# A Very Bad Day At The Office

This is how I feel *every time* I have to stop SK data-taking:

*What if a supernova neutrino wave is coming?*

What if I'm the poor, unlucky bastard who happens to cause us to miss it??

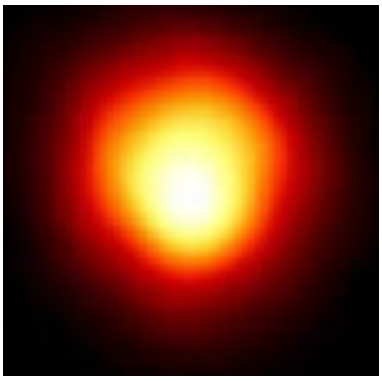
## ν's at 11

*What if we could tell that a neutrino wave was on its way and was about to pass through the Earth?*

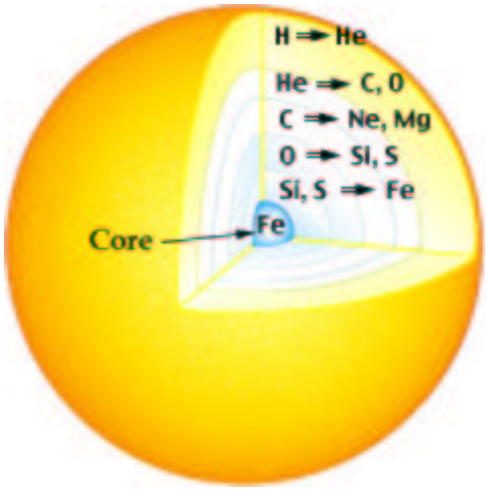
What follows on this topic is inspired by Odrzywolek, Misiaszek, and Kutschera's astro-ph/0311012, which was itself inspired by our recent GADZOOKS! paper...

# Burn Baby, Burn!

Let's suppose that a relatively close, rather large star, like Betelgeuse, is about to explode.



Carbon burning takes about 300 years, then neon and oxygen burning each power the star for half a year or so. Finally, silicon ignites, forming an inert iron core.



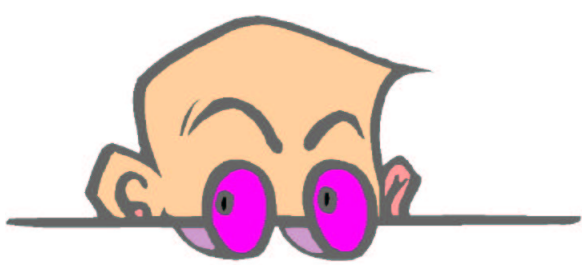
## Hot Enough For You?

About two days after the start of Si burning, the star explodes as a supernova.

But during silicon burning the star is hot enough ($T > 10^9$ K) that the pair annihilation process

$$e^+ + e^- \rightarrow \nu_x + \overline{\nu}_x$$

starts to produce large numbers of $\overline{\nu}_e$'s with an average energy of 1.87 MeV — which coincidentally is *just* above the inverse beta threshold of 1.8 MeV.

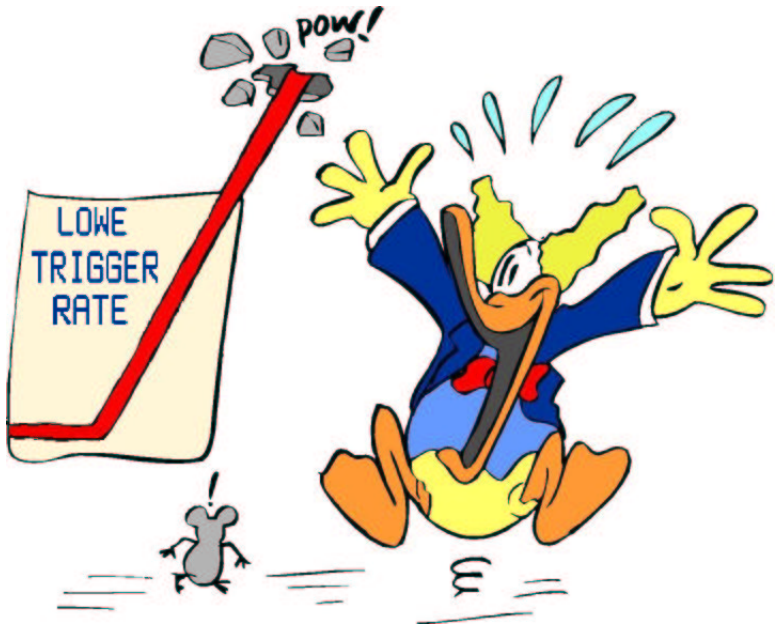


## The Silicon Signal

If Super–K has $GdCl_3$ in it when this happens, we would expect to see $\sim 1,000$ neutron capture singles a day from the reaction

$$\overline{\nu}_e + p \rightarrow e^+ + n$$

This is ten times our current lowe background singles rate, and could not be missed!




*No other detector on Earth will know the supernova neutrinos will arrive in a couple of days.*

# A Supernova Insurance Policy

Now, granted, the supernova has to be pretty close. This trick will only work well out to about 1 kpc in Super–K (though 5 kpc of coverage for Hyper–K isn't too shabby).

On the other hand, these are the most valuable bursts, where we would have the most to lose if we missed them.

So, think of it as a supernova insurance policy.