

Detecting supernova progenitors with virtual observatories

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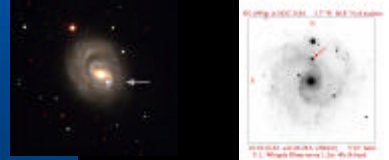
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The progenitors of (massive, core collapse) supernovae

- Massive stars ($M > 8M_{\text{Solar}}$) explode as supernovae (Types II, Ib and Ic)
- How do stars evolve up to the point of explosion ?
- Only detection of a Type II progenitor is SN1987A in LMC
- Could we image the last stages of stellar evolution before explosion ?



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The progenitors of supernovae

- If massive, luminous supergiants are the progenitors of SN – we can resolve and detect *single* stars within ~20 Mpc with the Hubble Space Telescope
- The HST archive – wealth of multi-colour imaging data of these galaxies
- What are the chances of having images *before* explosion ?



- Approx. 1 SN per 100 yr per $10^{10} L_{\odot}$
- 1000 galaxies within 20 Mpc – how much data ?

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ASTROVIRTEL – a European facility

- Initiative led by the HST European Coordinating Facility (ESO, Munich)
- Direct access to the HST archives and the ESO telescopes (2.2m, NTT, Very Large Telescope) – 7TB of data
- Assistance in developing and implementing novel archive science projects
- Development of new software tools – future general use
- Tools can be search, cross-correlation, analysis etc ...
- Programmes selected competitively (1 call per yr)
- Approx 1 ½ SY available at ECF (4-5 proposals per yr)

FOR MORE INFO...

<http://www.stecf.org/astrovirtel>

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ASTROVIRTEL – our supernova project

- Produce a database of all high-quality imaging data on nearby galaxies (HST + ESO telescopes)
- Cross correlate catalogues with the archive
- Allow archive searching across different telescope archives through one interface
- Provide a facility to determine if a particular sky coordinate falls on any image (geometry dependent)
- Include other archives – ING telescopes, CFHT ...?

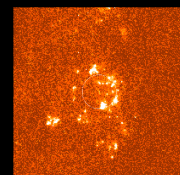
★ When a bright nearby supernova goes off – we immediately search all available archives

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SN1999gi – an example

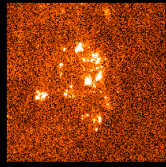
- SN1999gi – December 1999 in NGC3184 (d=8 Mpc)
- U and V band HST images before explosion
- Site of SN is a resolved star forming region – error ~2"
- Follow-up imaging scheduled for Feb/Mar 2001
- Will show if red or blue supergiant



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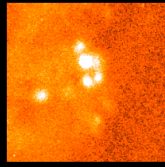
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SN1999gi – an example



Hubble Space Telescope
pre-explosion image of NGC3184
(pixel size = 0.1", resolution ~0.2")

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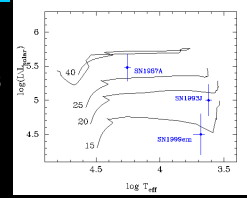


Ground based image from the
William Herschel Telescope
(pixel size = 0.1", resolution ~1.0")

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What can we learn about SN and their progenitors ?

- Statistical survey of the colours of SN progenitors
- Project lasting 3-5 years, 10-15 progenitors possible
- Attempt to relate progenitor properties to the SN evolution
- Would greatly benefit from further federation of archive material



HR diagram of positions of possible SN progenitors – SN1987A is the only definite detection. None of them are red (M-type) supergiants. (Geneva evolutionary tracks).

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Summary and future directions

- ASTROVIRTEL supporting science directly – what do astronomers want ?
- Search and cross-correlation tools for the SN project are widely applicable to other areas
 - X-ray transients, GRBs, QSO/AGN variability
 - Microlensing, proper motions
 - Multi-waveband, epoch, resolution work
- Tools will be made available for the community
- UK grid project can learn from this experience
- Valuable source of ideas directly from science requirements

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