved with WD model atmospheres indicate that a system composed of a WD pair with T_{eff}=18,000K and 10,000K would be detectable for separations larger than about $0\farcs050$. For cooler primaries, the magnitude difference decreases and closer pairs are detectable provided the system magnitude is brighter than about V=15.5. Thus, FGS1r observations of WDs should reveal new binaries, perhaps composed of a WD-M dwarf pair.

Double degenerates are also interesting for investigating the effects of evolution on binary systems. In a DD system considerable mass has been lost, leaving perhaps as little as 10% of the original amount (for a pair of 5 $M_{\odot}$progenitors). This should expand the orbit. On the other hand, if the stars experienced one or two episodes of common envelop evolution (CE), i.e., had an original separation less than 1 or 2 A.U., the orbits will have shrunk (provided certain criteria are met) to physical sizes too small for FGS resolution. Therefore, it is expected that no DD systems with a separation less than about 1 A.U. will be detected. By observing nearby white dwarfs we will be able to explore this hypothesis.

6 Follow up Observations

Discovering binary systems is important not only for establishing the incidence of duplicity among stars of various types in the solar neighborhood, but also for identifying the best candidates for follow up observations. High angular resolution observations allow for a determination of a system's visual orbit and the magnitude difference of the components. If either a trigonometric or orbital (SB2s) parallax can be determined, the system's total mass and absolute luminosity can be computed. Furthermore, if the motion of the components about the system barycenter can be determined, the mass of each star can be derived.

Determining the mass-luminosity relation for stars near the end of the main sequence is important for deriving the IMF near the hydrogen burning limit. Because these low mass stars are long lived, those in the solar neighborhood display a dispersion in age and hence metallicity. Detecting binary systems at various metallicities will allow for an establishment of a mass-metallicity-luminosity relation.

Discovering white dwarf binary systems (or white dwarf – M-dwarf systems) also identifies objects suitable for follow up studies for dynamical mass determinations, heretofore available for *only 3 WDs* (Sirus B, 40 Eri B, Procyon B). The newly detected systems may very well form the basis for the most important database to best calibrate the white dwarf mass-radius-luminosity relation.

Description of the Observations

1 FGS1r's High Angular resolution

HST/FGS1r is capable of detecting binary systems when the components are separated by as little as $0\rlap{.}''007$ provided the magnitude difference is less than about 2. At greater separations, systems with larger *dmag* can be resolved. The FGS measures the separation, accurate to about 1 mas, the position angle, accurate to about 0.03 degrees, and the magnitude difference of the components, accurate to about 10%. Thus, FGS1r is well suited for the program we propose.

2 Observing Strategy

We will use FGS1r in its high angular resolution Transfer Mode to observe our targets. To assure that no target is observed outside the BEA, we will employ the "BETWEEN" special requirement for each visit.

3 Target Selection

3.1 LMC and SMC

Our targets in the LMC and SMC include LBVs, Ofpe/WN9 stars, O3 and O4 supergiants, WRs, and OB stars. One object in particular, HDE 269810, is extremely interesting as it is suspected of being a single star with a mass approaching 170 $M_{\odot}$(Puls *et al.*1995), making it the candidate for the most massive star known. All the objects have been observed by HST's spectrographs and are important calibrators for studying star bursting regions in more distant galaxies as well as the wind momentum-luminosity relation for massive stars. Several of the objects have been observed by HST/WFPC2 in an attemp (mostly unsuccessful) to detect binarity. With an angular resolution of about $0\rlap{.}''007$, FGS1r will be able to determine if the objects are binary (or multiple) star systems down to a separation as small as 350 A.U (LMC) or 460 A.U. (SMC). If the LMC and/or SMC falls within the Bright Earth Avoidance (BEA) zone, as it is expected to do for an early Dec launch, we assign high priority to these targets.

3.2 Nearby M Dwarfs and White Drarfs

Since the nearby WD and M dwarf stars are more or less uniformly distributed across the sky, it will be possible for us to provide a target list from which a subset of objects can be observed regardless of the STS-103 launch date, *i.e.*, *regardless* of where the restricted viewing zone might actually end up being.

Given the prevalence of hierarchical multiple systems among the M dwarfs, we will not exclude known binary or triple systems from our target list. We will include known spectroscopic binary systems to establish the feasibility of obtaining visual orbits for these systems in follow up observations. Sufficiently bright targets will be drawn from the appropriate catalogs to assure that they are within approximately 50 pc of the sun.

The white dwarfs are a high priority since HST/FGS offers the best means available for detecting binarity in these objects at angular separations ranging from 10 mas out to the detection threshold of ground based imaging. The fact that there are only 3 WDs with dynamically determined masses underscores the need for discovering resolvable binary WD systems.

Special Requirements

Supporting/coordinated Observations

Justify Duplications

Related HST Programs