Status report: SDSS-II/SNe properties as a function of the distance to their host galaxies

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Motivation

- Recent studies of SNe properties depending on global characteristics of the hosts (Hubert, Mat...)
- Study SNe properties as a function of LOCAL characteristics (star-formation rate, metallicity...) of the hosts using the distance to the center of the galaxy as a proxy
- Correlate MLCS & SALT2 SNe parameters (Δ, A_V, x1, c...) and Hubble residuals with distance to the host center
- Analyze different Hubble diagrams selecting sets depending on distance

Sample Selection

SDSS-II/SNe

(SMP200Xv7 @sdssdp62)

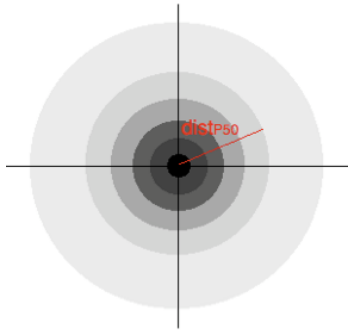
SNe classes	2005	2006	2007	all
[105] 1a photometric id + hostgal specZ	157	98	46	301
[106] non1a photometric id + hostgal specZ	122	102	103	327
[111] SDSS-confirmed Ib	3	2	5	10
[112] SDSS-confirmed Ic	4	6	2	12
[113] SDSS-confirmed II	10	16	38	64
[115] externally-confirmed Ib	-	-	1	1
[117] externally-confirmed II	1	-	-	1
[118] externally-confirmed Ia	1	5	3	9
[119] likely confirmed Ia	16	12	8	36
[120] SDSS-confirmed Ia	129	198	183	510
total	443	439	389	1271
SNe-Ia used for the analysis				
[105]+[118]+[119]+[120] Ia	303	313	240	856

Cuts applied in SNANA and in the code

Before SNANA cuts	856	
MLCS cuts	SALT2 cuts	
5 obs. in -20<t<60	5 obs. in -20<t<60	
1 obs. in t<-2d	1 obs. in t<t_{max}	
1 obs. in t>10d	1 obs. in t>9.5d	
1 ep. S/N>5 in *gri*	1 ep. S/N>5 in *gri*	
After SNANA cuts	598	556
	SNe after cuts	
Code cuts	MLCS	SALT2
SNANA fit χ^2/Ndof < 3 fit	575	556
Host assigned in SNANA file	575	550
Host assigned is not a STAR	563	548
PETRO50 in SDSS-DR7	561	546
Same ANG and PHO assigned	513	498
Large Projected GCD (< 50kpc)	511	496
Large Normalized GCD (< 10)	479	463
z<0.21	194	183
Spirals	125	116
Ellipticals	69	67
[105] Ia photo id + hostgal specZ	45	44
[118] externally-confirmed Ia	2	2
[119] likely confirmed Ia	7	3
[120] SDSS-confirmed Ia	139	133

Distance normalization

- 3 distance normalization methods (r band):
  - Petrosian radius 50: radius of a circle that contains 50% of the flux
  - Sersic profile: distance to the center of the isophotal ellipse containing half the luminosity
    - de Vaucouleurs profile (n=4) used for ellipticals
    - exponential profile (n=1) used for spirals

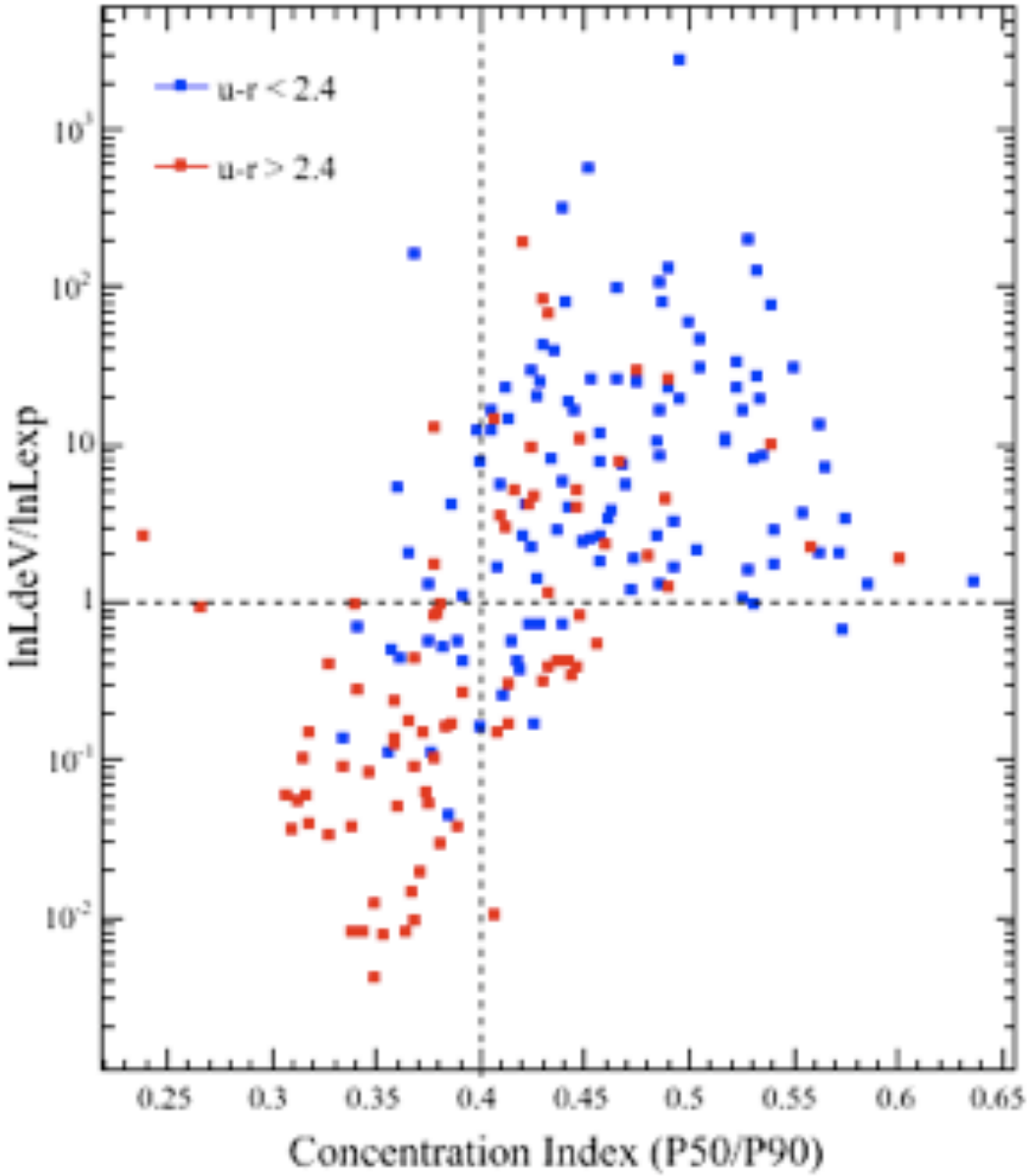


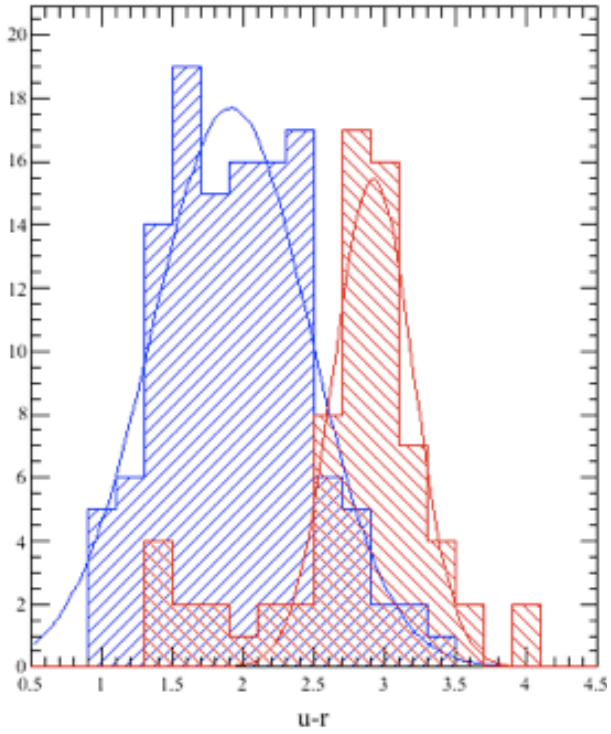
$$I(r) = I_0 \exp\left[-a\,(r/r_e)^{1/n}\right]$$

$$I(r) = I_0 \exp\left[-7.67\,(r/r_e)^{1/4}\right]$$

$$I(r) = I_0 \exp\left[-1.68\,(r/r_e)\right]$$

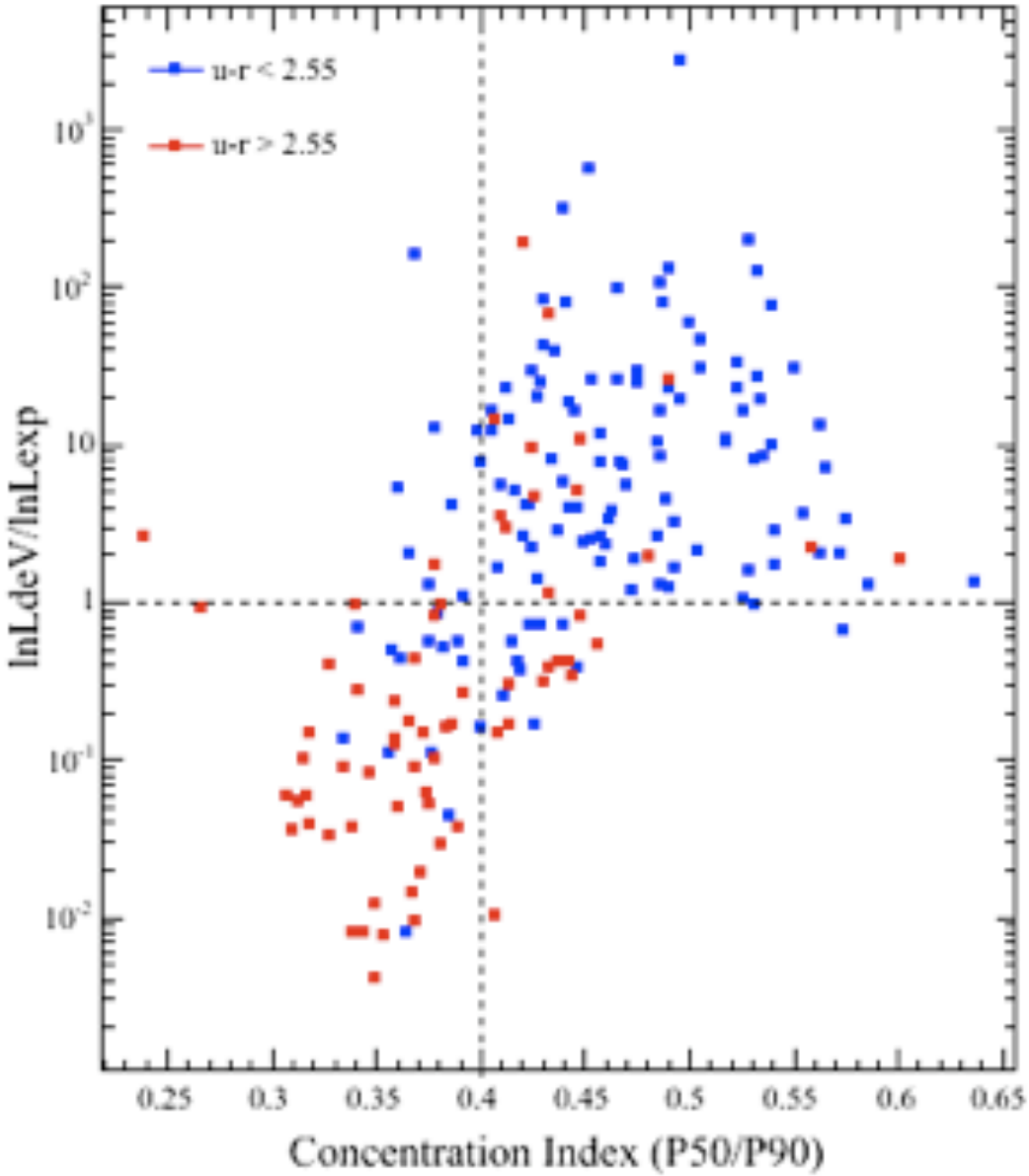
Host typing

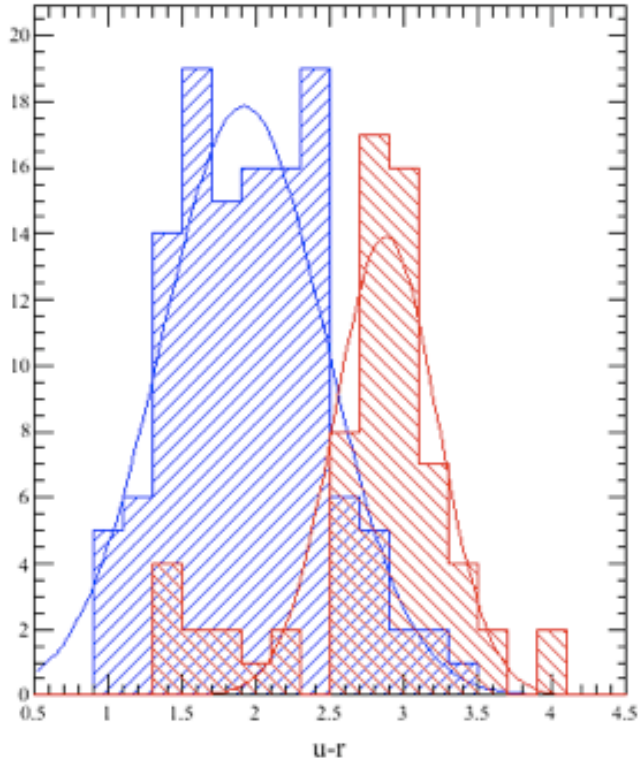




- 3 methods used in order to separate the hosts in elliptical and spiral
  - color index (u-r)
  - Inverse concentration index (Petro50/Petro90)
  - Likelihood fit (lnLdeV/lnLexp)
- Typing done by majority rule

Host typing (2.55)

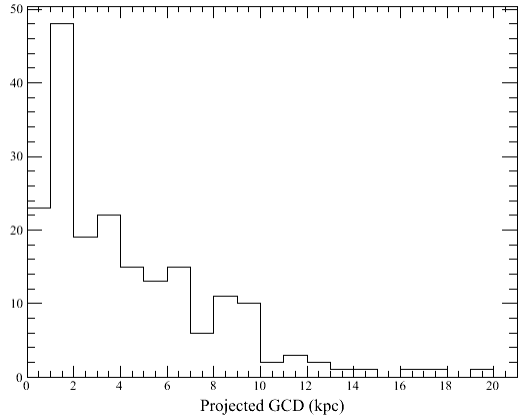


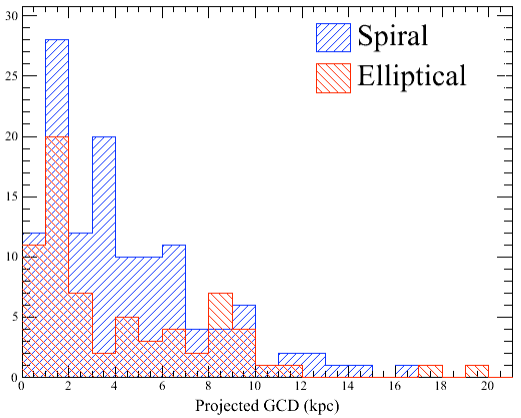


- Strateva et al. (2001) u-r=2.22
- Dilday et al. (2008) u-r=2.4
- Our best is u-r=2.55

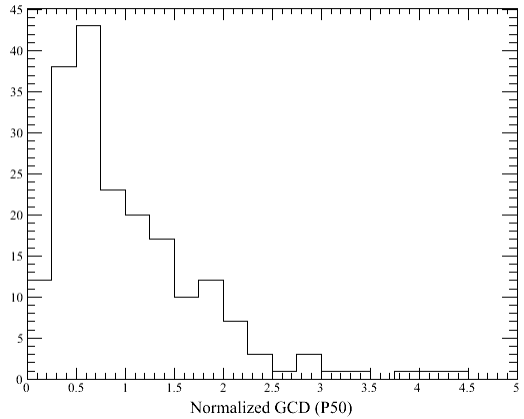
MLCS GCD distributions

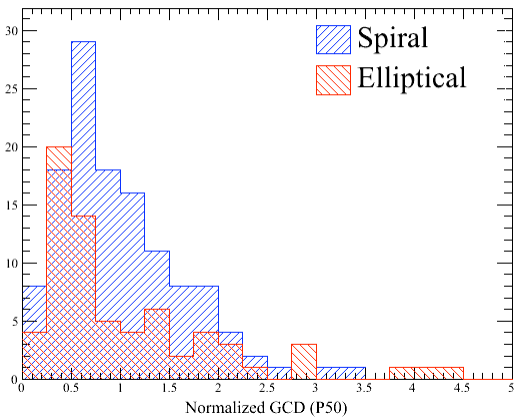
kpc



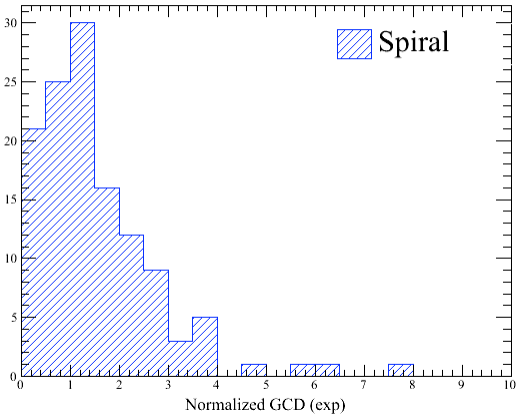


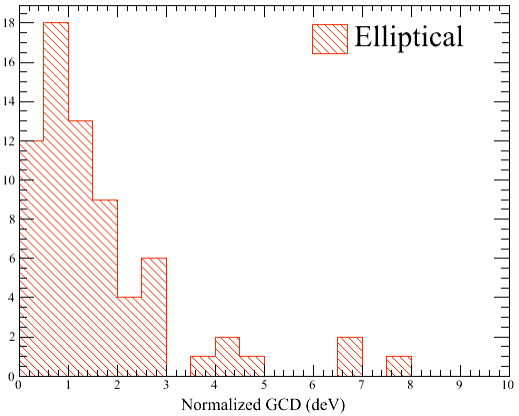
P50





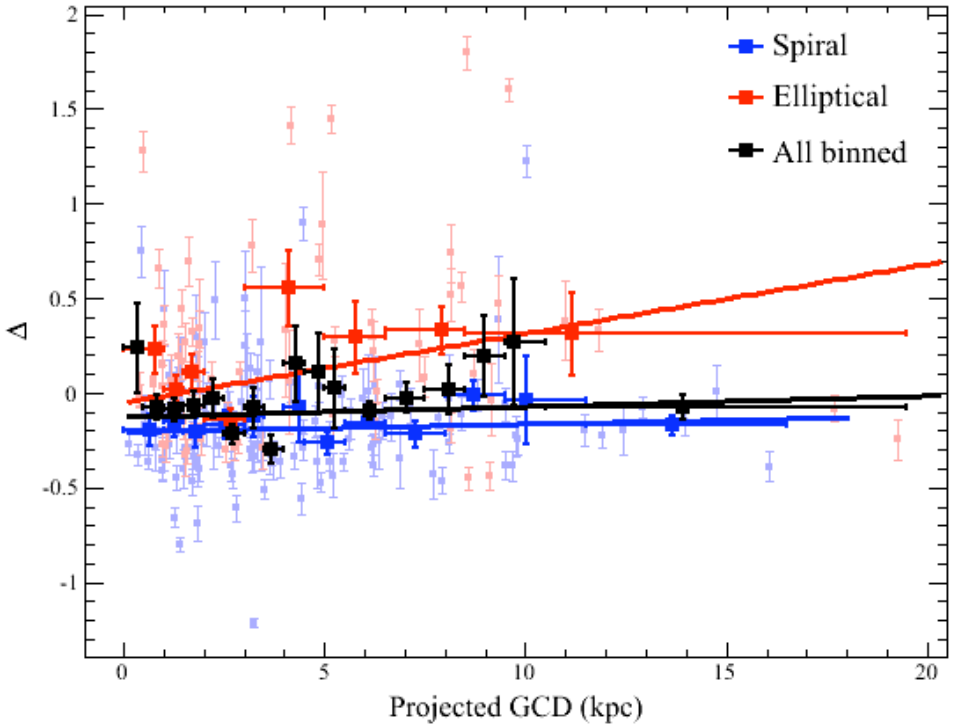
exp

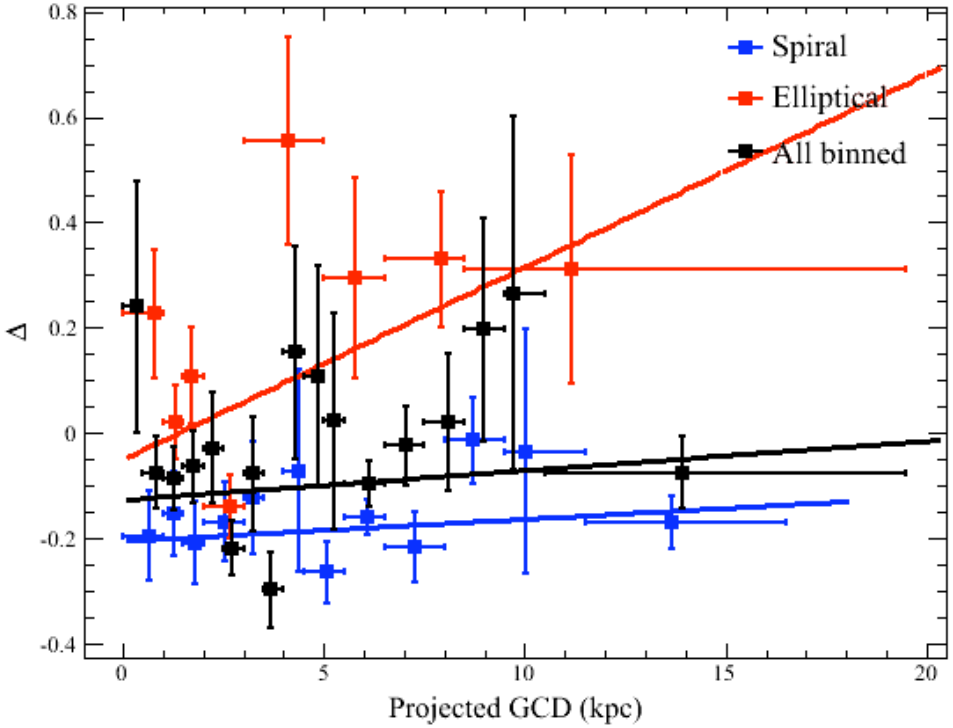




deV

MLCS SN properties vs. GCD





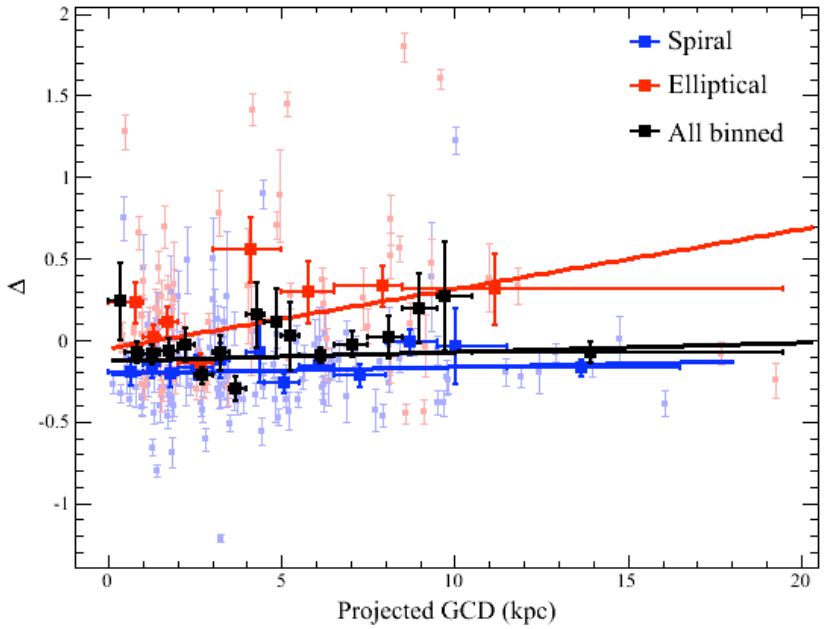
- A_V, Δ and Hubble residuals binned (at least 5 SNe) as a function of distance
- Linear fit of all the SNe and taking into account different host types

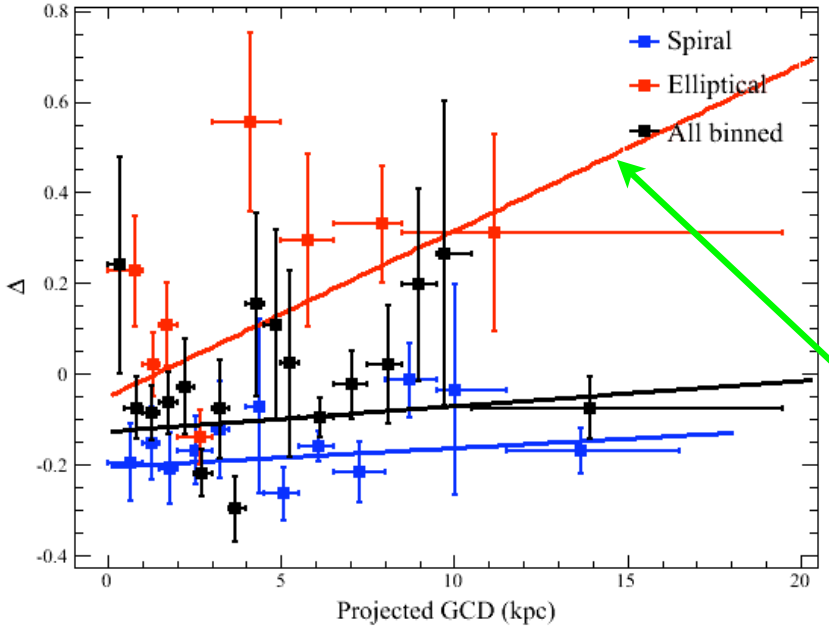
MLCS fit results

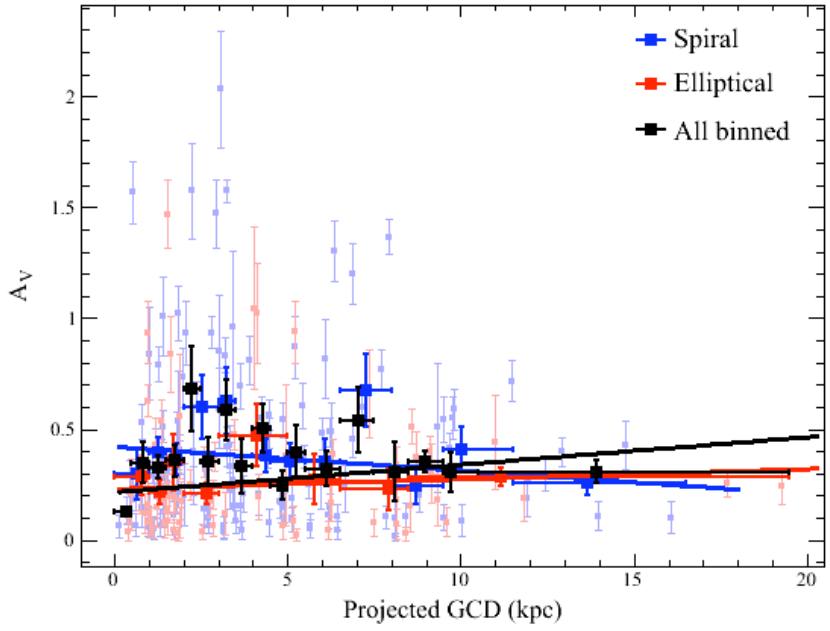
MLCS					
Parameter	Distance	Host type	Slope	σ	χ^2/Ndof
A_V	PGCD (kpc)	All	0.012 ± 0.004	3.47	$43.954/15 = 2.930$
		Spiral	-0.011 ± 0.005	1.99	$12.249/11 = 1.114$
		Elliptical	0.005 ± 0.005	0.87	$4.489/6 = 0.748$
	NGCD (P50)	All	0.030 ± 0.015	1.94	$53.508/8 = 6.689$
		Spiral	0.044 ± 0.023	1.95	$36.926/7 = 5.275$
		Elliptical	-0.031 ± 0.025	1.25	$3.135/4 = 0.784$
	NGCD (deV)	Elliptical	-0.001 ± 0.011	0.10	$15.781/6 = 2.630$
	NGCD (exp)	Spiral	0.006 ± 0.019	0.29	$14.211/9 = 1.579$
Δ	PGCD (kpc)	All	0.006 ± 0.006	1.01	$23.020/15 = 1.535$
		Spiral	0.004 ± 0.005	0.83	$10.195/11 = 0.927$
		Elliptical	0.037 ± 0.015	2.39	$21.554/6 = 3.592$
	NGCD (P50)	All	0.045 ± 0.039	1.16	$5.791/8 = 0.724$
		Spiral	0.004 ± 0.035	0.11	$9.228/7 = 1.318$
		Elliptical	0.092 ± 0.064	1.45	$3.446/4 = 0.861$
	NGCD (deV)	Elliptical	0.054 ± 0.042	1.30	$9.351/6 = 1.558$
	NGCD (exp)	Spiral	0.007 ± 0.022	0.31	$15.776/9 = 1.753$
$\delta\mu$	PGCD (kpc)	All	-0.008 ± 0.004	1.95	$14.601/15 = 0.973$
		Spiral	-0.006 ± 0.005	1.21	$17.791/11 = 1.617$
		Elliptical	-0.006 ± 0.006	1.00	$10.837/6 = 1.806$
	PGCD (P50)	All	-0.060 ± 0.018	3.33	$10.908/8 = 1.364$
		Spiral	-0.051 ± 0.028	1.79	$9.508/7 = 1.358$
		Elliptical	-0.014 ± 0.021	1.79	$1.307/4 = 0.327$
	NGCD (dev)	Elliptical	-0.008 ± 0.013	0.63	$11.519/6 = 1.920$
	NGCD (exp)	Spiral	-0.019 ± 0.020	0.99	$11.456/9 = 1.273$

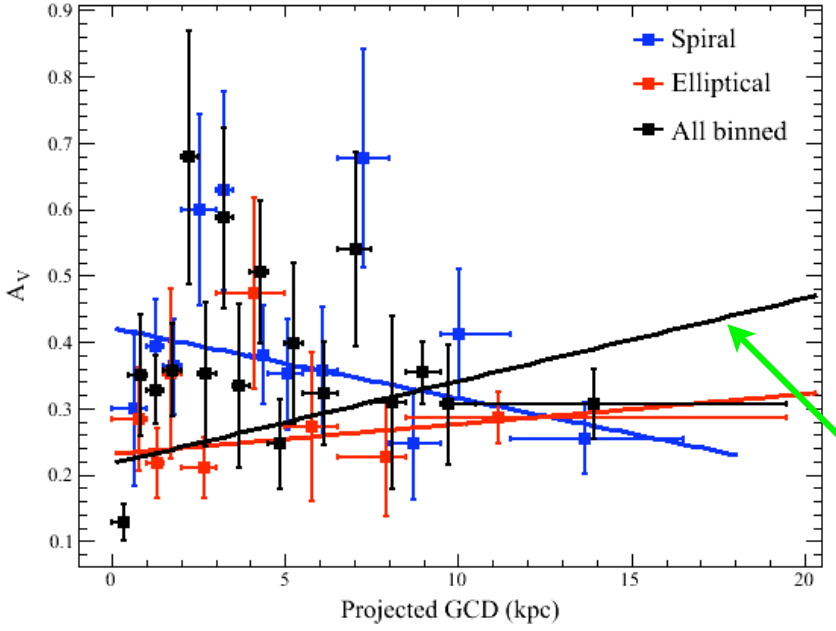
- few slopes significantly different from zero
- no significant different slope from fits separating ellipticals and spirals

MLCS Av & Δ (kpc)

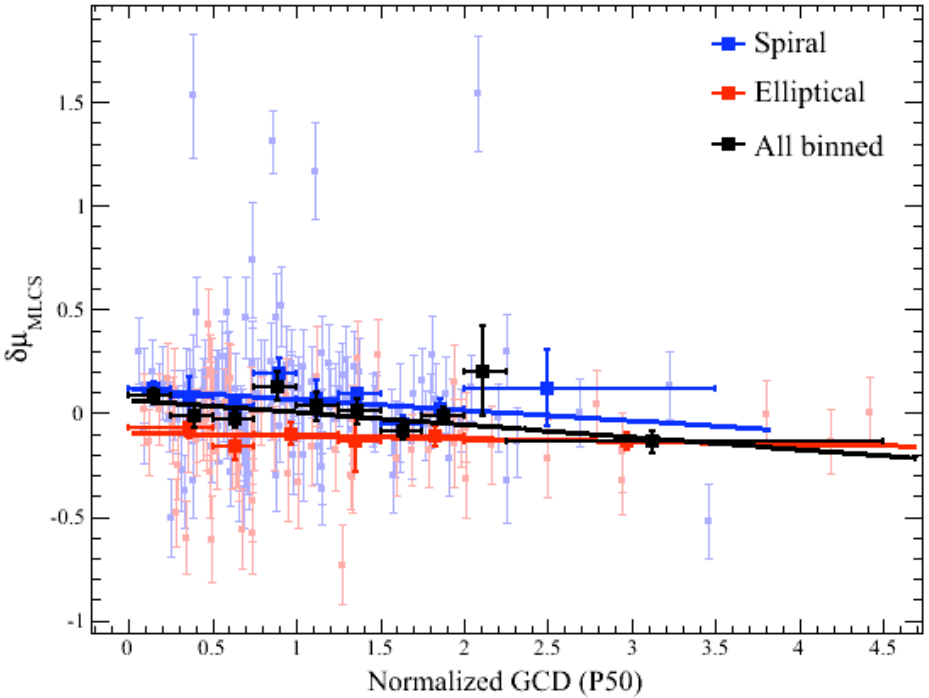

Spiral
Elliptical
All binned
Δ
Projected GCD (kpc)

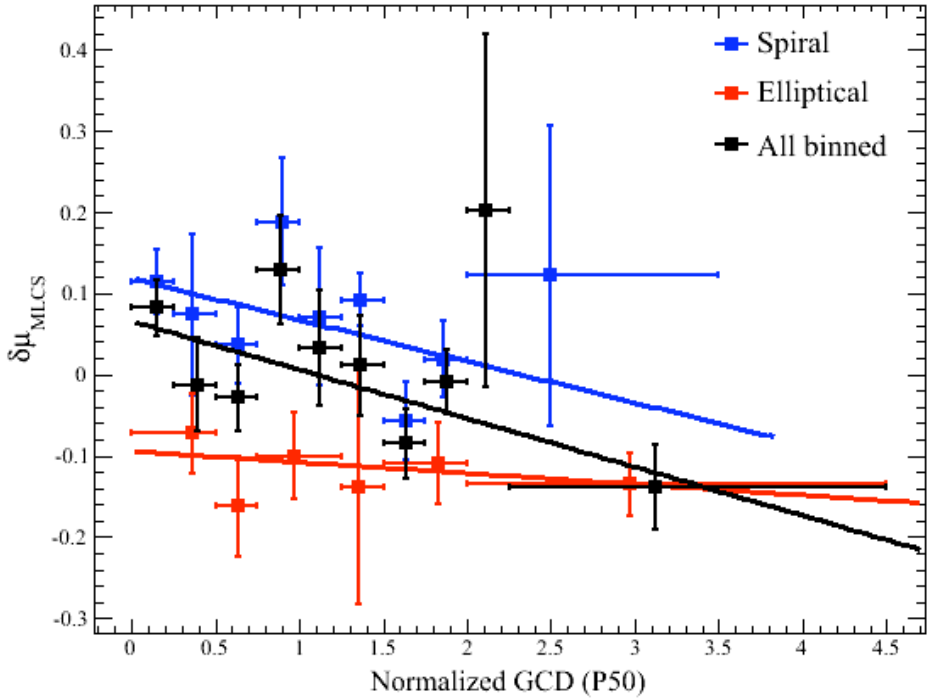

Spiral
Elliptical
All binned
Δ
Projected GCD (kpc)


Spiral
Elliptical
All binned
Av
Projected GCD (kpc)


Spiral
Elliptical
All binned
Av
Projected GCD (kpc)

MLCS residual (P50)

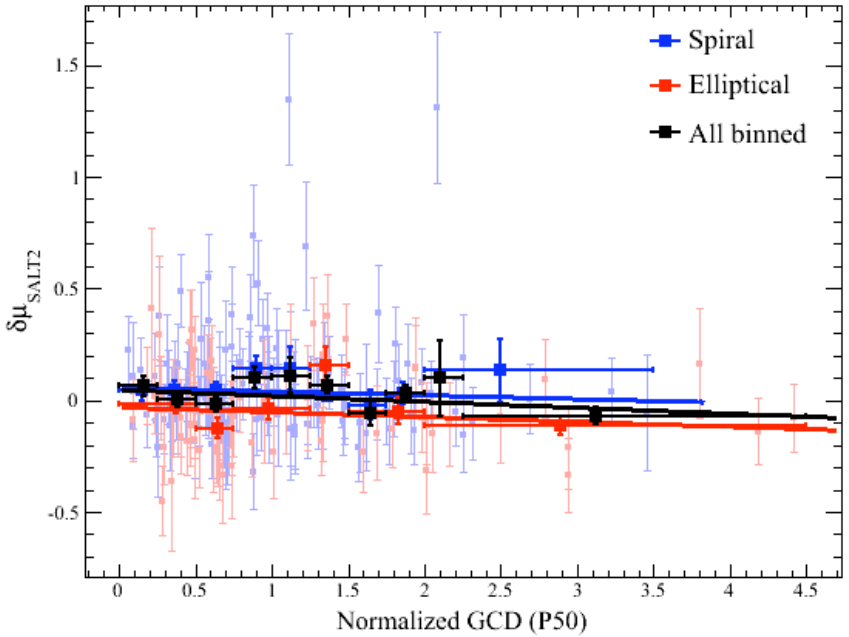


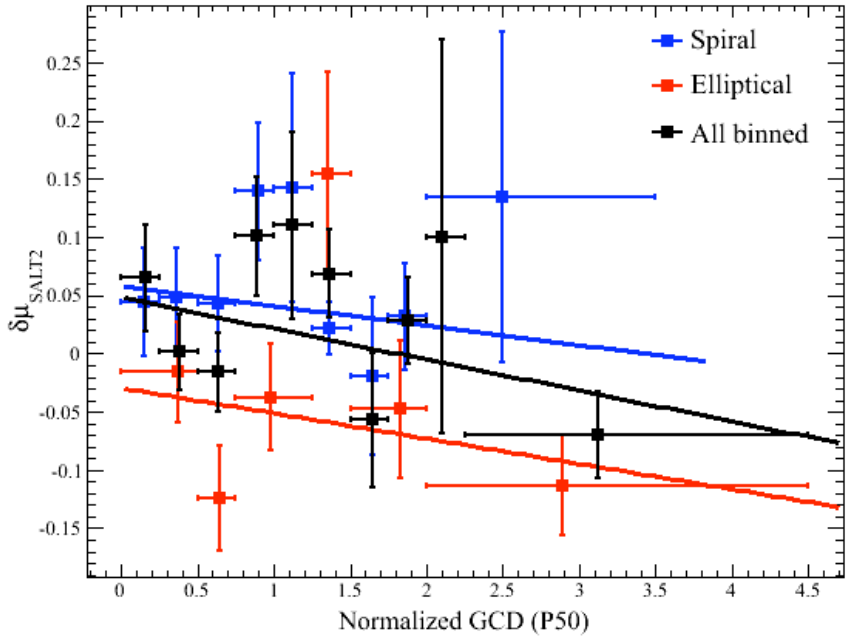


SALT2 results

- similar trend on δμ

SALT2					
Parameter	Distance	Host type	Slope	σ	χ^2/Ndof
c	PGCD (kpc)	All	-0.002 ± 0.002	0.84	16.654/13 = 1.281
		Spiral	-0.000 ± 0.004	0.07	11.267/10 = 1.127
		Elliptical	0.011 ± 0.005	2.34	20.074/6 = 3.346
	NGCD (P50)	All	-0.031 ± 0.015	2.07	11.099/8 = 1.387
		Spiral	-0.013 ± 0.019	0.66	14.755/7 = 2.108
		Elliptical	-0.001 ± 0.019	0.06	3.196/4 = 0.799
	NGCD (deV)	Elliptical	0.027 ± 0.013	2.01	9.931/6 = 1.655
	NGCD (exp)	Spiral	0.005 ± 0.012	0.41	7.406/7 = 1.058
x1	PGCD (kpc)	All	-0.006 ± 0.021	0.30	15.999/13 = 1.231
		Spiral	-0.026 ± 0.028	0.93	13.019/10 = 1.302
		Elliptical	-0.069 ± 0.041	1.70	14.697/6 = 2.450
	NGCD (P50)	All	-0.139 ± 0.115	1.21	16.726/8 = 2.091
		Spiral	-0.051 ± 0.128	0.40	6.942/7 = 0.992
		Elliptical	-0.270 ± 0.174	1.55	2.526/4 = 0.631
	NGCD (deV)	Elliptical	-0.129 ± 0.118	1.09	3.354/6 = 0.559
	NGCD (exp)	Spiral	-0.078 ± 0.069	1.13	13.794/7 = 1.971
$\delta\mu$	PGCD (kpc)	All	-0.002 ± 0.003	0.66	26.002/13 = 2.000
		Spiral	-0.002 ± 0.004	0.57	14.102/10 = 1.410
		Elliptical	-0.000 ± 0.006	0.00	14.841/6 = 2.473
	PGCD (P50)	All	-0.027 ± 0.015	1.78	12.281/8 = 1.535
		Spiral	-0.017 ± 0.026	0.64	5.435/7 = 0.776
		Elliptical	-0.022 ± 0.022	0.64	9.930/4 = 2.482
	NGCD (dev)	Elliptical	0.002 ± 0.015	0.14	6.408/6 = 1.068
	NGCD (exp)	Spiral	-0.000 ± 0.010	0.01	7.379/7 = 1.054





MLCS near-far binning

- 2 bins near/far:
  - PGCD: 4kpc
  - NGCD: 1 unit

MLCS						
Parameter	Distance	Host type	Near	Far	Difference	σ
A_V	PGCD (kpc)	All	0.386 ± 0.037	0.359 ± 0.034	-0.027 ± 0.050	-0.54
		Elliptical	0.275 ± 0.045	0.314 ± 0.052	0.039 ± 0.069	0.57
		Spiral	0.447 ± 0.050	0.383 ± 0.043	-0.064 ± 0.066	-0.97
	NGCD (P50)	All	0.416 ± 0.037	0.313 ± 0.031	-0.103 ± 0.048	-2.13
		Elliptical	0.314 ± 0.049	0.254 ± 0.038	-0.060 ± 0.062	-0.96
		Spiral	0.475 ± 0.049	0.342 ± 0.043	-0.134 ± 0.065	-2.05
	NGCD (deV)	Elliptical	0.294 ± 0.058	0.290 ± 0.040	-0.004 ± 0.071	-0.05
	NGCD (exp)	Spiral	0.435 ± 0.067	0.411 ± 0.038	-0.024 ± 0.077	-0.31
Δ	PGCD (kpc)	All	-0.085 ± 0.033	0.039 ± 0.054	0.123 ± 0.063	1.96
		Elliptical	0.085 ± 0.054	0.375 ± 0.107	0.291 ± 0.120	2.42
		Spiral	-0.179 ± 0.036	-0.145 ± 0.041	0.033 ± 0.055	0.61
	NGCD (P50)	All	-0.068 ± 0.036	0.020 ± 0.051	0.088 ± 0.062	1.41
		Elliptical	0.133 ± 0.064	0.329 ± 0.106	0.196 ± 0.124	1.58
		Spiral	-0.186 ± 0.036	-0.134 ± 0.041	0.052 ± 0.055	0.94
	NGCD (deV)	Elliptical	0.151 ± 0.081	0.250 ± 0.080	0.099 ± 0.114	0.87
	NGCD (exp)	Spiral	-0.162 ± 0.043	-0.166 ± 0.035	-0.004 ± 0.055	-0.07
$\delta\mu$	PGCD (kpc)	All	0.019 ± 0.028	-0.005 ± 0.034	-0.024 ± 0.044	-0.55
		Elliptical	-0.103 ± 0.035	-0.128 ± 0.041	-0.024 ± 0.054	-0.45
		Spiral	0.091 ± 0.037	0.056 ± 0.044	-0.035 ± 0.057	-0.61
	NGCD (P50)	All	0.026 ± 0.028	-0.013 ± 0.034	-0.040 ± 0.044	-0.90
		Elliptical	-0.098 ± 0.035	-0.132 ± 0.041	-0.034 ± 0.054	-0.62
		Spiral	0.095 ± 0.037	0.052 ± 0.044	-0.044 ± 0.058	-0.76
	NGCD (deV)	Elliptical	-0.074 ± 0.044	-0.142 ± 0.033	-0.067 ± 0.054	-1.23
	NGCD (exp)	Spiral	0.102 ± 0.053	0.062 ± 0.032	-0.040 ± 0.062	-0.64

SALT2 near-far binning

- 2 bins near/far:
  - PGCD: 4kpc
  - NGCD: 1 unit

SALT2						
Parameter	Distance	Host type	Near	Far	Difference	σ
c	PGCD (kpc)	All	0.076 ± 0.017	0.105 ± 0.020	0.030 ± 0.027	1.12
		Elliptical	0.065 ± 0.030	0.137 ± 0.033	0.072 ± 0.045	1.61
		Spiral	0.082 ± 0.022	0.088 ± 0.025	0.006 ± 0.033	0.18
	NGCD (P50)	All	0.091 ± 0.018	0.086 ± 0.020	-0.005 ± 0.027	-0.21
		Elliptical	0.087 ± 0.031	0.110 ± 0.032	0.023 ± 0.044	0.51
		Spiral	0.094 ± 0.021	0.073 ± 0.025	-0.021 ± 0.033	-0.63
	NGCD (deV)	Elliptical	0.090 ± 0.040	0.101 ± 0.026	0.011 ± 0.048	0.23
	NGCD (exp)	Spiral	0.063 ± 0.026	0.096 ± 0.020	0.033 ± 0.033	0.99
x1	PGCD (kpc)	All	-0.164 ± 0.116	-0.451 ± 0.149	-0.287 ± 0.188	-1.53
		Elliptical	-0.593 ± 0.200	-1.191 ± 0.221	-0.598 ± 0.298	-2.01
		Spiral	0.091 ± 0.131	-0.039 ± 0.171	-0.130 ± 0.216	-0.60
	NGCD (P50)	All	-0.173 ± 0.114	-0.451 ± 0.153	-0.278 ± 0.191	-1.46
		Elliptical	-0.615 ± 0.191	-1.203 ± 0.237	-0.588 ± 0.304	-1.93
		Spiral	0.100 ± 0.130	-0.052 ± 0.173	-0.152 ± 0.217	-0.70
	NGCD (deV)	Elliptical	-0.648 ± 0.236	-0.999 ± 0.196	-0.351 ± 0.307	-1.14
	NGCD (exp)	Spiral	-0.077 ± 0.143	0.088 ± 0.141	0.165 ± 0.201	0.82
$\delta\mu$	PGCD (kpc)	All	0.022 ± 0.020	0.040 ± 0.030	0.018 ± 0.037	0.48
		Elliptical	-0.056 ± 0.030	-0.024 ± 0.037	0.032 ± 0.048	0.66
		Spiral	0.070 ± 0.025	0.073 ± 0.041	0.004 ± 0.049	0.07
	NGCD (P50)	All	0.018 ± 0.019	0.044 ± 0.031	0.026 ± 0.037	0.71
		Elliptical	-0.062 ± 0.030	-0.017 ± 0.037	0.045 ± 0.048	0.95
		Spiral	0.066 ± 0.022	0.078 ± 0.043	0.012 ± 0.049	0.25
	NGCD (deV)	Elliptical	-0.040 ± 0.039	-0.045 ± 0.029	-0.005 ± 0.049	-0.11
	NGCD (exp)	Spiral	0.014 ± 0.027	0.100 ± 0.032	0.087 ± 0.041	2.10

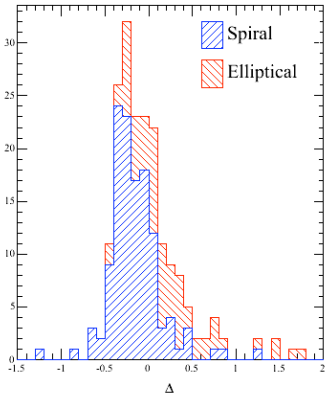
Summary

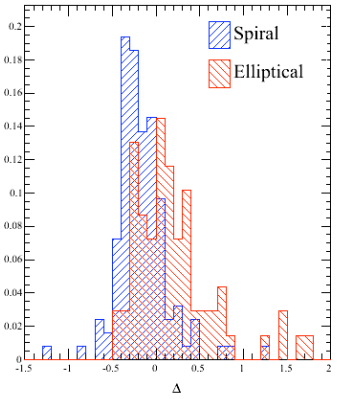
- No sign of significant slopes fitting the SN parameters as a function of the distance (except residuals vs P50)
- Not enough data to see differences taking into account the different host types
- With BOSS (SDSS-III) we are going to increase the number of spectroscopical hosts of photo-Ia [105].
- Things that we don't take into account: spiral arms, inclination ...

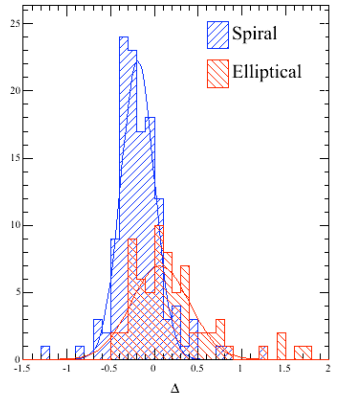
Plots

MLCS results

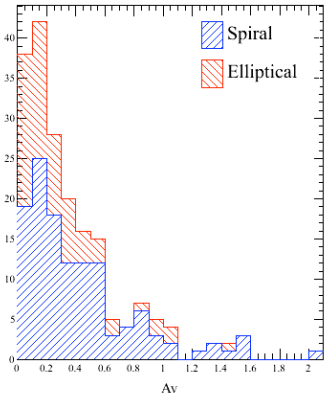
Stacked | Unit area | Absolute #

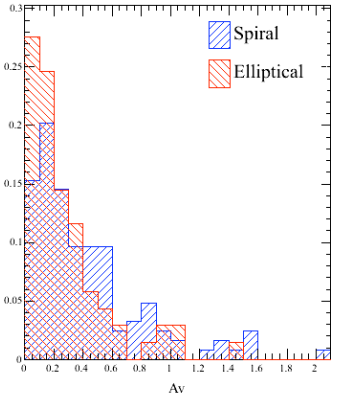


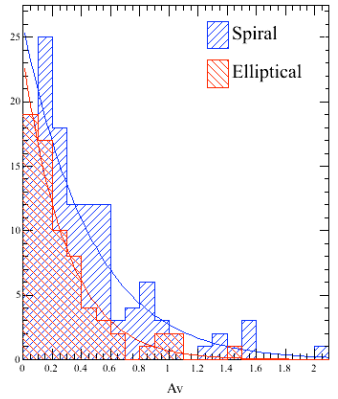




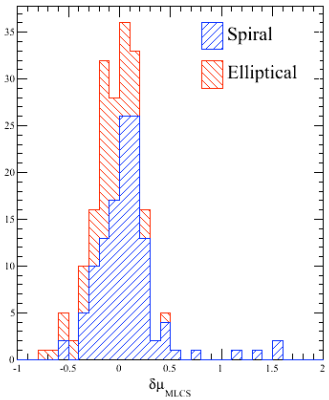
Δ

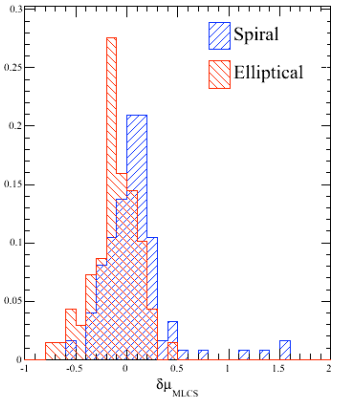


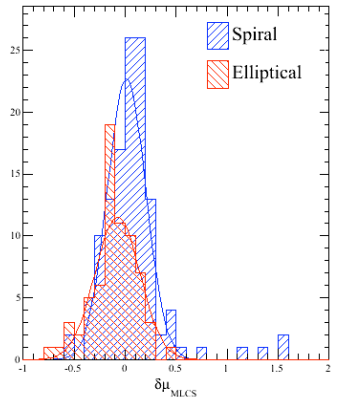




Av

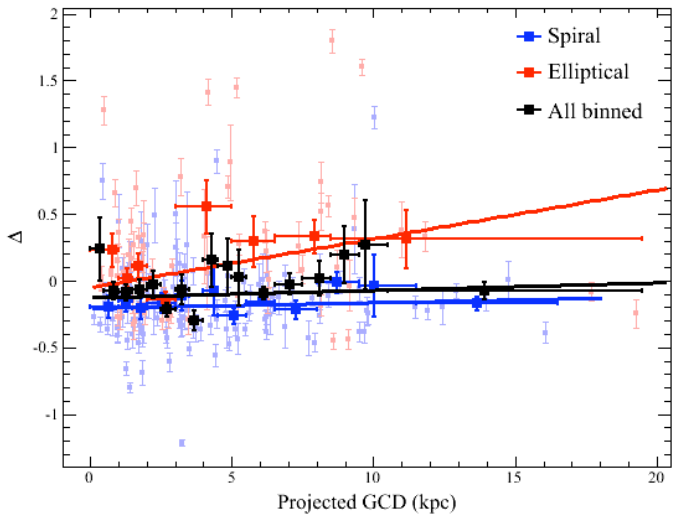


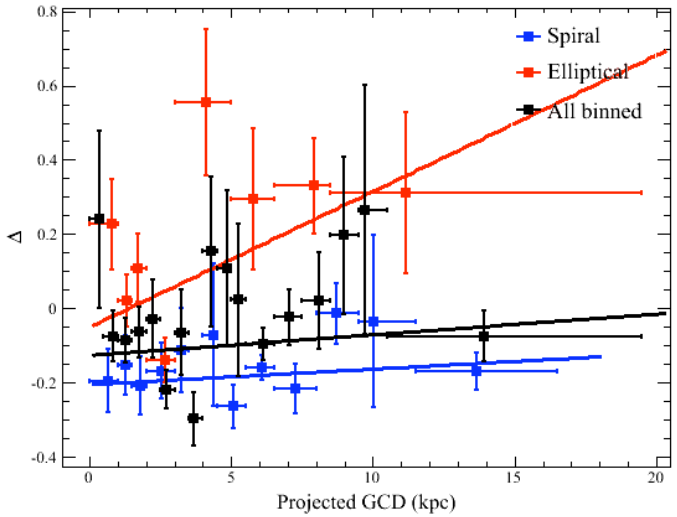


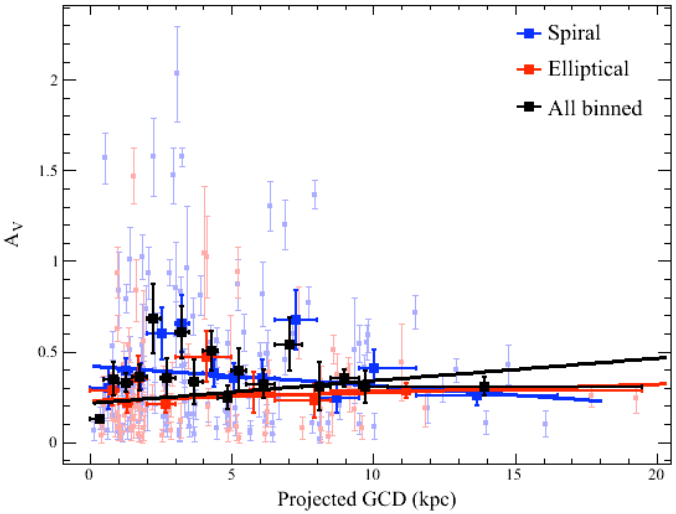


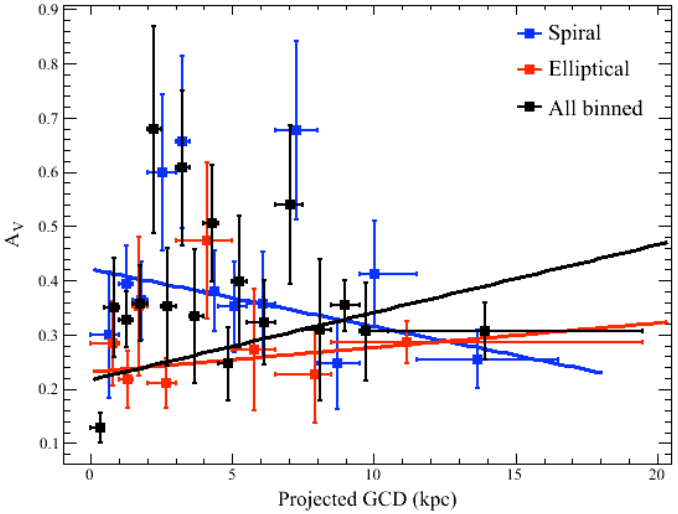
δμ

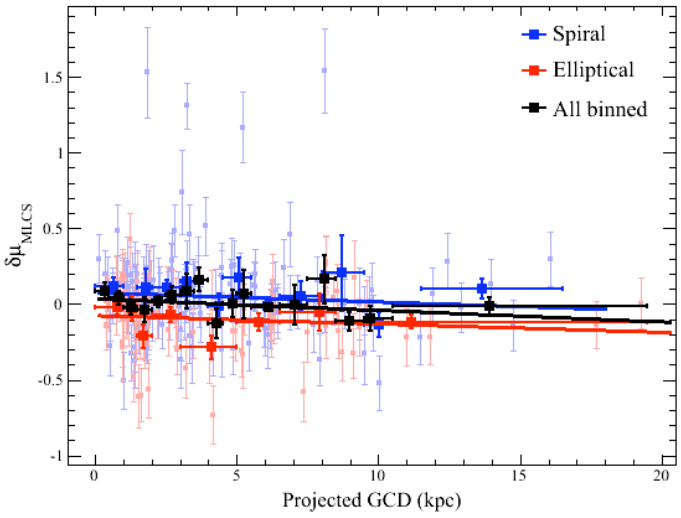
MLCS results (kpc)

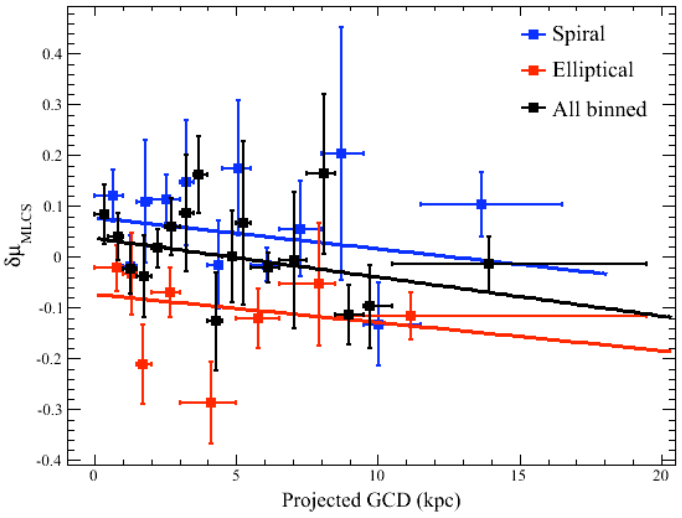




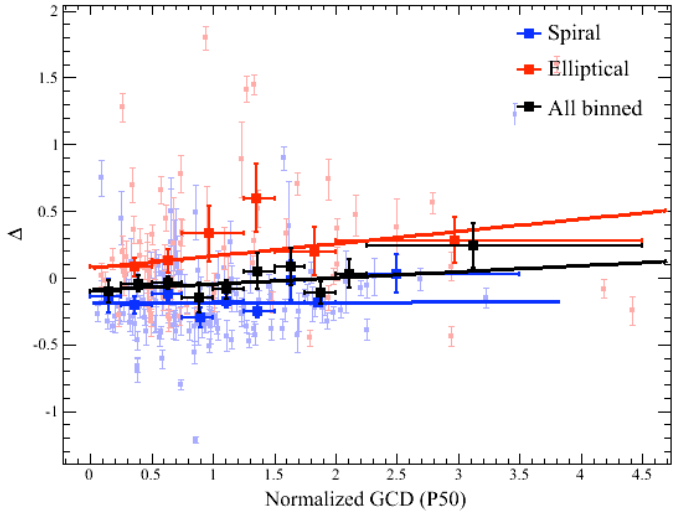


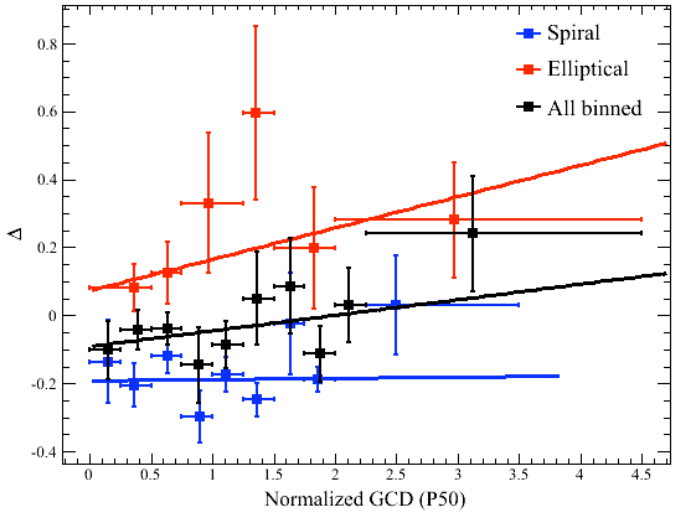


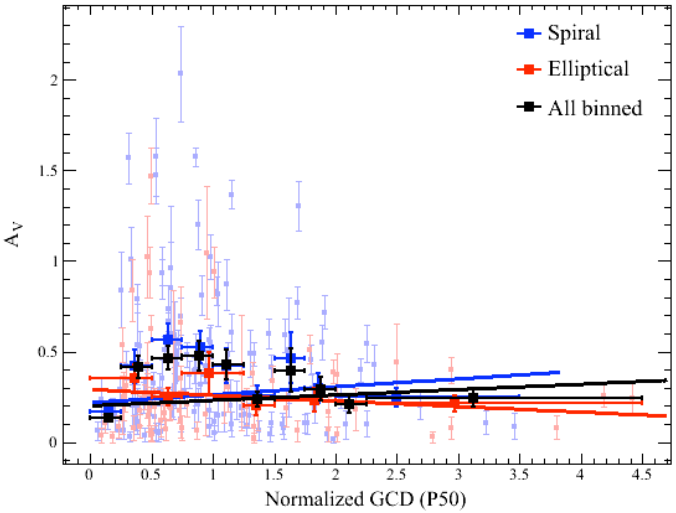


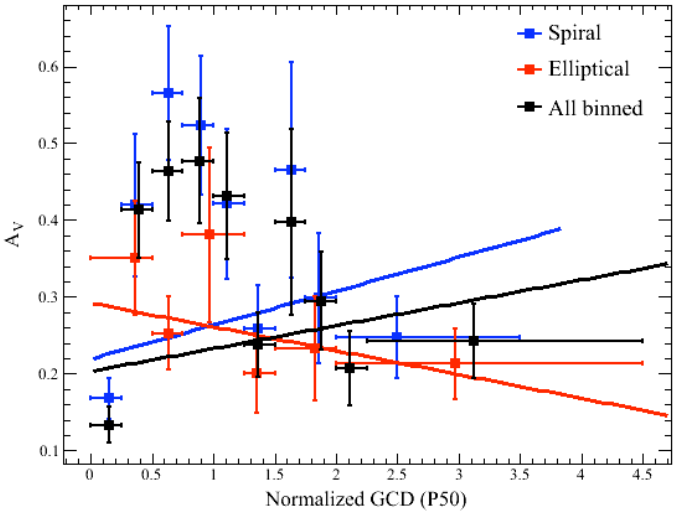


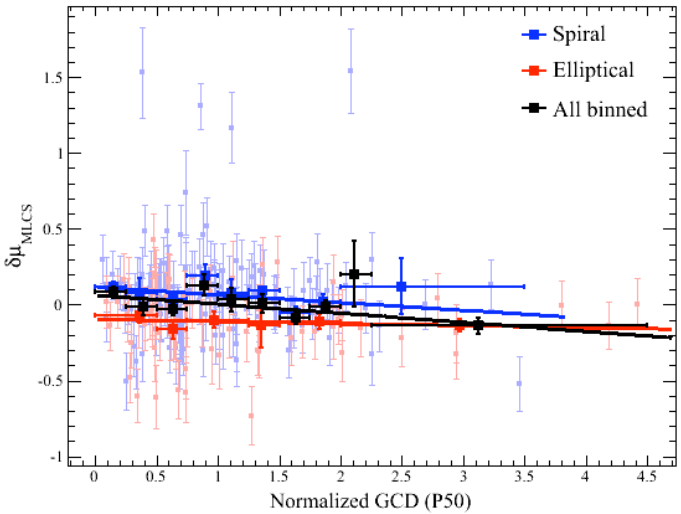
MLCS results (P50)

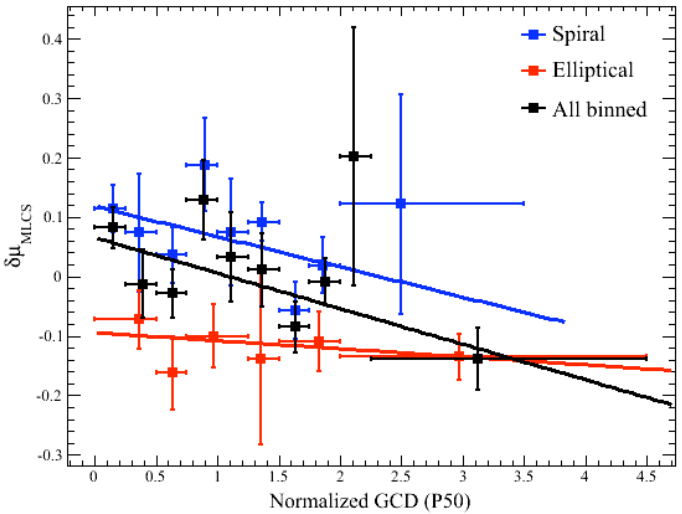




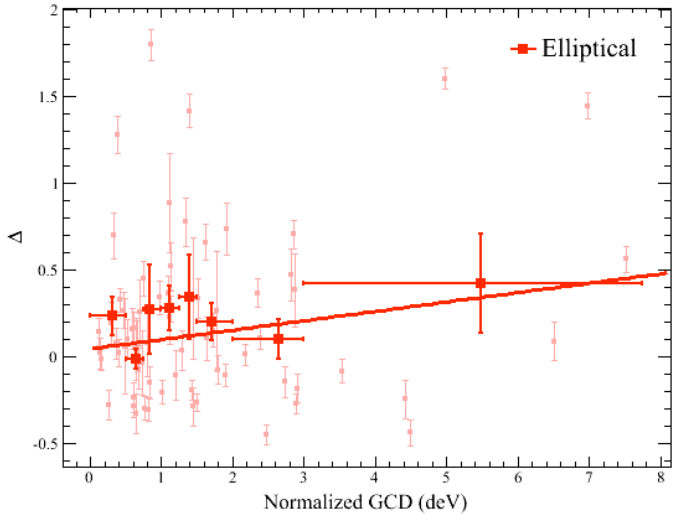


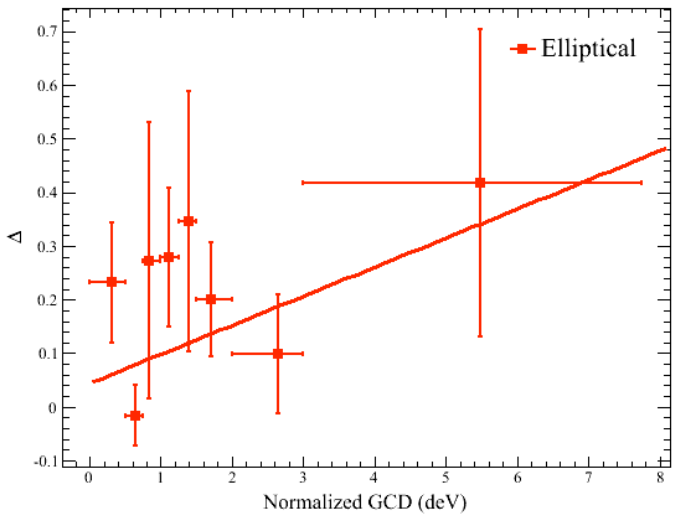


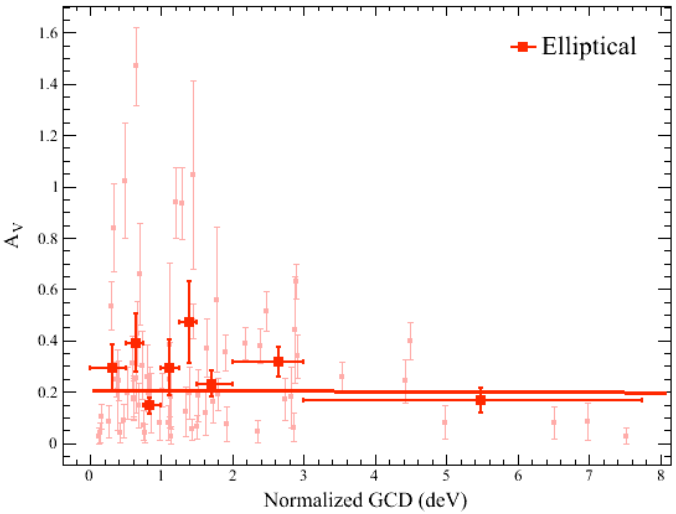


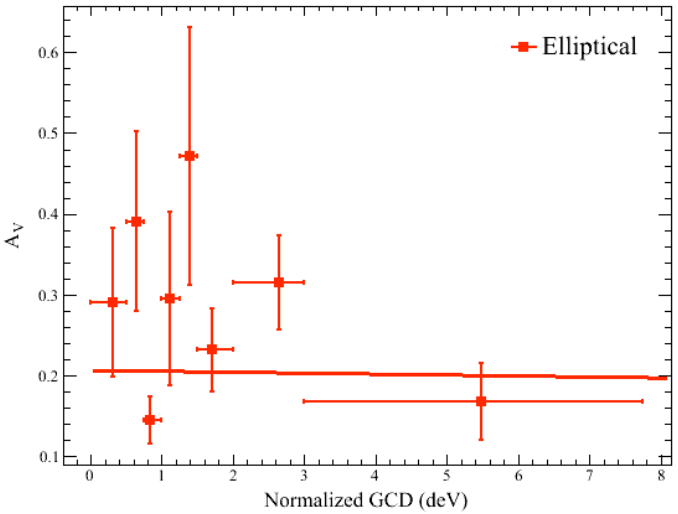


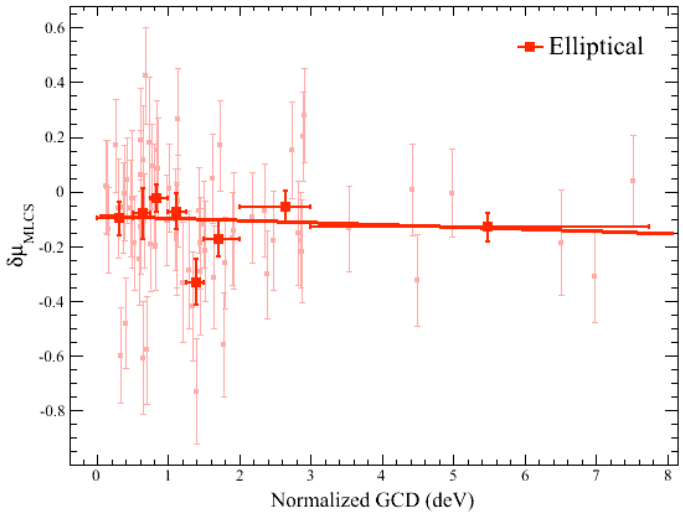
MLCS results (deV)

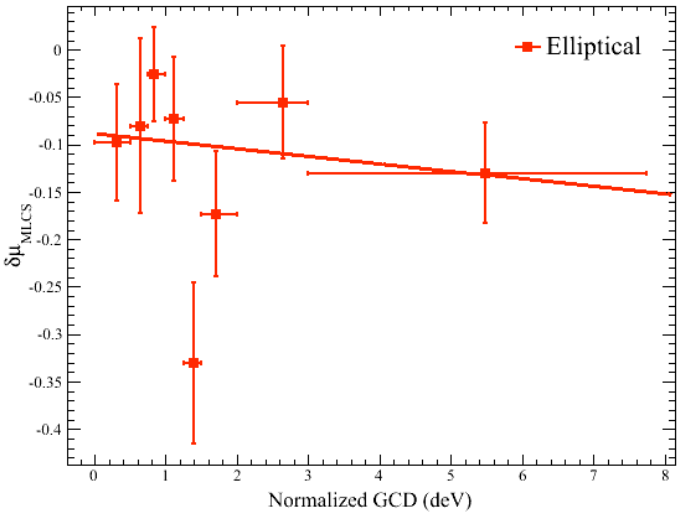




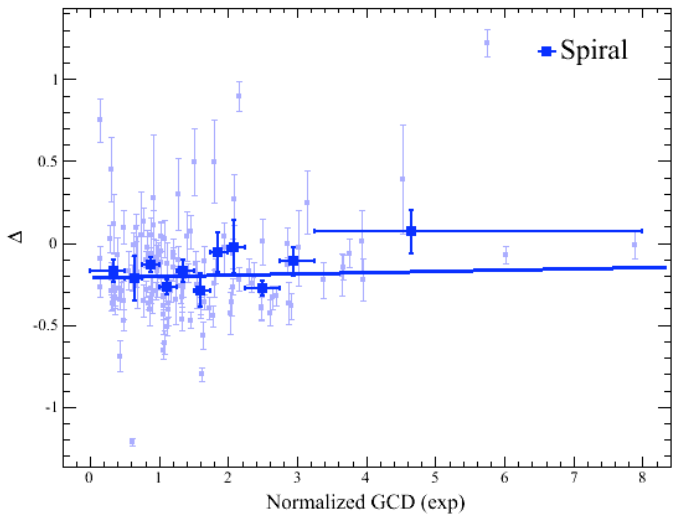


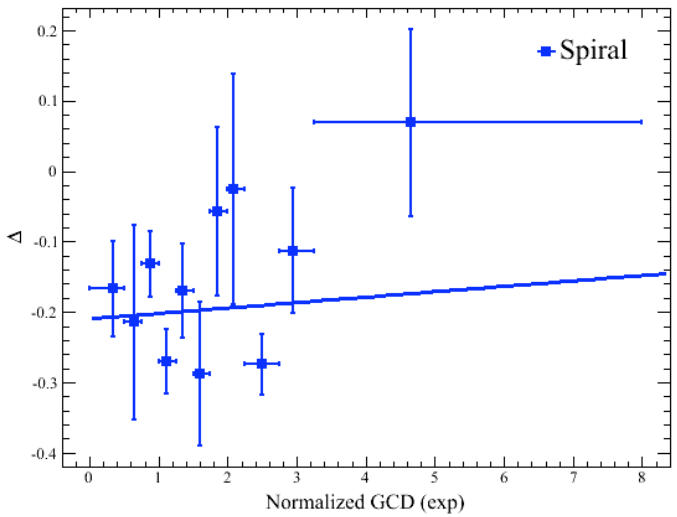


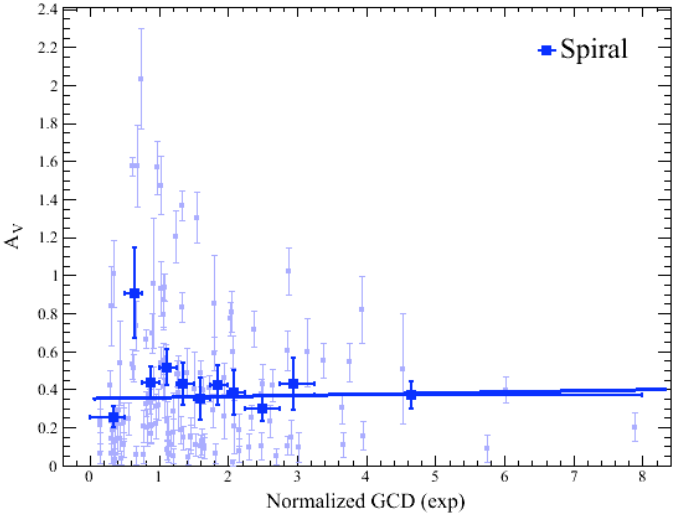


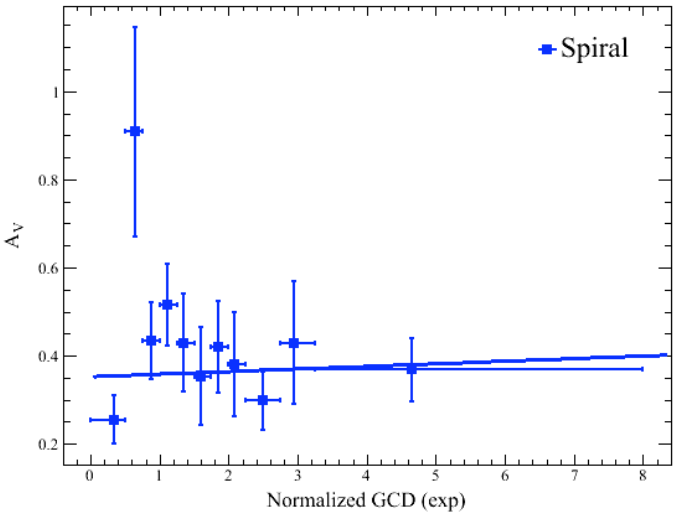


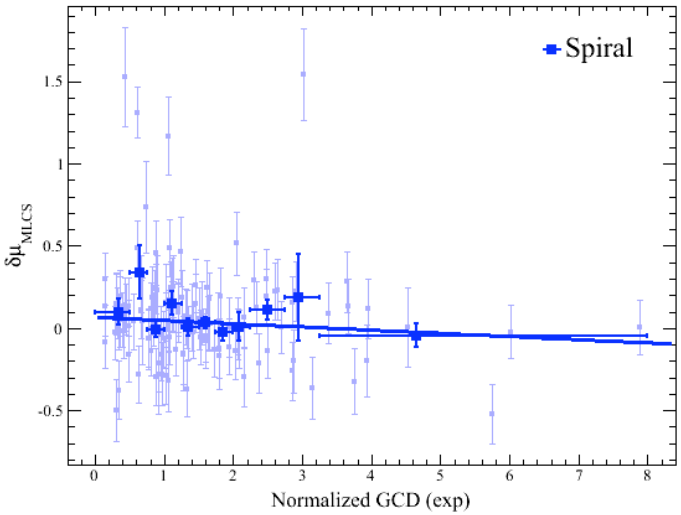
MLCS results (exp)

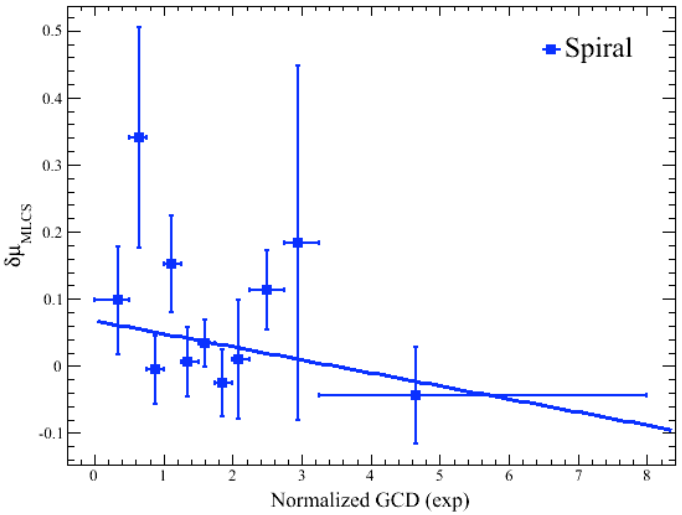




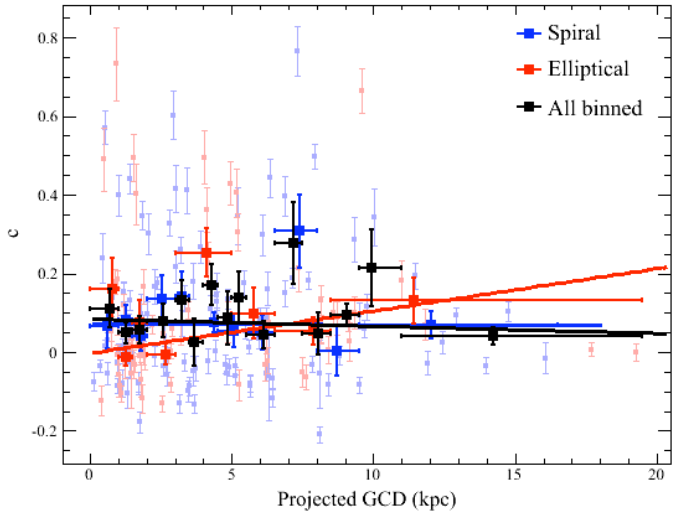


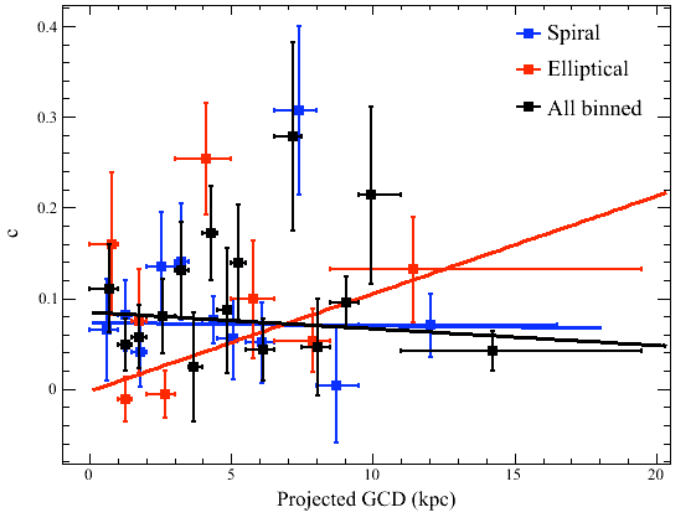


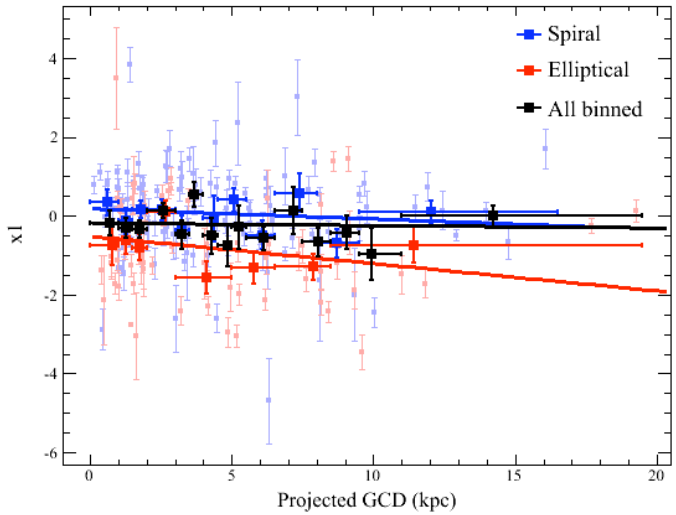


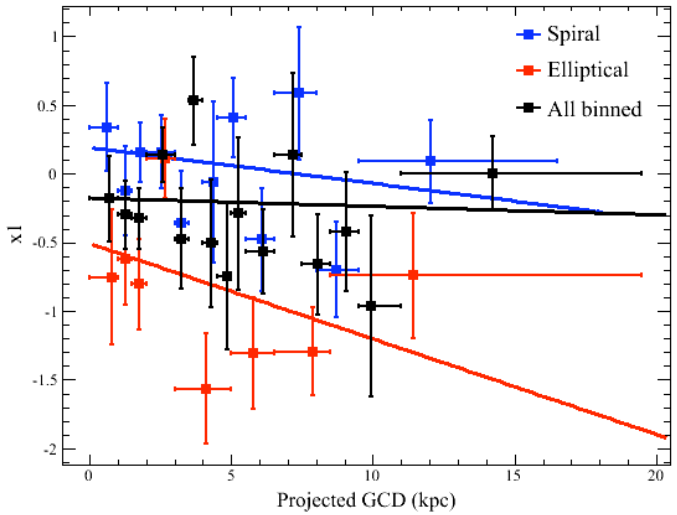


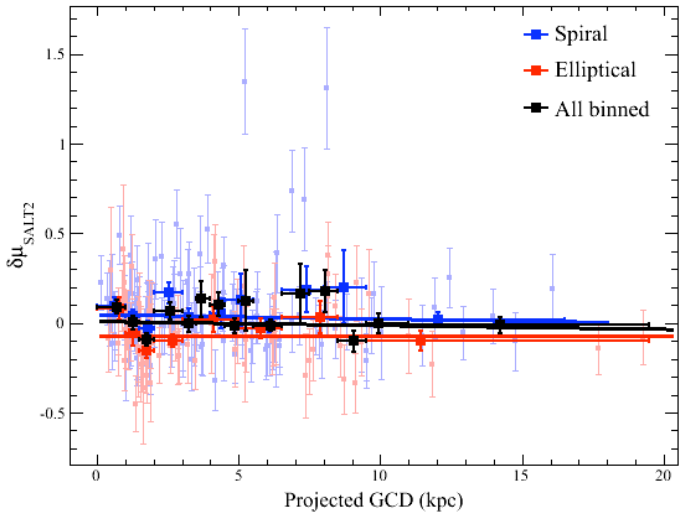
SALT2 results (kpc)

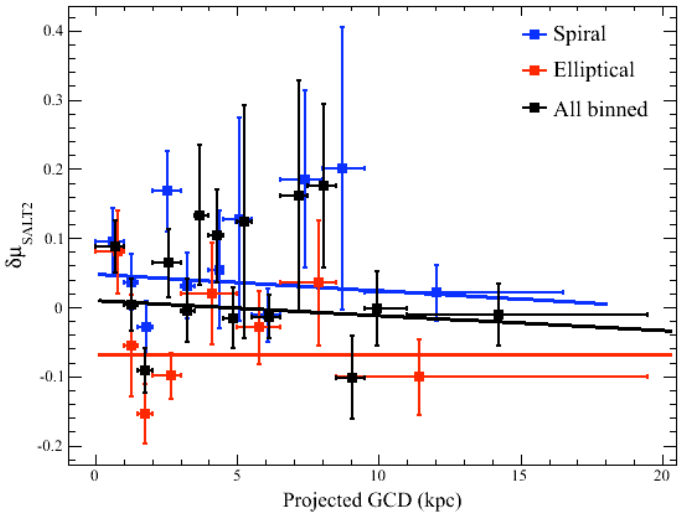




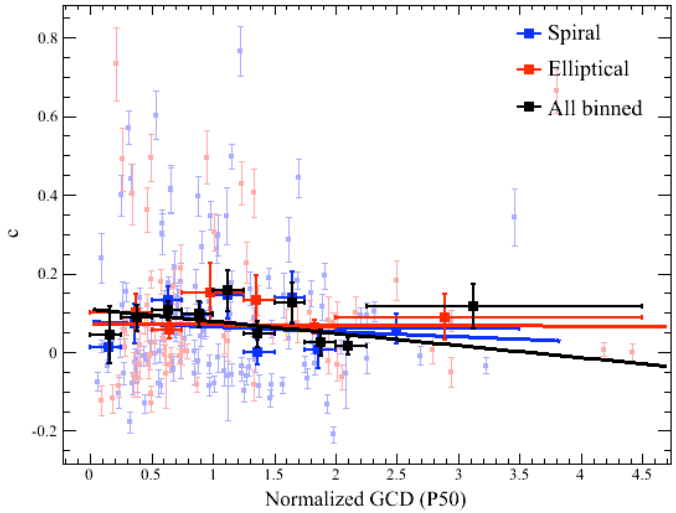


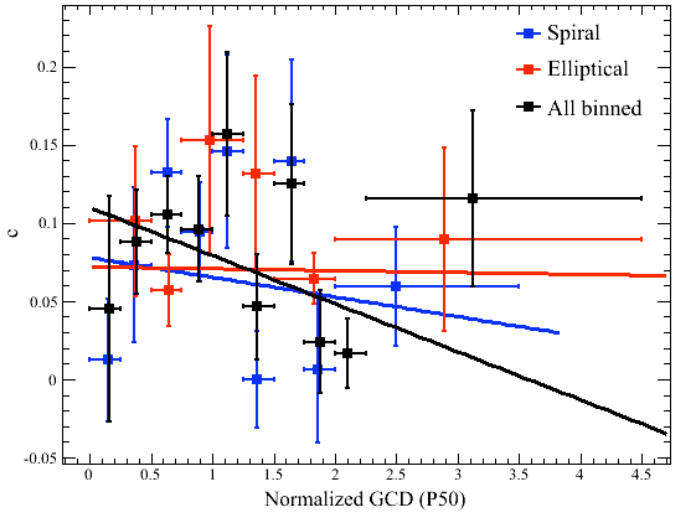


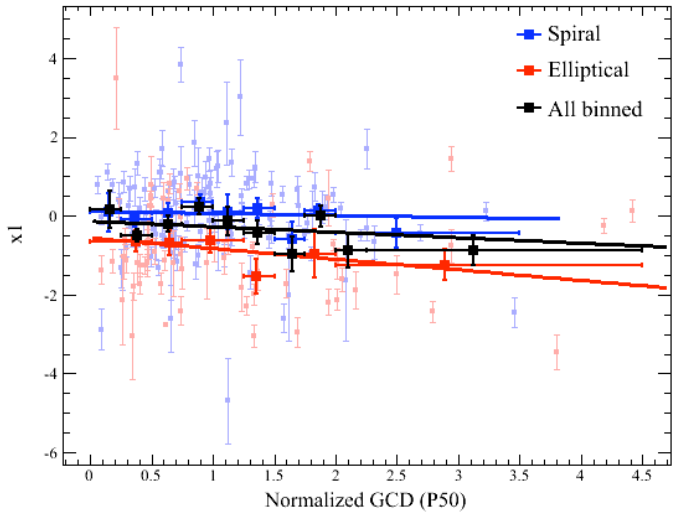


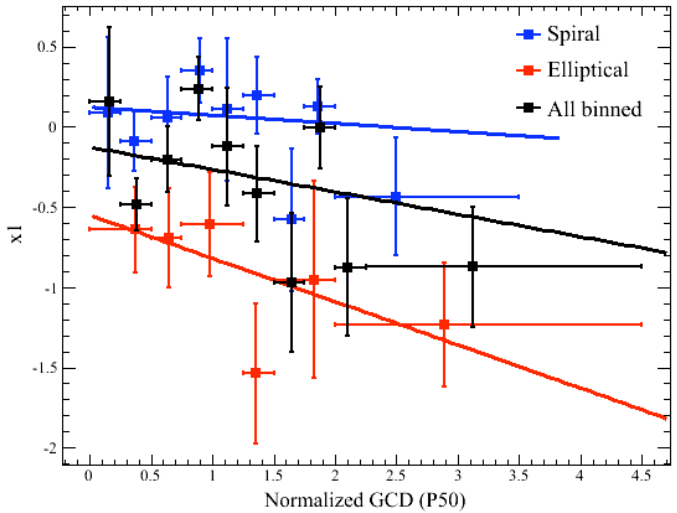


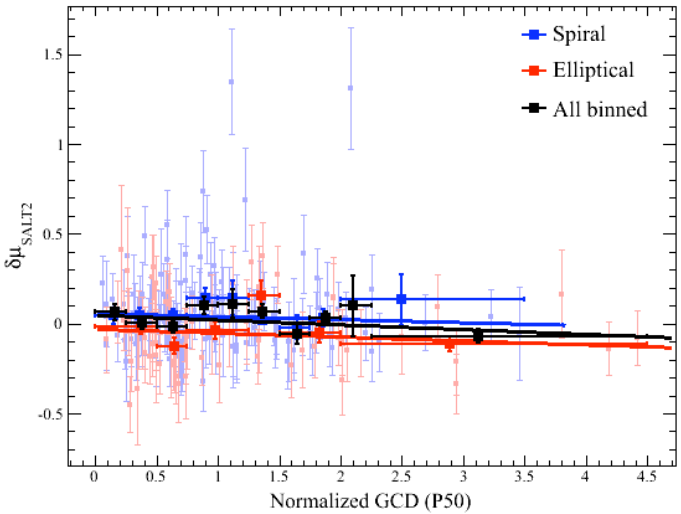
SALT2 results (P50)

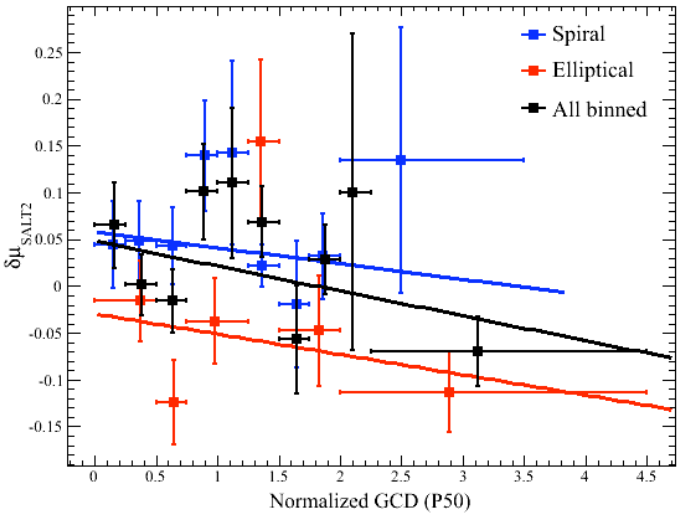




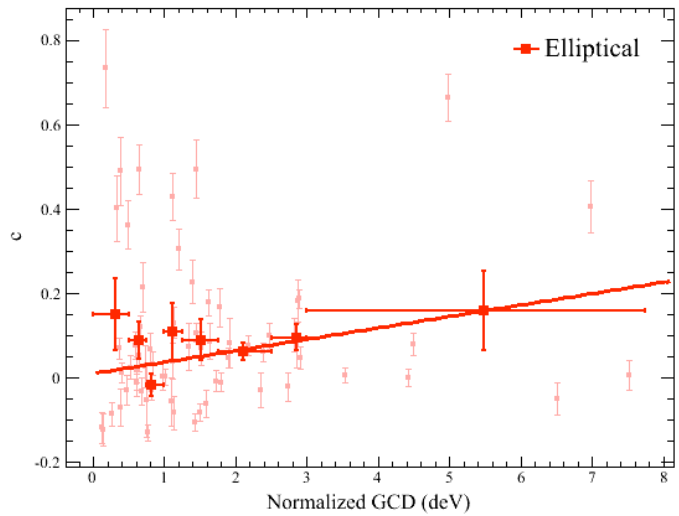


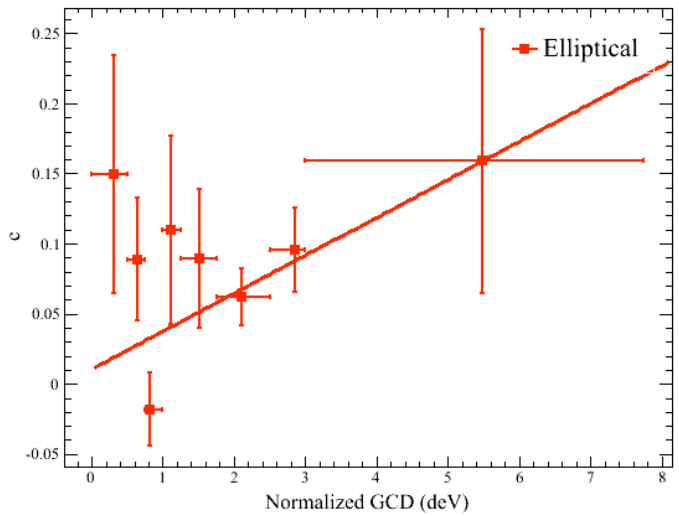


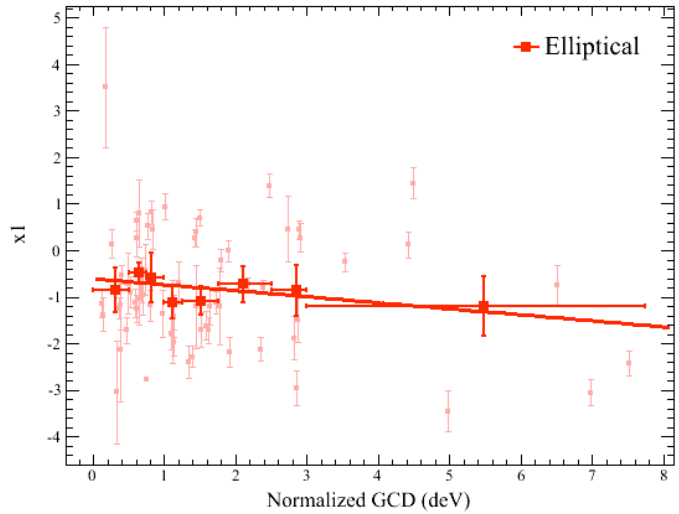


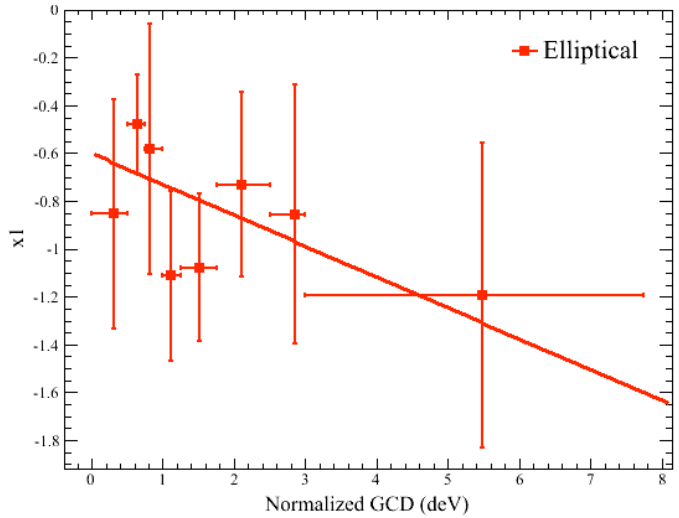


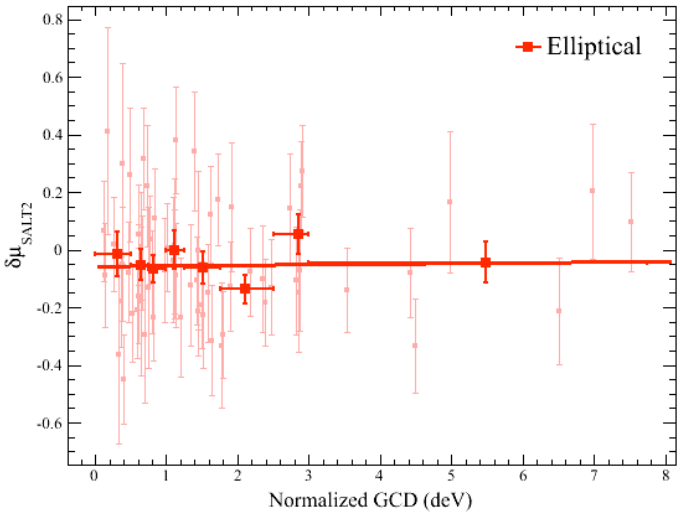
SALT2 results (deV)

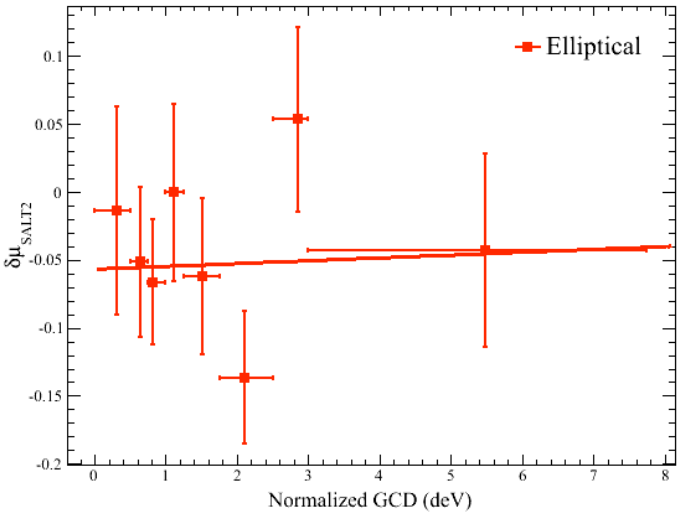












SALT2 results (exp)