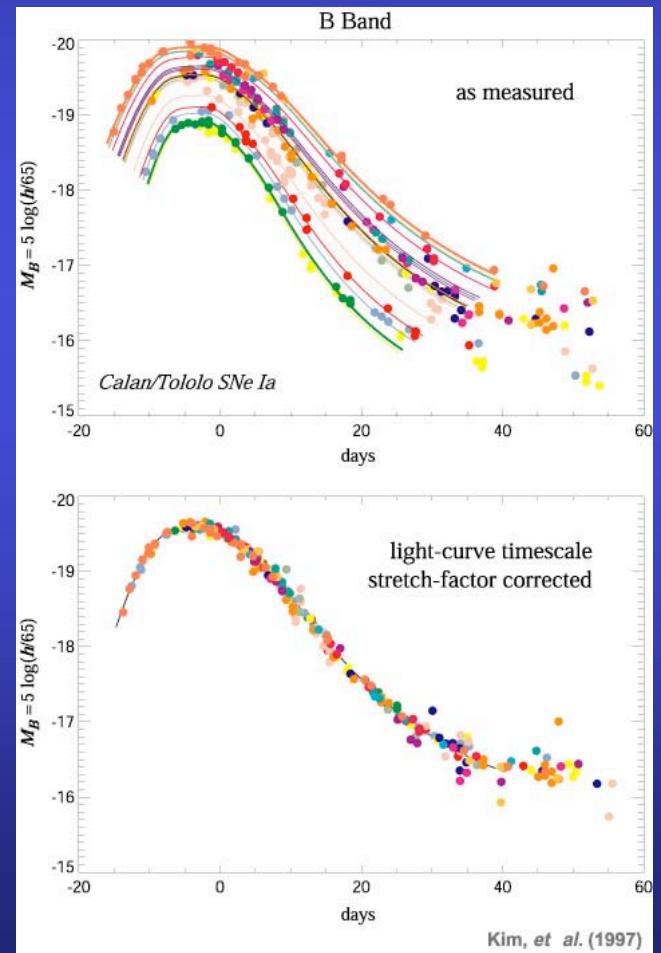
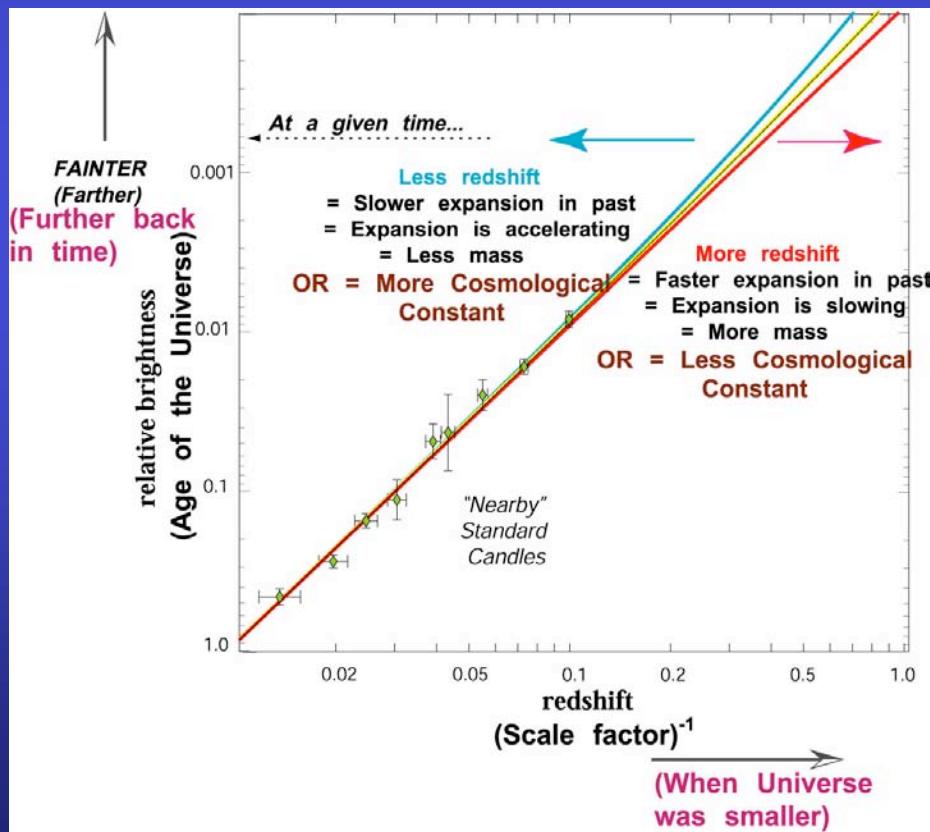


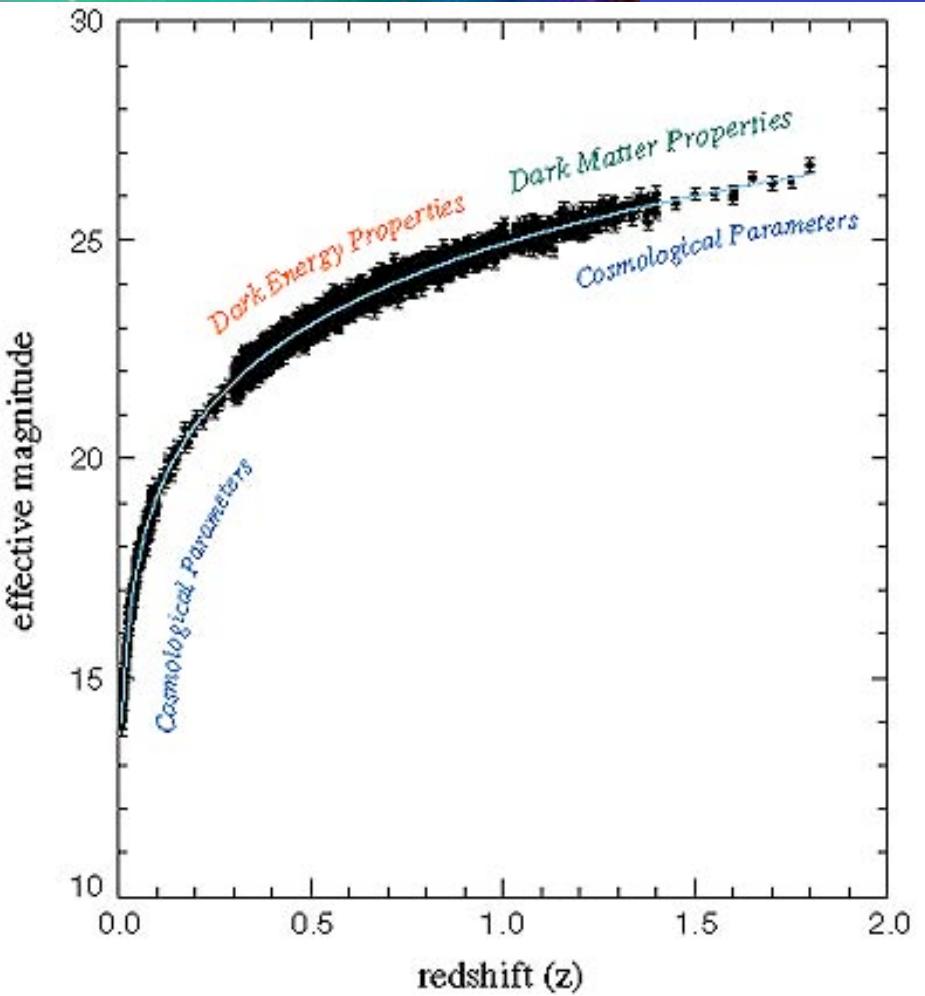
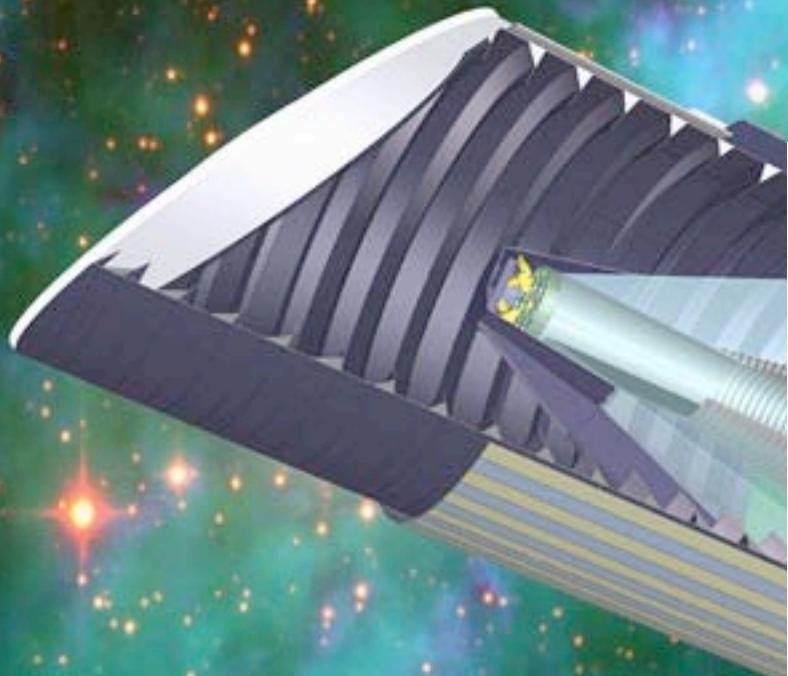
Studying the universe with Type Ia supernovae

Lifan Wang
Texas A&M University

Measuring Universe's History and Fate with Standard Candles



The Supernova Acceleration Probe (SNAP)



General Descriptions

- From light curve, deduce mags, colors, and light-curve-shapes
- Fit a function $D = f(\text{mags, colors, light-curve-shapes, } \dots)$
- Tests: D is uncorrelated to colors, l.c.s., etc

An Example

Δm_{15} method:

$$D = B - p_1 \Delta m_{15} - p_2 E(B-V)$$

Bayesian

vs

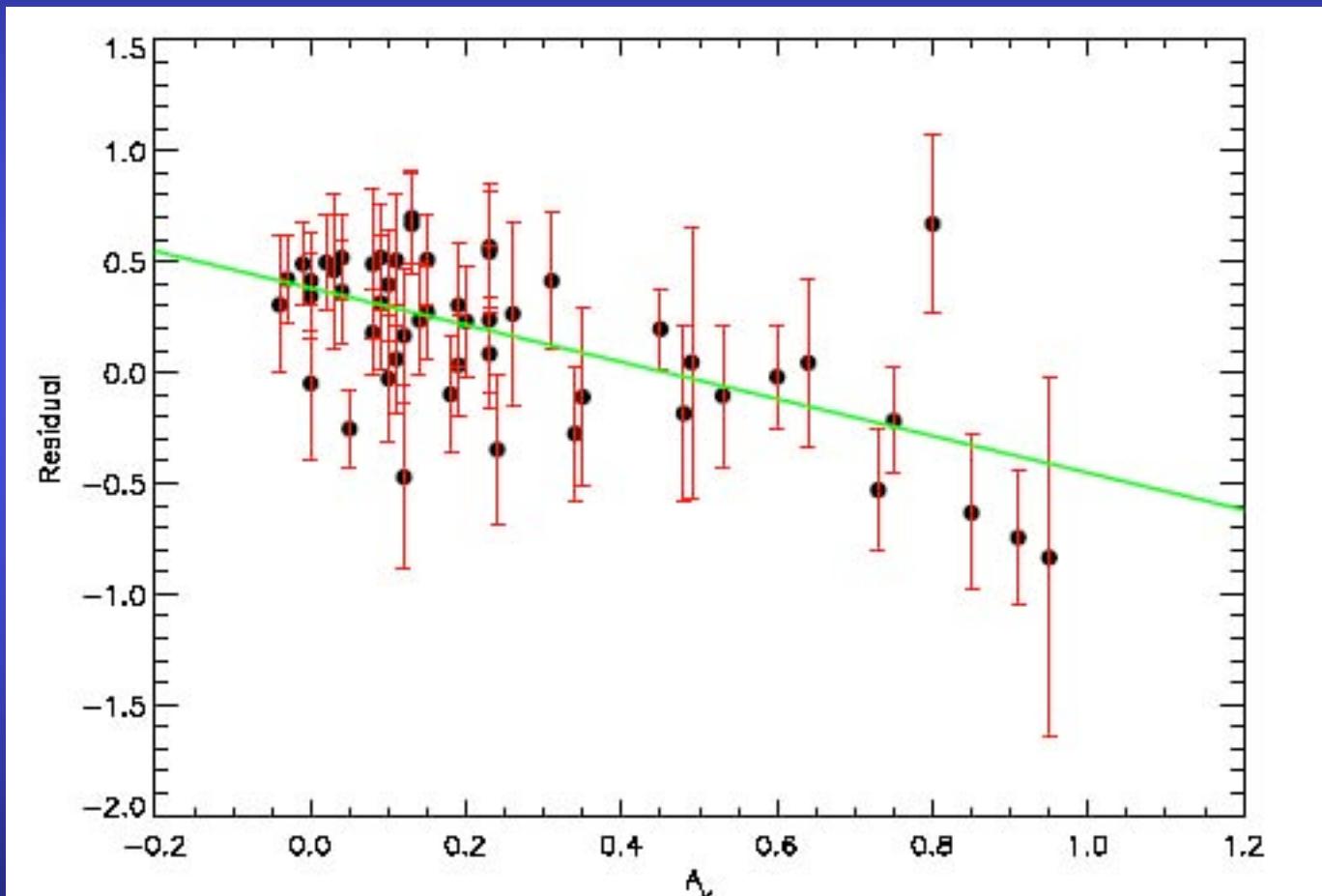
$$D = B - p_1 \Delta m_{15} - p_2 (B-V)$$

Frequentist

More parameters ...

Data from Riess Gold Sample

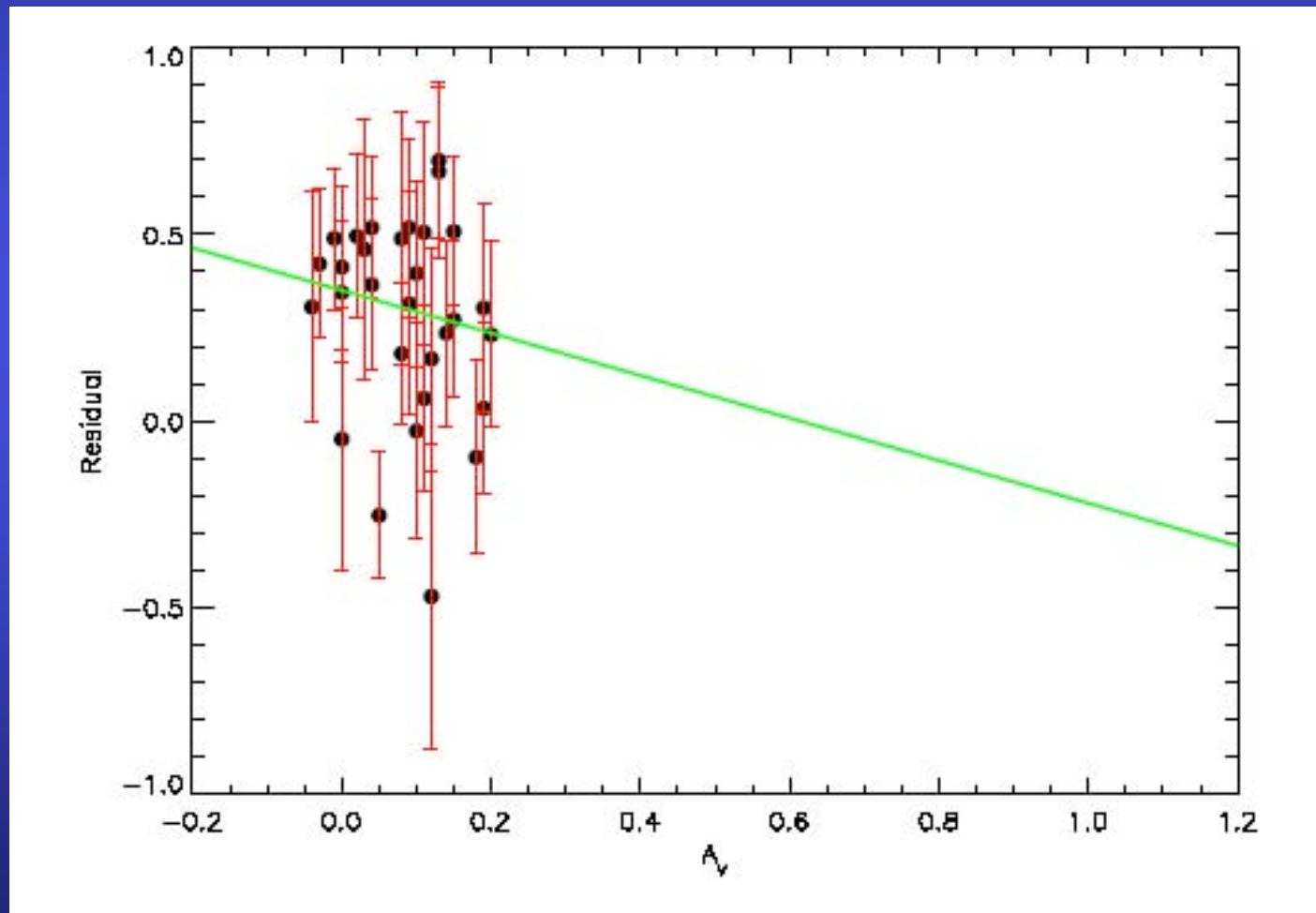
$$\Delta X^2 = 11$$



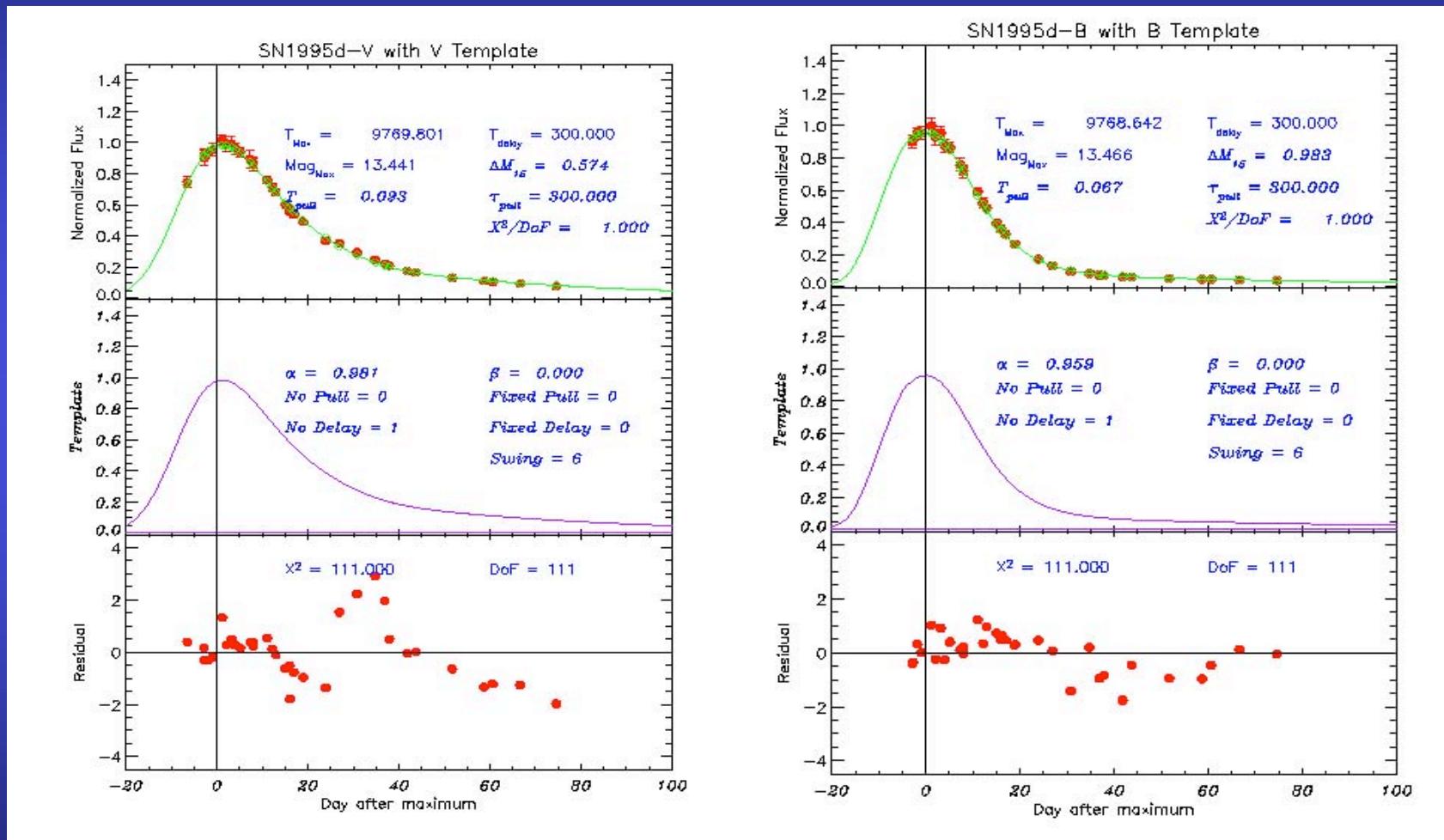
sigma change from 0.36 mag to 0.26 mag

Gold Sample?

$$\Delta X^2 = 1$$

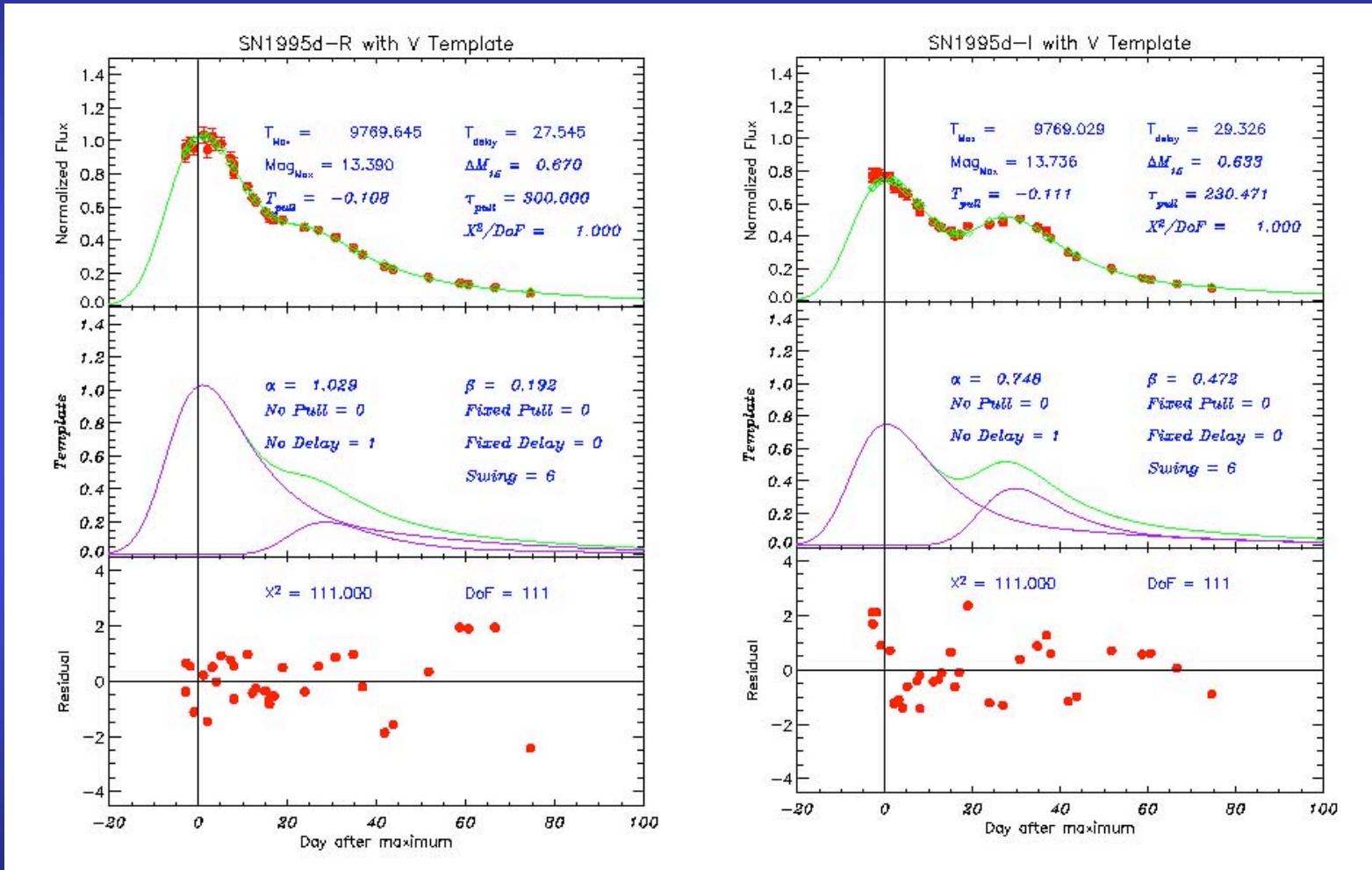


SS fit



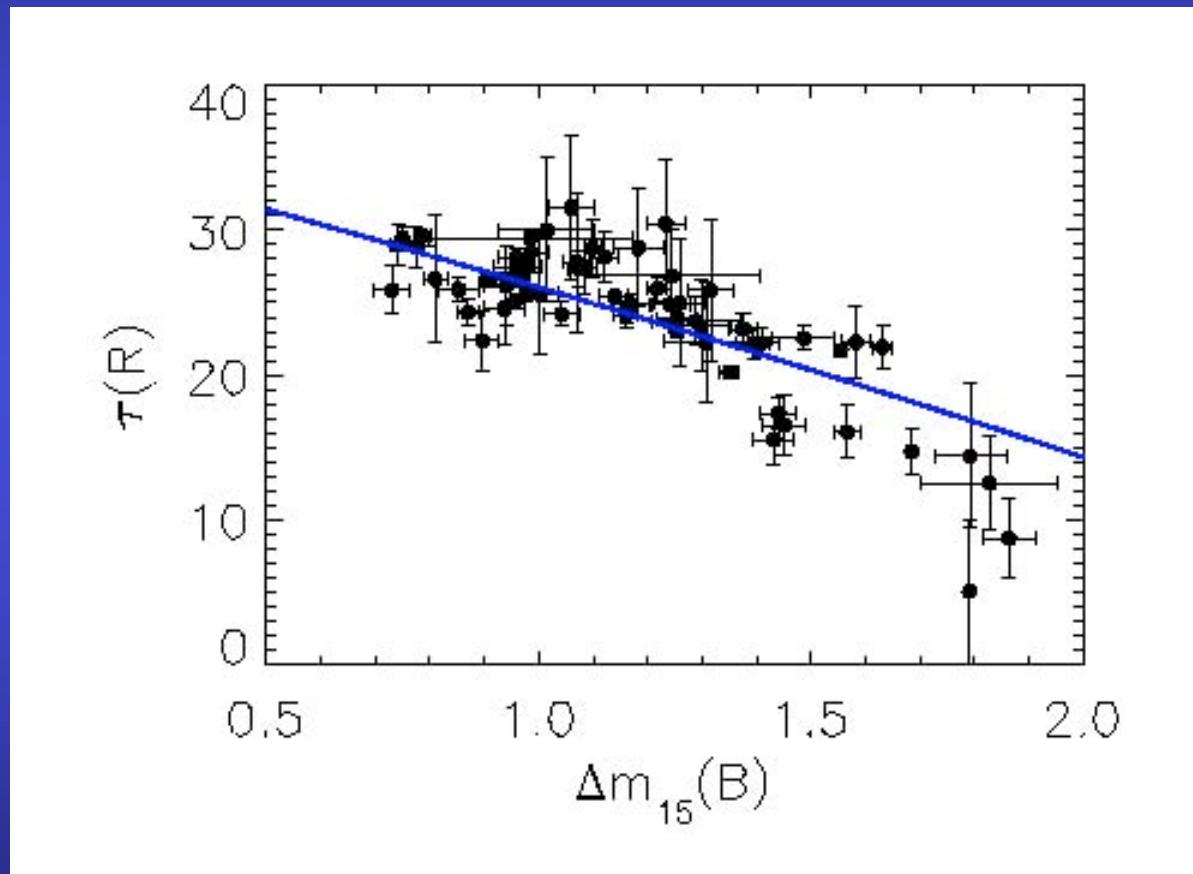
Wang et al. (2006): Super-stretch method

Supernovae for Cosmology



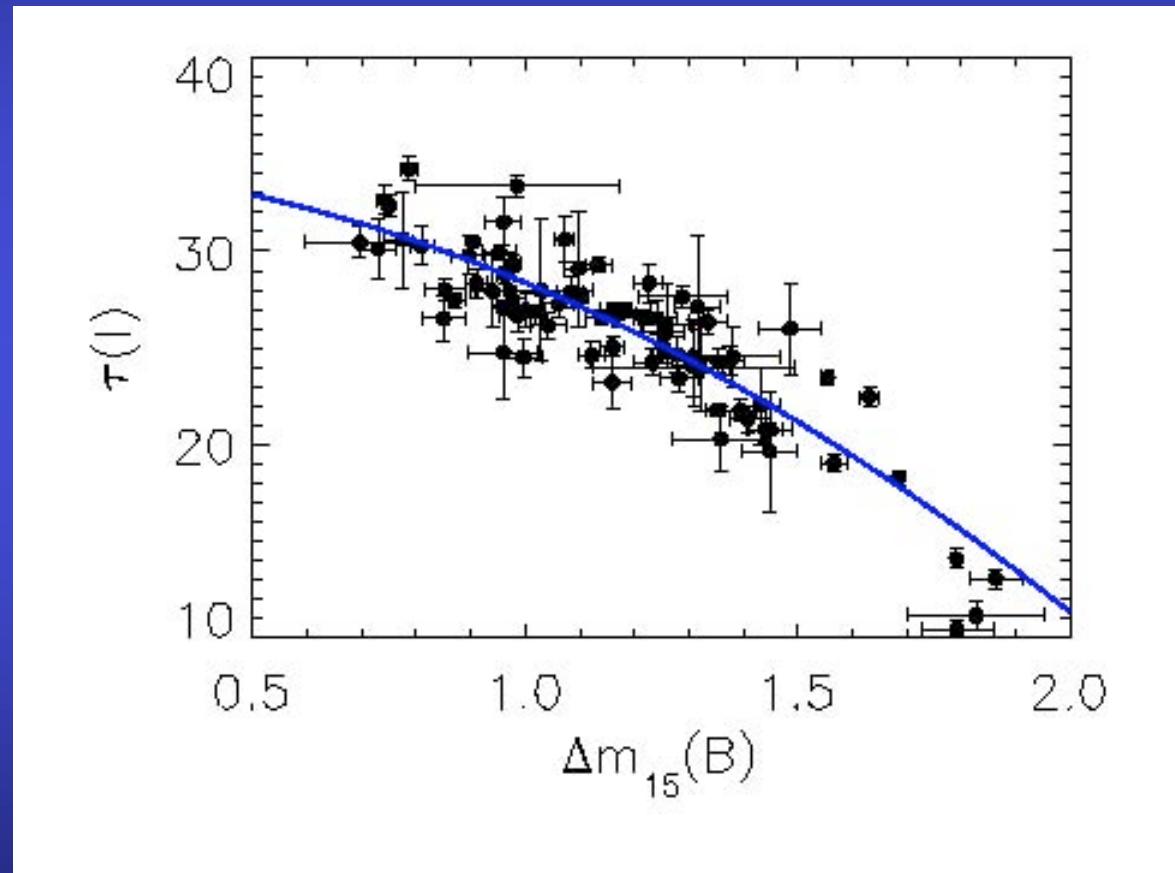
Wang et al. (2006): Super-stretch method

Redshifts from light curves?



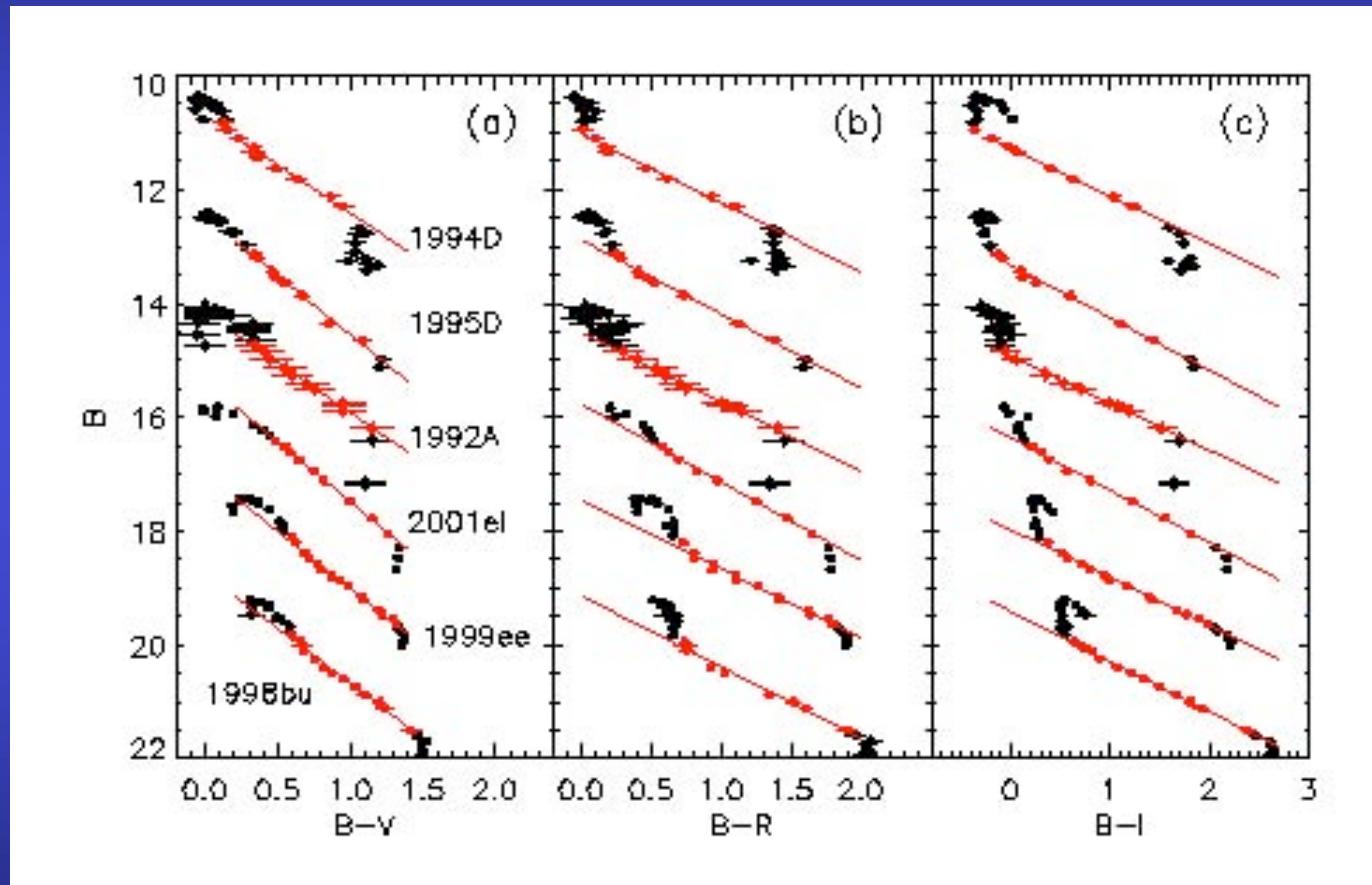
Wang et al. 2007

Redshifts from light curves?



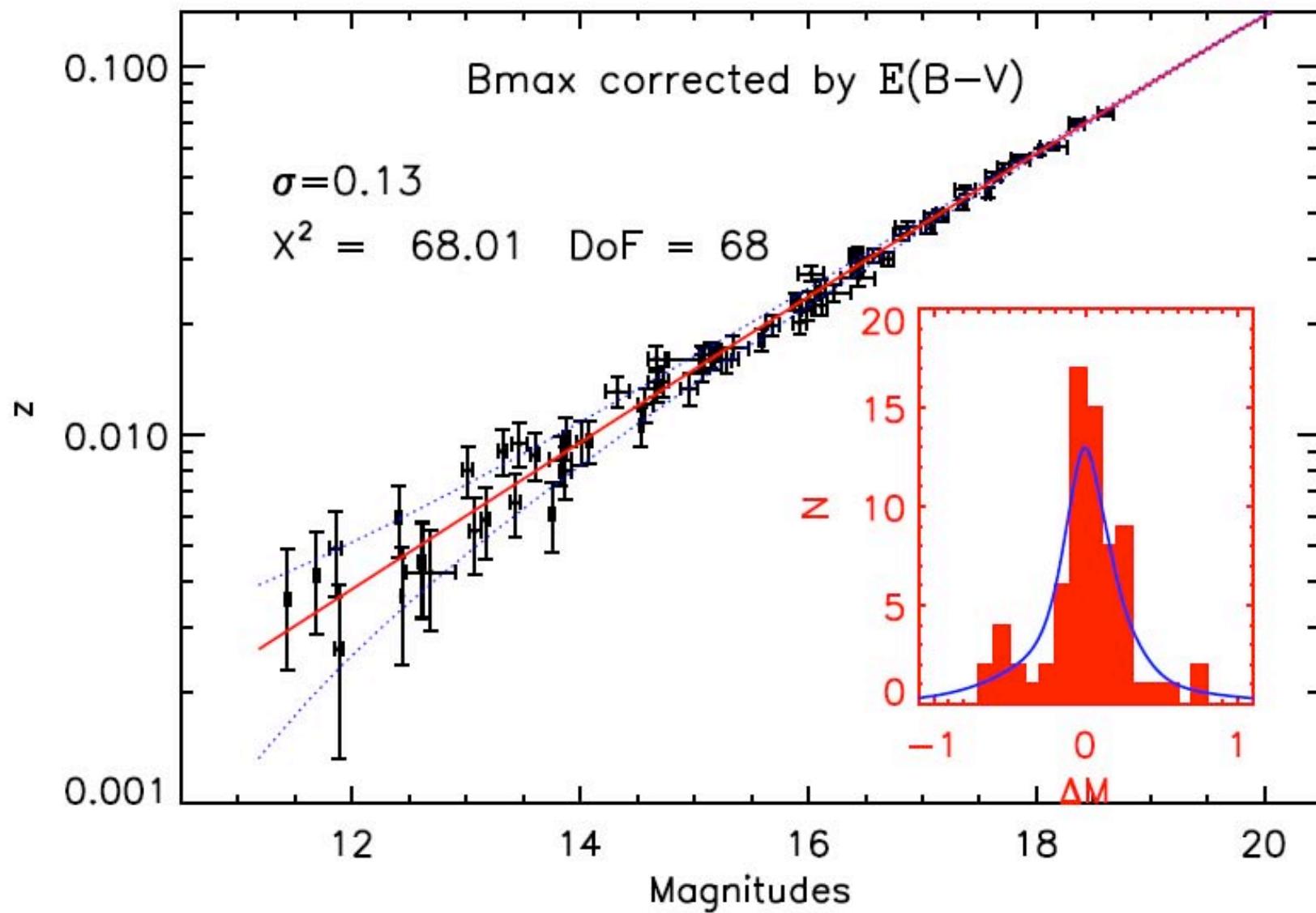
Wang et al. 2007

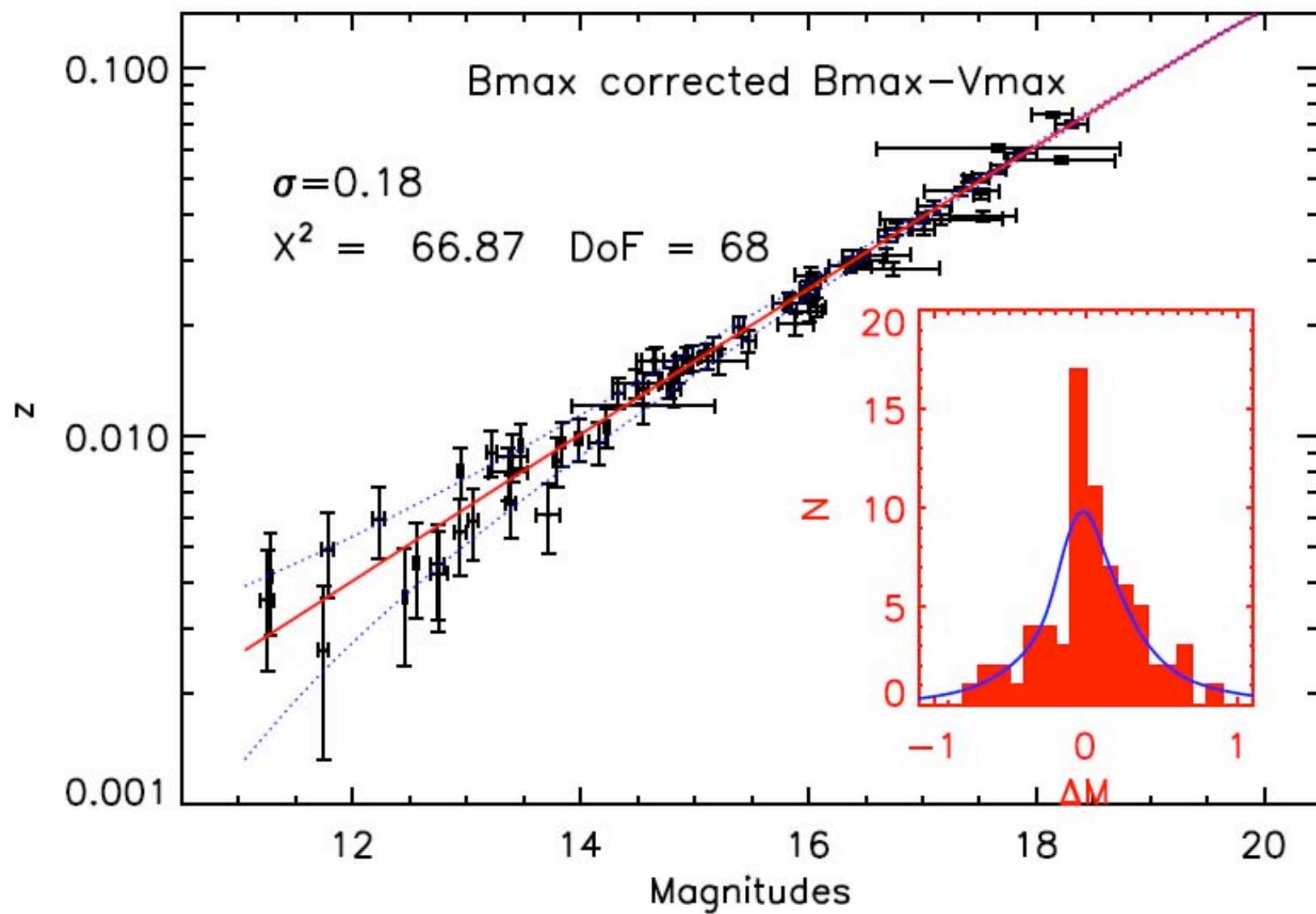
Color MAGnitude Intercept Calibrations (CMAGIC)

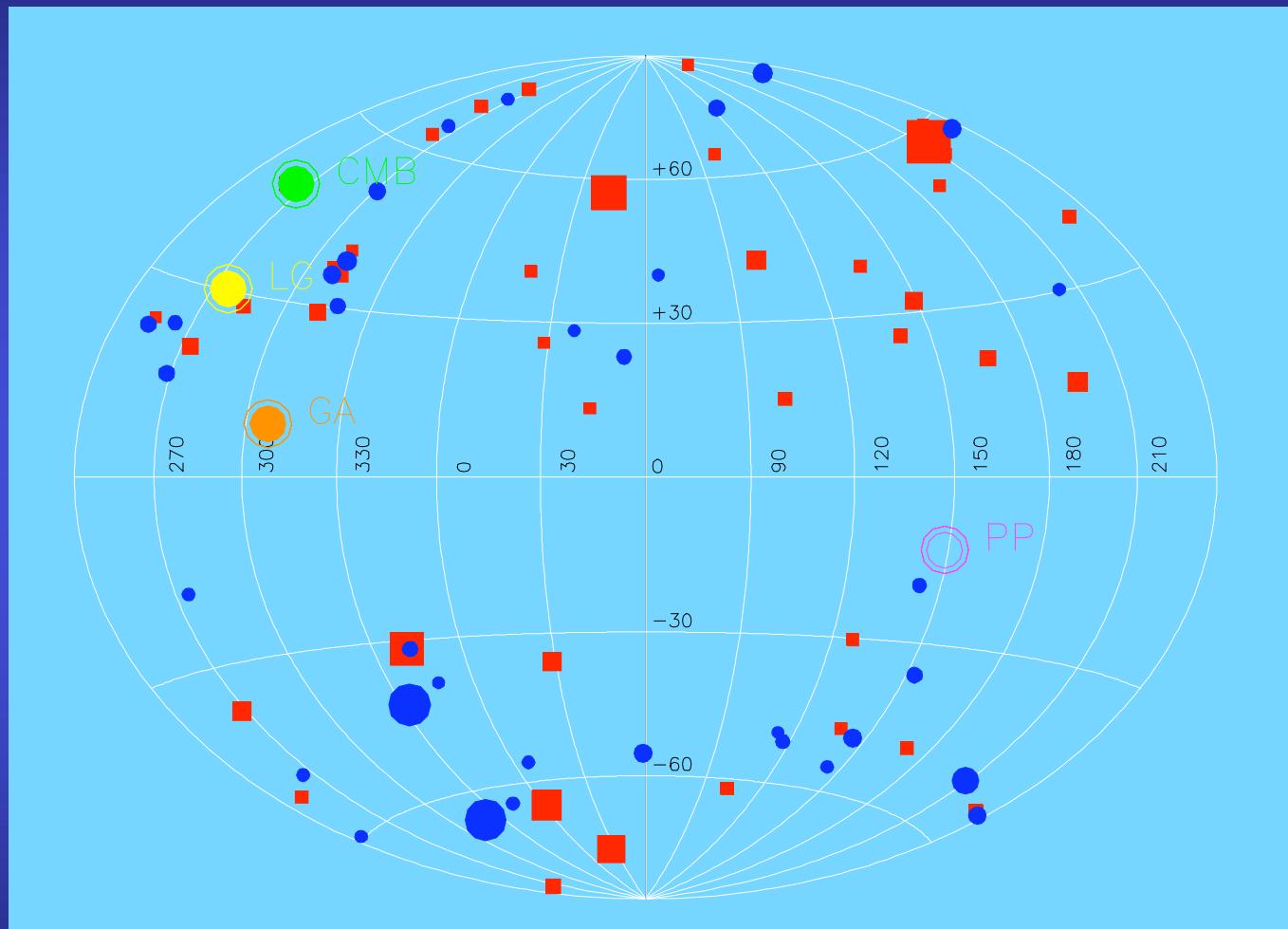


Asymmetry free!

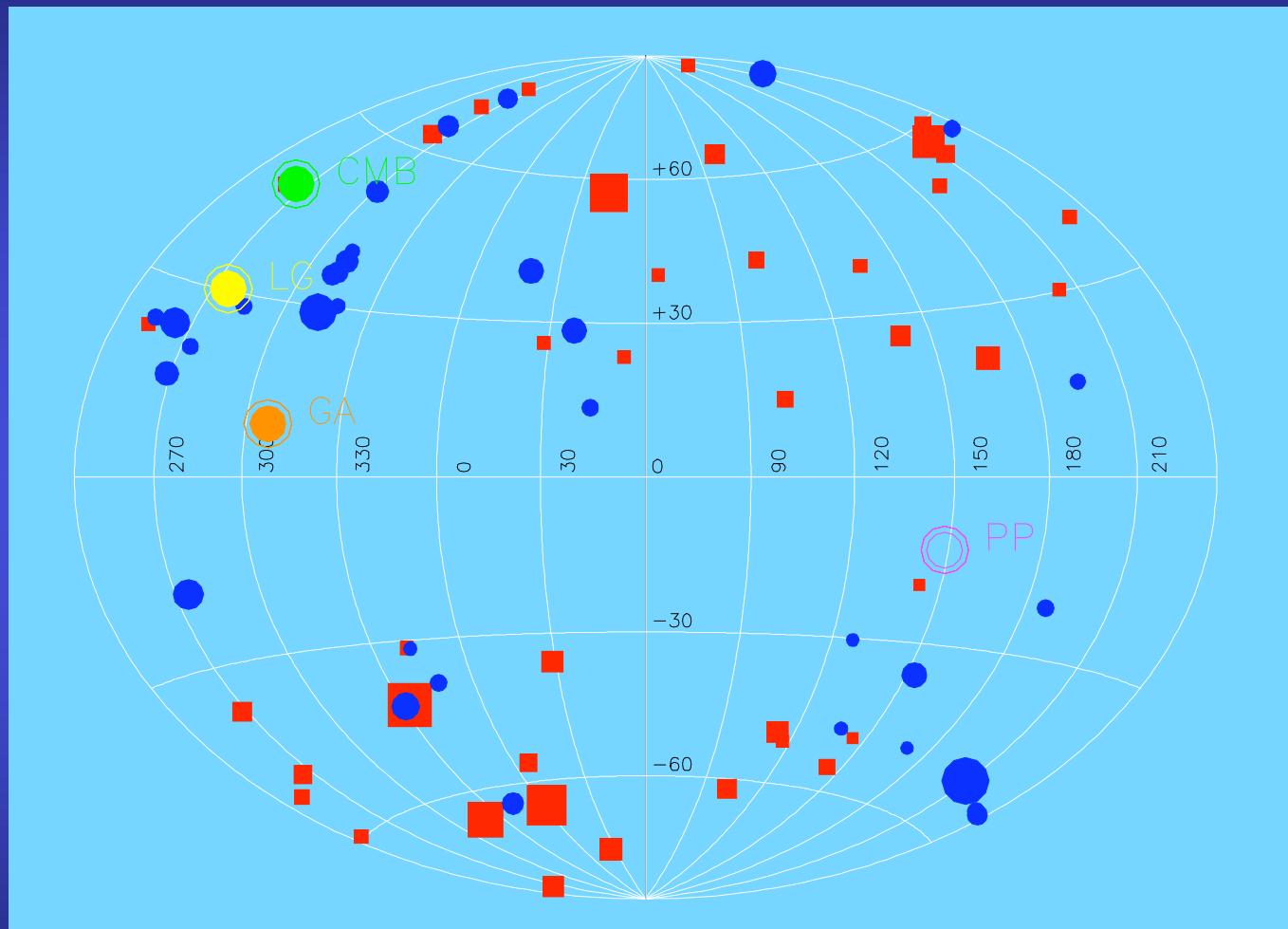
Wang et al. 2003
Wang et al. 2006







Conventional Method



CMAGIC Hubble Diagram Residuals

$$D = f(P(z) | B, B-V, B-R, B-I, \dots, \\ \Delta m_{15}(B), \Delta M_{15}(V), \tau_R, \tau_I, \dots, \\ SiII, FeII, CaII, \dots, \\ m(host), color(host), \dots, \\ \dots)$$

$$P(z) = [p_B, p_{B-V}, \dots, p_{color(host)}, \dots]$$

Summary

There are still a lot of open issues in applying SNIa for precision cosmology. A mathematically robust framework has yet to be constructed to optimize the analysis of the supernova data.

Astronomy on the Antarctic Plateau

L. Wang (Texas A&M)

D. York (U. Chicago), **C. Pennypacker** (U. Berkeley),

M. Swain (JPL), **A. Moore**, **A. Travoullion** (Caltech)

J. Mould (National Optical Astronomical Observatory)

E. Cappellero (Padua, Italy), **G. Niesen** (MPIA Heidelberg)

R. Hammerschlag (Astronomical Inst., Netherland)

R. Malina (Marseille Observatory, France)

J. Yan, L. Feng (Purple Mountain Observatory)

X. Cui, X. Yuan (Nanjing Institute Astronomical Optics Institute)

J. Hu (Beijing Astronomical Observatory)

Y. Li, Z. Zhu (Polar Research Inst. of China)

J. Storey, M. Burton, M. Ashley (UNSW, Australia)

Dome A is the summit of the antarctic icecap

Atlantic Ocean

Indian Ocean

South Pole

Dome A

Dome C

USGS image

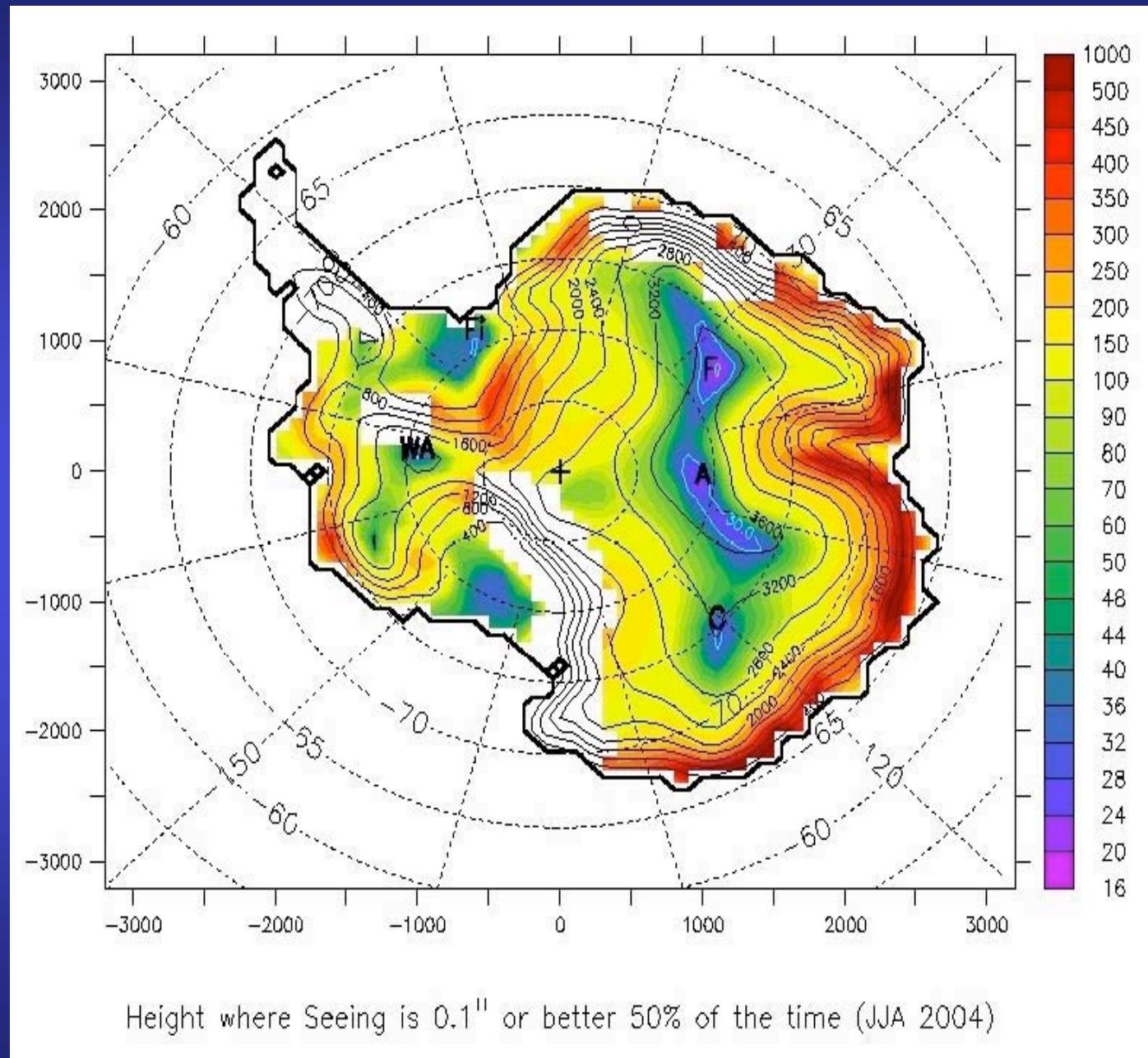
Pacific Ocean

0

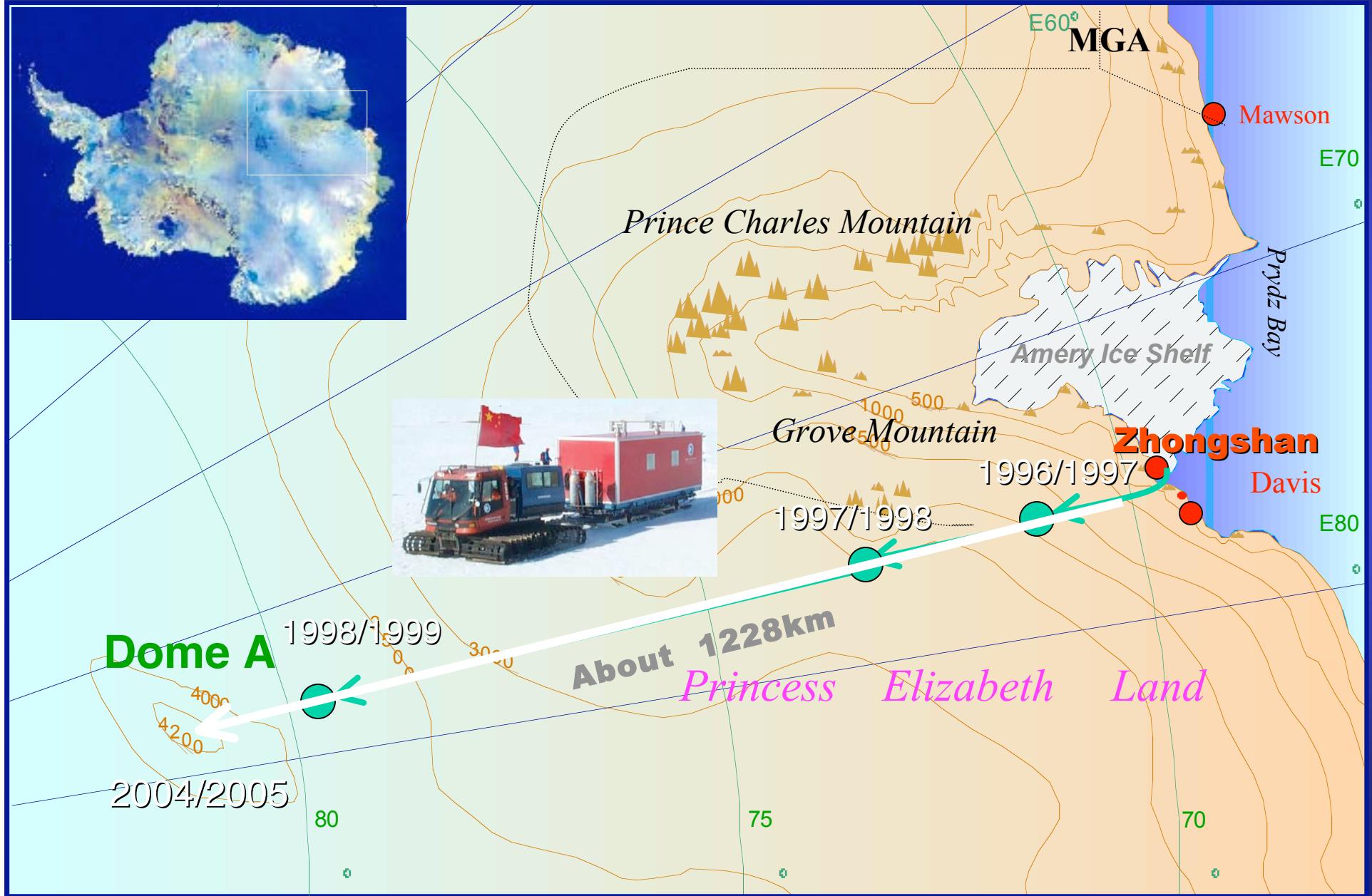
Elevation in meters

4000





East Antarctic Glaciological Exploration (EAGLE)



2007/2008 and 2008/2009 season:

Traverses from Zhongshan to Dome A

About 8 snow mobiles every time, can take about 700 tons.

Set up a 100 m² building at Dome A.

Install several Astronomy instruments at Dome A.

About 2010 :

Upgrade the Dome A station for winter-over



4-meter telescope

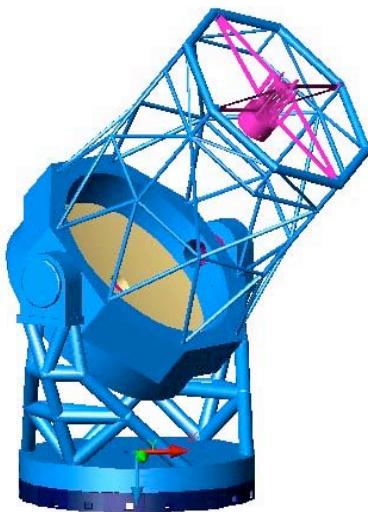
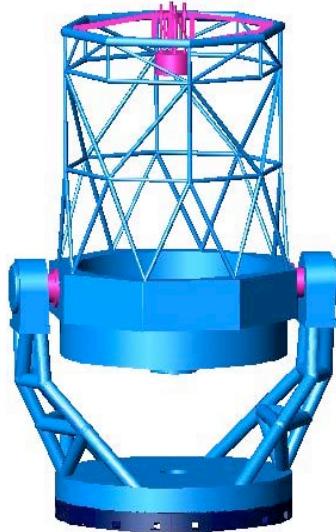


Figure 4 (b) 4m telescope

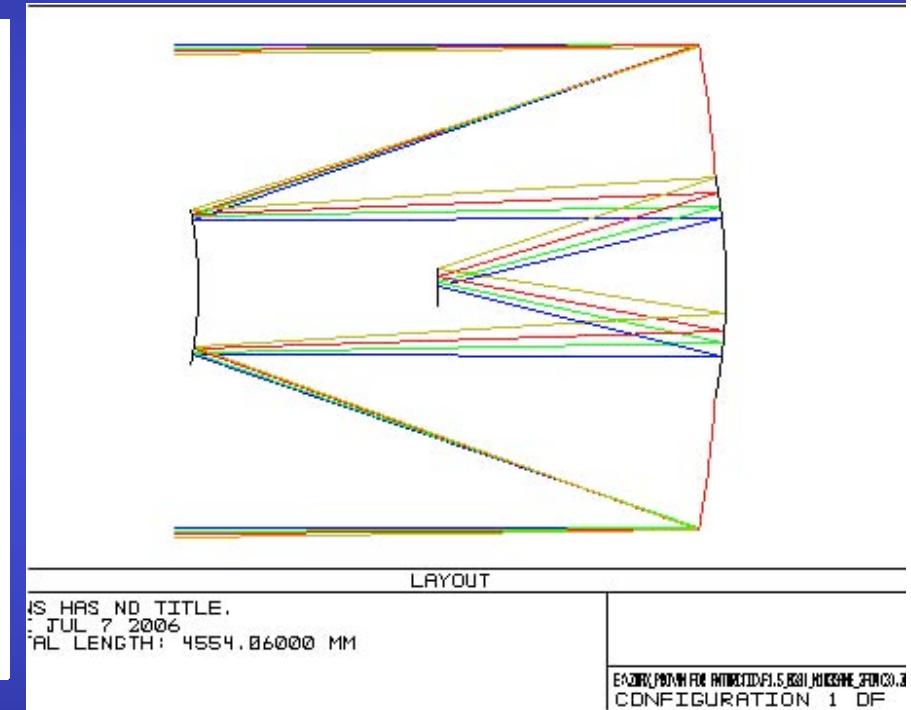




Fig. 4. Dutch Open Telescope (DOT) tower on La Palma:
a) *left*: summer: tent dome open for solar observations; b) *right*: winter: tent dome closed, ice in ladder/elevator framework

(a)

