1. Introduction
   1. Clusters are filled with hot ionized gas that can be studied by:
      1. X-ray emissions
      2. Thermal Sunyaev-Zel’dovich (SZ) effect
   2. Thermal SZ effect
      1. Generated by scattering of CMB photons off of ICM of clusters
      2. SZ’s magnitude is proportional to the Compton parameter, *y.*
         1. *y* =a measure of the gas pressure integrated along the line of sight
            1. y =
            2. is the Thomson cross section
            3. is the speed of light
            4. is the electron rest mass
            5. (the product of the electron number density and temperature.
         2. The total SZ signal is proportional to the integrated Compton parameter (YSZ) 🡨 this is the integrated Compton parameter

is the angular distance to the system, or the portionality constant in this form

Since is directly portional to the pressure of the cluster, P and P is directly related to the depth of the gravitational potential and the gravitational potential is directly related to cluster mass, is expected to be closely related to cluster mass.

* + - 1. Thus scales to the mass well regardless of gas physics with low scatter in general, however the normalization of the relation is dependent on the gas physics
      2. So determining P is very important since it determines normalization of the SZ effect and the exact among of scatter
      3. A pressure profile is also needed to use the new X-ray sister to the SZ, called YX

1. The REXCESS data set
   1. Classified in three groups
      1. Morphologically disturbed
      2. Cool core systems
      3. Both
   2. Gas density profiles were derived by Croston (2008)
   3. Masses are determined by the M500 to Y\_x relations
2. Scaled Pressure profiles
   1. Scaled Profiles
      1. P500 is defined, it is the value that the pressure is being normalized to
         1. P500 is the characteristic pressure and it is defined as function of M500 as well as h(z) and h70
      2. p(x) denotes the scaled pressure profiles where x\*R500 = r
      3. Cool core clusters, because of their peaked emission allow for their profiles to be measured deeper into the core than for disturbed clusters with more diffuse emissions.
   2. Average Scaled pressure profile
      1. At each x (or r depending on how you see it) value they took the pressure from each cluster and averaged them.
         1. So say cluster A has pressure= a at x, cluster B has pressure= b and so on the averaged scaled pressure profile has a value of pressure = a+b/2 at x
   3. Dispersion, Radial structure and dynamical state
      1. The pressure profiles are more regular and present less dispersion in the core than the density profiles
      2. Cool core clusters have peaked density profiles and a temperature drop towards the center
      3. Unrelaxed objects have flatter density cores and constant or increasing temperature towards the center
   4. Dependence on mass and mass-proxy relation
      1. M500 was derived from the M500 -YX relation, so M500 depends on the gas density and temperature: as a result:
         1. R500 , since it is defined via M500, is dependent on the gas density and temperature
         2. P500 , since it is defined via M500, is dependent on the gas density and temperature
         3. p(x) , since it is defined via M500, is dependent on the gas density and temperature
            1. p(x) Approximated from eq (6) in paper
            2. The first term as well as one omitted for time, depends on the gas structure within R500. They are responsible for the average “shape” of the scaled profile.
            3. The second term above depends on the global cluster scaling properties between Yx and M500 and determine the normalization of the average scaled profiles
         4. The effect of using the M500 -YX relation is greatest near the core and least as one moves outward
         5. Additionally, using the M500 -YX relation the M500 are likely to be underestimated and thus the normalization of the average scaled profile will be biased high.
      2. How is the scaled pressure profile effected by the mass
         1. Since P500 is defined in terms of M500, any deviated from the “self-similar” scaling will appear as a variation in M500.
         2. Thus the normalization of the scaled pressure profiles should increase slightly with mass, parameterized by αP <-- which by the way is a function of the non-standard slope of the M500 -YX relation in the event of a deviation from the self-similar scaling.
         3. αP corresponds to a modification of the standard self-similarity (a steeper mass dependence of the profile)
         4. In fact we can relate the scaled pressure profile to the average scaled pressure profile times a function of M500 and h70 raised to αP.
         5. However in general it appears to be the case that the scaled pressure is not altered considerably with changes in M500
3. The universal pressure profile
   1. So up this is point the Arnaud paper has used data from specific clusters to create a scaled pressure profile as well as an average scaled pressure profile, now he wants to look at what the generalized model is and if it fits with what was found with his specific clusters
   2. So the universal average pressure profile is given as a function of three parameters and x
   3. Also he defines a profile which is a combination of his p(x) of his actual clusters in the radial range [0.03-1] R500 and the generalized model of p based on the 3 parameters in the [1-4]R500 radial range.
4. Integrated Compton parameter scaling relations
5. Questions
   1. What exactly is meant by the integrated Compton parameter YSZ
   2. What is the difference between the scaled pressure profiles and the average scaled pressure profiles?
   3. Are these pressure profiles all projections into a 2-D plane?
   4. Why is resolution of the pressure profile near the center of the cluster hard to determine?