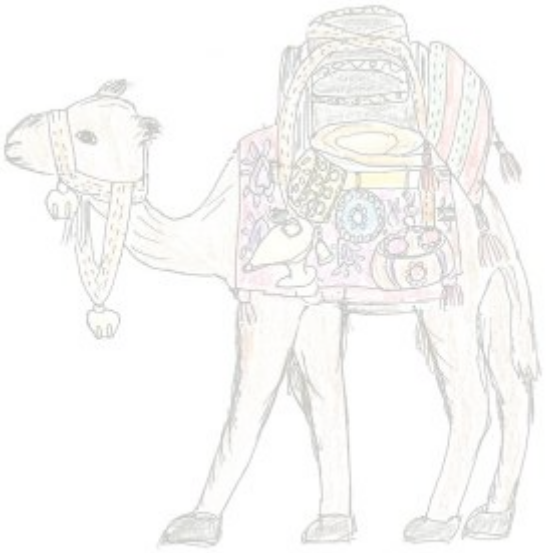
```
      SUBROUTINE G2_HANKEL(GB,G,M,N,XM,YM,SM,XN,YN,KH, H,HB)
C ***********************************************************************
      REAL GB(M,M),G(M,M),XM(M),YM(M),SM(M),XN(M),YN(M),KH
      COMPLEX IM,H(M,M),HB(M,M), RS,RT

      OPEN(UNIT=5,FILE='5.TMP',FORM='UNFORMATTED',status='UNKNOWN')
      OPEN(UNIT=4,FILE='4.TMP',FORM='UNFORMATTED',status='UNKNOWN')

      PAI=3.1415927
      IM=(0.,1.)
      DO 100 I=1,N
      DO 100 J=1,N
      IF(I.NE.J) THEN
        R=SQRT((XM(I)-XM(J))**2+(YM(I)-YM(J))**2)
        RK=KH*R
        CALL BESJNS(RK,0,BJO,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- J0'
1       FORMAT(1H0,'ILL=',I7,A5)
        CALL BESJNS(RK,1,BJ1,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- J1'
        CALL BESYNS(RK,0,BYO,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- Y0'
        CALL BESYNS(RK,1,BY1,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- Y1'
        RN=((XM(J)-XM(I))*XN(J)+(YM(J)-YM(I))*YN(J))/R
        RS=0.5*IM*KH*(BJ1+IM*BY1)*SM(J)*RN
        RT=-0.5*IM*(BJO+IM*BYO)*SM(J)
      ELSE
       RS=(1.,0.)
        RT=(ALOG(KH*SM(J)/4.)-0.42278-IM*PAI/2.)/PAI*SM(J)
      END IF
101   GB(I,J)=REAL(RS)
      G(I,J)=AIMAG(RS)
100   HB(I,J)=RT
      REWIND 5
      WRITE(5) ((GB(I,J),J=1,N),I=1,N)
      WRITE(5) ((G(I,J),J=1,N),I=1,N)
      ENDFILE (UNIT=5)
```

```
      CALL CMINVS(GB,G,M,N)
      DO    I=1,N
      DO    J=1,N
      RS=(0.,0.)
      DO    K=1,N
      RS=RS+(GB(I,K)+IM*G(I,K))*HB(K,J)
      END DO
      H(I,J)=RS
      END DO
      END DO
      CLOSE(4)
      CLOSE(5)
      RETURN
      END
C*******************************************************************
      SUBROUTINE BESJNS(X,N,BJN,ILL)
C ************************************
      BJN=0.0
      IF(N) 10,20,20
10    ILL=1
      RETURN
20    IF(X) 30,21,31
21    IF(N.GT.1) GO TO 30
      ILL=0
      IF(N.EQ.0) BJN=1.0
      RETURN
30    ILL=2
      RETURN
31    IF(X-15.0) 32,32,34
32    NTEST=20.0+10.0*X-X*X/3.0
      GO TO 36
34    NTEST=110.0+X/2.0
36    IF(N-NTEST) 40,38,38
38    ILL=3
      RETURN
40    ILL=0
C
C -- *** COMPUTE STARTING VALUE OF M *** --
```

```
C
      N1=0
      IF(X.LT.1.0) GO TO 54
      IF(X.LT.10.0) GO TO 53
      IF(X.LT.50.0) GO TO 52
      IF(X.LT.100.0) GO TO 51
      M=X+35.0
      GO TO 55
51    M=1.1*X+25.0
      GO TO 55
52    M=1.3*X+15.0
      N1=N+10
      GO TO 55
53    M=2.0*X+8.0
      N1=N+7
      GO TO 55
54    M=4.0*X+6.0
55    M=MAX0(M,N1)
C
C --- ** SET F(M),F(M-1) ** ---
C
      FM1=1.0E-30
      FM=0.0
      ALPHA=0.0
      IF(M-(M/2)*2) 120,110,120
110   JT=-1
      GO TO 130
120   JT=1
130   M2=M-2
      DO 160 K=1,M2
      MK=M-K
      FMK=FLOAT(MK)
      BMK=2.0*FMK*FM1/X-FM
      FM=FM1
      FM1=BMK
      IF(MK-N-1) 150,140,150
140   BJN=BMK
150   JT=-JT
```



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```
      S=1+JT
160   ALPHA=ALPHA+BMK*S
      BMK=2.0*FM1/X-FM
      IF(N) 180,170,180
170   BJN=BMK
180   ALPHA=ALPHA+BMK
      BJN=BJN/ALPHA
      RETURN
      END
C**************************************
      SUBROUTINE BESYNS(X,N,BYN,ILL)
C **************************************
      BYN=-1.0E30
      IF(N) 180,10,10
10    ILL=0
      IF(X) 190,11,20
11    IF(N.GT.1) GO TO 190
      RETURN
20    PI=3.141592653
      IF(X-4.0) 40,40,30
30    T=4.0/X
      T=T*T
      P0=((((-0.0000037043*T+0.0000173565)*T-0.0000487613)*T
     &+0.0001734300)*T-0.0017530620)*T+0.3989422793
      Q0=(((((0.0000032312*T-0.0000142078)*T+0.0000342468)*T
     &-0.0000869791)*T+0.0004564324)*T-0.0124669441
      P1=((((0.0000042414*T-0.0000200920)*T+0.0000580759)*T
     &-0.0002232030)*T+0.0029218256)*T+0.3989422819
      Q1=((((-0.0000036594*T+0.0000162200)*T-0.0000398708)*T
     &+0.0001064741)*T-0.0006390400)*T+0.0374008364
      A=SQRT(2.0*PI)
      B=4.0*A
      P0=A*P0
      Q0=B*Q0/X
      P1=A*P1
      Q1=B*Q1/X
      A=X-PI/4.0
      B=SQRT(2.0/(PI*X))
```

```
      Y0=B*(P0*SIN(A)+Q0*COS(A))
      Y1=B*(-P1*COS(A)+Q1*SIN(A))
      GO TO 90
C
C --- ** COMPUTE Y0,Y1 FOR X <= 4 ** ---
C
40    XX=X/2.0
      X2=XX*XX
      T=ALOG(XX)+0.5772156649
      SUM=0.0
      TERM=T
      Y0=T
      DO 70 L=1,15
      IF(L-1) 50,60,50
50    SUM=SUM+1.0/FLOAT(L-1)
60    FLL=L
      TS=T-SUM
      TERM=(TERM*(-X2)/(FLL*FLL))*(1.0-1.0/(FLL*TS))
70    Y0=Y0+TERM
      TERM=XX*(T-0.5)
      SUM=0.0
      Y1=TERM
      DO 80 L=2,16
      SUM=SUM+1.0/FLOAT(L-1)
      FLL=L
      FL1=FLL-1.0
      TS=T-SUM
      TERM=(TERM*(-X2)/(FL1*FLL))*((TS-0.5/FLL)/(TS+0.5/FL1))
80    Y1=Y1+TERM
      PI2=2.0/PI
      Y0=PI2*Y0
      Y1=-PI2/X+PI2*Y1
C
C --- ** CHECK IF ONLY Y0 OR Y1 IS DESIRED ** ---
C ** -------------------------------------- **
90    IF(N-1) 100,100,130
C ** -------------------------------------- **
C --- ** RETURN EITHER Y0 OR Y1 AS REQUIRED ** ---
```

```
C ** ---------------------------------------- **
100     IF(N) 110,120,110
110     BYN=Y1
        RETURN
120     BYN=Y0
        RETURN
C ----------------------------------------
C --- ** PERFORM RECURRENCE OPERATIONS TO FIND YN(X) ** ----
C ------------------------------------------------------
130     YA=Y0
        YB=Y1
        K=1
140     T=FLOAT(2*K)/X
        YC=T*YB-YA
        K=K+1
        IF(K-N) 150,160,150
150     YA=YB
        YB=YC
        GO TO 140
160     BYN=YC
        RETURN
180     ILL=1
        RETURN
190     ILL=2
        RETURN
        END
C*************************************************************
        SUBROUTINE CMINVS(A,B,M,N)
C **    [A+iB]的逆距陣                                    **
C **    將[A],[B]依序存入 unformatted file : UNIT 5       **
C **    使用暫存檔: UNIT 4                                **
C**     在主程式必須  open unit 4,5                       **
C ****************************************
        REAL A(M,M),B(M,M)
        REWIND 5
        READ(5) ((A(I,J),J=1,N),I=1,N)
        CALL MINVS(A,M,N,1E-7,ILL)
        IF(ILL.NE.0) WRITE(3,10) ILL
```

```
10      FORMAT('ILL CMINVS ='I7)
        READ(5) ((B(I,J),J=1,N),I=1,N)
        CALL SEKI(A,B,M,N,N,N)
        REWIND 4
        WRITE(4)   ((A(I,J),J=1,N),I=1,N)
        CALL SEKI(B,A,M,N,N,N)
        REWIND 5
        READ(5) ((A(I,J),J=1,N),I=1,N)
        DO 100 I=1,N
        DO 100 J=1,N
100     A(I,J)=A(I,J)+B(I,J)
        CALL MINVS(A,M,N,1E-7,ILL)
        IF(ILL.NE.0) WRITE(3,11) ILL
11      FORMAT(1H0,'ILL CS.2 =',I7)
        REWIND 4
        READ(4) ((B(I,J),J=1,N),I=1,N)
        CALL SEKI(B,A,M,N,N,N)
        DO I=1,N
        DO J=1,N
        B(I,J)=- B(I,J)
        END DO
        END DO
        RETURN
        END
C*************************************
        SUBROUTINE SA(A,B,NA,N,NS)
C*************************************************
C   [A],[B]宣告(na, na)
C   [B]=[A]-[B]
C   [B]資料被取代
C*************************************************
        REAL A(NA,NA),B(NA,NA)
        DO 100 I=1,N
        DO 100 J=1,NS
        B(I,J)=A(I,J)-B(I,J)
100     CONTINUE
        RETURN
        END
```

```
C**********************************
      SUBROUTINE MINVS(A,KO,N,EPS,ILL)
C **********************************************
C 宣告 A(KO,KO)，使用 A(N,N)，矩陣必須從 1 開始
C   KO<3000
C   ill=3000 輸入資料有誤，未計算
C   ill≠0    計算錯誤
C******************************************
      REAL A(KO,KO)
      INTEGER X(3000)
      LOGICAL B
      ILL=0
      IF((KO.GE.N).AND.(N.LE.3000).AND.(EPS.GT.0.0))GO TO 1
      ILL=30000
      RETURN
1     DO 10 I=1,N
      X(I)=I
10    CONTINUE
      DO 110 K=1,N
      M=K
      W=0.0
      DO 20 I=K,N
      ABSA=ABS(A(I,K))
      IF(ABSA.LE.W) GO TO 20
      W=ABSA
      M=I
20    CONTINUE
      IF(M.EQ.K) GO TO 50
      L=X(M)
      X(M)=X(K)
      X(K)=L
      DO 40 J=1,N
      W=A(K,J)
      A(K,J)=A(M,J)
      A(M,J)=W
40    CONTINUE
50    IF(ABS(A(K,K)).GE.EPS) GO TO 60
      ILL=K
```

```
      RETURN
60    P=1.0/A(K,K)
      DO 70 J=1,N
      A(K,J)=A(K,J)*P
70    CONTINUE
      DO 100 I=1,N
      T=-A(I,K)
      B=(I.NE.K).AND.(T.NE.0.0)
      IF(.NOT.B) GO TO 100
      DO 90 J=1,N
      A(I,J)=A(I,J)+A(K,J)*T
90    CONTINUE
100   A(I,K)=P*T
      A(K,K)=P
110   CONTINUE
      DO 140 I=1,N
120   IF(X(I).EQ.I) GO TO 140
      K=X(I)
      DO 130 J=1,N
      W=A(J,I)
      A(J,I)=A(J,K)
      A(J,K)=W
130   CONTINUE
      L=X(I)
      X(I)=X(K)
      X(K)=L
      GO TO 120
140   CONTINUE
      RETURN
      END
C*************************************
      SUBROUTINE SEKI(A,B,M,NA,NK,NB)
C*************************************************
C   [A],[B]宣告(m, m)
C   [A]=[A][B]
C   (na,nb)=(na,nk)x(nk,nb)
C   [A]資料被取代
C*************************************************
```

```
      REAL A(M,M),B(M,M),C(300)
      DO 100 I=1,NA
      DO 101 K=1,NK
      C(K)=A(I,K)
101   CONTINUE
      DO 100 J=1,NB
      R=0.
      DO 102 K=1,NK
      R=R+C(K)*B(K,J)
102   CONTINUE
      A(I,J)=R
100   CONTINUE
      RETURN
      END
C**********************************
      SUBROUTINE WA(A,B,NA,N,NS)
C************************************************
C  [A],[B]宣告(na, na)
C  [B]=[A]+[B]
C  B 資料被取代
C************************************************
      REAL A(NA,NA),B(NA,NA)
      DO 100 I=1,N
      DO 100 J=1,NS
      B(I,J)=A(I,J)+B(I,J)
100   CONTINUE
      RETURN
      END
```