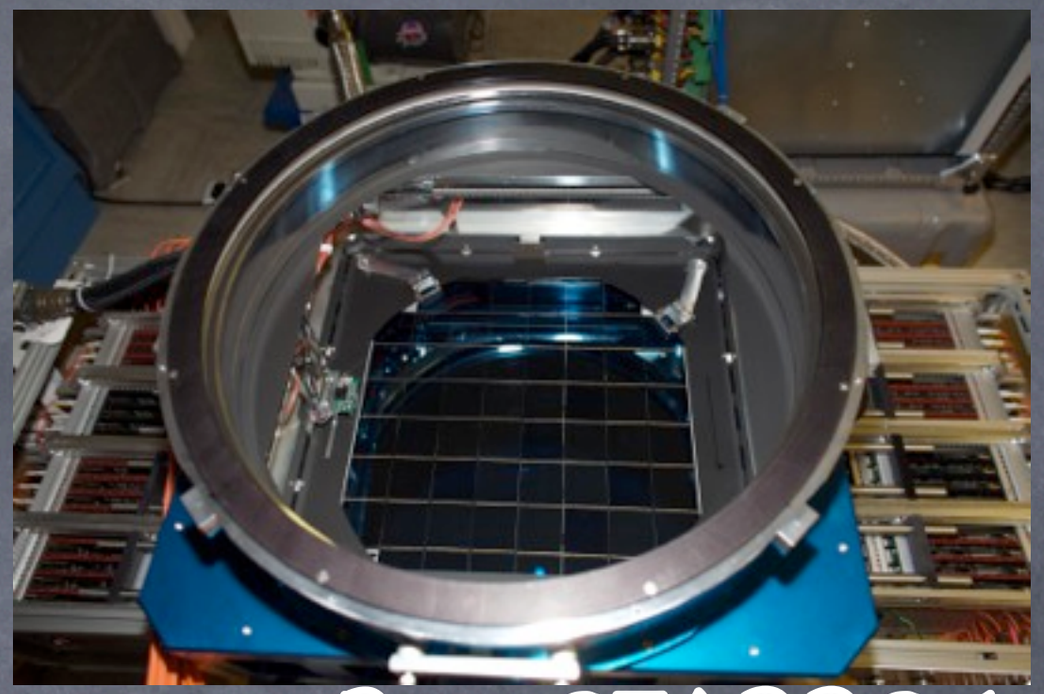
Type Ia Supernovae in the Coming Decade

Michael Wood-Vasey
Cosmic Acceleration Workshop
Carnegie Mellon University
2012 August 25

Current and Future SN Surveys

Dark Energy Survey

photo: Rich Talcott



Pan-STARRS 1

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+SkyMapper, DES, KAIT, PTF, ...

SuperNova Legacy Survey

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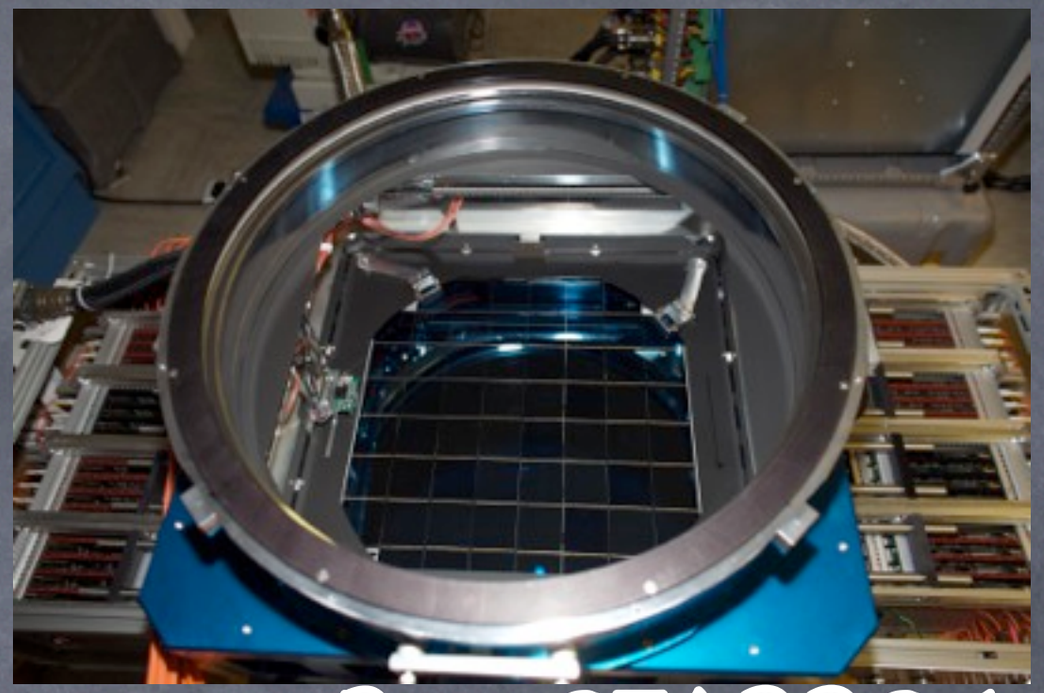

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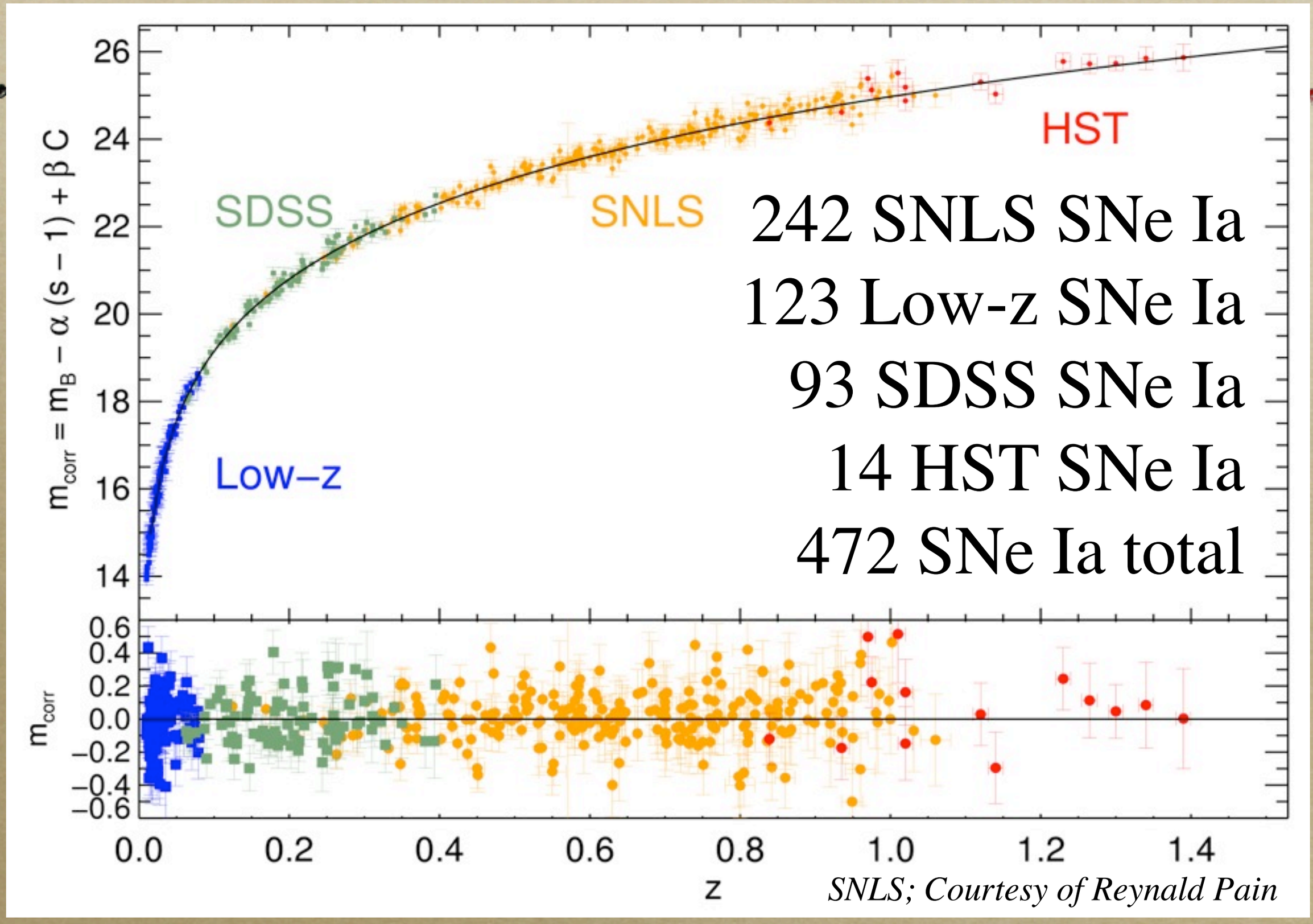
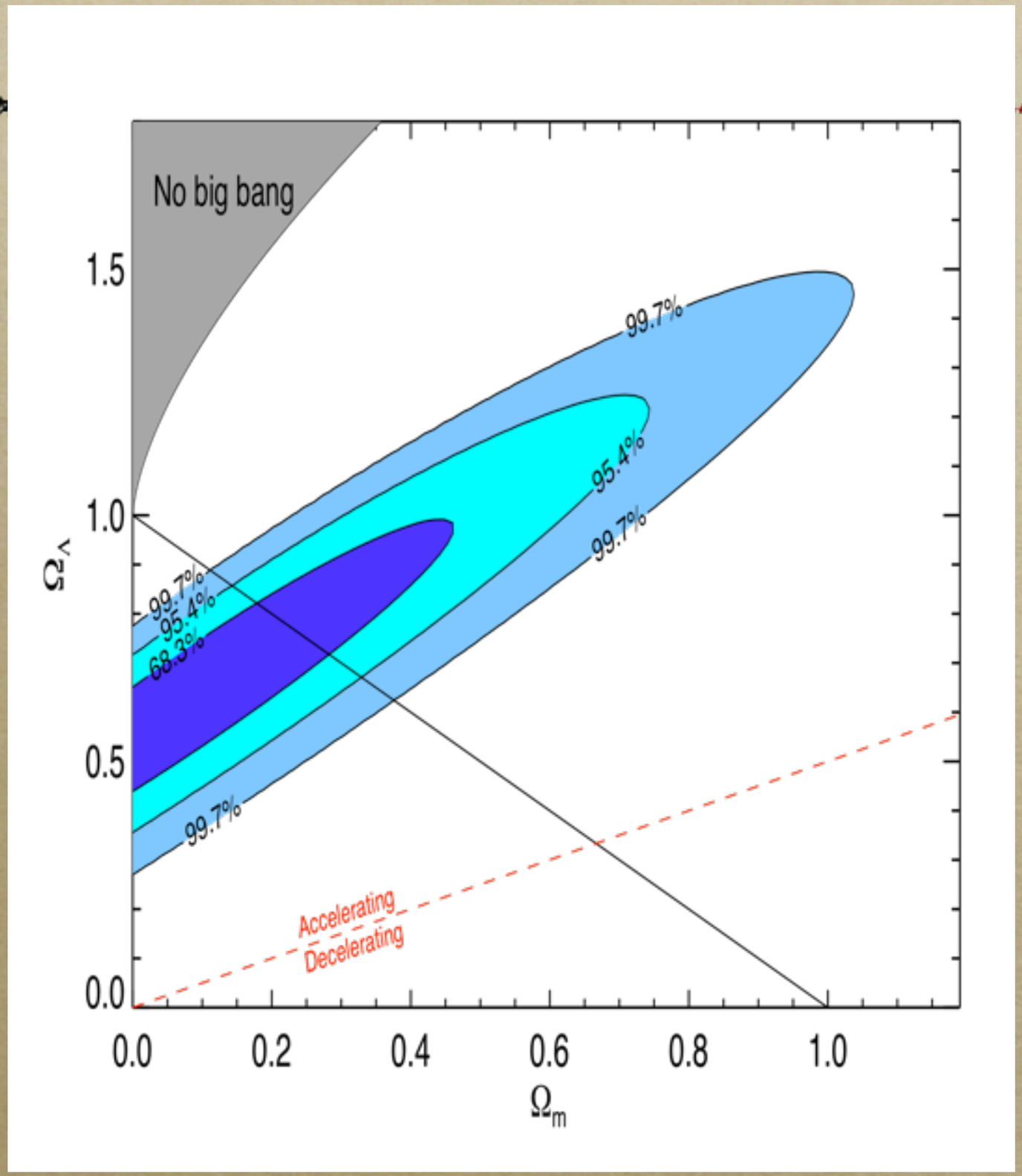
Latest SNLS SNIa Hubble diagram



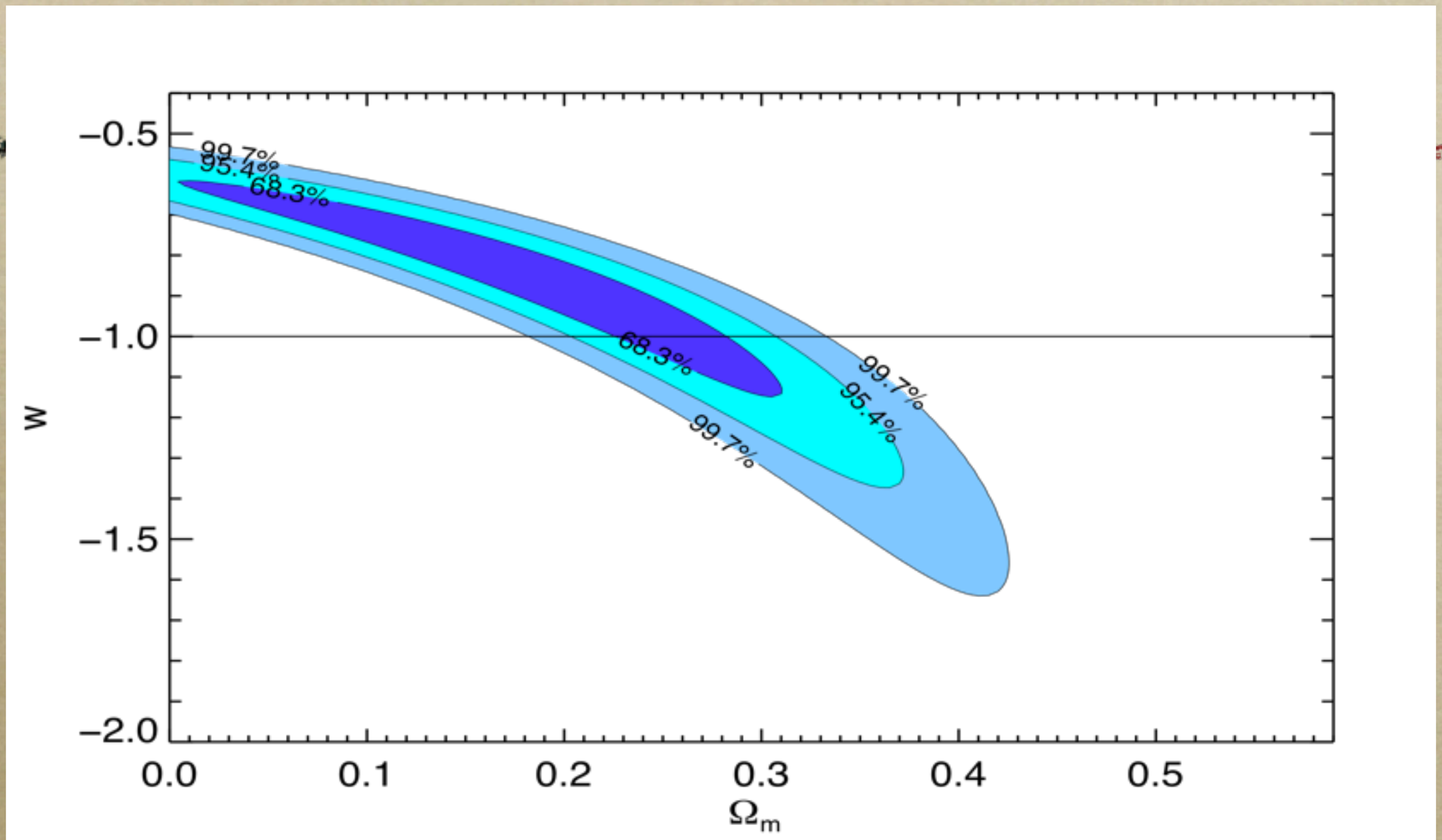
SNIa only constraints on Energy Density



Acceleration detected at >99% CL including systematic effects

SNLS; Conley et al. 2011.

SNIa only constraints on w



SNLS; Conley et al. 2011.

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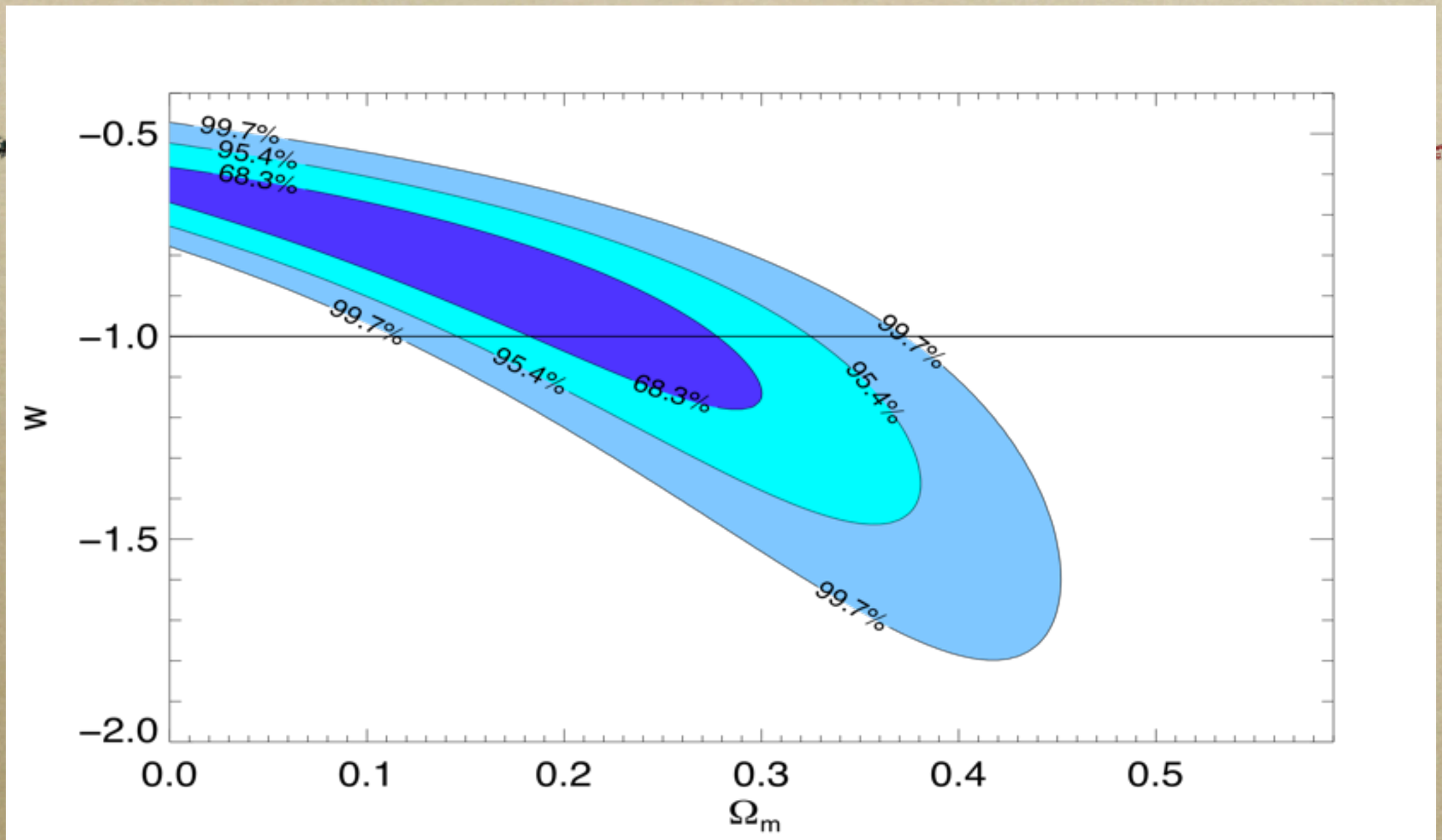
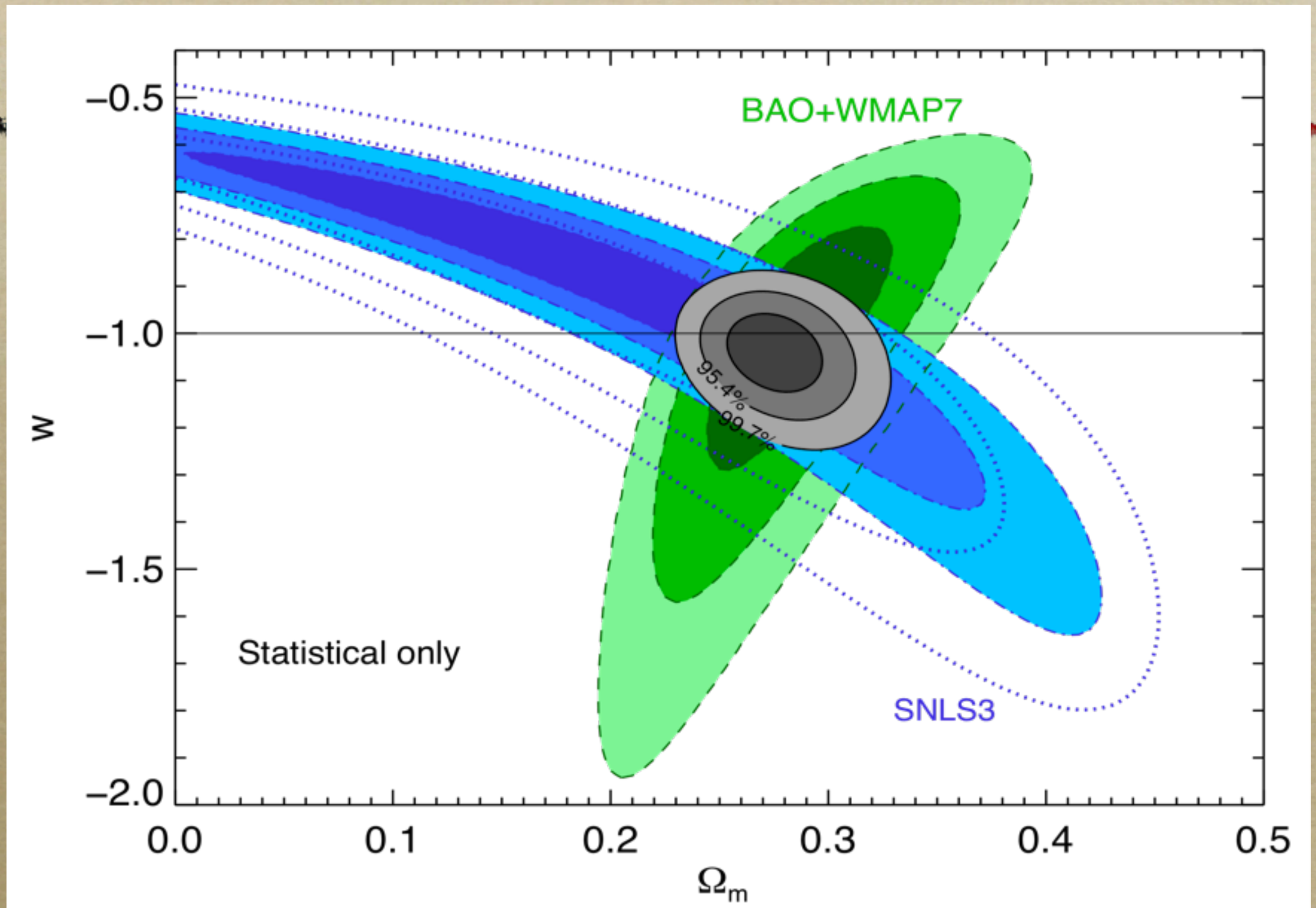


$w = -0.91 \,^{+0.15}_{-0.21}\text{(stat)} \,^{+0.07}_{-0.14}\text{(syst)}$

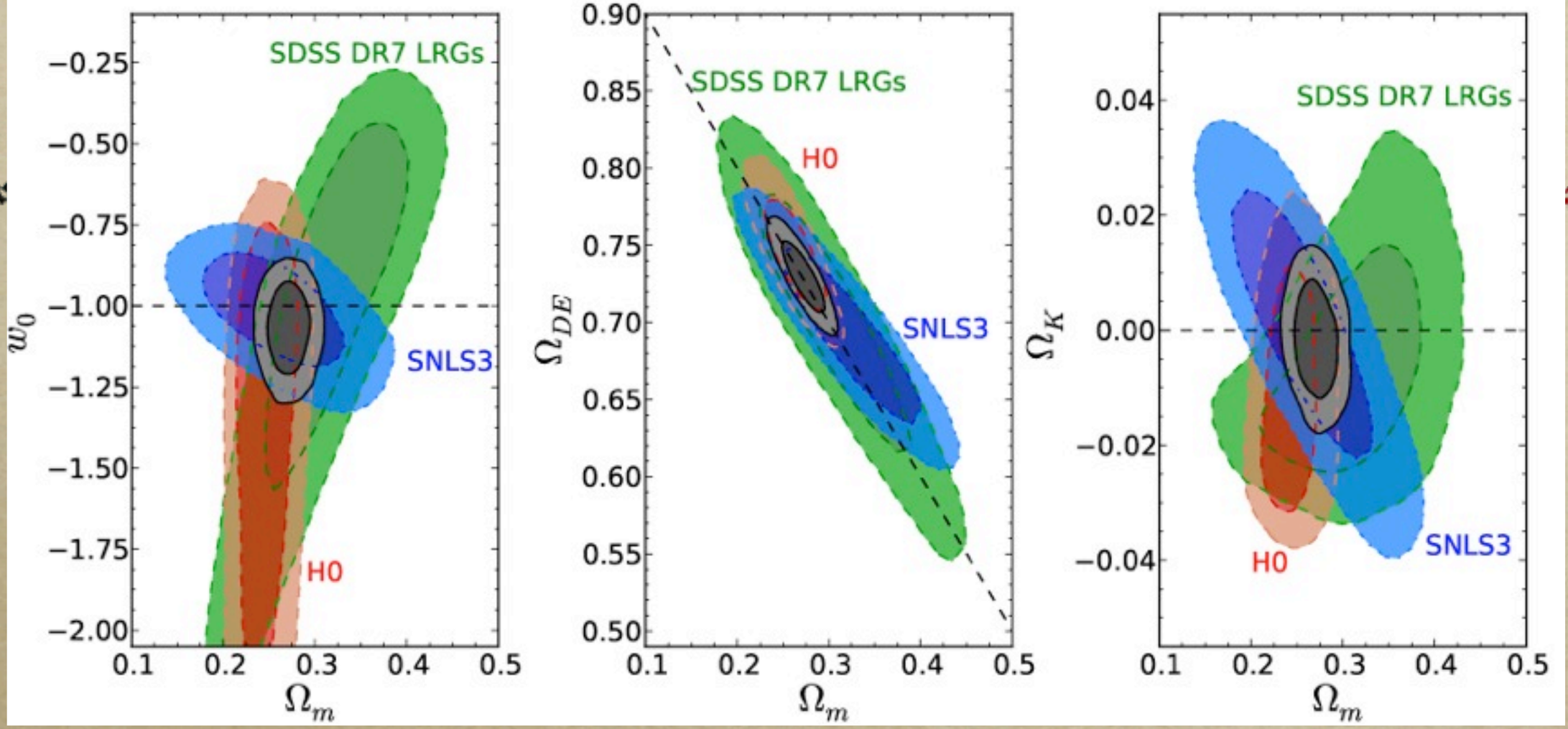
SNLS; Conley et al. 2011.

SNLS (stat. only) +WMAP7+BAO/DR7+H_0



SNLS; Sullivan et al. 2011.

SNLS+WMAP7+BAO/DR7+H_0



Flat:

$w = -1.061 \pm 0.069$

$\Omega_M = 0.269 \pm 0.015$

Non-Flat:

$w = -1.069 \pm 0.091$

$\Omega_M = 0.271 \pm 0.015$

$\Omega_k = -0.002 \pm 0.006$

Minus BAO:

$w = -1.018 \pm 0.111$

$\Omega_M = 0.259 \pm 0.049$

$\Omega_k = 0.001 \pm 0.015$

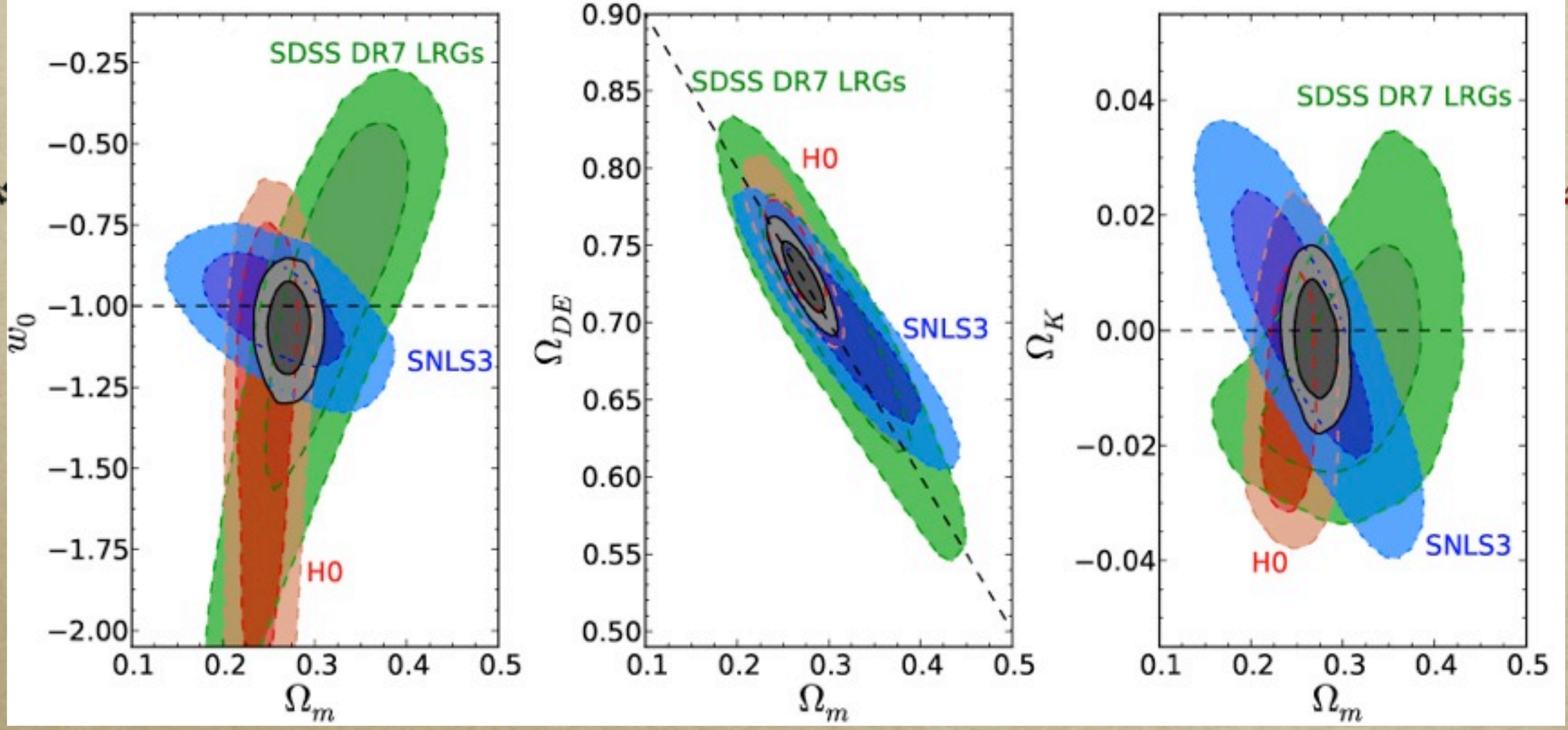
Minus SNela:

$w = -1.412 \pm 0.333$

$\Omega_M = 0.259 \pm 0.030$

$\Omega_k = -0.009 \pm 0.008$

SNLS+WMAP7+BAO/DR7+H_0



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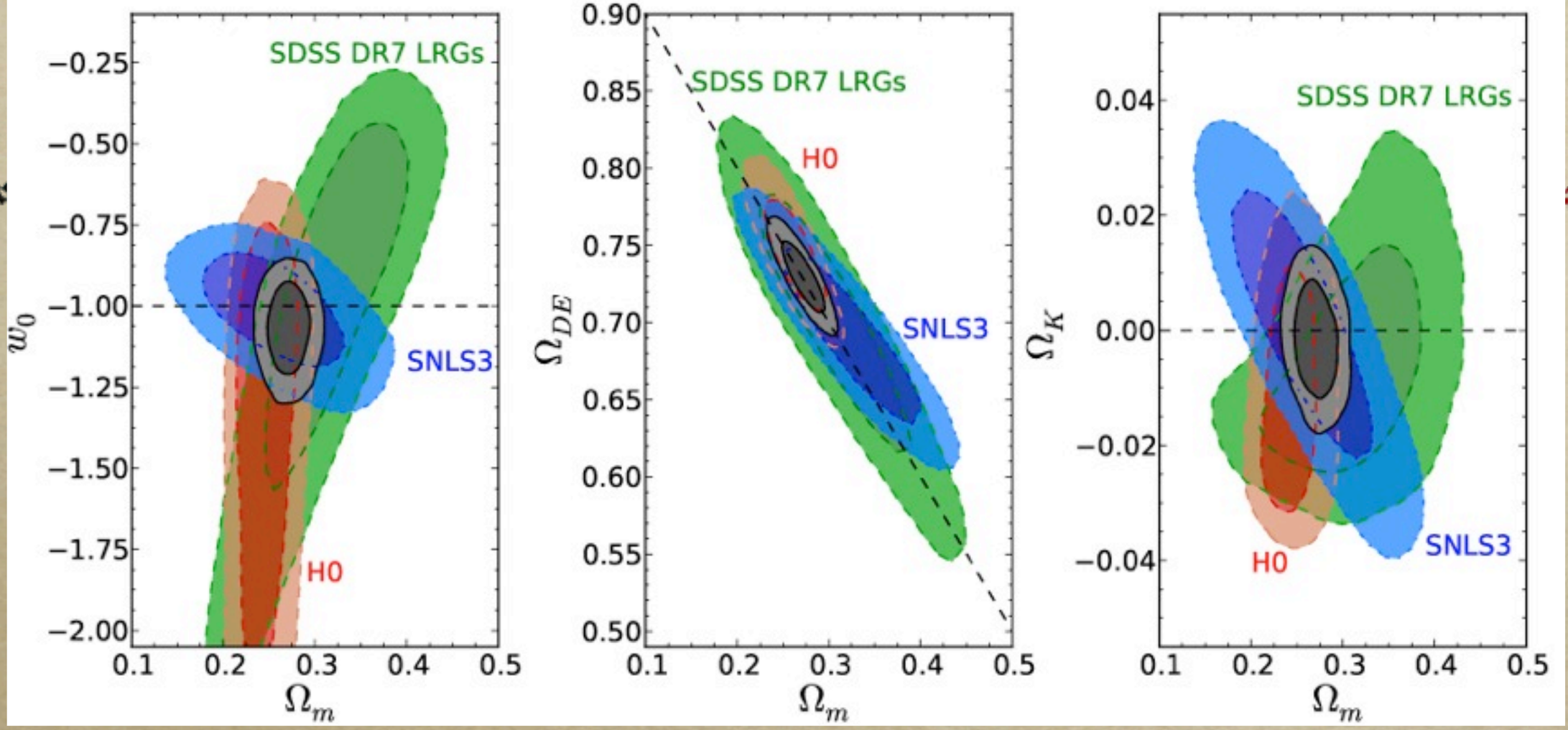

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Current and Future SN Surveys

Dark Energy Survey

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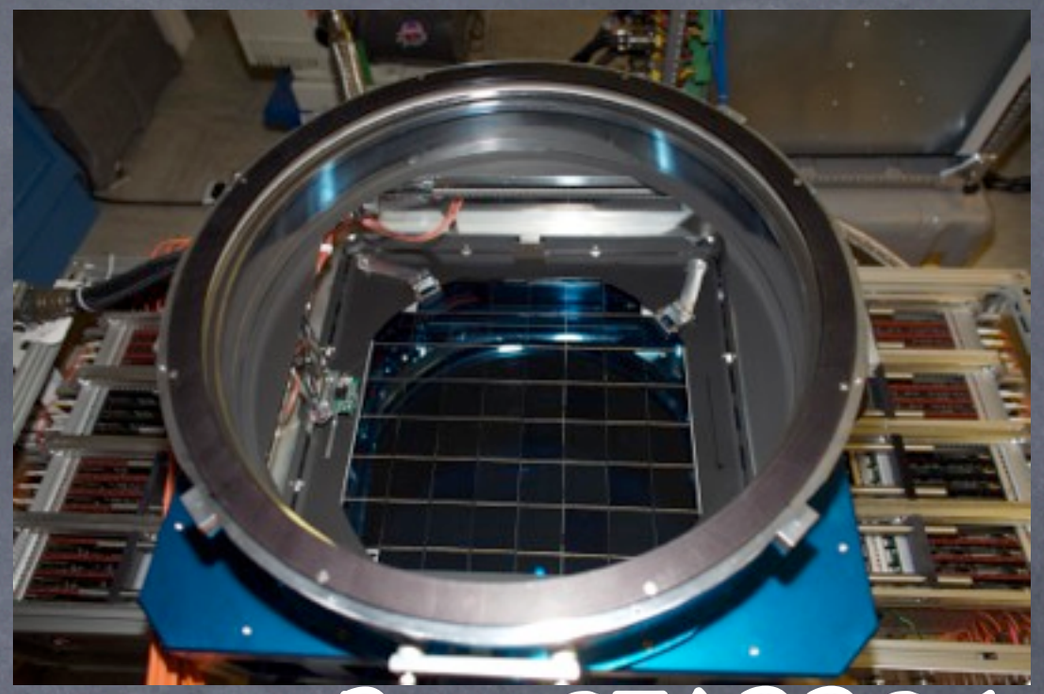

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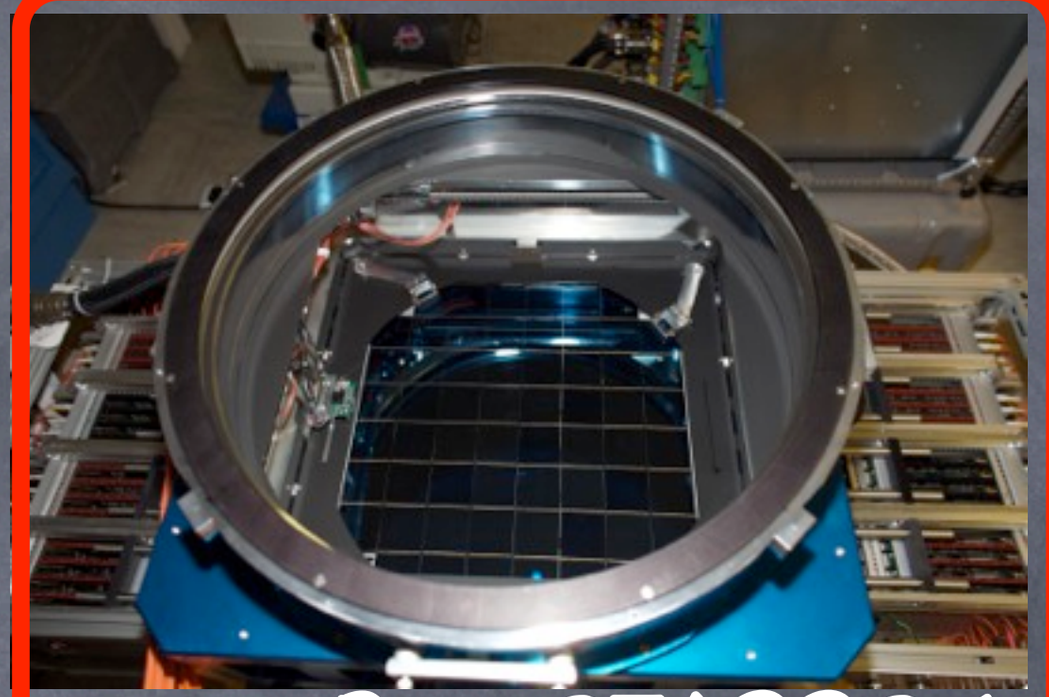

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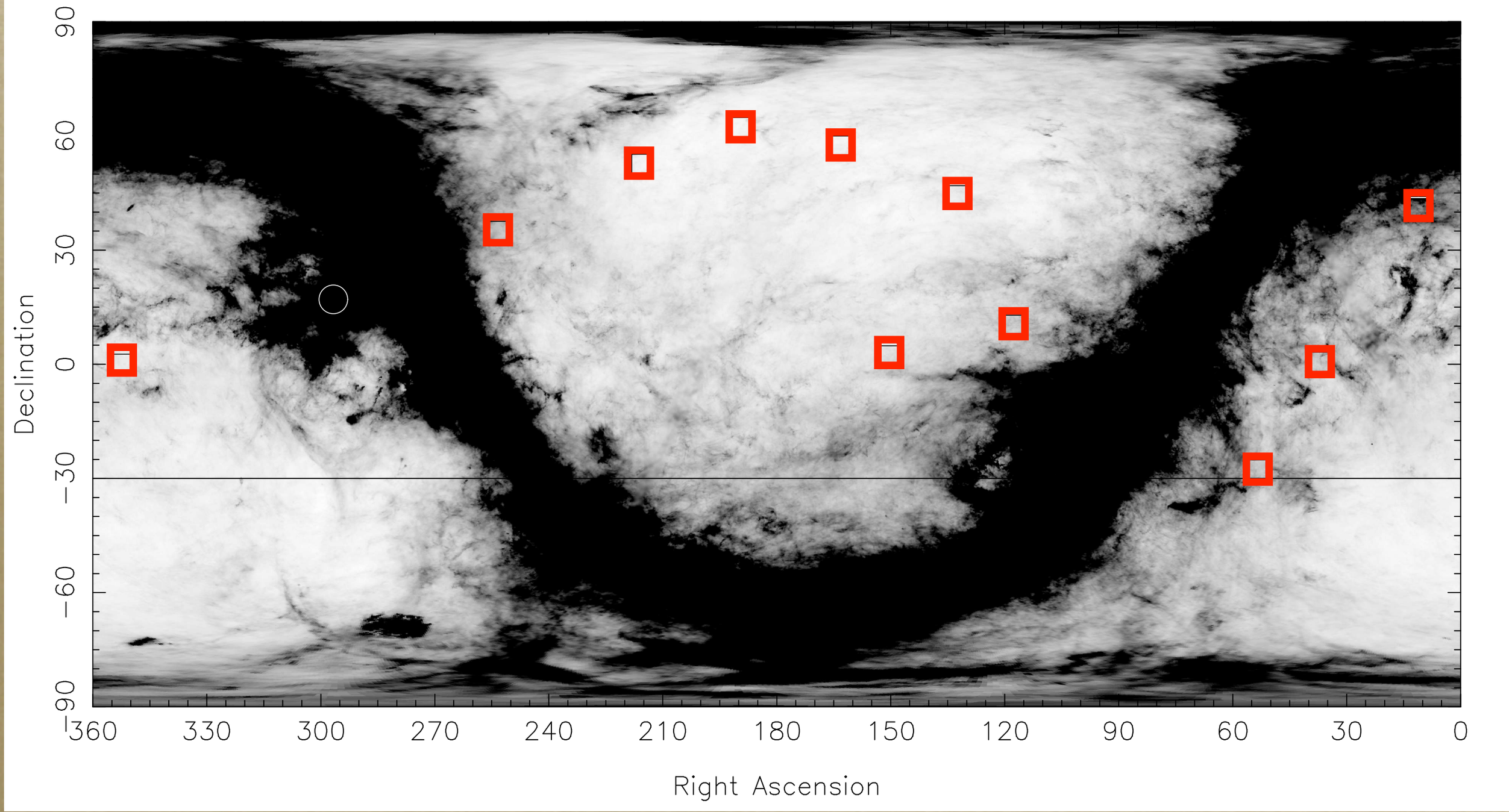
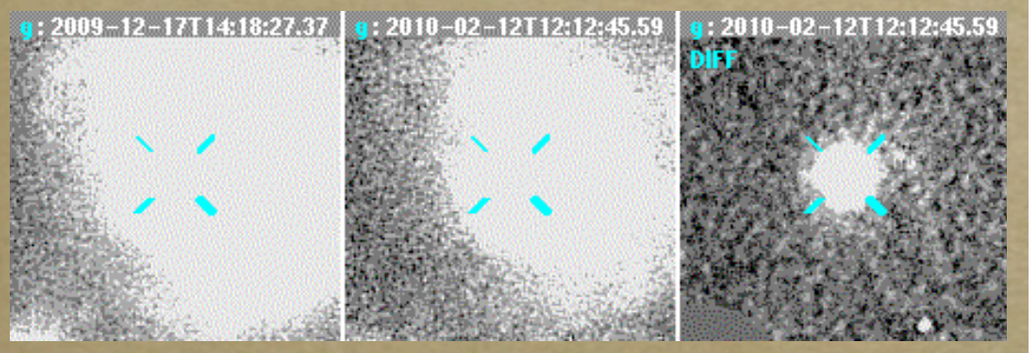
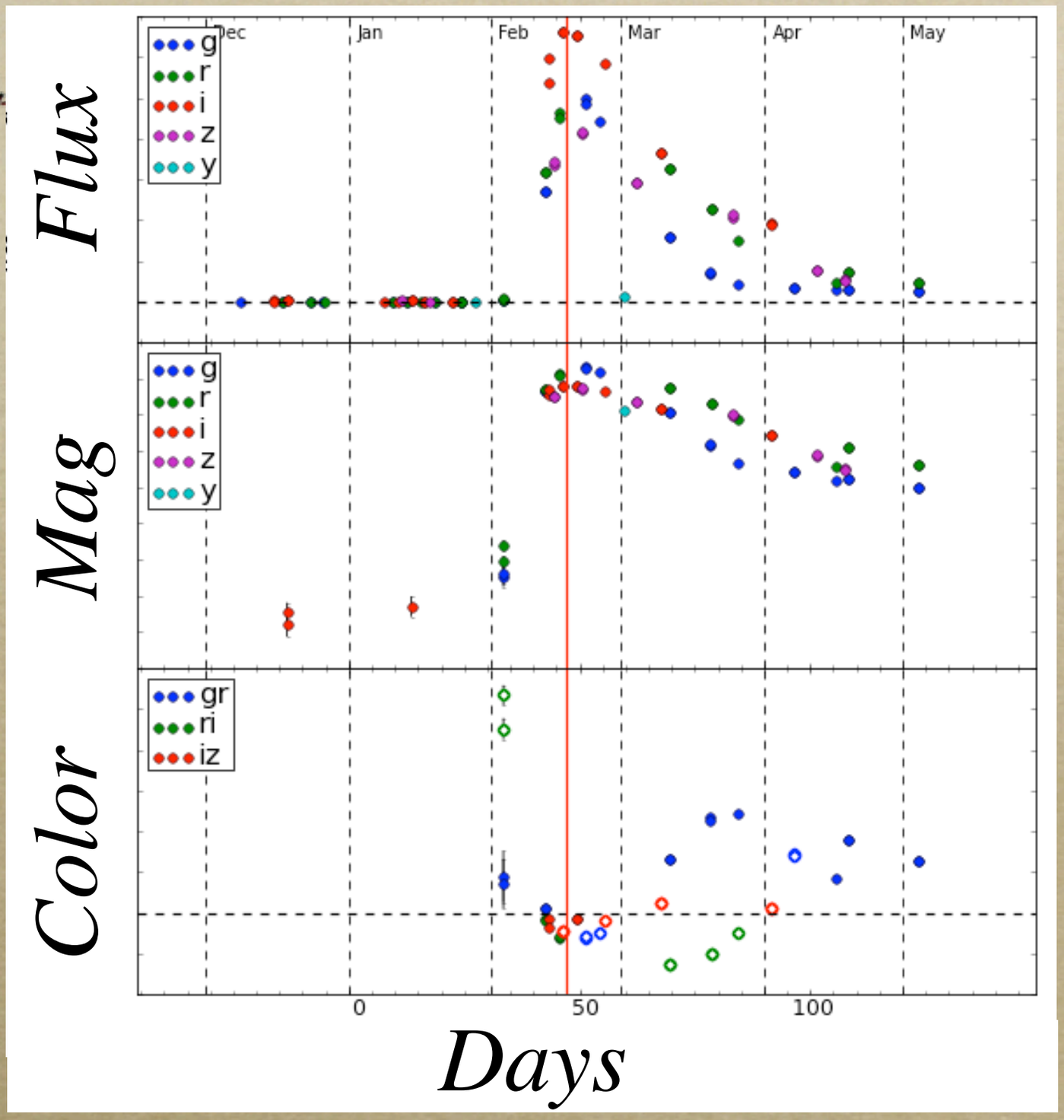
Pan-STARRS 1 Observes Nightly 10 Medium-Deep Fields



PS1-1000023 SNIa @ z=0.03

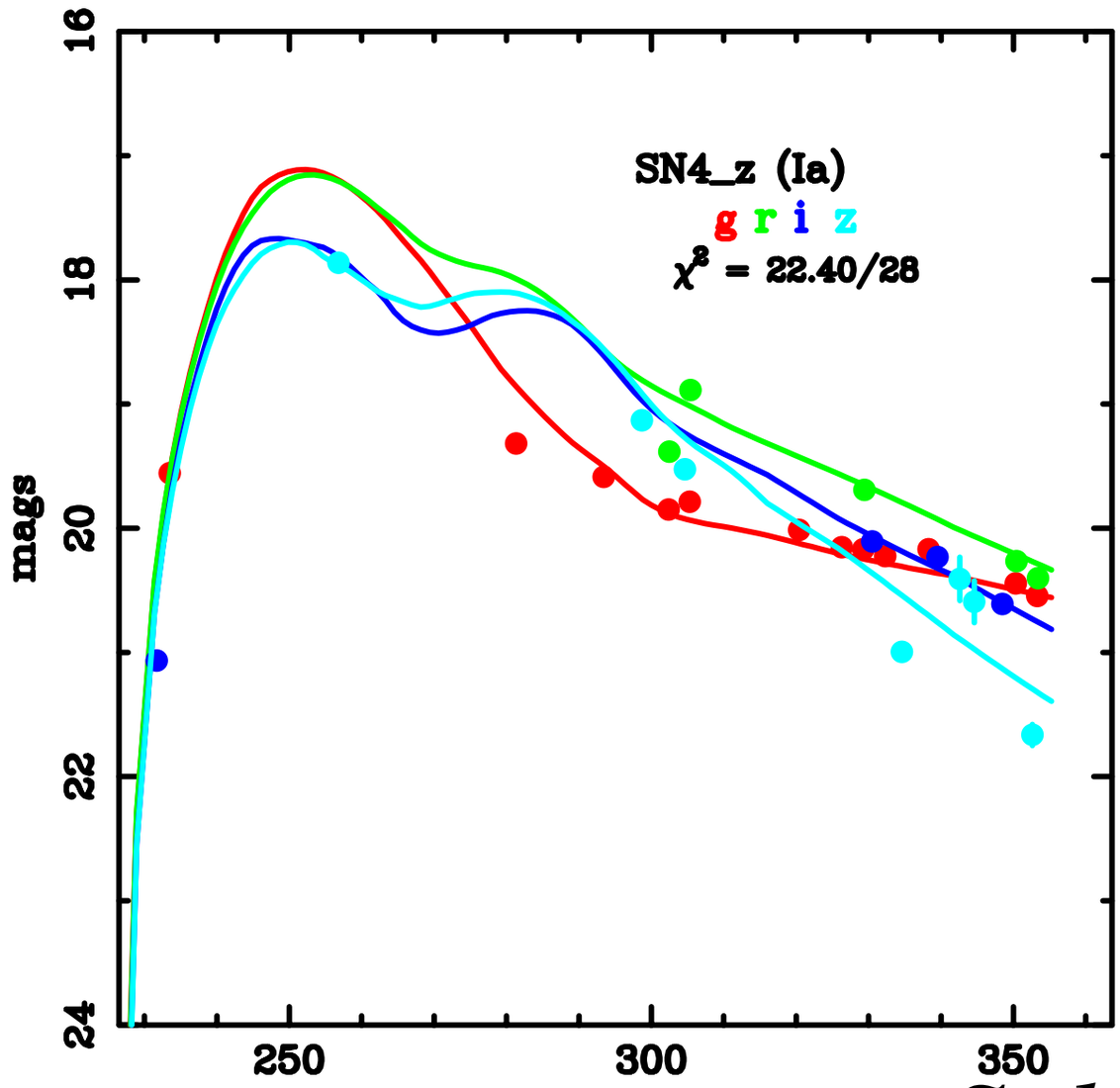




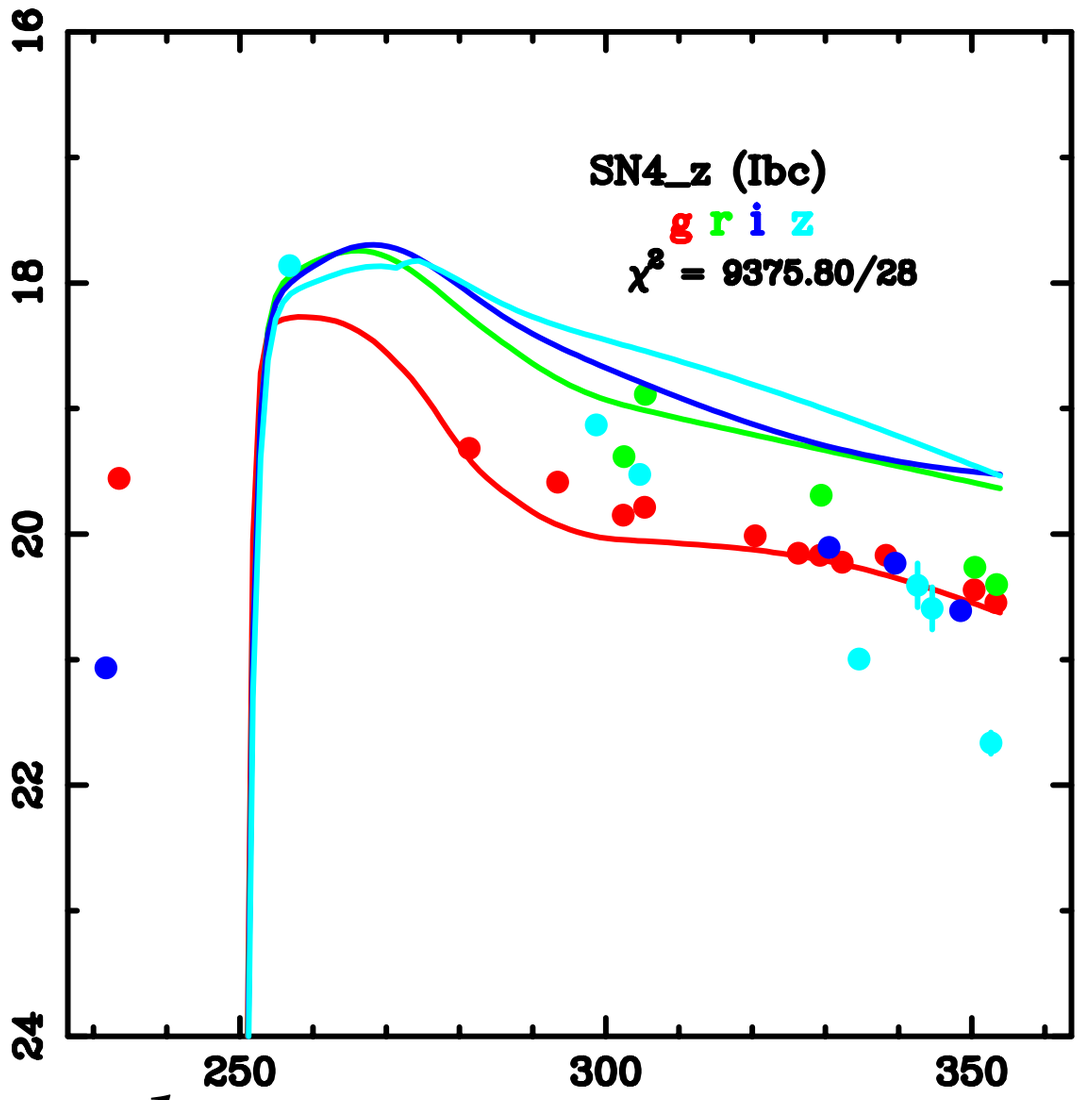
Challis et al. (2010), ATel #2448

We can type SNe with multi-color lightcurves

SN Ia model



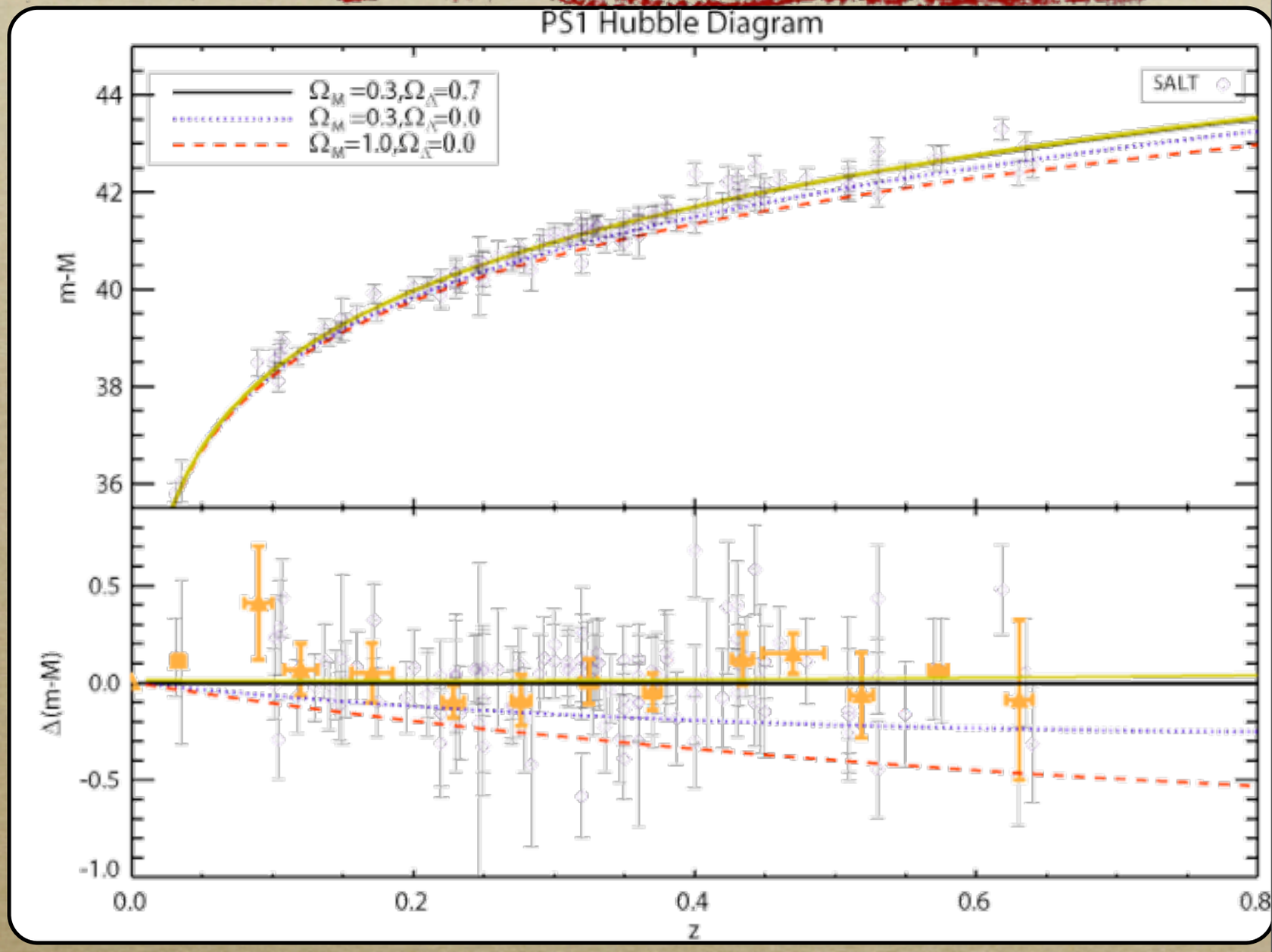
SN Ibc model



Sako et al.

PS1 Hubble diagram

- *Consistent photometry*
- *Small dispersion!*



Intrinsic dispersion: 0.12 mag
Nearby SNe: 0.16, SDSS: 0.09, ESSENCE: 0.13, SNLS: 0.16

Armin Rest (STScI)

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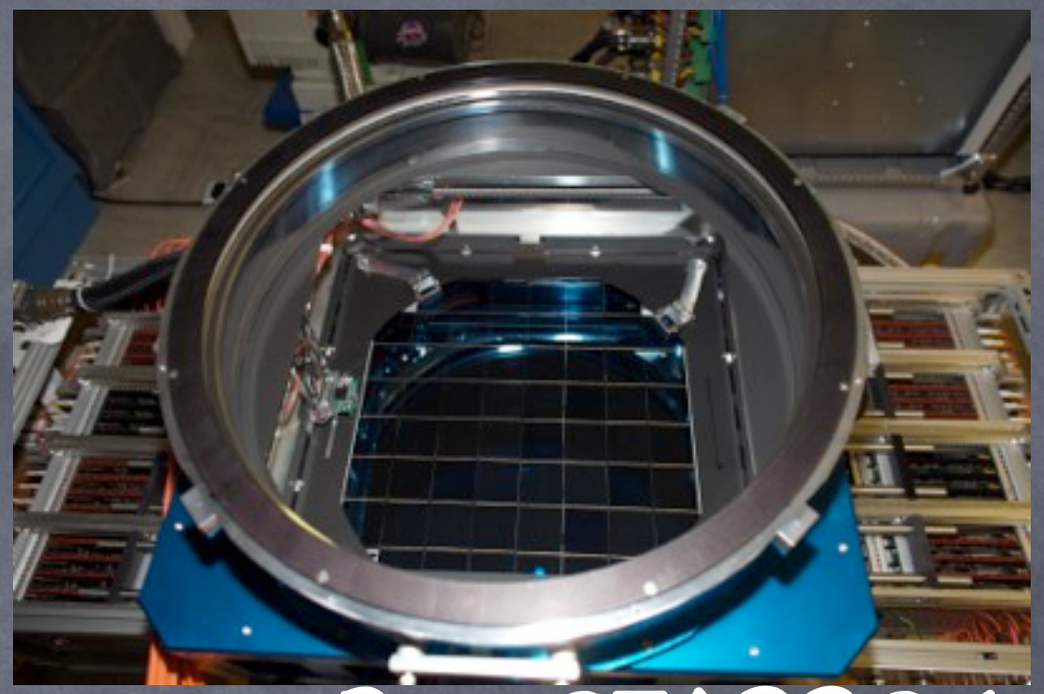

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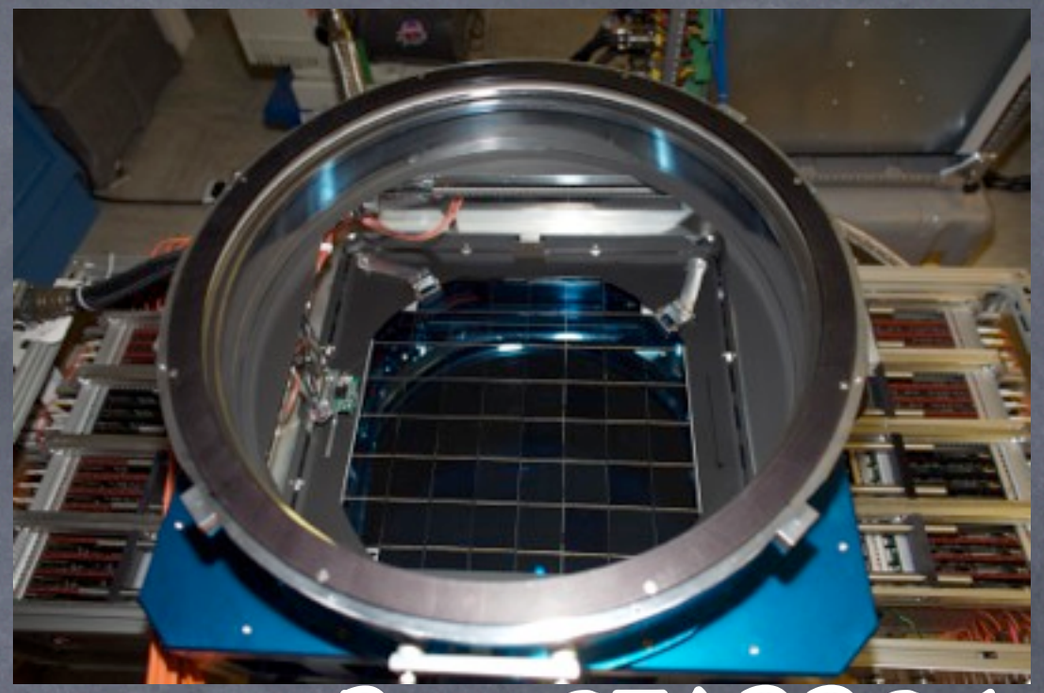

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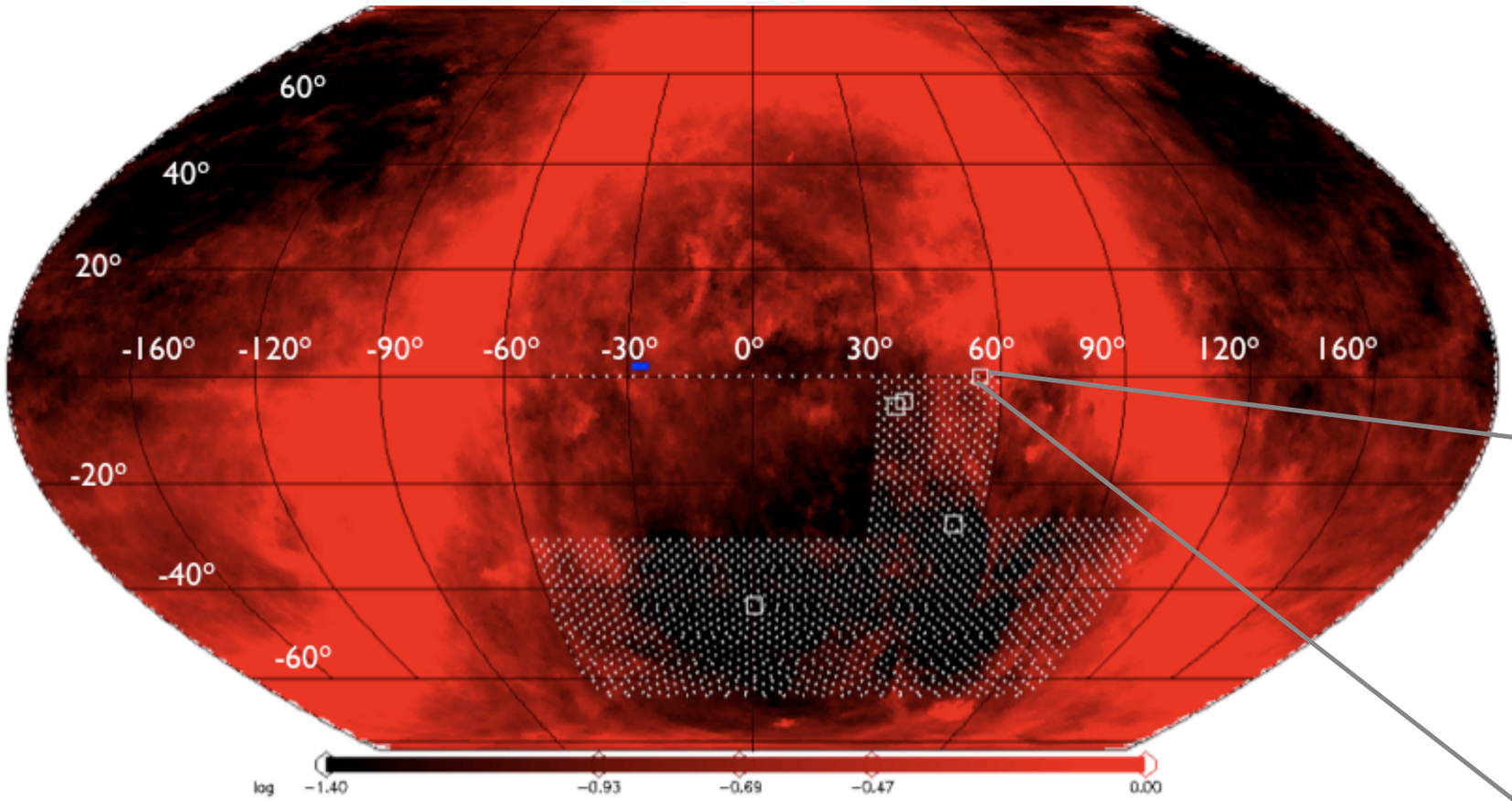
LSST

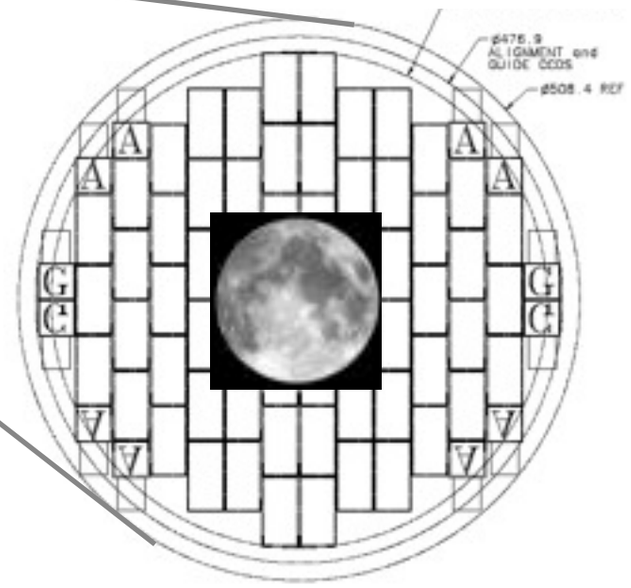
photo: LSST Corporation

DES SN Survey

DARK ENERGY SURVEY



Fields to overlap with existing and near-future deep imaging (e.g., CDF-S, SNLS, VIDEO) and spectroscopic surveys (DEEP2, VIPERS, VVDS, WiggleZ, GAMA I/II).



10 DES fields

Visit once every ~4 days.

2 deep + 8 shallow (30 deg^2)

deep: 6600 sec per visit (*griz*)

shallow: 800 sec per visit (*griz*)

good *z*-band efficiency (~4x higher than CFHT/MegaCam) and target high-z SN Ia

→ good rest-frame *g*-band light curves of z~1 SN Ia.

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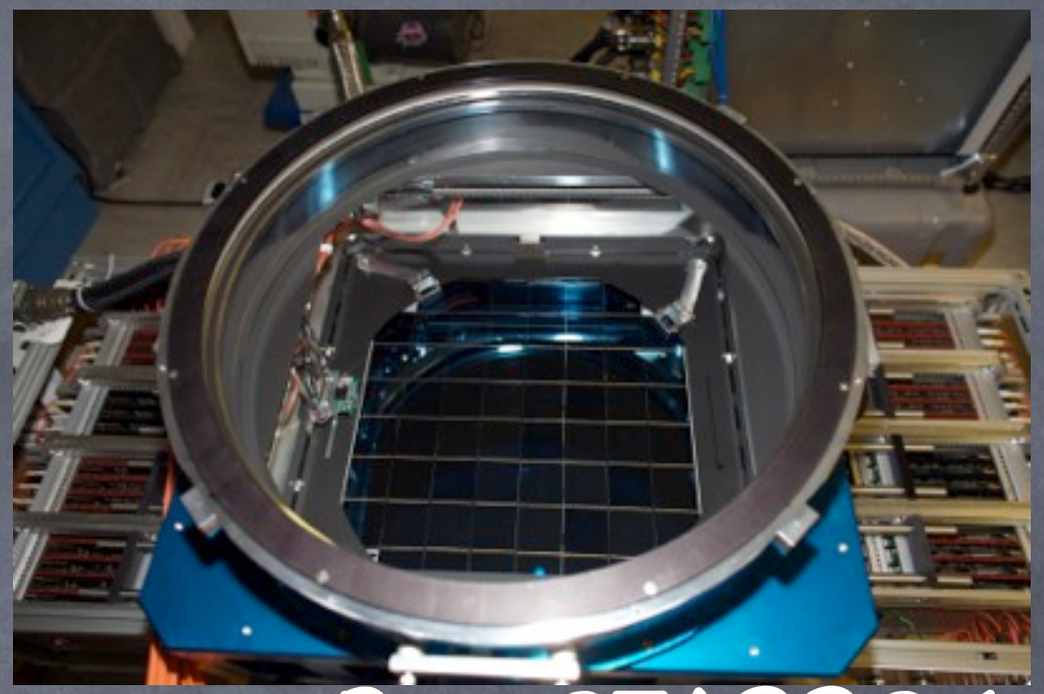

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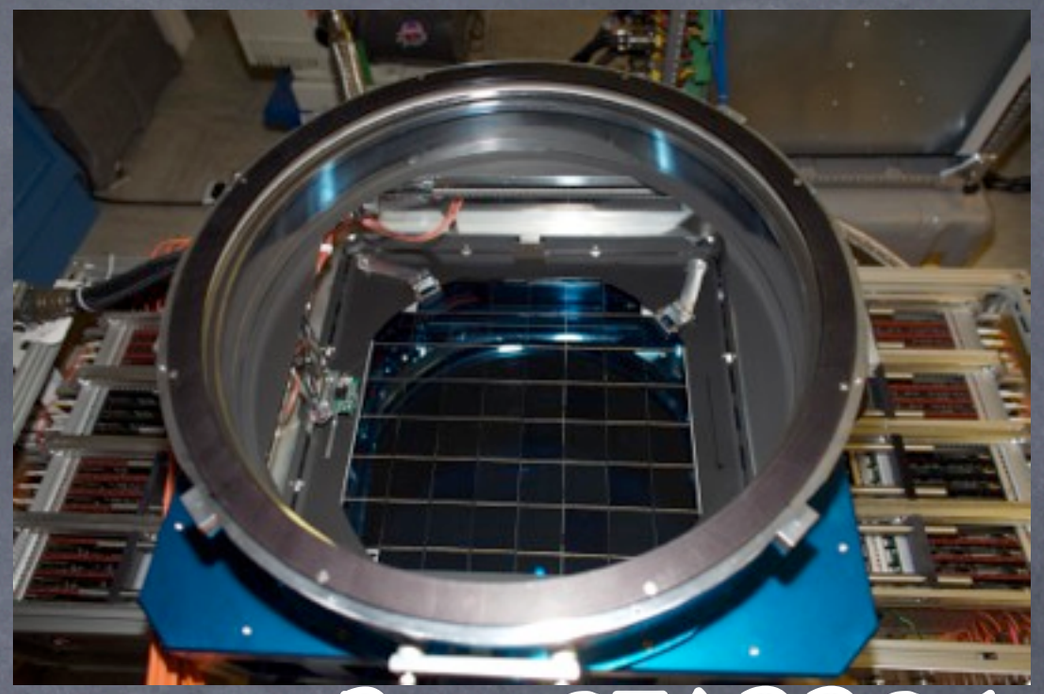

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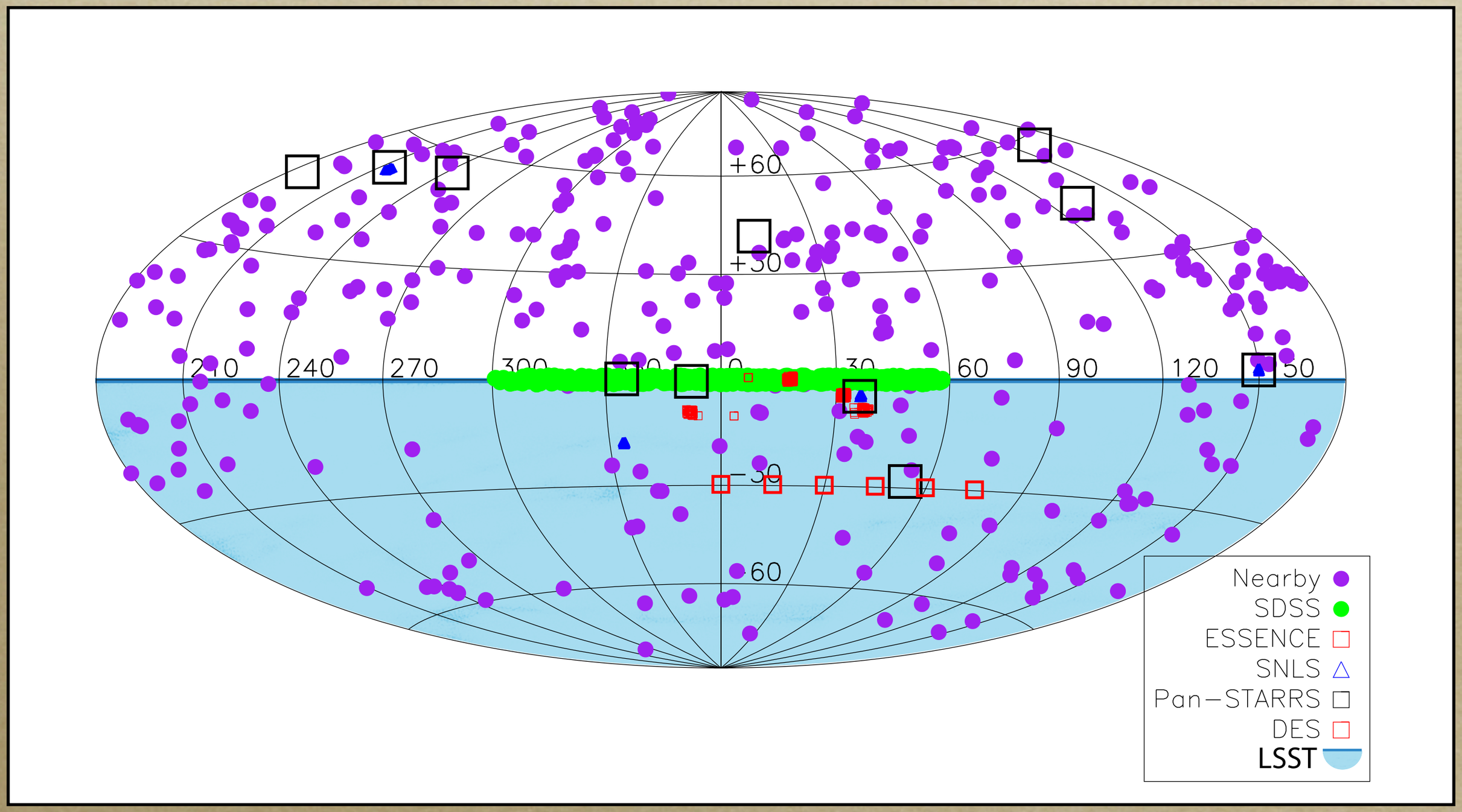
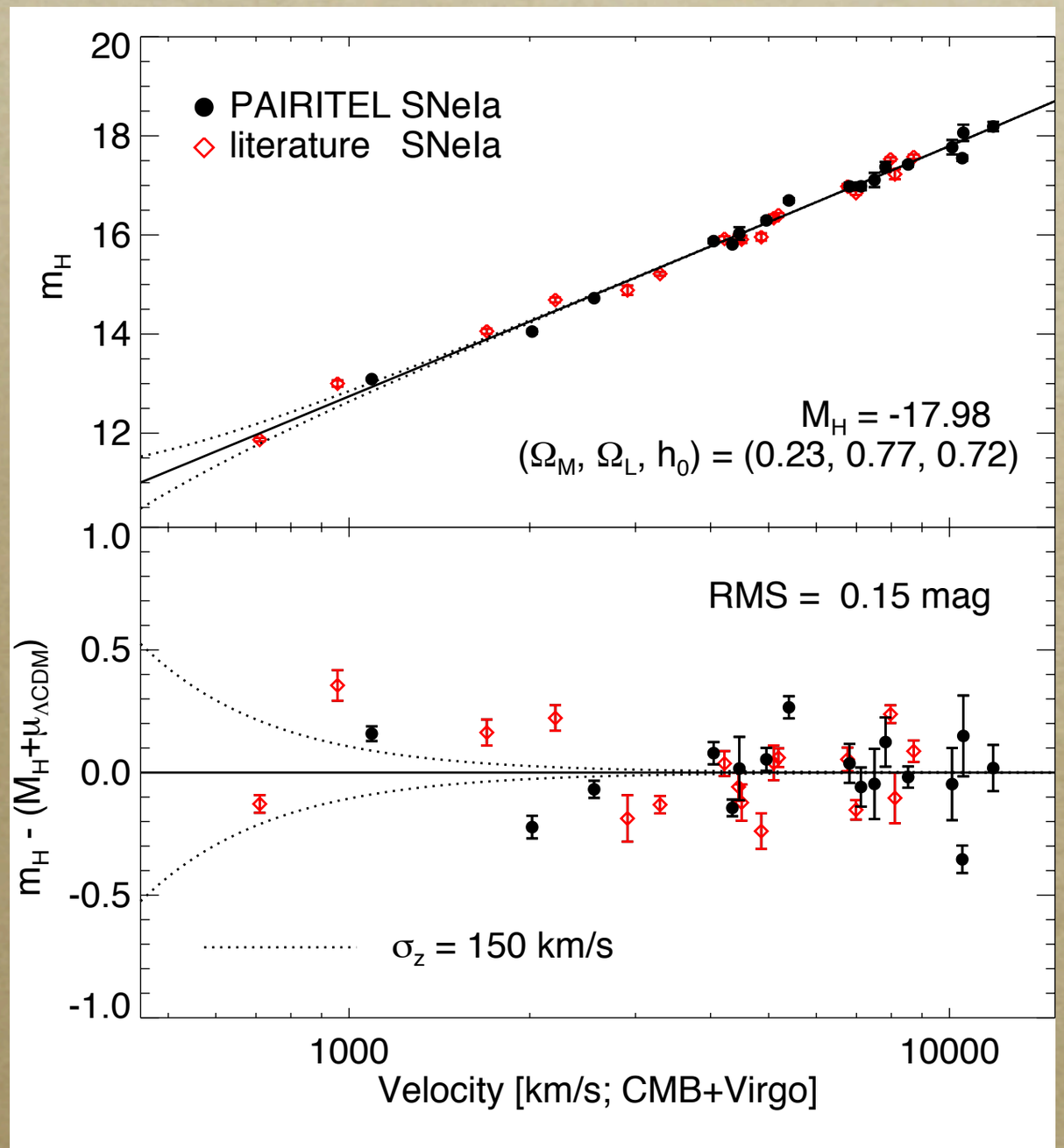
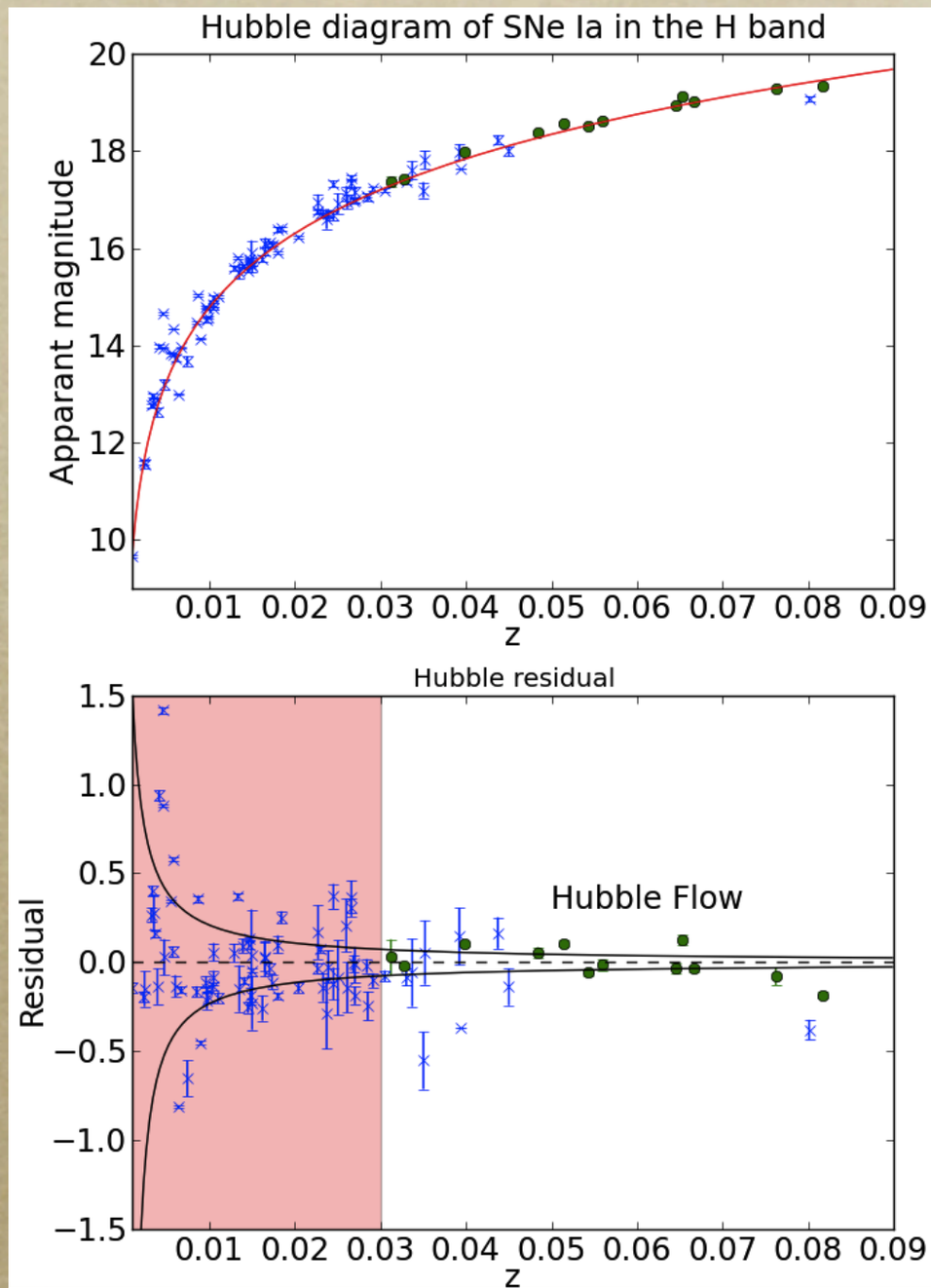
Future SN Surveys Will Cover the High-z Sky



SNeIa are Standard in the NIR

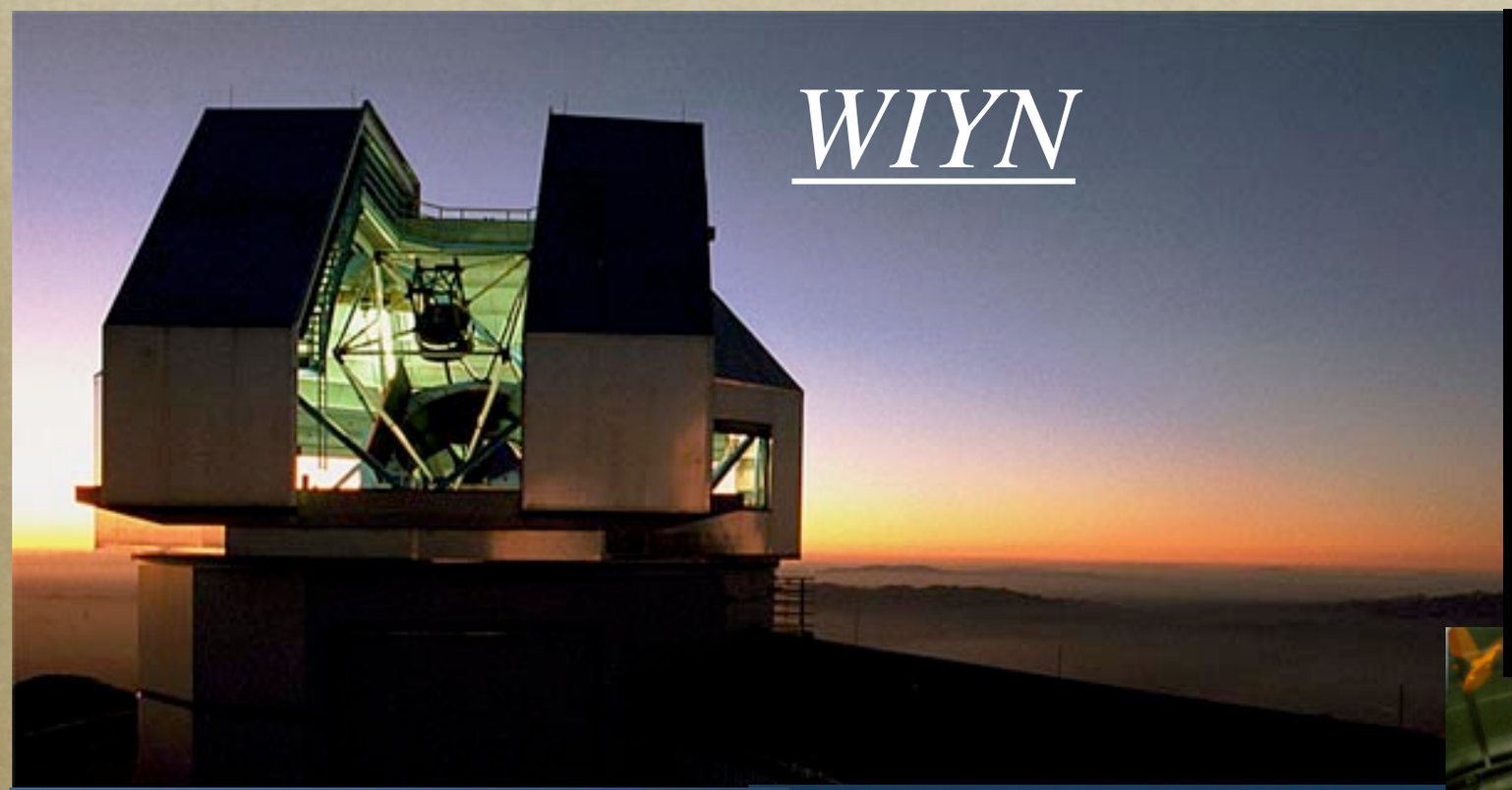


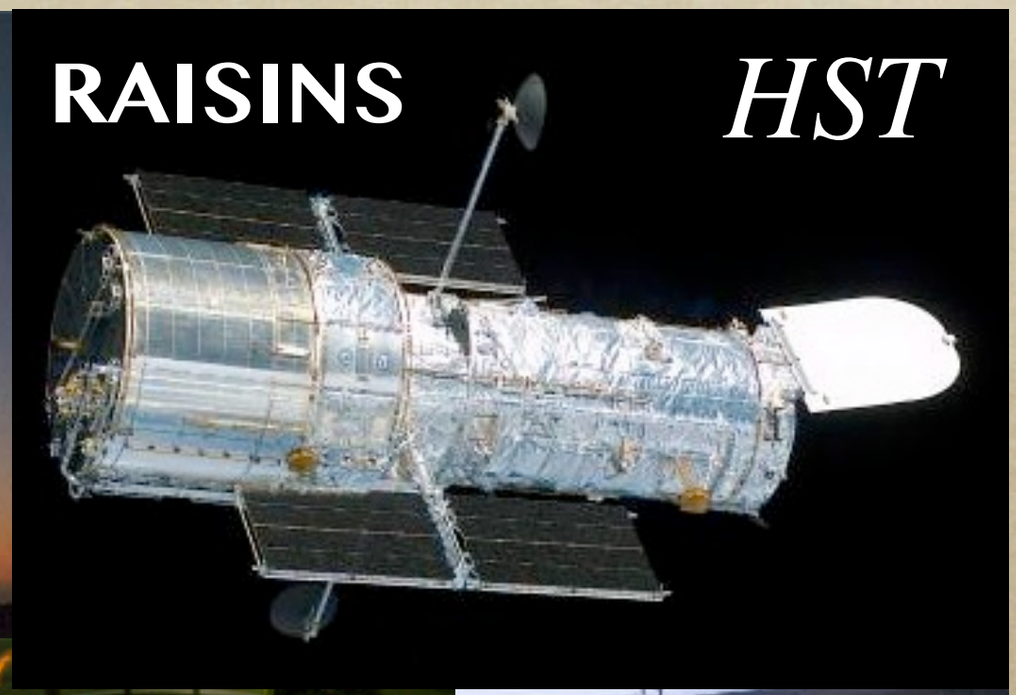
Wood-Vasey et al. (2008)

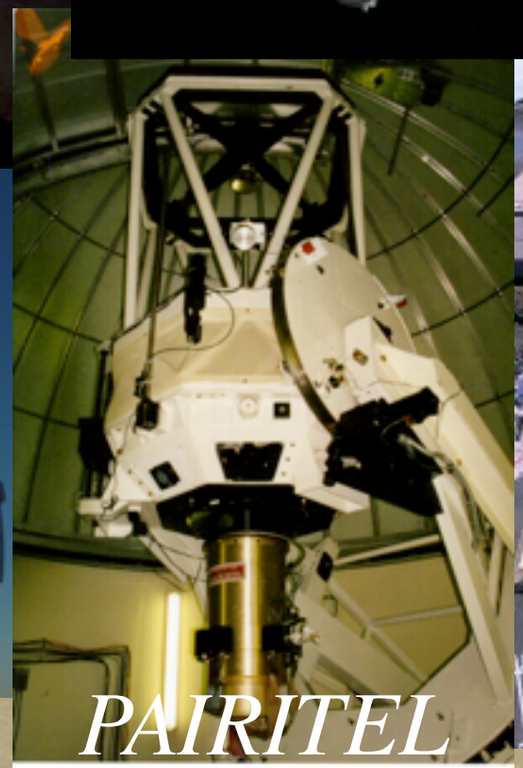


Barone-Nugent et al. (2012)

Let's get more NIR-SNeIa







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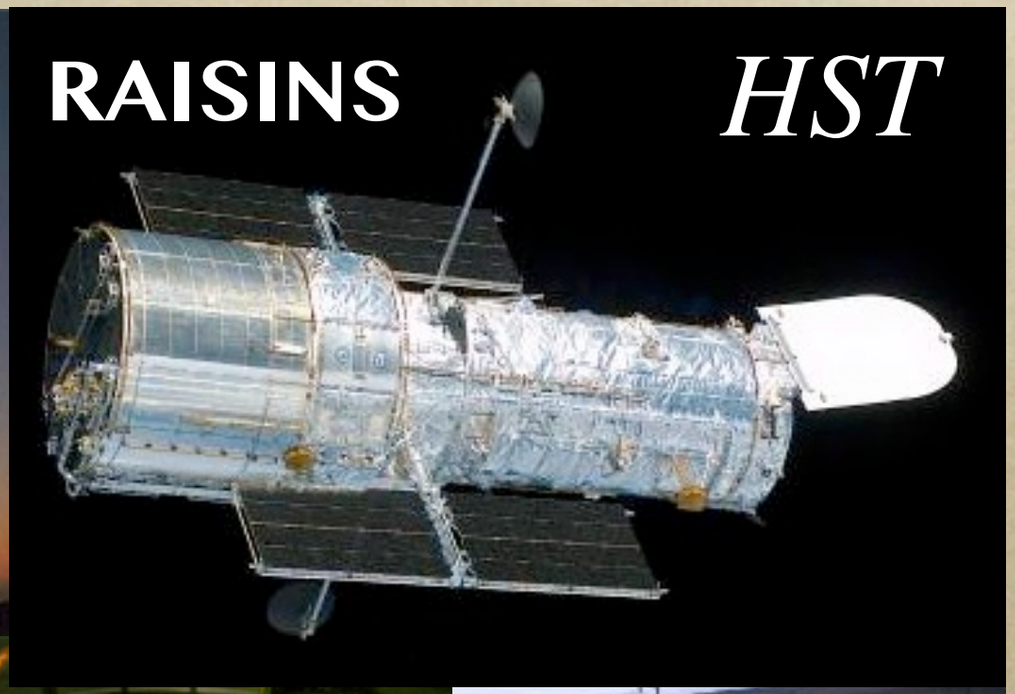

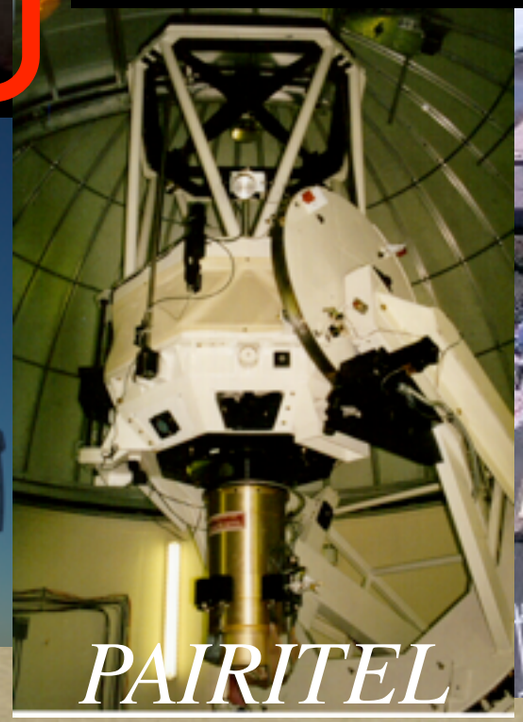

NOAO WIYN Survey :
72 nights for a Gross of NIR-SNeIa