Ongoing

Tasks

- maybe observations of bursty dwarfs were tidally affected? take the red dwarfs and look at Halpha to resolve Haines/Wang small disagreement (10% vs 0%).
-
  - RaP
    - Young stars compared to radiation field.
      - Smooth on cell scale?
    - Why do Nick's runs hit CFL?
      - tracer particles inserted when young stars are born? How fast are winds being launched?
    - Modify Nick's stuff to Andrey's parametrization
  - galaxies forming a significant mass at higher z are ALL ellipticals.
  - ->the mass in ellipticals has to at least equal the integral of the mass function at z=2...
  - fun
    - fix werk points
    -
    - remedy hod/direct observations differences (Group mass centrals v. satellites and high stellar mass fraction)
    -
    - is FIR/Halpha constant with SFR? Or does it also evolve with z,M*?
    -
    - Answer by calculating expected extinction for galaxies at higher z, multiplying that by the "SFR distribution function", and comparing to the SFR density in UV/FIR.
    -
    - Weisz (http://adsabs.harvard.edu/abs/2011arXiv1101.1301W Fig. 4) gives dIrr, dtrans, dsph counts and density ("density" parameter http://adsabs.harvard.edu/abs/2004AJ....127.2031K).
    - dIrr -> dTrans -> dSph -> ? stripped/dead.
    -
    - build a model for the dust life cycle
    -
    - take a (KS relation+gas density) + tau_ir + clumping factor + (stellar density = surface density -gas density)
    - == eddington pressue in the disk... how big can you smooth an still drive outflows?
    -
    - > how many peaks collapse from the baryon power spectrum when "galaxies"
    - > are displaced.
    - >
    - > spawning star particles that deposit energy (or advection field deposits energy? nah).
    - >
    - > can you determine the momentum transfer from stars to dust using the
    - > intrinsic-UV to IR ratio?
    - >
    -
    -
  -
  -
  -
  -
  - analyze a halo of nick's

- ***mass profile***, zprofile
    - check what it looks like in ART itself -- is this an analysis bug or a code bug?
        - (it persists in ifrit, so at the least it's a big analysis bug).
  -
  - **displacement checks**
  -
-
- **check on tracer particles**
    - use usual tool to pick read in particles at some time and output particles of interest for tracing. Write new routine that traces particles back in time.
    - output random subset 1, N
    - { TPcharacteristic(at z_{analysis}) [x1(t), x2(t),x3(t)...other properties] }{2} {3} {4}.... N
    - 0)write code to read and analyze tracer particles...
        - need to read a lot of files and connect particles across files...
        - read files and select subset of particles to track
        - p# t x y z od temp r-halo l-halo
    - 1)test tracers by running test codes on them and see if 1D tests pass.
    - 2)test tracers by comparing advected variable set at cells containing tracers to tracer density
-
-
- upgrade analysis code units
    - alter skewers methodology
        - do actual skewers by writing find_cell and find_neighbors functions
    - alter binning of cells
        - does changing bin range affect the profile shapes?
        - as in line 1290 of gas_analysis.c
        - 416 analysis_dhr/analysis.c
            - /* assure reasonable coverage if cell is large fraction of minimum bin */
            - min_bin_volume = 4.*M_PI/3.*pow(10.,3.0*(profile->rlmin+(double)min_bin*profile->drl));
            - if (cell_volume[level] > 0.1*min_bin_volume) {
            - num_points = 10*points_per_cell*cell_volume[level]/min_bin_volume;
            - cart_assert(num_points >= points_per_cell);
            - } else {
            - num_points = points_per_cell;
            - }
            -
            - /* throw random points */
            - for (i = 0; i < num_points; i++) {
            - for (j = 0; j < nDim; j++) {
            - pos[j] = cell->pos[j] + cell_size[level]*(cart_rand()-0.5); //-.5 to +.5 cell
            - }
            -
            - r = compute_distance_periodic(halo->pos, pos);
            - bin = compute_radial_bin(r, profile->rlmin, profile->drl);
            -
            - if (bin < profile->num_bins) {
            - bin_volume_fraction[bin]++;
            - }
            - }
    -
    -
    -
    -
    - DCMODE issues in halo finder and in analysis code.
        - units update in general
-
-
-
- run simulation with evolving refinement
-
- alter sf_logging to be a plugin
- Run cloudy (rhoh1? please no?)
    - Check scaling with metallicity by normalizing Abundance(z | rho, T) at rho0, T0
    - different column heights
    - an/cloudy/ ---- awk '{if($1==-5.0 && $2==-3.0)print($3)}' cloudyzrhotg.dat
    - different redshifts (ie different UVB)
    - /home/sleitner/research/c07_02_00/source/hirogridSAM.cpp
-
- Outline papers
        -

- write up UVB stuff and check for new observational constraints.
    - https://docs.google.com/Doc?docid=0Ad7LA8GrZifNZGdiZzdxMjJfMTA4ang0YjVjZ3E&hl=en

Implementation

blastwave

- how could you better mimic stinson '06? remove gas from the cooling curver -- less gas is participating in cooling in the cell effectively?
- Oscar's blastwave vs my version for merging 2 equal mass cells...
    - set xlabel 'time since birth in cell 1[Myr]'; set ylabel 'nocool for [Myr] for t2=10,25 since birth for cell 2'; m1=1; m2=1; ram(x,d1) =50-(d1)*(x)*(m1+m2)/(m2*(d1)+m1*(x)); art(x,d1)=(m1*(50-d1>0?50-d1:0)+m2*(50-x>0?50-x:0))/(m1+m2);plot [0:100][0:50] ram(x,25) lw 5,art(x,25) lw 2, ram(x,10) lw 5,art(x,10) lw 2

Looking at Nick's runs

- metallicity
    - reset; set logscale y; plot [1:200][]'outanalysis/gas/gann_sgn3zm5h0-r1rt-rs9_a0.3062_lev9_cyr20_000.dat' u 1:14 w l, 'outanalysis/gas/gann_s4zm3h27-r2u10ht-rs9_a0.3302_lev9_cyr20_000.dat' u 1:14 w l, 'outanalysis/gas/gann_s4zm3h27-rtr1-rs9_a0.3302_lev9_cyr20_000.dat' u 1:14 w l
    - ae=0.3062; aeu=0.33; reset; set logscale y; plot [0:10][0.001:1] 'outanalysis/gas/gann_s4zm3h27-r2u10ht-rs9_a0.3302_lev9_cyr20_000.dat' u ($1/aeu):14 w lp, 'outanalysis/gas/gann_s4zm3h27-rtr1-rs9_a0.3302_lev9_cyr20_000.dat' u ($1/aeu):14 w lp,'outanalysis/gas/gann_sgn3zm5h0-r1rt-rs9_a0.3062_lev9_cyr20_000.dat' u ($1/ae):14 w lp,'outanalysis/gas/gann_sgn3zm5h0-r1rt-rs9_a0.3062_lev9_cyr20_001.dat' u ($1/ae):14 w lp,'outanalysis/gas/gann_sgn3zm5h0-r1rt-rs9_a0.3062_lev9_cyr20_002.dat' u ($1/ae):14 w lp,'outanalysis/gas/gann_sgn3zm5h0-r1rt-rs9_a0.3062_lev9_cyr20_003.dat' u ($1/ae):14 w lp
    - outanalysis/gas/gann_l6n-r1rt-rs9_a0.2504_lev9_cyr20_000.dat
    - ouput from start.c
        - par.cray simple_mpi.pbs 1
        - cat out/log/stdout |grep snl1 >blah
        - reset ; a=20; set view 0,0; splot [-a:a][-a:a][-2:0]'blah' u ($5*1000):($6*1000):(log10($8)) pal pt 5 ps 1
- **Run names:**
    -
    -
    - "Small" - 6 chimp box, ~3M particles
    - "Medium" - this 25.6 chimp box, ~60M particles, 2 levels of refinement in IC
    - "Large" - this 25.6 chimp box, ~300M particles, 3 levels of refinement in IC (created by mistake)
    -
    - RUN.1: Medium, name GF25C.V1.201, full physics, with default SN feedback
    - some data files are on rein
    -
    - RUN.2: Medium, name GF25C.V1.202, full physics, no SN feedback
    - some data files are in **/lustre/ognedin/NG/GF25C.V1.202**
    -
    - *RUN.3: Large, name GF25C.V1.101, full physics, with default SN feedback,*
    - *some data files are in **/lustre/andrey/NG/GF25C.V1.101***
    -
    - *ADIABATIC: Large a=0.30 **/home/mzemp/work/Box25.6Mpc/box1-adiabatic/box1_03***
    -
    - RUN.4: Large, name GF25C.V1.102, full physics, no SN feedback
    - some data files are in /lustre/ognedin/NG/GF25C.V1.102

Match halos between catalogs: /lustre/sleitner/halo/match

MgII

-
- plot Wr against N and see if you need to do all this integration of the voigt profile BS
    - reset; set logscale; plot [1e10:1e20][0.01:10]'outanalysis/novlos/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 11:($10) w p, 'outanalysis/novlos/checkEW5kms.dat' w lp, 'outanalysis/novlos/checkEW200kms.dat' w lp, 'outanalysis/novlos/checkEW50kms.dat' w lp
    -
- Wr(r)
    - set key t r; set logscale ; plot [5:300][1e-5:10](x>20 ? (x<100 ? 10**(2.47-1.90*log10(x*.72)+0.73*log10((1+0.33)/(1+0.25))) : .0001) : 2) lt 3,'outanalysis/gas/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_z0.00_000.dat' u (sqrt($1**2+$2**2)):10 w p ti 'Mg2_EW (A) z' lt 1, 'outanalysis/gas/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_z0.10_000.dat' u (sqrt($1**2+$2**2)):($10 < 0.0001 ? 0.0001 : $10) w p ti 'Mg2_EW (A) z>0.1' lt 4, 'outanalysis/gas/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_z0.01_000.dat' u (sqrt($1**2+$2**2)):($10 < 0.0001 ? 0.0001 : $10) w p ti 'Mg2_EW (A) z>0.01' lt 5
    - logW¯r(2796)= -(1.90±0.11) log(rho[physical h-1kpc) + (2.47±0.15) - (0.25±0.03) (MB-MB) + (0.73±0.50) log(1 + z)/(1 + z0)
        - z0=0.25
    - make a Hsiao-Wen covering fraction plot (Wr as a function of radius) on top of her formula/data
        - Eq. 13 -- 0705

-
-
- plot Wr(rad,phi)
  - splot [-200:200][-200:200][-6:2]'outanalysis/gas/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:2:(log10($10)) w lp pal
  - set key t r; set logscale y; plot [0:300][1e-5:1000]'outanalysis/z/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u (sqrt($1**2+$2**2)):10 w p ti 'Mg2_EW (A)' lt 1, 'outanalysis/z/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u (sqrt($1**2+$2**2)):5 w p lt 3 ti 'CIV_EW(A)', 'outanalysis/z/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($14+$15) w l lw 3 lt 2 ti 'Z/Zsun', 'outanalysis/z/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($8) w l lw 3 ti '\Sigma_{cold}(r)Msun/pc^2', 'outanalysis/z/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($5) w l lw 3 ti '\Sigma(r)Msun/pc^2', 'outanalysis/z/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($17*1e-10) w l lw 3 lt 3 ti 'nCIV(r)/10^{10}' , 'outanalysis/z/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($22*1e-10) w l lw 3 lt 1 ti 'nMg2(r)/10^{10}'
  - set key t r; set logscale y; plot [0:300][1e-5:1000]'outanalysis/z01/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u (sqrt($1**2+$2**2)):10 w p ti 'Mg2_EW (A)' lt 1, 'outanalysis/z01/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u (sqrt($1**2+$2**2)):5 w p lt 3 ti 'CIV_EW(A)', 'outanalysis/z01/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($14+$15) w l lw 3 lt 2 ti 'Z/Zsun', 'outanalysis/z01/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($8) w l lw 3 ti '\Sigma_{cold}(r)Msun/pc^2', 'outanalysis/z01/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($5) w l lw 3 ti '\Sigma(r)Msun/pc^2', 'outanalysis/z01/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($17*1e-10) w l lw 3 lt 3 ti 'nCIV(r)/10^{10}' , 'outanalysis/z01/gann_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyr20_000.dat' u 1:($22*1e-10) w l lw 3 lt 1 ti 'nMg2(r)/10^{10}'
  - set key t r; set logscale y; plot [0:300][1e-5:1000]'outanalysis/gas/elsew_s4zm3h27-r2u10-rs9_a0.6016_lev9_000.dat' u (sqrt($1**2+$2**2)):10 w p ti 'Mg2_EW (A)' lt 1, 'outanalysis/gas/elsew_s4zm3h27-r2u10-rs9_a0.6016_lev9_000.dat' u (sqrt($1**2+$2**2)):5 w p lt 3 ti 'CIV_EW(A)', 'outanalysis/gas/gann_s4zm3h27-r2u10-rs9_a0.6016_lev9_cyr20_000.dat' u 1:($14+$15) w l lw 3 lt 2 ti 'Z/Zsun', 'outanalysis/gas/gann_s4zm3h27-r2u10-rs9_a0.6016_lev9_cyr20_000.dat' u 1:($8) w l lw 3 ti '\Sigma_{cold}(r)Msun/pc^2', 'outanalysis/gas/gann_s4zm3h27-r2u10-rs9_a0.6016_lev9_cyr20_000.dat' u 1:($5) w l lw 3 ti '\Sigma(r)Msun/pc^2', 'outanalysis/gas/gann_s4zm3h27-r2u10-rs9_a0.6016_lev9_cyr20_000.dat' u 1:($17*1e-10) w l lw 3 lt 3 ti 'nCIV(r)/10^{10}' , 'outanalysis/gas/gann_s4zm3h27-r2u10-rs9_a0.6016_lev9_cyr20_000.dat' u 1:($22*1e-10) w l lw 3 lt 1 ti 'nMg2(r)/10^{10}'
  -
- plot spectra
  - plot 'outanalysis/gas/spec_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:4 w l,'outanalysis/gas/spec_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:5 w l,'outanalysis/gas/spec_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:6 w l,'outanalysis/gas/spec_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:7 w l,'outanalysis/gas/spec_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:8 w l,'outanalysis/gas/spec_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:9 w l,'outanalysis/gas/spec_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u 1:10 w l
- distribution of heights for skewers, because of resolution in outer cells not smooth at all.
  - plot 'outanalysis/gas/elsew_s4zm3h27-r2u10-rs9_a0.7505_lev9_000.dat' u (sqrt($1**2+$2**2)):3
    - beyond 20 (-400) though, it is >200 ~200-700 == not bad
- cloudy check interpolation:
  - set cbrange [-3:20];set view 0,0; splot [2:7][][]'cloudy/all.z-5to1.h-6to3.Te2toe7' u ($1 == 0 ? log10($3) : -30):2:(log10($11)) pal pt 5
- cloudy check extrapolation:
  - for density:
    set cbrange [-3:20];set view 65,15; plot [-10:8][][]'cloudy/all.z-5to1.h-6to3.Te2toe7' u ($1 == -1 && log10($3) == 5 ? $2 : -20):(log10($5)) pal w p, 'testcloudy.dat' u 2:(log10($4))
  - for metals

Ideas

- Changes in physics during mergers?
  - Qualitative differences at high and low redshift? Dynamical time limited densely packed H2 → longer depletion times (i.e. can you reproduce the flattening of sSFR to Log(1/tdyn)?
  - Why do dust SEDs change shape?

- Is there some regime where there is a break in observations but simulations have no scale dependence? Why do galaxies keep growing at M*>10^11...

What drives the peak of star formation efficiency at L*? That is a different statement from why are most stars forming at L*. What drives the newest mass function results?

What causes the shorter depletion times in lower mass galaxies? how are disks "stabilized"? → the density pdfs are cut?

- how significant is the break to hot halo. What portion of the energy budget does the hot halo save?

- What drives **rising** star formation histories? Why does the transition region happen too early in simulation? Is there some simple scaling that describes the z=2 peak?

- Where are simulations breaking down? Gas can't be stored forever according to DLAs is there also a mechanism to eat gas? At very high densities shouldn't more fH2 be converted even in low metallicity systems?

- Compare H2 recipes: where are differences and where are they important? (Where does Nick's prescription differ from other H2 prescriptions?)

Andrey

gas surface density profiles for neutral gas in simulated galaxies at several representative redshifts as a function of host halo mass. Specific project with the goal of testing whether low mass halos have systematically lower gas surface density, so that they can be more subject to metallicity-driven suppression of SF.

Gas density PDFs in simulations and observations

Meh (need robust (sunrise) observations of simulation that take time)

- Is the SFR main sequence reproduced in simulations? What drives the scatter? Morphology? Show Wuyt's plots with simulations overplotted.
  - problems: don't quench star formation. don't produce realistic morphologies anyway
- clumpy disk frequency. (Are they molecular? are there too many? Do they persist in places they shouldn't be?)
  - If voids contain clumpy disks and clumpy disks create bulges then something is wrong with clumpy disks or clumps should be destroyed.
  - How much mass is in clumps?
  -

Bigger projects:

- At the interface of feedback and H2 formation: what sets star formation efficiency and where/when?
- Minor merging and reconciling simulations with Lotz merger rates
-
- Where are simulations breaking down?

Things to know: the luminosity function in L25 (how representative anyway? cosmic variance limited); dust corrections, etc.

- winds: what does it mean that winds are seen only in extreme environments? If they are launched on small scales with enough velocity to escape, then doesn't this mean that outflows should be seen everywhere? Or does it mean that the main thing keeping winds from escaping is not the disk surface gravity, but hydrodynamic instabilities. Calculate the difference you expect between these two things.
-
-
- constrain Xco from dynamical mass observations where you have a handle on the IMF? Or IMF doesn't matter?
- RT vs not
  - bracket the affects column density using cloudy for MgII
  - RT/H2 prescription comparison
-
- stellar+gas density = total density in high redshift progenitor galaxies on same physical scale? If lower then material MUST have been winded out...
      - vmax(r)
-
- predictions for ALMA+dynamical constraints on IMF (http://arxiv.org/abs/1101.4022v1)
-
-
- Think about TF (L-Vmax)
  - So if you overproduce the number of stars at a given vmax you get wrong "normalization
-
- filament cooling and resolution dependence
  - column density map...
  - simple resolution test
  - THEN go to very high mass resolution in a small region around the filament **near a galaxy?** can you robustly track particles in a filament to z=4
  -
- what sets the edge of gas disks in galaxies?
  - use particle tracers to understand where gas on the outer of edge of the disk comes from vs the hot gas just outside of the disk edge.
  -
- accretion rate scatter, galaxy to galaxy, environmental dependence and clumpyness by environment
  - context are accretion rates onto isolated disks systematically lower? higher? more/less clumpy
    - The formula has 80 Msun/yr at z=2 (not at z=0), and it scales as (1+z)^2.4, so at z=0 it is 5.7 Msun/yr for 10^12 Msun

halo. This is the average accretion rate of baryons into the virial radius of a halo, as deduced from the dark-matter accretion with a constant baryonic fraction 0.17, and the dark-matter part is confirmed in any cosmological N-body simulation. It is a robust result.

- variation in covering fraction (RE Andrey etc) and over time in simulations
- how does scatter in the accretion history of galaxies correlate with other properties? Do you have to get both the accretion history, the merger history right? Or is the accretion fairly universal?

-
- use particle tracers to explore the angular momentum problem in gas :)
-
- understand "chaos" in your runs
    - RAMSES/SPH comparison, tracer particle check as well
-
- use tight relations to say something about IMF and/or SPS modeling in general (e.g. Hsiao-Wen's recent paper)
-
- plot j1-0 CO transition against SF and j2-1 CO transition against SF
-
- How does shocking by satellite passes affect disk equilibrium measurements? Not sure it heats stars… "heating" doesn't include coherent motions.
-
- Compile a comprehensive test suite of observational results for galaxies by type, color and M*, so that a simulated galaxy can be placed in the N-dimensional space and you can declare it realistic in all dimensions.
    - Make parameters tunable so you can account for different IMFs...
    - Mass-metallicity , SFR-M* ,
-
-
- Naab's runs resolution v. efficiency in the context of Doug's results
    - only assembled ⅛ of stellar and dark matter mass before star formation essentially ceases in the galaxy. These galaxies seem to be in the hot mode at high z -- out to the virial radius (50kpc) is over 1million degrees at z=3...
    - This is totally crazy! Where does this amount of energy come from? Can you calculate (maybe using the Abel paper that it is impossible to generate? Or estimate what is generating it? Energy per mass accretion event perhaps?
-

HI
RT/no RT

- set ticslevel 0; set size square;splot [-50:50][][]'outanalysis/gas/disk_s4zm3h27-r2u10-rs9_a0.7505_000.dat' u 1:2:3 w lp pal , 'outanalysis/test/cells_s4zm3h27-r2u10-rs9_a0.7505_000.dat' u ($7>5e2 ? $1 : -100):2:3 w p pal
- ./cart_analysis_generic 20 7 out/ DAT/ s4zm3h27-r2u10-rs9 0.7505
- plot 'outanalysis/gas/gvert_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyz5_000.dat' u 1:5 w lp,'outanalysis/gas/gvert_s4zm3h27-r2u10-rs9_a0.7505_lev9_cyz15_000.dat' u 1:5 w lp

Resolution tests for filaments

- check filament densities in different resolution simulations.
- Where are stars in the simulation? output stellar particles in a format ifrit can handle.

Bugs

- **check nick's run's density profiles**
- check for bugs in 1.8beta
    - bugs in tracers

Disks in Simulations

disk rotation axis changes
set view 0,0 ; set ticslevel 0; set size square; splot [-10:10][-10:10][-10:10]'ideas/gdisk_s4zm3h27-r2u10-rs9_a0.3308_000.dat' u (log10($4) > 4 ? $8 : -100):9:10:(log10($4)) pal w p
disk rotation axis rotating is in response to the DM halo triaxiality...
baryon disk hasn't wrestled halo into spherical stable state -- low mass halos perform fractionally less adiabatic contraction?
-----> adiabatic contraction / sphericalization as a function of halo mass?

H2SF

how old are the stars that make up the outskirts of r2u10?

Haas Thesis:

As we show in panel (B) of Fig. 2.7 the slope, normalization and threshold density of the Kennicutt-Schmidt law are unimportant for the SFR of a halo. Making star formation at a given density either three times more e ective or making the star formation rate a steeper function of the local gas density (and more e ective at all densities) does not a ect the star formation rate of a halo. Also, making the threshold density for star formation a function of metallicity does not influence the star formation rate of a halo. This indicates strongly that the global star formation rates of haloes are set by the available fuel and feedback only and not by the details of how high density gas is treated and how star formation is implemented. In other words: star formation is self-regulated by the available fuel and feedback.

high resolution with enforced equations of state (implement in cosmo sims?)
--- convergence?

====================

density profiles:

```
plot [0:20]'outanalysis/star/sprof_s4zm3h27-fid-rs9_a1.0019_000.dat' u 1:5 w lp,'outanalysis/star/sprof_s4zm3h27-r2u10ef05-rs9_a1.0021_000.dat' u 1:5 w lp,'outanalysis/star/sprof_s4zm3h27-r2u10-rs9_a1.0014_000.dat' u 1:5 w lp
plot [0:20]'outanalysis/star/sprof_s3zm3h13-r2u10-rs9_a1.0016_000.dat' u 1:5 w l,'outanalysis/star/sprof_s3zm3h13-r2u10ef05-rs9_a1.0018_000.dat' u 1:5 w lp
plot [0:20]'outanalysis/star/sprof_s4zm3h19-r2u10-rs9_a1.0025_000.dat' u 1:5 w l,'outanalysis/star/sprof_s4zm3h19-r2u10ef05-rs9_a1.0009_000.dat' u 1:5 w lp
```

Cumulative SFH

```
plot 'outanalysis/star/sfh_s4zm3h27-fid-rs9_a1.0019_000.dat' u 2:6 w lp,'outanalysis/star/sfh_s4zm3h27-r2u10ef05-rs9_a1.0021_000.dat' u 2:6 w lp,'outanalysis/star/sfh_s4zm3h27-r2u10-rs9_a1.0014_000.dat' u 2:6 w lp
```

resolution increases early stellar mass while efficiency decreases it (lines with points are lower resolution):

```
plot 'outanalysis/star/sfh_s4zm3h27-fid-rs9_a0.2502_000.dat' u 2:6 w lp,'outanalysis/star/sfh_s4zm4h27-fid-rs10_a0.2505_000.dat' u 2:6 w l lt 1,'outanalysis/star/sfh_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat' u 2:6 w lp lt 2, 'outanalysis/star/sfh_s4zm4h27-r2u10ef05-rs10_a0.2501_000.dat' u 2:6 w l lt 2,'outanalysis/star/sfh_s4zm3h27-r2u10-rs9_a0.2500_000.dat' u 2:6 w lp lt 3,'outanalysis/star/sfh_s4zm4h27-r2u10-rs10_a0.2503_000.dat' u 2:6 w l lt 3
```

orientations:

```
set size square; set ticslevel 0; set cbrange[4:8]; set view 0,0; splot [-15:15][-15:15][-15:15]'outanalysis/star/evecs_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat'  u 7:8:9 w l lt 1,'outanalysis/star/evecs_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat'  u 1:2:3 w lp lt 1, 'outanalysis/gas/evecg_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat' w lp lt 3, 'outanalysis/gas/evecg_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat' u 4:5:6 w l lt 3, 'outanalysis/gas/evecg_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat' u 7:8:9 w l lt 3, 'outanalysis/testgdisk_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat' u (log10($4) > 4 ? $1 : -30):2:3:(log10($4)) pal w p, 'outanalysis/testsdisk_s4zm3h27-r2u10ef05-rs9_a0.2506_000.dat'  u (log10($4) > 4 ? $1 : -30):2:3:(log10($4)) pal w d
```

how much mass is in the hot phase?

how is filament density affected by resolution in AMR simulations?

The Galactic Fountain in order to understand feedback simulations

Games: Semi-Analytic + Computational

Q: To stop **bulge formation** how much gas do you need to stop from cooling and condensing?
A: You need all the gas that forms the bulge in simulations not to cool...
Q: Ok, but the simulations may not reflect the reality of bulge formation. Do you really know how much low angular momentum gas should be there from the large scale tidal field?
A: Tidal torque theory predicts this.
http://adsabs.harvard.edu/abs/2002MNRAS.332..325P
http://arxiv.org/abs/astro-ph/0105165
Q: then why do we need simulations to tell us that, at high resolution the bulge fraction in most disks is not converged? Are the higher resolution simulations converging to what tidal torque theory says?

Are there simple arguments that tell you this stuff? look in 2 galaxy formation books and papers before you think too hard about this. It seems like something that would be very hard to predict, but if you could do it and match some simulation results with a resolution parameter, that would be awesome.

===================================
Q: what is the **density PDF of galaxies** in simulations as a function of various parameters and resolution?
A: This is a very hard problem and will also depend on the exact feedback and SF prescription you implement.
Q: yes, but it is the fundamental question that needs to be understood before you can really know what it means for stars to be forming in your simulation... essentially **all this fuss about stellar mass etc boils down to the high density tail of your gas PDF**.

On a related note, functionally, a converged SFP consists of this: at different resolutions for the same galaxy you want the same fraction of gas to be forming stars... there are two dimensions to this problem:
1) a spatial dimension: what volume fraction of gas is forming stars?
2) a time dimension: how quickly is the gas being converted?

Does star formation actually happen in biased regions? So you are in an overdense portion of the disk and it is fluctuations in that portion that create stars

===========
Is the halo mass of a red galaxy the same as the halo mass of a blue galaxy for the same M*?
--assuming the universal baryon fraction, do the gas fractions differ?
--promote a change to HOD modeling.

Accretion and Growth of the Blue/Red clouds

What is **expected SMOOTH accretion rate of galaxies at z=0** (Mh<1e9, star-less clumps)
-- should the MW be accreting more dwarfs? no...LMC/SMC unusual already.)
-- how competitive is smooth accretion with merger/disruption events anyway?

Does the Bell2007 stuff match up with quenching via merging and stripping?

*al la Oscar/Romaine: If different disk morphologies are set up by different efficiencies, is this observable? What is the mechanism?

Is the **prochaska and chen SFE** a quantity that can be plotted on the K-S diagram? Is it actually a fair sample?
----- maybe the disks are thicker so that the column densities look higher, but the intrinsic densities are lower, too? This would mean they actually observe lower density gas, or sit on a higher SF(rho) relation than they think...

Metallicity predictions

SFR+M* -> SFH... SFH + HI mass function = Z(Mh)

double check SFR+M*->SFH -> build up of instantaneous stellar mass function

*metallicity predictions of momentum driven winds models?

Future

Exploring Star Formation Efficiency and Thresholds

The impact of the efficiency of star formation on galaxy and cluster properties.

Buyle et al. (2005) argued that the low values of MH i /LB typically
found in dEs may be a direct result of a near-complete gas
depletion due to enhanced star formation efficiency. They were
using the results of an analytical chemical evolution model (Pagel
&Tautvaisiene 1998) and stellarmass-to-light ratios (M /LB) from
a simple stellar population (SSP) model (Vazdekis et al. 1996

----

total baryonic mass in the low efficiency runs should always be higher.

1) How much more energy is radiated away waiting for stars to form?

2) How does this affect adiabatic contraction of the halo?

3) How does low resolution mimic high efficiency?
--->

4) What is the cooling time story?
---> At high redshift, cooling times are short, so everything cools. Stars therefore form on the gas consumption timescale.
----> At intermediate redshift the cooling time slows to depend on the mass of gas gas forms stars, and pushes down the **cooling rate**

Reproduce high gas densities seen in submm galaxies

Reproduce Observed Velocity Dispersion in Disks?

Simulation Bugs

Central Spike

today:
+) how do stellar surface densities change for your higher resolution run?

+) how does gas get to the center of the galaxy? Is it merging of gas density spikes?
++) Is there some easy way of tracking the position of stuff that ends up at the spike?

+) when do the density spikes form?
+++) can you **kill** them with resolution??
+++++) resolution helps when it lets you resolve the most important scale of the problem.
+++++) peak might broken up by having a million tiny peaks with much longer **dynamical friction timescales**
+++++) HOWEVER, if peaks **merge on many scales** before coalescing into a central peak then there's no hope
+++++) the power spectrum is **scale invariant** so without feedback there's no scale that you can get down to that will prevent the density spikes from occuring

.
+++++)++) **reionization**, might prevent density spikes and preserve some halos over some scale thereby preventing collapse and coalescence
++++++++)++) doesn't it just happen AFTER reionization in anycase?
--------------------------------------> one limit check might be to heat the gas until z=10, to each halos virial temperature, and then let it coalesce

+) what do the density spikes look like in Nick's runs?
... do a little analysis of Nick's 30 Mpc box.

3) what stellar component loses most of the mass-loss?
PNe/AGB, RGB, SNII, SNIA

Chaos

figure out when the kick happens and
1) rerun h48 with smaller timesteps in both adiabatic and cooling run.
2) check conservation of angular momentum.

"chaos" related:
-- systematic program for assessing differences between runs.
-----> run to scattering and then bump up the number of time steps
-----> ----->
----->
-----> ask Oscar and Robert about quantifying galaxy displacements
-----> (Robert: You don't really need to see the high surface density point in the KS plot in order to have a good idea of what it will be).
----->
----->
----->

----
why is SF spikey
plot 'log/sf.log' u 4:8 w lp, '../../s4zm4h139-r2u10-rs10/out/log/sf.log' u 4:8 w lp, '../../s4zm4h139-fid-rs10/out/log/sf.log' u 4:8 w l, '../../s4zm4h139-fid-rs10/out/log/sf.log' u 4:(50*$11) w lp