spacewar 4.8 7/24/63 pt. 2 dfw

nob=30   /total number of colliding objects

```
m10,        setup m̄tc, 5000    /delay for loop
            init ml1, mtb      /loc of calc routines
            init mx1, nx1      /x
            init my1, ny1      /y
            init ma1, na1      /count for length of explosion or torp
            init mb1, nb1      /time taken by calc routine
            init mdx, ndx      /dx
            init mdy, ndy      /dy
            init mom, nom      /angular velocity
            init mth, nth      /angle
            init mfu, nfu      /fuel
            init mtr, ntr      /number torps remaining           .
            init mot, not      /outline of spaceship
            init mco, nco      /old control word
            law nh1
            dac m̄h1
            law nh2
            dac m̄h2
            law nh3
            dac m̄h3
            law nh4
            dac m̄h4
            lac mtb
            sza i
            jmp mdn
            lac mtb 1
            sza i
            jmp mdn             /ship all gone away
            lac ntr             /test if both ships out of torps
            ior ntr 1
            sza i
            jmp mdn
            jmp ml1
```

```
/ control word get routines

mg1,        dap mg3
            cli
            iot 11
            rir 4s
mg3,        jmp .

mg2,        dap mg4
            lat
            swap
mg4,        jmp .

idl,        idx mth
            idx mfu
            idx mtr
            idx mco
            idx mot
            idx mom
            idx m̄h1
            idx m̄h2
            idx m̄h3
            idx m̄h4
ids,        idx mx1
            idx my1
            idx ma1
            idx mb1
            idx mdy
            idx mdx
ml1,        lac .          / 1st control word
            sza i          / zero if not active
            jmp mq1        / not active
            dap mjm        /jmp to calc routine or make explode
            spa            /control word + if object collidible
            jmp mjm

            law 1          /proximity test
            add ml1
            sad (lac mtb nob
            jmp mjm-1
            dap ml2
            law 1
            add mx1
            dap mx2
            law 1
            add my1
            dap my2
            law 1
            add ma1
            dap ma2
            law 1
            add mb1
            dap mb2
```

```
ml2,      lac  .            / 2nd control word
          spq               / can it collide?
          jmp mq2           / no
mx1,      lac  .            / calc if collision
mx2,      sub  .            / delta x
          spa               / take abs val
          cma
          dac t̄1
          sub me1           / < epsilon ?
          sma
          jmp mq2           / no
my1,      lac  .
my2,      sub  .
          spa
          cma
          sub me1           / < epsilon ?
          sma
          jmp mq2           / no
          add t̄1
          sub me2
          spa
          jmp mjm
mq2,      idx mx2           / end of comparison loop
          idx my2
          idx ma2
          idx mb2
          index ml2, (lac mtb nob, ml2

          idx mjm
mjm,      jmp  .            /to calc routine or make object explode

mb1,      lac  .            / alter count of number of instructions
          add m̄tc
          dac m̄tc
mq1,      idx ml1
          sad (lac mtb 1
          jmp idl
          sas (lac mtb nob
          jmp ids
          background
          jsp blp           / display massive star
          count m̄tc, .      / use up rest of time of main loop
          jmp ml0           / repeat whole works
```

```
blt,        law 20                  /routine to set explosion
            dac i mb1
            dac i mb2

sex,        lac (mex 400000         /alternate entry point
            dac i ml1               / replace calc routine with explosion
            dac i ml2
            lac i mb1               / duration of explosion
mb2,        add .
            cma
            sar 8s
            add (1
ma1,        dac .
ma2,        dac .
            jmp mb1

/ misc calculation routines

            / explosion

mex,        lac i mdx
            sar 3s
            add i mx1
            dac i mx1
            lac i mdy
            sar 3s
            add i my1
            dac i my1
            law mst
            dap msh
            lac i mb1               / time involved
            cma cli-opr
            sar 3s
            dac t̄1
            sub (140
            sma
            idx msh
mz1,        lac ran
            and (777
            ior (scl
            dac mi1
            random
            scr 9s
            sir 9s
msh,        xct .
mi1,        hlt
            add i my1
            swap
            add i mx1
            dpy-i 300
            count t̄1, mz1
            count i ma1, mb1
            dzm i ml1
            jmp mb1

mst,        scr 1s
            scr 3s
```

```
/ torpedo calc routine

tcr,        jmp blt
            count i ma1, tc1
            lac (mex 400000
            dac i ml1
            law i 2
            dac i ma1
            law 20
            dac i mb1
            jmp mb1


tc1,        lac i mx1
            sar 9s
            xct the
mdy,        add ndy
            dac i mdy
            sar 3s
            add i my1
            dac i my1
            sar 9s
            xct the
mdx,        add ndx
            dac i mdx
            sar 3s
            add i mx1
            dac i mx1
            dispt i, i my1, 1
            jmp mb1


/ hyperspace routines

/ this routine handles a non-colliding ship invisibly
/ in hyperspace

hp1,        count i ma1, mb1
            law hp3             / next step
            dac i ml1
            law 7
            dac i mb1
            random
            scr 9s
            sir 9s
            xct hr1
            add i mx1
            dac i mx1
            swap
            add i my1
            dac i my1
            dzm i mdx
            dzm i mdy
            xct hd2
            dac i ma1
            jmp mb1
```

/ this routine handles a ship breaking out of
/ hyperspace.

```
hp3,        jmp sex
            count i ma1,hp6
            law 2000
            dac i mb1
            lac i m̄h4
            add hur
            dac i m̄h4
            random
            ior (400000
            add i m̄h4
            sma
            jmp po1
            lac i m̄h1
            dac i ml1
            lac ran
            scr 9s
            sir 9s
            xct hr2
            dac i mdy
            dio i mdx
            setup t̄1,3
            lac ran
            dac i mth
hp4,        lac i mth
            sma
            sub (311040
            spa
            add (311040
            dac i mth
            count t̄1,hp4
            count i m̄h2,hp7
            dzm i m̄h2
hp7         xct hd3
            dac i m̄h3
hp6,        lac i mx1
            dispt i, i my1  2
            jmp mb1
```

```
/ spaceship calc
ss1,      jmp sex             /something came too close
          jsp i cwg
          jmp sr0

ss2,      jmp sex
          jsp i cwg
          rir 4s
sr0,      dio scw

sc1,      clf 6 cla-opr       /update angle
          spi
          add maa
          ril 1s
          spi
          sub maa
mom,      add .
          dac i mom
          szs 10
          jmp . 3
          dzm i mom
          ral 5s
          ril 1s
          spi
          stf 6
mfu,      lio nfu
          spi i
          clf 6

mth,      add .
          sma
          sub (311040
          spa
          add (311040
          dac i mth
          jda sin
          dac sn
          dzm bx
          dzm by
          szs 60
          jmp bsg
          lac i mx1
          dac t1
          mul t1
          scr 1s
          dac acx
          cla
          scr 2s
          dio iox
          lac i my1
          dac t1
          mul t1
          scr 1s
          dac acy

          cla
          scr 2s
          swap
          add iox
          swap
          scl 2s
          add acx
          add acy
```

```
        sub str
        sma i sza-skp
        jmp pof
        add str
        varsft
        dac t̄1
        jda sqt
        mul t̄1
        undosft
        scr 9s
        scr 6s
        szs i 20                          / switch 2 for light star
        scr 2s
        sza
        jmp bsg
        scr 1s
        dio t̄1
        integrate mx1, b̄x
        integrate my1, b̄y
bsg,    lac i mth
        jda cos
        dac c̄s
        sar 9s
        xct sac
        szf i 6
        cla
        add b̄y
        diff mdy, my1, (sar 3s
        lac s̄n
        sar 9s
        xct sac
        cma
        szf i 6
        cla
        add b̄x
        diff mdx, mx1, (sar 3s
        scale s̄n, 5s, s̄sn
        scale c̄s, 5s, s̄cn
        lac i mx1
        sub s̄sn
        dac s̄x1
        sub s̄sn
        dac s̄tx
```

```
                        lac i my1
                        add scn
                        dac sy1
                        add scn
                        dac sty
                        scale sn, 9s, ssn
                        scale cs, 9s, scn
                        dac scm
                        lac ssn
                        dac ssm
                        add scn
                        dac ssc
                        dac ssd
                        lac ssn
                        sub scn
                        dac csn
                        cma
                        dac csm
                        cla cli-opr
                        dpy-4000
        mot,sp5,        jmp i .
        sq6,            szf i 6
                        jmp sq9                 /not blasting or no fuel
                        ranct sar 9s, sar 4s, src
                        scale sn, 8s, ssn
                        scale cs, 8s, scn
        sq7,            count i mfu, st2
                        dzm i mfu
                        jmp sq9
        st2             yincr sx1 sy1, sub
                        dispt i, sy1
                        count src,sq7
        sq9,            count i ma1, sr5   / check if torp tube reloaded
                        dzm 1 ma1          / prevent count around
        mco,            lac .              / previous control word
                        cma
                        szs i 30
                        clc
                        and scw            / present control word
                        ral 3s             / torpedo bit to bit 0
                        sma
                        jmp sr5            / no launch
        mtr,            count ntr, st1     / check if torpedos exhausted
                        dzm i mtr                      / prevent count around
                        jmp sr5
        st1,            init sr1, mtb nob-1            /search for unused object
        sr1,            lac .
                        sza i              / 0 if unused
                        jmp sr2
                        law i 1
                        add sr1
                        dap sr1
                        sas (lac mtb-1
                        jmp sr1
                        hlt                / no space for new objects
                        jmp sr5            /go on anyway
```

```
sr2,        lac (tcr                        / set up torpedo calc
            dac i sr1
            law nob
            add sr1
            dap ss3
            lio s̄tx
ss3,        dio .
            add (nob
            dap ss4
            lio s̄ty
ss4         dio .
            add (nob
            dap sr6
            add (nob
            dap sr7
            add (nob
            dap sr3
            add (nob
            dap s̄r4
            lac s̄n
            xct tvl
            cma
            add i mdx
sr3,        dac .
            lac c̄s
            xct tvl
            add i mdy
sr4,        dac .
            xct rlt
            dac i ma1              / permit torp tubes to cool
            xct tlf               / life of torpedo
sr6,        dac .
            lac (lac mtb nob-1
            sub sr1
            sal 3s
            add (30
sr7,        dap .                 / length of torp calc.
sr5,        lac s̄cw
            dac i mco
            count i mh3, mb1
            dzm i m̄h3
            lac m̄h2
            sza i
            jmp mb1
            lac s̄cw
            spa
            ral 1s
            sma                   /hyperspace button on?
            jmp mb1               /no
            lac i ml1
            dac i m̄h1
            lac (hp1 400000
            dac i ml1
            xct hd1
            dac i ma1
            law 2
            dac i mb1
            jmp mb1
```

/ here to handle spaceships dragged into star

/ spaceship in star

```
pof         dzm i mdx
            dzm i mdy
            szs 50
            jmp po1
            lac (377777
            dac i mx1
            dac i my1
            jmp mq1


po1,        lac (mex 400000    / now go bang
            dac i ml1
            law i 10
            dac i ma1
            jmp mq1
```

/ here if a ship exploded or both ships out of torps

```
mdn,        count n̄td, ml1    /wait awhile
            stf 1
            stf 2
            law ss1
            xor mtb
            sza
            clf 1
            sza i
            idx 1̄sc
            law ss2
            xor mtb 1
            sza
            clf 2
            sza i
            idx 2̄sc
            clf 2
            jmp a
```

```
a1,         law mg2              / test word control
            dac c̄wg
            jmp a

a40,        law cwr   / here from start at 4
            dac c̄wg
            jmp a6

a,          lac ḡct
            sma
            jmp a5
            count ḡct, a5
            lac Ī sc
            sas 2̄sc
            jmp a4
            law i 1
            dac ḡct
a5,         lat
            and (40
            sza i
            jmp a2
a4,         lac Ī sc
            lio 2̄sc
            hlt
            lat
            and (40
            sza
            jmp a2
            dzm Ī sc
            dzm 2̄sc
a6,         lat
            rar 6s
            and (37
            sza
            cma
            dac ḡct
a2,         clear mtb, nnn-1  / clear out all tables
            law ss1
            dac mtb
            law ss2
            dac mtb 1
            lac (200000
            dac nx1
            dac ny1
            cma
            dac nx1 1
            dac ny1 1
            lac (144420
            dac nth
```

```
            law nnn             / start of outline program
            dac not
            lio ddd
            spi i
            jmp a3
            jda oc              / compile outline
            ot1
a3,         dac not 1
            jda oc
            ot2
            xct tno
            dac ntr
            dac ntr 1
            lac foo
            dac nfu
            dac nfu+1
            law 2000
            dac nb1
            dac nb1 1
            xct mhs
            dac nh2
            dac nh2 1
            xct tlf
            sal 1s
            dac ntd             / restart delay is 2xtorp life
            jmp ml0            /start new game

/ outlines of spaceships

ot1,        111131
            111111
            111111
            111163
            311111
            146111
            111114
            700000
     5/

ot2,        013113
            113111
            116313
            131111
            161151
            111633
            365114
            700000
 . 5/



            variables
            constants
```

```
mtb,                              / table of objects and their properties

nx1=mtb nob
ny1=nx1 nob
na1=ny1 nob
nb1=na1 nob
ndx=nb1 nob
ndy=ndx nob
nom=ndy nob
nth=nom 2
nfu=nth 2
ntr=nfu 2
not=ntr 2
nco=not 2
nh1=nco 2
nh2=nh1 2
nh3=nh2 2
nh4=nh3 2
nnn=nh4 2

start 4
```