```
      FUNCTION RANF0()
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      COMMON /CC2/IRAN
      IRAN=AND(IRAN*50392677,2147483647)
C         IRAN=IAND(IRAN*50392677,2147483647)
      RANF0=IRAN/2147483777.0D0
      RETURN
      END
C----------------------
      FUNCTION GAM(X)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      A=X
      B=1D0
   10 IF(A.LE.1D0) GOTO 20
      A=A-1D0
      B=A*B
      GOTO 10
   20 GAM=(1D0-A*(0.577191652-A*(0.988205891-
     @    A*(0.897056937-A*(0.918206857-A*
     @    (0.756704078-A*(0.482199394-A*
     @    (0.193527818-A*0.035868343)))))))*B/A
      RETURN
      END
C----------------------
      FUNCTION ERF(X)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      Y=1./(1.+0.3275911D0*X)
      ERF=1.-Y*(0.254829592D0+Y*(-0.284496736D0+
     @    Y*(1.421413741D0+Y*(-1.453152027D0+
     @    Y*1.061405429D0))))*EXP(-X*X)
      RETURN
      END
C**************************
      PROGRAM JET01
C************************** C2022
      PARAMETER (MOL=1200000, NCELL=40000)
C
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      COMMON /CC2/IRAN
C2024-11-1   CU1  ---------------------------------------1-start
      REAL*8  P(3,MOL),PZ1(MOL),PZ2(MOL)
      REAL*8  CTA(NCELL)
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^1^end
      DIMENSION  LCR(MOL),IP(MOL)
      DIMENSION  IC1(NCELL),IC2(NCELL)
      DIMENSION  SC(8,NCELL),SS(8),OP(50),ASC(8)
      CHARACTER  CHAF*3,FTT*4,FT2*8
      DIMENSION  PRI(4,500),U0(240)
C
C2024-11-1   CU2+ ---------------------------------------2-start
```

```
      PARAMETER (KST9=260, KOT9=240)
      DIMENSION UV(2,KST9+1,KOT9+1),TXY(2,KST9+1,KOT9+1)
      DIMENSION AUV(2,KST9),BUV(2,KOT9)
      DIMENSION AV2(3),ALAM(3)
      DIMENSION BV2(3)
      UB1=3.0
      UB2=1./UB1
      IUSYS=0
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^2^end
C2024-11-1   CU3  ---------------------------------------3-start
      write(*,*) ' INPUT 1=(Usys)  or  0=(Bird)'
      READ(*,*) IUB
      IERR3=0
      IERR4=0
      IERR5=0
      IERR6=0
      IERR7=0
      IERR8=0
      TXMAX=-300.
      TXMIN=300.
      TYMAX=-300.
      TYMIN=300.
      UMAX=-500.
      UMIN=500.
      VMAX=-500.
      VMIN=500.
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^3^end
C
      IERR=0
      IERR1=0
      IERR2=0
C
      RVRALL=1E-10
      RVRGT=0.
      IRAN=584287
      PI=3.14159265358979D0
      SQPI=SQRT(PI)
C
      TEMP=273.+15.
      TEMPW=TEMP
      PTOR=50.
      PPAS=PTOR*101300./760.
      ANUM=PPAS/(1.3807E-23*TEMP)
      PRAT=50.
      ORID=0.0025
      EZA=ORID*0.5
      EZA2=EZA*EZA
C-------------------------
      NIS=1
C2024-11-2
```

```
      K100=5000
C      K100=1000
      I9=100000
      FTT='sjet'
      KS=164
      ES0=1.02
      I2=40
      KO=I2*6
C
      AMC=0.5
      ACT=8.0
C--------------------
      TKN=EZA/I2
      TKN05=TKN*0.5
      TKN000=TKN/1000.0
C------------
      AL1=(ES0-1.)/TKN
      AL2=1./LOG(ES0)
C
      WRITE(*,*) TKN,' =TKN'
C================================
      DO 730 I=1,KO
C
      C05=TKN*(I-1)
      C25=TKN*I
      CTT=(C25*C25-C05*C05)*PI
C
      DO 720 J=1,KS
      N=KS*(I-1)+J
      T15=TKN*DBLE(ES0)**(J-1)
      CTA(N)=CTT*T15
      IF(I.EQ.3) THEN
        CTA(N-KS*2)=CTA(N)+CTA(N-KS)+CTA(N-KS*2)
      ELSEIF(I.GE.4) THEN
        CTA(N-KS*2)=CTA(N)
      ENDIF
  720 CONTINUE
C
  730 CONTINUE
C
      NC=KS*(KO-2)
      WRITE(*,'(A,5I10)') ' NC===',NC
C================================
      CH=TKN*TKN*TKN*PI
      BNUM=ANUM*CH
      WEI=BNUM/AMC
C.................. Argon
      IVSS=0
      OME=0.81
      OMEX=OME-0.5
```

```
      OMEY=(1.-2.*OME)+1.0
      FW=GAM(2.5-OME)
      IF(IVSS.NE.1) THEN
        ALP=1.00
      ELSE
        ALP=1.40
        RALP=1./ALP
      ENDIF
      AMOL=39.94
      RGAS=8314.3/AMOL
      RG2=2.*RGAS
      AMAS=AMOL/6.02E26
      BOL=AMAS*RGAS
      BOL2=2.*BOL
      AMR=AMAS*0.5
      HNH=5./3.
      VISC=2.2E-5
      DIRM=SQRT(5.*(ALP+1.)*(ALP+2.)*SQRT(AMAS*
     @     BOL*273./PI)/(4.*ALP*(5.-2.*OME)*
     @     (7.-2.*OME)*VISC))
      ACXS=PI*DIRM*DIRM
      VM=SQRT(2.*RGAS*TEMP)
      BETA=1./VM
      AVA=2./SQPI*VM
      VRM=SQRT(2.)*AVA
      AMFP=1./(SQRT(2.)*PI*DIRM*DIRM*ANUM*(273./
     @     TEMP)**(OME-0.5))
      DEN0=PPAS/(RGAS*TEMP)
      TAU=AMFP/AVA
C
      RRKN=ORID/AMFP
C-----------------------
      WRITE(*,*) AMAS,DIRM,AMFP,RRKN
C
      VMW=SQRT(RG2*TEMPW)
      BETAW=1./VMW
C-------------------------------------
      CMUL=3.0
      VRMAX=CMUL*VRM
C
      SIG=VRMAX**OMEY
      SIG2=ACXS*(BOL2*273./AMR)**OMEX/FW
      SMAX=SIG*SIG2
C=====================================
      TEX=2./(HNH+1.)*TEMP
      VTEX=SQRT(RG2*TEX)
      BETB=1./VTEX
      EXX=SQRT(HNH*RGAS*TEX)
      DEN01=(2./(HNH+1.))**(1./(HNH-1.))
      WRITE(*,*) ' TEX,         EXX,         DEN'
```

```
      WRITE(*,'(3F15.8)') TEX,EXX,DEN01
C-----------------------------------------------
      UUM=(EXX+SQRT(EXX*EXX+4.*RGAS*TEX))*0.5
      CON=-AMAS/(2.*BOL*TEX)
      UU=UUM*EXP(CON*(UUM-EXX)*(UUM-EXX))
C...UU: Maximum value
      EX=EXX/SQRT(RG2*TEX)
      USA=EXP(-EX*EX)+SQPI*EX*(1+ERF(EX))
      FIN0=(1./4.)*DEN01*ANUM*
     @     SQRT(8.*RGAS*TEX/PI)*USA
      DFIN0=(1./4.)*ANUM/PRAT*AVA
      FINB=(1./4.)*ANUM*AVA
C
      NMO=MOL
C
      ES=TKN*(ES0**KS-1.)/(ES0-1.)
      EO=TKN*KO
C
      DTM=TAU*ACT
C
      FIN=FIN0*EZA*EZA*PI/WEI*DTM
      DFIN=DFIN0*EO*EO*PI/WEI*DTM
      DFINS=DFIN*(EO*2.*PI*ES)/(EO*EO*PI)
C
      FINBAS=FINB*EZA*EZA*PI/WEI*DTM
      write(*,*) fin,dfin,dfins
C-----------------------------------------
      NM=EO*EO*PI*ES*ANUM/PRAT/WEI
      NMM=NM
C2022 -----------------------------------------
      DO 18 M=1,8
   18 SS(M)=0.
      DO 19 L=1,NC
      SC(1,L)=1E-10
      DO 19 M=2,8
   19 SC(M,L)=0.
      DO 191 M=1,KO
  191 U0(M)=0.
C
C2024-11-1   CU4  ---------------------------------------4-start
C: Store the data of the lower left position of the cell and
C: the cell width in an array.
      DO 4411 J=1,KS
        AUV(2,J)=TKN*DBLE(ES0)**(J-1)
 4411   AUV(1,J)=TKN*(DBLE(ES0)**(J-1)-1.)/(ES0-1.)
      DO 4311 I=1,KO-2
        IF(I.EQ.1) THEN
          BUV(1,I)=0.0
          BUV(2,I)=TKN*3.0
        ELSE
```

```
          BUV(1,I)=(I+1.0)*TKN
          BUV(2,I)=TKN
        ENDIF
 4311 CONTINUE
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^4^end
C-------------------------------------------------
      WRITE(*,*) ' SIMULATE-->1  or  MANAGE-->2'
      READ(*,*) KDO
      IF(KDO.EQ.2) GOTO 3354
C-------------------------------------------------
      DO 222 J=1,NM
      PZ1(J)=RANF0()*ES
      PZ2(J)=EO*SQRT(RANF0())
C
      B=SQRT(-LOG(RANF0()))/BETA
      A=2.*PI*RANF0()
      P(1,J)=B*SIN(A)
        B=SQRT(-LOG(RANF0()))/BETA
        A=2.*PI*RANF0()
        P(2,J)=B*SIN(A)
      B=SQRT(-LOG(RANF0()))/BETA
      A=2.*PI*RANF0()
  222 P(3,J)=B*SIN(A)
C-------------------------------------------------
C
      DO 100 J1=1,I9
      IF((J1-1).EQ.(J1-1)/10*10) THEN
      OV=RVRGT/RVRALL
C
C2024-11-1   CU5  ---------------------------------------5-start
      WRITE(*,666) J1,NM,NMM,IERR,IERR1,IERR2,OV
     @      ,IERR3,IERR4,IERR5,IERR6,IERR7,IERR8
  666 FORMAT(I7,I8,'=NM 'I8,'=NMM ',3I7,F15.7,6I7)
      ENDIF
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^5^end
C
      WRITE(*,'(I7$)') J1
      DO 24 I=1,NIS
C
      WRITE(*,'(A$)') ' - M'
      IN=-1
      N=0
C------- MOTION START --------
C
  502 N=N+1
      X0=PZ1(N)
      Y0=PZ2(N)
      U=P(1,N)
      V=P(2,N)
      W=P(3,N)
```

```
      IF (IN.LT.0) THEN
      DTT=DTM
      ELSE
      DTT=DTM*RANF0()
      ENDIF
      X=X0+U*DTT
C
      IF (X.LT.0.) THEN
        DTE=-X0/U
        S=Y0+V*DTE
        S2=W*DTE
        Y2=SQRT(S*S+S2*S2)
        IF (Y2.LE.EZA) GOTO 504
        IF(Y2.GE.EO) GOTO 514
        V=(V*S+W*S2)/Y2
        W=W*Y0/Y2
        DTT=DTT-DTE
C
        B=VMW*SQRT(-LOG(RANF0()))
        A=2.*PI*RANF0()
        U=VMW*SQRT(-LOG(RANF0()))
        V=B*SIN(A)
        W=B*COS(A)
        X0=TKN000
        Y0=Y2
        X=X0+U*DTT
      ENDIF
      IF (X.GT.ES) GOTO 514
      S=Y0+V*DTT
      S2=W*DTT
      Y=SQRT(S*S+S2*S2)
      IF (Y.GE.EO) GOTO 514
      V=(V*S+W*S2)/Y
      W=W*Y0/Y
      GOTO 525
C
  504 SS(2)=SS(2)+1.
      GOTO 544
  514 SS(3)=SS(3)+1.
  544 P(1,N)=P(1,NM)
      P(2,N)=P(2,NM)
      P(3,N)=P(3,NM)
      PZ1(N)=PZ1(NM)
      PZ2(N)=PZ2(NM)
      N=N-1
      NM=NM-1
      GOTO 25
C
  525 PZ1(N)=X
      PZ2(N)=Y
```

```
      P(1,N)=U
      P(2,N)=V
      P(3,N)=W
C
   25 IF (N.LT.NM) GOTO 502
      IF (IN.LT.0) GOTO 560
C
      IF (NM.GT.NMM) NMM=NM
      GOTO 540
C
C---------------- FLOW IN NEW MOL. --------------
  560 CONTINUE
      WRITE(*,'(A$)') 'F'
C
      IN=FIN
      B2=FIN-IN
      IF (B2.GT.RANF0()) IN=IN+1
      SS(5)=SS(5)+FINBAS
      SS(1)=SS(1)+FIN
      DO 1002 MI=1,IN
      NM=NM+1
      PZ1(NM)=0.
      PZ2(NM)=EZA*SQRT(RANF0())*0.999999
C
      B=SQRT(-LOG(RANF0()))/BETB
      A=2.*PI*RANF0()
  825 U=4.*VTEX*RANF0()
      AA=U-EXX
      UB=U*EXP(CON*AA*AA)/UU
      IF (RANF0().GT.UB) GOTO 825
      P(1,NM)=U
      P(2,NM)=B*SIN(A)
 1002 P(3,NM)=B*COS(A)
C
      IF (NM.GT.NMO) THEN
      WRITE(*,'(A)') ' ???  OVER MOL.(1)  ???'
      STOP
      ENDIF
C-------- FLOW IN NEW MOL FROM DOWNSTREAM. -------
C
      WRITE(*,'(A$)') 'D'
      IN=DFINS
      B2=DFINS-IN
      IF (B2.GT.RANF0()) IN=IN+1
      SS(4)=SS(4)+DFINS
      DO 2001 MI=1,IN
      NM=NM+1
      PZ1(NM)=ES*RANF0()
      PZ2(NM)=EO
C
```

```
401       B=SQRT(-LOG(RANF0()))/BETA
402       A=2.*PI*RANF0()
403       P(1,NM)=B*SIN(A)
404       P(3,NM)=B*COS(A)
405  2001 P(2,NM)=-SQRT(-LOG(RANF0()))/BETA
406 C
407       IF (NM.GT.NMO) THEN
408       WRITE(*,'(A)') ' ???  OVER MOL.(2)  ???'
409       STOP
410       ENDIF
411 C
412       IN=DFIN
413       B2=DFIN-IN
414       IF (B2.GT.RANF0()) IN=IN+1
415       SS(4)=SS(4)+DFIN
416       DO 2002 MI=1,IN
417       NM=NM+1
418       PZ1(NM)=ES
419       PZ2(NM)=EO*SQRT(RANF0())
420 C2022
421       KU=PZ2(NM)/TKN-1.00001
422       IF(KU<1) KU=1
423       P(1,NM)=-SQRT(-LOG(RANF0()))/BETA+U0(KU)
424       B=SQRT(-LOG(RANF0()))/BETA
425       A=2.*PI*RANF0()
426       P(2,NM)=B*SIN(A)
427  2002 P(3,NM)=B*COS(A)
428 C
429       IF (NM.GT.NMO) THEN
430       WRITE(*,'(A)') ' ???  OVER MOL.(3)  ???'
431       STOP
432       ENDIF
433       GOTO 502
434 C ---------------IDENT-------------------
435   540 WRITE(*,'(A$)') 'I'
436 C
437       DO 135 N=1,NM
438 C
439       IF(PZ1(N).LT.0.) THEN
440         PZ1(N)=1.E-10
441         IERR=IERR+1
442       ENDIF
443       IF(PZ2(N).LT.0.) THEN
444         PZ2(N)=1.E-10
445         IERR1=IERR1+1
446       ENDIF
447 C
448         A=LOG(AL1*PZ1(N)+1.)*AL2
449         II=A+0.999999D0
450         IF(II.EQ.0) II=1
```

```
C
        JJ=DBLE(PZ2(N))/TKN+0.9999999D0
        IF(JJ.LE.3) THEN
          JJ=1
        ELSE
          JJ=JJ-2
        ENDIF
C
        IP(N)=KS*(JJ-1)+II
        IF(IP(N).GT.NC) THEN
          IP(N)=NC
          IERR2=IERR2+1
        ENDIF
C
  135 CONTINUE
C
C-----------------INDEX---------------------
      WRITE(*,'(A$)') 'X'
C
      DO 27 N=1,NC
   27 IC1(N)=0
      DO 28 M=1,NM
      N=IP(M)
   28 IC1(N)=IC1(N)+1
      K=0
      DO 29 N=1,NC
      IC2(N)=K
      K=K+IC1(N)
   29 IC1(N)=0
      DO 30 M=1,NM
      N=IP(M)
      IC1(N)=IC1(N)+1
      K=IC2(N)+IC1(N)
   30 LCR(K)=M
C
C----------------- COLLISION -------------------
      WRITE(*,'(A$)') 'C'
C
C2024-11-1   CU6  ---------------------------------------6-start
      IF(IUSYS==0 .OR. IUB==0) THEN
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^6^end
C
      DO 3241 N=1,NC
C
      IF(IC1(N).LT.2) GOTO 3241
      AUT=IC1(N)*(IC1(N)-1.0)*WEI*SMAX/(2.*CTA(N))
      CN=AUT*DTM
      ICN=INT(CN)
      COCN=CN-ICN
      IF(RANF0().LT.COCN) ICN=ICN+1
```

```
C
      DO 367 IH=1,ICN
C
      K=DBLE(RANF0())*IC1(N)+IC2(N)+0.9999999D0
C
      IF(K.EQ.IC2(N)) K=K+1
      L=LCR(K)
C
      K2=DBLE(RANF0())*(IC1(N)-1)+IC2(N)+
     @   0.9999999D0
      IF(K2.EQ.IC2(N)) K2=K2+1
      IF(K.EQ.K2) K2=IC1(N)+IC2(N)
      M=LCR(K2)
C
      VRC1=P(1,L)-P(1,M)
      VRC2=P(2,L)-P(2,M)
      VRC3=P(3,L)-P(3,M)
C
      VR=SQRT(VRC1*VRC1+VRC2*VRC2+VRC3*VRC3)
C
      RVRALL=RVRALL+1.
      IF(VR.GT.VRMAX) RVRGT=RVRGT+1.
      B=VR**OMEY/SIG
      A=RANF0()
      IF(A.GE.B) GOTO 367
C
      IF(IVSS.NE.1) THEN
        B=2.*RANF0()-1.
        A=SQRT(1.-B*B)
        VRC1=B*VR
        B=2.*PI*RANF0()
        VRC2=A*COS(B)*VR
        VRC3=A*SIN(B)*VR
      ELSE
        B=2.*(RANF0()**RALP)-1.
        A=SQRT(1.-B*B)
        C=2.*PI*RANF0()
        CO=COS(C)
        SI=SIN(C)
        D=SQRT(VRC2*VRC2+VRC3*VRC3)
        IF(D.GT.1.E-6) THEN
          V1T=B*VRC1+A*SI*D
          V2T=B*VRC2+A*(VR*VRC3*CO-VRC1*VRC2*SI)/D
         VRC3=B*VRC3-A*(VR*VRC2*CO+VRC1*VRC3*SI)/D
         VRC1=V1T
         VRC2=V2T
        ELSE
          V1T=B*VRC1
          VRC2=A*CO*VRC1
          VRC3=A*SI*VRC1
```

```
551           VRC1=V1T
552         ENDIF
553       ENDIF
554 C
555       SC(8,N)=SC(8,N)+1.
556 C
557       VCCM=0.5*(P(1,L)+P(1,M))
558       P(1,L)=VCCM+VRC1*0.5
559       P(1,M)=VCCM-VRC1*0.5
560       VCCM=0.5*(P(2,L)+P(2,M))
561       P(2,L)=VCCM+VRC2*0.5
562       P(2,M)=VCCM-VRC2*0.5
563       VCCM=0.5*(P(3,L)+P(3,M))
564       P(3,L)=VCCM+VRC3*0.5
565       P(3,M)=VCCM-VRC3*0.5
566 C
567   367 CONTINUE
568 C
569  3241 CONTINUE
570 C
571 C
572 C2024-11-1   CU7  ---------------------------------------7-start
573       ELSE
574 C
575       WRITE(*,'(A$)') '-Usys'
576 C
577       DO 13241 N=1,NC
578 C
579        I7=(N-1)/KS+1
580        J=MOD(N-1,KS)+1
581 C2024-10-31
582        I7P=I7+1
583        JP=J+1
584 C
585       IF(IC1(N).LT.2) GOTO 13241
586 C
587 C2012-8
588       AV1=0
589       AV3=0
590       BV3=0
591       DO JJ=1,3
592         AV2(JJ)=0
593         BV2(JJ)=0
594       ENDDO
595 C2012-8
596       DO JJ=1,IC1(N)
597         M=LCR(IC2(N)+JJ)
598         AV1=AV1+1
599         AV3=AV3+(P(1,M)*P(1,M)+P(2,M)*P(2,M)+P(3,M)*P(3,M))
600       DO JJ2=1,3
```

```
601         AV2(JJ2)=AV2(JJ2)+P(JJ2,M)
602       ENDDO
603       ENDDO
604       AV22=AV2(1)*AV2(1)+AV2(2)*AV2(2)+AV2(3)*AV2(3)
605 C
606       AUT=IC1(N)*(IC1(N)-1.0)*WEI*SMAX/(2.*CTA(N))
607       CN=AUT*DTM
608       ICN=INT(CN)
609       COCN=CN-ICN
610       IF(RANF0().LT.COCN) ICN=ICN+1
611 C
612       DO 1367 IH=1,ICN
613 C
614       K=DBLE(RANF0())*IC1(N)+IC2(N)+0.9999999D0
615 C
616       IF(K.EQ.IC2(N)) K=K+1
617       L=LCR(K)
618 C
619 C: Calculate the difference between the molecular position and the lower
620 C: left of the cell, and using its ratio to the cell width start bilinear
621 C: interpolation calculation.
622       DDXX=(PZ1(L)-AUV(1,J))
623       APP=DDXX/AUV(2,J)
624       APPM=1.0-APP
625 C: Same as above.
626       DDYY=(PZ2(L)-BUV(1,I7))
627       AQQ=DDYY/BUV(2,I7)
628       AQQM=1.0-AQQ
629 C: Calculation of temperature and flow velocity at the molecular position
630 C: by bilinear interpolation.
631       TTXL=AQQM*(APPM*TXY(1,J,I7)+APP*TXY(1,JP,I7))+
632      +     AQQ*(APPM*TXY(1,J,I7P)+APP*TXY(1,JP,I7P))
633 C: Same as above.
634       TTYL=AQQM*(APPM*TXY(2,J,I7)+APP*TXY(2,JP,I7))+
635      +     AQQ*(APPM*TXY(2,J,I7P)+APP*TXY(2,JP,I7P))
636 C: Same as above.
637       UUL=AQQM*(APPM*UV(1,J,I7)+APP*UV(1,JP,I7))+
638      +    AQQ*(APPM*UV(1,J,I7P)+APP*UV(1,JP,I7P))
639 C: Same as above.
640       VVL=AQQM*(APPM*UV(2,J,I7)+APP*UV(2,JP,I7))+
641      +    AQQ*(APPM*UV(2,J,I7P)+APP*UV(2,JP,I7P))
642 C
643       K2=DBLE(RANF0())*(IC1(N)-1)+IC2(N)+
644      @   0.9999999D0
645       IF(K2.EQ.IC2(N)) K2=K2+1
646       IF(K.EQ.K2) K2=IC1(N)+IC2(N)
647       M=LCR(K2)
648 C
649 C: Perform the same operation as above for the second molecular position.
650       DDXX=(PZ1(M)-AUV(1,J))
```

```
      APP=DDXX/AUV(2,J)
      APPM=1.0-APP
C: Same as above.
      DDYY=(PZ2(M)-BUV(1,I7))
      AQQ=DDYY/BUV(2,I7)
      AQQM=1.0-AQQ
C: Same as above.
      TTXM=AQQM*(APPM*TXY(1,J,I7)+APP*TXY(1,JP,I7))+
     +     AQQ*(APPM*TXY(1,J,I7P)+APP*TXY(1,JP,I7P))
C: Same as above.
      TTYM=AQQM*(APPM*TXY(2,J,I7)+APP*TXY(2,JP,I7))+
     +     AQQ*(APPM*TXY(2,J,I7P)+APP*TXY(2,JP,I7P))
C: Same as above.
      UUM=AQQM*(APPM*UV(1,J,I7)+APP*UV(1,JP,I7))+
     +    AQQ*(APPM*UV(1,J,I7P)+APP*UV(1,JP,I7P))
C: Same as above.
      VVM=AQQM*(APPM*UV(2,J,I7)+APP*UV(2,JP,I7))+
     +    AQQ*(APPM*UV(2,J,I7P)+APP*UV(2,JP,I7P))
C
C-------------
C: Check the limit of the temperature ratio (and velocity difference).
      TSX=TTXL/TTXM
      IF(TSX.GT.UB1) THEN
        TSX=SQRT(UB1)
        IERR3=IERR3+1
      ELSEIF(TSX.LT.UB2) THEN
        TSX=SQRT(UB2)
        IERR4=IERR4+1
      ELSE
        TSX=SQRT(TSX)
      ENDIF
C: Same as above.
      TSY=TTYL/TTYM
      IF(TSY.GT.UB1) THEN
        TSY=SQRT(UB1)
        IERR5=IERR5+1
      ELSEIF(TSY.LT.UB2) THEN
        TSY=SQRT(UB2)
        IERR6=IERR6+1
      ELSE
        TSY=SQRT(TSY)
      ENDIF
C: Molecular velocity correction.
      P1M=UUL+(P(1,M)-UUM)*TSX
      P2M=VVL+(P(2,M)-VVM)*TSY
      P3M=P(3,M)*TSY
C: Perform collision calculation using the conventional method
C: with the corrected molecular velocity.
      VRC1=P(1,L)-P1M
      VRC2=P(2,L)-P2M
```

```
      VRC3=P(3,L)-P3M
C
      VR=SQRT(VRC1*VRC1+VRC2*VRC2+VRC3*VRC3)
C
      RVRALL=RVRALL+1.
      IF(VR.GT.VRMAX) RVRGT=RVRGT+1.
      B=VR**OMEY/SIG
      A=RANF0()
      IF(A.GE.B) GOTO 1367
C
      IF(IVSS.NE.1) THEN
        B=2.*RANF0()-1.
        A=SQRT(1.-B*B)
        VRC1=B*VR
        B=2.*PI*RANF0()
        VRC2=A*COS(B)*VR
        VRC3=A*SIN(B)*VR
      ELSE
        B=2.*(RANF0()**RALP)-1.
        A=SQRT(1.-B*B)
        C=2.*PI*RANF0()
        CO=COS(C)
        SI=SIN(C)
        D=SQRT(VRC2*VRC2+VRC3*VRC3)
        IF(D.GT.1.E-6) THEN
          V1T=B*VRC1+A*SI*D
          V2T=B*VRC2+A*(VR*VRC3*CO-VRC1*VRC2*SI)/D
         VRC3=B*VRC3-A*(VR*VRC2*CO+VRC1*VRC3*SI)/D
         VRC1=V1T
         VRC2=V2T
        ELSE
          V1T=B*VRC1
          VRC2=A*CO*VRC1
          VRC3=A*SI*VRC1
          VRC1=V1T
        ENDIF
      ENDIF
C
C: Note the variable symbols of the molecular velocity components.
      VCCM=0.5*(P(1,L)+P1M)
      AP1L=VCCM+VRC1*0.5
      P1M=VCCM-VRC1*0.5
      VCCM=0.5*(P(2,L)+P2M)
      AP2L=VCCM+VRC2*0.5
      P2M=VCCM-VRC2*0.5
      VCCM=0.5*(P(3,L)+P3M)
      AP3L=VCCM+VRC3*0.5
      P3M=VCCM-VRC3*0.5
C: Velocity correction caused by returning to the original position.
      AP1M=(P1M-UUL)/TSX+UUM
```

```
      AP2M=(P2M-VVL)/TSY+VVM
      AP3M=P3M/TSY
C
CBB3---START
C2022-4-6
C2022-4-8        SC(8,N)=SC(8,N)+1.0
C2008-4
        P(1,L)=AP1L
        P(2,L)=AP2L
        P(3,L)=AP3L
        P(1,M)=AP1M
        P(2,M)=AP2M
        P(3,M)=AP3M
C
 1367 CONTINUE
C
C2012-8
      DO JJ=1,IC1(N)
        M=LCR(IC2(N)+JJ)
        BV3=BV3+(P(1,M)*P(1,M)+P(2,M)*P(2,M)+P(3,M)*P(3,M))
        DO JJ2=1,3
          BV2(JJ2)=BV2(JJ2)+P(JJ2,M)
        ENDDO
      ENDDO
      BV22=BV2(1)*BV2(1)+BV2(2)*BV2(2)+BV2(3)*BV2(3)
C2012-8 C2012-9 PLUS (Negative values are not allowed.)
      ATAU=  SQRT( (AV1*BV3-BV22)/(AV1*AV3-AV22) )
C2012-8
      DO JJ2=1,3
        ALAM(JJ2)=(BV2(JJ2)-ATAU*AV2(JJ2))/AV1
      ENDDO
      DO JJ=1,IC1(N)
        M=LCR(IC2(N)+JJ)
        DO JJ2=1,3
          P(JJ2,M)=(P(JJ2,M)-ALAM(JJ2))/ATAU
        ENDDO
      ENDDO
C
C2012-8 -CHECK
      BV3=0
      DO JJ=1,3
        BV2(JJ)=0
      ENDDO
      DO JJ=1,IC1(N)
        M=LCR(IC2(N)+JJ)
        BV3=BV3+(P(1,M)*P(1,M)+P(2,M)*P(2,M)+P(3,M)*P(3,M))
        DO JJ2=1,3
          BV2(JJ2)=BV2(JJ2)+P(JJ2,M)
        ENDDO
      ENDDO
```

```
      DO JJ2=1,3
        AVAV=(AV2(JJ2)-BV2(JJ2))/AV2(JJ2)
C2022-4 C2024-11-2
        IF(AVAV.GT.1E-4) THEN
C        IF(AVAV.GT.1E-3) THEN
C2022-4          WRITE(*,'(A,4I10,G15.7)') ' C2012-AV ',N,JJ,M,JJ2,AVAV
C2022-4          STOP
          IERR7=IERR7+1
        ENDIF
      ENDDO
      AVAV=(AV3-BV3)/AV3
C2022-4
      IF(AVAV.GT.1E-4) THEN
C2022-4        WRITE(*,'(A,3I10,G15.7)') ' C2012-AE ',N,JJ,M,AVAV
C2022-4        STOP
        IERR8=IERR8+1
      ENDIF
C
13241 CONTINUE
C
      ENDIF
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^7^end
C
C
   24 CONTINUE
C----------------------
C
      DO 23 M=1,NM
C
      N=IP(M)
      SC(1,N)=SC(1,N)+1.
      SC(2,N)=SC(2,N)+P(1,M)
      SC(3,N)=SC(3,N)+P(2,M)
      SC(4,N)=SC(4,N)+P(3,M)
      SC(5,N)=SC(5,N)+P(1,M)*P(1,M)
      SC(6,N)=SC(6,N)+P(2,M)*P(2,M)
      SC(7,N)=SC(7,N)+P(3,M)*P(3,M)
C
   23 CONTINUE
C
      WRITE(*,'(A,2I9)') ' E ',NM,NMM
C
      II22=J1/K100
      IF(J1.EQ.II22*K100) THEN
      KEIZOK=II22
         LC1=MOD(KEIZOK,10)+48
         LC2=MOD(KEIZOK/10,10)+48
       IF(KEIZOK.LT.100) THEN
         CHAF=CHAR(LC2)//CHAR(LC1)
       ELSE
```

```
851          LC3=MOD(KEIZOK/100,10)+48
852          CHAF=CHAR(LC3)//CHAR(LC2)//CHAR(LC1)
853         ENDIF
854          FT2=FTT//'c'//CHAF
855 C2022-----------------------------------------
856       OPEN(3,FILE=FT2,STATUS='UNKNOWN')
857       WRITE(3,'(I8)') NC
858       DO 451 N=1,NC
859       WRITE(3,466) (SC(L,N),L=1,7)
860   466 FORMAT(12E15.7)
861       N3=MOD(N-1,KS)+1
862       IF(N3==KS) THEN
863       N2=(N-1)/KS+1
864       U0(N2)=(SC(2,N-2)/SC(1,N-2)+
865      @    SC(2,N-1)/SC(1,N-1)+SC(2,N)/SC(1,N))/3
866       ENDIF
867   451 CONTINUE
868       CLOSE(3)
869 C
870 C
871 C2024-11-1   CU8  ---------------------------------------8-start
872       TXMAX=-300.
873       TXMIN=300.
874       TYMAX=-300.
875       TYMIN=300.
876       UMAX=-500.
877       UMIN=500.
878       VMAX=-500.
879       VMIN=500.
880 C
881       N=0
882       DO 7302 I=1,KO-2
883       DO 7303 J=1,KS
884       N=N+1
885       OP(1)=SC(1,N)
886       OP(4)=SC(2,N)/OP(1)
887       OP(5)=SC(3,N)/OP(1)
888       OP(6)=SC(4,N)/OP(1)
889       OP(7)=(SC(5,N)/OP(1)-OP(4)*OP(4))/RGAS
890       OP(8)=(SC(6,N)/OP(1)-OP(5)*OP(5))/RGAS
891       OP(9)=(SC(7,N)/OP(1)-OP(6)*OP(6))/RGAS
892       OP(10)=(OP(7)+OP(8)+OP(9))/3.
893       OP(11)=(OP(8)+OP(9))/2.
894 C
895       IF(TXMAX.LT.OP(7)) TXMAX=OP(7)
896       IF(TXMIN.GT.OP(7)) TXMIN=OP(7)
897       IF(TYMAX.LT.OP(11)) TYMAX=OP(11)
898       IF(TYMIN.GT.OP(11)) TYMIN=OP(11)
899       IF(UMAX.LT.OP(4)) UMAX=OP(4)
900       IF(UMIN.GT.OP(4)) UMIN=OP(4)
```

```
      IF(VMAX.LT.OP(5)) VMAX=OP(5)
      IF(VMIN.GT.OP(5)) VMIN=OP(5)
C
C: Flow velocity at the center of the cell is extracted to create data
C: for the edge of the cell.
      UV(1,J,I)=OP(4)
      UV(2,J,I)=OP(5)
C: Temperature at the center of the cell is extracted to create data
C: for the edge of the cell.
C      TXY(1,J,I)=OP(10)
C      TXY(2,J,I)=OP(10)
      TXY(1,J,I)=OP(7)
      TXY(2,J,I)=OP(11)
C
 7303 CONTINUE
 7302 CONTINUE
C
      IUSYS=1
C
C: Create data on both ends of the cell in the x and y directions
C: (a slightly complicated).
C5
      DO M=KO-2+1,1,-1
      DO L=1,KS
        IF(M==KO-2+1) THEN
          UV(1,L,M)=(UV(1,L,M-1)*3.-UV(1,L,M-2))*0.5
          UV(2,L,M)=(UV(2,L,M-1)*3.-UV(2,L,M-2))*0.5
          TXY(1,L,M)=(TXY(1,L,M-1)*3.-TXY(1,L,M-2))*0.5
          TXY(2,L,M)=(TXY(2,L,M-1)*3.-TXY(2,L,M-2))*0.5
        ELSEIF(M==2) THEN
          UV(1,L,M)=(UV(1,L,M)*3.+UV(1,L,M-1))/4.
          UV(2,L,M)=(UV(2,L,M)*3.+UV(2,L,M-1))/4.
          TXY(1,L,M)=(TXY(1,L,M)*3.+TXY(1,L,M-1))/4.
          TXY(2,L,M)=(TXY(2,L,M)*3.+TXY(2,L,M-1))/4.
        ELSEIF(M==1) THEN
          UV(1,L,M)=UV(1,L,M)*2.-UV(1,L,M+1)
          UV(2,L,M)=UV(2,L,M)*2.-UV(2,L,M+1)
          TXY(1,L,M)=TXY(1,L,M)*2.-TXY(1,L,M+1)
          TXY(2,L,M)=TXY(2,L,M)*2.-TXY(2,L,M+1)
        ELSE
          UV(1,L,M)=(UV(1,L,M)+UV(1,L,M-1))*0.5
          UV(2,L,M)=(UV(2,L,M)+UV(2,L,M-1))*0.5
          TXY(1,L,M)=(TXY(1,L,M)+TXY(1,L,M-1))*0.5
          TXY(2,L,M)=(TXY(2,L,M)+TXY(2,L,M-1))*0.5
        ENDIF
      ENDDO
      ENDDO
CC5
      DO L=KS+1,1,-1
      DO M=1,KO-2+1
```

```
          IF(L==KS+1) THEN
            UV(1,L,M)=(UV(1,KS,M)*3.-UV(1,KS-1,M))*0.5
            UV(2,L,M)=(UV(2,KS,M)*3.-UV(2,KS-1,M))*0.5
            TXY(1,L,M)=(TXY(1,KS,M)*3.-TXY(1,KS-1,M))*0.5
            TXY(2,L,M)=(TXY(2,KS,M)*3.-TXY(2,KS-1,M))*0.5
          ELSEIF(L==1) THEN
            UV(1,L,M)=UV(1,L,M)*2.-UV(1,L+1,M)
            UV(2,L,M)=UV(2,L,M)*2.-UV(2,L+1,M)
            TXY(1,L,M)=TXY(1,L,M)*2.-TXY(1,L+1,M)
            TXY(2,L,M)=TXY(2,L,M)*2.-TXY(2,L+1,M)
          ELSE
            UV(1,L,M)=(UV(1,L,M)+UV(1,L-1,M))*0.5
            UV(2,L,M)=(UV(2,L,M)+UV(2,L-1,M))*0.5
            TXY(1,L,M)=(TXY(1,L,M)+TXY(1,L-1,M))*0.5
            TXY(2,L,M)=(TXY(2,L,M)+TXY(2,L-1,M))*0.5
          ENDIF
      ENDDO
      ENDDO
CC5
      DO M=41,241
        UV(1,1,M)=0.
        UV(2,1,M)=0.
        TXY(1,1,M)=288.
        TXY(2,1,M)=288.
      ENDDO
CC5
      DO M=1,40
        UV(1,1,M)=EXX
        UV(2,1,M)=0.
        TXY(1,1,M)=TEX
        TXY(2,1,M)=TEX
      ENDDO
CC5-end
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^8^end
C
C
C---------------------------------
      A=NIS*DTM*K100/WEI
      DO 140 M=4,8
  140 OP(M)=SS(M-3)/A
      OP(11)=A
      OP(12)=(OP(6)-OP(7))/OP(8)
      OP(13)=(OP(4)-OP(5))/OP(8)
C
      DO 42 N=1,2
   42 PRI(N,KEIZOK)=OP(N+11)
C
      J0=KEIZOK
      OPEN(9,FILE=FTT//'4',STATUS='UNKNOWN')
      DO 43 N=1,2
```

```
      WRITE(9,'(I8,F12.7)') 1,PRI(N,1)
      DO 402 K=1,J0-1
      I2=J0-K
c
      S=0
      DO 404 K1=K,J0
  404 S=S+PRI(N,K1)
      S=S/(I2+1)
c
      WRITE(9,'(I8,F12.7,I10,F12.7)')
     @                K+1,PRI(N,K+1),I2+1,S
  402 CONTINUE
      write(9,*) ' --------------------------'
C
   43 CONTINUE
      CLOSE(9)
C
      DO 118 M=1,8
  118 SS(M)=0.
      DO 119 L=1,NC
      SC(1,L)=1E-10
      DO 119 M=2,8
  119 SC(M,L)=0.
C
      ENDIF
C
  100 CONTINUE
C
      STOP
C================================================
 3354 WRITE(*,*) ' ***** DATA MANAGEMENT *****'
      WRITE(*,*) ' INPUT X LIMIT.....   10 ?'
      READ(*,*) XLIM
      WRITE(*,*) ' INPUT START No.'
      READ(*,*) KDO1
      WRITE(*,*) ' INPUT LAST No.'
      READ(*,*) KDO2
C
      KKD=KDO2-KDO1+1
      DO 3355 I=KDO1,KDO2
      WRITE(*,*) I
C
         LC1=MOD(I,10)+48
         LC2=MOD(I/10,10)+48
       IF(I.LT.100) THEN
         CHAF=CHAR(LC2)//CHAR(LC1)
       ELSE
         LC3=MOD(I/100,10)+48
         CHAF=CHAR(LC3)//CHAR(LC2)//CHAR(LC1)
       ENDIF
```

```
1051          FT2=FTT//'c'//CHAF
1052 C
1053       OPEN(3,FILE=FT2,STATUS='UNKNOWN')
1054       READ(3,'(I8)') NC
1055       DO 4513 N=1,NC
1056       READ(3,466) (ASC(L),L=1,7)
1057       DO 4514 L=1,7
1058  4514 SC(L,N)=SC(L,N)+ASC(L)
1059  4513 CONTINUE
1060       CLOSE(3)
1061 C
1062  3355 CONTINUE
1063 C
1064       DO 301 N=1,NC
1065       DO 301 L=1,7
1066   301 SC(L,N)=SC(L,N)/KKD
1067 CM
1068       N=0
1069       OPEN(8,FILE='OUTD',STATUS='UNKNOWN')
1070 C
1071 C2024-11-1   CU9  --------  FOR TECPLOT  ---------------9-start
1072 C        KSNEW=0
1073 C        DO J=1,KS
1074 C          C15=TKN*(DBLE(ES0)**(J-1)-1.)/(ES0-1.)
1075 C          T15=TKN*DBLE(ES0)**(J-1)*0.5
1076 C          C1=C15+T15
1077 C          XZ=C1/(2.*EZA)
1078 C          IF(XZ.GT.XLIM) THEN
1079 C          ELSE
1080 C            KSNEW=KSNEW+1
1081 C          ENDIF
1082 C        ENDDO
1083 C        WRITE(8,'(A,A)') 'VARIABLES =  "x", "y", "n", "u", "v",',
1084 C     +                   ' "T", "Tx", "Ty", "M"'
1085 C        WRITE(8,'(A,I7,A,I7,A)') 'ZONE I=',KSNEW,
1086 C     +                           ',   J=',KO-2,',  F=POINT'
1087 C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^9^end
1088 C
1089       DO 302 I=1,KO-2
1090       IF(I.EQ.1) THEN
1091         C2=TKN*1.5
1092       ELSE
1093         C2=TKN*(I+1.5)
1094       ENDIF
1095       DO 303 J=1,KS
1096       N=N+1
1097       C15=TKN*(DBLE(ES0)**(J-1)-1.)/(ES0-1.)
1098       T15=TKN*DBLE(ES0)**(J-1)*0.5
1099       C1=C15+T15
1100       XZ=C1/(2.*EZA)
```

```
      YZ=C2/(2.*EZA)
      IF(XZ.GT.XLIM) GOTO 303
      OP(1)=SC(1,N)
      OP(2)=OP(1)/(AMC*K100)
      OP(3)=OP(2)*CH/CTA(N)
      OP(4)=SC(2,N)/OP(1)
      OP(5)=SC(3,N)/OP(1)
      OP(6)=SC(4,N)/OP(1)
      OP(7)=(SC(5,N)/OP(1)-OP(4)*OP(4))/RGAS
      OP(8)=(SC(6,N)/OP(1)-OP(5)*OP(5))/RGAS
      OP(9)=(SC(7,N)/OP(1)-OP(6)*OP(6))/RGAS
      OP(10)=(OP(7)+OP(8)+OP(9))/3.
      OP(11)=(OP(8)+OP(9))/2.
      OP(12)=SQRT((OP(4)*OP(4)+OP(5)*OP(5)+
     @       OP(6)*OP(6))/(HNH*RGAS*OP(10)))
      WRITE(8,93) XZ,YZ,OP(3),OP(4)/VM,OP(5)/VM,
     @  OP(10)/TEMP,OP(7)/TEMP,OP(11)/TEMP,OP(12)
   93 FORMAT(10E15.7)
  303 CONTINUE
      WRITE(8,'(1X)')
  302 CONTINUE
      CLOSE(8)
C
      WRITE(*,*) '      E  N  D  '
      STOP
C
      END
```