CMFGEN Novice User's Guide
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**** RUNNING A BRAND NEW MODEL ****
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I. Select a starting model and set up the directory
  - Create a new directory for the star's model

  - Determine the ogrid model that most closely matches
    - Mdot, Teff, log g
  > cpmod oldModel newModel
  > cd newModel

II. Get VADAT Reasonable
  - edit VADAT
    - Vinfin, B, Mdot, L (change from logL), Teff, log g
    - edit abundances by using MOD_SUM Z(Sun) (but H = +1.0 and He = 0.1)
      - LMC = - Z(SUN) * 0.5
      - SMC = - Z(SUN) * 0.2
    - LIN_INT = F if new Teff; T if the model is close in Teff
    - T_INIT_TAU = 0.5 -> 1.5
    - Make sure clumping is turned on

III. Compute LTE opacities
  > mkdir lte (local thermodynamic equilibrium)
  > cp VADAT lte
  > cp MODEL_SPEC lte
  - From another model / lte
    > cp GRID_PARAMS lte
    > cp ltebat.sh lte
  > cd lte
  - Admire GRID_PARAMS
    - Should say 25 and 37 (and 25 x 37 = 925)
  - edit MODEL_SPEC
    - ND = 925
    - NP = 940 (ND + 15)
  > ltebat.sh &

IV. We want to make reasonable initial hydro file.
  > cd ..
  > mkdir hydro_dir (DO NOT call it hydro)
  - copy everything from another hydro_dir into the new hydro_dir
  > cd hydro_dir
  - edit HYDRO_PARAMS
    - REF_R (Reference Radius) = R(Tau=2/3) * 6.96
    - CON_R (Connection Radius) = A little larger than REF_R (194)
    - RSTAR = A little smaller than REF_R (188)
    - LOG_G, TEFF, MDOT, VINF, BETA
    - OB_P1 = 30 -> 200

  - Assume that ltebat finished (check with top ... should last between 10 and 15 minutes)

  > cp ../lte/ROSSELAND_LTE_TAB .
  > $cmfdist/exe/wind_hyd.exe
    > /null
    > e
    > 65 (number of grid points)
    > 100 (tau max for model)
  > cp RVSIG_COL_NEW ../RVSIG_COL
  > cp ROSSELAND_LTE_TAB ../
  > cd ..
  - Feel free to clean up lte with rmlinks, rm POP*, and rm *OUT

V. Set file to make 1 iteration so that we can check input paramters etc.
  - edit VADAT
    - RSTAR = RVSIG_COL's core Rad
    - RMAX = RVSIG_COL's ratio of inner to outer
  - edit IN_ITS
    - NUM_ITS = 1 (only want one iteration)
    - LAMBDA = T (both, but it's the first one that is forcing it)
  - edit MODEL_SPEC
    - ND = 65
    - NP = 80
  - From another SMC or LMC model (depending on the star)
    > cp GREY_SCL_FACOUT GREY_SCL_FAC_IN
  > batch.sh & (should run for around 20 minutes)
  - Check the output files (see below).

VI. Run a complete model with Hydro turned on:
  - edit HYDRO_DEFAULTS
    - N_ITS = 3
    - STRT_ITS = 10 (or 12)
    - FREQ_ITS = 10
    - add 100 [MAX_R] if it isn't already there
  - edit IN_ITS
    - NUM_ITS = 100
    - LAMBDAS should both be true
  > rm OUTGEN (only if not reasonable 1st iteartion).
  > batch.sh &

VII. After a few hours, check the output files (see below) and adjust the model if need be (see below)

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**** RUNNING A MODEL OFF A PRE-EXISTING STAR ****
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  - Create a new directory for the star's model
  > cpmod old new

  - edit VADAT
    - If you change the mass loss rate, change the filling factors (FIL_FAC_1 and FIL_FAC_2) to preserve XRay Luminosity. The XRay Luminosity scales as the inverse of the mass loss rate. The filling factor must then be adjusted appropriately and if you want to increase the XRay Luminosity by a factor of four, double both filling factors.
    - Also, if clumping is being turned on, the mass loss rate must be decreased by (a factor of 3.33) 1/3
        EXAMPLE:
                Current Mdot = 1
                Desired Mdot = 1.5
                50% increase

                So, the XRay Luminosity needs to decrease by 50%
                (.50)^(1/2) = .7
                So, the filling factor needs to increase by 70%.
                        Current filling factor: 1
                        New filling factor: 0.3
  - edit HYDRO_DEFAULTS
    - N_ITS = 3
    - STRT_ITS = 10
    - FREQ_ITS = 10
  - edit IN_ITS (Lambda = T, 100 iterations)

  > batch.sh &

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**** AFTER MODEL IS FINISHED ****
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  > dscratch
  > rmlinks
  > clean
    - remove EDDFACTOR?
    - remove EDDFACTOR_INFO?

  - get rid of all iterations except a few at the end
    > $cmfdist/exe/rewrite_scr.exe
      - 1
      - (defaults)
    > $cmfdist/com/mvscr.sh

  - examine:
      OUTGEN
      OBSFLUX
      CORRECTION_SUM
      MOD_SUM
      HYDRO

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**** ADJUSTING A MODE ON THE FLY ****
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  - edit IN_ITS to do 0 more iterations (stop gracefully)

   - Changing X-ray luminosity
     - Adjust filling factors, set DO_LAM_IT=T in IN_ITS, and restart.

   - Forcing more hydrostatic iterations
     - determine the last iteration by looking at POINT1
     - edit HYDRO_DEFAULTS:
          N_ITS = ?
          STRT_ITS = last iteration +1
    - if good convergence at depth: cp GREY_SCL_FACOUT GREY_SCL_FAC_IN

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**** FIXING POOR CONVERGENCE ****
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  - Force the model to average the last two iterations (if oscillating)
    > $cmfdist/exe/do_ng_v2.exe
    - Then restart the model in same directory.
    - You can always force an Ng accelration by the same code.

  - Insert more depth points
    - Make sure running model ended gracefully.
    - Create a new model directory, and do "cpmod"
    - Use $cmfdist/exe/rev_rvsig.exe to update RVSIG_COL file with additional grid points.
    - Revise MODEL_SPEC with new ND/NP.
    - Set LIN_INT=T in VADAT
    > batch.sh &

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**** OUTPUT FILES ****
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  OUTGEN - summary of changes at each iteration
    > grep Maximum OUTGEN (the change at the end should be small)
    > tail OUTGEN (anything bad at the end?)
    - Look at top of file (especially if changing atomic data, non-regular parameter for unusual output).

  CORRECTION_SUM - summary of changes at each depth
    - check to see if the model is oscillating or if it has actually already converged
    - often convergence may be limited by a few populations at a few depths (if corrections for only few pops > 10%, you may want to
for an NG or do an AV).

  HYDRO
    - look at the errors when velocity = 10 km/s. The errors should be better than 4%
    - If they aren't, then more hydro iterations are needed
    - edit HYDRO_DEFAULTS to be 1 or 2 (perhaps copying GREY_SCL_FACOUT to GRAY_SCL_FAC_IN).

  OBSFLUX
    - check the luminosity (should be consistent within a percent)
    - XRay Luminosity
      > tail OBSFLUX
      - Look at second number from bottom ... should be at around 1.0E-7
      - If it isn't, then edit VADAT
      - Search on FIL_FAC
      - Edit the filling factor
      - If you want to increase the XRay Luminosity by a factor of four, double both filling factors

  MOD_SUM - summary of model
    - examine Teff and log g and make sure they haven't changed drastically from the initial values
    - check abundances etc

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**** MAKE A SPECTRUM ****
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  > mkdir obs (in model directory.)
  - Copy from another obs directory
    - batobs.sh
    - CMF_FLUX_PARAM_INIT
  > cd obs
  > batobs.sh &

  - If the job is killed, rm CMF_FLUX_PARAM

  - This process takes around 3 hours
        - One big run that takes around 2 hours
        - One smaller job that takes around 1 hour
        - One last job that takes around 20 minutes

 (Ask DJH how to run spectra with scaled abundances etc).

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**** PLOTTING ****
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(more complete plotting manual for pg_plot: http://www.astro.caltech.edu/~tjp/pgplot/)

  > plt_spec
  obs > model observed spectrum (e.g.: obs_fin_10)
      * use obs_fin_10 for supergiants
      * use obs_fin_5 for dwarfs
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  plt_spec
    rd_mod - read model observational data
    rd_obs(rad_vel=-actual rad_vel) - read in observed spectrum and correct to rest frame
        /Users/massey/cmfspect/*.txt

    rot - rotate (need a flam to send it to the plot buffer)
    norm - normalize (if optical ... don't need an flam)
        Continuum file = obs_cont
    flam - corrects for the reddening

  Note: Options can be appended with arbitary extensions. These create a unique extension with
  which to use the . approach. .rd_obs(rad_vel=-50) will do old rd_obs option, but update
  rad_vel.

GRAMON_PGPLOT
    a - define the axis
    c - set certain plots to be visible or invisible
        L - line
        I - invisible
    e - exit
    h - help
    nm - normalize within a region
    noi - exits the plot package
    yar - y arithmetic
    colors
      1 = red
      2 = blue
      3 = green
    See web page for more info.
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