Peculiar velocities of SN Ia in clusters of galaxies: the impact on distance measurements

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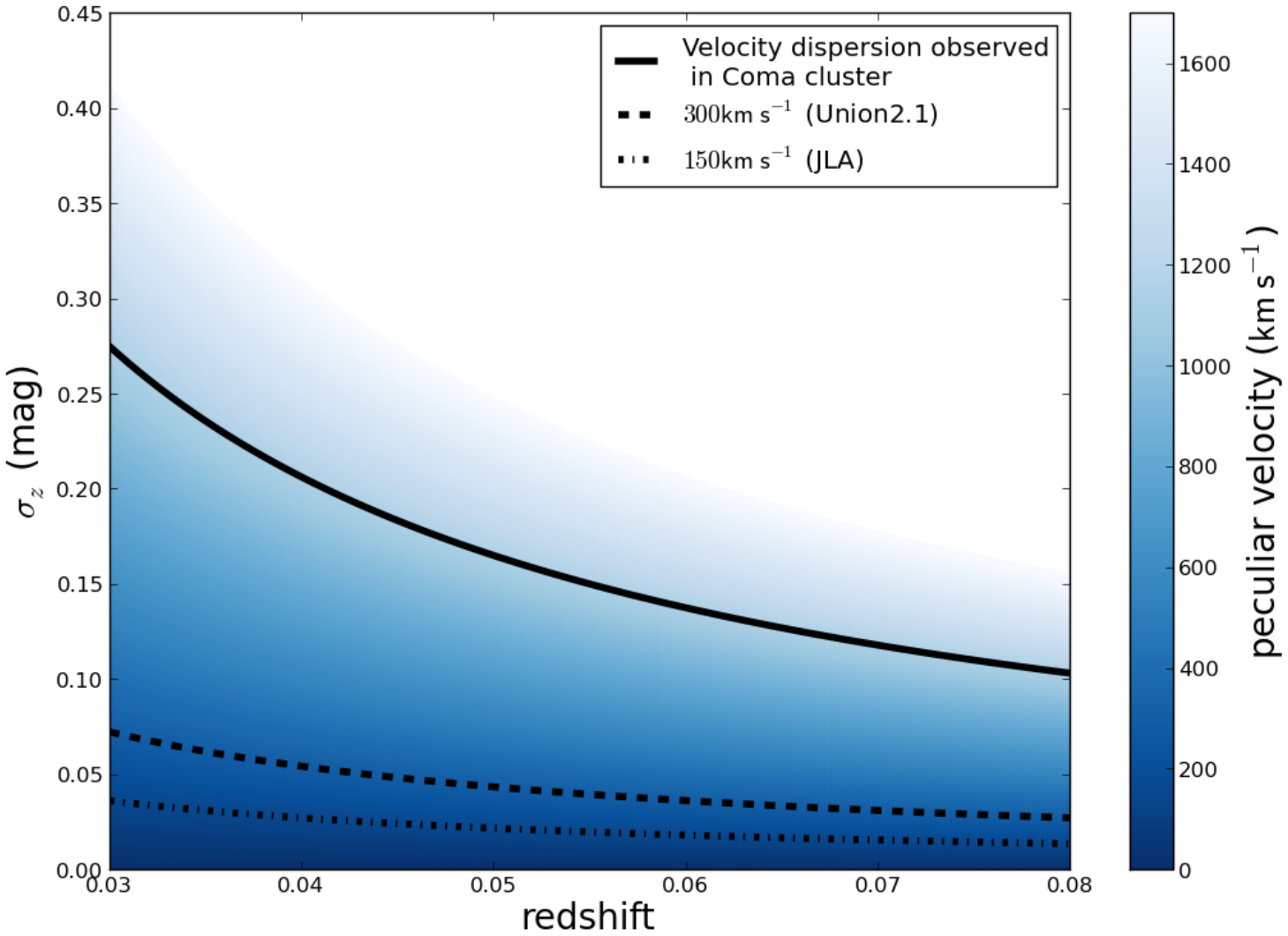
March 19, 2017

Introduction

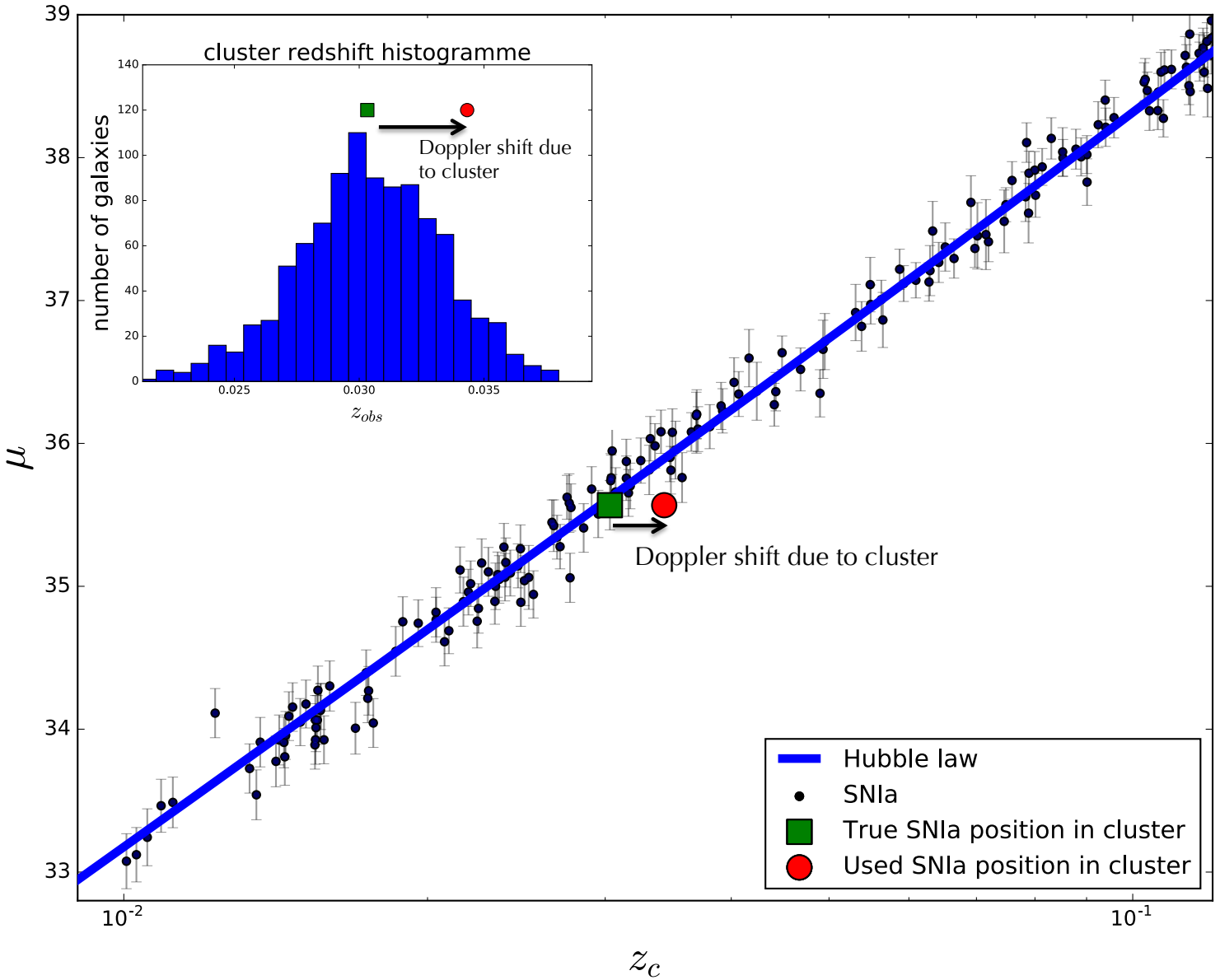
Cosmology with SN Ia

- "luminosity distance-redshift" relation
- Is the uncertainty on the redshift negligible?
  $(1 + z_{obs}) = (1 + z_c)(1 + z_d)$
- For low and intermediate redshifts ($z < 0.2$):
  - high intrinsic velocity dispersion (300 km/s, Suzuki et al., 2012)
  - velocity maps of the nearby Universe (150 km/s, Hudson et al., 2004; Conley et al., 2011; Betoule et al., 2014)
- $\sigma_m = \frac{5\,\sigma_z}{z \ln 10}$

Introduction



Introduction



Introduction

To use the host cluster redshift instead of the host galaxy redshift

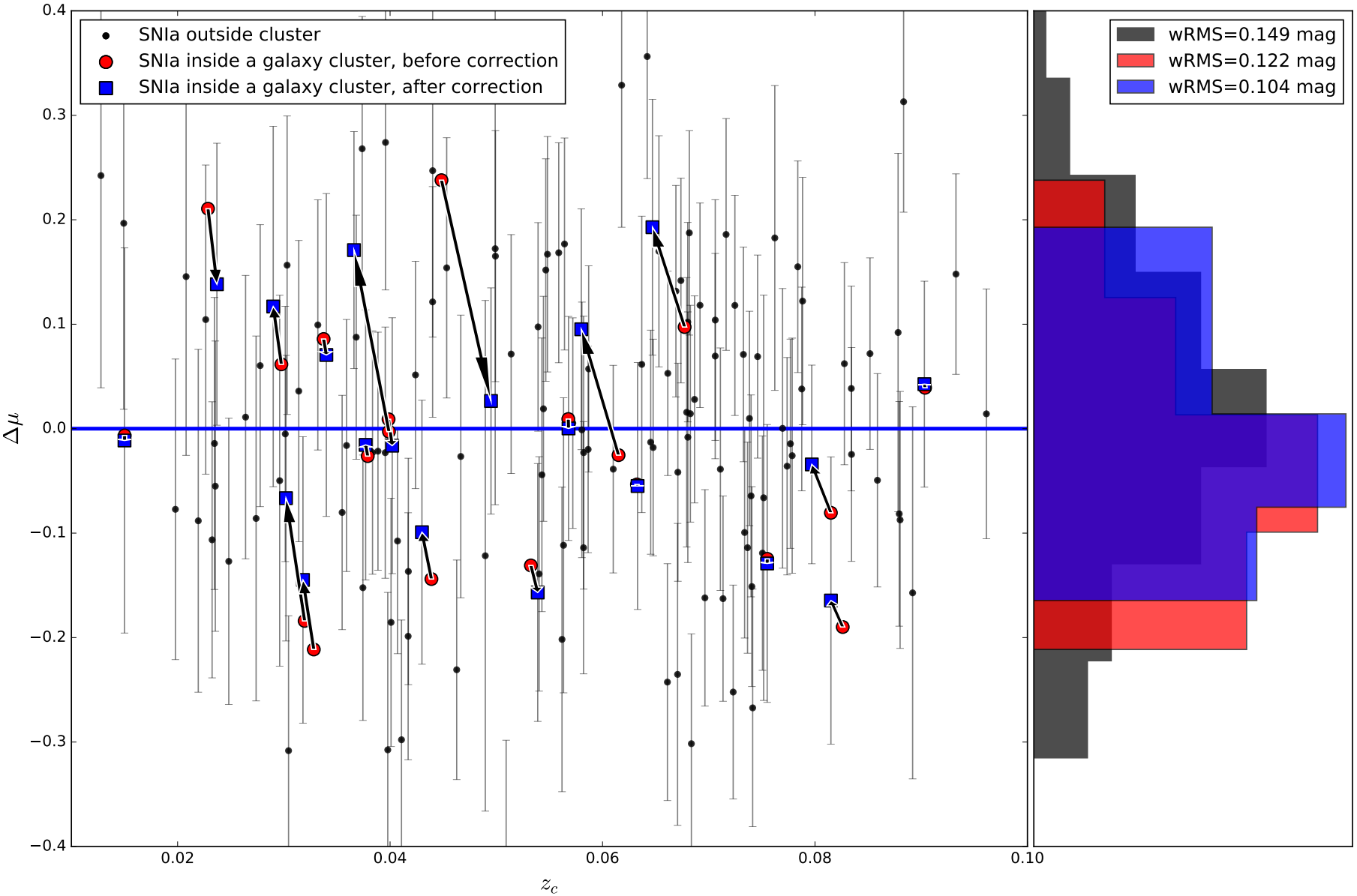
Host clusters

$d < 1$ Mpc
$\Delta z < 0.01$

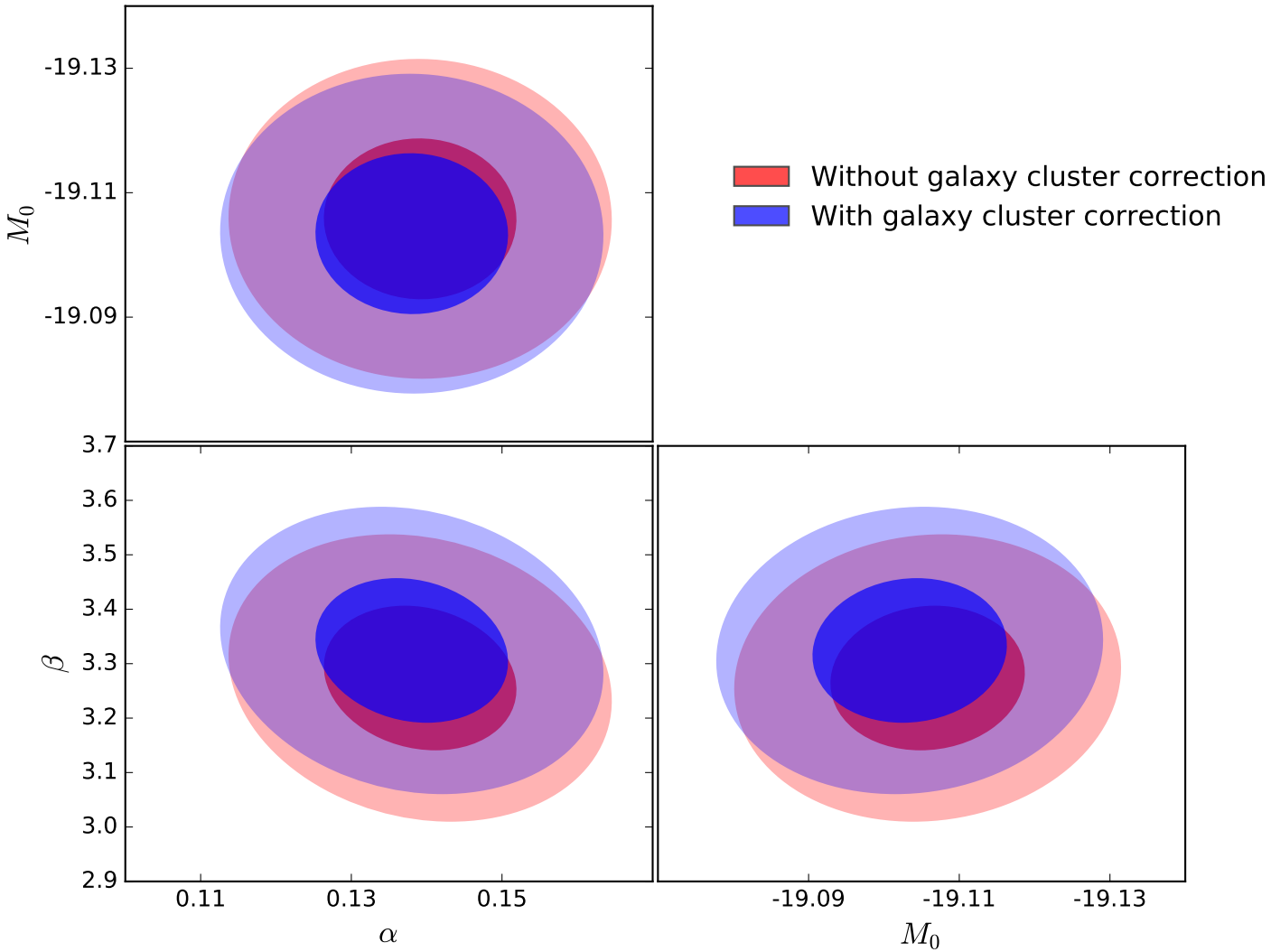
SN name	Galaxy cluster	MCXC name	R_{200}	z_{sn}	z_{cl}	z_{er}^{cl}	N_{gal}	Source
PTF09foz	A0087	in BAX	2.01[b]	0.0533	0.0539	0.0003	62	SDSS
SN2004gc	WBL 113		1.24[c]	0.032	0.0302	0.0010	8	[3-7]
SN2007nq	A0119	J0056.3-0112	1.43[a]	0.0439	0.0430	0.0003	132	SDSS
SN2008ec	ZwCl 2259+0746		0.39[c]	0.015	0.0150	0.0004	5	[14]
SN2009hi	A2589	J2323.8+1648	1.33[a]	0.0399	0.0402	0.0003	58	[10]
SNF20051003-004	RXJ0228.2+2811	J0228.1+2811	0.92[a]	0.0337	0.0340	0.0015	2	[19]
SNF20051113-000	[DEM94] 042751.5-174203		1.00[d]	0.0826	0.0815	0.0012	4	[11]
SNF20060609-002	A2151a	J1604.5+1743	1.16[a]	0.0399	0.0366	0.0002	175	SDSS
SNF20061020-000	A0076	J0040.0+0649	1.06[a]	0.0379	0.0377	0.0009	7	[17]
SNF20061021-003	[WHL2012]J003555.3+071306		0.77	0.0615	0.0580	0.0013	2	[12]
SNF20061111-002	RXC J2306.8-1324	J2306.8-1324	1.08[a]	0.0677	0.0647	0.0018	2	[18]
SNF20070403-001	[SPD2011] 27349		0.96	0.0815	0.0797	0.0002	23	SDSS
SNF20070417-002	[WHL2012] J132045.4+211627		1.27	0.0904	0.0903	0.0005	35	SDSS
SNF20070712-000	ZwCl 1743+5528		1.37[c]	0.0298	0.0290	0.0016	4	[20]
SNF20080512-010	[WHL2012] J161104.1+522701		1.50	0.0632	0.0633	0.0002	30	SDSS
SNF20080514-002	RXC J1329.5+1147	J1329.5+1147	0.77[a]	0.0229	0.0237	0.0002	46	SDSS
SNF20080612-003	RXC J1615.5+1927	J1615.5+1927	0.76[a]	0.0328	0.0318	0.0010	3	[21]
SNF20080623-001	ZwCl8338	J1811.0+4954	1.17[a]	0.0448	0.0495	0.0003	55	[10]
SNF20080731-000	ZwCl 1742+3306	J1744.2+3259	1.55[a]	0.0755	0.0755	0.0026	2	[22]
SNF20080803-000	[YSS2008] 510		0.48	0.0568	0.0568	0.0007	14	SDSS

Table: The association of the SNF supernovae with host clusters (based on SIMBAD data).

Result
Hubble diagram



Results


Without galaxy cluster correction
With galaxy cluster correction
M_0
-19.13
-19.11
-19.09
β
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
2.9
0.11
0.13
0.15
α
-19.09
-19.11
-19.13
M_0

Merci pour votre attention !