


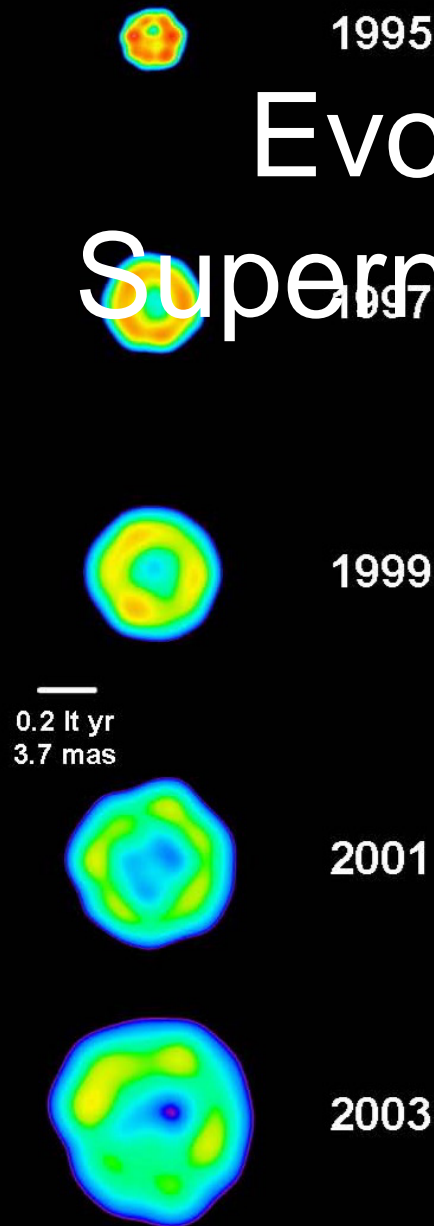
The Future of Radio Supernova Observations



Chris Stockdale
Marquette University

K.W. Weiler (NRL), R.A. Sramek (NRAO), J.M. Marcaide
(Valencia), N. Panagia (STScI), S.D. Van Dyk (Spitzer)

Evolution of Historical Supernovae using the VLBA

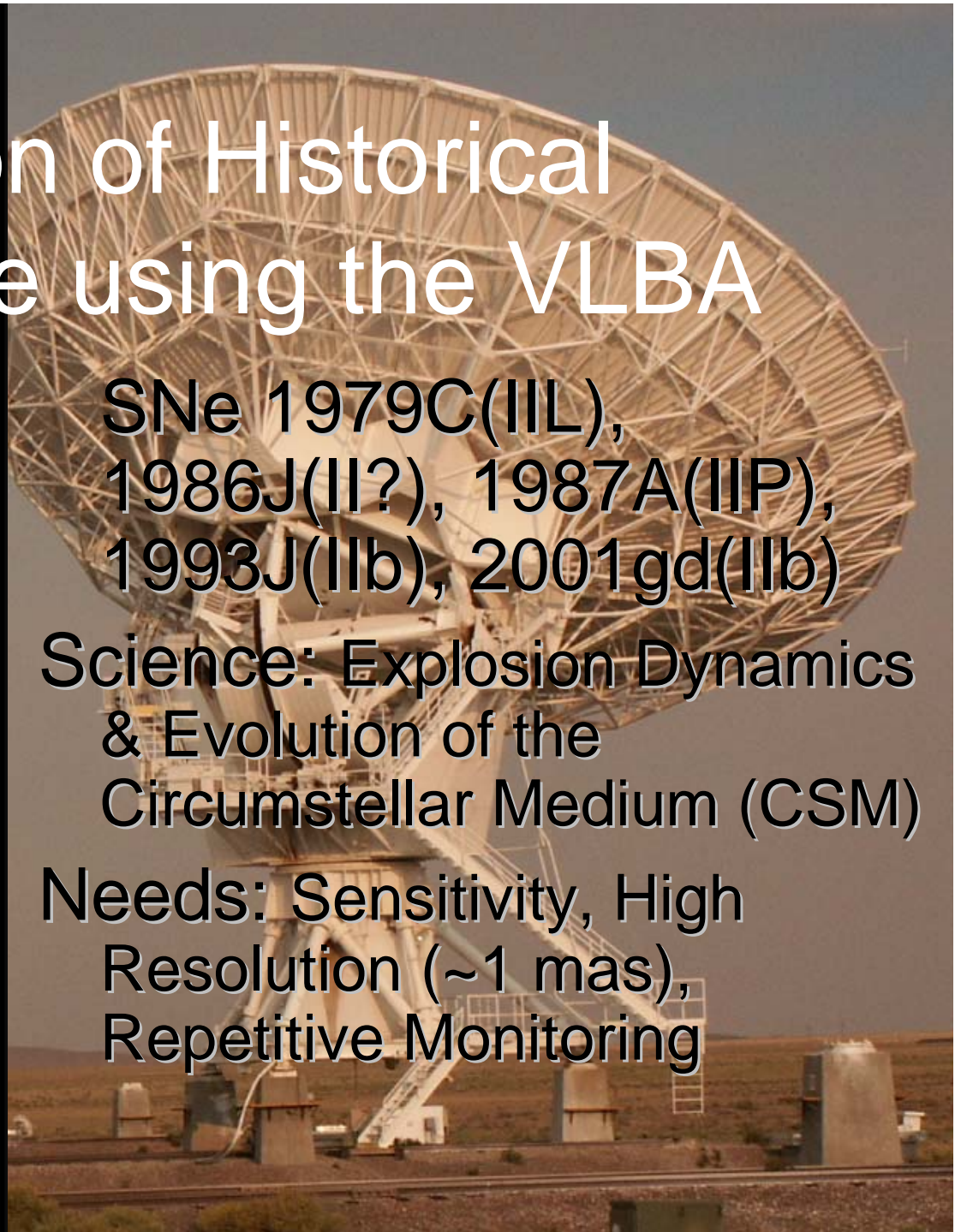


A Decade of Expansion of SN 1993J

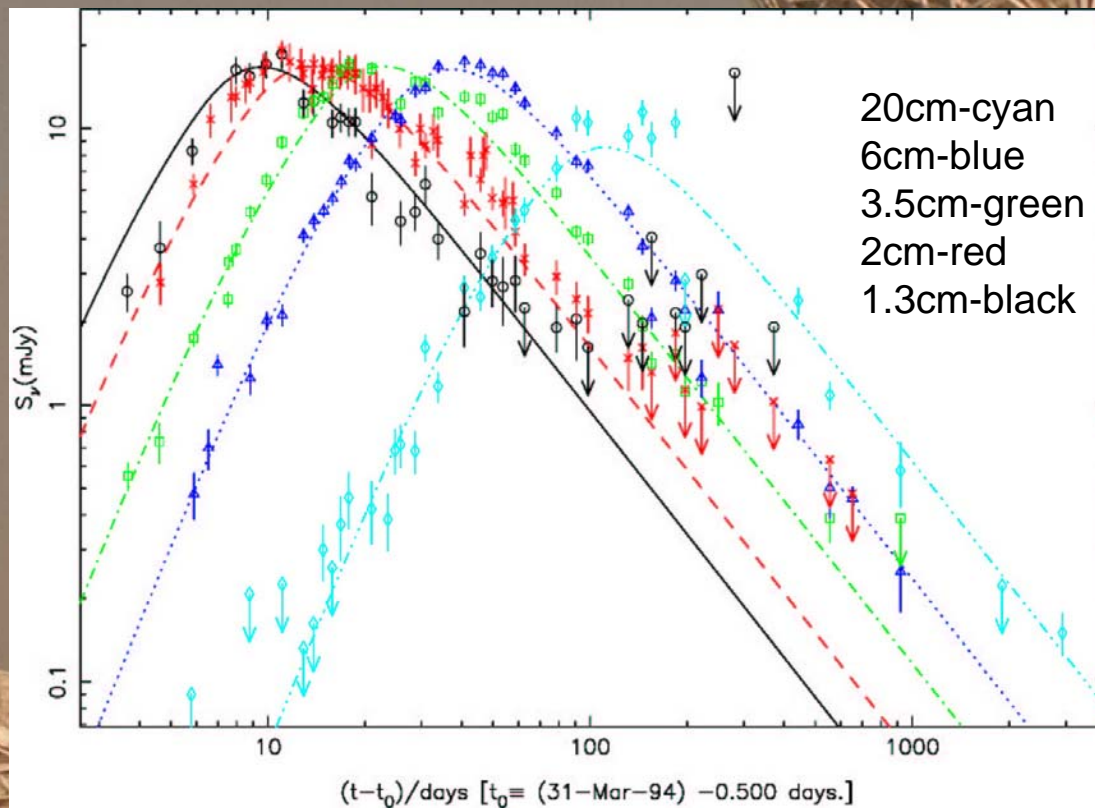
SNe 1979C(IIL),
1986J(II?), 1987A(IIP),
1993J(IIb), 2001gd(IIb)

Science: Explosion Dynamics
& Evolution of the
Circumstellar Medium (CSM)

Needs: Sensitivity, High
Resolution (~ 1 mas),
Repetitive Monitoring



Early Density Structure of the CSM & Absorption Mechanisms

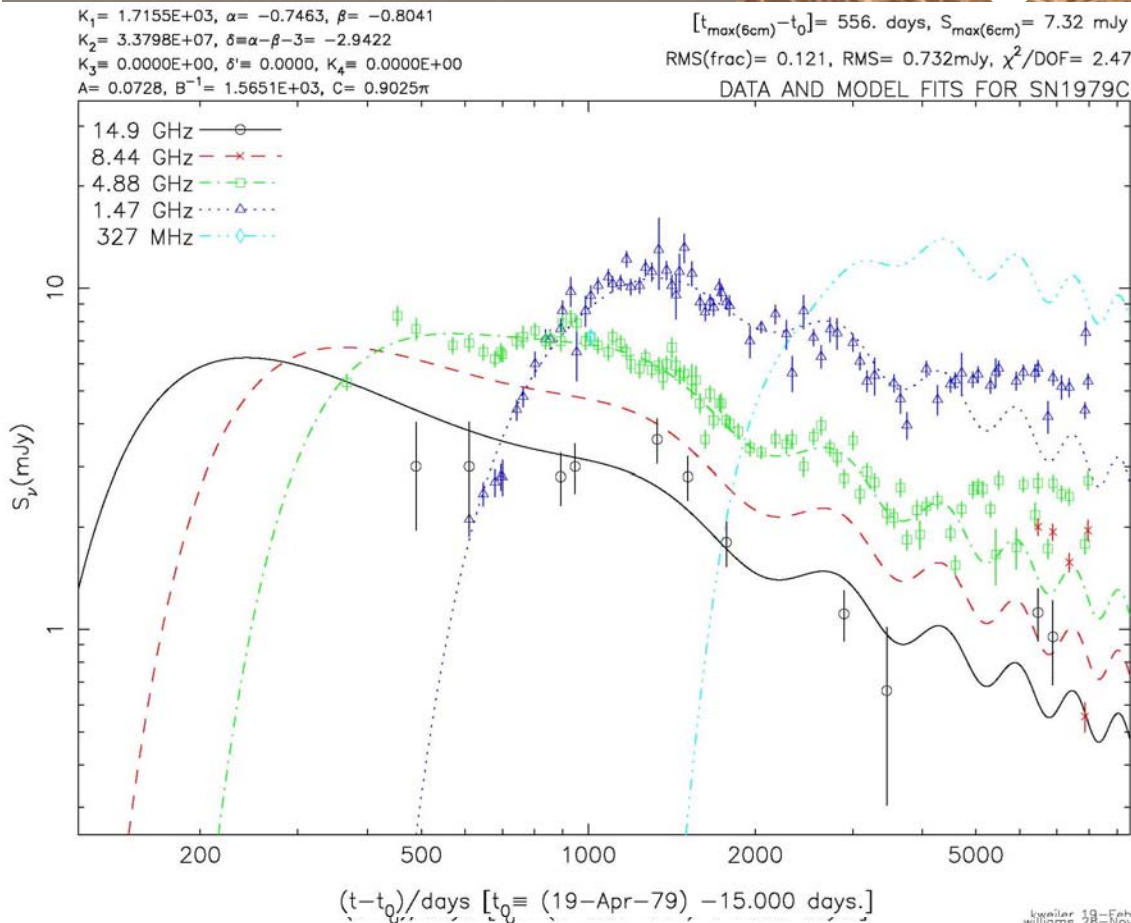


SN 1994I - type Ic
Synchrotron Self
Absorption

Science: Progenitor
Mass-Loss Rates &
Evolution of the
Circumstellar Medium
(CSM)

Needs: Sensitivity, $\sim 1''$
Resolution, Repetitive
Monitoring, Rapid
Response, Multi-
Spectral

Late Density Structure of the CSM & Final Stage of Progenitor



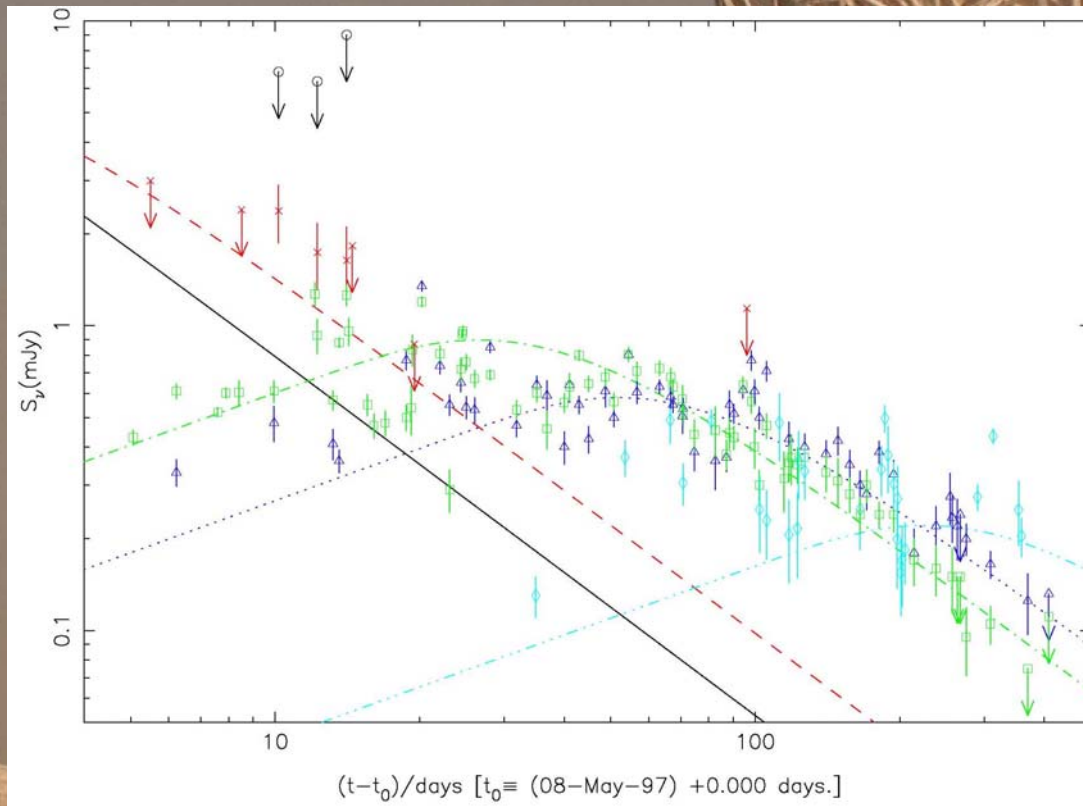
SN 1979-type II
(Montes et al. 2000)

SN 2001gd-type IIb
(Stockdale et al. 2003)

Science: Binary
Systems, Progenitor
Mass & Mass-Loss
Evolution

Needs: Sensitivity, $\sim 1''$
Resolution, Repetitive
Monitoring, Long-Term
Monitoring, Multi-
spectral

Interstellar Scintillation

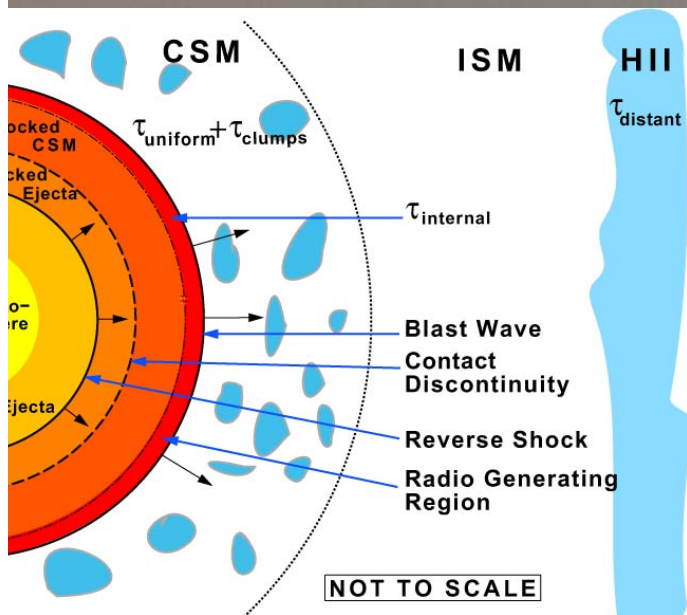


GRB970508
(Waxman Kulkarni & Frail 1998)

Science: Determine Size of Emitting Region

**Needs: Sensitivity, $\sim 1''$
Resolution, Repetitive Monitoring, Rapid Response, Multi-spectral**

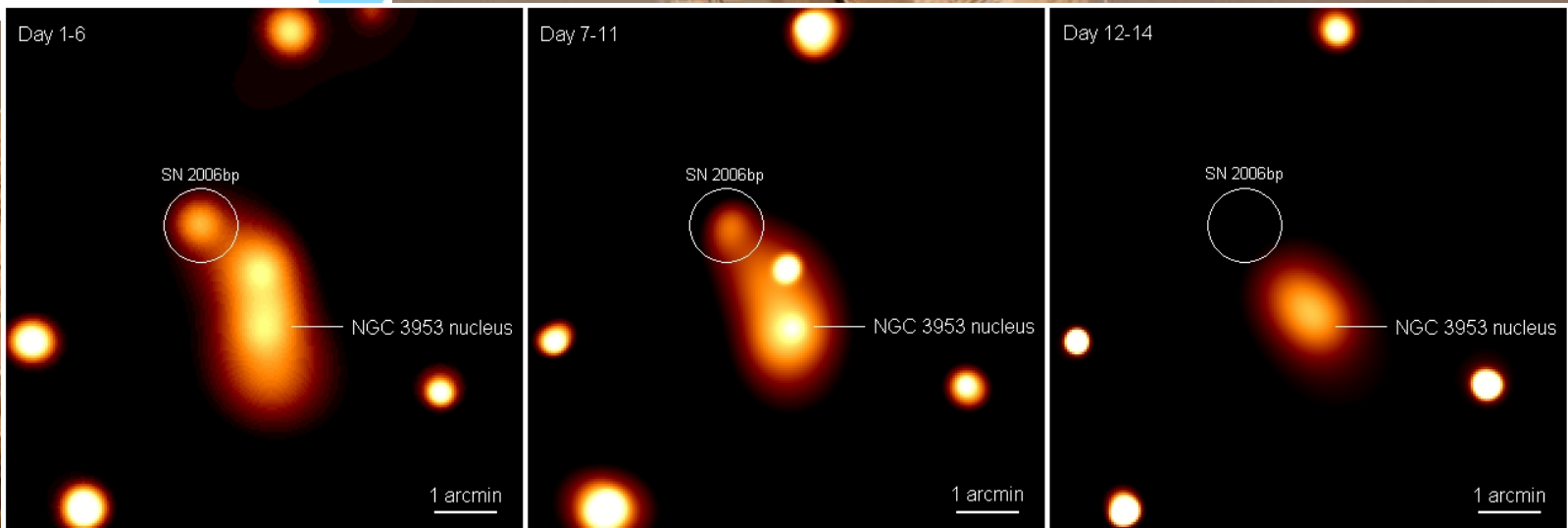
X-Ray/Radio Connection



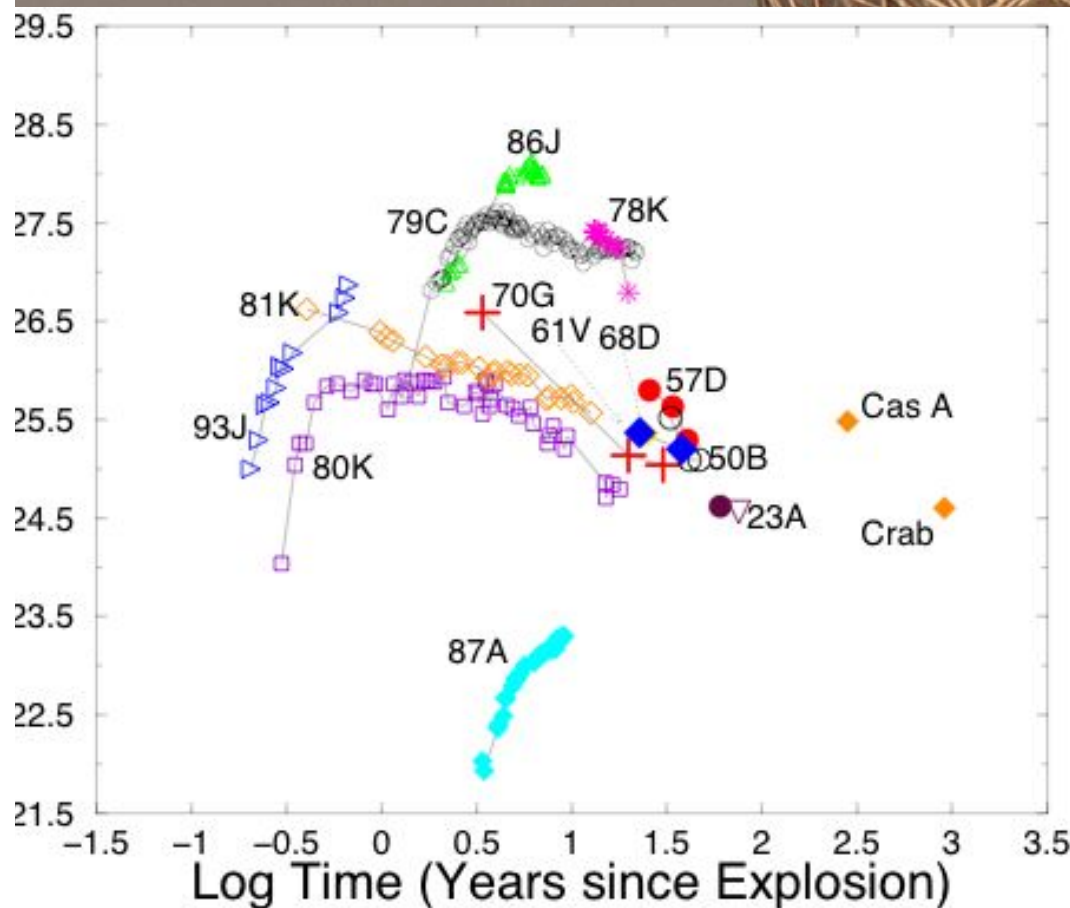
SN 2006bp-type II (Immler et al. & Kelley et al. 2006)

Science: Determine Nature of X-Ray Emission Mechanisms

Needs: Sensitivity, $\sim 1''$ Resolution, Rapid Response, Multi-spectral



Supernova to Supernova Remnant



SNe 1923A(II),
1950B(II), and
1957D(II) in M83
(Stockdale et al. 2006)

Science: Chart the
Evolution as the
Blastwave Transitions
from Interaction with
CSM to ISM

Needs:

Improved Sensitivity,
~1" Resolution,
Long-Term Monitoring,
Multi-spectral

Supernova-GRB Connection

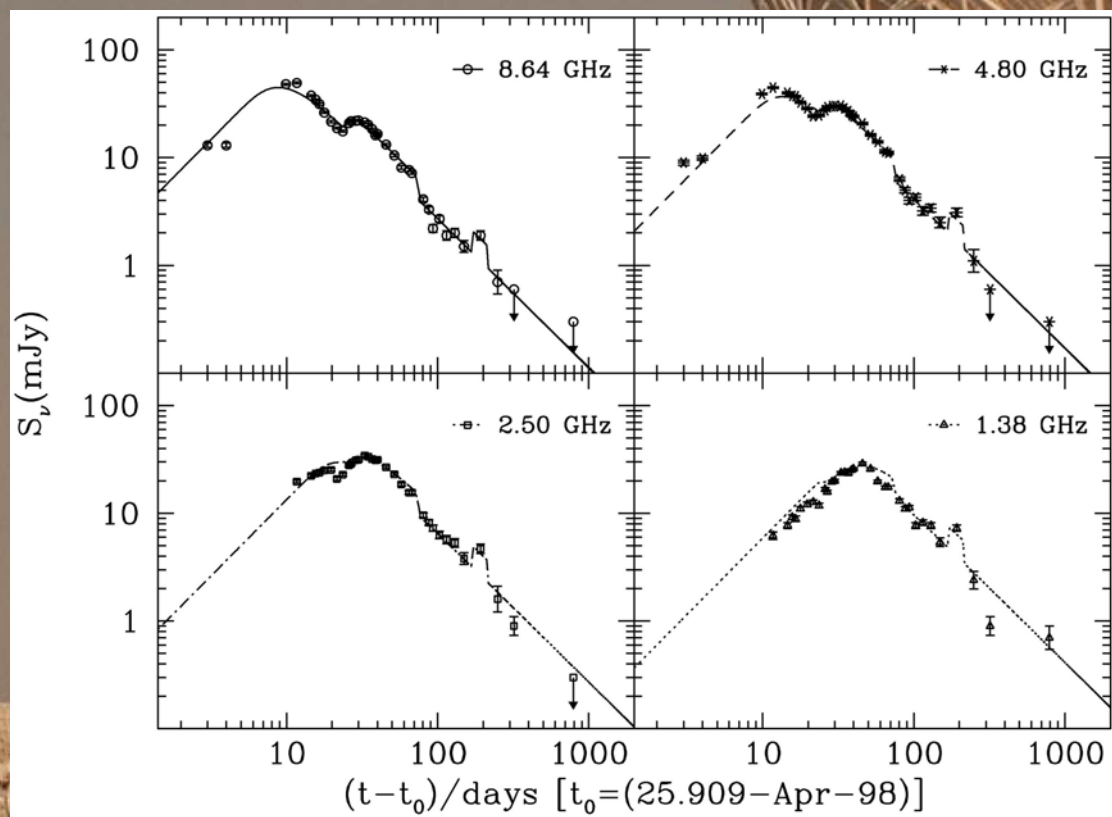
SN 1998bw-type Ic
(Weiler Panagia &
Montes 2001)

Science:

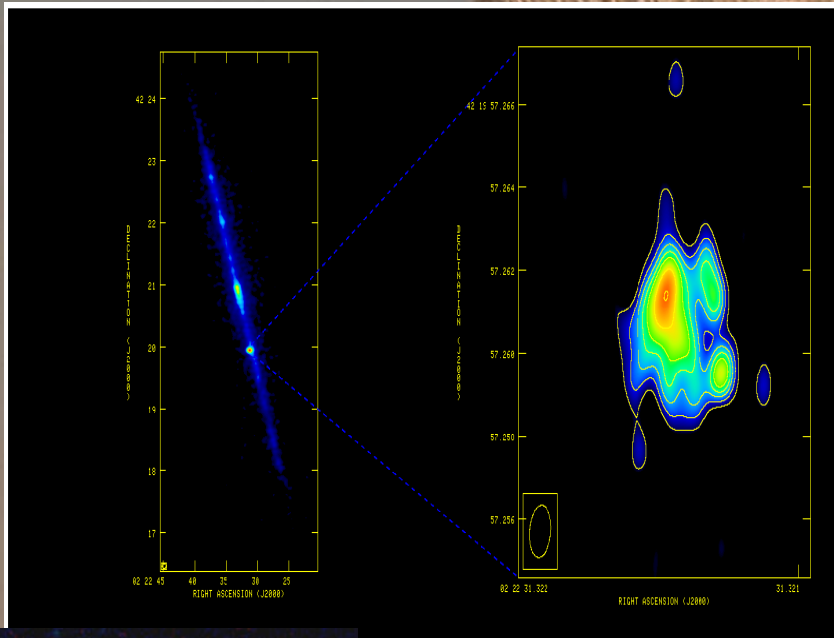
Long Bursts: SN Ib/c –
CSM Structure &
Evolution

Short Bursts: SN Ia??? –
Progenitor & CSM
Evolution

Needs: Improved
Sensitivity, $\sim 1''$ Res.,
Repetitive Monitoring,
Very Rapid Response,
Multi-spectral



Hidden Supernovae

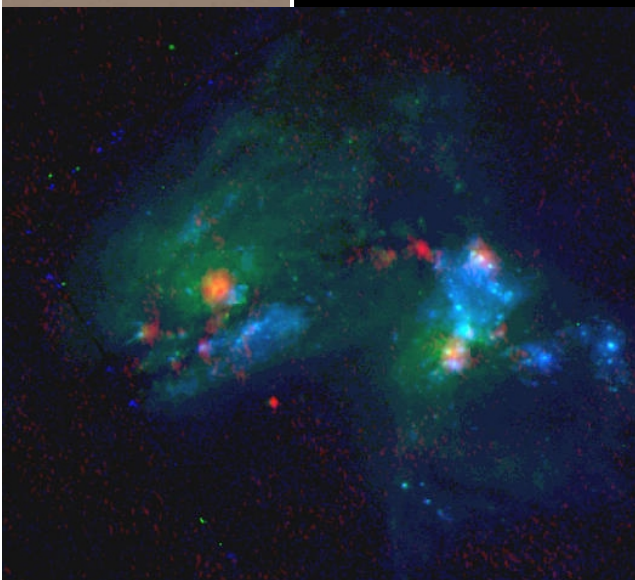


SN 1986J (II)
(Bietenholz, Bartel, & Rupen 2002)

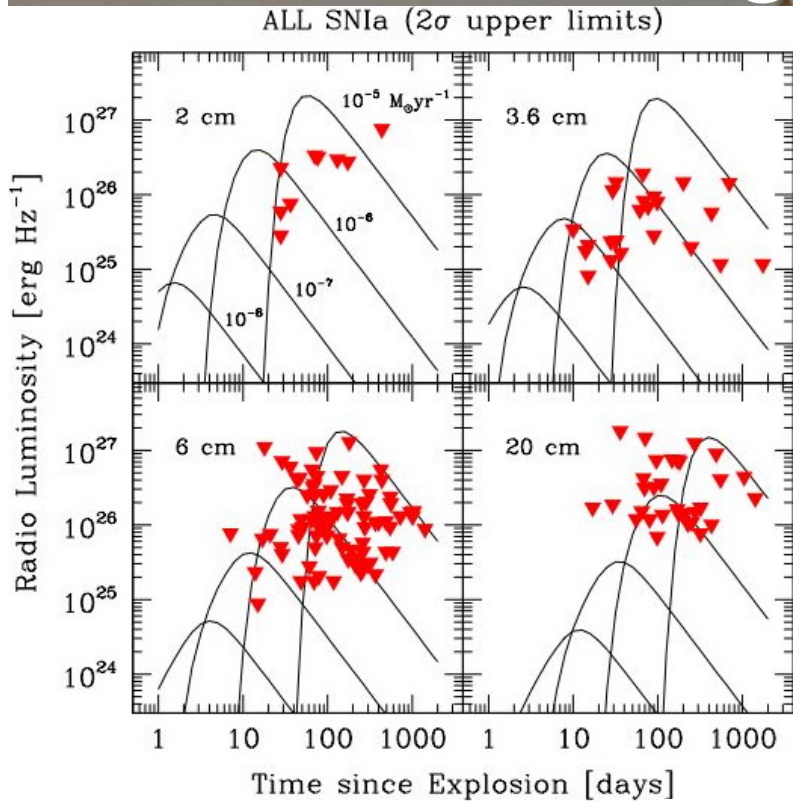
Arp 299
(Neff, Ulvestad, & Teng 2004)

Science: Star Forming Rates & Neutron Star Formation

Needs: Sensitivity,
1mas -1" Resolution,
Repetitive Monitoring,
Multi-spectral, Pipeline
Mapping/Survey
Capability



Cosmology Supernovae Ia

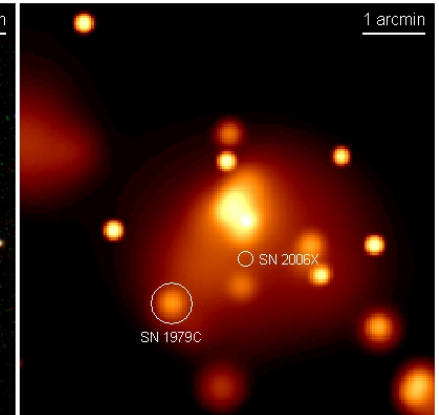
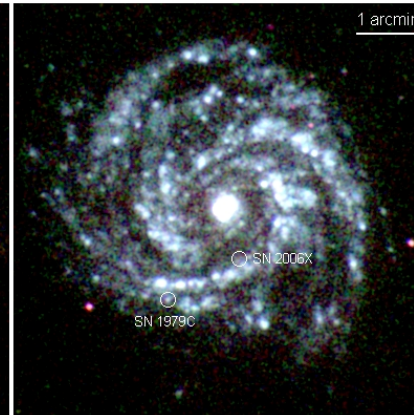
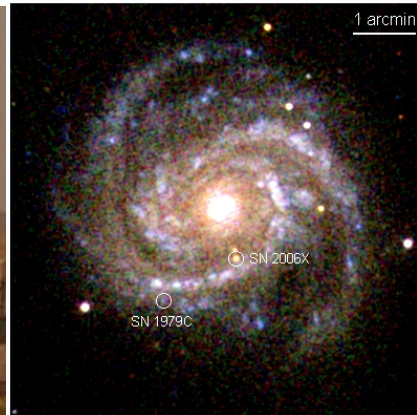


Radio Search for Supernovae Ia
(Panagia et al. 2006)

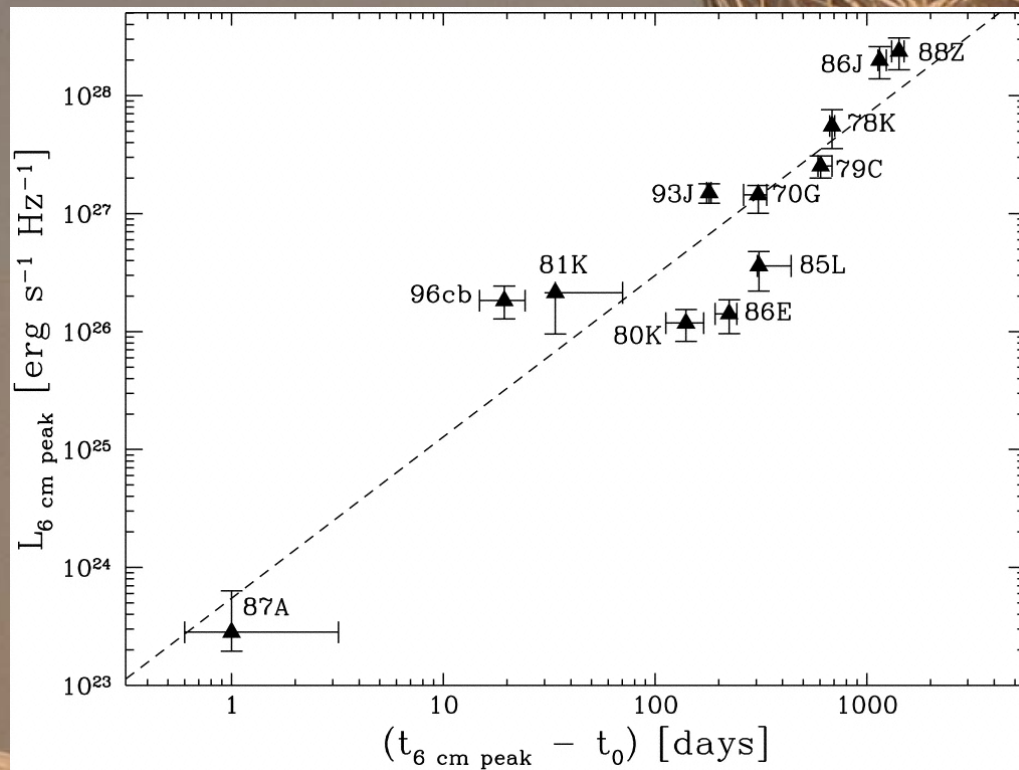
SN 2006X (Stockdale & Immler et al. 2006)

Science: Determine Nature of Progenitor, Mass Loss Rates, & Evolution

Needs: High Sensitivity, $\sim 1''$ Resolution, Very Rapid Response



Cosmology & Supernovae II



Luminosity - Time to Peak Relation
(Weiler et al. 1998)

Science: Standard Distance Candle

Needs: Sensitivity, $\sim 1''$
Resolution, Repetitive Monitoring

The Future Needs

Improved Sensitivity

1" Resolution Always Available

Improved Frequency Coverage

Rapid ToO Response

Early, Repetitive Monitoring

Long-Term Monitoring

Search Capability

Automated, Rapid Mapping

(and a Galactic SN during my lifetime, please!)

