1 Histrionics

- Mihalas was an *Observer* and wanted to analyze his data
- He and Auer tried equivalent two level atom;partial linearization
- Suceeded with complete linearization H/He model atmospheres
- Mihalas first edition had more detail
- Linear A for trace elements with Feautrier scheme (scales as ND*NF**3)
- Linear B using Rybicki scheme (scales as NF*ND**3)
- A few examples to show the importance, then left field
- Auer and Heasley (net radiative brackets)
- but needed a driver
- Sid Wright and Jack Giddings - DETAIL/SURFACE for arbitrary atoms
- following Auer and Heasley, with Gauss-Seidel, SOR (see Mihalas)
- Used overlays because CDC 7600, world's fastest computer with 10 Mflops maximum and large core memory of 512K (for University of London)
- I put in variable dimensions and took them over as Jack moved into Starlink (IUEDR)
- Jack via jets to motor engines; Sid Wright to Australia and computer science
- Linearization was problematic, could never really linearize everything (background transitions)
- Later came ALI, velocity field, fortran 90

A sample DETAIL input

```
:V2
:T========================================================================
:T            OI DATASET FOR DETAIL
:T
:T            VERSION BASCHEK ET AL. 1977, WITH SOME MODIFICATIONS
:T            10-JUN-2007 - NORBERT PRZYBILLA
:T
:T========================================================================
:T TITLE DETAIL DATASET FOR OI   BASCHEK ET AL. 1977
:T--------------------------------------------------
:T        FREQUENCY GRID
:T--------------------------------------------------
 FREQ
   10          1.00000000E+17
   N2287       7.61777390E+16
   N2083       7.56301307E+16

   . . .

   120         1.00000000E+12
   130         1.00000000E+11
 0
:T--------------------------------------------------
:T        OXYGEN ATOM
:T--------------------------------------------------
 ATOM       O      0.0        16.        7.41E-4
 L
  12P3P4    9.      3.2904933E15      22P4S
  13S5S     5.      1.0813160E15      22P4S
  13P5P    15.      6.9575625E14      22P4S
  14S5S     5.      4.3051072E14      22P4S
  13D5D    25.      3.7223047E14      22P4S
  14P5P    15.      3.2206570E14      22P4S
  15S5S     5.      2.3144943E14      22P4S
  14D5D    25.      2.0899904E14      22P4S
 0
 K
```

```
:T-----------------------------------------------------
:T   OXYGEN STATISTICS AND OPACITIES
:T-----------------------------------------------------
 TL   10000.
 DB 9    -4.    -2.    -1.33   -.66   0.   .66    1.33    2.   4.
 TY   CBB    22    2    CBB
   12P3P4  13S5S   0.26E-6   .2
   13S5S   13P5P   0.922     .7
   13S5S   14P5P   0.00229   .2
   13P5P   14S5S   0.173     .2
   13P5P   13D5D   0.900     .7
   13P5P   15S5S   0.0148    .2
   13P5P   14D5D   0.0664    .2
 0
 TY   CBF   15    1  CBF   22P4S
   12P3P4 4.839E-18   13S5S  7.203E-21
   13P5P  4.686E-18   14S5S  4.446E-20
   13D5D  2.024E-17   14P5P  1.263E-17
   15S5S  2.833E-19   14D5D  3.780E-17
 0
 TY   RBB     1    1    RBB
   12P3P4  13S5S   0.26E-6
   13S5S   13P5P   0.922
   13S5S   14P5P   0.00229
   13P5P   14S5S   0.173
   13P5P   13D5D   0.900
   13P5P   15S5S   0.0148
   13P5P   14D5D   0.0664
 0
 TY RBF 101  1   RBF   22P4S
   12P3P4   O10   O11     O1PICH    12P3P4  22P4S
   13S5S    O20   O21     O1PICH    13S5S   22P4S
   13P5P    O30   O31     O1PICH    13P5P   22P4S
   14S5S    O40   O41     O1PICH    14S5S   22P4S
   13D5D    O50   O51     O1PICH    13D5D   22P4S
   14P5P    O60   O61     O1PICH    14P5P   22P4S
   15S5S    O70   O71     O1PICH    15S5S   22P4S
   14D5D    O80   O81     O1PICH    14D5D   22P4S
 0
```

```
:T-----------------------------------------------------
:T   BACKGROUND OPACITIES
:T-----------------------------------------------------
 ATOM H 0.0 1.008 0.911
 L
  H11       2.     0.328805282E16   H21
  H12       8.     0.822013206E15   H21
  H13      18.     0.365339202E15   H21
  H14      32.     0.205503301E15   H21
  H15      50.     0.131522113E15   H21
 0
 K
 H21        1.      0.0             NONE
 TY RBF 5 1 RBF H21
  H11 10 HHE030 1   H12 10 HHE080 2   H13 10 HHE110 3
  H14 10 HHE130 4   H15 10 HHE150 5
 0
 TY RFF 1 0 RFF H21  0    TY RFF 2 1 RFF H21  (6)   0
 ATOM HE 0.0 4.0026 0.089
 L
  HE11        1.     5.948620002E15  HE21
  HE12S1      1.     9.603359103E14  HE21
  HE12P1      3.     8.147174578E14  HE21
  HE12S3      3.     1.152845000E15  HE21
  HE12P3      9.     8.761150639E14  HE21
  HE13       36.     3.653392020E14  HE21
  HE14       64.     2.055033010E14  HE21
  HE15      100.     1.315221130E14  HE21
 0
 K
  HE21        2.     0.131575659E17  HE31
 TY RBF 6 3 RBF HE21  HE11   10 HHE020 (7.3E-18 1.373E0 -2.311E-16)      0
 TY RBF 2 2 RBF HE21  HE12S1 10 HHE060 (1.079E-17 -1.91)                 0
 TY RBF 3 4 RBF HE21  HE12P1 10 HHE090  (1.322E-17 -3.5 6.315E-19 -3.3)
                      HE12P3 10 HHE070  (1.726E-17 -2.9 5.627E-19 -3.3)  0
 TY RBF 7 3 RBF HE21  HE12S3 10 HHE050  (-2.783E2 1.488E1 -2.311E-1)     0
 TY RBF 5 1 RBF HE21  HE13   10 HHE110  3
                      HE14   10 HHE130  4
                      HE15   10 HHE150  5                                0
 TY RFF 1 0 RFF HE21  0    TY RFF 2 1  RFF HE21 (6)   0
```

```
 MULTI 1
 LINEAR 0
:T--------------------------------------------------
:T   ATMOSPHERIC STRUCTURE
:T--------------------------------------------------
 MODEL TEFF     9550.0  GRAVITY    3.95000  YHE     .08900
TITLE SDSC GRID  [-0.5]   VTURB 2.0 KM/S
 STRUCTURE  81 TITLE ATLAS9 OUTPUT
  1 .269155E-06    5161.1 .301434E+10 .338300E+09 .100000E+01 .100000E+01
  2 .360892E-06    5191.8 .403660E+10 .431800E+09 .100000E+01 .100000E+01
  3 .491148E-06    5212.2 .551690E+10 .540400E+09 .100000E+01 .100000E+01

  . . .

 80 .535918E+01   26272.2 .643752E+16 .640400E+16 .100000E+01 .100000E+01
 81 .719494E+01   28261.7 .803689E+16 .799600E+16 .100000E+01 .100000E+01
:T--------------------------------------------------
:T   DETAIL CONTROL COMMANDS
:T--------------------------------------------------
ABUNDANCE   H 0.911    HE 0.089  C 1.51E-4  N 3.80E-5  O 3.09E-4 0
TURBULENCE 2.
BABS
OPACITY RAYLGH ODF AVE LIT END
 PRINT 1 1 1 1
 GO
 PRINT 0 0
 ALI 15 0
 PRINT 3 1
 ALI 1 0
 SCRIBE
 QUIT
```

- Lots of levels missing. Partition function inaccurate
- Note the small f-value and collision rate

```
12P3P4  13S5S   0.26E-6   .2
```

- 12P3P4 and other levels hardly coupled. Will behave like two separate atoms
- I would split this into 3 files (atom model ctrl say) then

```
cat atom model ctrl > input
detail < input > output
```

makes replacing atmosphere and ctrl easier (atom doesn't change)