Halo Tidal Star Streams with DECAM

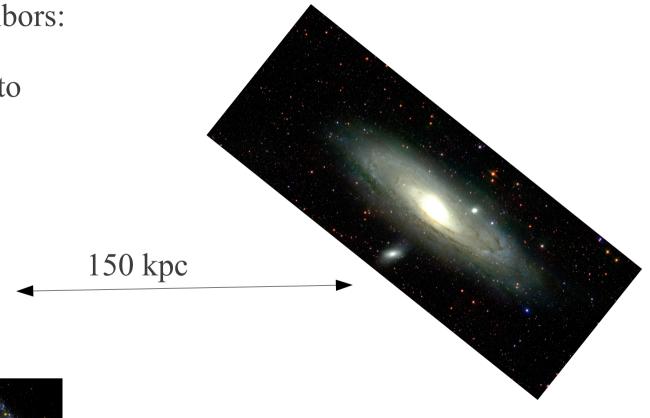
Brian Yanny Fermilab

DECam Community Workshop NOAO Tucson Aug 19 2011

M31 (Andromeda)

Our Local Group neighbors:

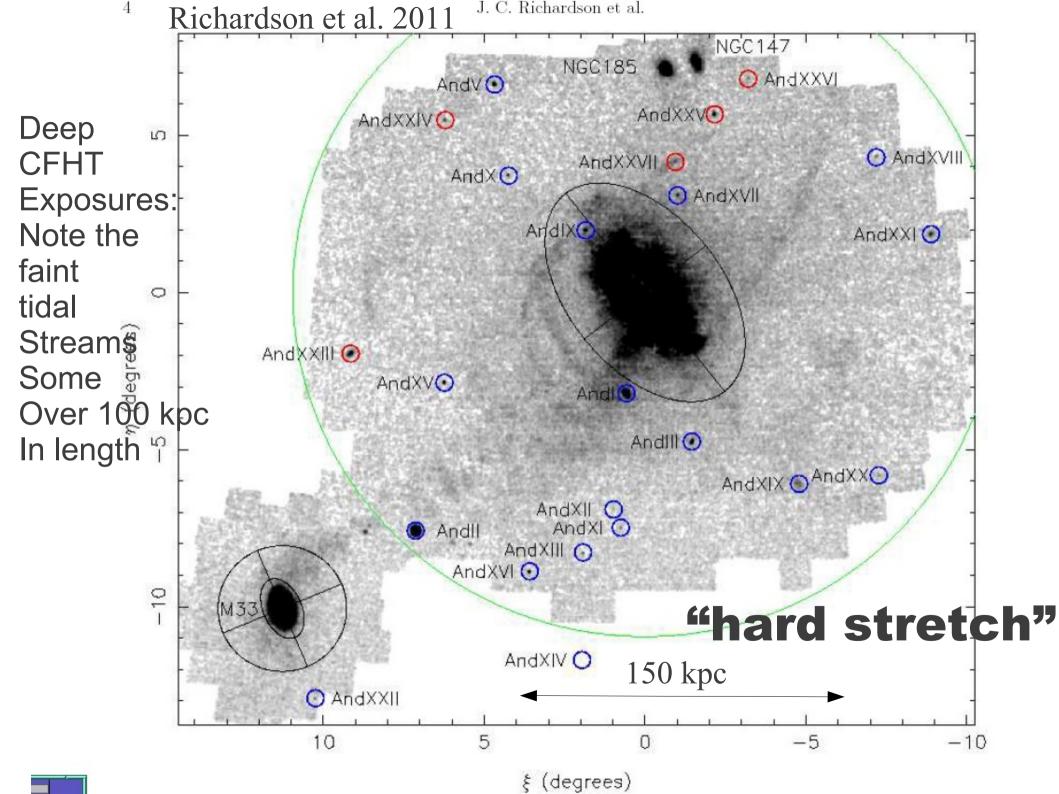
Spiral galaxies similar to The Milky Way





M33 (Triangulum)

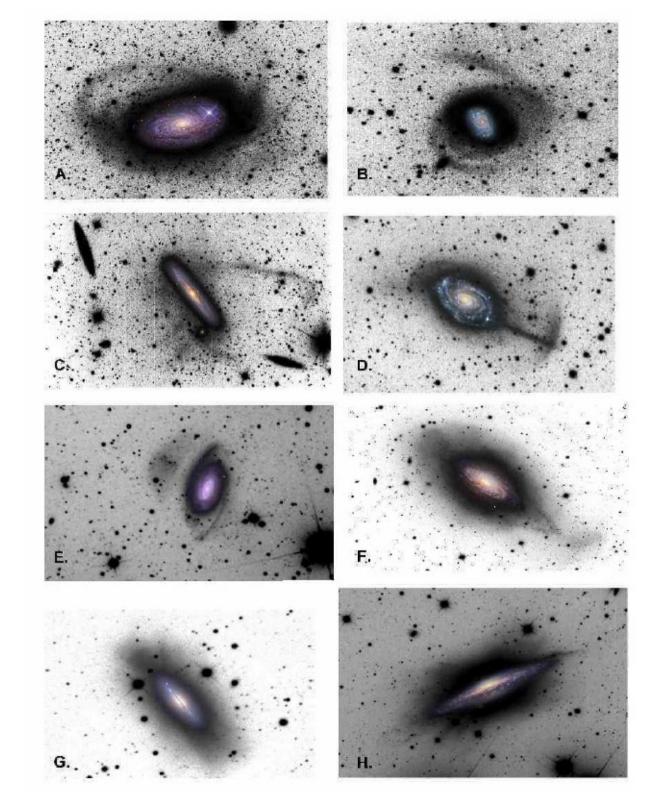
"Soft Stretch..."



Martinez-Delgado et al. 2010 has now found tidal streams around A large number of spiral galaxies.

If we look in our own neighborhood we also see these streams.

The halo of the Milky Way is a special place to view these streams, since kinematic information is also possible. (radial velocities and proper motions



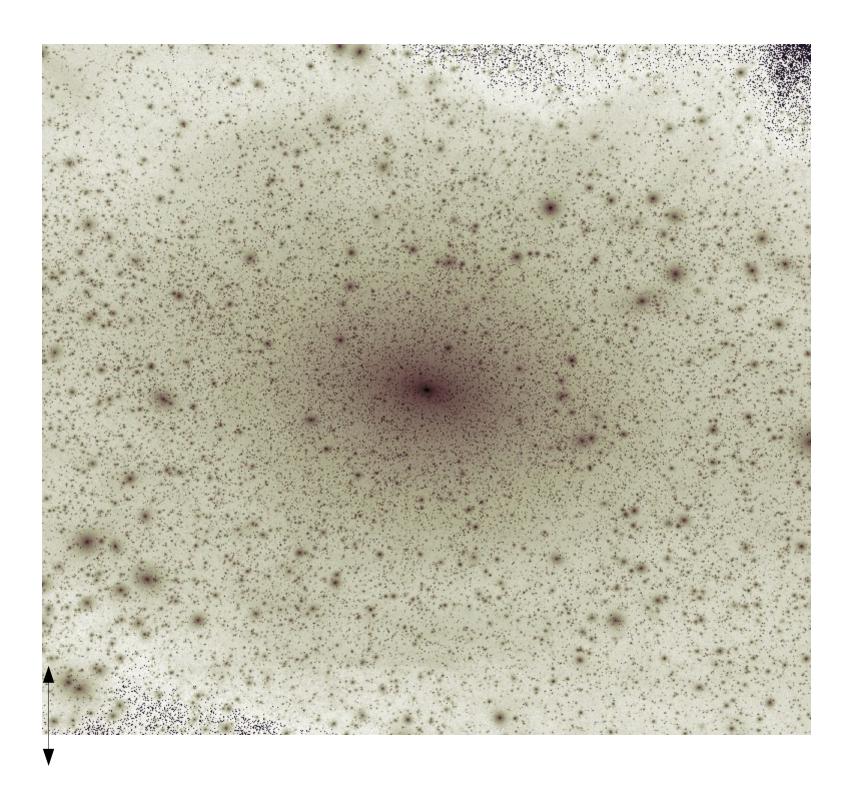
Ultimate science goals of a deep halo stream search:

(The full program will require kinematic information beyond DES [LSST, Gaia, spectroscopic followup])

Map the gravitational potential of the outer galaxy and halo:

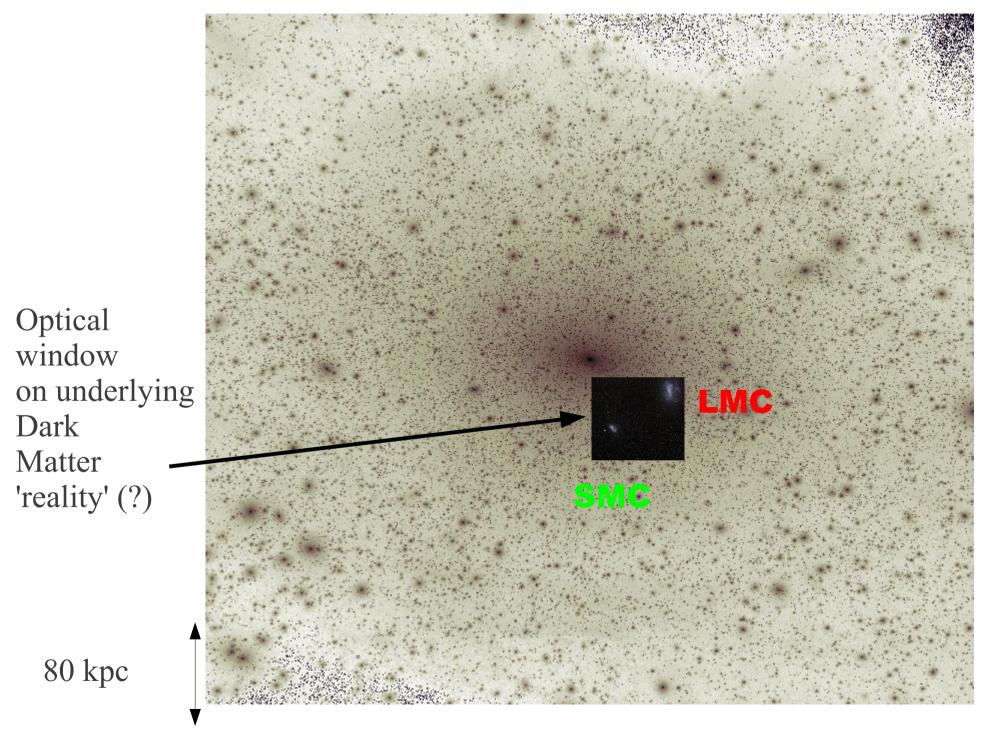
- Shape (flattened, triaxial, spherical, lumps?)
- Extent (total mass of Galaxy + Dark Matter to r ~ 100 kpc)
- Profile (falls off as r^-2 or r^?, radius dependent?)

Via
Lactea
DARK
MATTER
halo lump
Simulation



80 kpc

We observe the stars, which orbit within the overall Gravitational Potential

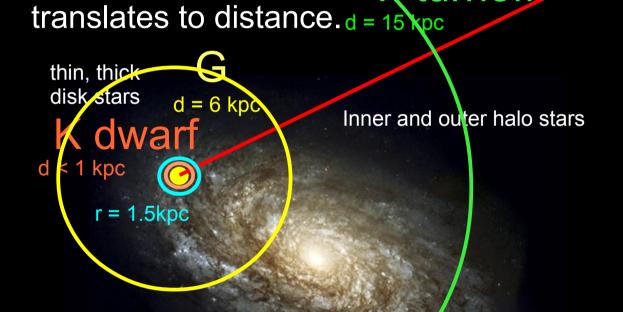


DES will go out to d > 100 kpc using turnoff, BHB and K/M giant 'standard candle' tracers (all stars of the same color/temperature BHB\A have roughly the same absolute d = 35 kpc brightness). Thus apparent brightness

E turnoff

K giant

Streams and outer halo stars



o kpc

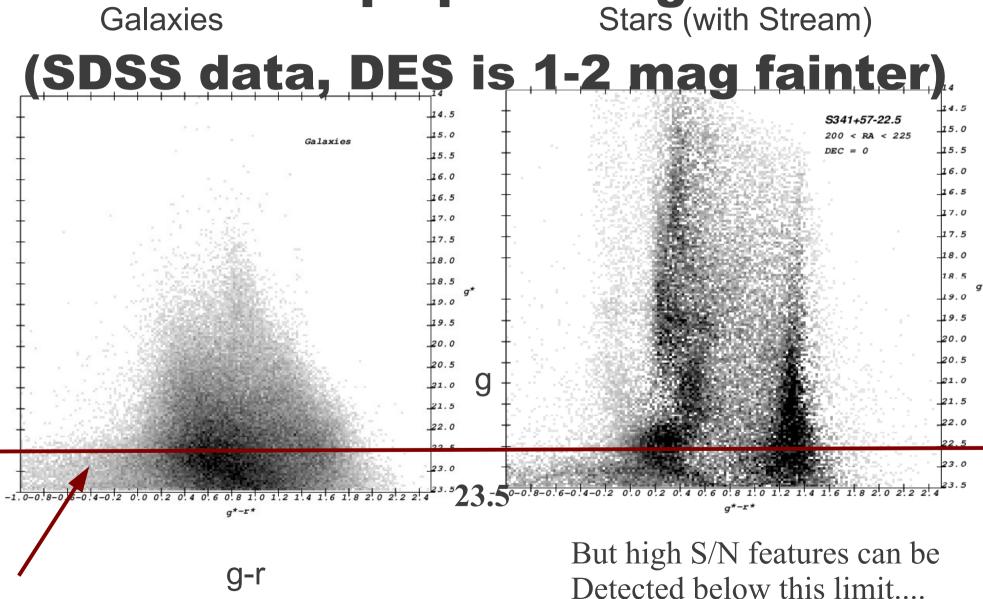
Basic Method

Two difficulties:

- 1. Star-Galaxy separation breaks down at faint magnitudes (r ~22.5)
- 2. No u-band filter (initially), reduces ability to break stellar-type degeneracies:
 - A. BHBs vs. Blue Straggler/A main seq.
 - B. F turnoff vs. QSO
 - C. M-dwarf vs. M-giant

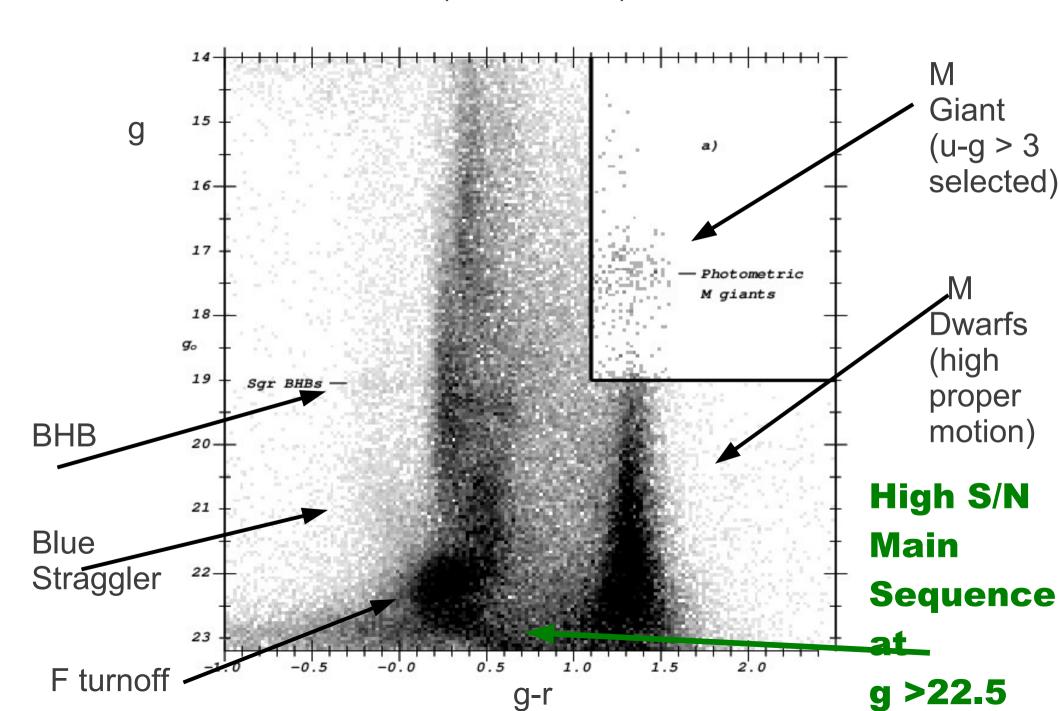
[Opportunity to study red color cuts for spectral type separation]

Multi-color selection can help split star/gals



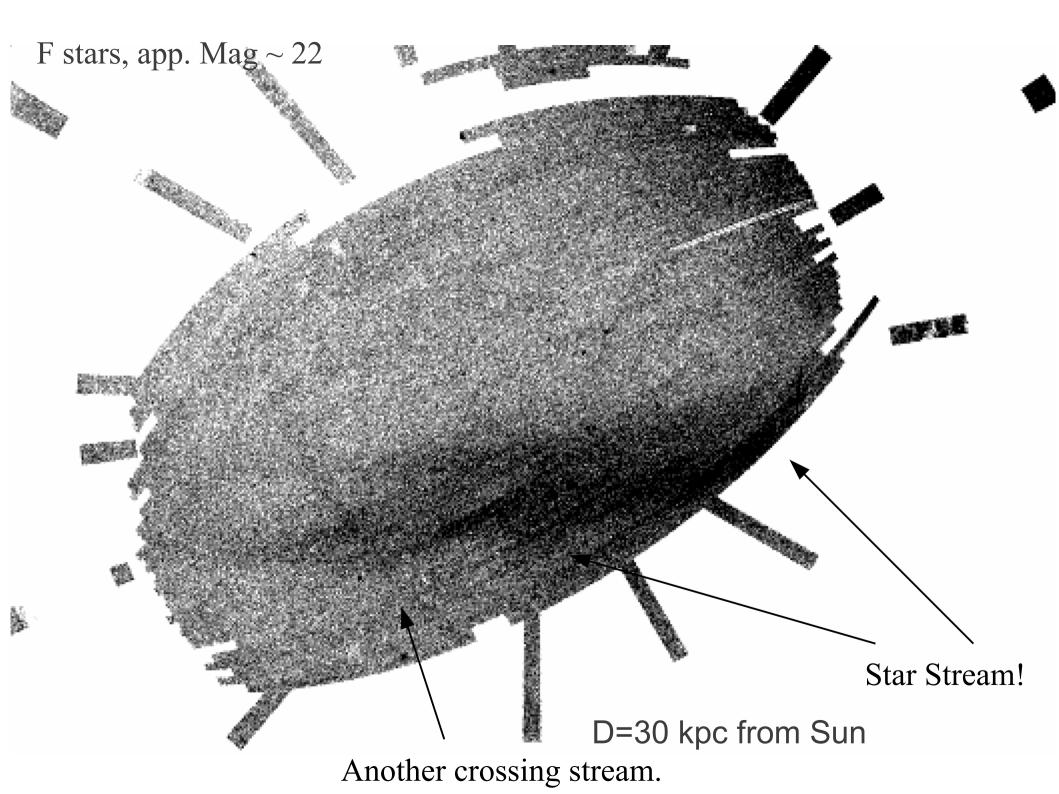
g~22.5 rough limit of practical star/gal sep.

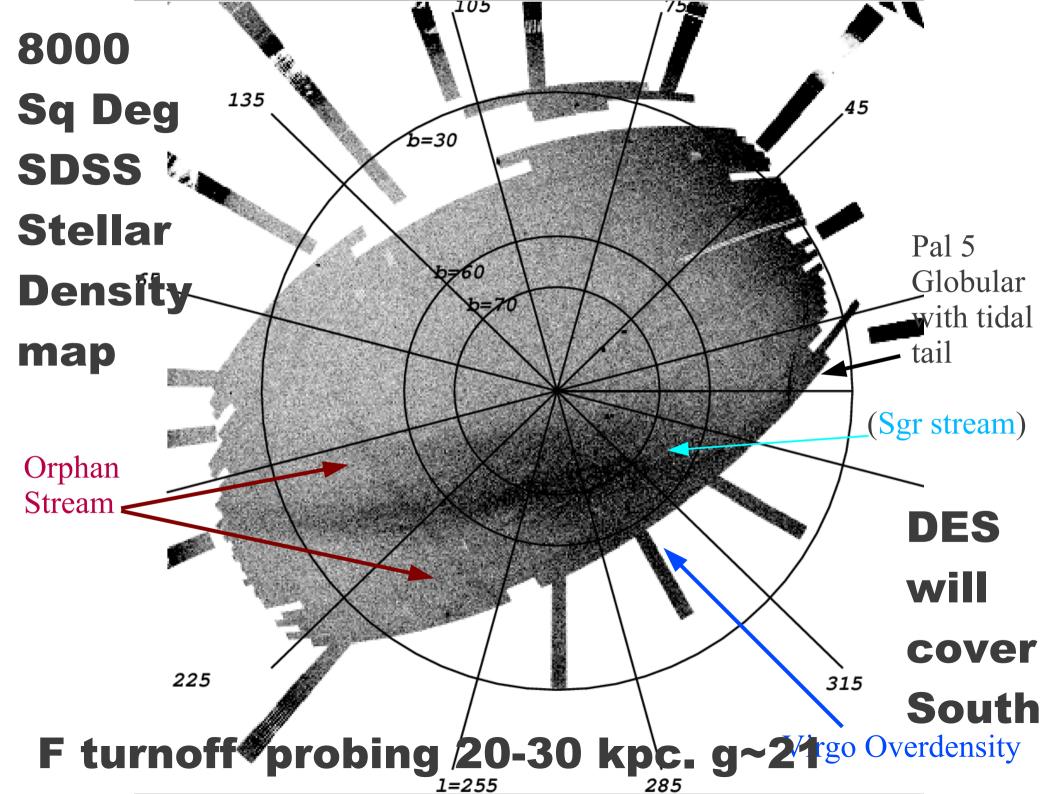
Stars (with Stream)



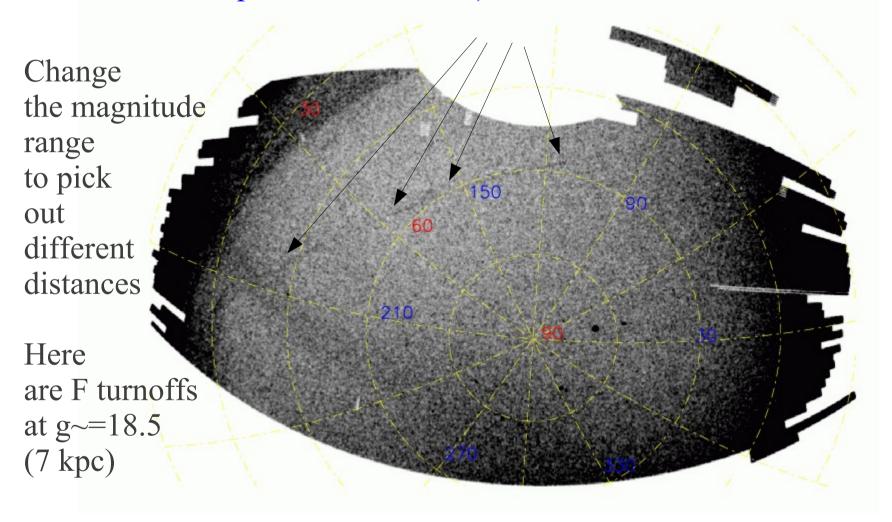
Two qualities that will improve stream-finding:

- 1. Large area, faint, uniform star density maps (matched filter techniques of Rockosi et al 2002, Odenkirchen et al 2001, Grillmair 2006) help isolate stellar streams as long, narrow objects against background.
- 2. Proper motions will be available
 - A. against UCAC catalog to r~20 (3 mas/yr)
 - B. internally after 5-years (~10 mas/yr)
 - Can help distinguish dwarfs/giants, qsos/foreground, halo vs. disk members.



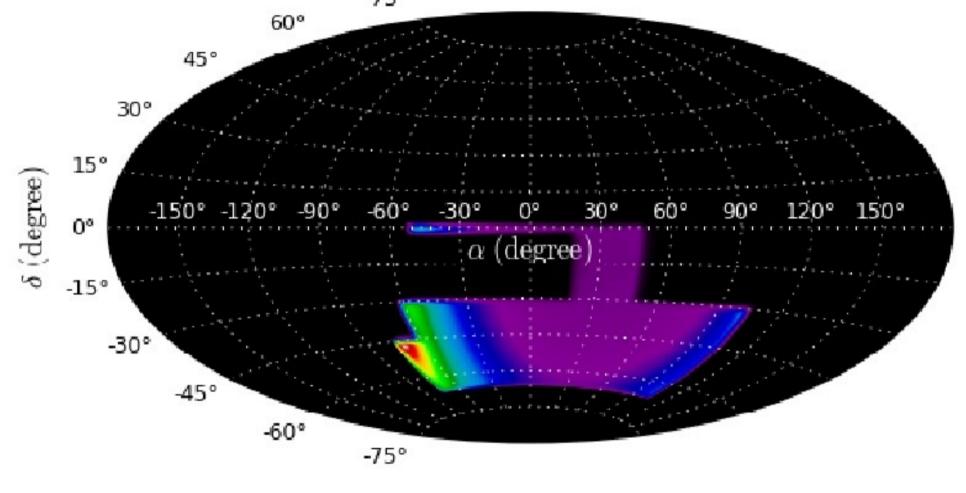


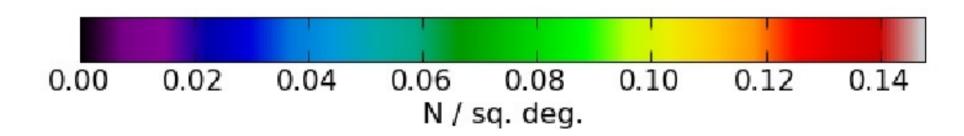
We geometrically distort the sky so that the stars in the stream lie along a straight line (easier to pick them out then).



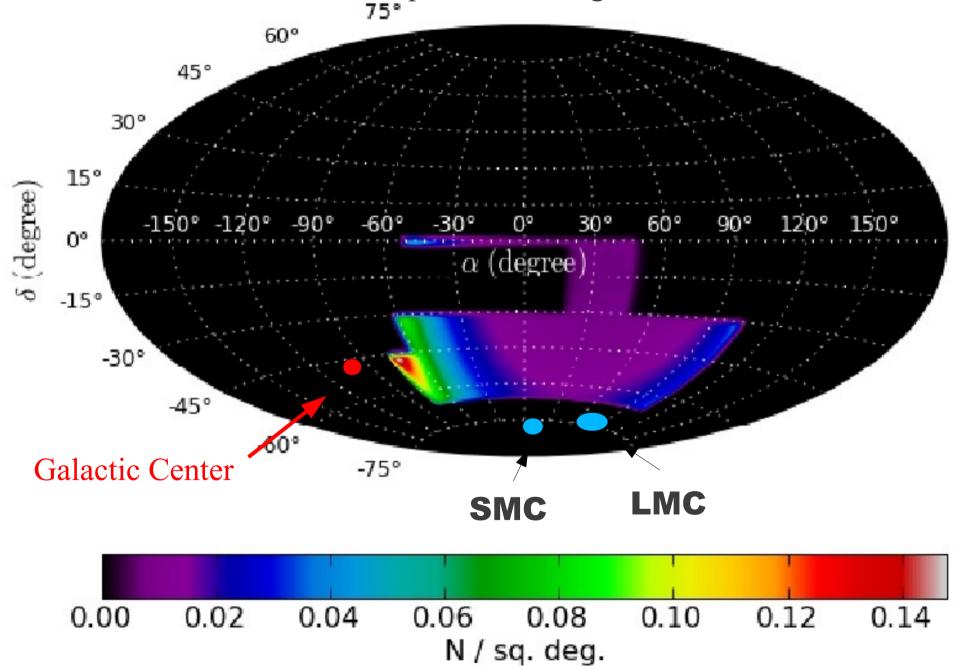
Yields another faint stream: "GD-1", about 7 kpc distance from the sun, very faint...

DES footprint (Equatorial Coordinates) with A star density Rossetto, B. et al. 2011 AJ 141, 185: "Stellar science with DES"





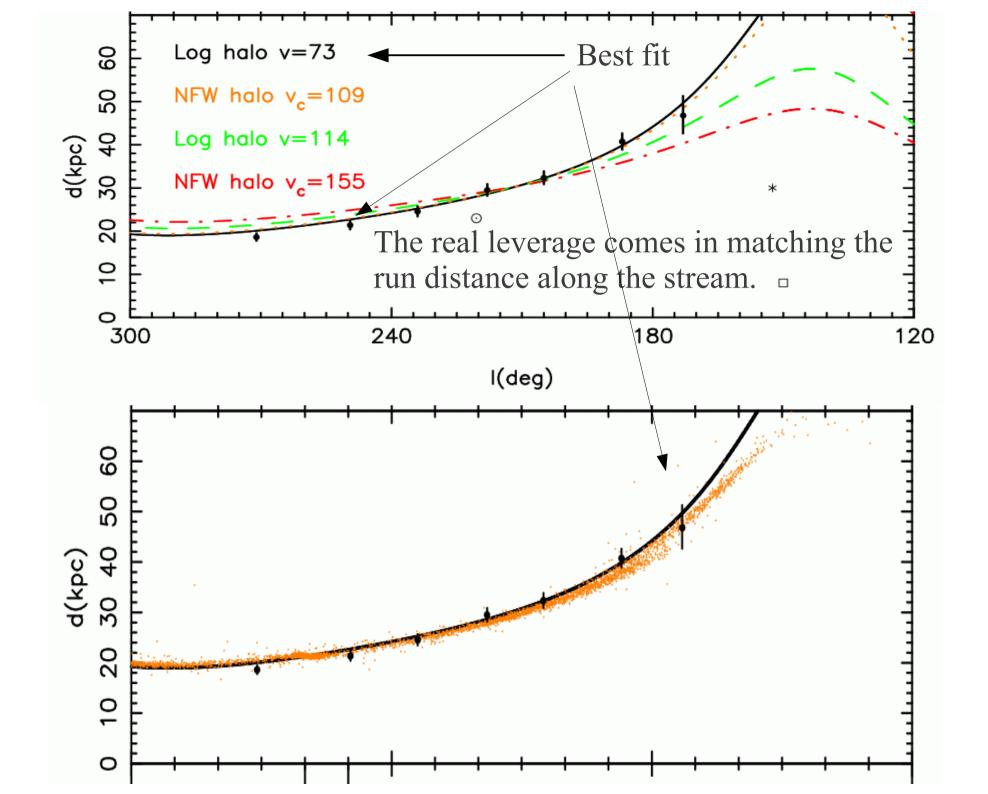
Many opportunities for Community Pipeline Proposals Outside the DES footprint, including LMC/SMC!



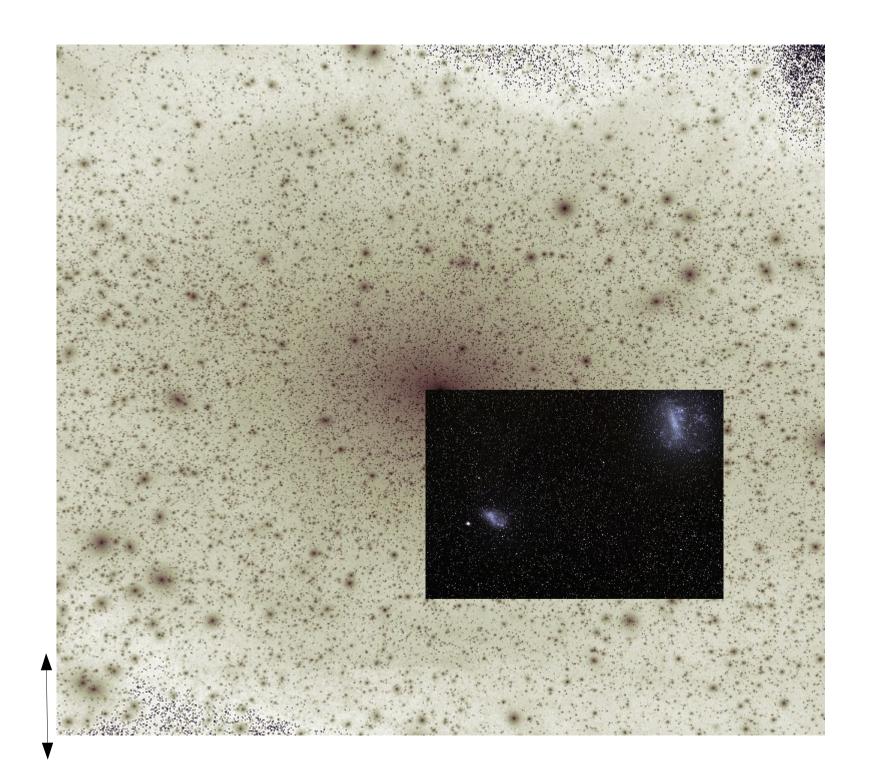
Summary:

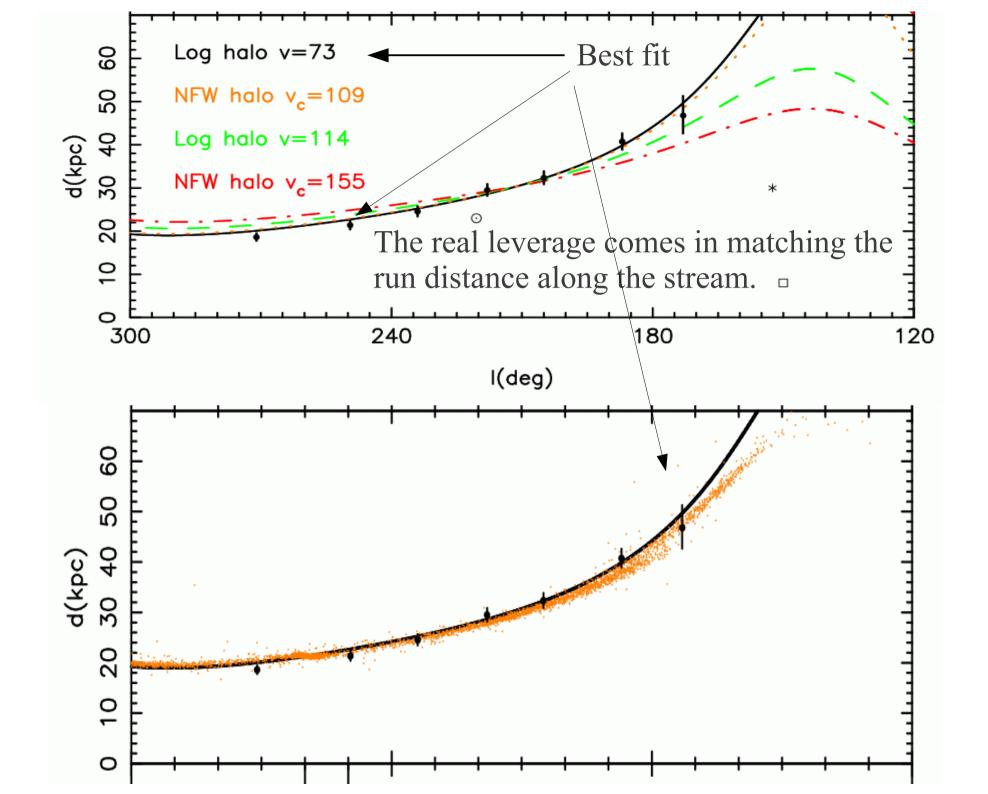
Many interesting Galactic Structure and Dynamics projects possible with DECam.

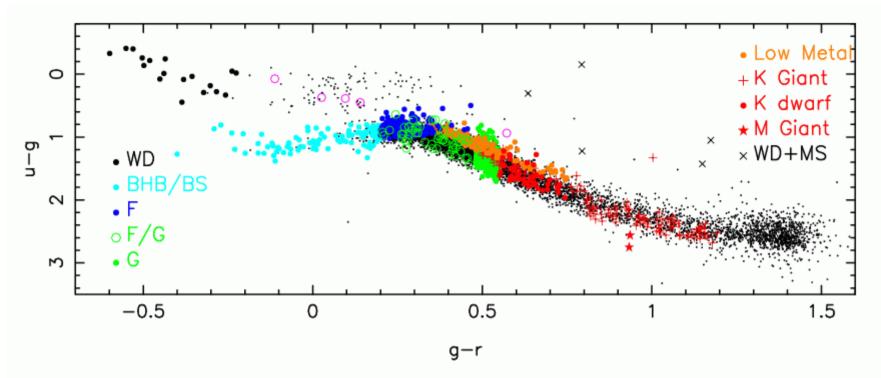
We encourage DECam Community Proposals and look forward to working with many!



Tracer star orbits within a 'log r' potential have a characteristic 'trefoil' shape: (Toto, we're not in Kepler's Solar system any more) Fellhauer et al. Internal dispersion within a tidal dwarf 60 stream gives the orbit 'thickness', and it deviates from the central thin orbit track. 40 20 -20D > 20 kpc-40-6020 40 80 160 140 -2060 220 200 -60X [kpc] RA [deg]







SEGUE Target Selection (color,color)

