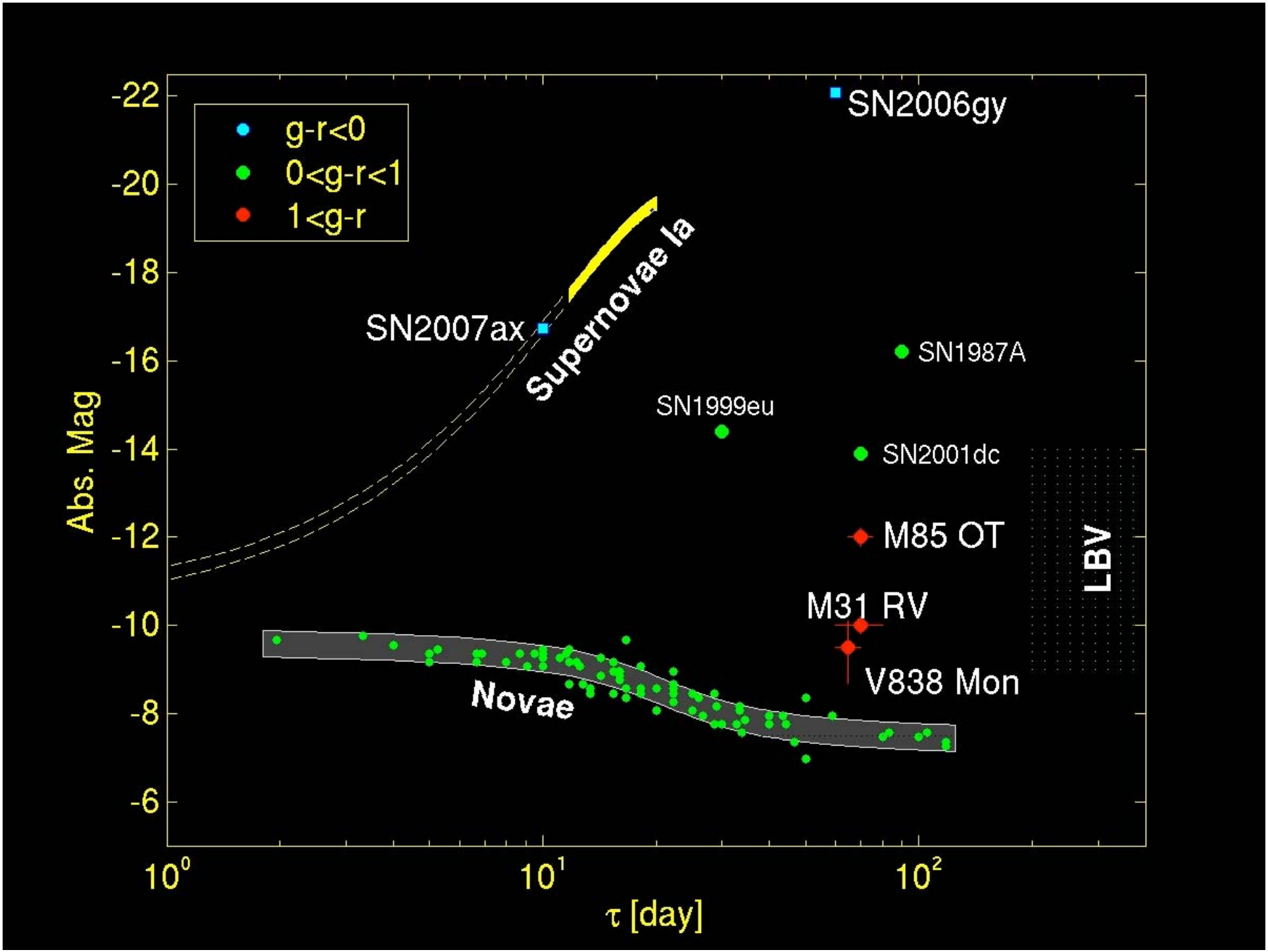
In Search of Extragalactic Transients: Palomar Transient Factory & P60-FasTING

Mansi Kasliwal

KITP Seminar Presentation

December 12, 2007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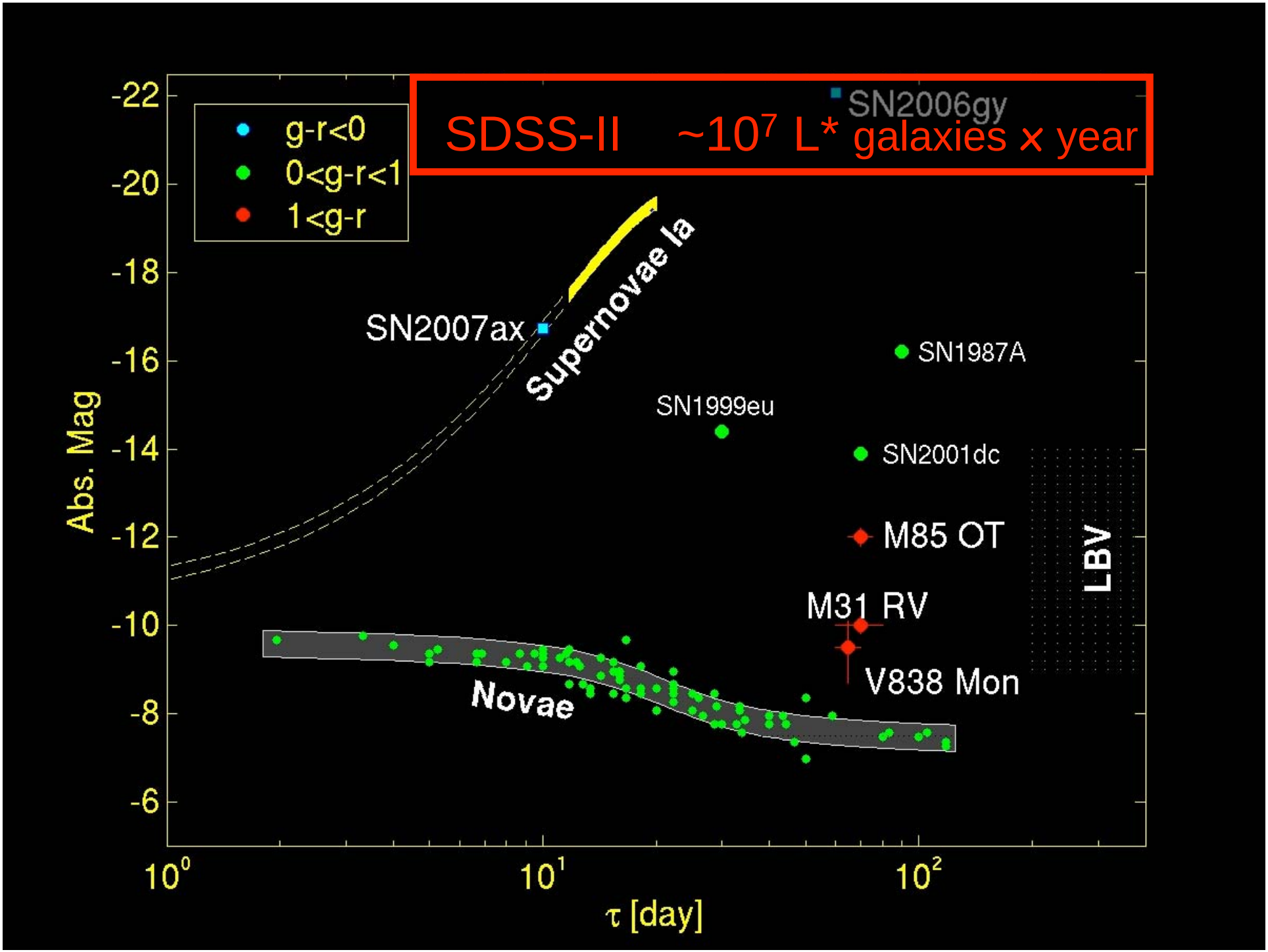
SN2006gy
SN2007ax
Supernovae Ia
SN1987A
SN1999eu
SN2001dc
M85 OT
LBV
M31 RV
V838 Mon
Novae
Abs. Mag
τ [day]
-22
-20
-18
-16
-14
-12
-10
-8
-6
10^0
10^1
10^2


SDSS-II ~10^7 L* galaxies x year
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SN2007ax
Supernovae Ia
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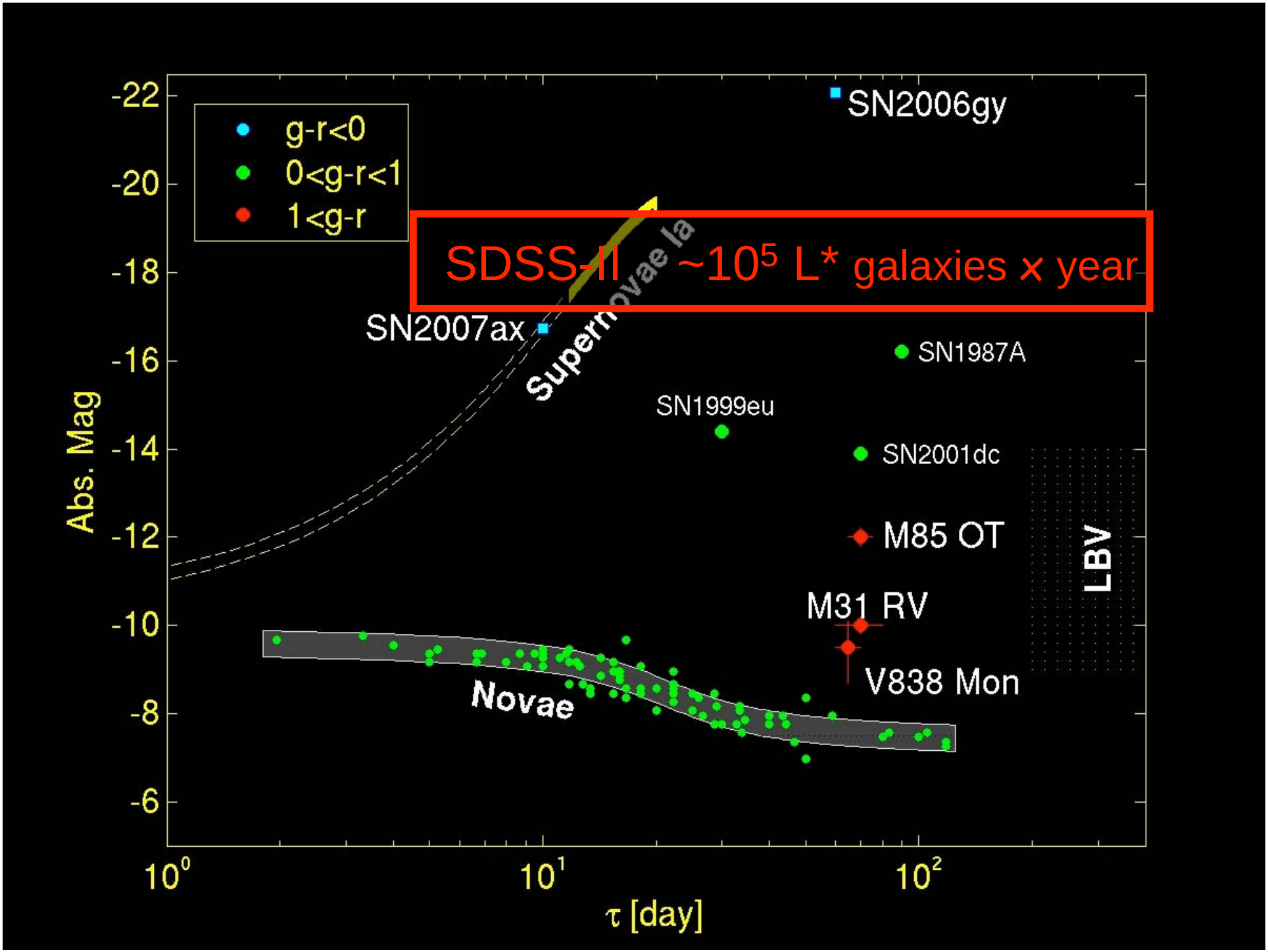
g-r<0
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1<g-r
SDSS-II ~10^5 L* galaxies x year
SN2006gy
SN2007ax
Supernovae Ia
SN1987A
SN1999eu
SN2001dc
M85 OT
LBV
M31 RV
V838 Mon
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Abs. Mag
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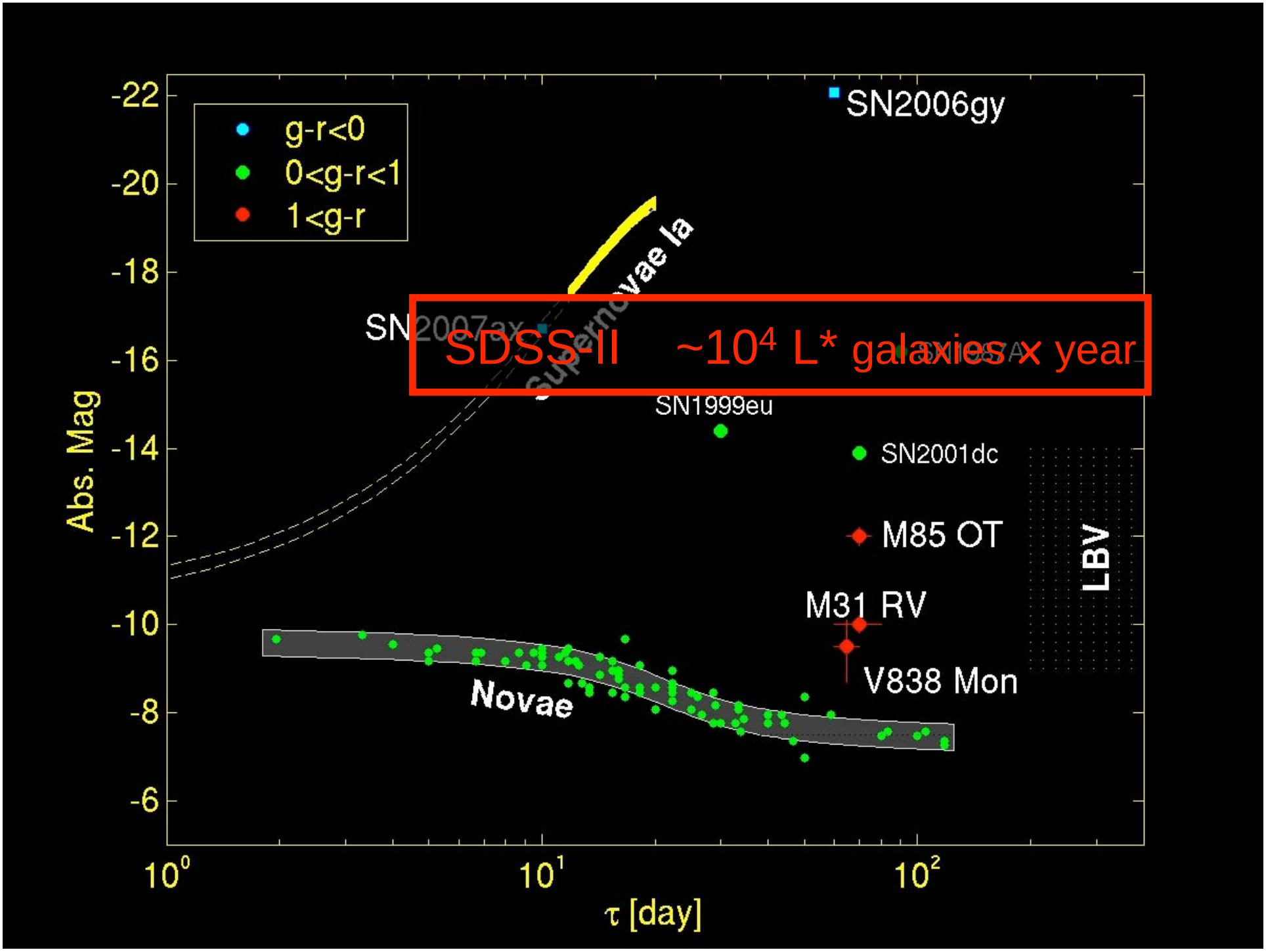
10^0
10^1
10^2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SN2006gy
SN2007ax
Supernovae Ia
SDSS-II ~10^4 L* galaxies x year
SN1999eu
SN2001dc
M85 OT
LBV
M31 RV
V838 Mon
Novae
Abs. Mag
τ [day]
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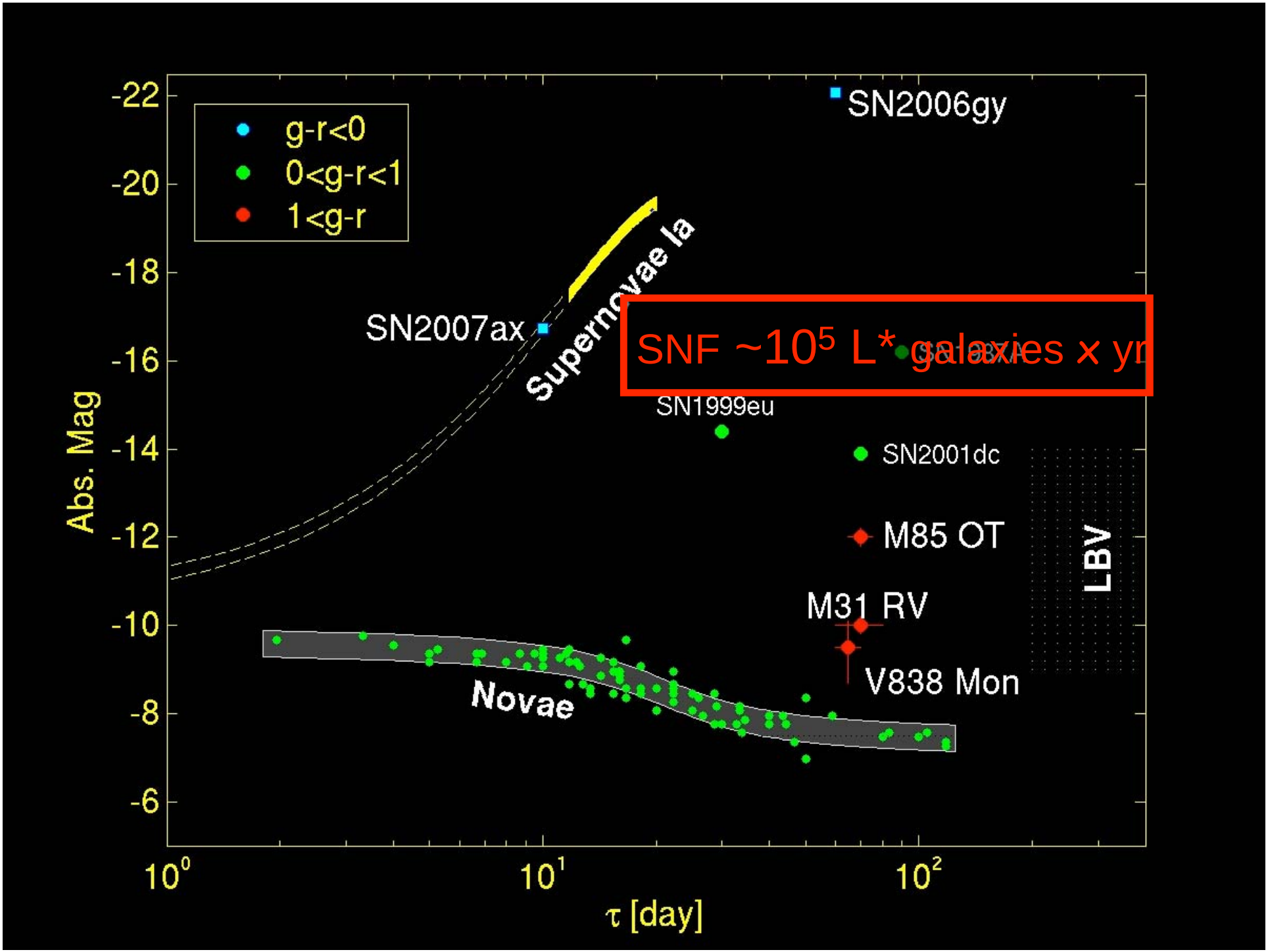
-20
-18
-16
-14
-12
-10
-8
-6
10^0
10^1
10^2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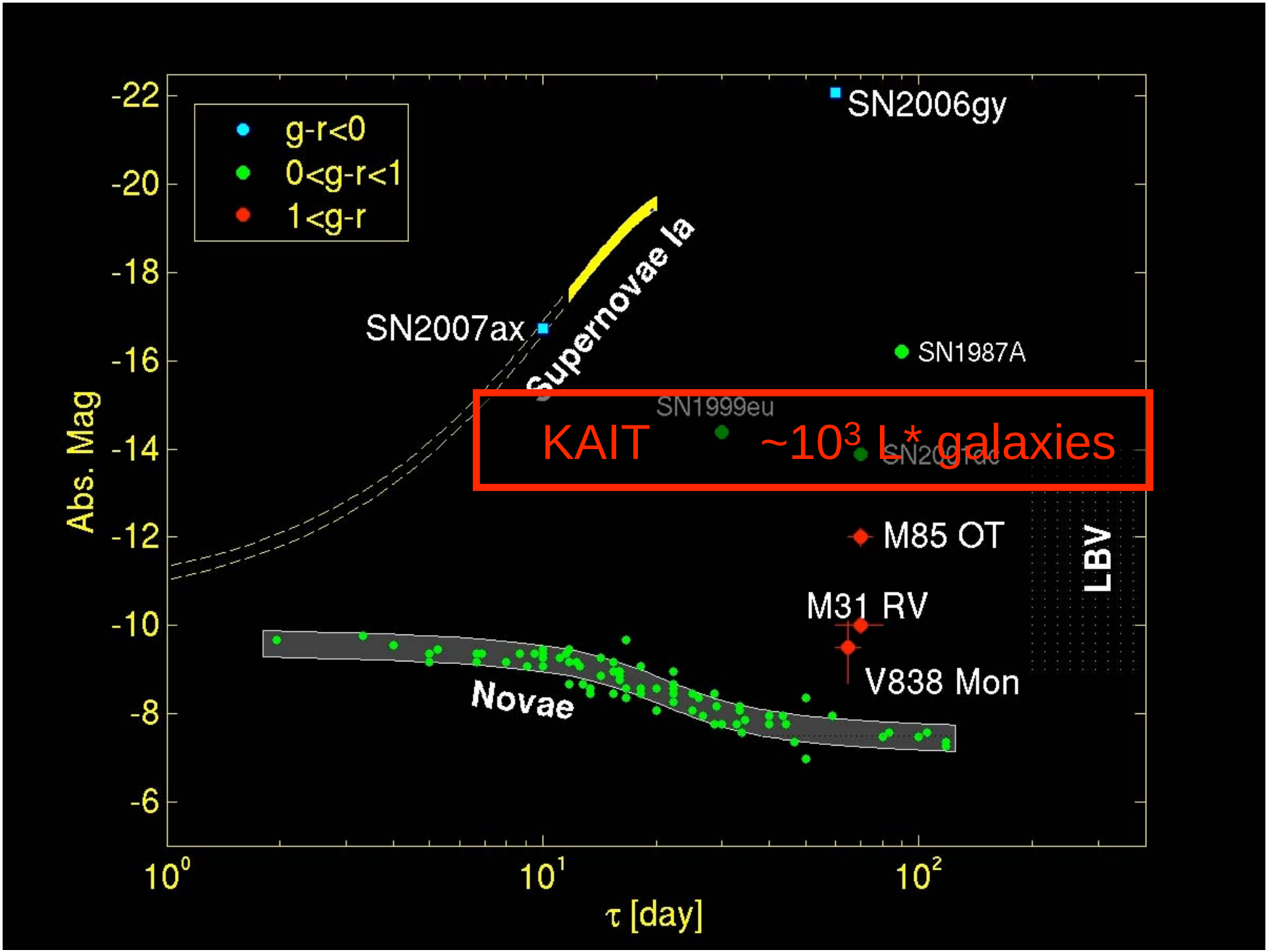
1<g-r
SN2006gy
SN2007ax
Supernovae Ia
SN1999eu
SN2001dc
M85 OT
M31 RV
V838 Mon
LBV
Novae
SNF ~10^5 L* galaxies x yr
Abs. Mag
τ [day]
-22
-20
-18
-16
-14
-12
-10
-8
-6
10^0
10^1
10^2


g-r<0
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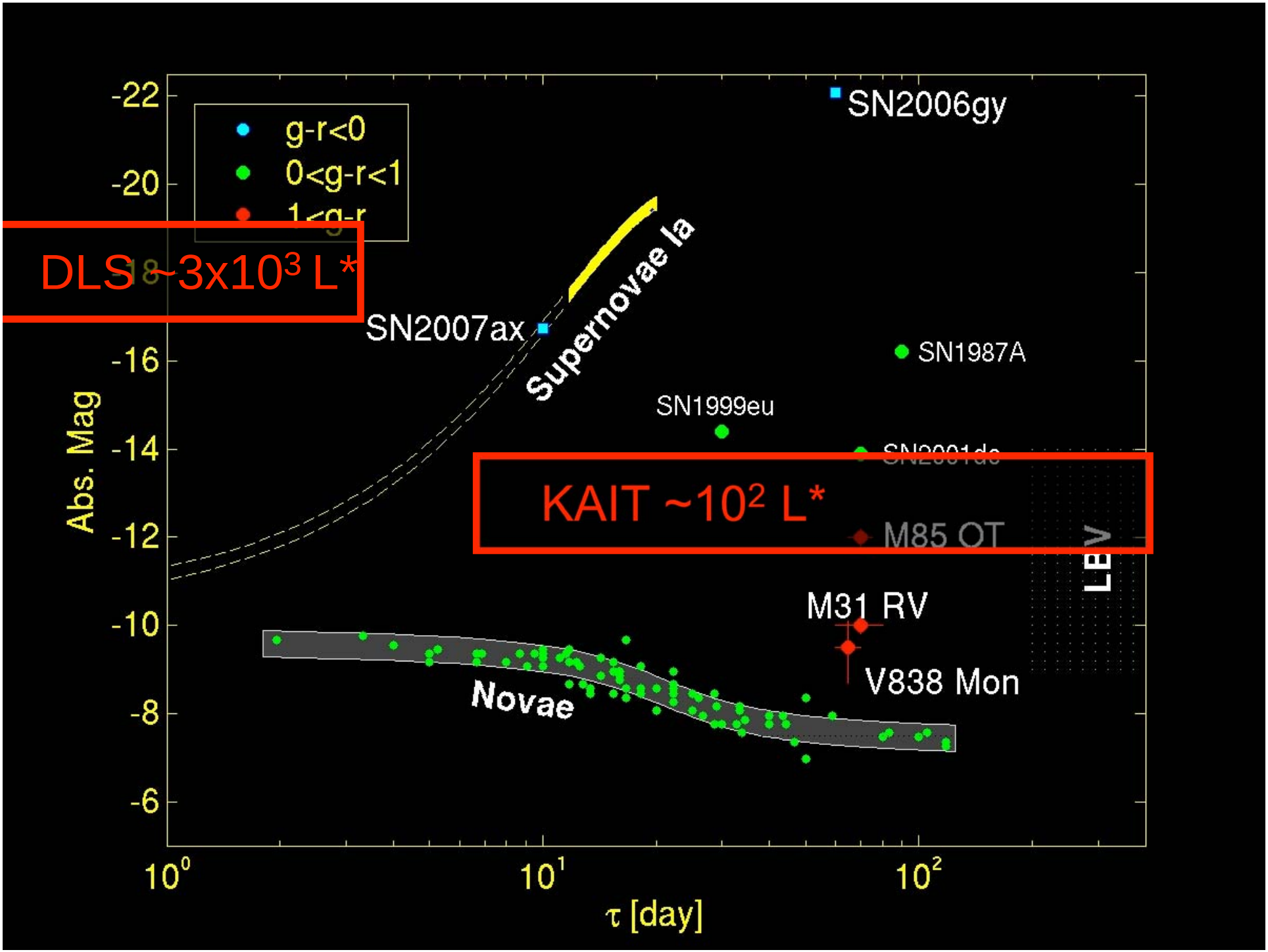
1<g-r
SN2006gy
SN2007ax
Supernovae Ia
SN1987A
SN1999eu
KAIT ~10³ L* galaxies
M85 OT
LBV
M31 RV
V838 Mon
Novae
Abs. Mag
τ [day]
-22
-20
-18
-16
-14
-12
-10
-8
-6
10⁰
10¹
10²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0<g-r<1
1<g-r
DLS ~3x10³ L*
KAIT ~10² L*
SN2006gy
SN2007ax
Supernovae Ia
SN1987A
SN1999eu
M85 OT
M31 RV
V838 Mon
Novae
LBV
Abs. Mag
τ [day]
-22
-20
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-14
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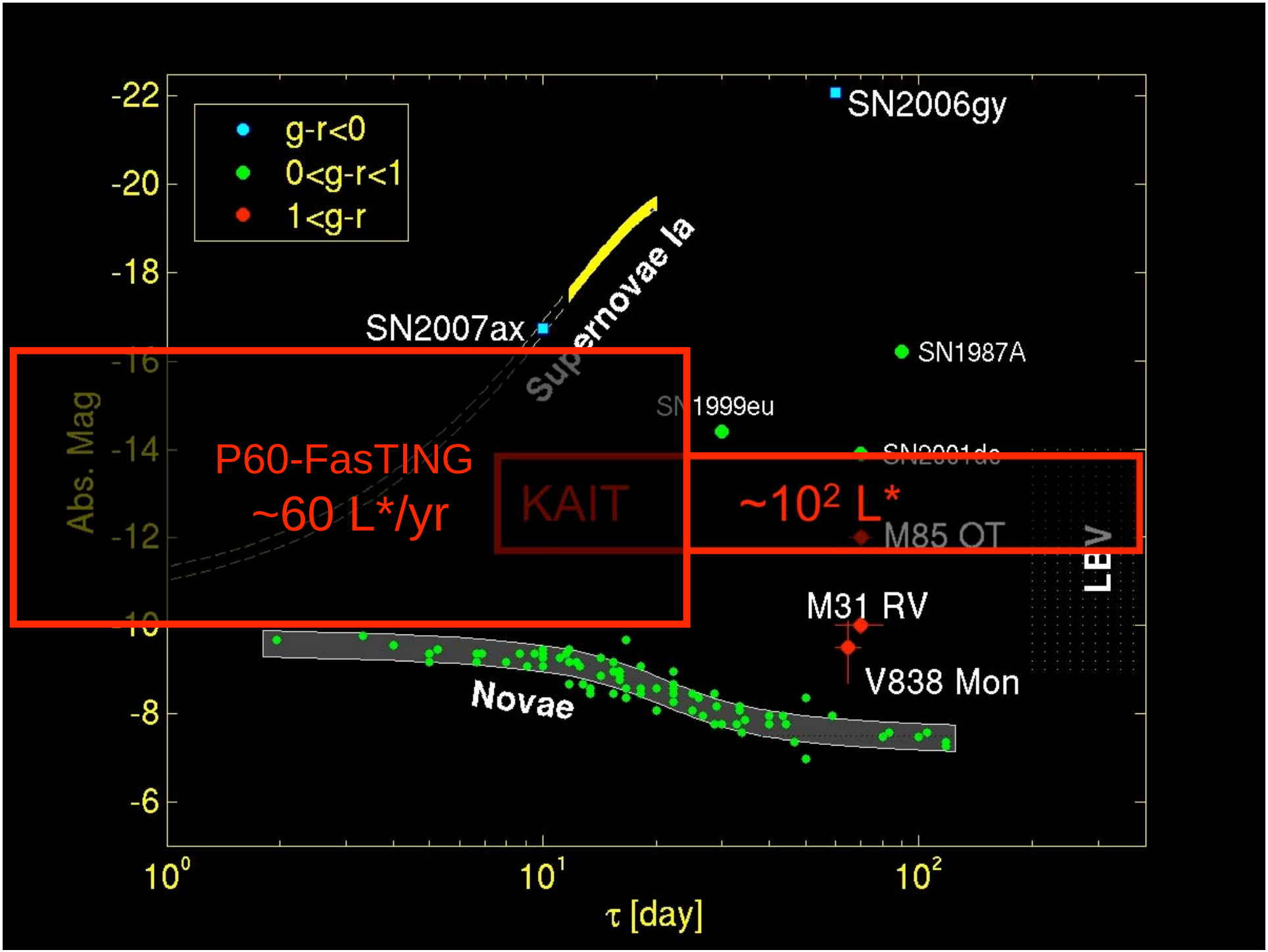
-10
-8
-6
10⁰
10¹
10²


g-r<0
0<g-r<1
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SN2006gy
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Supernovae Ia
SN1987A
SN 1999eu
M85 OT
P60-FasTING
~60 L*/yr
KAIT
~10² L*
LBV
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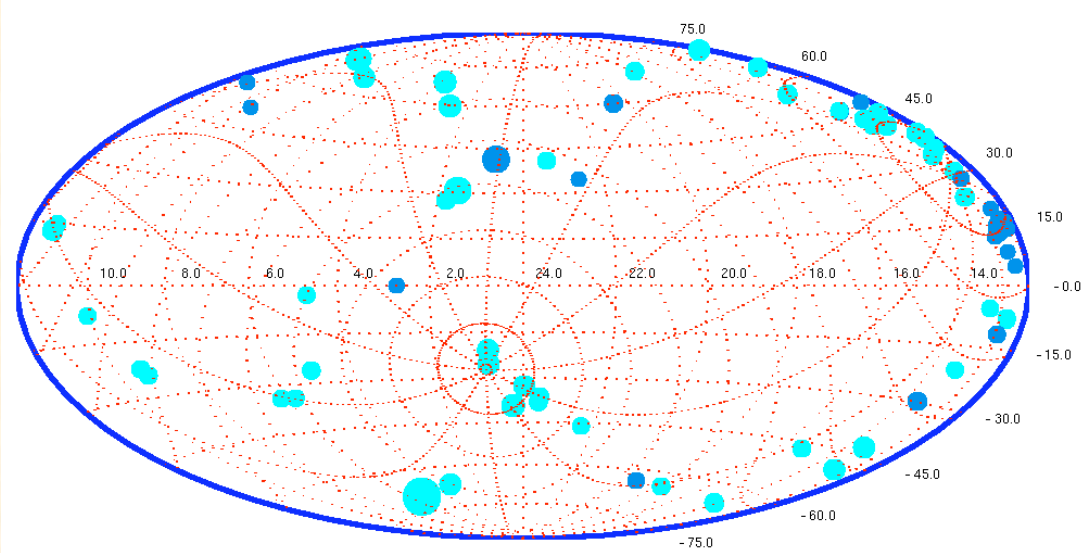
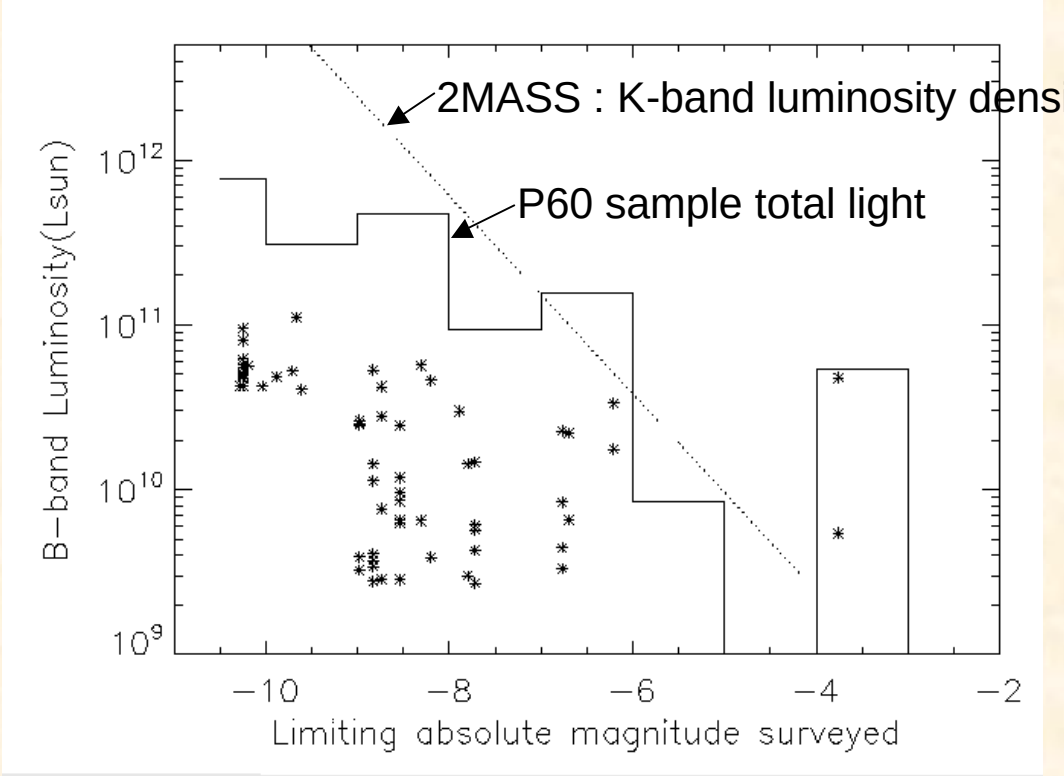
P60-FasTING

Fast Transients In Nearest Galaxies

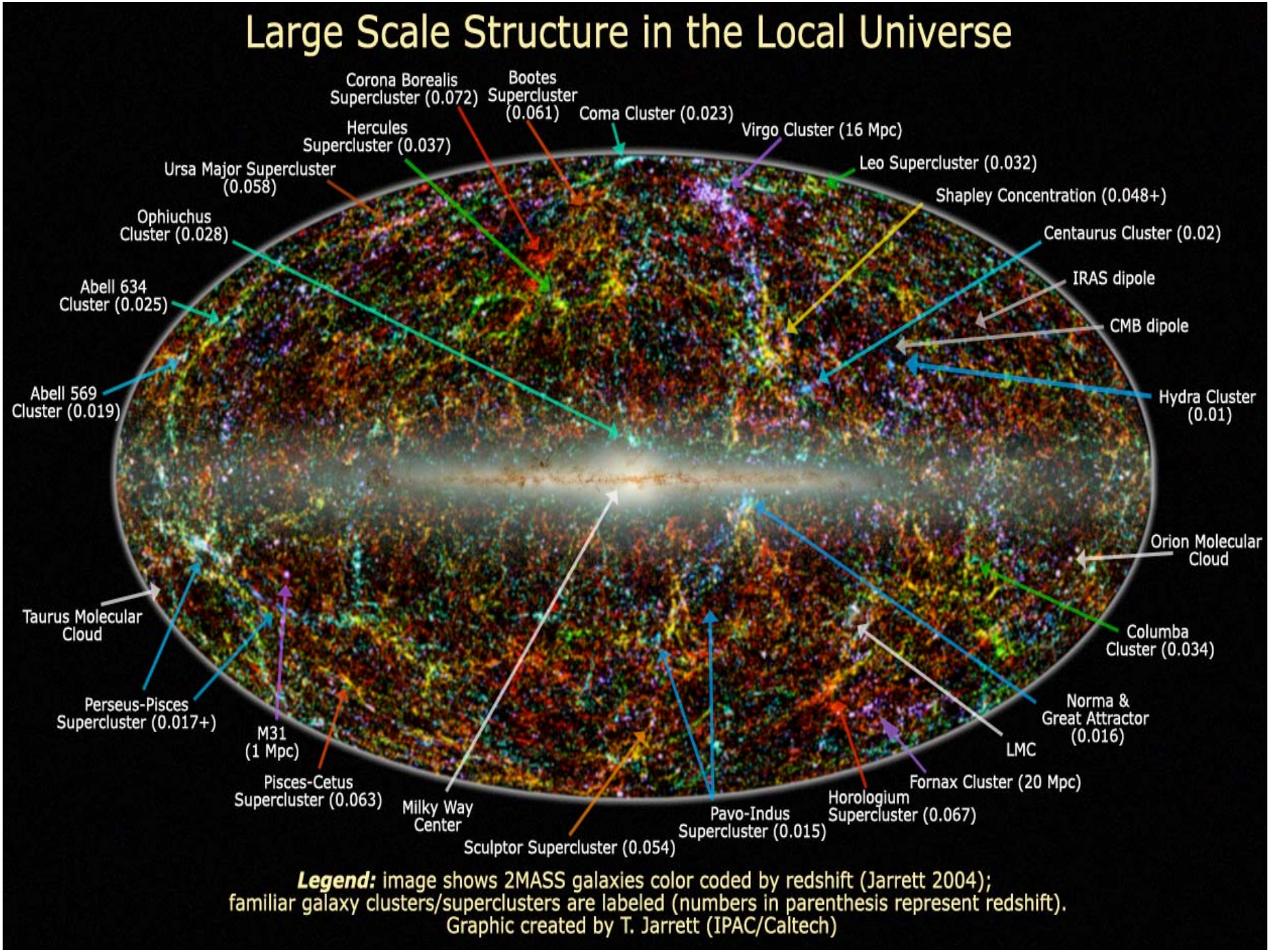


- Nearest Galaxies (<10 Mpc, M_B < -18) and Brightest Galaxies (M_B < -21)
- Depth : g~21 => G = -9 @ 10Mpc,
- Cadence : Few Hours, Daily & Single-Band (g,i)
- Real-time reduction : ~10min
- Thus Far : Novae (3), LBV (1), Flare Star(1)

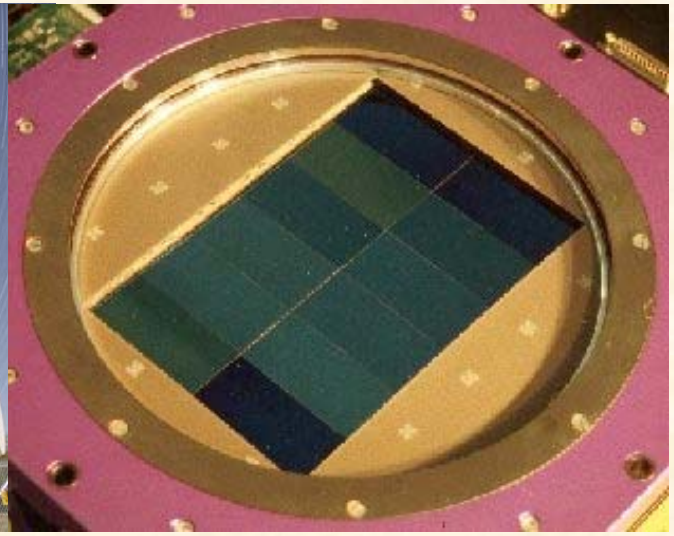
All Sky vs. Nearest Galaxies



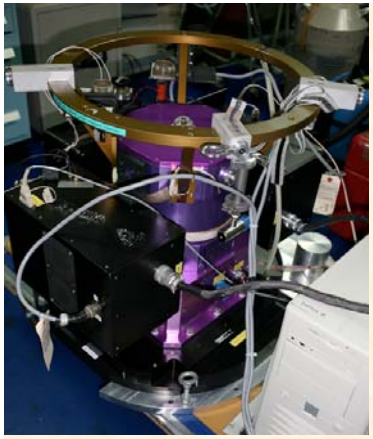
- Tradeoff between depth/cadence and volume surveyed
- For the faintest transients, it is advantageous to do fewer specific pointings!


Large Scale Structure in the Local Universe
Corona Borealis Supercluster (0.072)
Bootes Supercluster (0.061)
Coma Cluster (0.023)
Virgo Cluster (16 Mpc)
Hercules Supercluster (0.037)
Leo Supercluster (0.032)
Ursa Major Supercluster (0.058)
Shapley Concentration (0.048+)
Ophiuchus Cluster (0.028)
Centaurus Cluster (0.02)
Abell 634 Cluster (0.025)
IRAS dipole
CMB dipole
Abell 569 Cluster (0.019)
Hydra Cluster (0.01)
Orion Molecular Cloud
Taurus Molecular Cloud
Columba Cluster (0.034)
Perseus-Pisces Supercluster (0.017+)
Norma & Great Attractor (0.016)
M31 (1 Mpc)
LMC
Pisces-Cetus Supercluster (0.063)
Fornax Cluster (20 Mpc)
Milky Way Center
Horologium Supercluster (0.067)
Pavo-Indus Supercluster (0.015)
Sculptor Supercluster (0.054)
Legend: image shows 2MASS galaxies color coded by redshift (Jarrett 2004);
familiar galaxy clusters/superclusters are labeled (numbers in parenthesis represent redshift).
Graphic created by T. Jarrett (IPAC/Caltech)

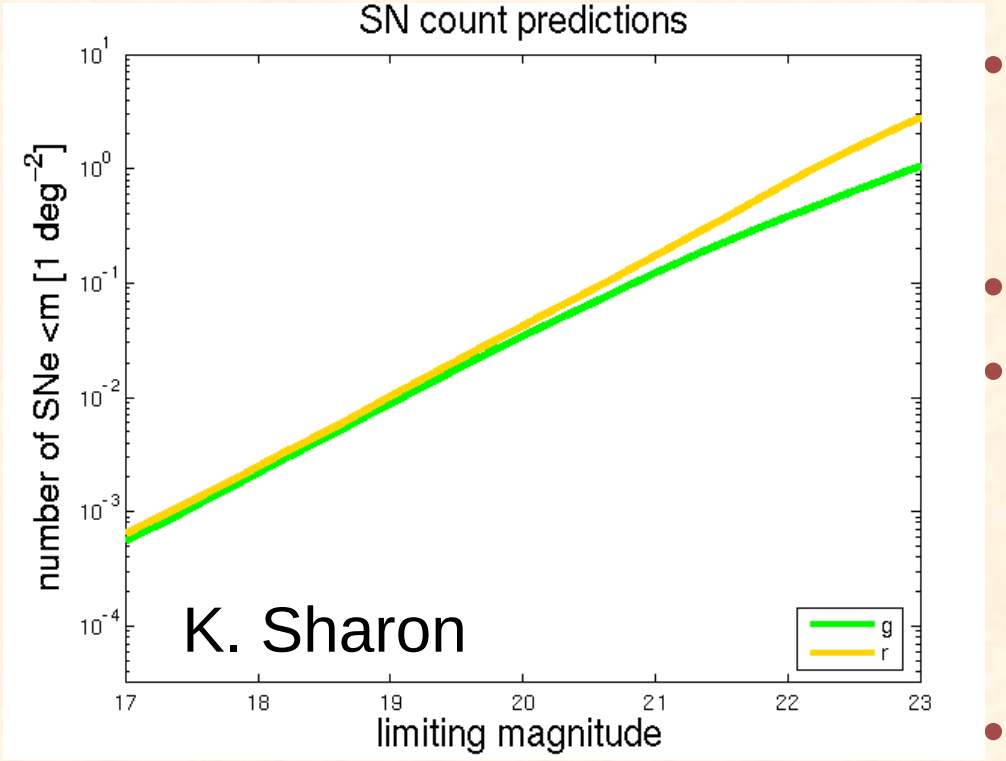
Palomar Transient Factory



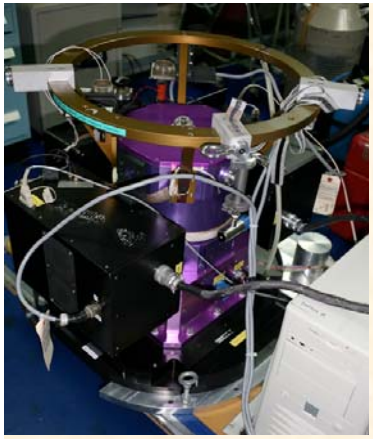
- *Collaboration:Caltech,LBL,LCOGT,Columbia,Wiezmann,IPAC*
- Palomar 48-inch Telescope & CFH12K camera
- 7.7 sq deg FoV @1”/pix ; Depth ~ 21 in 60s; Filters : g,r
- Real-time Transient Identification, Classification and Follow-Up



5-day Cadence, 7000 deg^2



- Primary Motivation : Type Ia and Core-Collapse Supernovae
- 1400/yr ?
- Ancillary Science : Luminous Red Novae, subluminous Ia, Extragalactic Novae, RR Lyr
- R-band, High-b Fields with SDSS overlap, 60s triplets per epoch

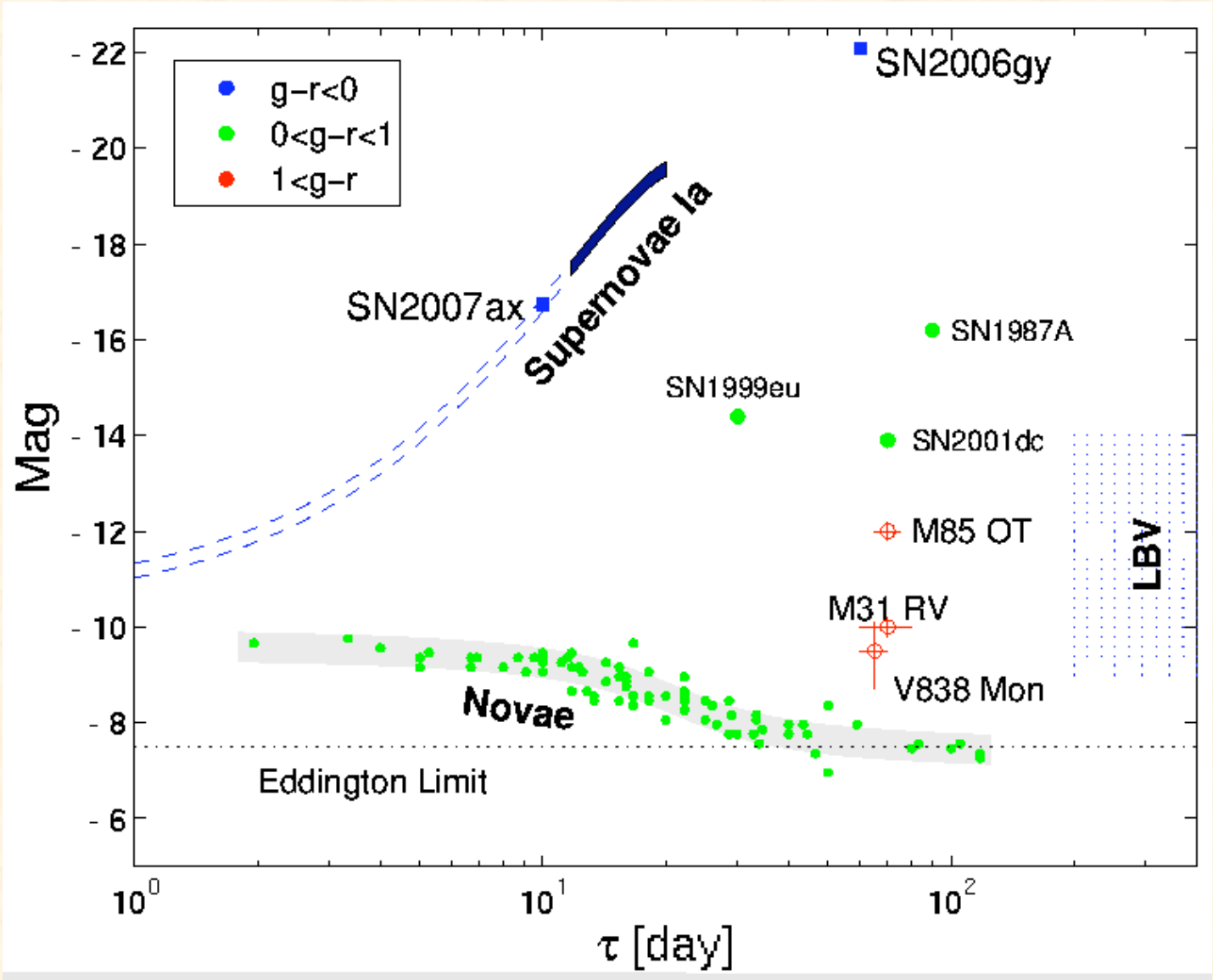


Full-Moon Narrowband Survey

- 3π Survey,12 months, 1 filter
- 3 nights around full moon
- Hα (6584A, 76A) ; O[III] (5084A, 86A) ; z
- Motivation : high-z quasars as z-band dropouts, galactic high resolution Hα structure, low surface brightness satellites and planetary nebulae, identification of strong galactic Hα emitters

Dynamic Cadence

- Motivation : Systematic search for new classes of transients on 1 min - 1 day timescales
- Three two-month Experiments:
  - Continuous Observations, 38 deg^2 @ 7.5min
    - 5 fields/week, during commissioning phase.
  - Nearby Galaxies, 15 fields @ 22 min
    - M31, M33, M81, M82, M51, M101, M109, Virgo, Coma, Perseus
  - 300 deg^2 @ 2 hours
    - 40 fields including nearby galaxy fields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10^0
10^1
10^2

GRB070610