First results from a search for pAGB stars in dSph galaxies with the Hobby-Eberly Telescope[1]

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Abstract

We present results of a survey of the blue side of the Red Giant Branch in the Ursa Minor and Draco dSph galaxies. Using the LRS (Hill et al. 1998), HRS (Tull 1998) and for the first time the MRS (Horner et al. 1998) spectrographs on the Hobby-Eberly Telescope. This study covers potential post-AGB, AGB, very metal-poor star and extremely young star candidates. Using new radial velocities and high resolution abundance analysis, we present a color-magnitude diagram and a list of our confirmed members and non-members as well as their derived metallicities.

Introduction and Motivation

Post-Asymptotic Giant Branch (pAGB) stars begin their lives with low to intermediate mass, and evolve through the AGB phase to spend 10^2-10^4 years until their transition into Planetary Nebulae. Sources of motivation to study these objects are a better understanding of this phase in stellar evolution and their possible use as extragalactic standard candles. Since these are old population stars with low metallicity, they should be located in regions of low gas and low dust such as the halo of our galaxy or galaxies that are metal poor.

Dwarf Spheriodal (dSph) galaxies tend to have an old, metal-poor population of stars which provides an excellent place to search for pAGB stars. Post-AGB stars are located blueward of the Red Giant Branch (RGB). On a Color-Magnitude Diagram (CMD) the blue side of the RGB is dominated by non-members, extremely metal-poor members, very young members, AGB stars, and pAGB stars.

The HET Survey

This survey searches the blue side of the RGB for extremely metal-poor stars and pAGB stars, using the available instruments on the HET: LRS, MRS and HRS. The HRS was used to follow up candidates with velocities confirmed to be near the systematic velocity of the dSph.

One star in the Draco dSph appears to be a potential pAGB star. Draco10b was only observed with the LRS and the resultant S/N was somewhat poor. This star will be followed up with a higher resolution and higher S/N spectrum.

HRS Abundances

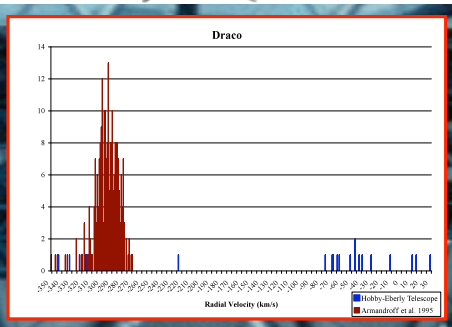
Star	S/N(pix)	Teff	log g	[Fe/H]
Draco 14	25	4370	0.44	-2.30 +/- 0.16
Draco 19219	50	4325	0.46	-3.03 +/- 0.12
Draco 61	24	4920	2.7	-1.33 +/- 0.19
Draco IV18	32	4470	0.72	-2.70 +/- 0.15
Draco IV6	12	4580	1.09	-1.90 +/- 0.28
UMi 33533	30	4410	0.63	-2.96 +/- 0.17
UMi Cos60	32	4100	0	-2.50 +/- 0.15
UMi m1	10	5530	1.55	-0.2 +/- 0.80

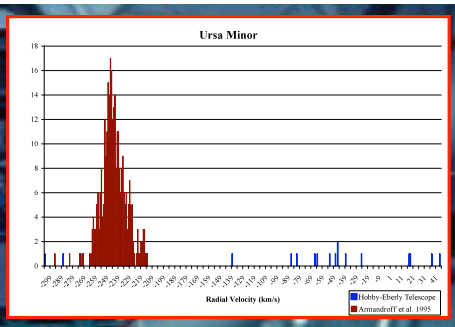
Abundance Follow-up

The HRS spectra allow for an analysis of the metallicity, and confirmation of the surface gravity (evolutionary status) of the members. One star, Draco 61, has a spectroscopic surface gravity far larger than any Draco member should have with its absolute magnitude. In addition the derived metallicity, [Fe/H] = -1.3, is larger than most of the Draco members. Despite having the same systematic velocity as Draco we label Draco 61 as a non-member.

We find several extremely metal-poor stars in our survey: Draco 19219, Draco IV18 and Ursa Minor 33533. These are consistent with the most metal-poor dSph stars know: Draco 119, [Fe/H] = -2.97, and Sextans S49, [Fe/H] = -2.85.

One star in our sample, Ursa Minor Cos 60, is above the tip of the RGB in V, Mv = -3.41. This star's spectrum exhibits very strong iron lines that can only be fit with a very large microturbulent velocity. This star is a potential pAGB star and is under further investigation.





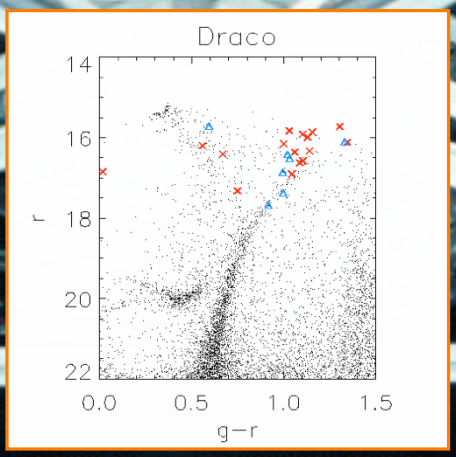
To determine radial velocity members, we calculated the radial velocities of our targets (blue) and compared them to the radial velocity dispersion of members calculated in Armandroff et al. 1995 (RED).

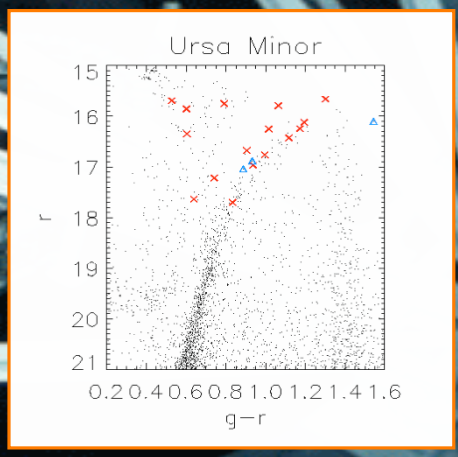
Draco

Star	RA	DEC	Instrument	RV	error
Draco1a	17:17:29.21	58:00:01.5	LRS_g3	11	10
Draco2a	17:21:22.20	57:51:50.9	LRS_g3	-64	10
Draco2b	17:21:26.27	57:52:07.0	LRS_g3	-315	12
Draco3a	17:19:22.61	58:10:56.0	LRS_g3	-297	10
Draco3b	17:19:17.43	58:10:40.4	LRS_g3	-30	10
Draco4	17:21:38.87	57:47:46.9	LRS_g3	-46	10
Draco4	17:21:38.87	57:47:46.9	HRS_15k	-42	2
Draco5a	17:17:40.22	57:41:22.4	LRS_g3	-62	10
Draco6a	17:19:05.68	57:46:24.7	LRS_g3	-68	20
Draco6b	17:19:03.58	57:46:42.7	LRS_g3	-295	15
Draco7	17:20:02.13	57:40:18.0	LRS_g3	-76	11
Draco8	17:19:19.06	57:46:34.0	HRS_15k	-11	2
Draco9	17:20:44.87	57:53:26.7	HRS_15k	15	2
Draco10a	17:19:58.71	57:45:12.1	LRS_g3	-46	11
Draco10b	17:20:07.34	57:44:24.0	LRS_g3	-286	28
Draco11	17:20:17.89	57:47:11.6	LRS_g3	-51	14
Draco12	17:21:11.31	58:09:47.3	LRS_g3	-69	10
Draco13	17:18:06.14	57:40:49.0	LRS_g3	-291	18
Draco14	17:19:41.88	57:52:19.3	HRS_15k	-293	1.8
Draco116	17:19:24.51	57:52:49.6	MRS	29	4.5
Draco61	17:19:46.57	57:56:56.5	MRS	-343	5.6
Draco61	17:19:46.56	57:56:56.1	HRS_15k	-332	1.4

Ursa Minor

Star	RA	DEC	Instrument	RV	error
UM1a	15:05:39.05	67:13:17.1	LRS_g3	14	11
UM2a	15:10:52.21	67:20:19.4	LRS_g3	-86	10
UM3a	15:07:25.59	67:12:54.5	LRS_g3	-43	10
UM3b	15:07:22.56	67:12:00.85	LRS_g3	-308	10
UM4	15:09:42.03	67:02:36.6	LRS_g3	-68	20
UM5	15:05:56.90	67:07:59.7	LRS_g3	-50	10
UM6	15:08:26.48	67:26:58.5	LRS_g3	-70	10
UM7	15:07:51.77	67:22:36.5	LRS_g3	-50	10
UM8	15:07:02.90	67:09:32.1	LRS_g3	-57	10
UM9	15:09:00.30	67:09:27.3	LRS_g3	-91	10
UM11	15:10:17.55	67:15:53.2	LRS_g3	-254	14
UM12	15:08:05.32	67:08:33.5	LRS_g3	-218	26
m1	15:07:31.35	67:09:47.3	LRS_g3	-277	31
m1	15:07:31.42	67:09:47.4	HRS_15k	-292	2.4
UM1537	15:08:32.50	67:04:30.2	LRS_g3	-143	19
Umi124	15:10:23.00	67:27:11.6	MRS	33	6.2
Umi1537	15:08:32.50	67:04:30.2	MRS	40	6
Umi33533	15:13:26.10	67:16:23	HRS_15k	-252	2.2
Cos60	15:09:13.80	67:15:33	HRS_15k	-235	2
746	15:08:51.60	67:25:11	HRS_15k	-52	4
783	15:07:14.50	67:20:30	HRS_15k	-29	4
1406	15:07:23.90	67:11:05	HRS_15k	13	N/A





Color-Magnitude Diagrams were constructed from data provided by M. Irwin (private communication). Non-members are represented as red crosses and members are blue triangles. Some data points are not included due to lack of photometry.

References:
Arandroff, T. E., Olzewski, E. W., Pryor, C., 1995, AJ, 110, 2131
Hill et al. 1998 Proc SPIE 3355, 375.
Horner et al. 1998 Proc SPIE 3355, 399
Tull 1998, Proc SPIE 3355, 387

[1]The Hobby-Eberly Telescope (HET) is a joint project of the University of Texas at Austin, the Pennsylvania State University, Stanford University, Ludwig-Maximilians-Universität München, and Georg-August-Universität Göttingen. The HET is named in honor of its principal benefactors, William P. Hobby and Robert E. Eberly.