The Outer Halo in SEGUE

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and

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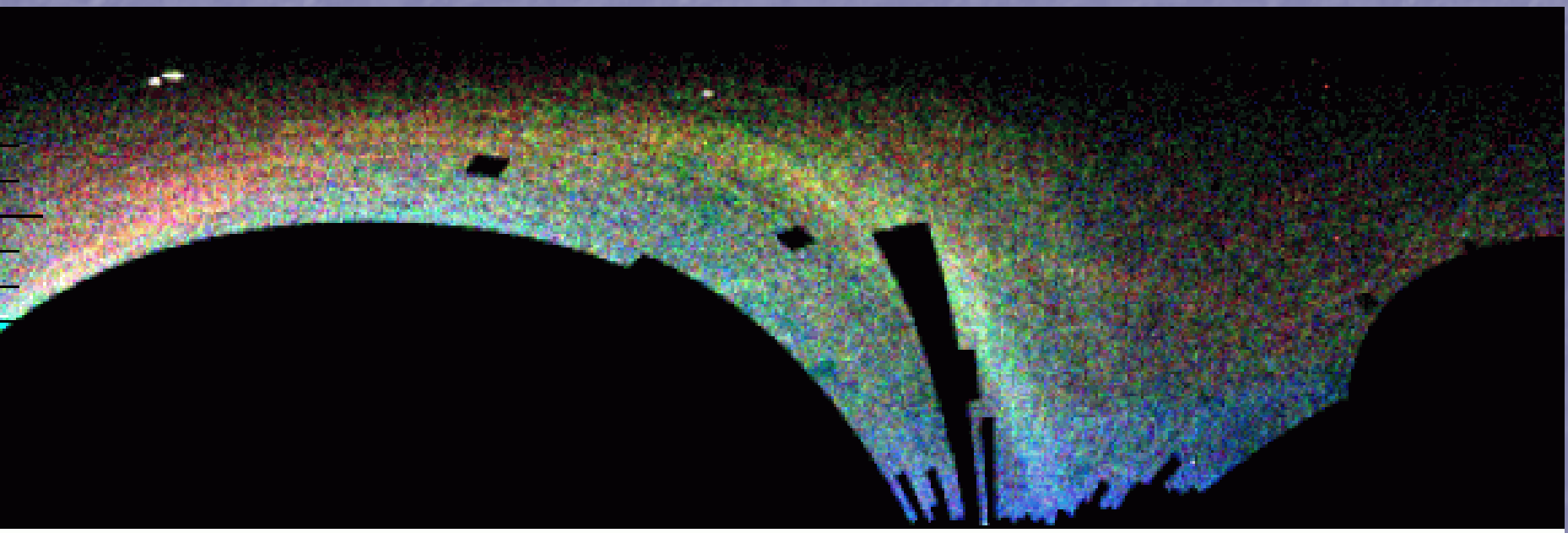
(thanks to Eric Bell for the subtraction idea .....)

How was the halo formed? Streams as icing or cake?



Field of Streams: Belokurov et al 2006

Photometric search for streams using turnoff stars

- Yanny/Newberg pioneered this technique with SDSS data
- Stars selected at turnoff color for old, metal-poor population: box in (g,g-r)
- Distance from magnitude
- Limit ~35 kpc for SDSS imaging data

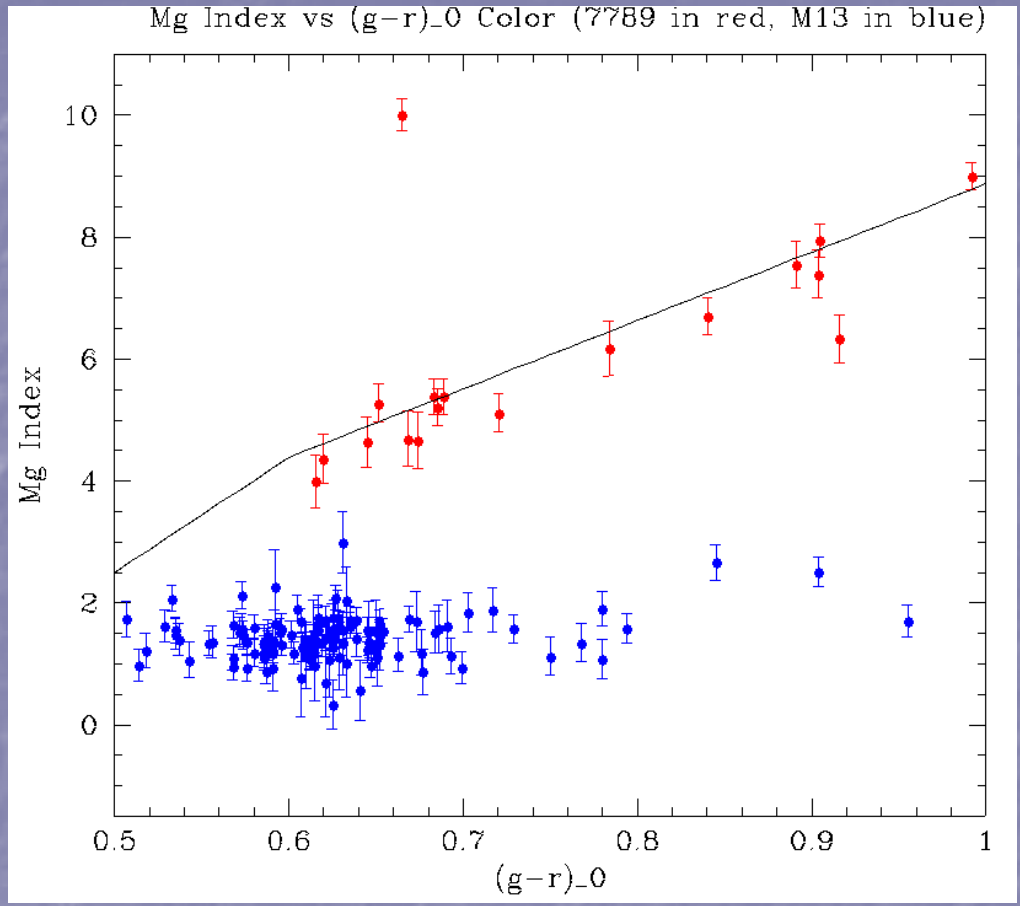
Could we use K giants??

- Simple color cut will not work: there are many foreground K dwarfs belonging to the disk;
- They outnumber the more distant K giants
- However, K giants will probe to much higher distances (50-100 kpc)

Use spectra to quantify disk dwarf numbers

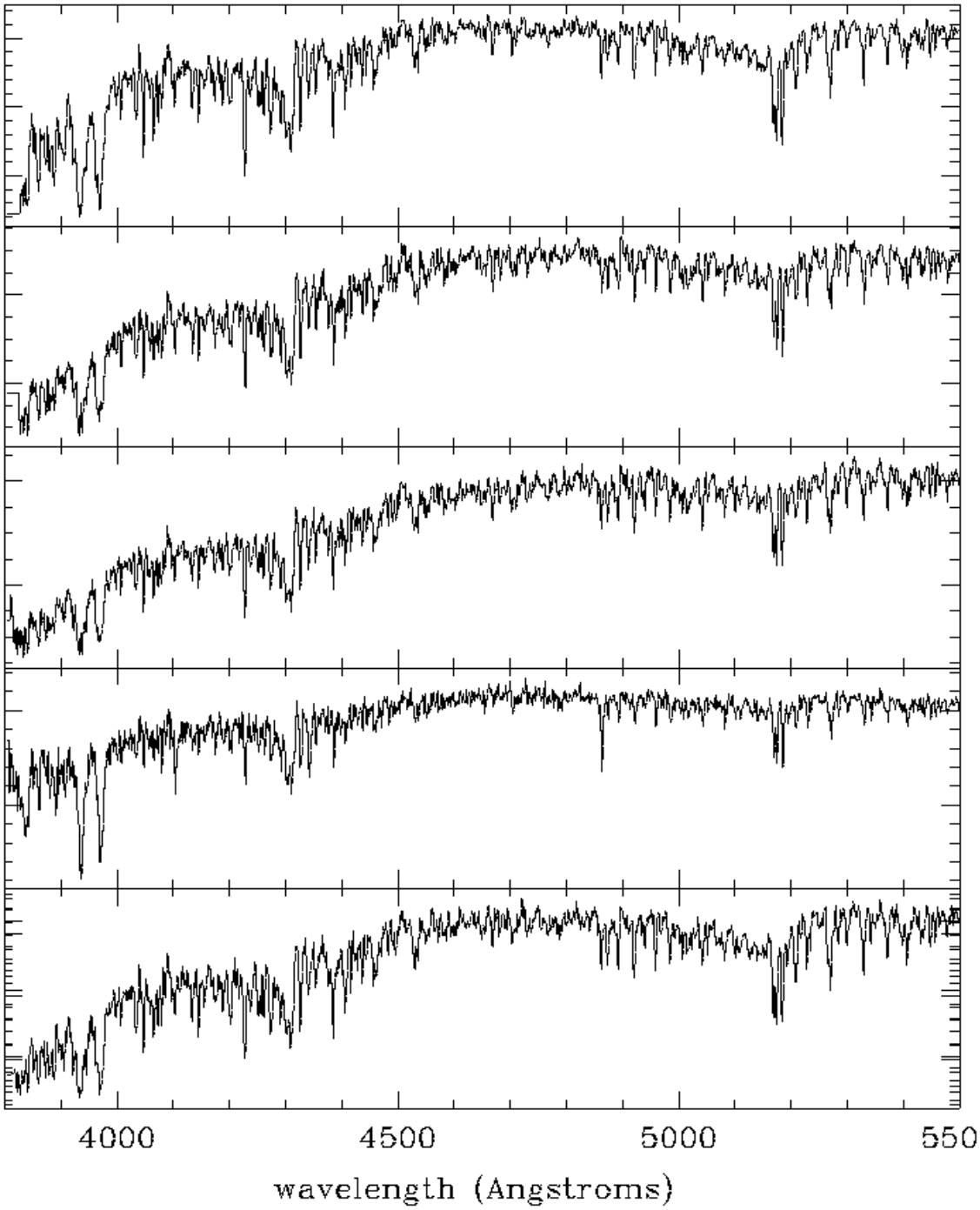
- K dwarfs will only be 1-2 kpc away at most
- Their numbers should change slowly with (l,b)
- Model and subtract foreground disk from K star counts using spectroscopic plates
- What remains should be distant K giants

How to identify giants/dwarfs

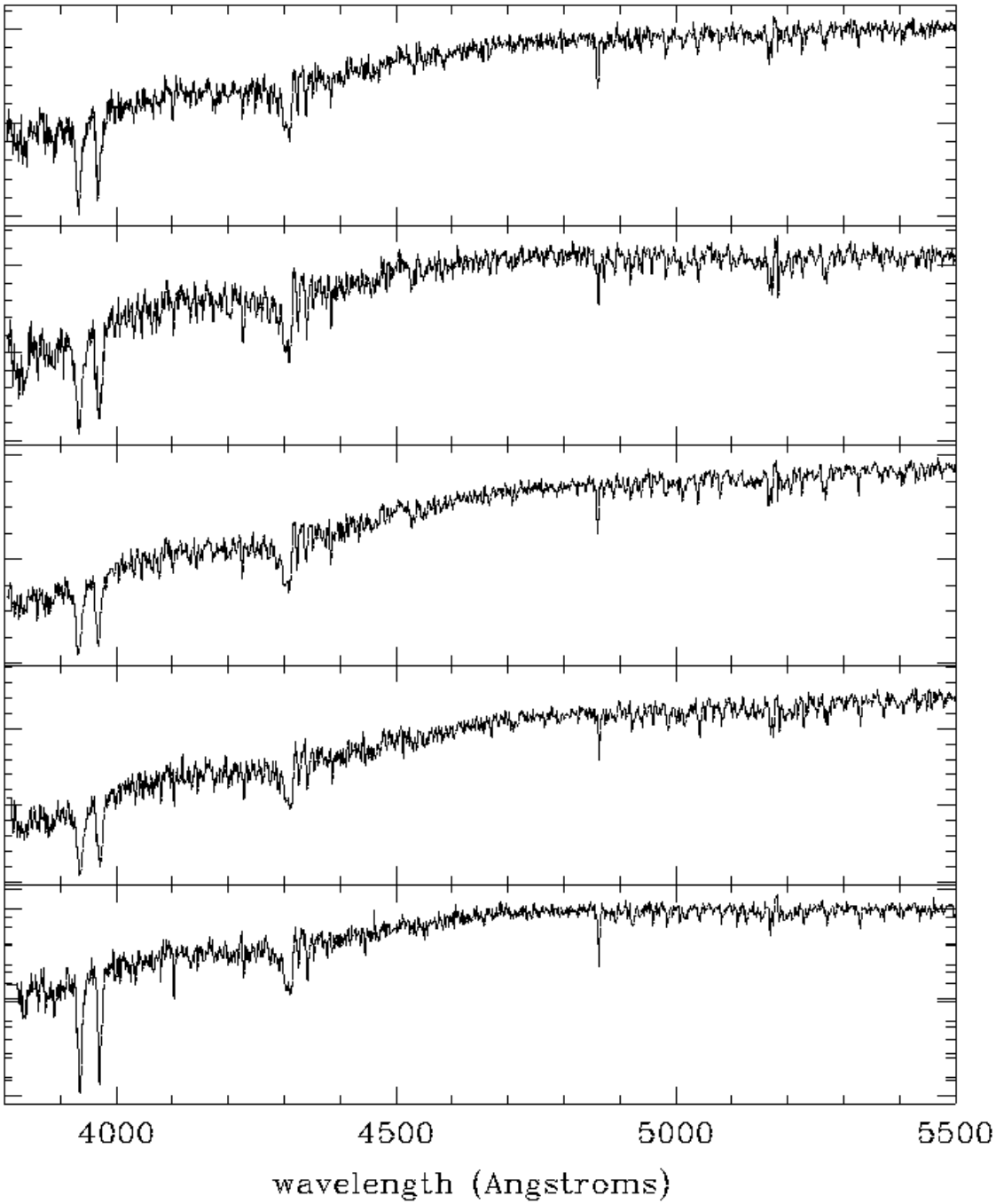


NGC 7789 is roughly solar abundance

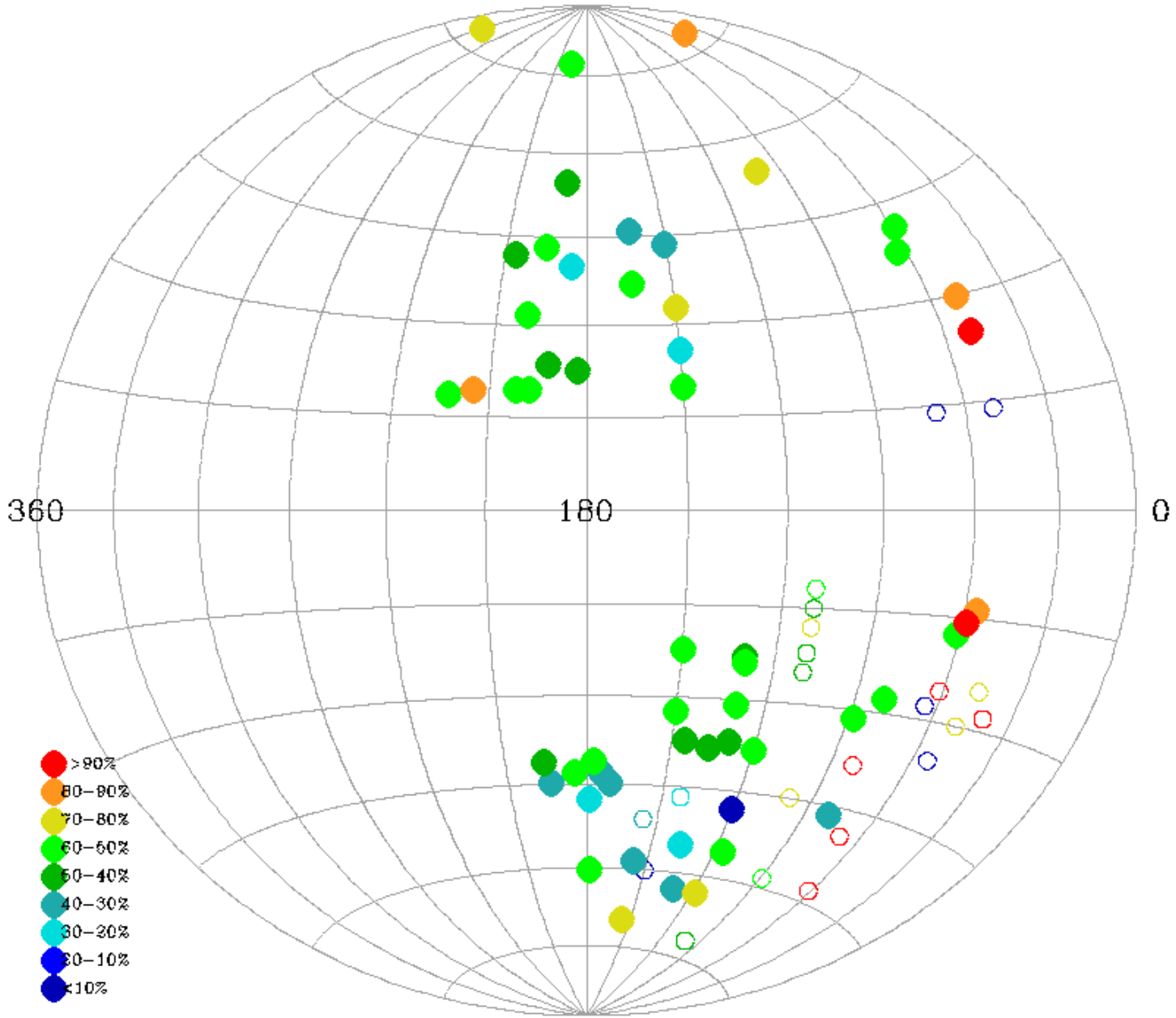
Only dwarfs should be above NGC7789 line



Dwarf spectra



Giant spectra



g=
14-16

Field-to-field variation?

- Overall trend of success rate with galactic longitude, as expected

- Some interesting variations over small spatial scales, can be caused by

  --- different target selection algorithms

  --- variations in photometric zeropoints

OR

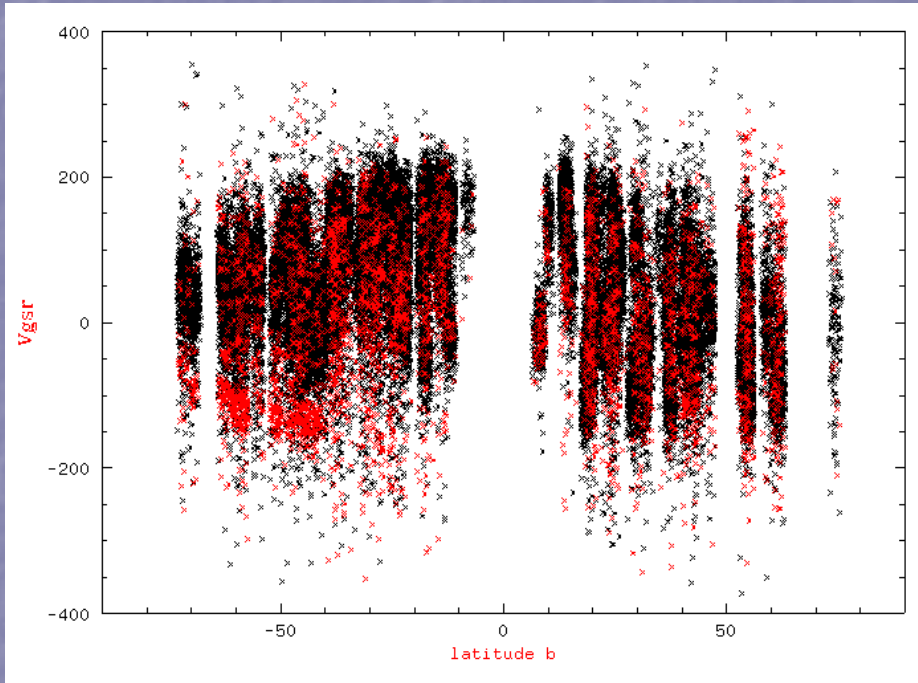
  --- star streams!

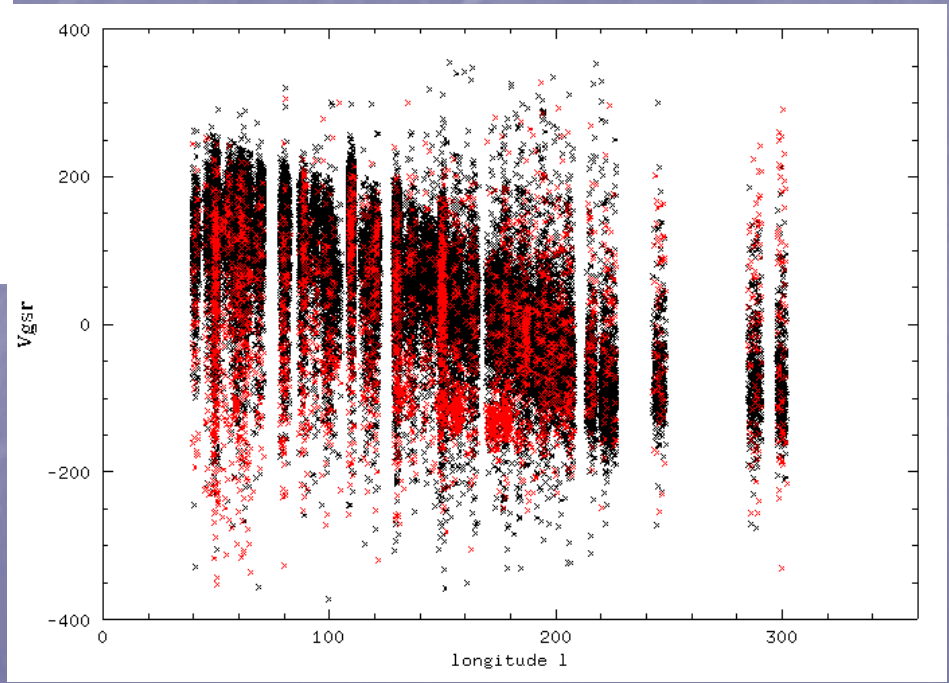
How to make a field of streams for giants:

- Use photometry to get numbers of stars in each target type per plate
- This will give absolute numbers of disk dwarfs per plate

- Subtract!!

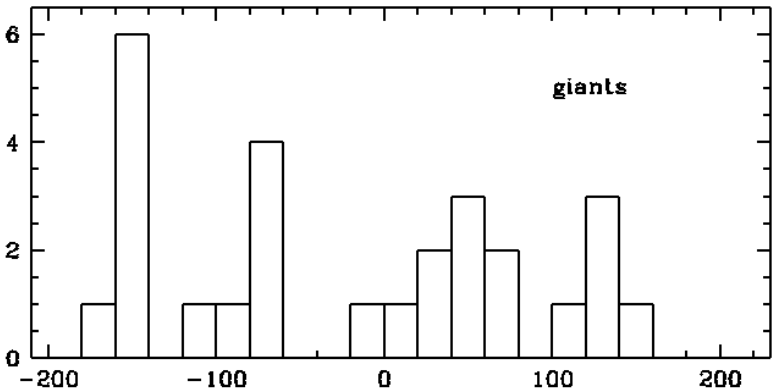
Velocity distributions





Red: giants

Black: foreground dwarfs



For example:

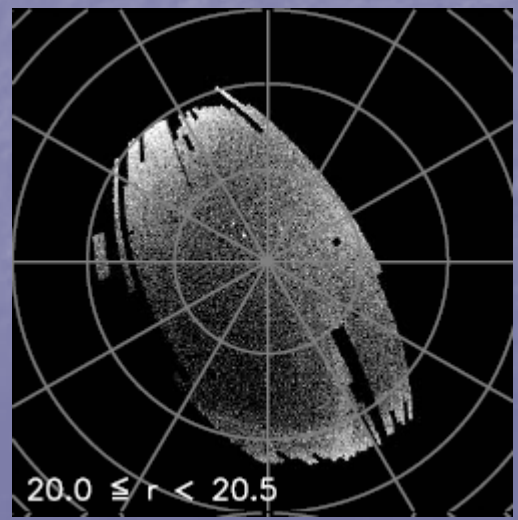
Two NGP fields with high giant success rate

Giants have distances of ~15 kpc

Virgo overdensity?

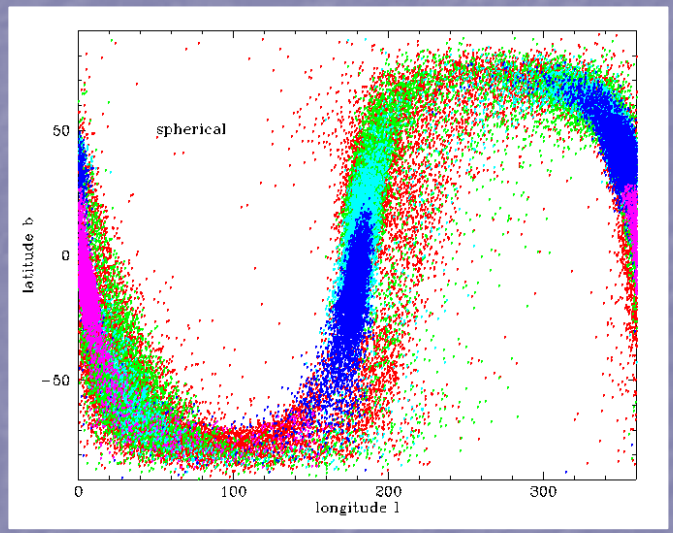
Similar velocity substructure seen at NGP by Kinman et al 2007, Newberg/Yanny 2006, Vivas et al (this meeting)

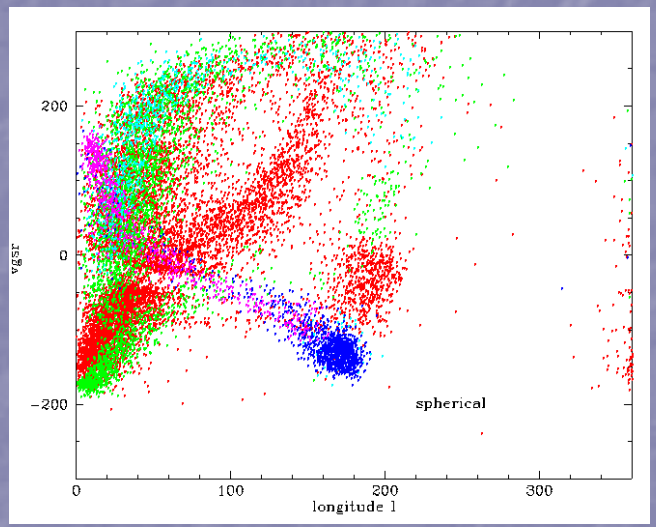
Unlikely to be Sgr tails



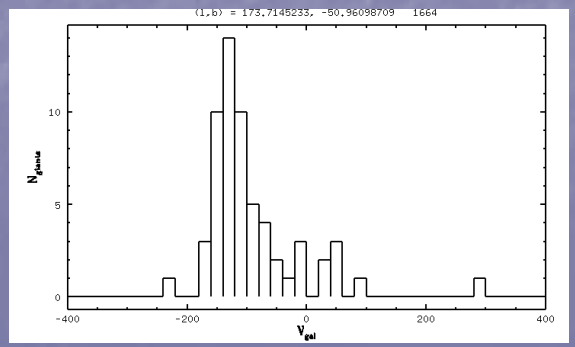
Bell et al 2007

Could we remove Sgr please?

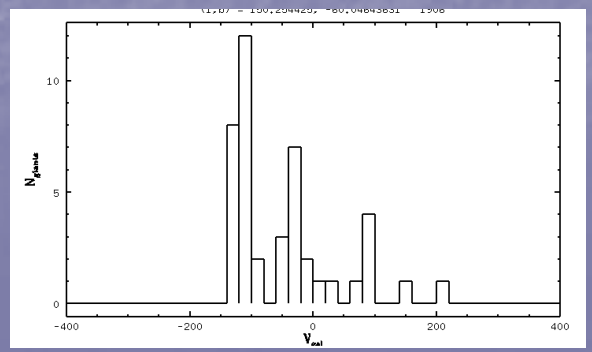




Law et al 2005



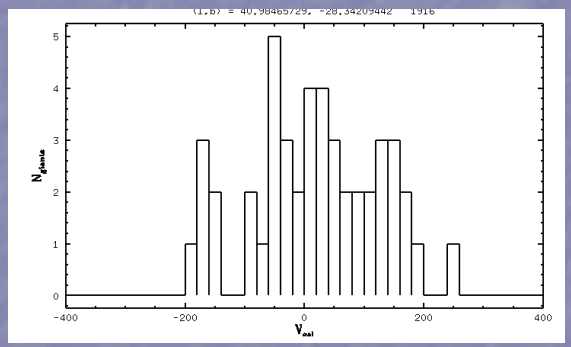
At least 12 separate plates contain Sgr debris in the South

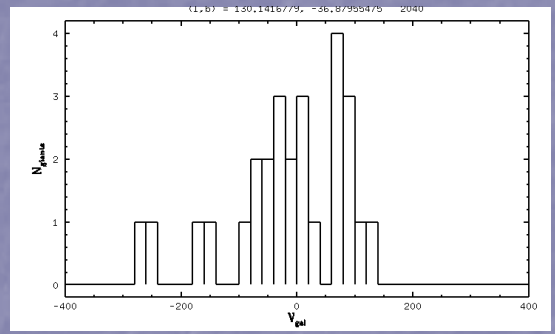


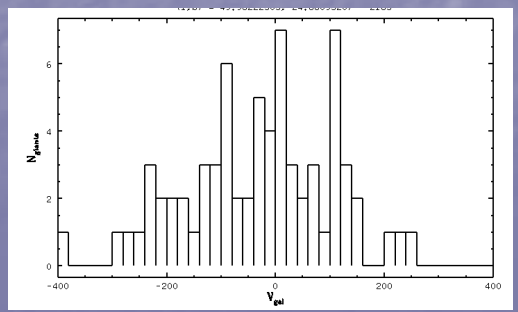
Star streams: icing or cake?

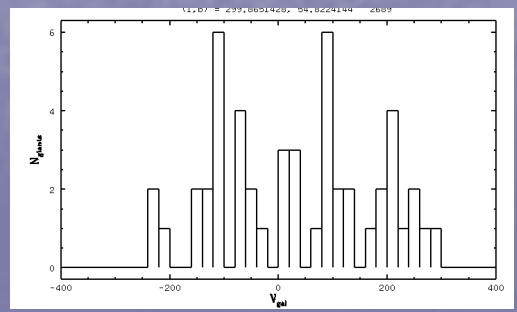
Icing: there are some smooth velocity fields

Cake: there are about the same number of fields with clear velocity substructure









Summary

- K giants with distances of 15-40 kpc show roughly equal numbers with velocity substructure and with well mixed distributions: the halo has many streams (cf de Jong, Vivas talks)

- Prospects for a more distant “field of streams” using K giants look good