The Supernova Legacy Survey

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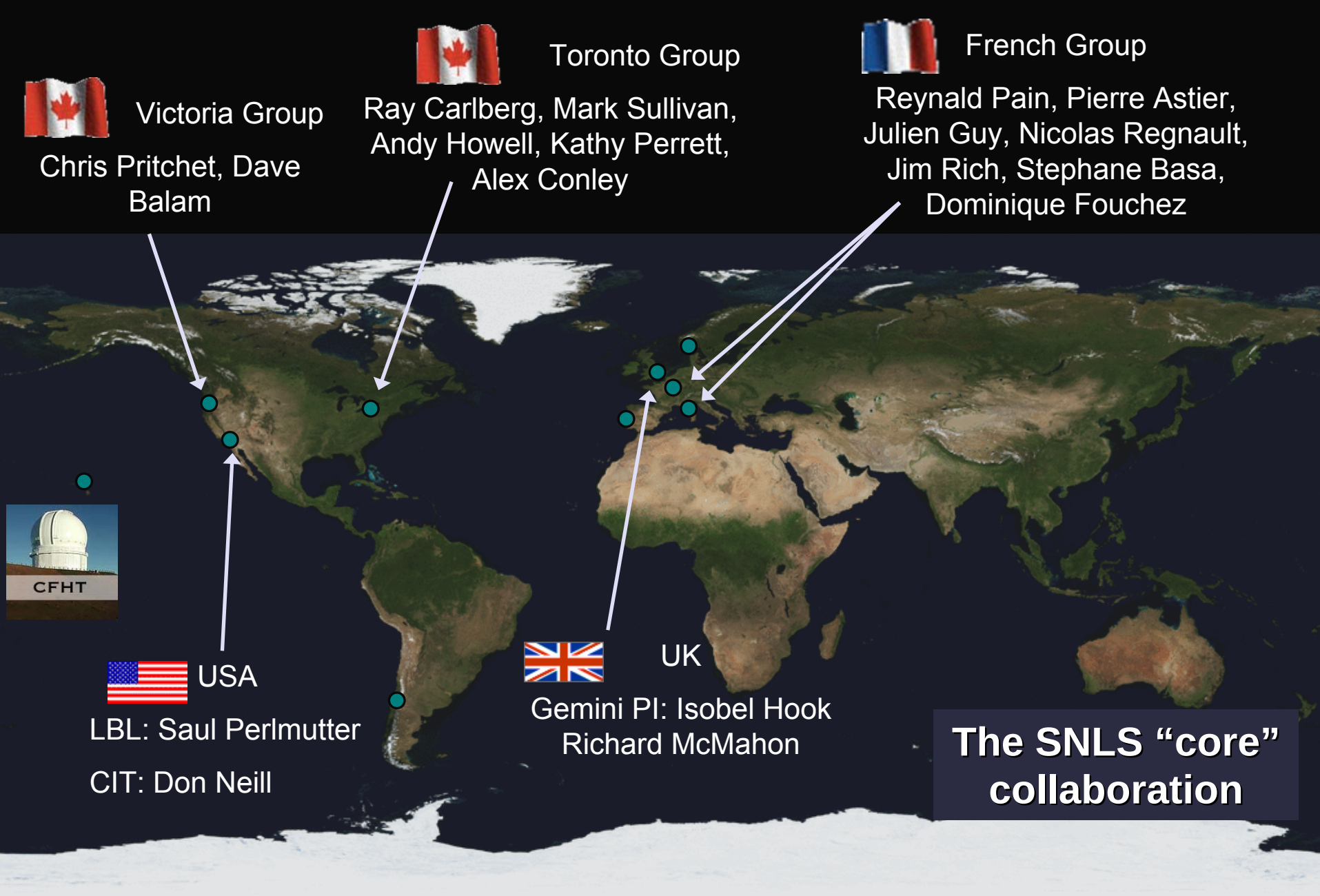
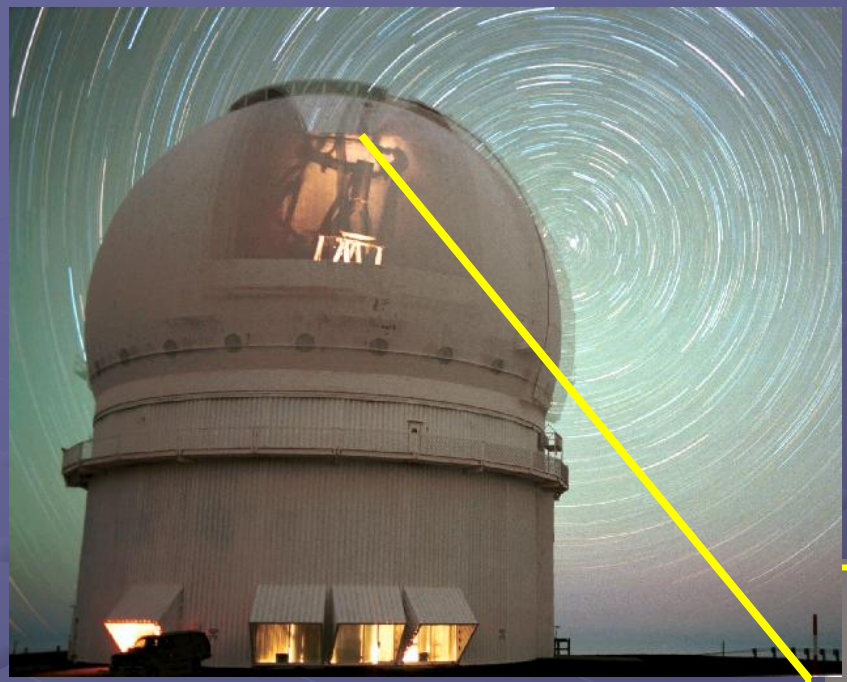
http://legacy.astro.utoronto.ca/

http://cfht.hawaii.edu/SNLS/

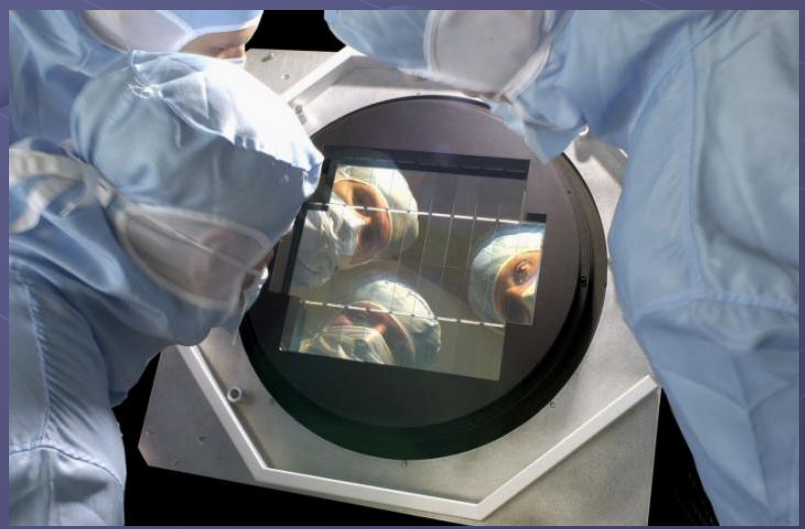


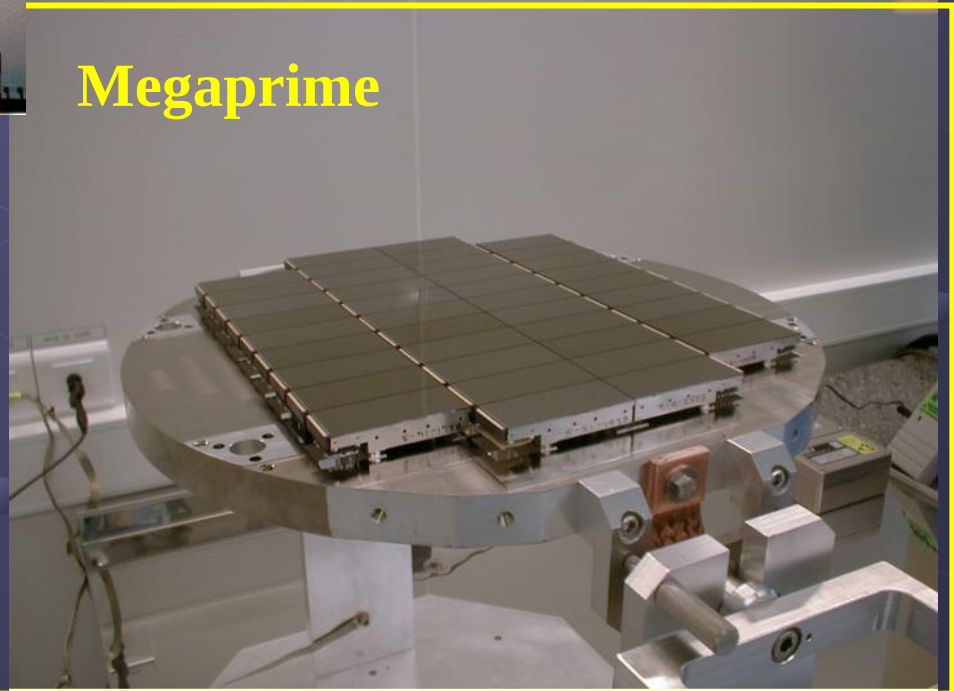
Full list of students and associates at: http://cfht.hawaii.edu/SNLS/

CFHT Legacy Survey (2003-2008)



- 5 year survey, goal: 500 distant SNe Ia to measure “w”
- Uses CFHT/“Megacam”
- 36 CCDs, good blue response
- 4 filters for good k-corrections and color measurement





CFHT-LS Organisation

CFHT-LS (imaging) – 2003-2008

DEEP	WIDE
Galaxy studies	Cosmic shear
Time sequenced dataset (202n over 5 years)	Clusters

SNLS collaboration

- Data-processing
- Major Spectroscopic Program
  - Gemini (Canada/UK/USA)
    120 hrs/yr (60:40:20)
  - VLT (France/Other Euros)
    120 hrs/yr
  - Keck (through LBL)
    40 hrs/yr
- Cosmological analyses

Magellan near-IR study (Freedman et al.)

- Rest-frame I-band Hubble diagram

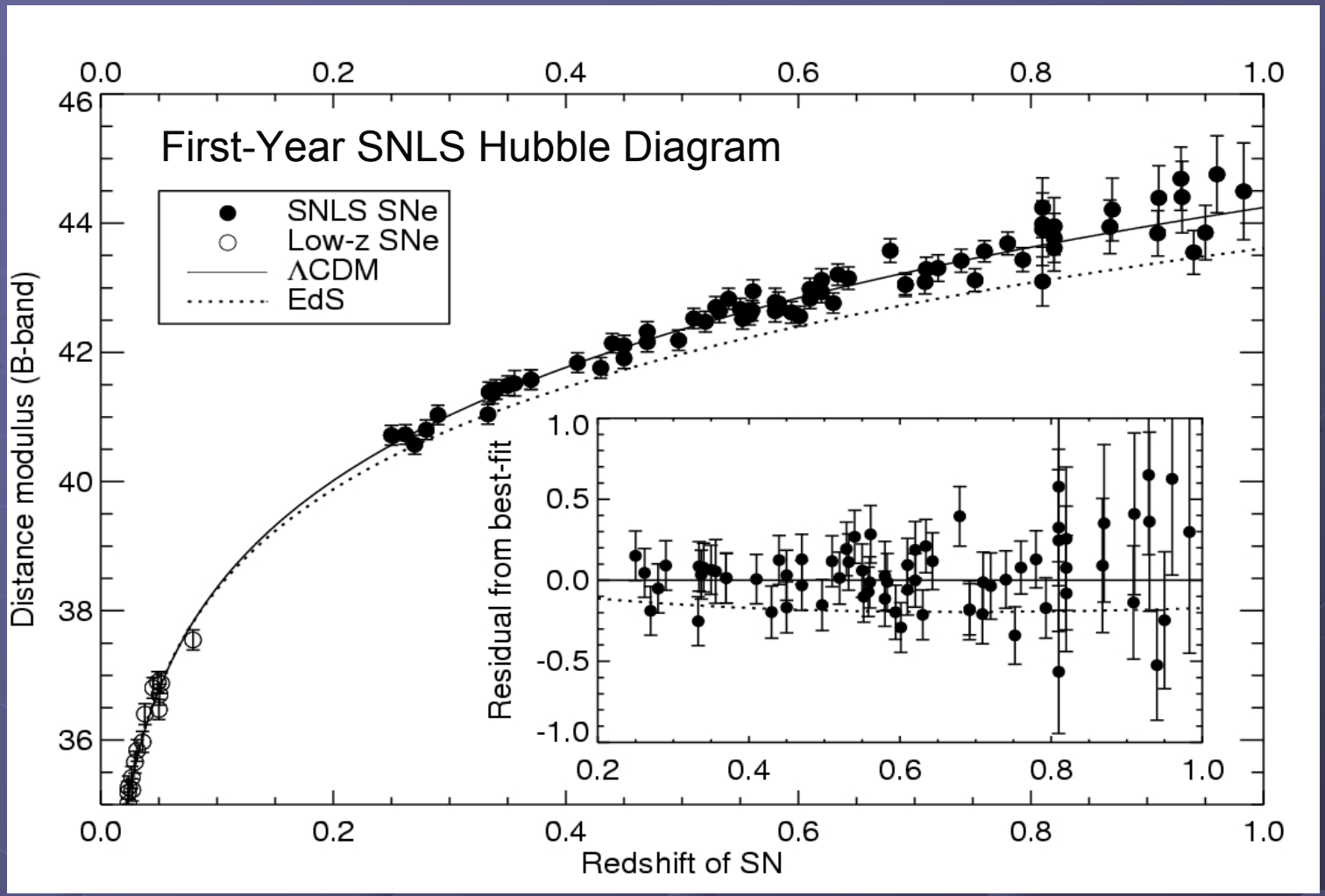
Keck SN Ia UV study (Ellis/Sullivan et al.)

- LRIS high-S/N - metallicity through UV lines
- Testing accuracy of k-corrections in the UV

SN IIP study (Nugent/Sullivan/Ellis et al.)

- Using SNe IIP as standard candles
- Independent Hubble diagram to z=0.5

SNLS 1st year

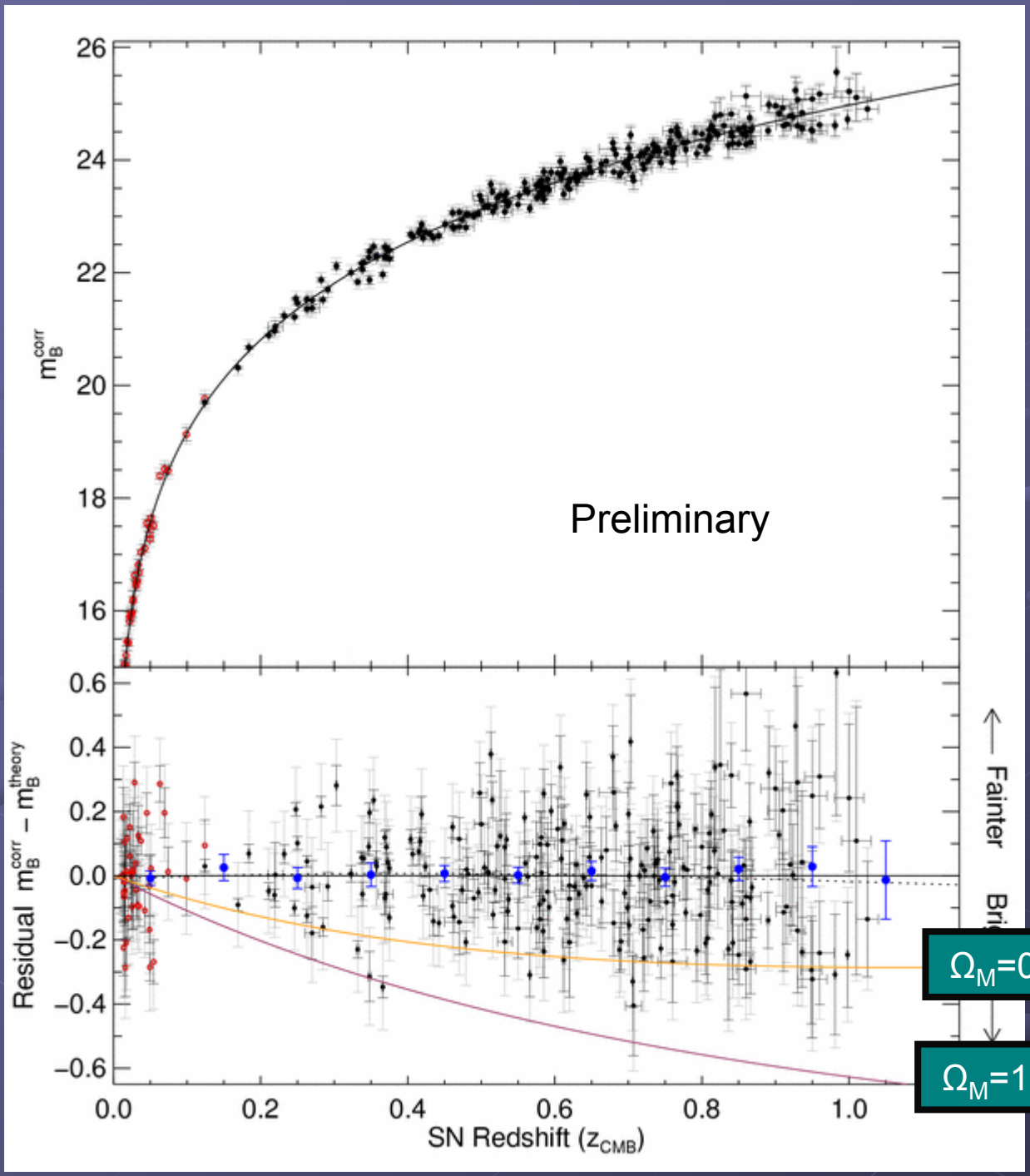


$\Omega_M = 0.263 \pm 0.042\ (stat) \pm 0.032\ (sys)$

$\langle w \rangle = -1.02 \pm 0.09\ (stat) \pm 0.054\ (sys)$

Astier et al. 2006

"Third year" SNLS Hubble Diagram (**preliminary**)



Best-fit for SNLS+flatness

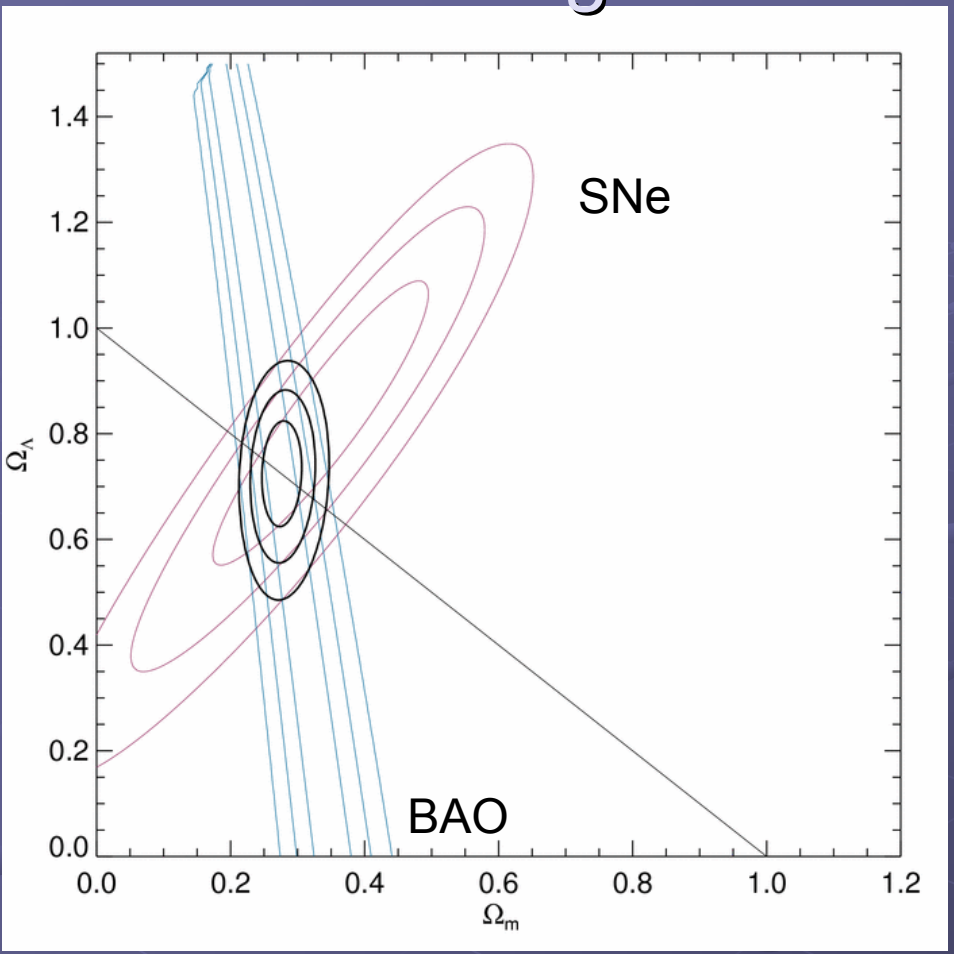
$$\Omega_M = 0.26^{+0.03}_{-0.03}$$

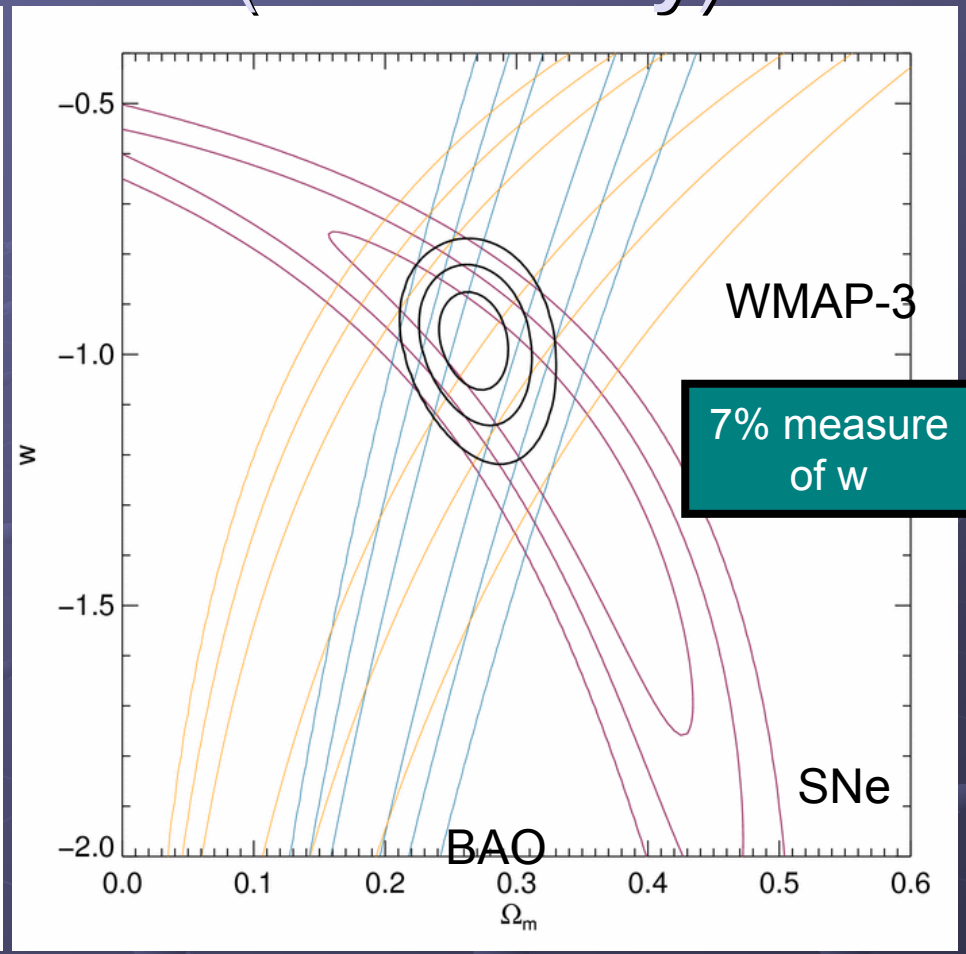
Ω_M=0.3, Ω_λ=0

Ω_M=1.0, Ω_λ=0

Sullivan et al. 2007

Cosmological Constraints (**Preliminary**)





7% measure of w

SNLS+BAO (No flatness)

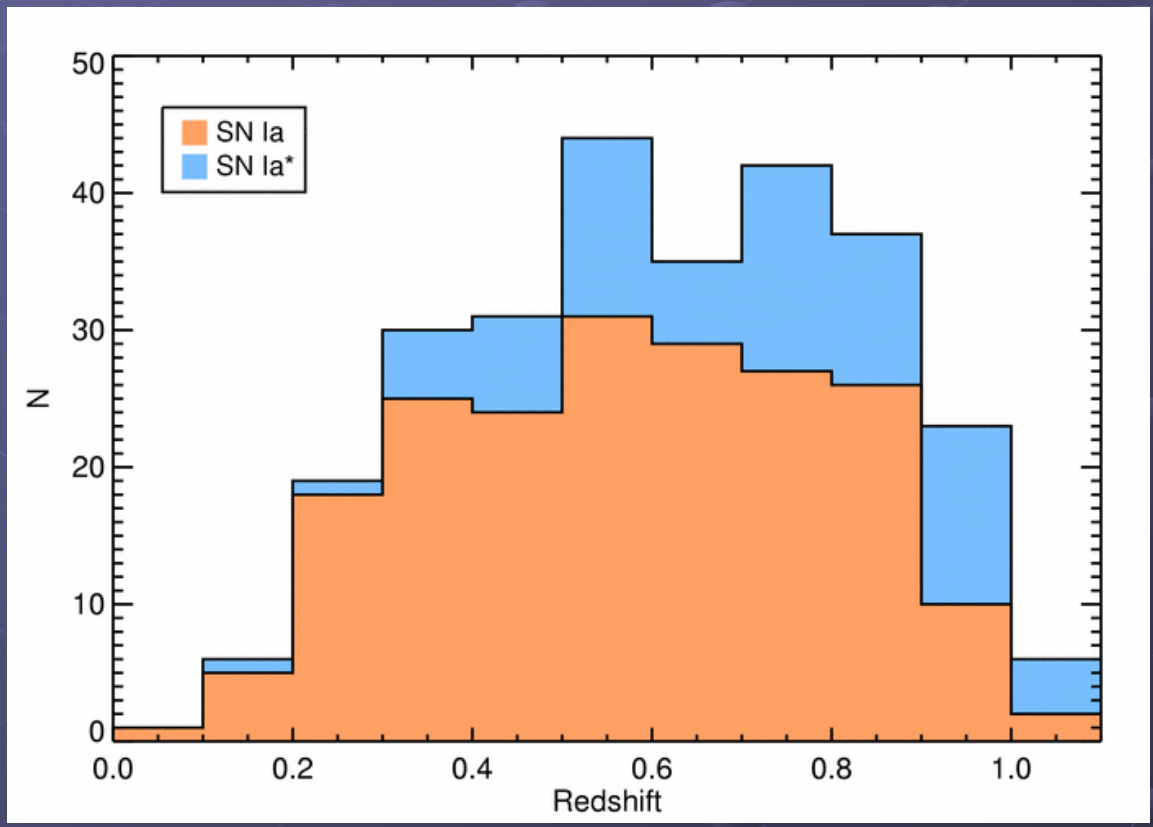
SNLS + BAO + simple WMAP + Flat

SNLS Vital Statistics

- Duration/Area/Number of SNe Ia
  - 5 Years (2003-2008), ~ 500 confirmed, ~ 1000 all z photo-typed
  - 4 sq degrees; 10 “sq. deg. years”
- Redshift and Filter coverage
  - $0.08<z<1.06$ $(0.2<z<0.9)$: 50% @ $z=0.85$
  - g’r’i’z’: 4 filters are essential over $0.2<z<1.0$

Redshift distribution

- Survey running for 3.5 years
- >2000 likely SN detections
- ~310 confirmed distant SNe Ia (+ 40-50 not yet processed)
  - 500 **spectroscopically confirmed** SNe Ia by survey end



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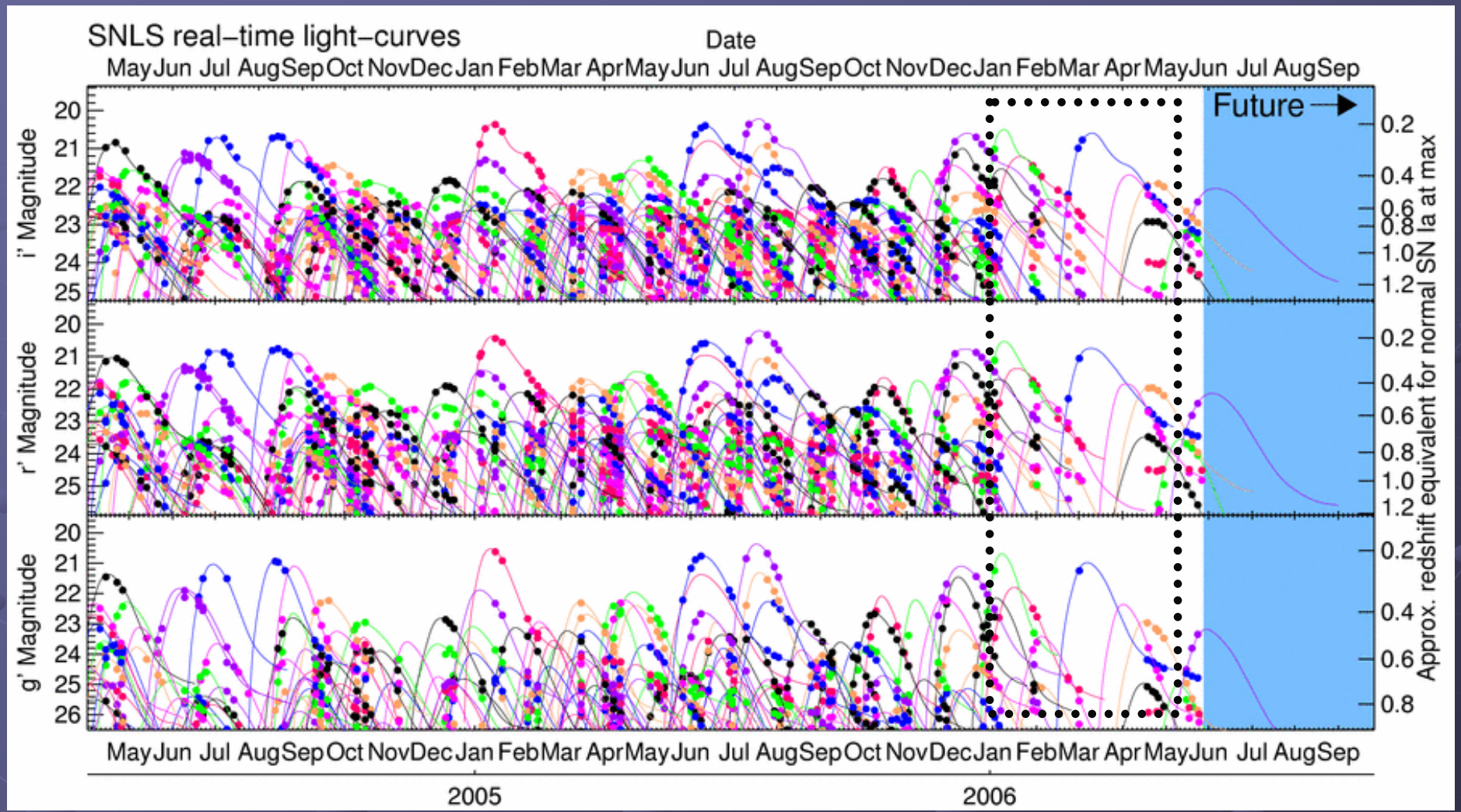
- Cadence
  - Queue Scheduled: 3-4 days during 14-18 days/month (5 epochs/month)
  - “Cadence within a night”: 15 images over two hours

Cadence: “Rolling” light-curves



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  - 4 sq degree fields; 6 months/yr/field; 10 “sq. deg. years”
- Redshift and Filter coverage
  - $0.08<z<1.06$ $(0.2<z<0.9)$: 50% @ z=0.85 (2.6×10^3 Gpc^3 per field)
  - g’r’i’z’: 4 filters are essential over $0.2<z<1.0$
- Cadence
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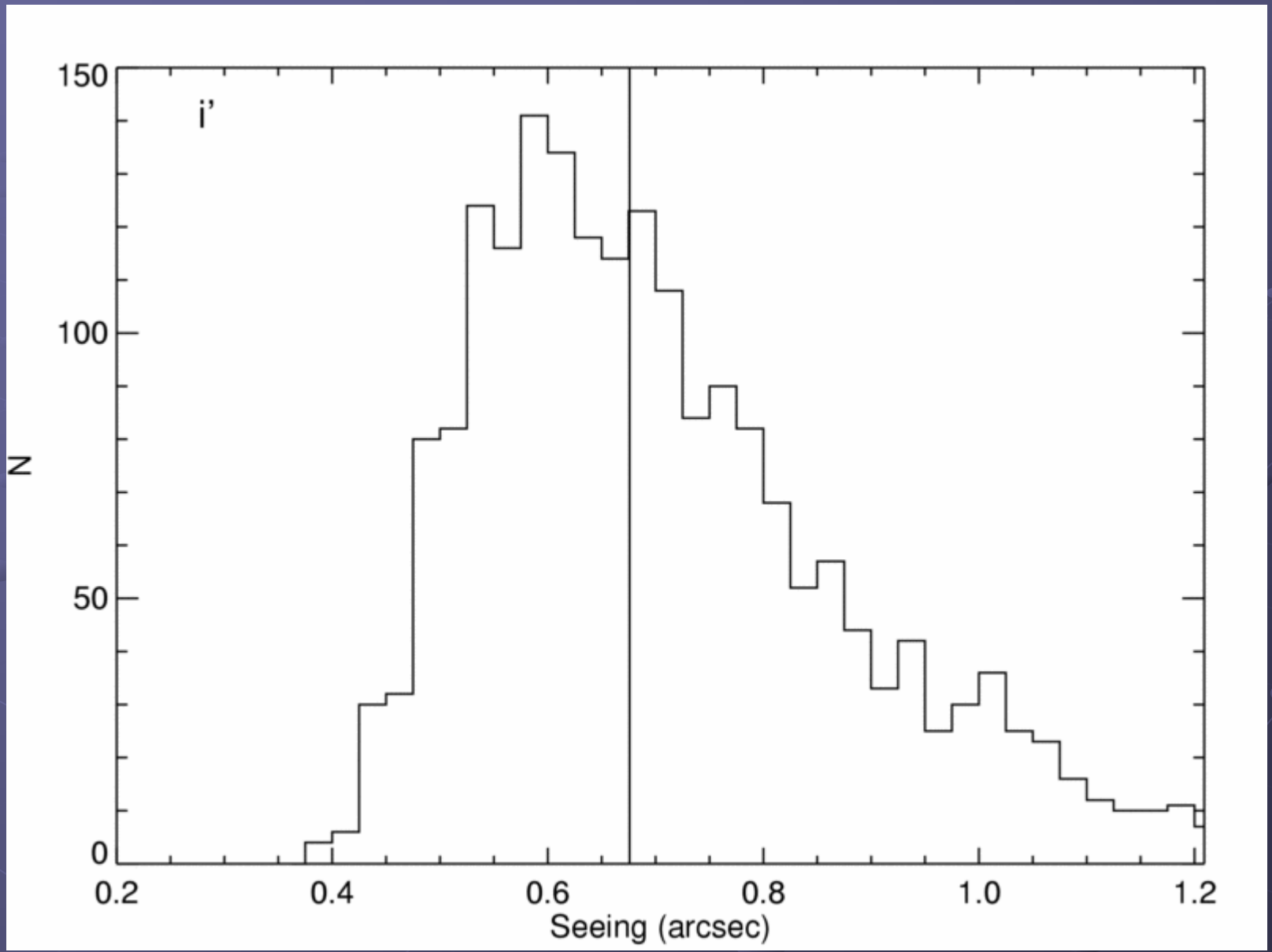
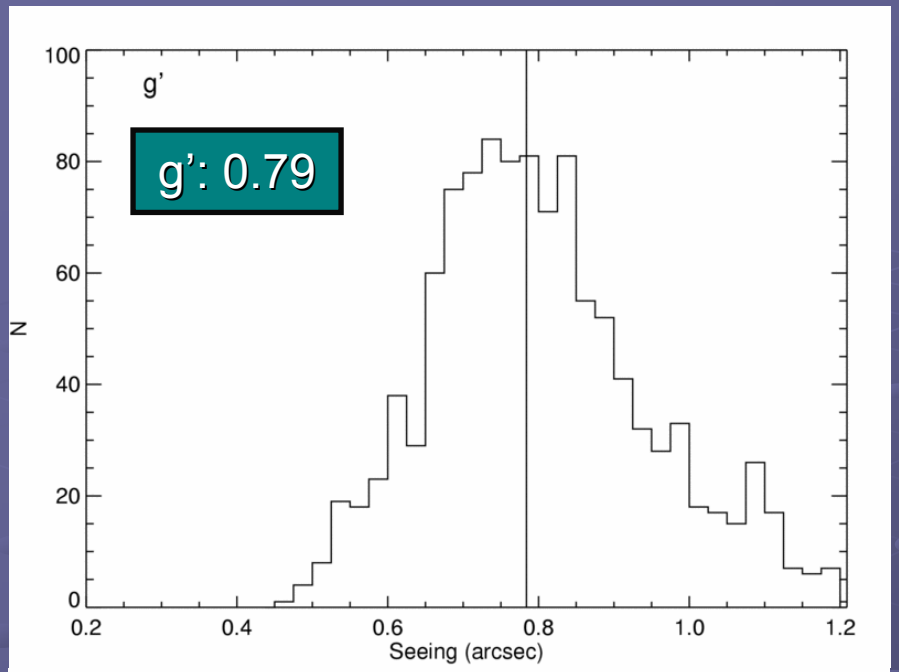
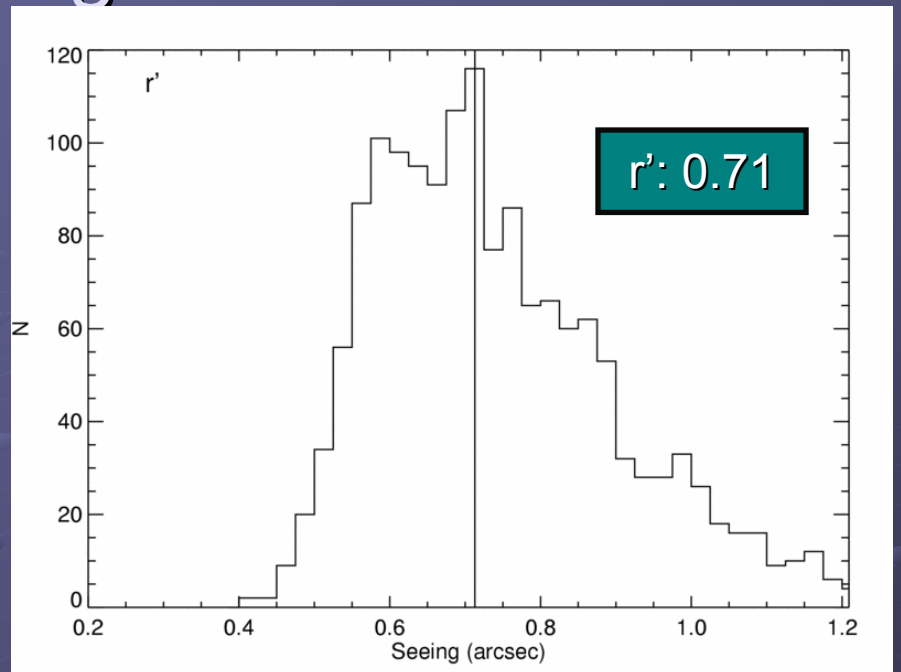
- Seeing
  - Median 0.65” in i’; regularly 0.6” or better

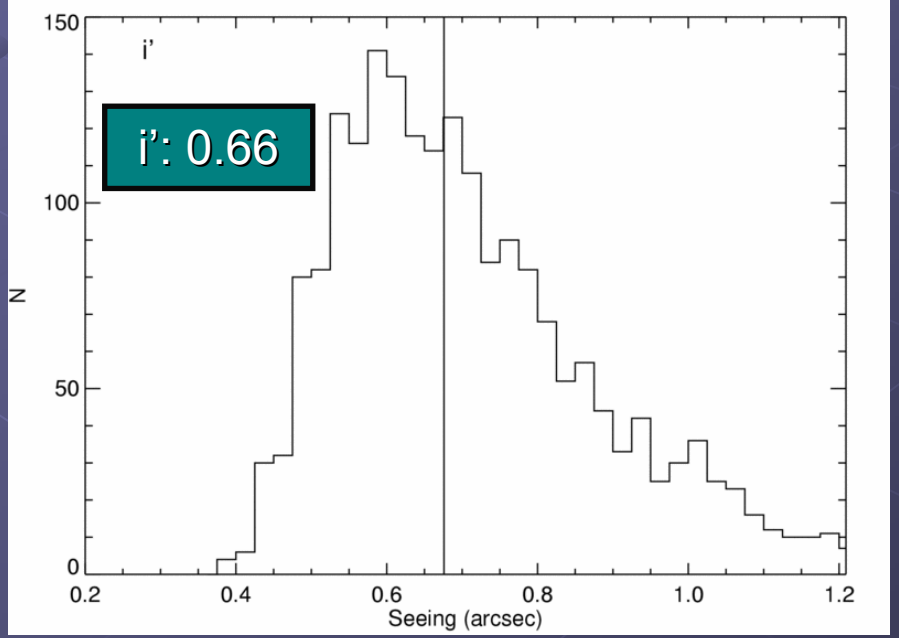
Seeing – detection filter (i’)

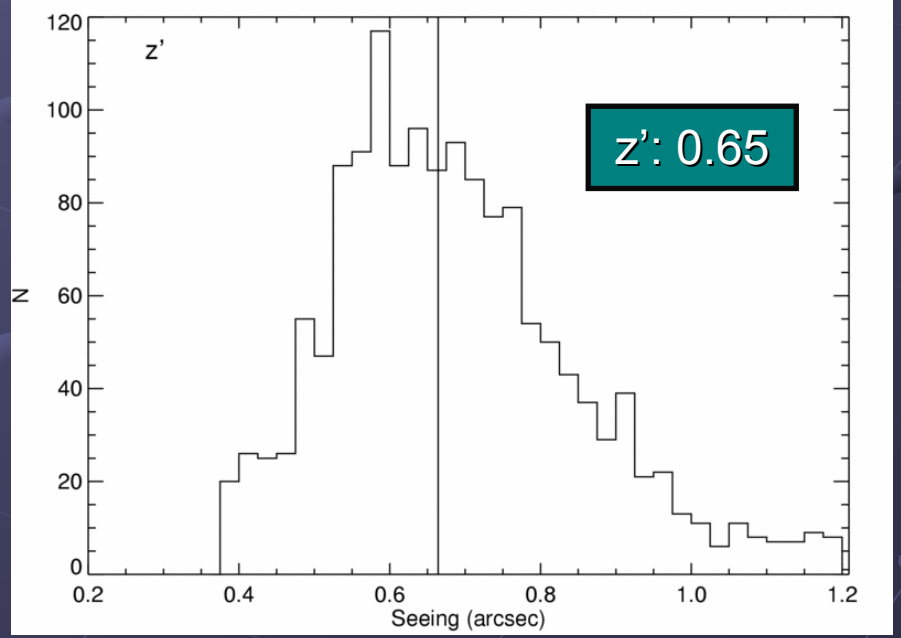


Seeing

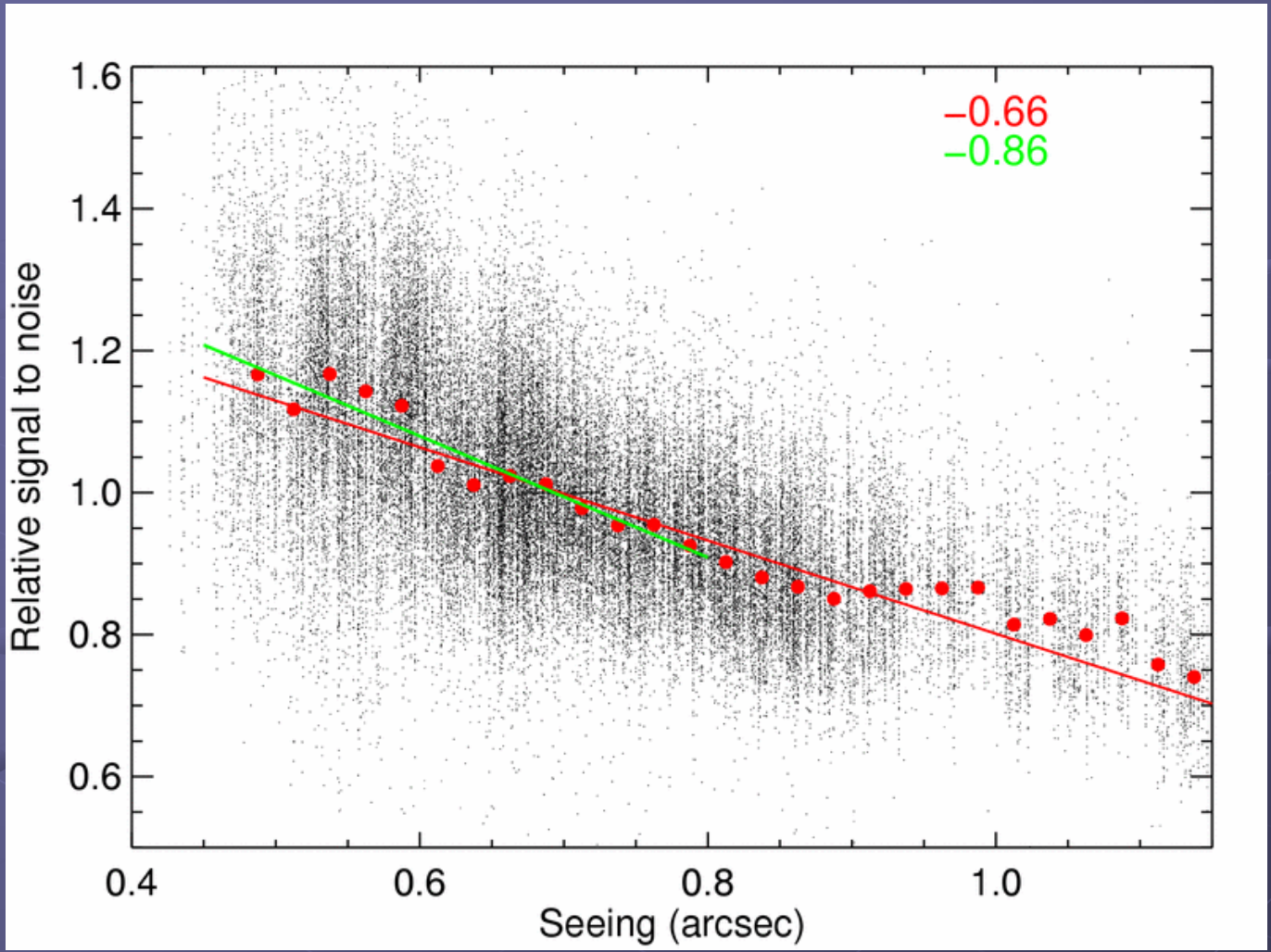

g'
g': 0.79
N
Seeing (arcsec)


r'
r': 0.71
N
Seeing (arcsec)


i'
i': 0.66
N
Seeing (arcsec)


z'
z': 0.65
N
Seeing (arcsec)

Seeing versus S/N



PSF photometry of i=20-22 stars

S/N strongly depends on seeing (almost a linear relation)

Seeing also affects quality of PSF-matching

If seeing degrades by 50%, exposure times must be doubled to reach the same S/N

CFHT spent considerable resources on optimising megacam image quality

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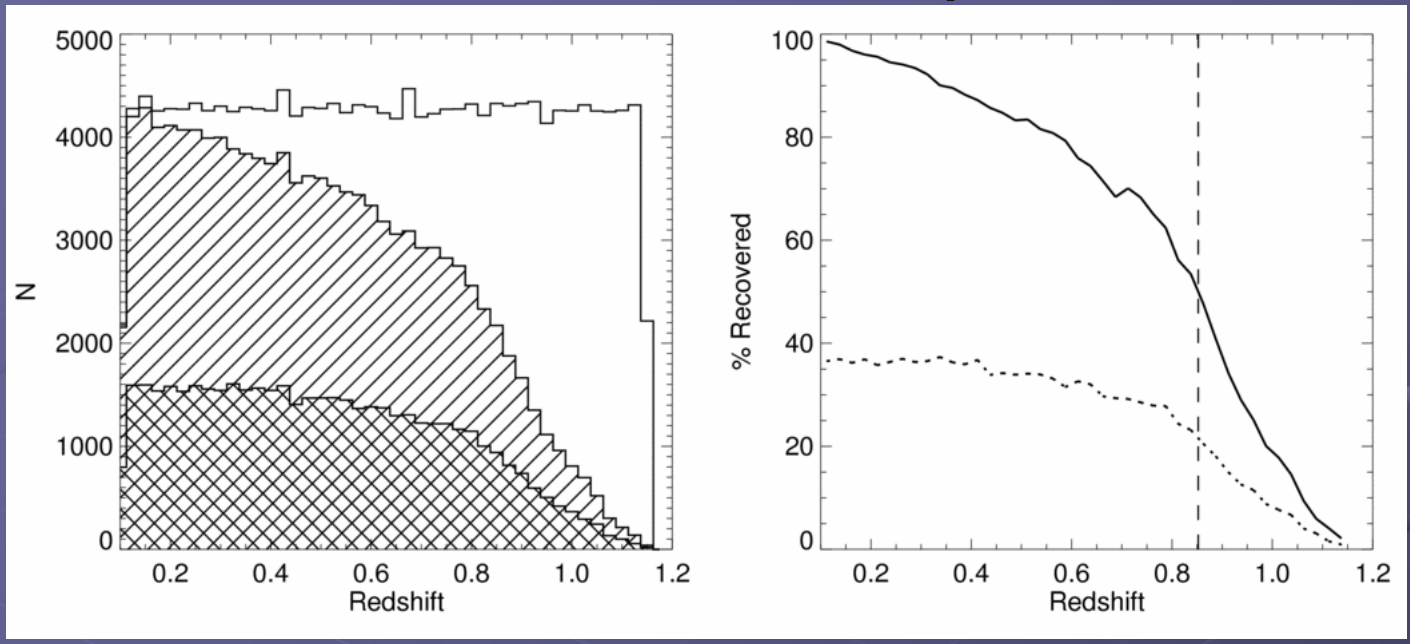
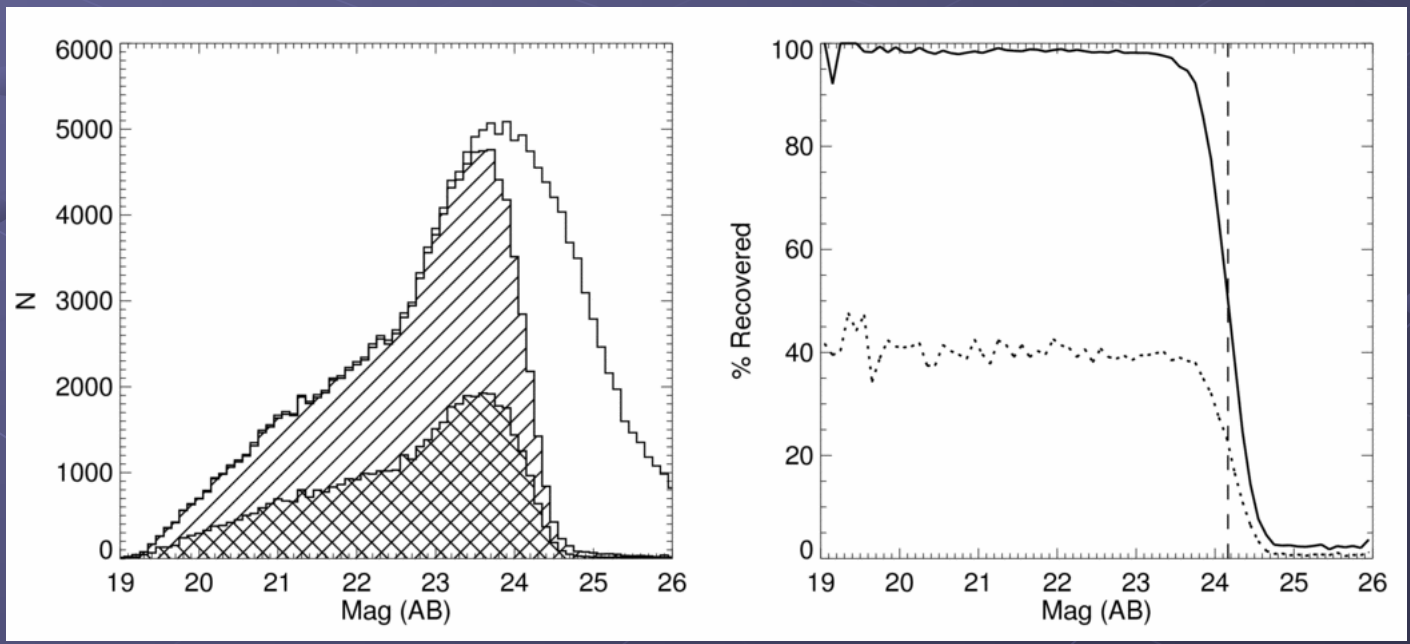
- Seeing
  - Median 0.65” in i’; regularly 0.6” or better
- Depth for SNe (AB):
  - Can’t take 5-σ point source limiting mag and claim this as the depth
  - Detection depth (RTA) SNe Ia: 50% @ i=24.3 (peak) ~ z=1.05
    - (Spectroscopic depth: i=24.0, 30% increase over host)
  - Core collapse SNe: z=0.4-0.5
  - (Point source depth: 5-σ ➔ i=25.0)

Depth



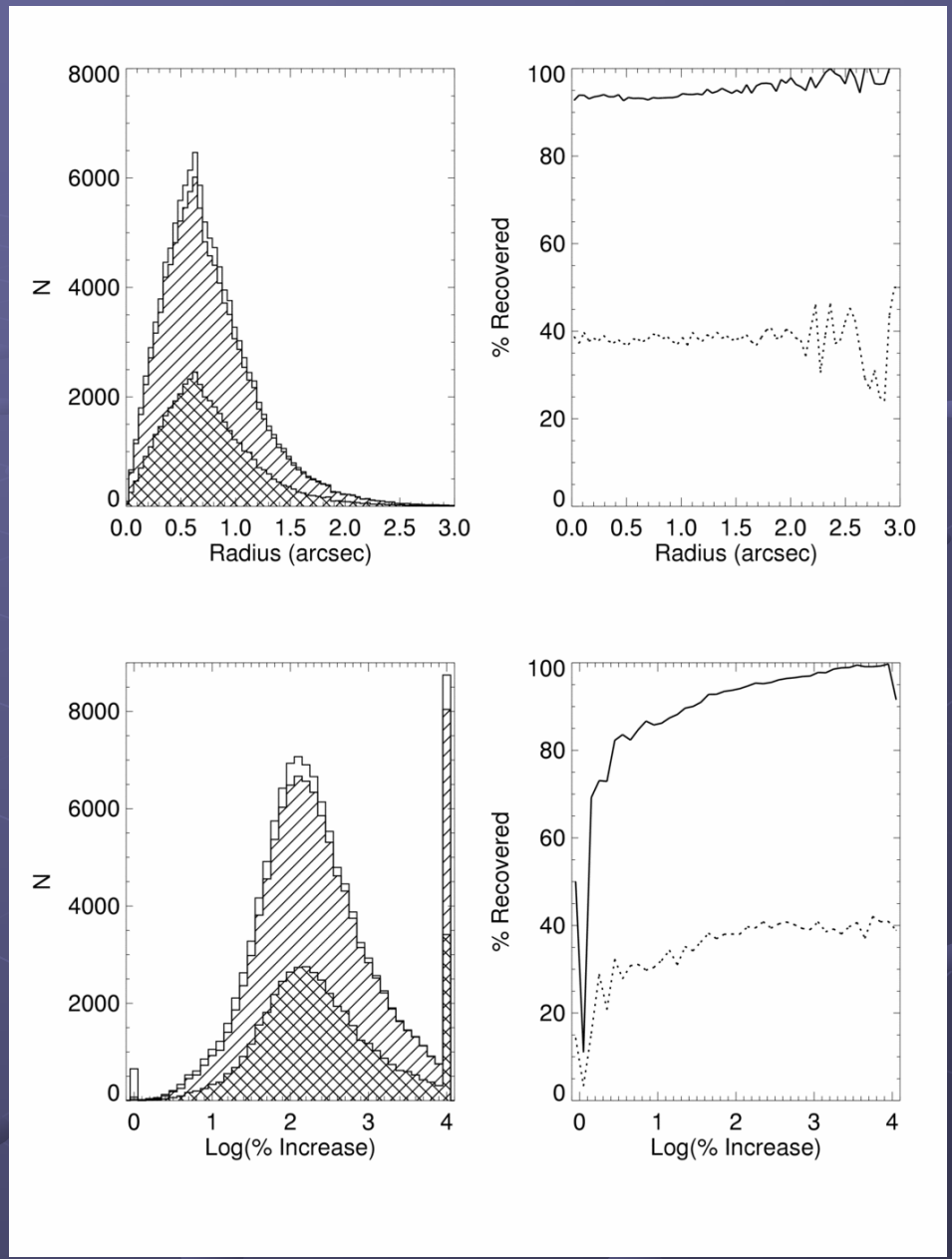


Simulations based on realistic SN populations (including A+B) and RTA software

Redshift

Magnitude

Perrett et al. 2007


8000
6000
4000
2000
0
N
0.0 0.5 1.0 1.5 2.0 2.5 3.0
Radius (arcsec)
100
80
60
40
20
0
% Recovered
0.0 0.5 1.0 1.5 2.0 2.5 3.0
Radius (arcsec)
8000
6000
4000
2000
0
N
0 1 2 3 4
Log(% Increase)
100
80
60
40
20
0
% Recovered
0 1 2 3 4
Log(% Increase)

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