

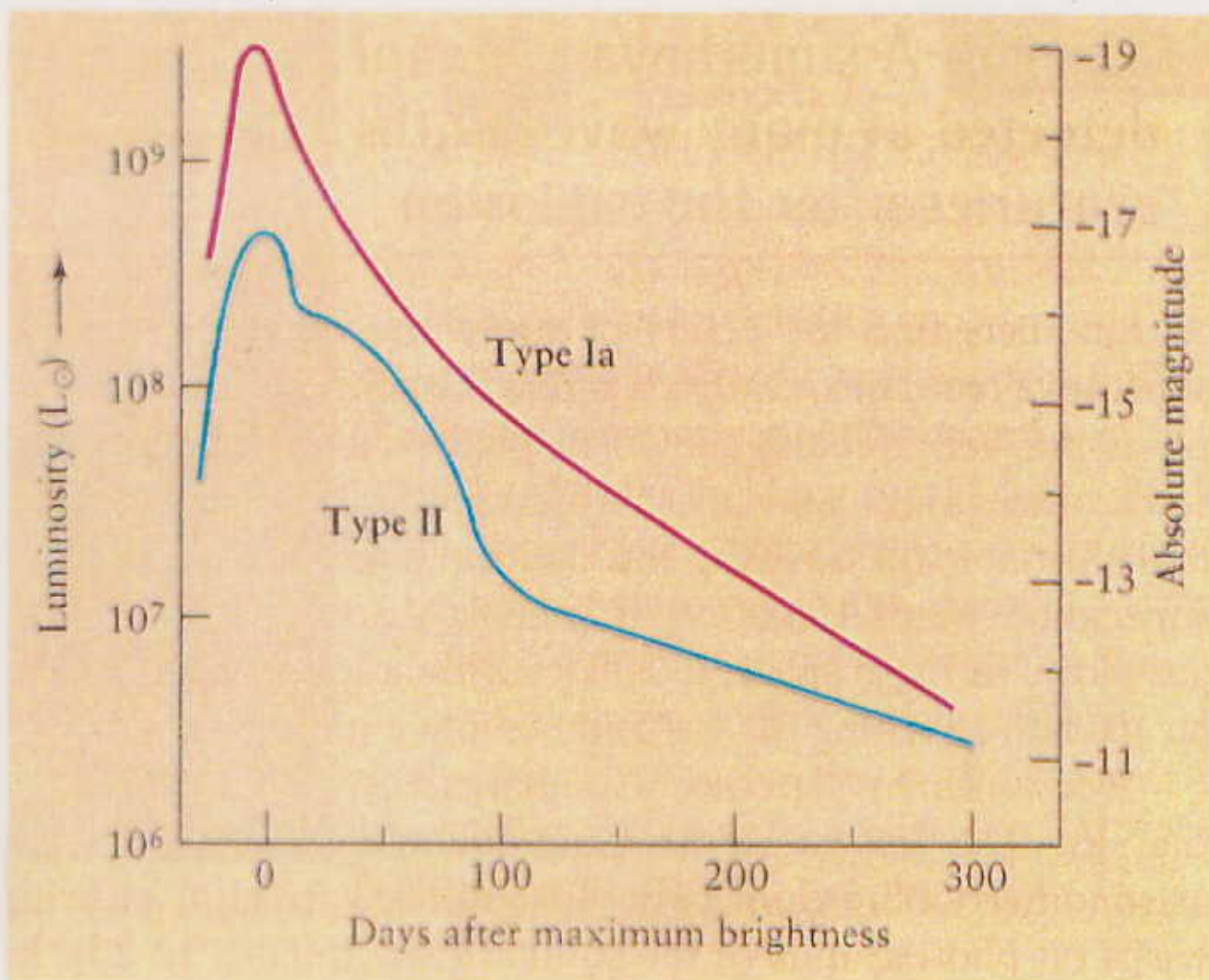
Physical Sciences 120  
Winter 2005

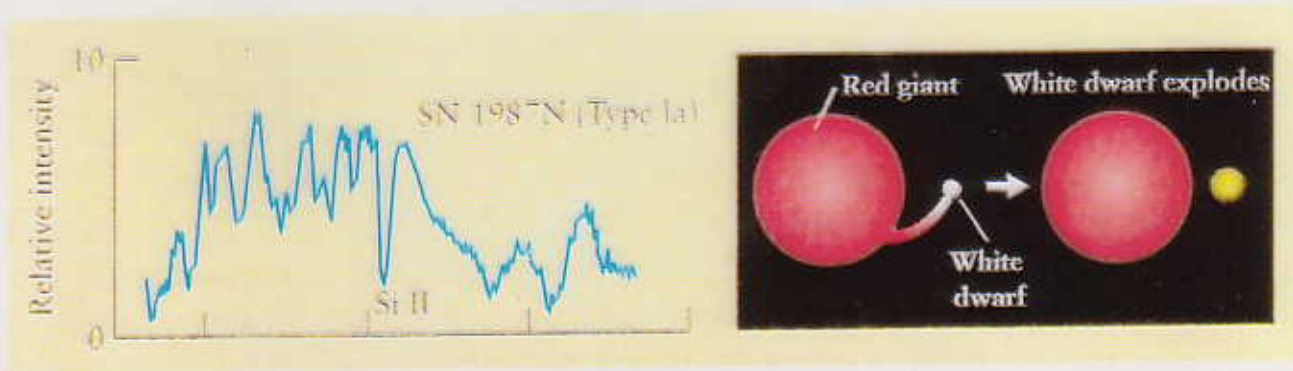
*Origin of the Universe,  
and How We Know*

Don Q. Lamb

Lecture 20

**TYPE Ib/c  
SUPERNOVAE**

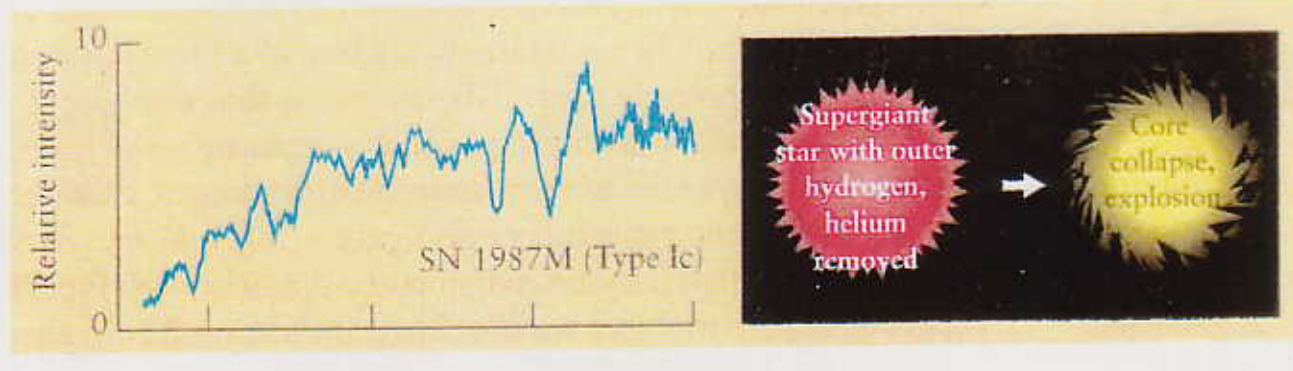




a



b



c



d

PHY. SCI. 120  
Spring Quarter 2004

TABLE  
Properties of Supernovae

Property	Type Ia	Type Ib	Type Ic	Type II
Energy Source	Nuclear	Gravity	Gravity	Gravity
Total Energy (ergs)	$3 \times 10^{51}$	$3 \times 10^{53}$	$3 \times 10^{53}$	$3 \times 10^{53}$
Fraction of Energy in $\nu$ 's	$\approx 0$	$\approx 0.1$	$\approx 0.1$	0.99
Fraction of Energy in KE	$\approx 1$	$\approx 1$	$\approx 1$	$10^{-2}$
Fraction of Energy in Light	$3 \times 10^{-3}$	$3 \times 10^{-3}$	$3 \times 10^{-3}$	$3 \times 10^{-3}$
H in Spectrum (Yes/No)	No	No	No	Yes
He in Spectrum (Yes/No)	No	Yes	No	Yes
Si in Spectrum (Yes/No)	Yes	No	No	No
Progenitor Star	White Dwarf	$20 - 60 M_{\odot}$ Star	$20 - 60 M_{\odot}$ Star	$10 - 60 M_{\odot}$ Star
Remnant	None	Black Hole	Black Hole	Neutron Star or Black Hole



**M74 - Digital Sky Survey  
1990**



**Mt. Hopkins 1.2m - SN 2002ap  
Jan 31, 2002**

