Very important

- The “f-value” is in fact $g_i f_{ij}/G_i$
- since we assume the population is split according to the statistical weights
- line opacity is $n_i f_{ij}$
- $n_i = g_i/G_i \times N_i$ by assumption
- DETAIL/SURFACE have calculated N_i
- if we use $N_i(g_i f_{ij}/G_i)$ we get the right answer.

A sample SURFACE input

```
:V2
:T -------------------------------------------------------------------------
:T
:T OI DATASET FOR SURFACE
:T USE WITH DETAIL MODEL ATOM ACCORDING TO BASCHEK, SCHOLZ & SEDLMAYR
:T
:T -------------------------------------------------------------------------
 TITLE SURFACE DATASET FOR OI   VERSION BSS
:T -------------------------------------------------------------------------
:T FREQUENCY GRID
:T -------------------------------------------------------------------------
 FREQ
   1          1.00000000E+17
   O1267      6.14347140E+16
   O1085      5.91024265E+16

   . . .

   76         3.00000000E+11
   77         9.00000000E+10
 0
:T -------------------------------------------------------------------------
:T OXYGEN ATOM
:T -------------------------------------------------------------------------
 ATOM       O      0.0        16.        6.17E-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
  22P4S     4.      8.4922479E15       NONE
```

```
:T ----------------------------------------------------------------------
:T OXYGEN LINE FORMATION
:T ----------------------------------------------------------------------
 DL 53 -20. -15. -10. -8. -6. -4. -3. -2. -1. -.8 -.6 -.5 -.4 -.35 -.3 -.25
       -.21  -.18  -.15  -.13  -.11  -.09  -.07  -.05  -.03  -.01  0.0  .01
       .03 .05 .07 .09 .11 .13 .15 .18 .21 .25 .3 .35 .4 .5 .6 .8 1. 2.
       3.  4.  6.  8.  10.  15.  20.
 CL  TY  RBB  2  5  RBB
   13S5S     13P5P         7771.94  .431     2.94E+6    0.0    0.0    1.13E-6
   13S5S     13P5P         7774.17  .307     2.94E+6    0.0    0.0    1.13E-6
   13S5S     13P5P         7775.39  .184     2.94E+6    0.0    0.0    1.13E-6
   13S5S     14P5P         3947.29  .0016    4.21E+5    0.0    0.0    4.00E-6
   13S5S     14P5P         3947.48  .0011    4.21E+5    0.0    0.0    4.00E-6
   13S5S     14P5P         3947.59  .0007    4.21E+5    0.0    0.0    4.00E-6
   13P5P     14D5D         6155.96  .0029    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6155.97  .0065    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6155.99  .0051    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6156.74  .0022    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6156.76  .0084    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6156.78  .0135    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6158.15  .0010    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6158.17  .0067    4.06E+6    0.0    0.0    9.66E-6
   13P5P     14D5D         6158.19  .0260    4.06E+6    0.0    0.0    9.66E-6
   13P5P     15S5S         6453.60  .0034    4.03E+6    0.0    0.0    7.88E-6
   13P5P     15S5S         6454.44  .0057    4.03E+6    0.0    0.0    7.88E-6
   13P5P     15S5S         6455.98  .0080    4.03E+6    0.0    0.0    7.88E-6
 0
:T ----------------------------------------------------------------------
:T BACKGROUND OPACITIES FOR HYDROGEN & HELIUM
:T ----------------------------------------------------------------------
 ATOM HE 0.0 4.0026 0.089
 L
      HE11S1        1.     5.948620002E15  HE21
      HE12S1        1.     9.603359103E14  HE21
      HE12P1        3.     8.147174578E14  HE21
      HE13S1        1.     4.031016681E14  HE21
      HE13P1        3.     3.627915012E14  HE21
      HE13D1        5.     3.659273362E14  HE21
      HE14S1        1.     2.209624301E14  HE21
      HE14P1        3.     2.044003662E14  HE21
```

```
     HE16N1       36.     9.141388900E13  HE21
     HE17N1       49.     6.716122400E13  HE21
     HE18N1       64.     5.142031300E13  HE21
     HE12S3        3.     1.152845000E15  HE21
     HE12P3        9.     8.761150639E14  HE21
     HE13S3        3.     4.519049700E14  HE21
     HE13P3        9.     3.821161582E14  HE21
     HE13D3       15.     3.660472501E14  HE21
     HE14S3        3.     2.402103401E14  HE21
     HE14P3        9.     2.126611620E14  HE21
     HE14D3       15.     2.058438701E14  HE21
     HE14F3       21.     2.056100310E14  HE21
     HE15N3       75.     1.316080000E14  HE21
     HE16N3      108.     9.139444400E13  HE21
     HE17N3      147.     6.714693900E13  HE21
     HE18N3      192.     5.140937500E13  HE21
0
S
     HE19N1   0.0 1.0  3.2909E15 0.0   9 16  HE21
     HE19N3   0.0 3.0  3.2902E15 0.0   9 16  HE21
0
K
     HE21        2.     0.131575659E17    HE31
TY RBF 6 3 RBF HE21
     HE11S1 1 14 (7.3E-18 1.373E0 -2.311E-16)  0
TY RBF 7 3 RBF HE21
     HE12S3 1  28  (-2.783E2 1.488E1 -2.311E-1)     0
TY RBF 2 2 RBF HE21
     HE12S1 1  31 (1.079E-17 -1.91)  0
TY RBF 3 4 RBF HE21
     HE12P3  1  33  (1.726E-17 -2.9 5.627E-19 -3.3)
     HE12P1  1  37  (1.322E-17 -3.5 6.315E-19 -3.3)
0
TY RBF 5 1 RBF HE21
     HE13S1 1 45 (3)   HE13P1 1 49 (3)   HE13D1 1 49 (3)
     HE14S1 1 56 (4)   HE14P1 1 60 (4)   HE14D1 1 60 (4)
     HE14F1 1 60 (4)   HE15N1 1 66 (5)   HE16N1 1 80 (6)
     HE17N1 1 82 (7)   HE18N1 1 84 (8)   HE13S3 1 43 (3)
     HE13P3 1 47 (3)   HE13D3 1 49 (3)   HE14S3 1 54 (4)
     HE14P3 1 58 (4)   HE14D3 1 60 (4)   HE14F3 1 60 (4)
```

```
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
     H16       72.     0.913348006E14   H21
     H17       98.     0.671031189E14   H21
     H18      128.     0.513758253E14   H21
     H19      162.     0.40593337E14    H21
     H110     200.     0.32880577E14    H21
     H111     242.     2.7174027E13     H21
     H112     288.     2.2833632E13     H21
     H113     338.     1.9455870E13     H21
     H114     392.     1.6775726E13     H21
     H115     450.     1.4613623E13     H21
     H116     512.     1.2843948E13     H21
     H117     578.     1.1377334E13     H21
     H118     648.     1.0148304E13     H21
     H119     722.     9.1081745E12     H21
     H120     800.     8.2201293E12     H21
0
K
     H21        1.     0.0              H21
TY RBF 5 1 RBF H21
H11    1     H1101  (1)    H12    1     H1201  (2)
H13    1     H1301  (3)    H14    1     H1401  (4)
H15    1     H1501  (5)    H16    1     H1601  (6)
H17    1     H1701  (7)    H18    1     H1801  (8)
H19    1     H1901  (9)    H110   1     H11001 (10)
H111   1     H11101 (11)   H112   1     H11201 (12)
H113   1     H11301 (13)   H114   1     H11401 (14)
H115   1     H11501 (15)   H116   1     H11601 (16)
H117   1     H11701 (17)   H118   1     H11801 (18)
H119   1     H11901 (19)   H120   1     H12001 (20)
0
TY RFF 1 0 RFF H21  0    TY RFF 2 1 RFF H21  (21)   0
MULTI 3
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   NLTE POPULATIONS FROM PREVIOUS DETAIL RUN
:T--------------------------------------------------
 POPULATIONS  81 TITLE RESULTS FROM DETAILED ATOM
 ATOM O          ZEFF   0.00000 WT  16.00000 ABUNDANCE  3.090000E-04
 12P3P4           9.0  3.2904933E+15    22P4S
  1.56134E+04  2.63845E+04  4.46851E+04  7.85182E+04  1.40451E+05  2.52193E+05
  4.50635E+05  7.93349E+05  1.37304E+06  2.32387E+06  3.84651E+06  6.22531E+06

  . . .

  2.00757E+09  1.56322E+09  1.25420E+09  1.02837E+09  8.63412E+08  7.37911E+08
  6.43770E+08  5.68263E+08  5.20057E+08
 13S5S            5.0  1.0813160E+15    22P4S
  2.78202E-03  4.71702E-03  8.00678E-03  1.41148E-02  2.53480E-02  4.57223E-02

  . . .

 0
:T--------------------------------------------------
:T   SURFACE CONTROL COMMANDS
:T--------------------------------------------------
ABUNDANCE H .911  HE .089  O 3.09E-4  0
TURBULENCE 2.
OPACITY RAYLGH END
PRINT 3 3 3 3
```