The Chemical Evolution of Milky Way Satellite Galaxies
from Keck/DEIMOS Multi-Element Abundance Measurements

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Abstract. A Keck/DEIMOS spectroscopic campaign of eight Milky Way (MW) dwarf spheroidal (dSph) satellite galaxies has generated spectral synthesis-based abundance measurements for nearly 3000 stars. The elements measured are Fe and the α elements Mg, Si, Ca, and Ti. The dSph metallicity distributions show that the histories of the less luminous dSphs were marked by massive amounts of gas loss. The [α/Fe] distributions indicate that the early star formation histories of most dSphs were very similar and that Type Ia supernova ejecta contributed to the abundances of all but the most metal-poor ([Fe/H] < −2.5) stars. Finally, a numerical chemical evolution model reveals that the star formation history of a dSph is a strong function of its present-day luminosity, but not velocity dispersion, half-light radius, or Galactocentric distance.

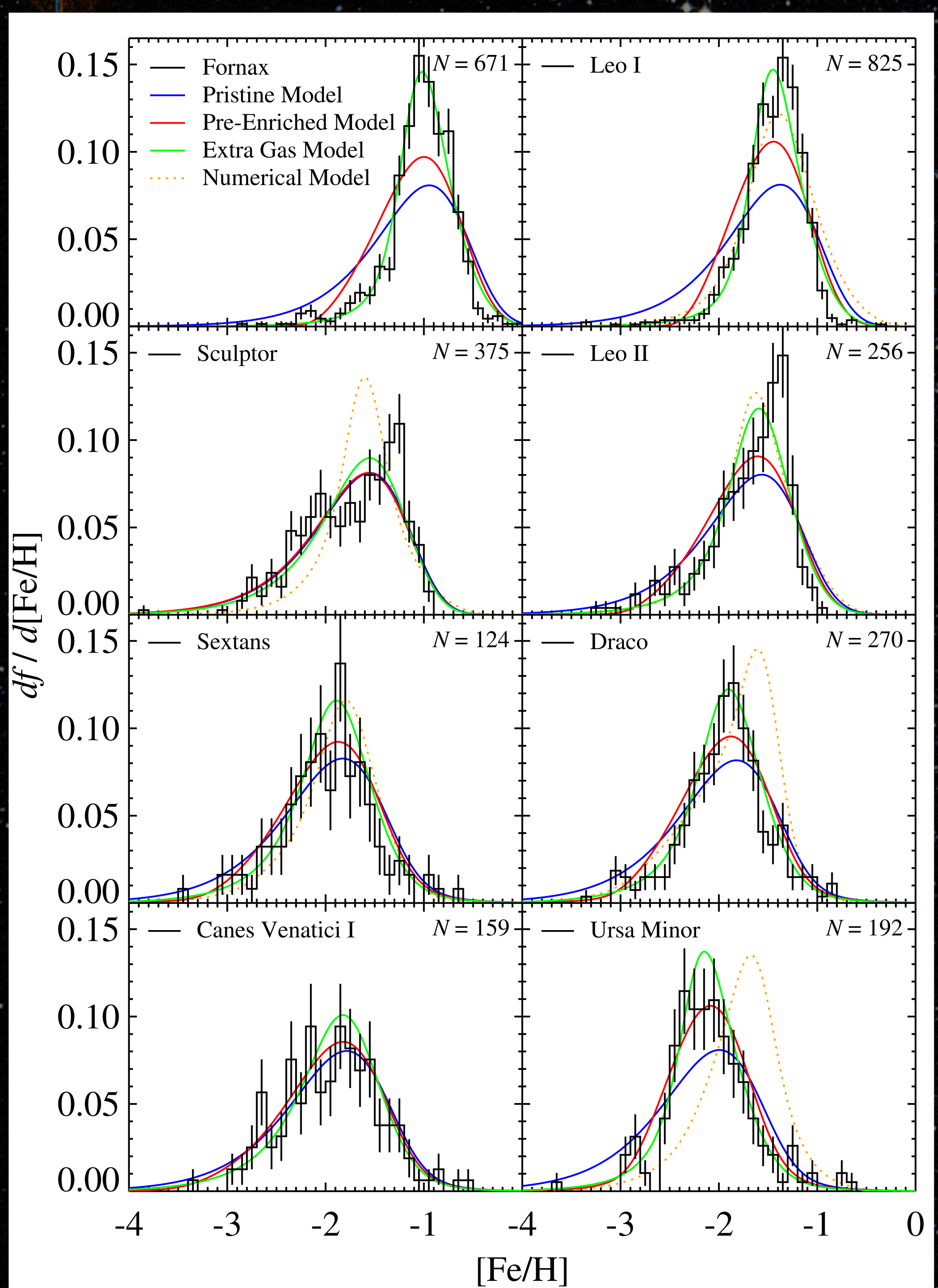

Figure 1. Metallicity distributions of MW dSphs, ordered from most to least luminous. As dSph luminosity decreases, the average [Fe/H] also decreases, a sign that the less luminous dSphs lost a great deal of gas during their star formation lifetimes. Furthermore, the more luminous dSphs fit an analytic chemical evolution model with gas infall better than the less luminous dSphs. The metallicity distributions of the less luminous dSphs are less peaked, more symmetric, and better matched to a leaky box model.

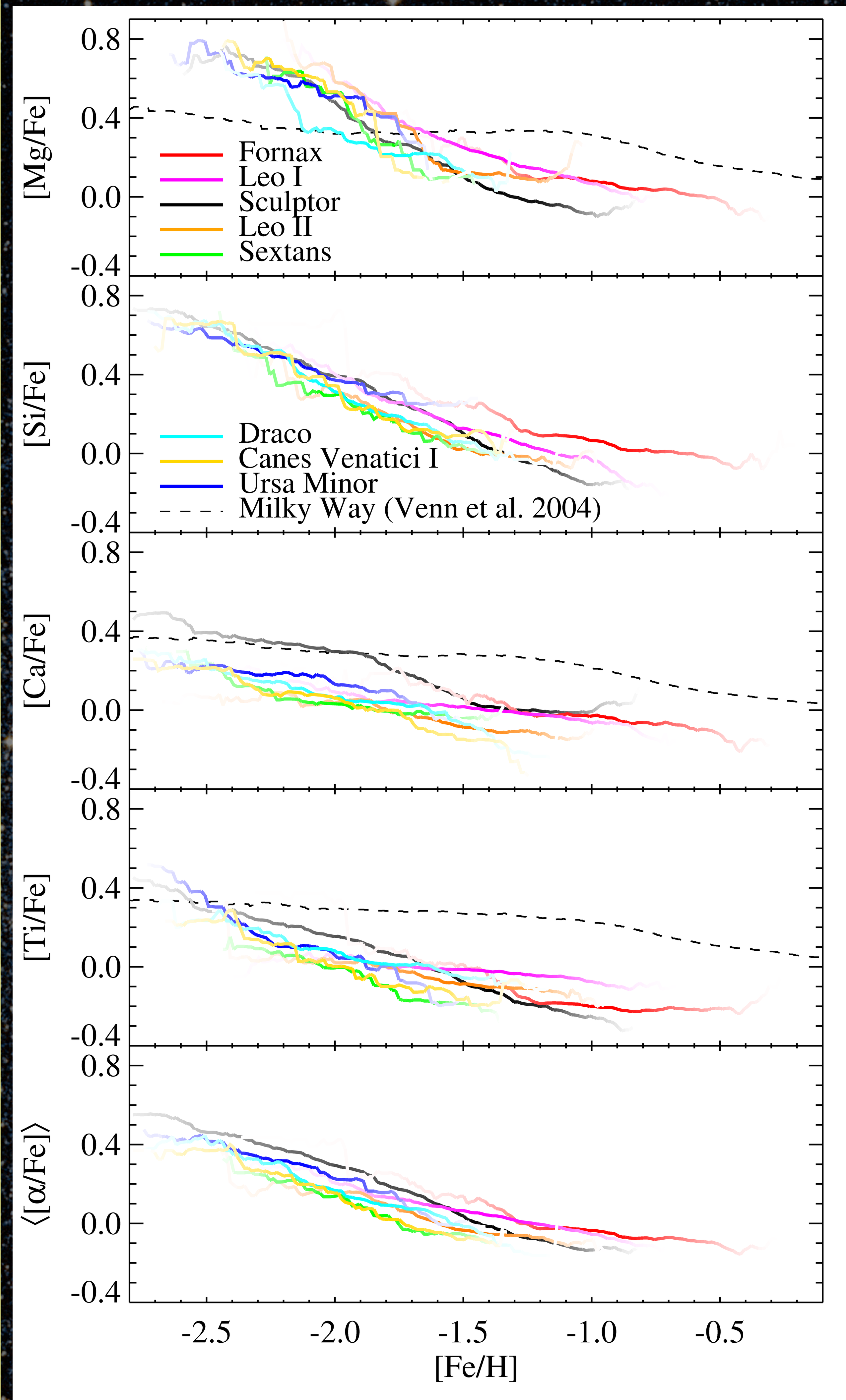

Figure 2. Moving averages of the [α/Fe] ratios in MW dSphs. The figure legend lists the dSphs in order of decreasing luminosity. At [Fe/H] < −1.2, the [α/Fe] ratios follow nearly the same path in all dSphs, suggesting similar star formation histories at early times. Furthermore, with few exceptions, there are no [α/Fe] plateaus at [Fe/H] > −2.5, which indicates that Type Ia supernova ejecta contributed to all but the most metal-poor stars.

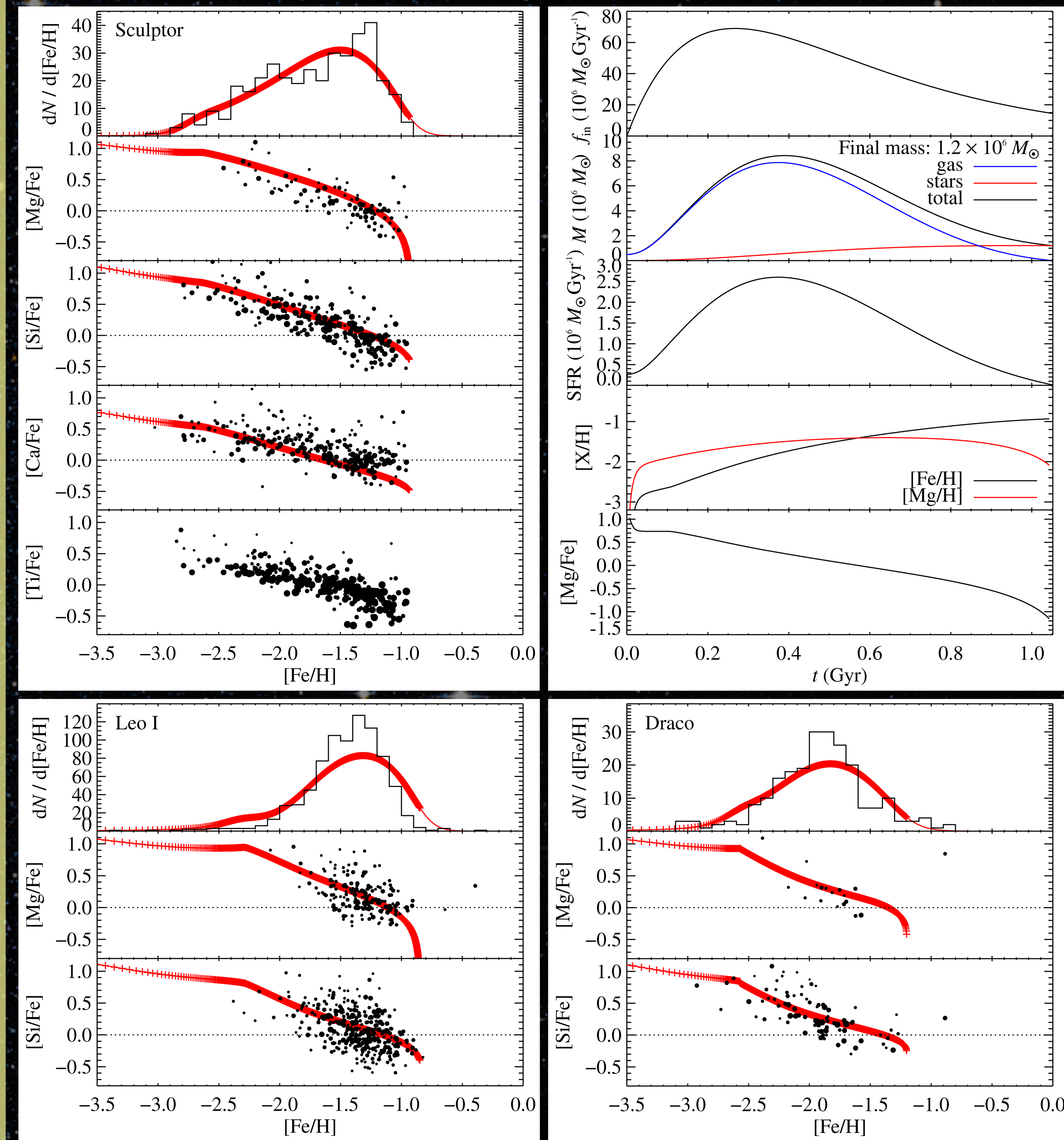

Figure 3. *Top left*: Observed abundance distributions for the Sculptor dSph (*black*) with a best-fit chemical evolution model (*red*) that tracks the star formation rate, Types II and Ia supernova element production, and supernova feedback. *Top right:* Gas infall rate, mass, star formation rate, metallicity, and [Mg/Fe] as a function of time in the model. *Bottom:* Observed and modeled abundance distributions for the more luminous dSph Leo I and the fainter dSph Draco.

Additional reading:

Kirby et al. 2010, ApJS, 191, 352, arXiv:1011.4516
Kirby et al. 2011, ApJ, 727, 78, arXiv:1011.4937
Kirby et al. 2011, ApJ, 727, 79, arXiv:1011.5221

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Background image of the Fornax dSph: European Southern Observatory/Digitized Sky Survey 2