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Stellar Neutrino Emission across the Mass–Metallicity Plane

Ebraheem Farag[1], F. X. Timmes[1], Morgan T. Chidester[1], Samalka Anandagoda[2], and Dieter H. Hartmann[2]

Abstract

We explore neutrino emission from nonrotating, single-star models across six initial metallicities and 70 initial masses from the zero-age main sequence to the final fate. ...

ApJS, 30 pages, 23 figures, 4 tables, 260 references.

Global results

Low mass stars at 1 and 6 metallicities

High mass stars at 1 and 6 metallicities

Simple Stellar Population cluster models

THE ASTROPHYSICAL JOURNAL, 418:L21–L24, 1993 November 20
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RINGS OF FIRE: NUCLEAR BURNING AS THE ORIGIN OF SUB-HERTZ NOISE AND WEAK X-RAY BURSTS IN ACCRETING NEUTRON STARS

LARS BILDSTEN
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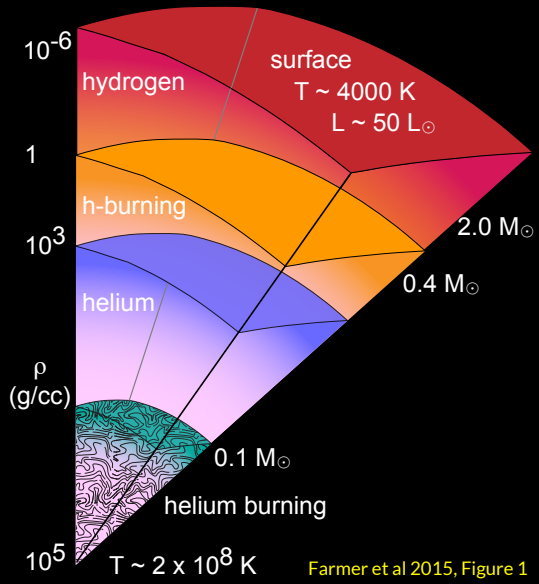
e-mail: I: bildsten@tapir.caltech.edu
Received 1993 August 12; accepted 1993 September 2

ABSTRACT

We identify a new regime of time-dependent nuclear burning on accreting neutron stars. Only two regimes were previously recognized...

All the initial CNO piles up at ^{14}N during H burning because $^{14}N(p,\gamma)^{15}O$ is the slowest step in the CNO cycle.

During He burning, $^{14}N(\alpha,\gamma)^{18}F(,e^{+}\nu_e)^{18}O(\alpha,\gamma)^{22}Ne$.



Connect ^{22}Ne to something else, and one has a connection between that something else and the initial metallicity.

THE ASTROPHYSICAL JOURNAL, 590:L83–L86, 2003 June 20
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ON VARIATIONS IN THE PEAK LUMINOSITY OF TYPE Ia SUPERNOVAE

F. X. TIMMES,[1,2] EDWARD F. BROWN,[1,3] AND J. W. TRURAN[1,2,3]

ABSTRACT

We explore the idea that the observed variations in the peak luminosities of Type Ia supernovae (SNe Ia) originate in part from a scatter in metallicity of the main-sequence stars that become white dwarfs...

Connecting ^{22}Ne to ^{56}Ni ...

The Astrophysical Journal, 910:24 (17pp), 2021 March 20 https://doi.org/10.3847/1538-4357/abdec4
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On the Impact of ^{22}Ne on the Pulsation Periods of Carbon–Oxygen White Dwarfs with Helium-dominated Atmospheres

Morgan T. Chidester[1,2], F. X. Timmes[1,2], Josiah Schwab[3], Richard H. D. Townsend[4], Ebraheem Farag[1,2], Anne Thoul[5], C. E. Fields[2,6], Evan B. Bauer[7,8], and Michael H. Montgomery[9]

Abstract

We explore changes in the adiabatic low-order g-mode pulsation periods of 0.526, 0.560, and 0.729 $M_\odot$ carbon–oxygen white dwarf models with helium-dominated envelopes due to the presence, absence, and enhancement of ^{22}Ne in the interior...

Connecting ^{22}Ne to WD pulsations ...

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High mass stars at 1 and 6 metallicities

Simple Stellar Population cluster models

Across the mass-metallicity plane we identify the sequence

initial CNO $\longrightarrow$ ^{14}N $\longrightarrow$ ^{22}Ne $\longrightarrow$ ^{25}Mg $\longrightarrow$ ^{26}Al $\longrightarrow$ ^{26}Mg $\longrightarrow$ ^{30}P $\longrightarrow$ ^{30}Si

as making primary contributions to the neutrino luminosity at different phases of evolution.

MESA I
2011

The Astrophysical Journal Supplement Series, 192:3 (35pp), 2011 January doi:10.1088/0067-0049/192/1/3
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MODULES FOR EXPERIMENTS IN STELLAR ASTROPHYSICS (MESA)

Bill Paxton[1], Lars Bildsten[1], Aaron Dotter[2,5], Falk Herwig[2], Pierre Lesaffre[3], and Frank Timmes[4]

MESA II
2013

The Astrophysical Journal Supplement Series, 208:4 (43pp), 2013 September doi:10.1088/0067-0049/208/1/4
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MODULES FOR EXPERIMENTS IN STELLAR ASTROPHYSICS (MESA): PLANETS, OSCILLATIONS, ROTATION, AND MASSIVE STARS

Bill Paxton[1], Matteo Cantiello[1], Phil Arras[2], Lars Bildsten[1,3], Edward F. Brown[4], Aaron Dotter[5], Christopher Mankovich[3], M. H. Montgomery[6], Dennis Stello[7], F. X. Timmes[8], and Richard Townsend[9]

MESA III
2015

The Astrophysical Journal Supplement Series, 220:15 (44pp), 2015 September doi:10.1088/0067-0049/220/1/15
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MODULES FOR EXPERIMENTS IN STELLAR ASTROPHYSICS (MESA): BINARIES, PULSATIONS, AND EXPLOSIONS

Bill Paxton[1], Pablo Marchant[2], Josiah Schwab[3,4], Evan B. Bauer[5], Lars Bildsten[1,5], Matteo Cantiello[1], Luc Dessart[6], R. Farmer[7], H. Hu[8], N. Langer[2], R. H. D. Townsend[9], Dean M. Townsley[10], and F. X. Timmes[7]

MESA IV
2018

The Astrophysical Journal Supplement Series, 234:34 (50pp), 2018 February https://doi.org/10.3847/1538-4365/aaa5a8
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Modules for Experiments in Stellar Astrophysics (MESA): Convective Boundaries, Element Diffusion, and Massive Star Explosions

Bill Paxton[1], Josiah Schwab[2,13], Evan B. Bauer[3], Lars Bildsten[1,3], Sergei Blinnikov[4,5,6], Paul Duffell[7], R. Farmer[8,9], Jared A. Goldberg[3], Pablo Marchant[10], Elena Sorokina[4,5], Anne Thoul[11], Richard H. D. Townsend[12], and F. X. Timmes[9]

MESA V
2019

The Astrophysical Journal Supplement Series, 243:10 (44pp), 2019 July https://doi.org/10.3847/1538-4365/ab2241
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Modules for Experiments in Stellar Astrophysics (MESA): Pulsating Variable Stars, Rotation, Convective Boundaries, and Energy Conservation

Bill Paxton[1], R. Smolec[2], Josiah Schwab[3,18], A. Gautschy[4], Lars Bildsten[1,5], Matteo Cantiello[6,7], Aaron Dotter[8], R. Farmer[9,10], Jared A. Goldberg[3], Adam S. Jermyn[1], S. M. Kanbur[11], Pablo Marchant[12], Anne Thoul[13], Richard H. D. Townsend[14], William M. Wolf[15,16], Michael Zhang[17], and F. X. Timmes[16]

MESA VI
2023

The Astrophysical Journal Supplement Series, 265:15 (38pp), 2023 March https://doi.org/10.3847/1538-4365/acae8d
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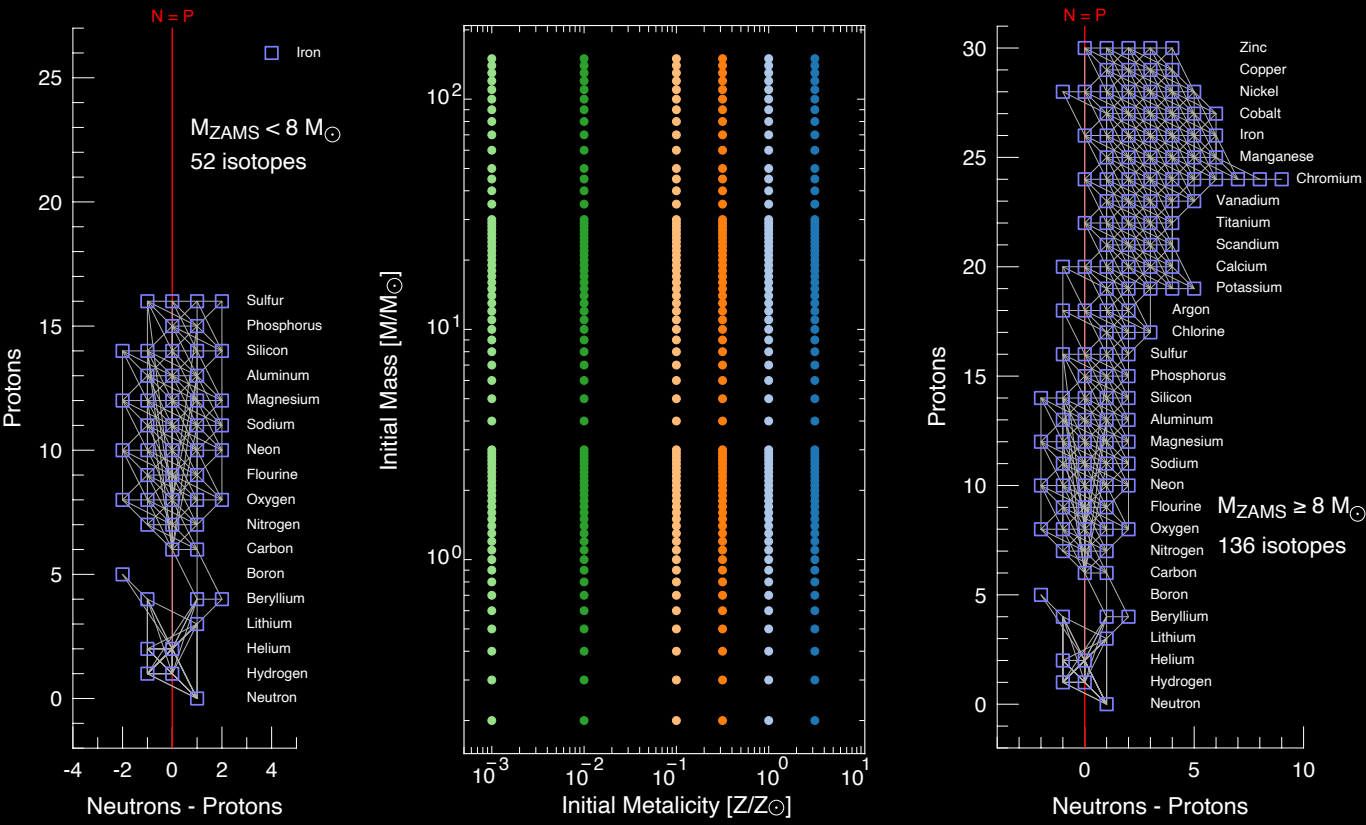
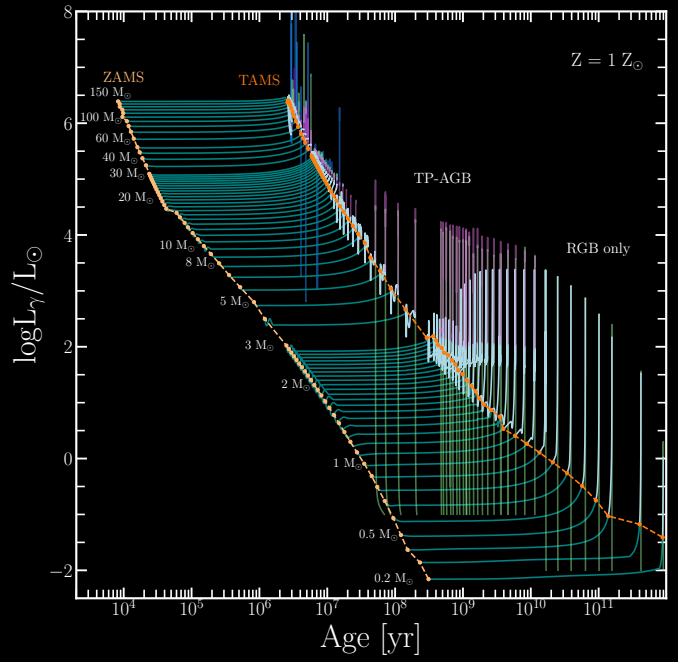
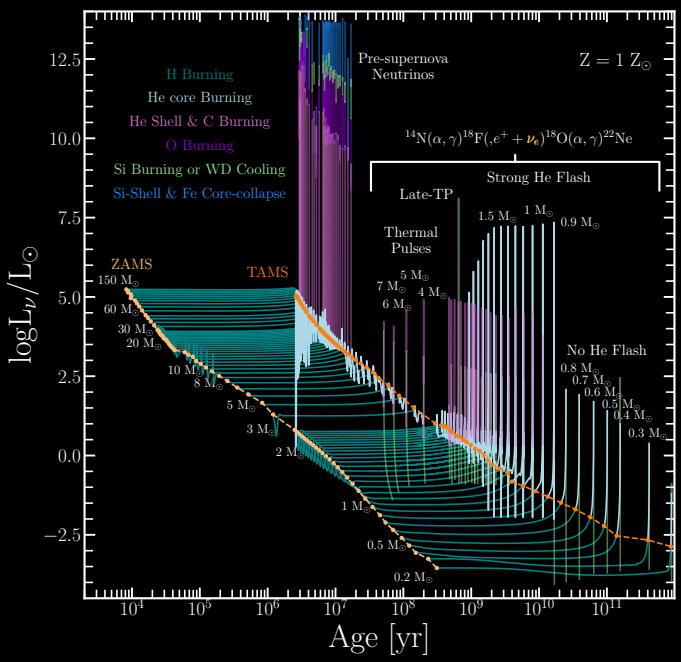
Modules for Experiments in Stellar Astrophysics (MESA): Time-dependent Convection, Energy Conservation, Automatic Differentiation, and Infrastructure

Adam S. Jermyn[1], Evan B. Bauer[2], Josiah Schwab[3], R. Farmer[4], Warrick H. Ball[5], Earl P. Bellinger[3,6], Aaron Dotter[7], Meridith Joyce[8,9,10], Pablo Marchant[11], Joey S. G. Mombarg[11], William M. Wolf[12], Tin Long Sunny Wong[13], Giulia C. Cinquegrana[14,15], Eoin Farrell[16], R. Smolec[17], Anne Thoul[18], Matteo Cantiello[19,20], Falk Herwig[21], Odette Toloza[22,23], Lars Bildsten[13,24], Richard H. D. Townsend[25], and F. X. Timmes[26]

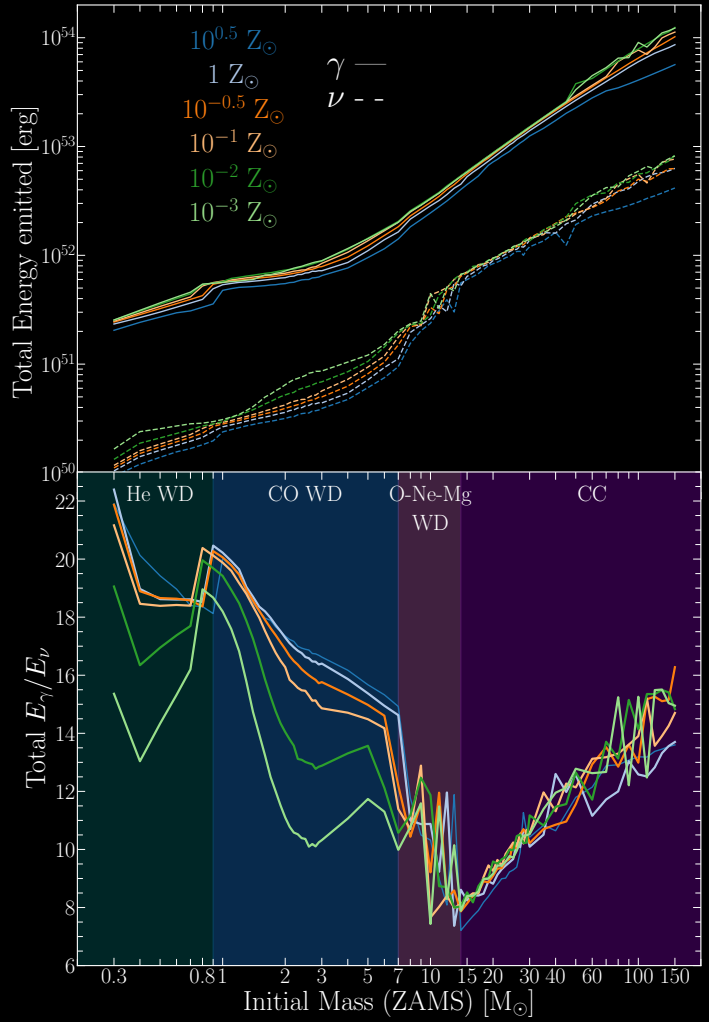


Farag et al 2024, Figure 1





Farag et al 2024, Figure 2



Farag et al 2024, Figure 3

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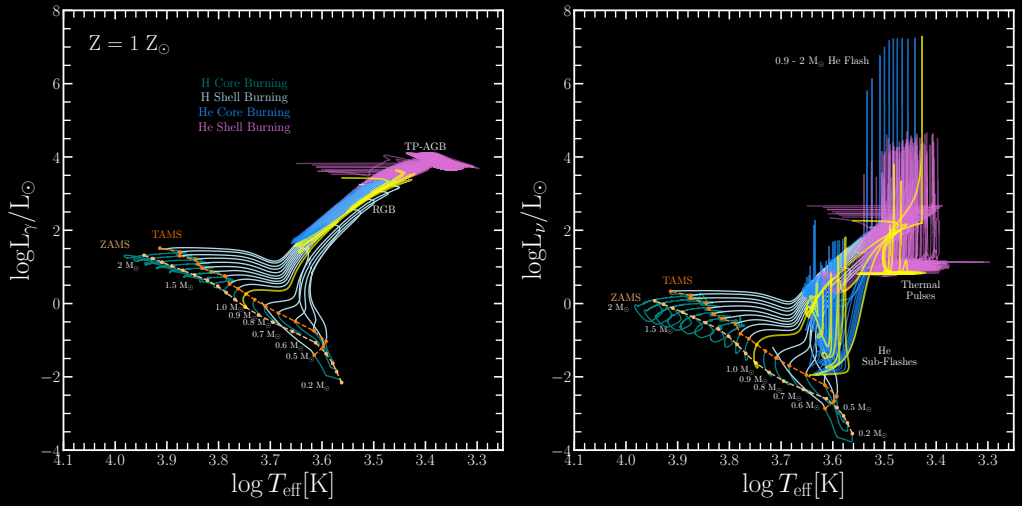

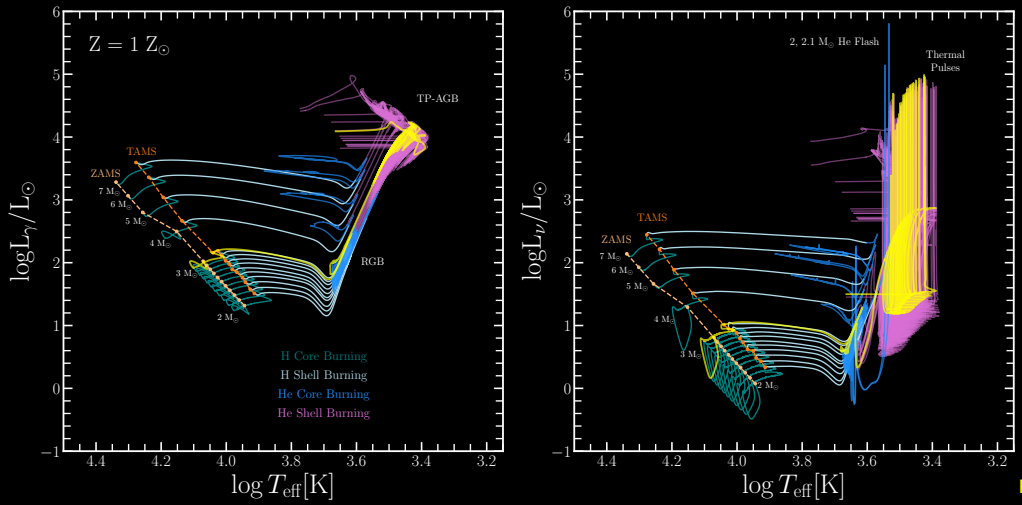

Farag et al 2024, Figure 5

Thank you for your time and attention.