Anderson and Bregman

Pulsar Dispersion Measure (DM)

- integral of ne along the line of sight
- galaxy disk has a WIM of 47cm^-3pc for an exponential disk model (eg Gaensler)
    - several pulsars in the direction of LMC have DM of <47
    - others ~70cm^-3pc leaving ~23cm-3pc
        - probably the LMC is responsible for much of this, but conservatively include all.
        - 5e-4cm^-3 uniformly distributed would contain 8e11 - more than all of the missing baryons
        - but assume NFW conc=12 and get 1.2e10 == 4% of missing baryons
            - or take inner truncation radius of 10kpc (conservative) and get 5%

ne_DM(50kpc)<1e-4
ne_MS(45kpc)<9e-5
ne_HVC(50kpc)=3-6e-5
ne_RP(>100kpc)>1.5e-5

Magellanic Stream's clumps confined?
--balance internal pressure with gas pressure of hot halo (... how long would they take to disrupt anyway? Are they in equilibrium?)
----clumps confined by gas pressure neglecting turbulent/magnetic pressure so upper limit(?): ~same result
HVCs
--T and rho of ionized metals to infer gas pressure... highly uncertain, but consistent
Emission Measure:
--Decompose soft X-ray BG into components and unidentified stuff is hot halo
-- at most 3% of the missing baryons
Ram Pressure Stripping:
-- ne**>**2.5e-5 in the local group ... hot halo is denser than local group so

Summary: MW gas obeys NFW and contains severalx1e9 Msun extending to 50kpc, but equals IGM density at 80kpc
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OVII along QSOs
--FANG 20 AGN sightlines shows groups cannot contain missing baryons extending to large distances, must be in L* halos (?)
--derive upper limit <70% missing baryons at 3sigma from AGN lines (subject to Z and f(OVII) assumptions, but reasonable values chosen)
XRAYS
--measure xray surface brightness instead
--figure 1 shows detection prediction for NFW profile -- detection should be possible out to several times the disk scale length, but detections are limited to the area around the disk such that there is an upper limit on the mass of 10-25% of the missing baryons.
--profile does not drop as steeply as NFW -- beta model ... take a much flatter beta model (same as flattest early times) as a lower limit

- <u>No AGN/SF feedback?</u>
- So something must be keeping baryons out of galaxies?
- AGN correlates with bulge stellar mass
- SNe correlate with stellar mass
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- BUT baryon fractions **only** depend on circular velocity (total mass).
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- Residuals of baryon fraction (baryonic tully-fisher) show no trend as a function of galaxy type.
- -- could detect trend of 20% or larger...AGN activity can remove <20% of observed baryons (which make up 5-30%) or 1-5% of universal baryons
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- residuals of baryon fraction (baryonic tully-fisher) for gas rich disks show no trend as a function of stellar mass fraction.
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- <u>A flatter halo?</u>

a flatter halo doesn't change OVII constraint <70%, loosens pulsar dispersion measure to <58%, doesn't change HVC/MC constraints <15%, still expect to see xray emission beyond the disk and don't

- <u>Relation to Other Work (cluster enrichment?)</u>

READ
Fang 2006 (AGN sightlines)
Blitz+Robishaw 2000 (Ram Pressure)

Rasmussen 2009 -- X-ray
Crain 2010 -- simulations

Yao 2010: R>100Kpc, line absorption (http://adsabs.harvard.edu/abs/2010ApJ...716.1514Y)
These results thus indicate that the bulk of the CGM is unlikely to reside in a chemically enriched warm-hot phase (at temperatures ranging from 10^5.5 to 10^6.3 K) where our X-ray absorption line spectroscopy is sensitive.

...While in this work the intervening galaxies are located at projected impact distances of 100–500 kpc along the selected sight lines (e.g., Figure 1), the “associated” Lyα and O vi absorbers have also been detected at similar distances around galaxies (e.g., Stocke et al. 2006; Wakker & Savage 2009). The gas traced by O vi absorbers (T   10^5.3 –10^5.7 K, if collisionally ionized) can account for up to 10% of the baryon mass associated with individual dark matter halos in the present universe (Tripp & Savage 2000; Danforth & Shull 2008; Wakker & Savage 2009). But recent work indicates that a large fraction of the O vi absorbers could be due to photoionization of cool gas clouds (e.g., Tripp et al. 2008). Therefore, for a remaining component to account for the missing baryons, its temperatures must be too high (e.g., 106.3 K) and/or its metal abundance is too low (< 0.1 A) to avoid the detection in X-ray absorption lines.