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FP
        #fundamental plane - group problem

        #read in calibrators
        data calib.dat
        read { NGC 1 re 2 reunc 3 uv 4 uvunc 5 logsig 6 }

        set sig = 10**logsig
        set sigunc = sig*0.1

        #convert to physical units of re - kpc
        define d 16000
        set rekpc = 2*$d*tand(re/7200)
        set rekpcunc = 2*$d*tand(reunc/7200)


        set y = 1.24*logsig - 0.82*lg(uv)
        set yunc = sqrt( (sigunc*1.24/(sig*ln(10)))**2 + (uvunc*-0.82/(uv*ln(10)))**2)
        set x = lg(rekpc)
        set xunc = rekpcunc/(rekpc*ln(10))


#       device x11 -device 0
        device postencap 'group1.ps'
        expand 1.0001
        define TeX_strings 1
        era
        ctype black

        lim -0.1 1.2 1.2 2.2
        bo
        points x y
        errorbar x y xunc 1
        errorbar x y xunc 3
        errorbar x y yunc 2
        errorbar x y yunc 4
        xlabel x = log(r_e_v) [kpc]
        ylabel y = 1.24 log(\sigma) - 0.82 log(<u>_v)
        toplabel FP in Virgo Cluster

        #do least squares fit
        set xfit = 0.0001, 3, 0.0001
        lsq x y xfit yfit rms
        connect xfit yfit
        lim 0 10 0 10
        relocate 0.5 9.3
        label y = ($a +/- $sig_a)x +
        relocate 1.5 9
        label ($b +/- $sig_b)
```

```
        define Virgoa $a
        define Virgoaunc $sig_a
        define Virgob $b
        define Virgobunc $sig_b



        #now read in Coma data
        data ComaFP.dat
        read { Cgal 2.s logCre 3 logCreunc 4 Cub 5 Cuvunc 6 vr 7 br 8 logCsig 9 }

        set Csig = 10**logCsig
        set Csigunc = Csig*0.1

        set Cre = 10**logCre
        set CreHigh = 10**(logCre+logCreunc)
        set CreLow = 10**(logCre-logCreunc)
        set Creunc = (abs(CreHigh - Cre) + abs(CreLow - Cre))/2

        set Cuv = Cub-br+vr

        set Cy = 1.24*lg(Csig)-0.82*lg(Cuv)
        set Cyunc = sqrt( (Csigunc*1.24/(Csig*ln(10)))**2 + (Cuvunc*-0.82/(Cuv*ln(10)))**2)

        set Cx = lg(Cre)
        set Cxunc = Creunc/(Cre*ln(10))

#       device x11 -device 1
        device postencap 'group2.ps'
        expand 1.0001
        define TeX_strings 1
        era
        ctype black

#       lim -0.1 1.2 1.2 2.2
        lim Cx Cy
        bo
        points Cx Cy
        errorbar Cx Cy Cxunc 1
        errorbar Cx Cy Cxunc 3
        errorbar Cx Cy Cyunc 2
        errorbar Cx Cy Cyunc 4
        xlabel x = log(r_e_v) [arcseconds]
        ylabel y = 1.24 log(\sigma) - 0.82 log(<u>_v)
        toplabel FP in Coma Cluster (with offset fit line from Virgo)

        #finding xoffset of fit line from before
        #fit line is y = ax + b
        #yVirgo = Virgoa (+/- Virgoaunc)*x + Virgob (+/- Virgobunc)
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```
        #minimising chi square:
        #looping over distances
        define best 10000000
        define bestnum 0
        do ofst = 1, 300000, 10 {
                #with this distance, calculate re[kpc] from re[arcseconds]
                set Crekpc = 2*$ofst*tand(Cre/7200)
                set Cxfit = lg(Crekpc)
                set chivect = Cy - (($Virgoa*Cxfit) + $Virgob)
                set chivs = chivect**2
                define tempsum sum(chivs)
#               echo sum for offset = $ofst is $tempsum
                if ($tempsum < $best) {
                        define best $tempsum
                        define bestnum $ofst
                }
        }
        set Crekpc = 2*$bestnum*tand(Cre/7200)
        set Cxfit = lg(Crekpc)
        set Cyfit = $Virgoa*(Cxfit) + $Virgob
        connect Cxfit Cyfit

        #calculate statistics on this line fit?

        lim 0 10 0 10
        relocate 0.5 9.3
        label y_{Coma}(x_{Coma}) = y_{Virgo}(x_{Virgo} + $bestnum kpc)

        #figure out errors
        #make residuals
        set ComaResiduals = Cy - Cyfit
        stats ComaResiduals Cmean Csig Ck
```