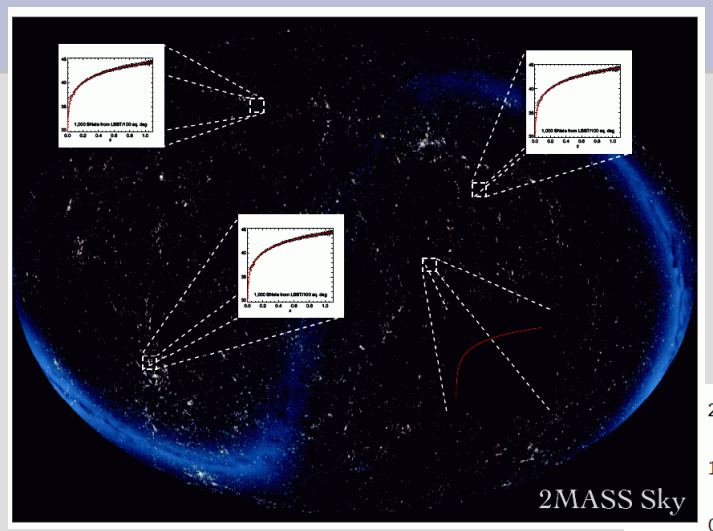
News from the
The DESC Supernova Working Group

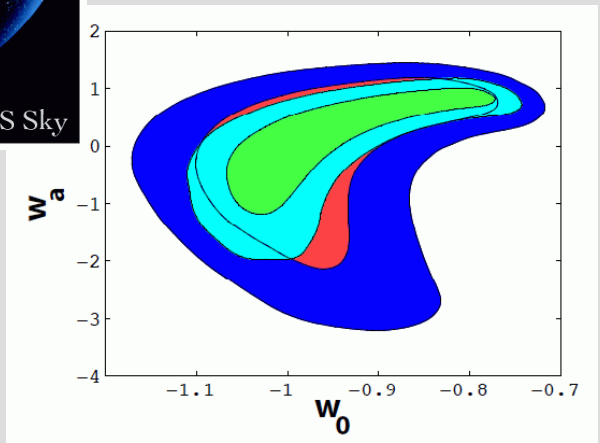
LSST- FRANCE
8 June 2016

Dominique Fouchez, CPPM

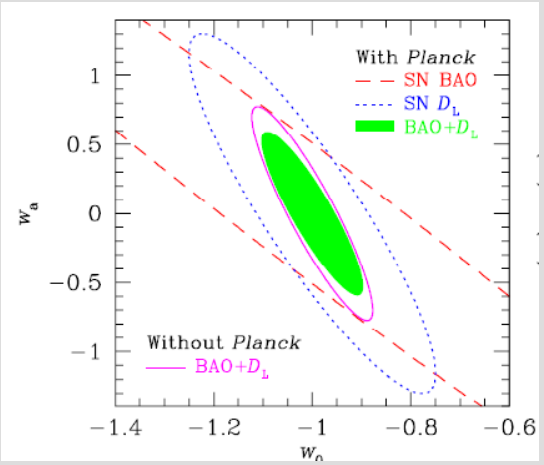
Supernovae Dark Energy science with LSST
The DESC SN-WG program



Isotropy constraints



Dark Energy constraints

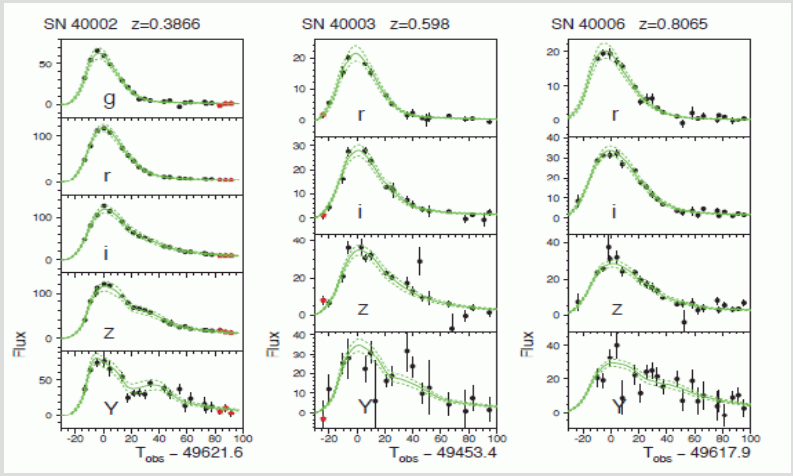


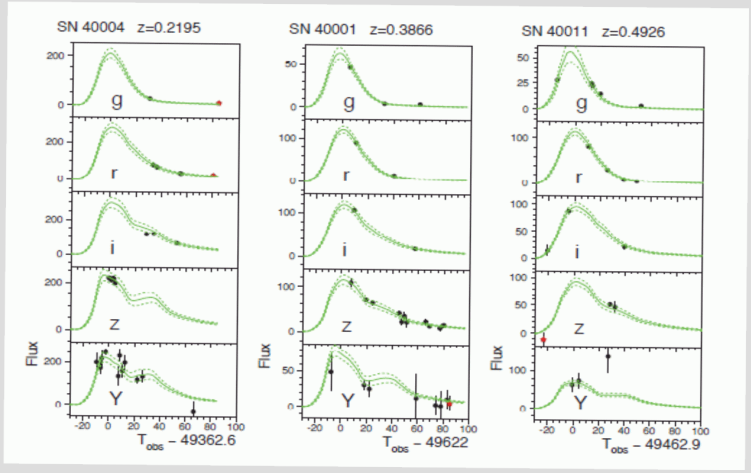
BAO with supernovae

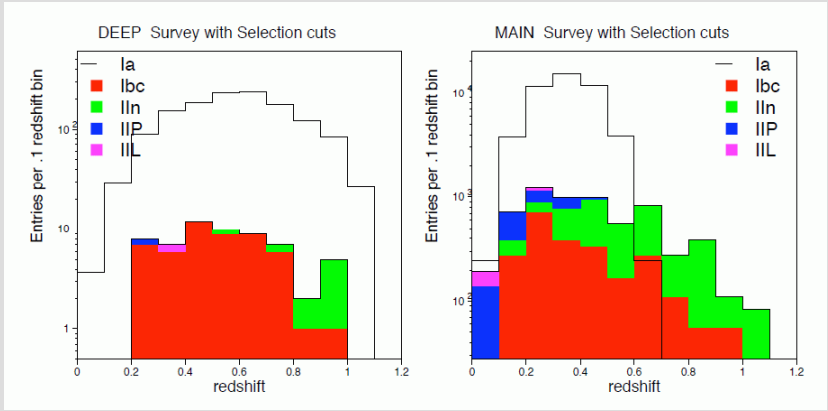
Two LSST observing Cadences

Deep Drilling :
Every day, multiple f lters

Main survey :
Every 3.5 days with one f lter







The DESC Supernova WG

- About 30 members
  - Recent increase thanks to new UK members
- 1 visioconf every f ŕst Friday of each month
- Co-Conveners :
  - Michael Wood-Vasey (change after summer)
  - Saurabh Jha
- https://conf luence.slac.stanford.edu/display/LSSTDESC/Supernovae
- A RoadMap
- Data Challenges

Science Road Map

Supernovae Key Projects:

SRM – Key analysis

Table 3.5.1: SN key analysis steps, and their associated software tools.

Code name	Purpose	DC1	DC2	DC3	ComCam
SUPERNOVAREALIZER	Simulate SN light curves and populations	**SN1 Produce reasonable SN samples in CATSIM and PHOSIM**	Refine with new templates as they become available	Refine with new templates as they become available	Apply to ComCam data
SUPERNOVAMONITOR	Extract light curves for all SN candidates	**CX2 Extract optimally-measured SN flux from sets of images**	Verify on Twinkles 2.0	Test and refine for accuracy and speed	Apply to ComCam data
SUPERNOVATYPE	Determine type and redshift of SN candidates	**SN2** Build basic code. Implement multiple methods and run on SDSS, SNLS, DES.	**SN4** Provide covariances. Simulate LSST. Develop spectroscopic follow-up plan.	**SN6** Integrate with joint cosmology. Add early-time prediction capability for follow-up decisions.	Apply to ComCam data
SUPERNOVADISTANCE	Determine relative distances to SN Ia	Collect newly available samples from nearby, SDSS, SNLS	Improve dust, color treatment from nearby, PS1, DES	**SN5 (development); SN6 (application)**	Apply to ComCam data
SUPERNOVACADENCE	Compute DE Metric from given cadence and SN population	Learn from DES coverage	**SN3**	Refine observing strategy recommendations including other probes	Observing strategy to include developed recommendations

SRM – Data Challenge

Table 3.5.2: SN challenge datasets.

Name	Era	Data	Builders	Processing	Key Projects	Collaborators
SN Realizer Test, **Twinkles 1**	DC1	PHOSIM images	Twinkles Task Force (SL,SN,SS,CI)	SS? (DM Stack Level 2); SL (SLMONITOR)	CX2	SN, CI, SS
Observing Strategy	DC2	OPSIM runs; SN Population sims	SN	SN SN3	SN	
Better Distances	DC3	SN population models. DES and nearby SN data sets	SN	SN SN5	SN	
Photo-typing Set 1	DC1	Catalog of 10^8 SN	SN	SN	SN2	SN
Photo-typing Set 2	DC2	Catalog of 10^9 SN. photo-z mock galaxy catalogs	SN, PZ	SN SN4	SN	
Photo-typing Set 3	DC3	OPSIM. Catalog of 10^9 SN. photo-z mock galaxy catalogs	SN, PZ	SN SN4	SN	

Current activities (new and continuation)

- Cadence Whitepaper
- Likelihood photometric analysis
- Twinkles
  - SN realizer / Mock catalog / SN host
- Photometric classification
  - Lochner study (paper)
  - Photometric classification workshop
  - Hack day on Photometric classifier @ Oxford

March 2016 DESC Meeting
SN-WG Highlights

SN realizator

SN classification

Complementary survey (WFIRST/SNFactory)

Modeling PCA, Sugar

Host galaxy correlation

Image subtraction

Observing strategy

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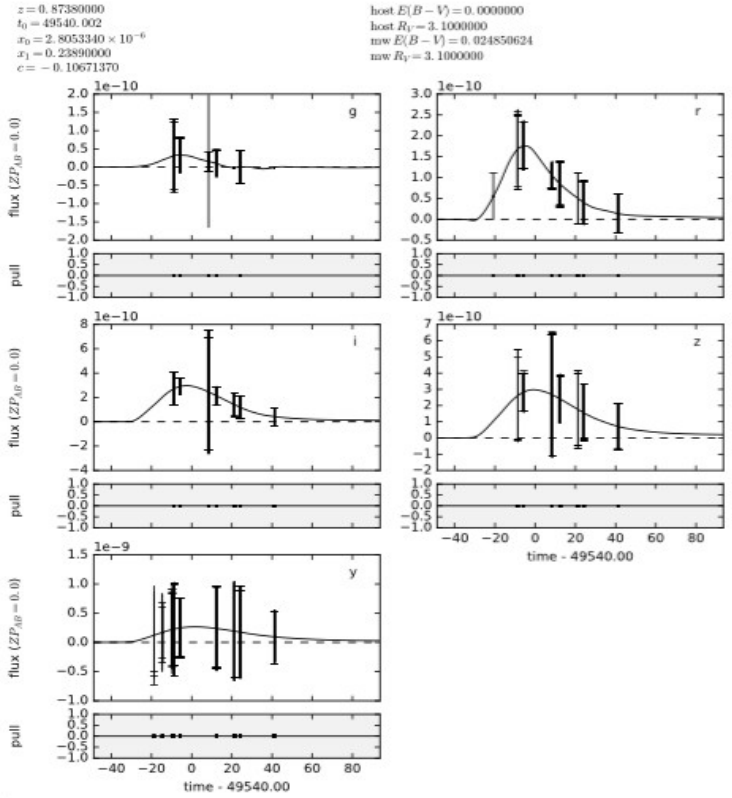
SN realizer : Lightcurves

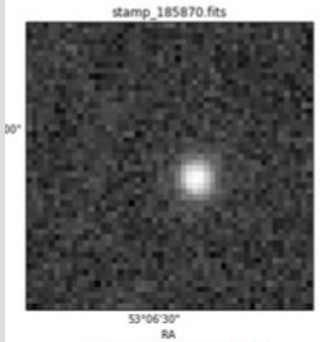
Examples of Light Curve



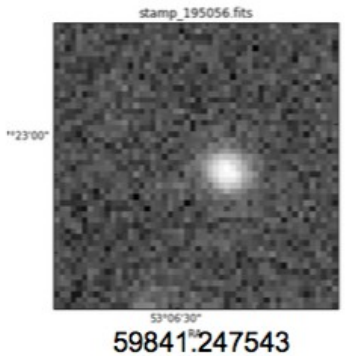
- Light curve from SNCatalog combining instance catalog entries for the same object
- Truth information only: No Scatter added

SN realizer : images from Phosim

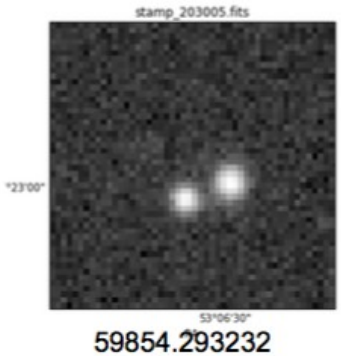
Bryce Kalmbach, Jim Chiang



59825.262477

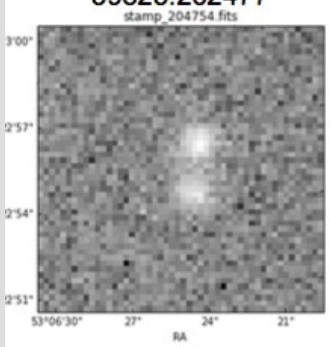


59841.247543



59854.293232

z = 0.175
t0= 59865.8
c= 0.
x1 = -1.18



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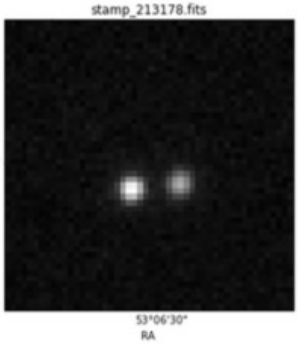

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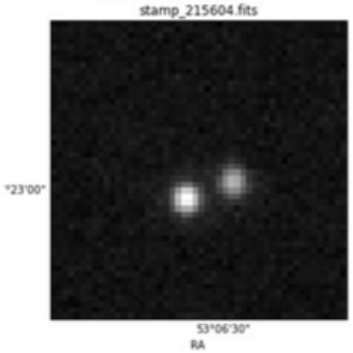

59871.151417

SN in r band

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SN-WG Highlights

SN realizator

SN classification

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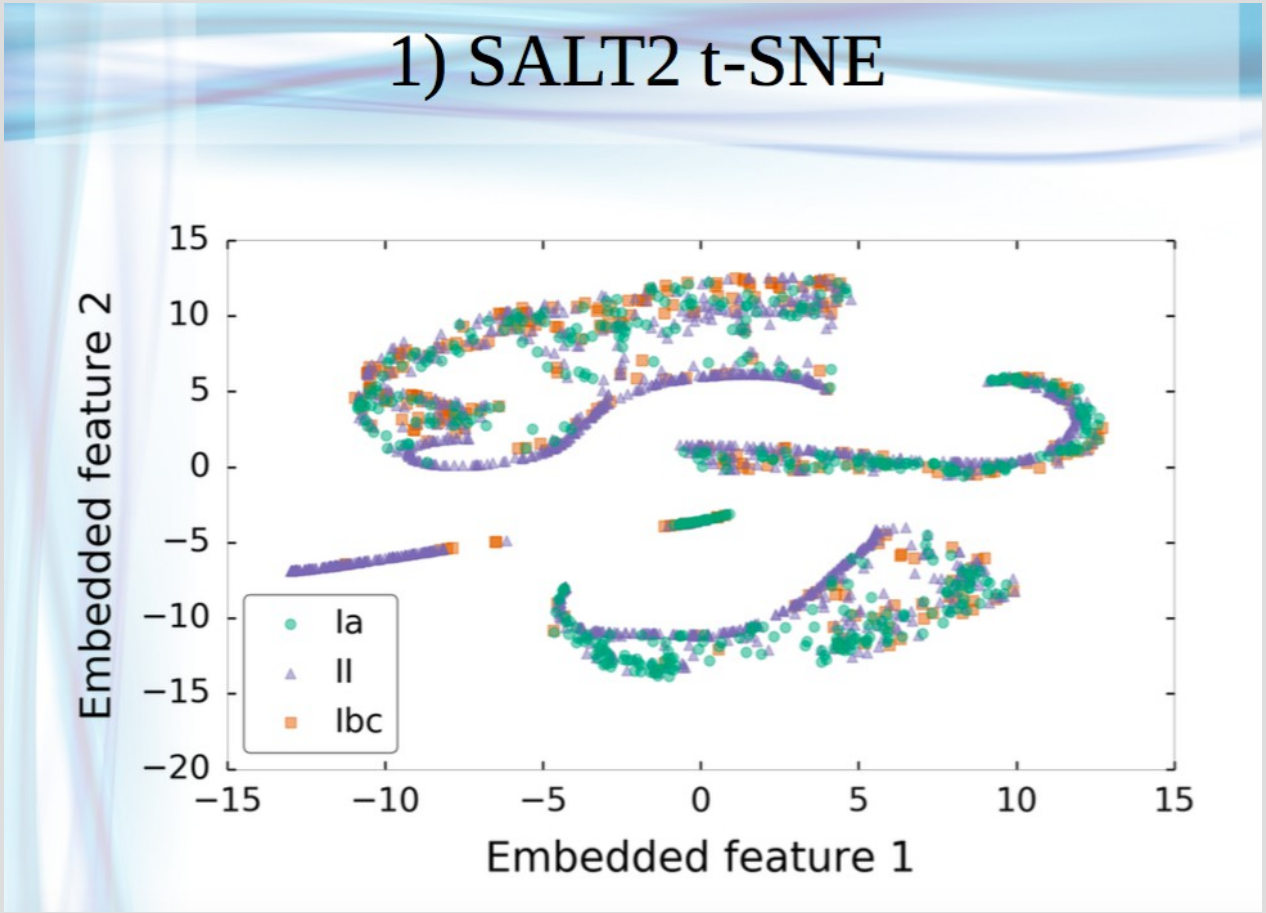
Host galaxy correlation

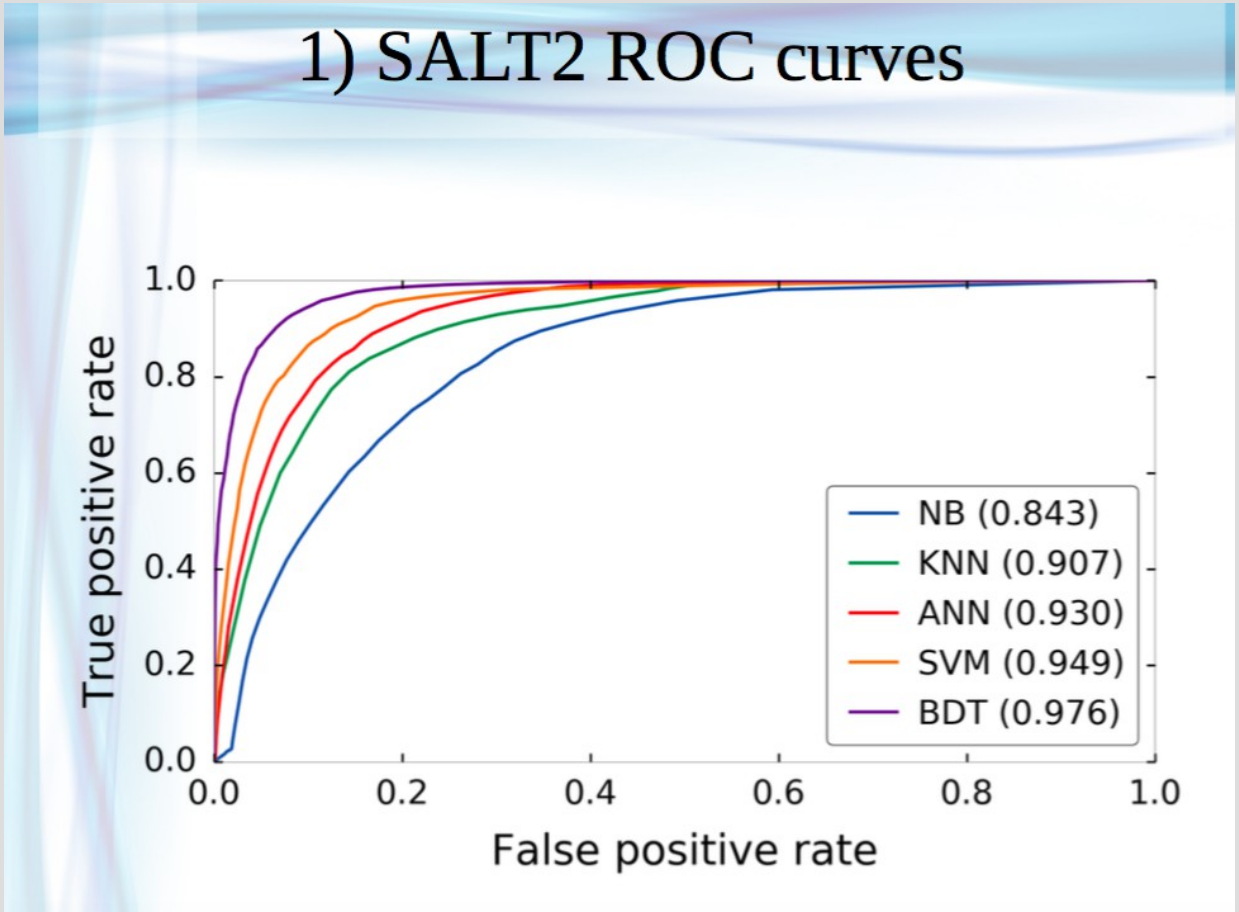
Image subtraction

Observing strategy

SN Classification : Distributed Stochastic Neighbour Embedding (t-SNE)



SN classif ication : BDT wins ...



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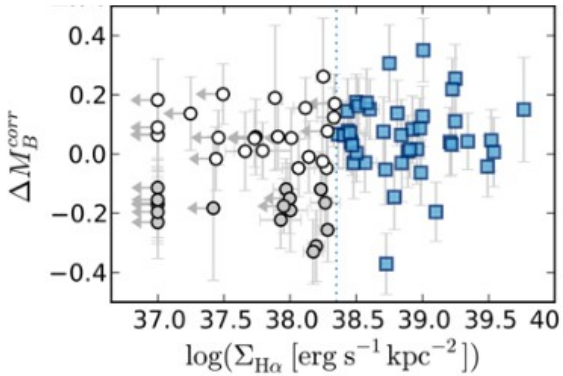
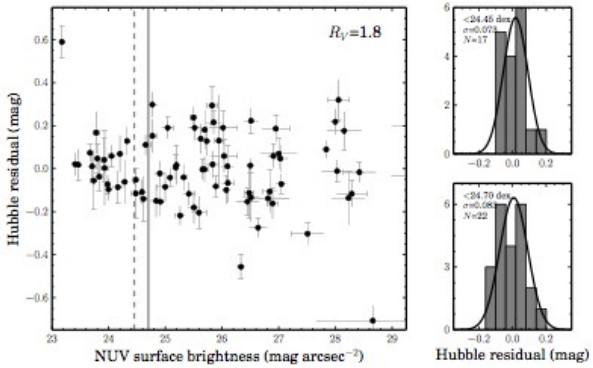
SN host galaxies

Rest-frame UV to study SN Ia with comparatively young progenitors

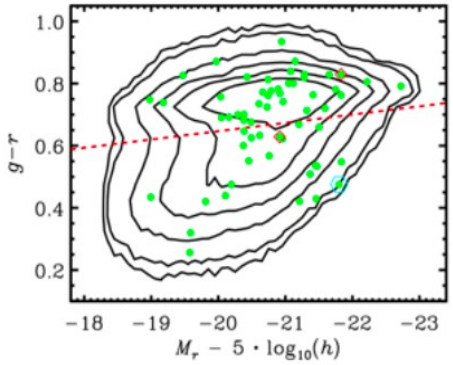
Rigault+13,15



Kelly+15

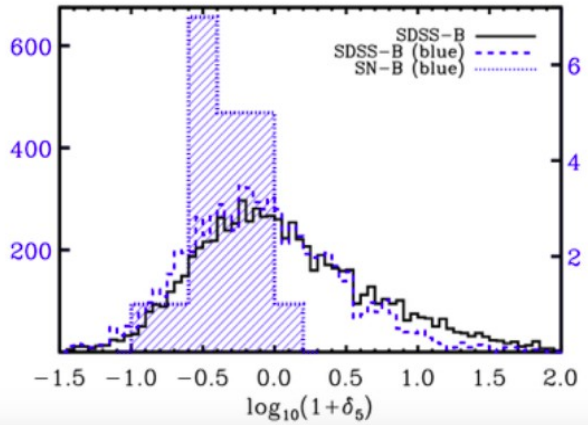


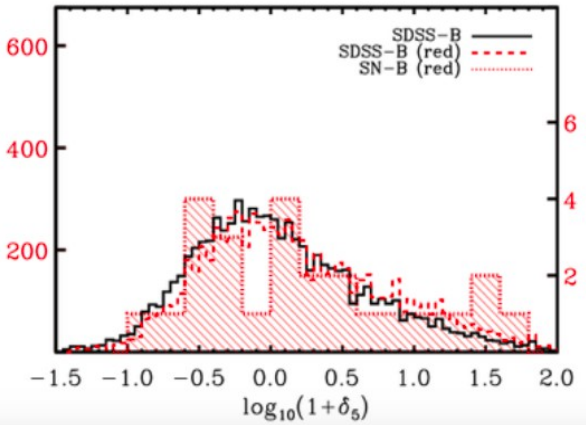
SN host galaxies



Rate of SN Ia in blue galaxies much higher when galaxy is *isolated*

Cooper, Newman & Yan (2009)





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Observing strategy :

Field or No.	(RA,Dec)	No. of LSST data per year (u,g,r,i,z,y)	Avg. No. Per filter Per 45 days (avgN)	Category (TPR)
290 Deep	(349.386,-63.321)	2363(398,229,402,414,522,396)	53	A(1)
1	(190,-83)	239(38,41,41,44,33,42)	5.3	B (*0.4*)
2	(20,-83)	252(52,56,40,21,37,44)	5.7	B
3	(116,-66)	*220(36,38,37,32,44,33)*	5.0	B
309	(240.05,-62.02)	101(2,5,11,19,19,45)	2.2	B
5	(120,-50)	80(4,7,9,18,24,18)	1.8	C
6	(80,-40)	96(5,8,15,17,27,24)	2.2	C
7	(280,-40)	86(4,2,6,4,24,18)	2.0	C
8	(30,-20)	86(3,4,10,21,27,21)	1.96	C
9	(100,-20)	58(4,2,6,4,24,18)	1.3	D
309	(6.097, -1.105)			C(*0.1*)
11	(50,+1.5)	72(3,6,10,12,22,19)	1.64	D
12	(320, +5)	7(0,0,2,0,4,0)	0.15	E
13	(60,+5)	66(0,7,11,20,28,0)	1.5	D
14	(60,+20)	72(0,8,13,22,29,0)	1.64	D
15	(60,+30)	44(0,5,6,15,18,0)	1.0	E

A: avgN>9

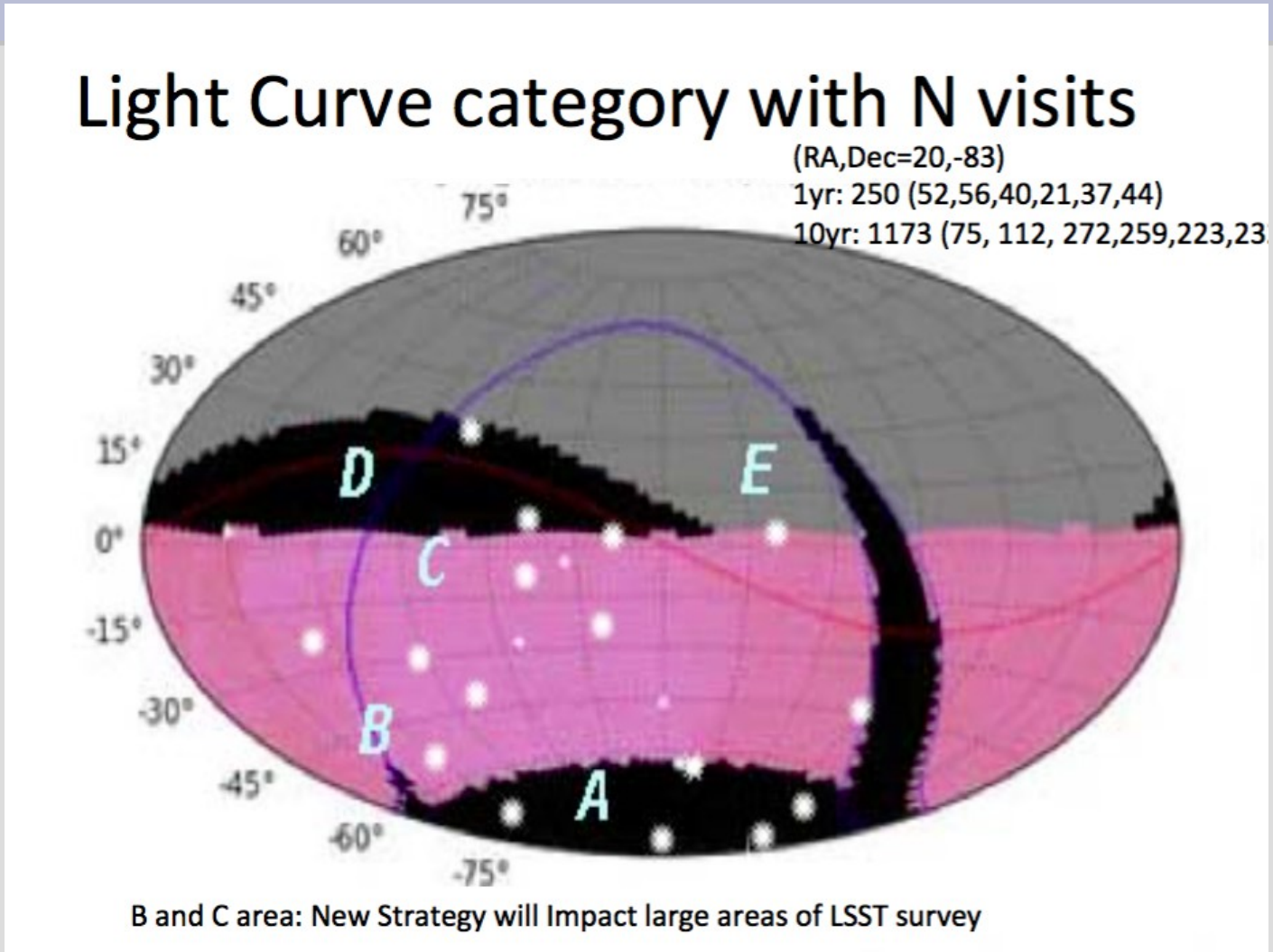
B: avgN~5-9

C: avgN~1.8-5

D: avgN~1-1.8

E: avgN<1

Observing strategy



And Many French activities

17:00 - 19:00 **Sondes cosmologiques : Supernova**

Convener: Mr. Dominique Fouchez (CPPM)

- 17:00 **DESC SuperNova Working Group status** *10'*
  Speaker: Mr. Dominique Fouchez (CPPM)
- 17:10 **Data Release Production validation tool** *10'*
  Speaker: Mr. Alexandre Ciulli (LPC)
- 17:20 **Image Subtraction characterisation** *10'*
  Speaker: Mr. Juan Pablo REYES GOMEZ (CPPM)
- 17:30 **Observing Strategy** *10'*
  Speaker: Philippe Gris (LPC Clermont-Ferrand)
- 17:40 **SUGAR and JLA Lightcurve fitting with SUGAR** *15'*
  Speakers: Emmanuel Gangler (LPC), Dr. Maria Pruzhinskaya (LPC)
- 17:55 **Photometric Classification** *10'*
  Speaker: Dr. Emille Ishida (LPC-UBP)
- 18:05 **Supernova Programs in Europe** *10'*
  Speaker: Emmanuel Gangler (LPC)
- 18:15 **The Supernova Subaru Program** *20'*
  Speaker: Nicolas Regnault (LPNHE)
- 18:35 **Discussion** *15'*
  Speaker: Mr. Dominique Fouchez (CPPM)