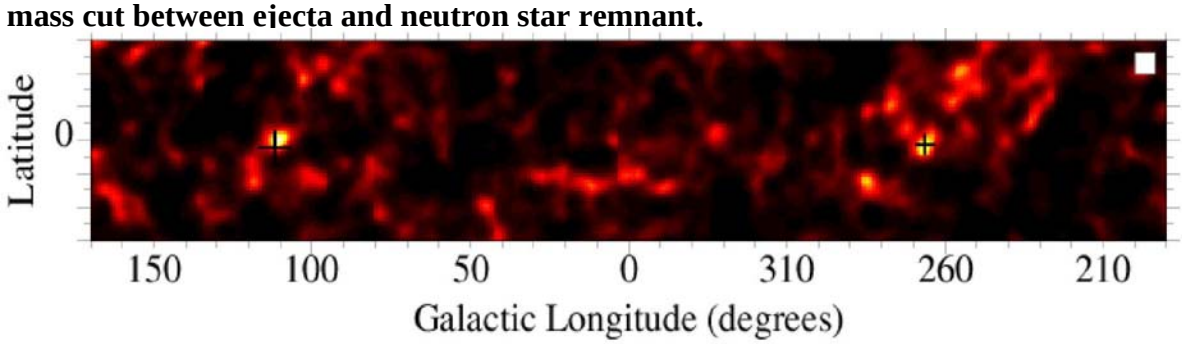
^{44}Ti and Rate of Supernovae in the Galaxy

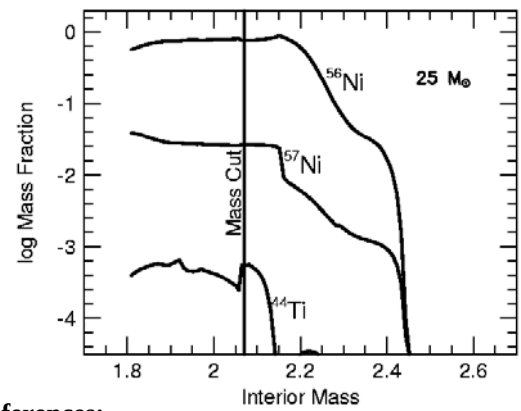
Core collapse supernovae have been demonstrated to produce ^{44}Ti radioactivity gamma-rays, for the case of Cas A. Considering the Galactic supernova rate and the radioactive lifetime of ^{44}Ti of 89 years, it is striking that only one such event has been seen in ^{44}Ti, at 3.4 kpc distance and an age of 340 years. Possibly, deviations from spherical symmetry are decisive for ^{44}Ti ejection (or not) in core collapse supernovae, as ^{44}Ti production is deep inside near the mass cut between ejecta and neutron star remnant.



The COMPTEL survey of the plane of the Galaxy for young supernovae in gamma-ray line emission from ^{44}Ti decay has shown one source very clearly: The Cas A SNR al l=112º. Possibly another source may have been seen in the Vela region.

The expected positions of these sources in the Galaxy are the regions where massive stars have been formed recently, i.e. the inner Galaxy and the molecular ring, out to longitudes of 35-40º.

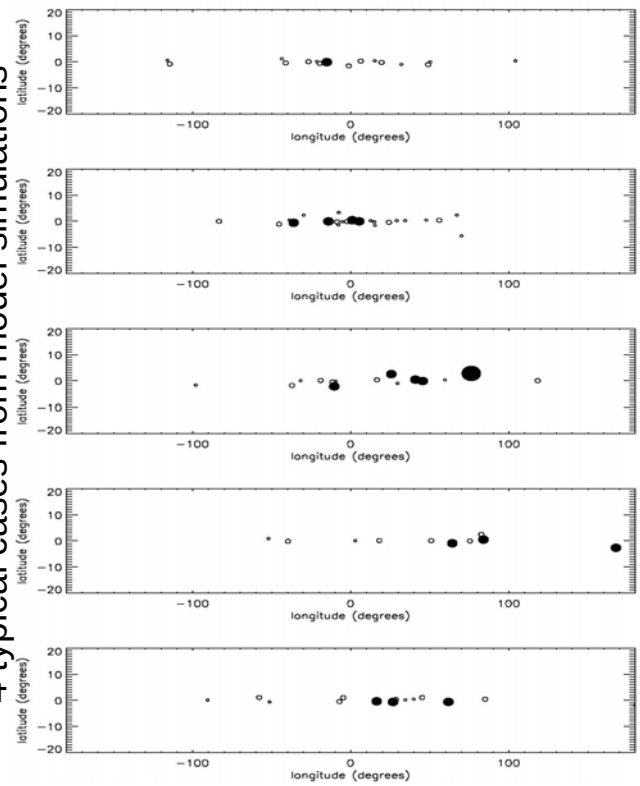
Simulations show that statistical effects, combined with the sensitivity threshold of such a gamma-ray telescope, can lead to detections of less than a handful of sources, for a supernova rate of ~1/30 years, as is plausible for the Galaxy.



References:

- The L., Diehl R., Hartmann D., et al.: AIP 510, 64 (2000)
- The L.-S., Clayton D.D., Diehl R., et al.: (*in preparation*)
- Iyudin A.F., et al.: Astroph.Lett.Comm. 38, 383 (2000)

4 typical cases from model simulations



Nevertheless, the low number of candidate excesses seen by COMPTEL in the inner Galaxy is surprising, when estimated from standard models. This suggests that not every core collapse supernova may eject radioactive ^{44}Ti - a conclusion that appears also plausible, given that ^{44}Ti is produced very near the mass cut, hence is very sensitive to 3D effects/deviations from spherical symmetry. The ^{44}Ti source Cas A is known to be asymmetric, even containing a jet.

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