

DEIMOS spectroscopy of the wreckage of a galactic collision in Andromeda

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Abstract: Analysis of DEIMOS data from M31 RGB stars is used to analyse the Giant Southern Stream. 8 DEIMOS fields within the GSS are used. Radial velocity and [Fe/H] are measured. An expectation maximisation algorithm is used to derive velocity and [Fe/H] dispersions. Using specified velocity ranges for the stream peak, single and double gaussian fits are made. A two component model of the stream progenitor is indicated.

Introduction: M31, being our nearest (785kpc) large galaxy is a useful laboratory for testing models of galaxy formation. In the Λ CDM paradigm, a hierarchical model of galaxy formation is preferred, and this work is looking at the remains of hierarchical formation in the M31 halo, specifically the largest substructure feature, the Giant Southern Stream.

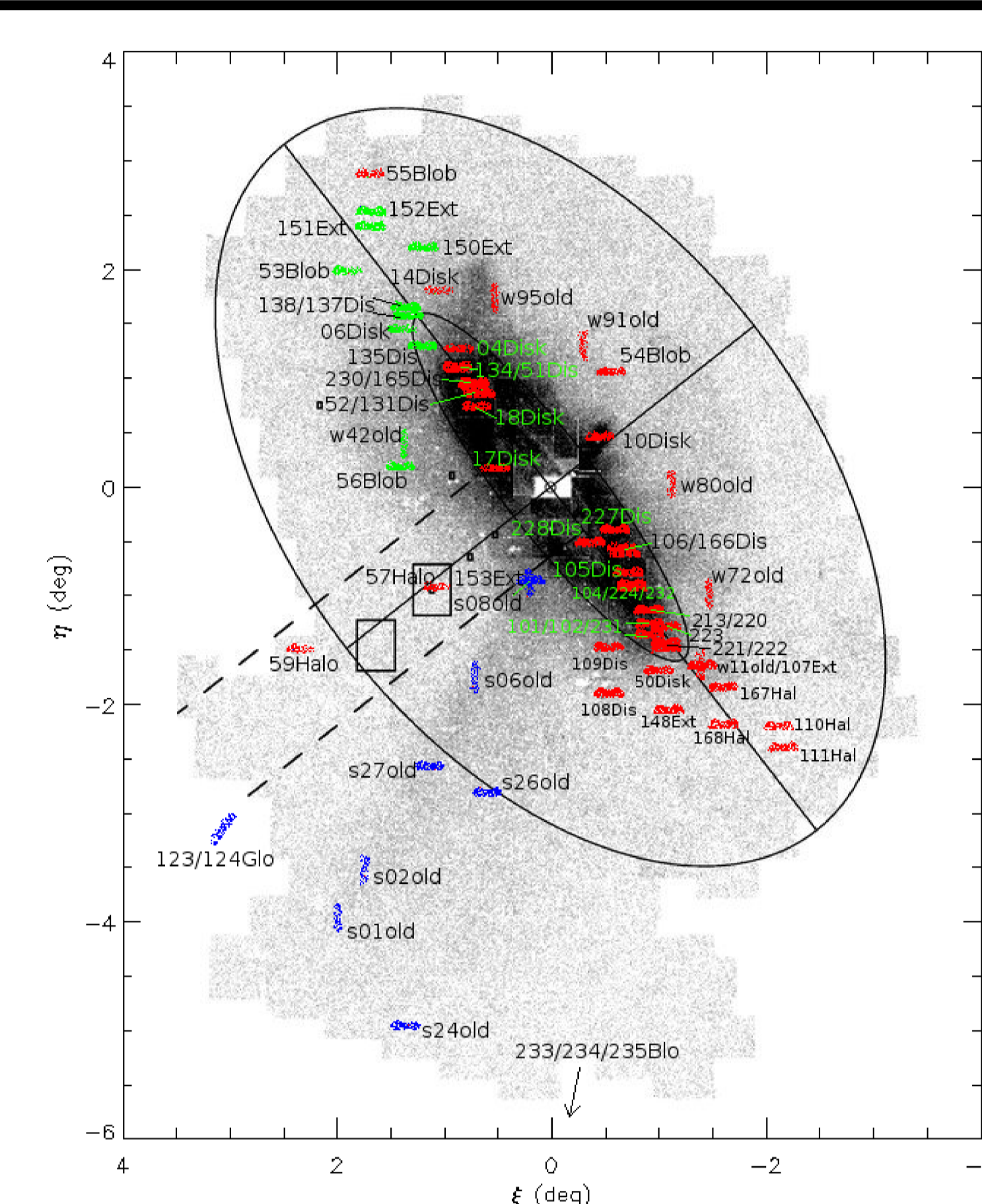
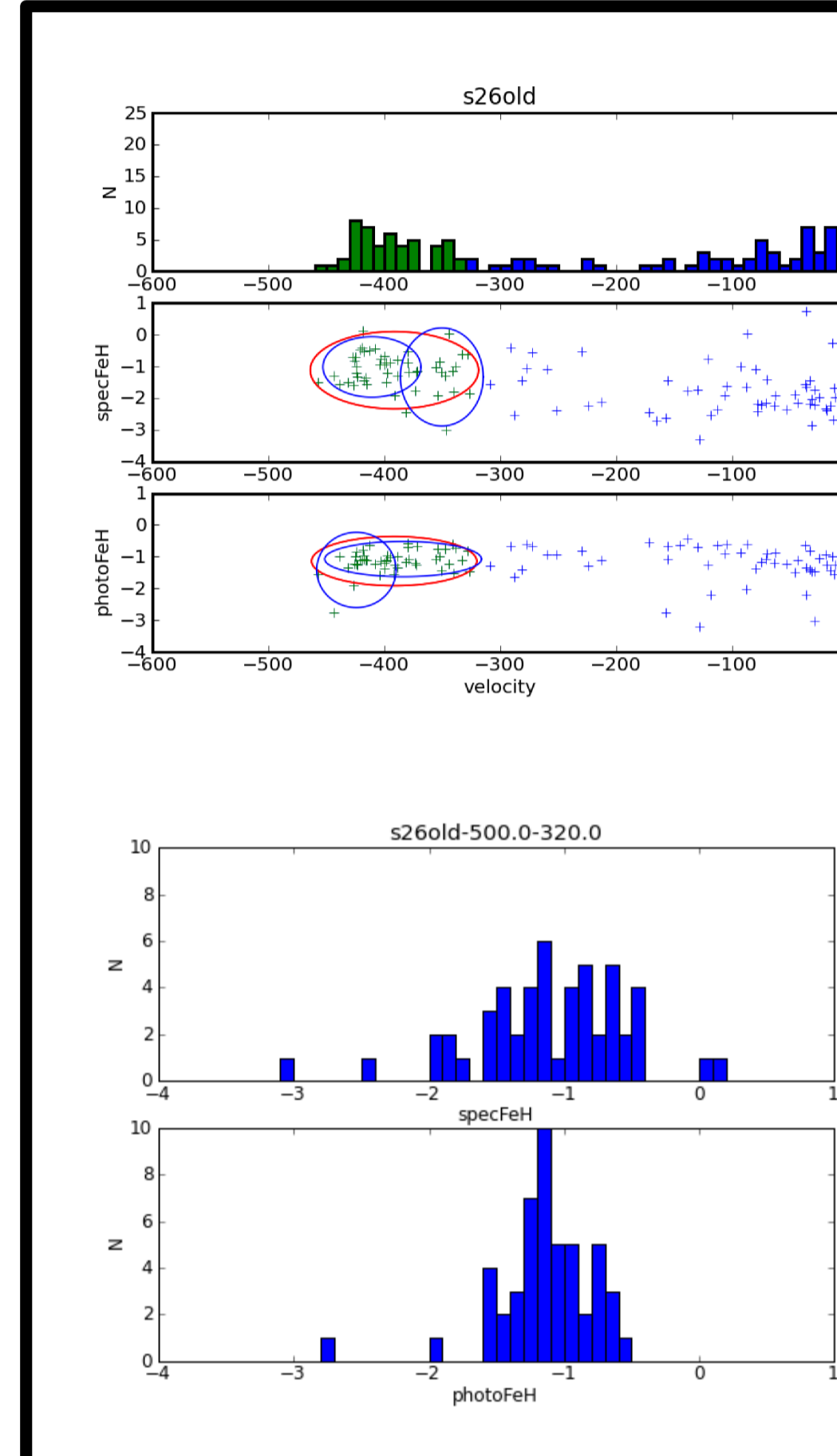


Diagram showing the position of the DEIMOS masks relative to M31. The stream fields are coloured in blue.

The projected radii of these masks relative to M31 range from 13 to 70 kpc.



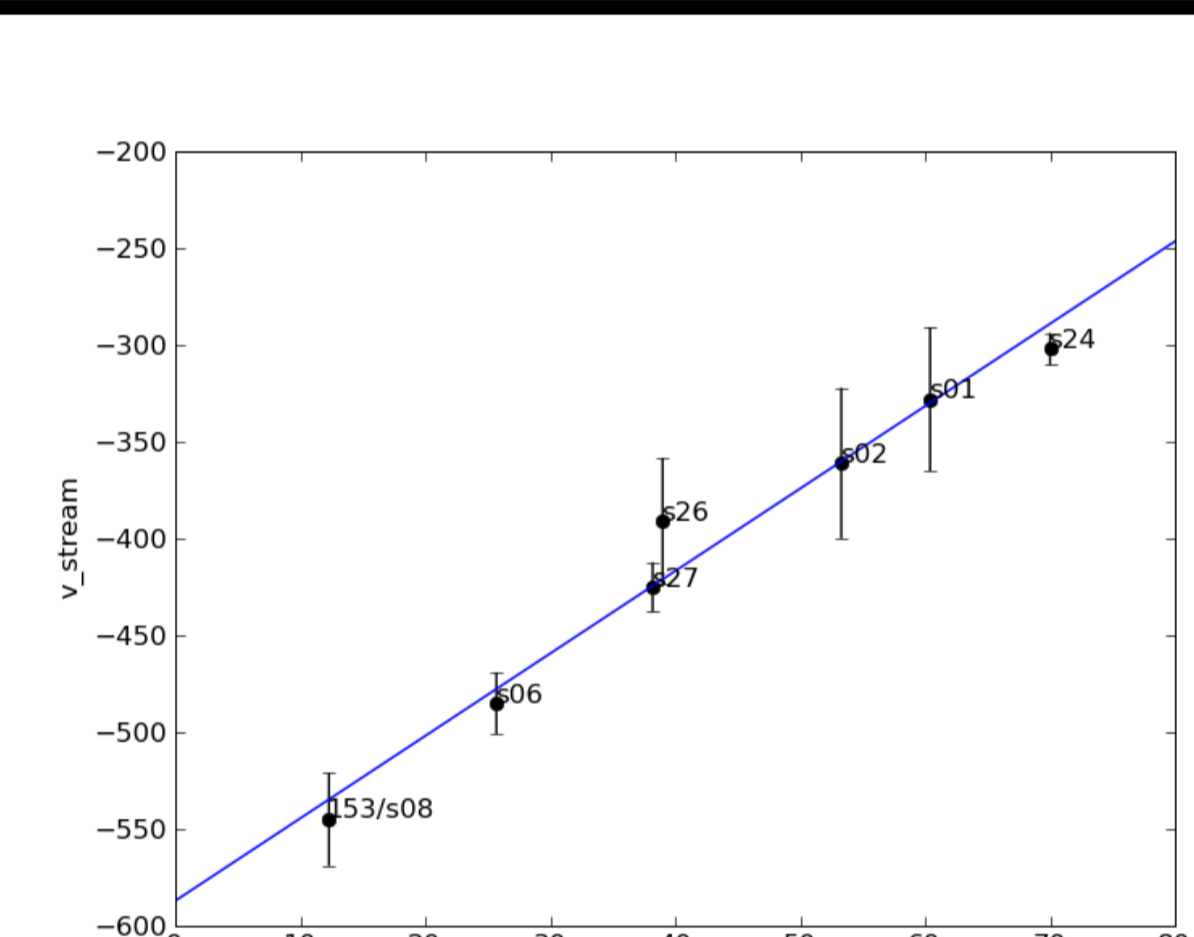
An example analysis of a DEIMOS mask

By processing through a pipeline (see Ibata et al. 05 for details) radial velocities and spectroscopic [Fe/H]s are derived.

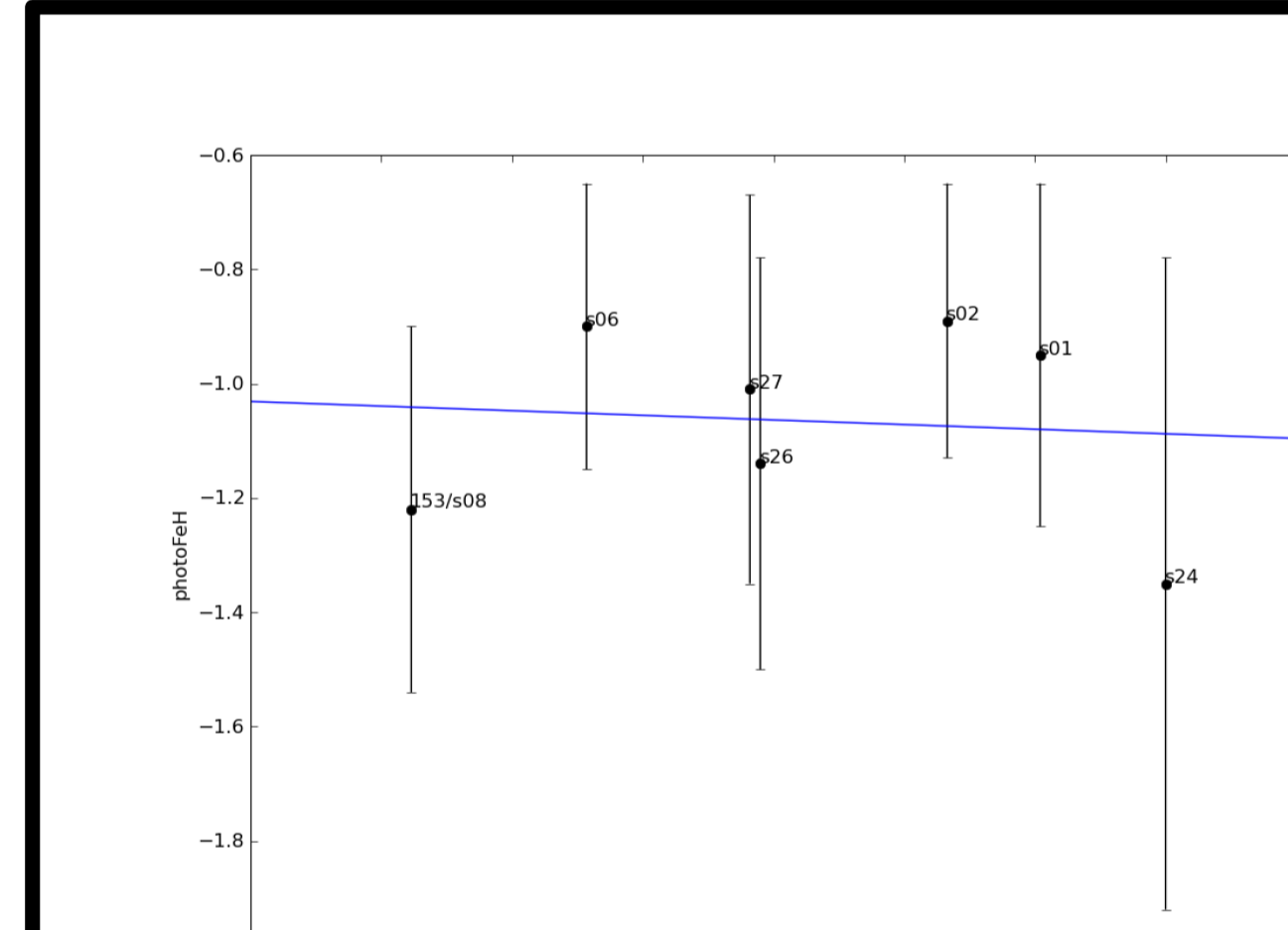
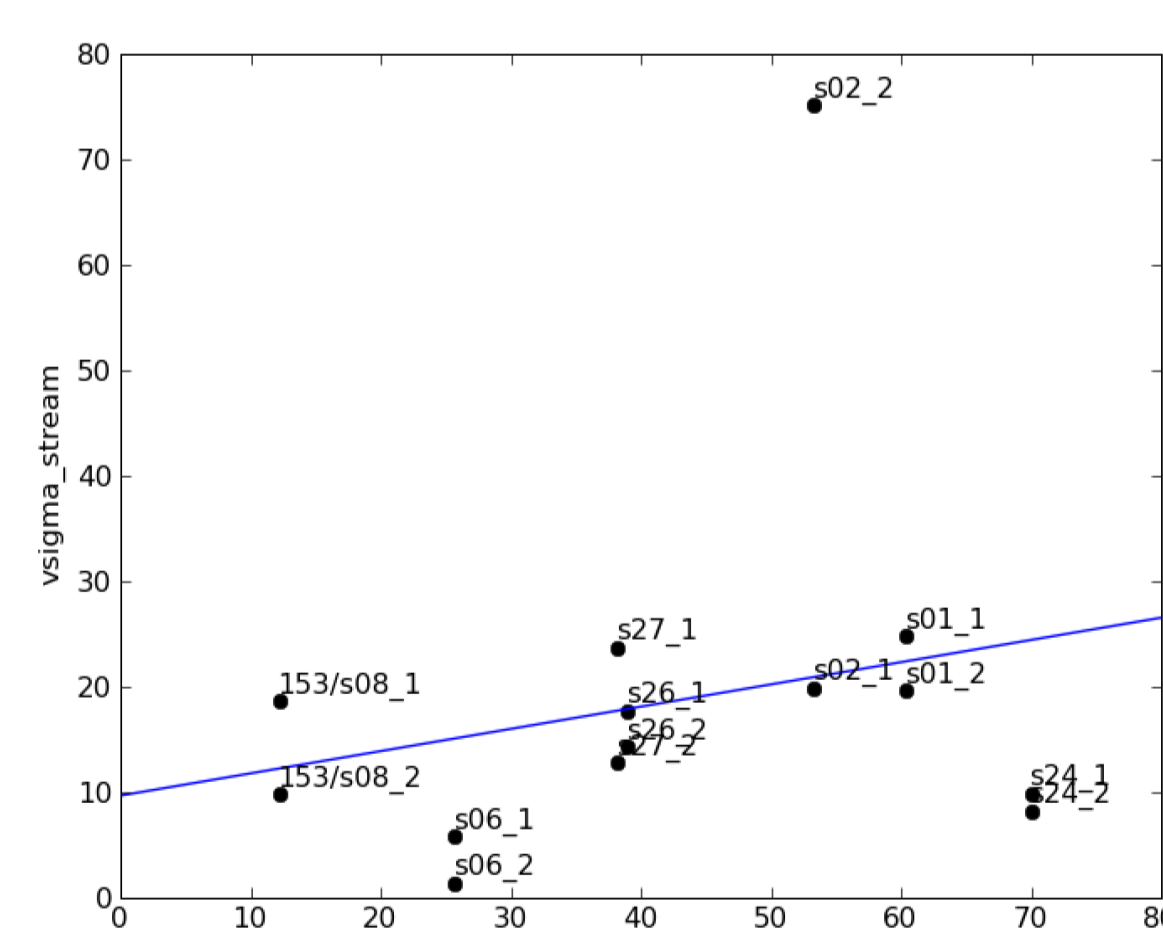
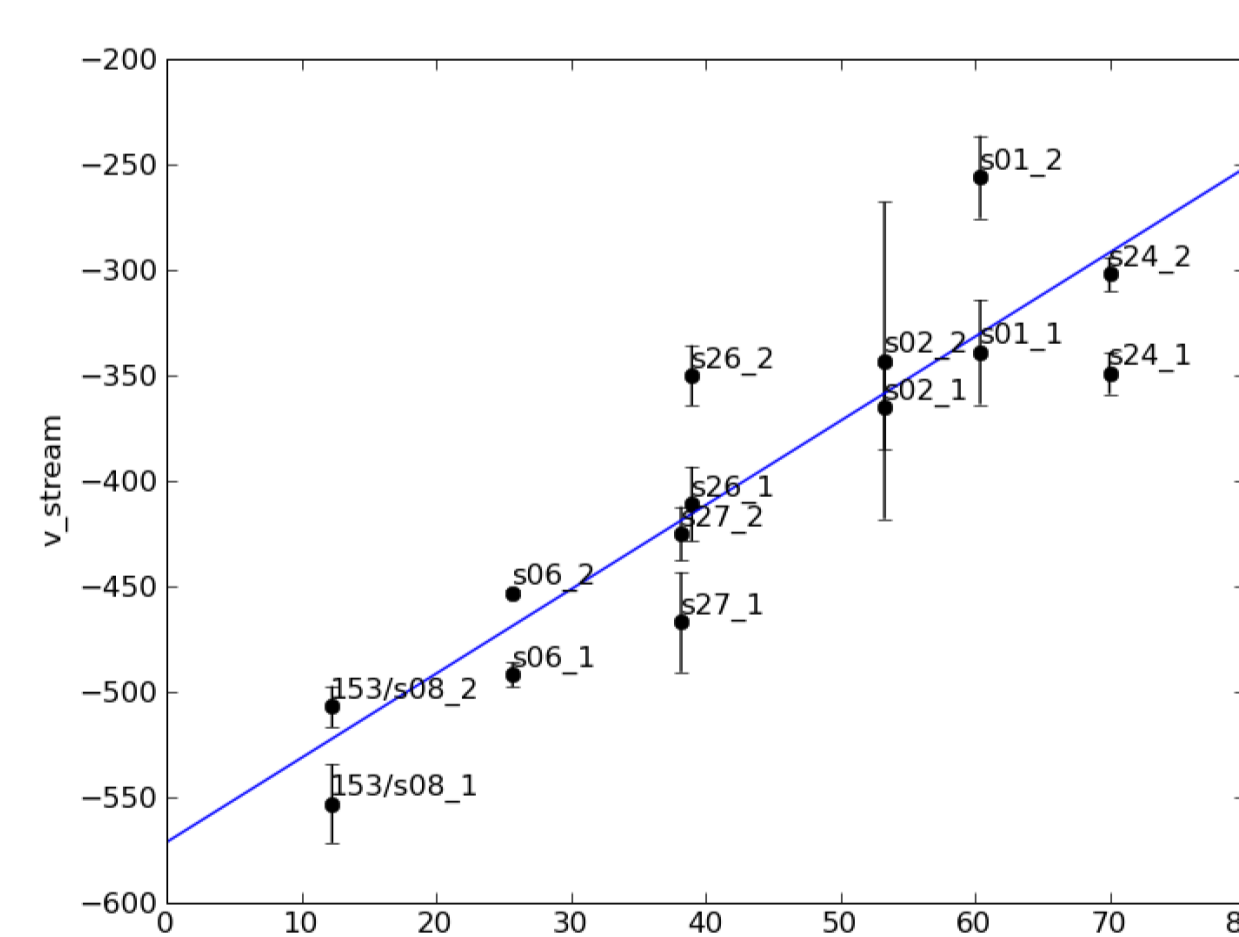
We produce fits using an expectation maximisation algorithm, an iterative process which automatically fits a Gaussian mixture model to the data.

We fit to specified velocity ranges which isolate the stream peak, to avoid disk and MW stars skewing the result.

We used a variety of approaches, including leaving the algorithm free to choose the number of components, and forcing a single or a double gaussian fit.



The three panels here show the stream peak velocity and σ_v varying along the stream. The left panels show the gradient in velocity along the stream, which is fairly well approximated by a straight line in the range we observe it. The upper one is forcing a single gaussian fit, the lower a double gaussian to the stream peak. The lower right panel shows the velocity dispersion, we see there is some evidence for a gradient with radius.



These two panels show the trends in photometric [Fe/H], using a single gaussian fit for the upper panel, and a double gaussian fit for the lower one. The data is consistent with no overall trend in [Fe/H] with radius.

The dispersions in the spectroscopic [Fe/H]s are large, since there are large individual errors in the [Fe/H] measurements, therefore we have concentrated on photometric [Fe/H] here.

Ibata et al. 2007 detected a metal rich core to the stream, and a metal poor envelope. We should expect a clear core/envelope divide at large radii and greater mixing at small radii.

Here we show a table of the single gaussian fits to the stream peaks from the stream masks.

It can be observed that s26old, s02old and s01old have large σ_v and therefore may have two components.

We see that the stream halo fields have a lower [Fe/H] of -1.34 than the stream core which has an average of -0.94 excluding the innermost fields of 153Ext and s08old.

The innermost fields also have a lower [Fe/H]. This is possibly due to mixing of stream core and halo.

Field	r (kpc)	Velocity range (km/s)	V_{peak} (km/s)	$V\sigma$ (km/s)	Photo [Fe/H] peak	Photo [Fe/H] σ
153Ext + s08old	12.3	-620,-500	-546	24.0	-1.22	0.32
s06old	25.7	-550,-440	-485	15.9	-0.90	0.25
s27old	38.2	-600,-370	-429	18.3	-1.01	0.34
s02old	53.3	-500,-200	-361	38.9	-0.89	0.24
s01old	60.4	-400,-200	-328	37.0	-0.95	0.30
s26old + s24old	39.0, 7.0	-500,-320; -390,-280	-391, -337	32.7, 22.3	-1.34	0.33

Conclusions

There appears to be a mixture of a metal rich and a metal poor population. This would support models in which the stream progenitor was a dwarf spiral or dwarf irregular rather than a dwarf spheroidal.

An increase in σ_v with increasing radius is observed for both the single and double gaussian fits. We observe a slow increase in contrast to Font et al. model which predicts a spike at apocentre.

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