

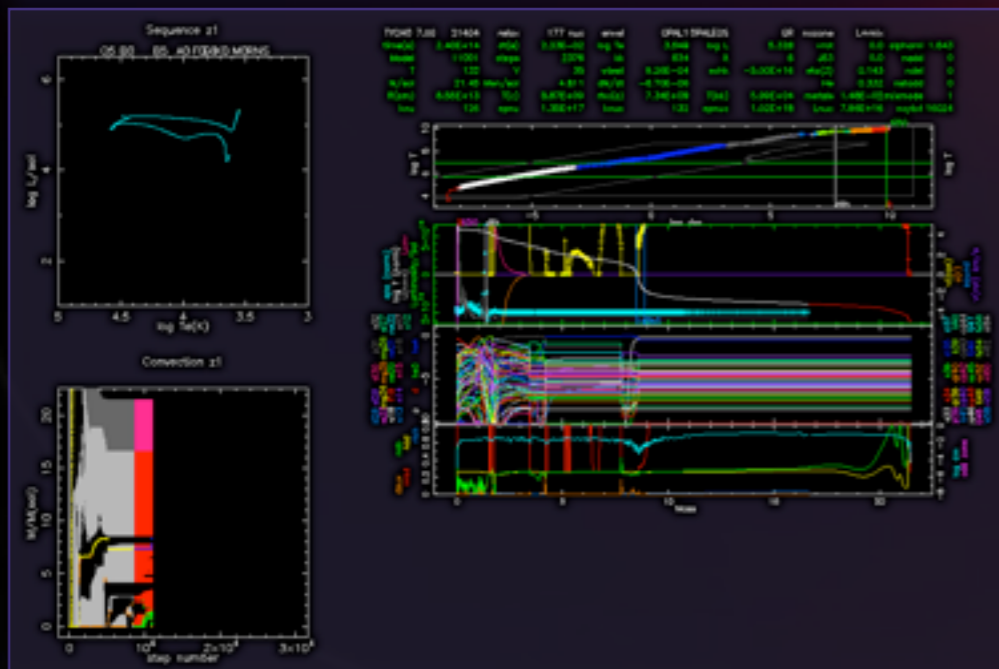
Evolution / Explosions of Massive Stars and Elements in the Solar Neighborhood



From tasks outlined in ASU's proposal to the NAI:

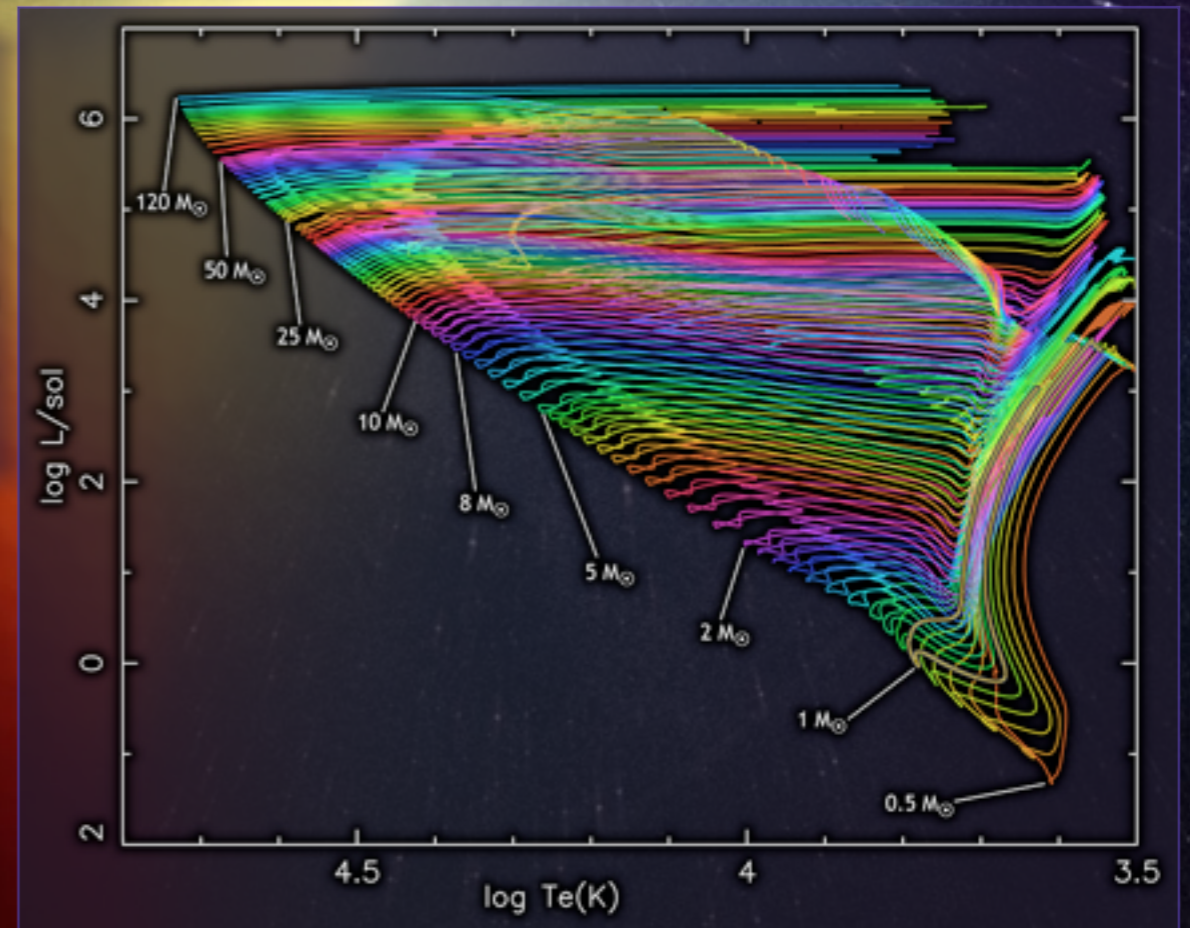
1. Model in detail the chemical and dynamical evolution of a massive star as it evolves on the main sequence and then explodes; determine which elemental or isotopic ratios correlate with key (*i.e.*, "bioessential") elements
2. Construct an updated catalog of elemental ratios in nearby stars against which we can test our proxies

- Stars 8-120 M_{\odot} evolved to core collapse with "TYCHO" [1,5]
- 1st series: $z = \text{solar}$ [2,3]; includes mass loss, but not rotation
- 1-D and 3-D (SNSPH [4]) codes will yield possible elemental abundances and distributions in asymmetric supernova ejecta
- Post-processing could generate yields for 524-3300 isotopes, depending on the conditions of nuclear burning



left: evolution of a 25 M_{\odot} star in TYCHO [1]

right: evolutionary tracks (incomplete) of 0.5 to 120 M_{\odot} stars evolved with TYCHO [1]



♪ Evolving, evolving, evolving, ...
... evo~ooo~olving the massive stars! ♪



Nahks Tr'Ehnl

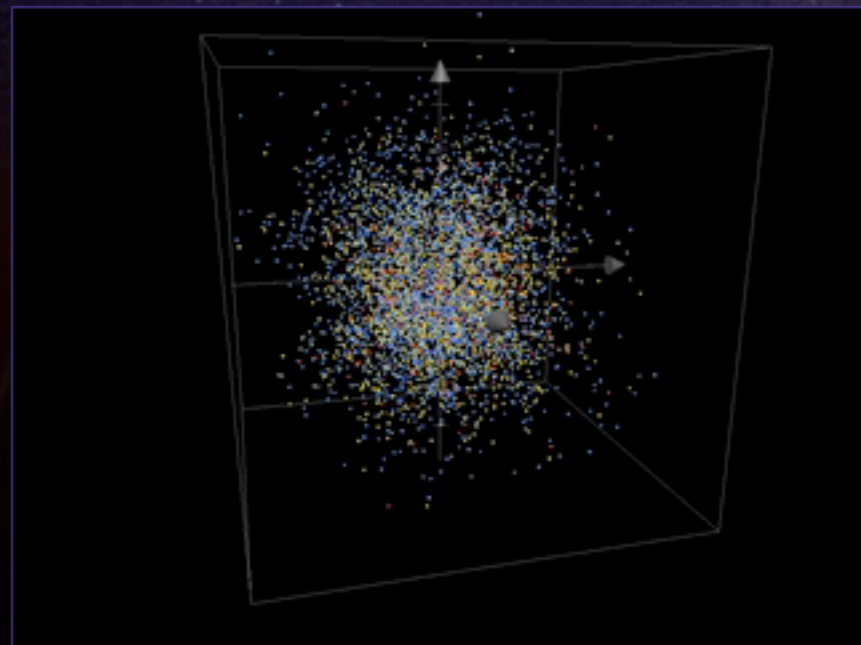
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advisors: F.X. Timmes, P.A. Young, A.D. Anbar



Evolution / Explosions of Massive Stars and Elements in the Solar Neighborhood

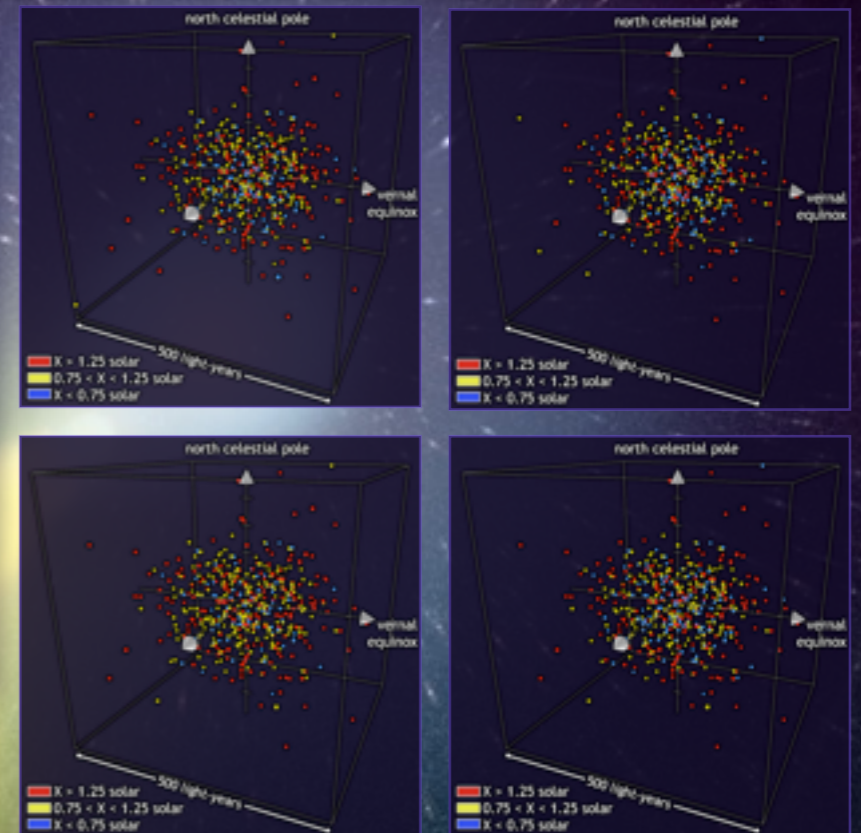


- Turnbull and Tarter's original "HabCat" [6,7]: a target list for the Search for Extraterrestrial Intelligence (SETI), 17,129 stars from the *Hipparcos Catalogue*
- [Fe/H] estimates of the parent star appear to correlate with detection of exoplanets [8]



- Interested in abundances of "bioessential" elements (HCNOPS, trace metals, etc.) and short-lived radionuclides (^{26}Al , ^{60}Fe) [9]

left: alternating complete "HabCat" [6] (purple) and select stars with [Fe/H] measurements (key in right-side figures)



clockwise, beginning top left: selected "HabCat" stars with values for (Fe/H), (Na/H), (Si/H), and (Ni/H), relative to solar abundances [6,10-15]

Background / Interests:

Astrobiology

Astronomy/Astrophysics: habitable planets; extrasolar planet detection and characterization; planetary system evolution; cosmochemistry and evolution of habitability in planetary bodies, stellar systems, galaxies, and the Universe; SETI

Biology: biological evolution; phylogenetics; extremophiles

Geosciences: Earth system science; paleontology and mass extinction events; biology's impacts on habitability

Science communication

Visualizations; speculative space art
Education / public outreach

References: [1] Young P.A. and Arnett D., (2005) *ApJ*, 618, 908; [2] Lodders K., (2003) *ApJ*, 591, 1220; [3] Grevesse N. *et al.*, (2007) *SpSciRev*, 130, 105; [4] Fryer C.L. *et al.*, (2006) *ApJ*, 643, 292; [5] Arnett D. *et al.*, (2009) *ApJ*, 690, 1715; [6] Turnbull M.C. and Tarter J.C., (2003) *ApJSS*, 145, 181; [7] Turnbull M.C. and Tarter J.C., (2003) *ApJSS*, 149, 423; [8] Fischer, D.A. and Valenti, J.A., (2005) *ApJ*, 622, 1102; [9] Young *et al.*, (2009) *ApJ*, 699, 938; [10] Laird, J.B., (1985) *ApJ*, 289, 566; [11] Thevenin, F., (1998) *VizieR On-line Data Catalog: III/193*; [12] Valenti, J.A. and Fischer, D.A., (2005) *ApJSS*, 159, 141; [13] Edvardsson, B. *et al.*, (1993) *A&A*, 275, 101; [14] Bensby, T. *et al.*, (2005) *A&A*, 433, 185; [15] Carbon, D.F. *et al.*, (1987) *PASP*, 99, 335.

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