S5 First Public Data Release (DR1)

Introduction and Overview

This is the documentation for the first public data release (DR1) of the Southern Stellar Stream Spectroscopic Survey (S5). S5 is an ongoing spectroscopic survey conducted with the 3.9 m Anglo-Australia Telescope (AAT) at the Siding Spring Observatory. S5 DR1 contains all observations taken between 2018-2019. For details on target selection, data reduction, survey validation, can be found in Li et al. (2019). If any data from this release is used for publication, please cite Li et al. (2019) for reference.

S5 DR1 includes the radial velocities (RV) and stellar parameters (logg, Teff and metallicity) from rvspecfit using the spectra from the dual arm (blue and red) spectrograph AAOmega. We picked 580V in the blue which covers 3800-5800 Angstrom at a spectral resolution R~1300 and 1700D in the red which covers 8400-8800 Angstrom at a spectral resolution R~10000, and we derived the stellar parameters from each arm independently. In S5 DR1, only parameters from 1700D are presented as it gives much better RV precision. Additional columns from cross-matching with external catalogs, including Gaia eDR3, DES DR1, DECaLS DR8, 2MASS, etc, are also included in this release. See details in the Column Description Section.

S5 is mostly a stellar stream survey; in this release, the following 12 stellar streams were observed (see details in Li et al. (2019)): ATLAS, Aliqa Uma, Elqui, Indus, Jhelum, Orphan/Chenab, Palca, Phoenix, Willka Yaku, Ravi, Pal 5, Sagittarius. Figure 1 shows the footprint of S5 DR1. Among these, ATLAS, Aliqa Uma, Palca were published in Li et al. 2021, Phoenix was published in Wan et al. 2020. A few more papers are still under preparation on other streams.

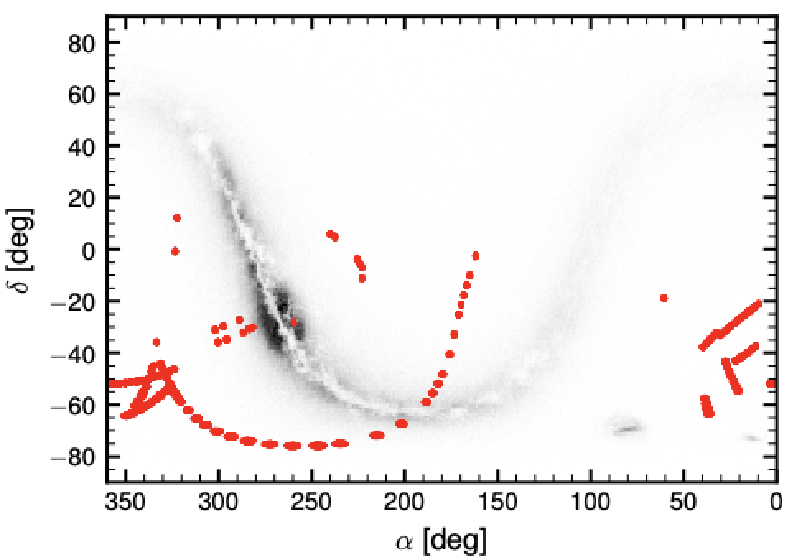

Figure 1: Footprint of S5 DR1 in red, with the background of stellar density from Gaia eDR3. The field centers for S5 DR1 can be found in Table 2 of Li et al. (2019).

In addition to stellar streams, the spare fibers were used to survey the halo stars (S5-halo) and nearby (unresolved) galaxies (S5-lowz). Galaxy targets have priority <= 2 in the catalog and their parameters from rvspect are not reliable and therefore are not released. As mentioned in Li et al. (2019), S5-halo targets interesting halo targets such as blue stars, RR Lyrae stars, metal-poor stars, white dwarfs, etc. The community is very welcome to explore the stream targets as well as the halo targets for additional science.

The catalog of DR1 is identical to internal data release version iDR1.5 in S5 (which produced papers such as Li et al. 2019, Koposov et al. 2019, Wan et al. 2020, Li et al. 2021), with the cross-matched external catalogs to the latest release (e.g. Gaia eDR3, DES DR2, DECaLS DR9 NSC DR2, Skymapper DR2, etc.). If you wish to access the reduced spectra for your own spectral fit, please contact the S5 Leadership team or any S5 members. We are happy to share the reduced spectra.

More S5 observations were taken in 2020 and the survey is continuing in 2021 with more streams observed. S5 DR2 (from iDR2) will include all data from 2018-2021 and is expected to happen in late 2022. DR2 will include a slightly different spectral template fitting algorithm that fits the blue and red arm simultaneously, which improves the fitting on stellar parameters and produces spectrophotometric distances. If you are interested in accessing the iDR2, please contact the S5 Leadership team or any S5 members.

You are always welcome to find the latest news and updates on S5 from our website.

Finally, the spectra and the best fit model can be viewed at the S5 visualization page.

Column Description

Here we provide the description of each column in S5 DR1. Columns highlighted in boldface are the recommended ones (i.e. most users will only need those), although other columns also provide important information. We prepare two fits table, one is the light version that only includes the boldfaced columns and the other includes all the columns listed below. We also decide to only release the targets with good_star == 1 and sn_1700d > 3 to ensure the high quality of this dataset (as measurements with good_star == 0 or sn_1700d < 3 are likely to be unreliable).
The two fits table: s5_pdr1.fits and s5_pdr1_light.fits are self-documented and can be read with table.Table.read function in astropy.
Again, for details on how each column is derived, we refer reader to find more details in Li et al. (2019).

Column Name	Type	Unit	Description
vel1 vel16 vel50 vel84 vel99 vel_kurt vel_skew vel_std	float64	km/s	Radial velocity (RV) statistics from rvspecfit. 1st, 16th, 50th, 84th, 99th percentile of the RV posterior distribution, in addition to the kurtosis, skewness, and standard deviation of the distribution. For radial velocity, we recommend the vel_calib column.
feh1 feh16 **feh50** feh84 feh99 feh_kurt feh_skew feh_std	float64	dex	Metallicity statistics from rvspecfit. feh50 is recommended to be used as mean metallicity for each star.
logg1 logg16 logg50 logg84 logg99 logg_kurt logg_skew logg_std	float64		Surface gravity statistics from rvspecfit.
teff1 teff16 teff50 teff84 teff99 teff_kurt teff_skew teff_std	float64	K	Effective temperature statistics from rvspecfit.
vel_calib	float64	km/s	radial velocity calibrated to have no zeropoint offset. Offset is determined by cross-matching with APOGEE data. See details in Section 4.1 of [Li et al. (2019)]().

vel_calib_std	float64	km/s	calibrated radial velocity uncertainty using repeated observations.
feh_calib_std	float64	dex	Calibrated [Fe/H] uncertainty using repeated observations.
redchisq_1700d	float64		Reduced chi square from the best fit template model from rvspecfit
chisq_1700d	float64		Chi square from the best fit template model from rvspecfit
absdev_1700d	float64		Median absolute deviation from the best fit template model from rvspecfit, defined as Median(Data-Model)/Median(Model)
ra	float64	deg	Right ascension of the object
dec	float64	deg	Declination of the object
name	str		Object name used for AAT observation. For stellar targets, name is usually source_id from Gaia DR2, for galaxy targets (S5-lowz), the name is usually object_id from DES DR1. Some observations prior S5 were also included and for those, names could follow different conventions..
field	str		Name of the stream fields, corresponding to field name in Table 2 of Li et al. (2019)
fileinfo	str		Filename of the reduced AAT spectra from each field.
utmjd	float64	day	UTMJD of the observation
sn_1700d	float64		Median Signal-to-Noise ratio of the 1700d spectra **For DR1, we decide to only release objects with sn_1700d > 3 to ensure the high quality of this dataset.**
moon_dist	float64	deg	Moon distance
moon_phase	float64	%	Moon phase (0 -100% fraction of surface illumination). 0% corresponds to new moon and 100% corresponds to full moon
moon_alt	float64	deg	Moon altitude

qso_flag_wise	0 or 1		1 = Likely QSO objects based on WISE photometry. 0 = not a QSO See details in Section 4.4 of Li et al. (2019)
priority	int64		initial target selection priorities. Integer 1 to 9 is used. 9 is highest and 1 is lowest. 7-9 are stream targets; 3-6 are halo star targets; 1-2 are galaxy targets and therefore the parameters derived here with rvspecfit should not be used. For details, please refer to Section 2 of Li et al. (2019). A few fields were observed prior to the official S5 observations and priority is set to -1 for these targets.
primary	bool		For some object, multiple observations were taken. Primary = True if this is the observation with the highest S/N. For objects that only one observation was taken, Primary is always True. This column is useful if you want to get only one measurement per target to remove duplicates
good_star_pb	float64	%	Good star probability based on random forest trained on the following parameters as features: chi-squared values of the fit, radial velocity error, radial velocity posterior skewness and kurtosis, effective temperature, median signal to noise in the spectrum and median absolute deviation from the best fit template model. See details in Section 4.5 of Li et al. (2019).
good_star	0 or 1		A flag to select stellar spectra with good fitting quality. good_star = 0 if it meets one of the 3 following criteria: 1. good_star_pb < 0.5 2. priority < = 2 3. qso_flag_wise == 1 See details in Section 4.5 of Li et al. (2019). **For DR1, we decide to only release objects with good_star = 1 to ensure the high quality of this dataset.**
ebv	float64		E(B-V) from Schlegel et al (1998).

gaia_source_id parallax parallax_error pmra pmdec pmra_error pmdec_error pmra_pmdec_corr phot_g_mean_mag phot_bp_mean_mag Phot_rp_mean_mag phot_bp_rp_excess_factor	various	various	Measurements from Gaia eDR3
g_decam r_decam i_decam z_decam	float64	mag	DECam photometry (without reddening correction) from DES DR1, DECaLS DR9 or NSC DR2. If the object is in multiple catalogs, then DES is first considered, then DECaLS and finally NSC. See decam_phot_src_bits for the source of the photometry
decam_phot_src_bits	int64		The source of the decam photometry. It is a 12 bit integer 'ABC DEF GHI JKL' where ABC bits describe the source of g photometry, DEF bits the source of r photometry, etc. The value of 1 corresponds to DES DR2, 2 to DECALS, 3 to NSC. For example, decam_phot_src_bits = 585 corresponds to 001001001001, which means that griz photometry all comes from DES DR2; decam_phot_src_bits = 83 corresponds to 000 001 010 011, which means that the griz photometry comes from NONE, DES, DECALS, NSC.
flux_w1 flux_w2 dflux_w1 dflux_w2	float64	nano-maggies	unWISE photometry from Schlafly+2019 fluxes and uncertainties in vega nano-maggies, i.e. to convert into mags one need to do 22.5-2.5*log_10(f)
j_2mass h_2mass k_2mass	float64	mag	

u_skm g_skm r_skm i_skm z_skm	float64	mag	Skymapper DR2 photometry
starhorse_dist05 starhorse_dist16 starhorse_dist50 starhorse_dist84 starhorse_dist95	float64	kpc	starhorse distances at 5th, 16th, 50th, 84th, 95th percentile from Queiroz et al+2018