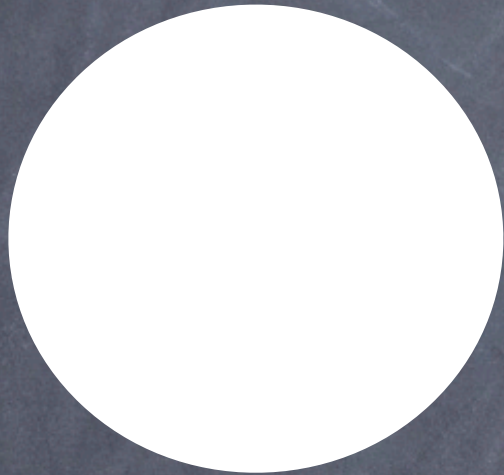


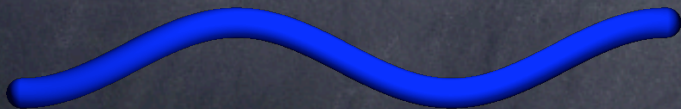
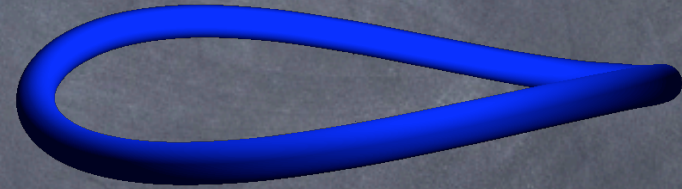
Chapter 14: String Theory

Spin 0, 1, 2

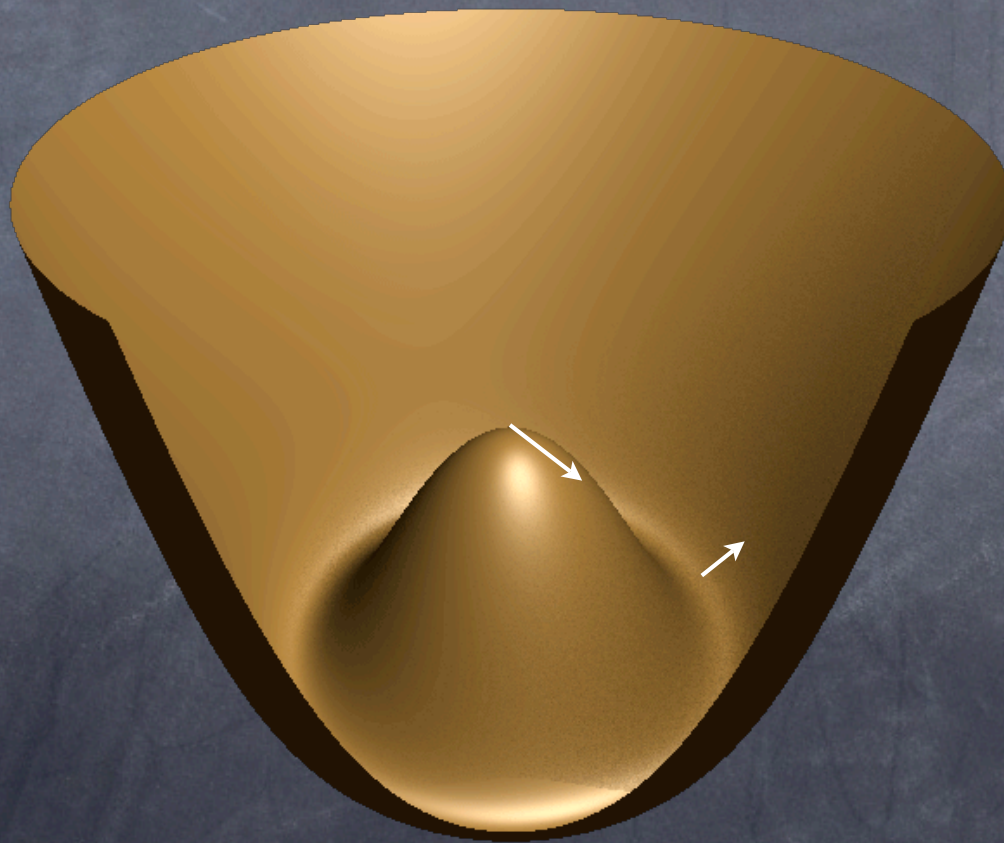


eg. Higgs boson, photon, graviton

Open and Closed Strings



Tachyons



Supersymmetry+Strings

Superstrings

no tachyons

spin $0, \frac{1}{2}, 1, \frac{3}{2}, 2$

Green and Schwarz

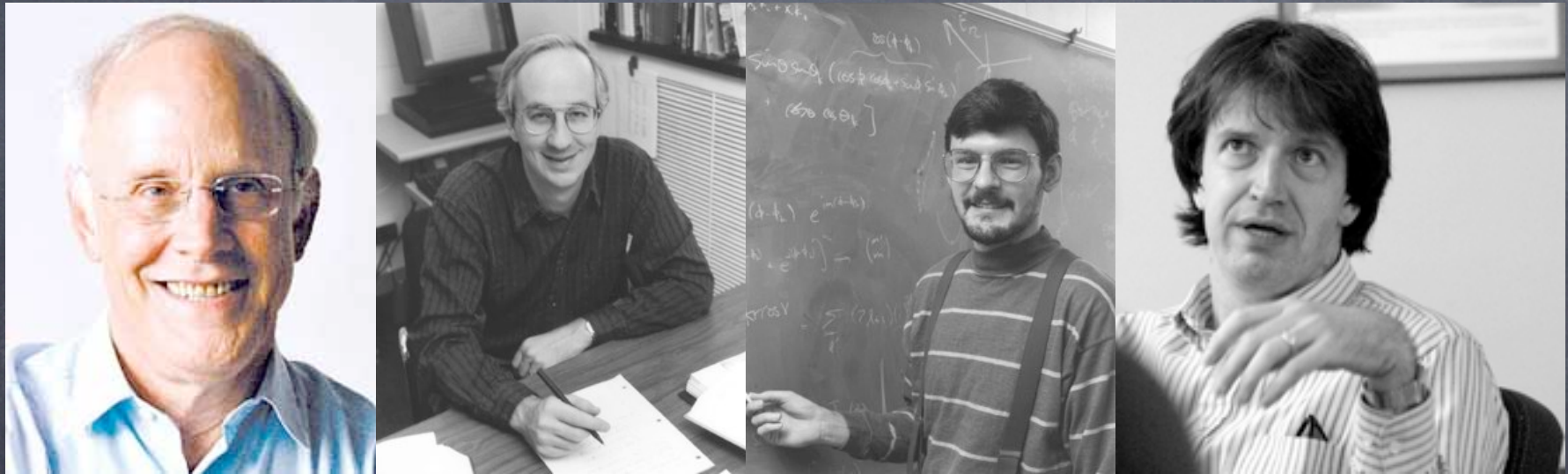


need 10 dimensions

Type I, Type IIA, Type IIB

Gross, Harvey, Martinec, Rohm

Princeton String Quartet



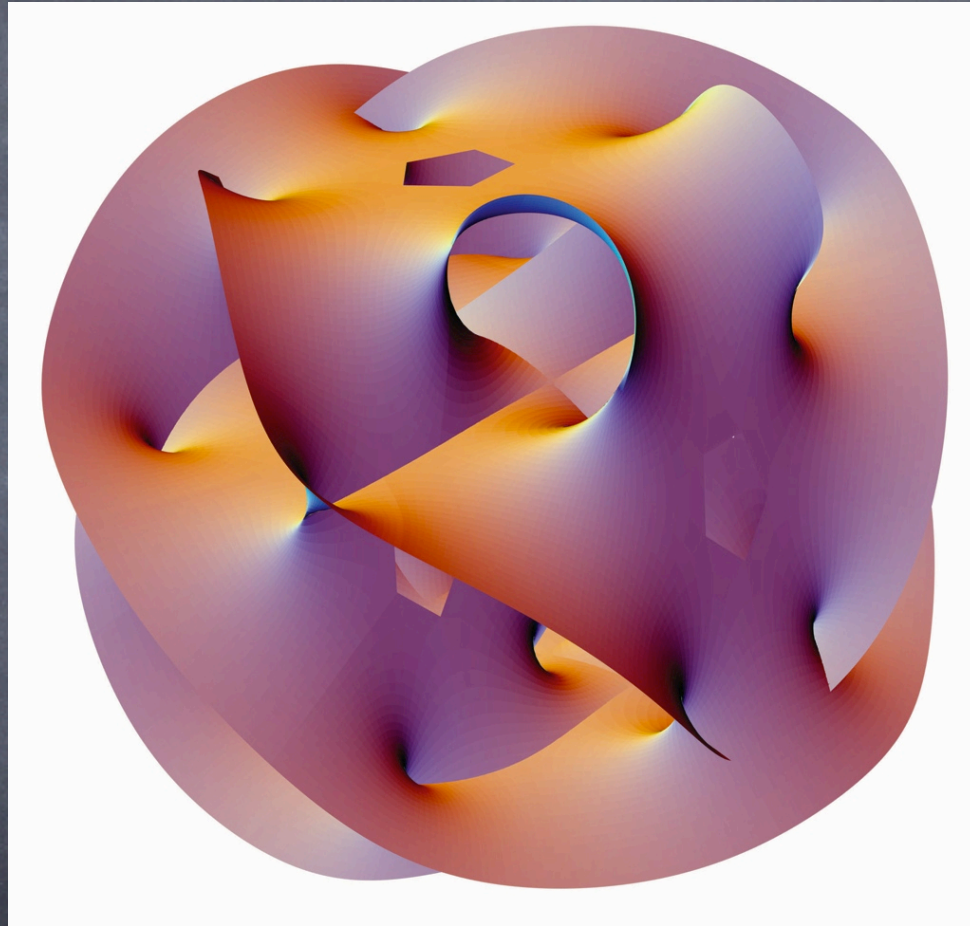
“heterotic” string

Candelas, Horowitz, Strominger, Witten



Hide Extra Dimensions in
Calabi-Yau

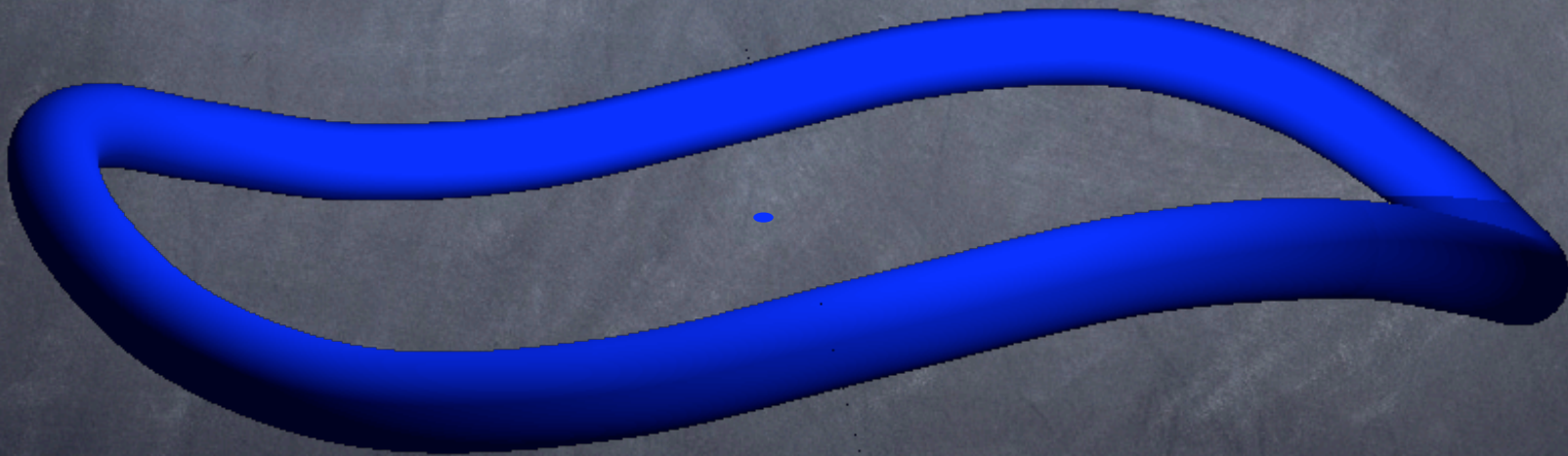
Calabi-Yau



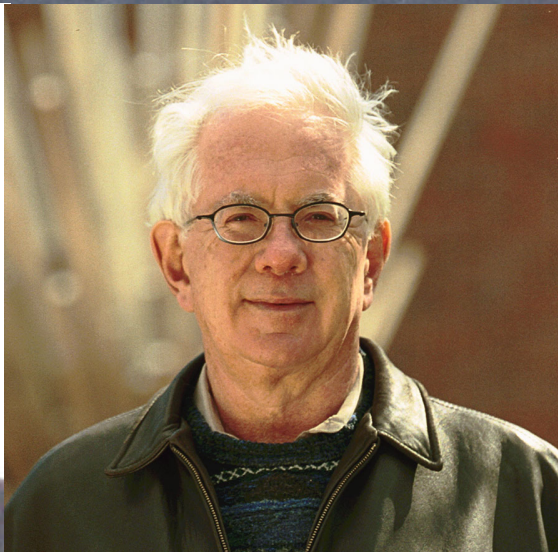
distinguishes left and right handed fermions
without destroying SUSY

Effective Theory

Planck Length: 10^{-33} cm



Harvard vs Princeton



opposing camps 1984-1997

Too many String Theories

10^{500} possibilities

which one is right?

and what about the
vacuum energy?

Edwin Hubble

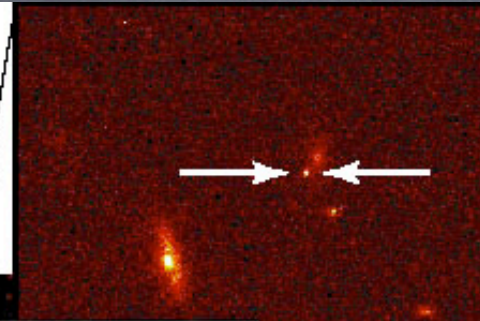


Universe is expanding

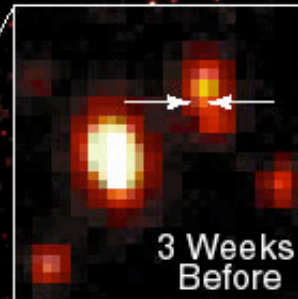
Supernova Cosmology



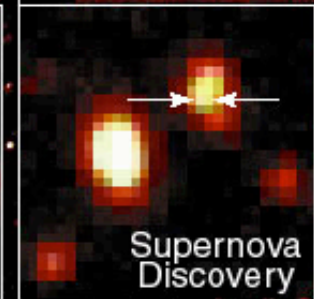
Supernova 1998ba
Supernova Cosmology Project
(Perlmutter, *et al.*, 1998)



(as seen from
Hubble Space
Telescope)

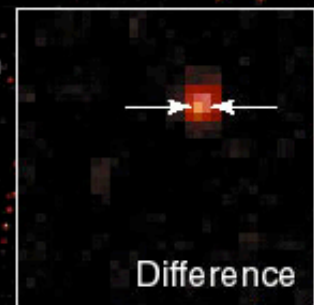


3 Weeks
Before

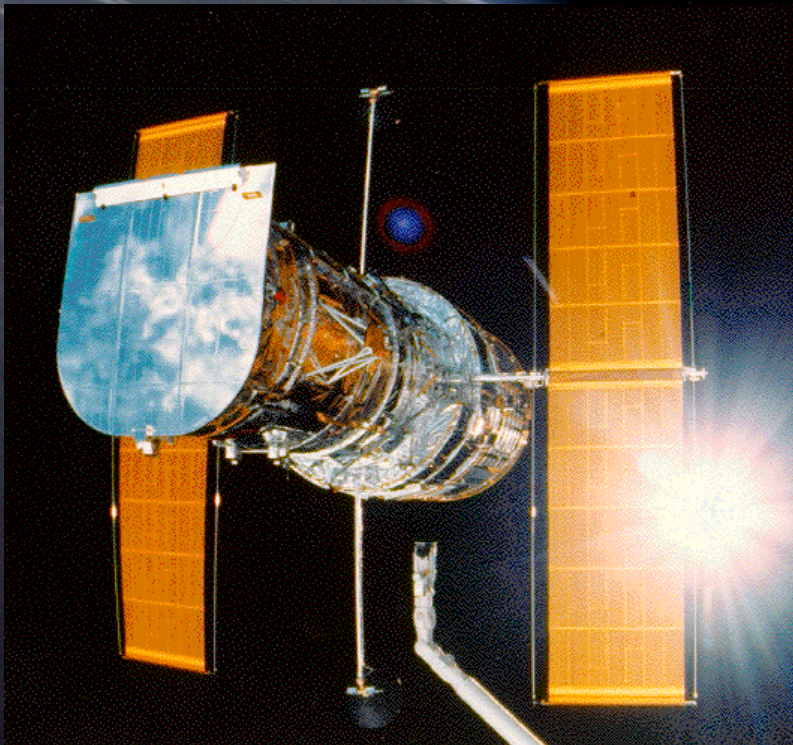


Supernova
Discovery

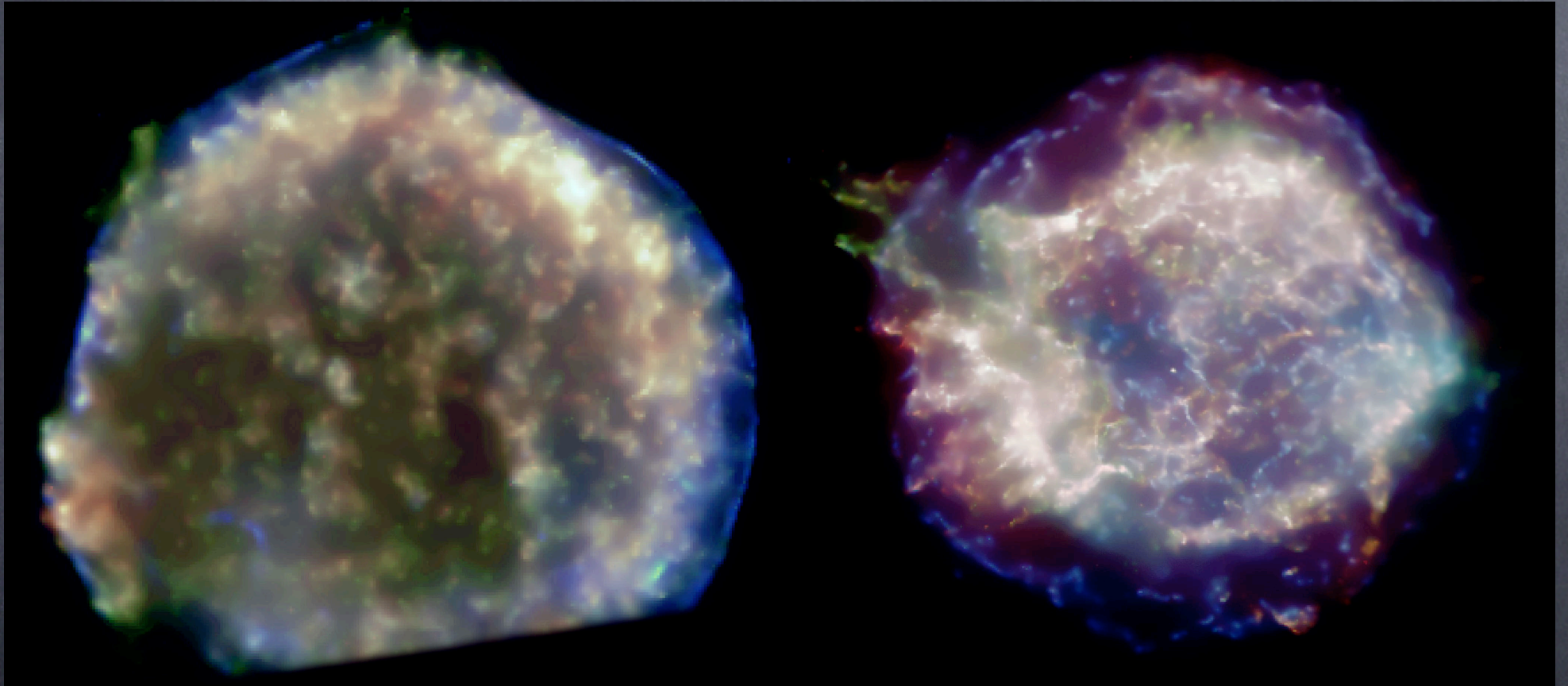
(as seen from
telescopes
on Earth)



Difference



Type I and Type II

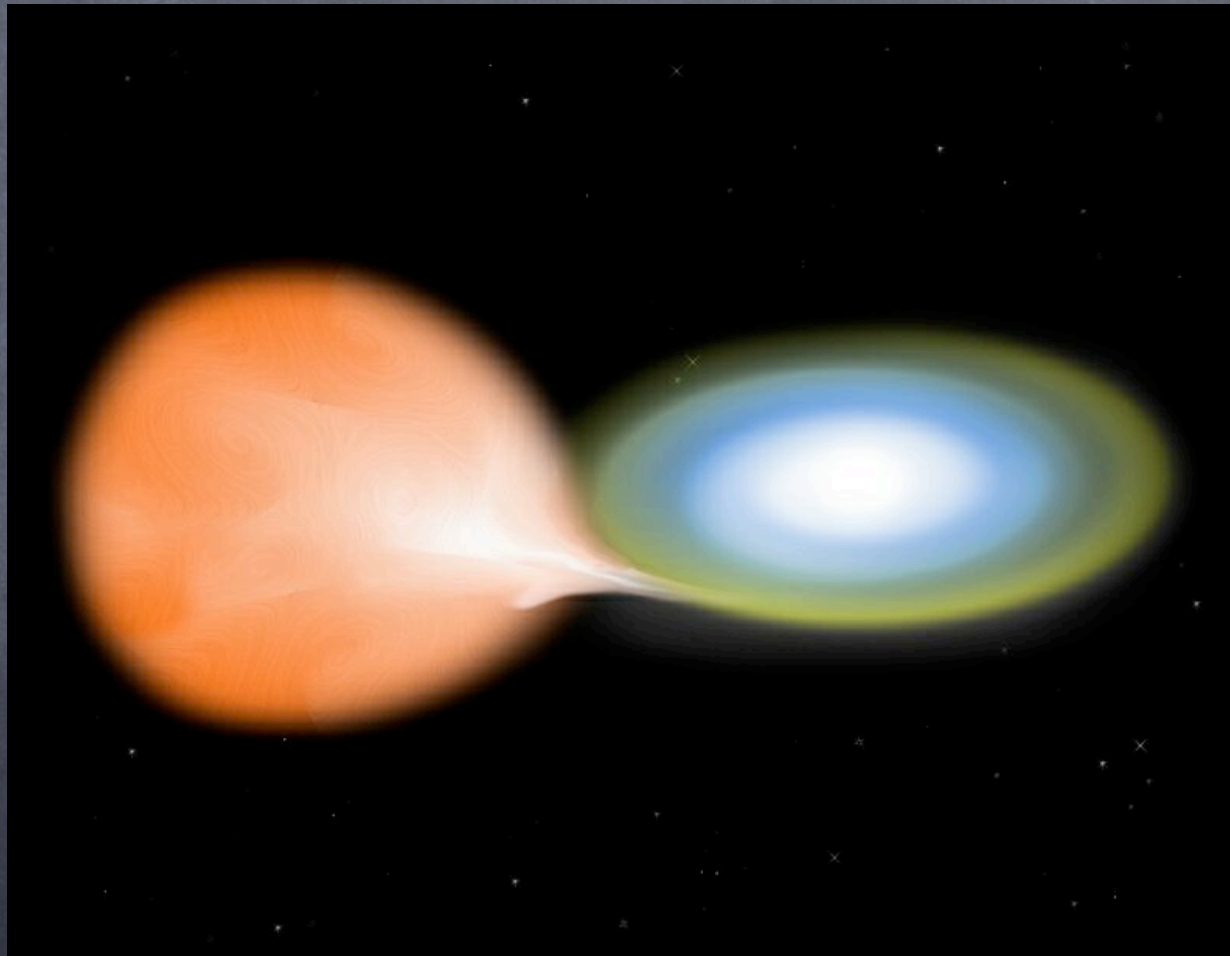


SN1572 "Tycho"

Cassiopeia A

Chandra X-Ray Observatory

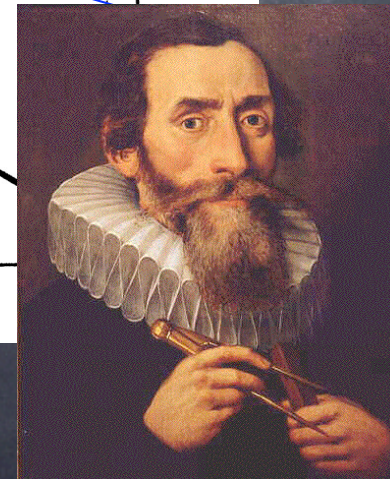
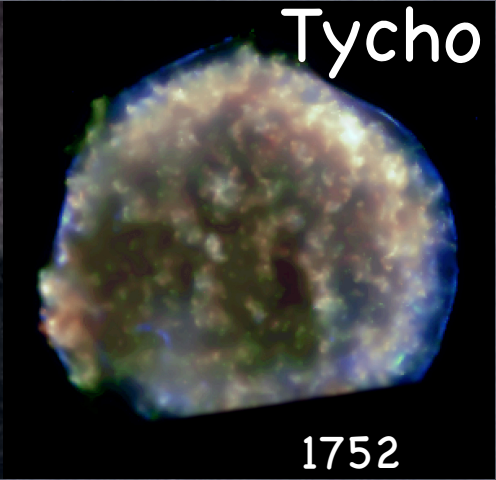
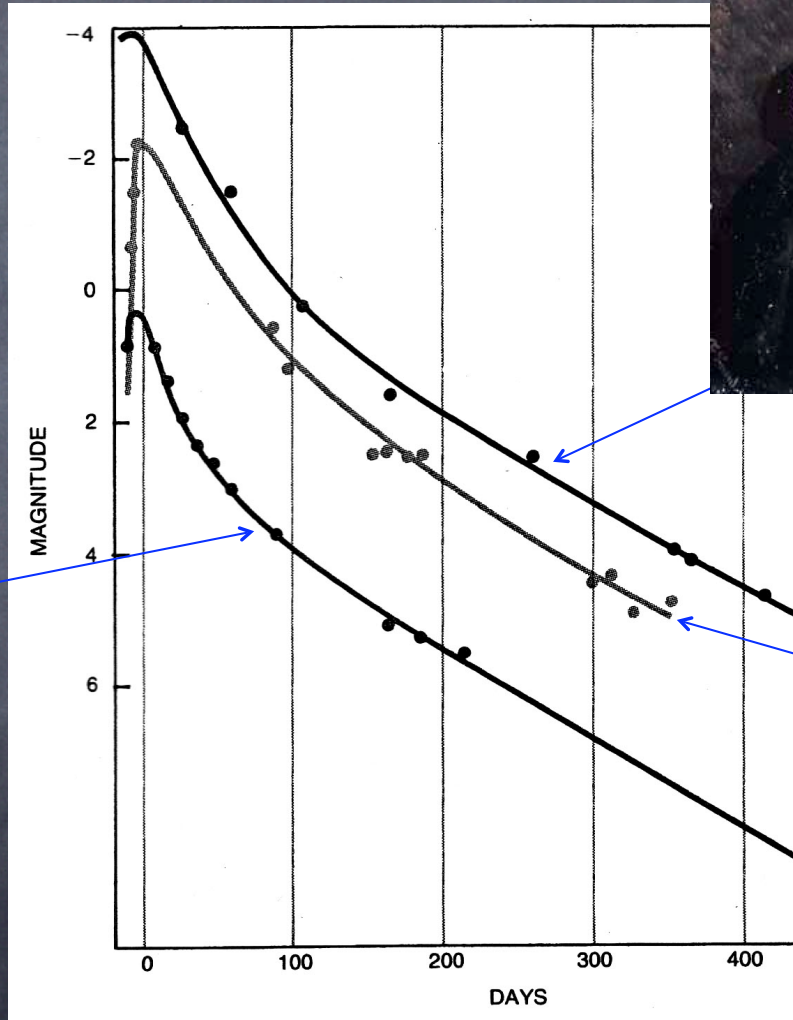
Type Ia Supernova: Accretion on a White Dwarf



M. Weiss, CXC, NASA

Type Ia SN Light Curve

SN 1937C
in IC 4182

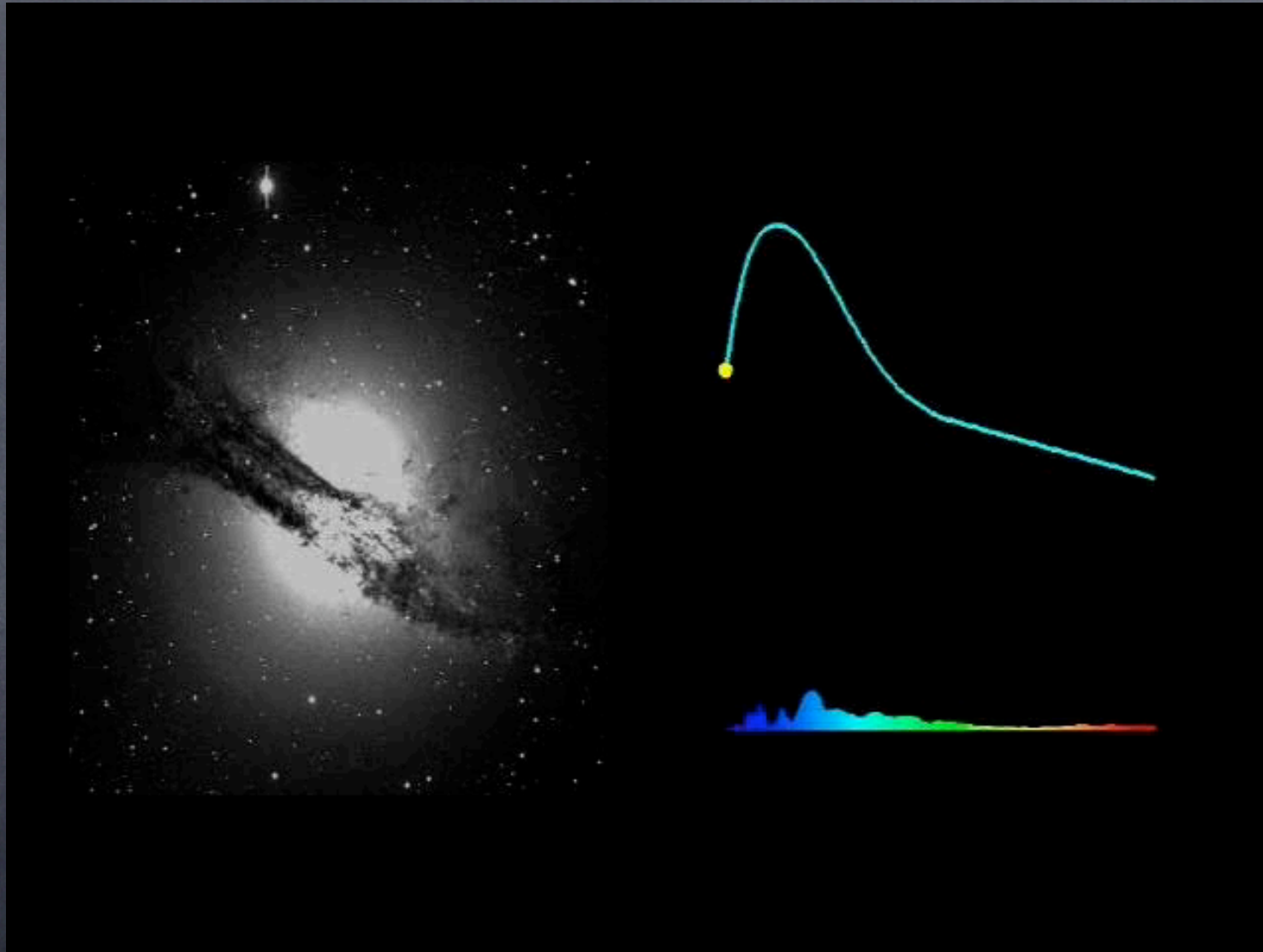


SN 1937C



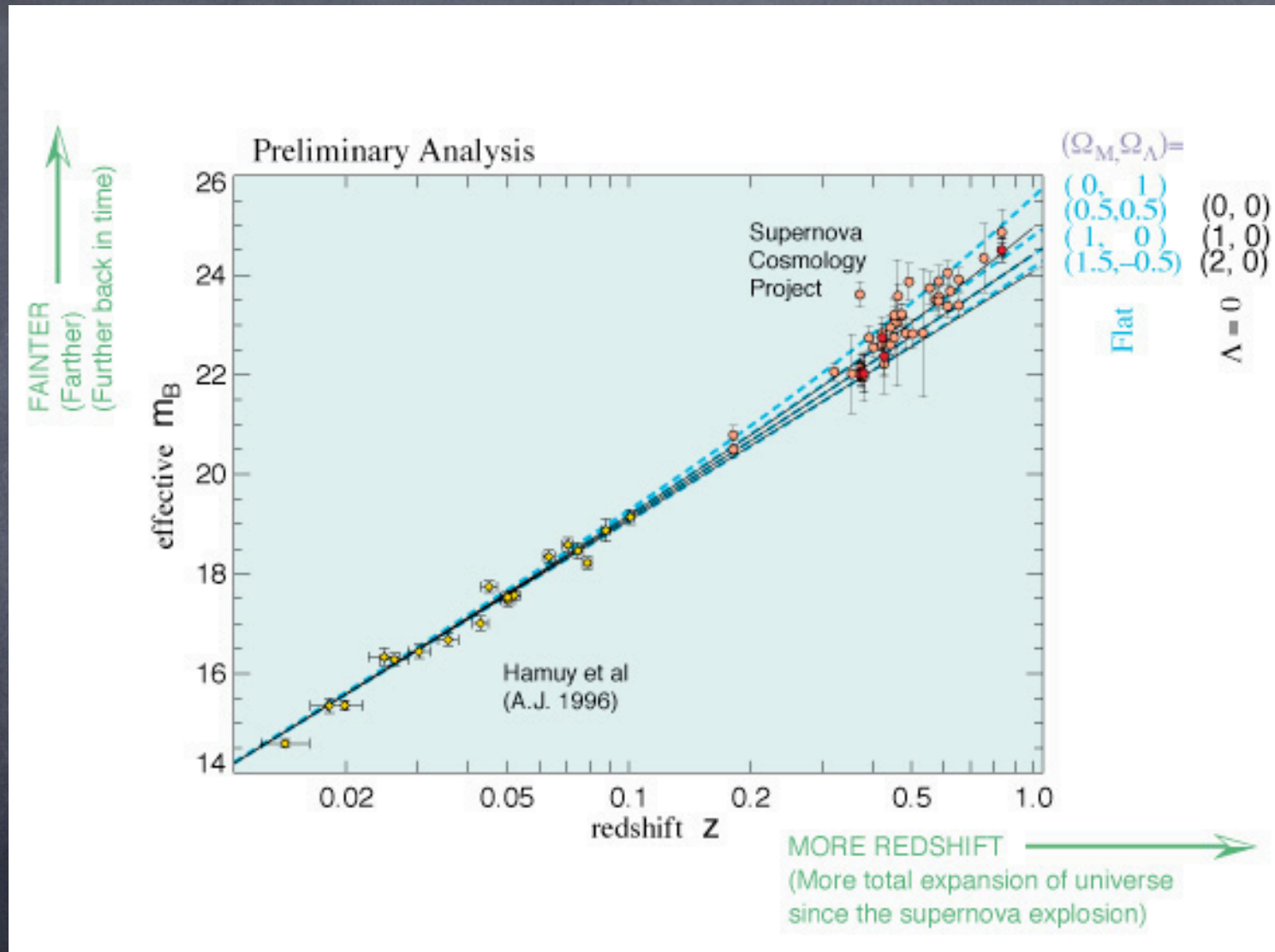
Baade & Zwicky, Ap.J. 88 (1938) 411,
courtesy G. Jacoby NOAO

Centarus A Light Curve



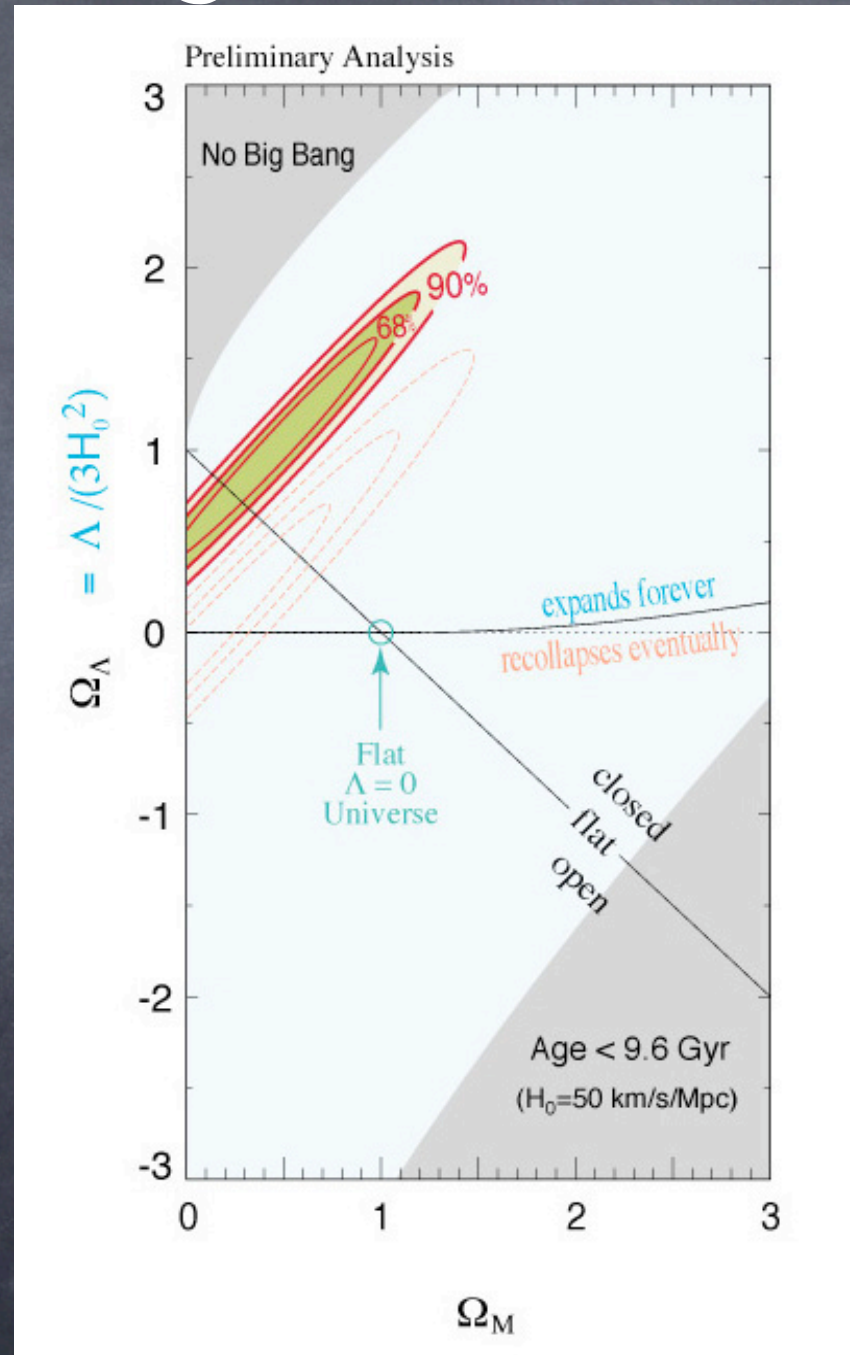
SN 1986G in Centarus A, from SCP LBL

Hubble Expansion



Expansion is accelerating

"Cosmological Constant" Λ



"Cosmological Constant"

$$\frac{\Lambda}{M_{Pl}^2} \approx 10^{-120}$$

$$\frac{\Lambda}{1 \text{ TeV}^2} \approx 10^{-60}$$

Susskind and the Landscape

