The Evolution of Accreting Oxygen-Neon White Dwarfs

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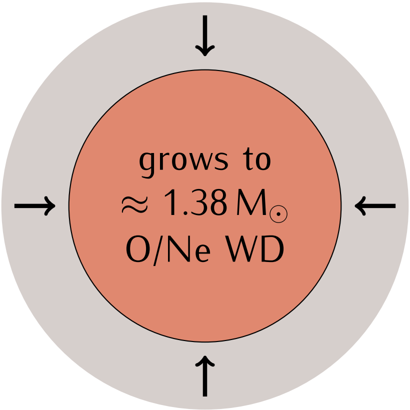
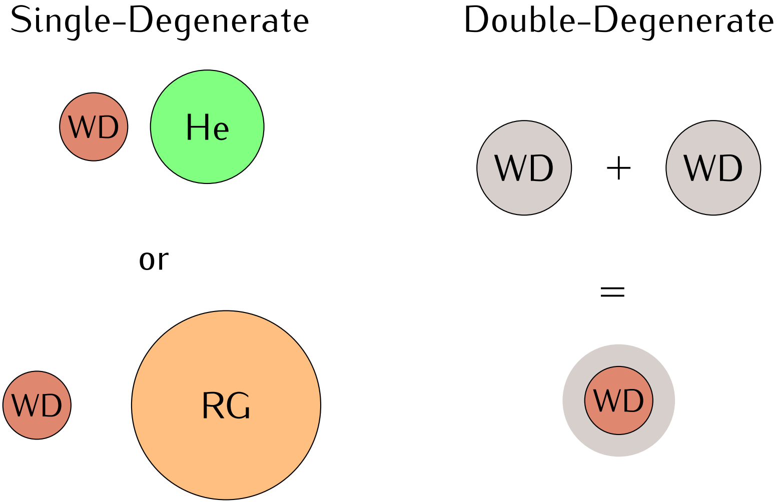
O/Ne WDs can collapse if they grow in mass and reach a critical central density.



AIC = Accretion-induced collapse

The progenitors of AIC are the "classic" (super-) Chandrasekhar Type Ia progenitor systems.



Multi-D models that explore the onset of collapse are not unambiguously showing formation of a NS.

- Leung & Nomoto (2017) emphasize that models flip between explosion and collapse within existing uncertainties in the initial model.
- Jones et al. (2016) find only their highest density models collapse to NSs, with other models leaving sub-Chandra bound remnants.

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- There may be a connection between AIC and low-mass WDs with peculiar compositions.

To improve our understanding, we want to produce more accurate AIC progenitor models.

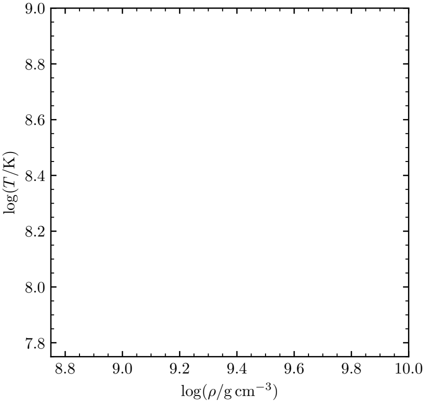
- There's been recent progress in providing suitable weak reaction rates and incorporating them in stellar evolution codes.

  Jones et al. (2013); Martinez-Pinedo et al. (2014); JS et al. (2015); Suzuki et al. (2016)

- We want models of ONe WDs with composition profiles self-consistently generated from SAGB star models.

  e.g., Camisassa et al. (2018); Lauffer et al. (2018)

Nuclear reactions on key isotopes in the WD have important and varied effects.



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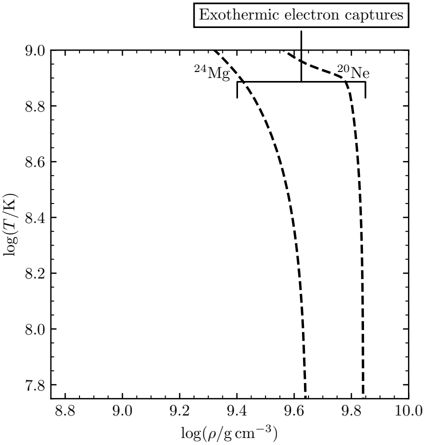

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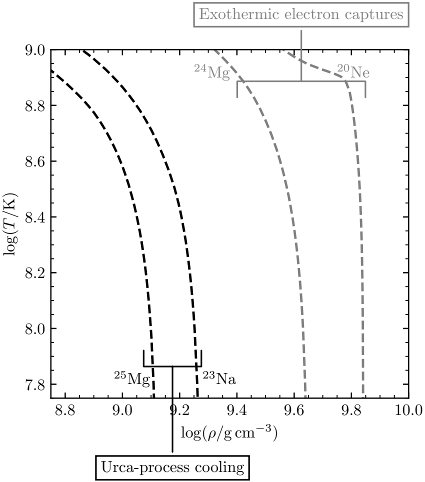

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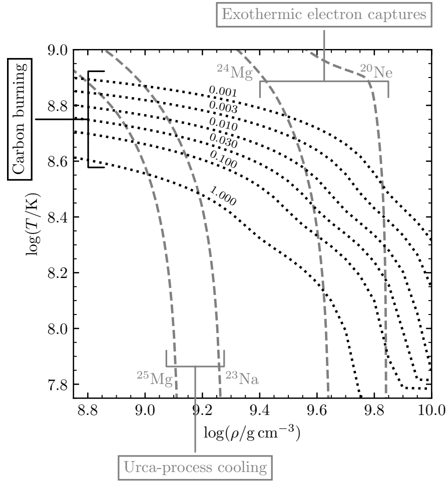
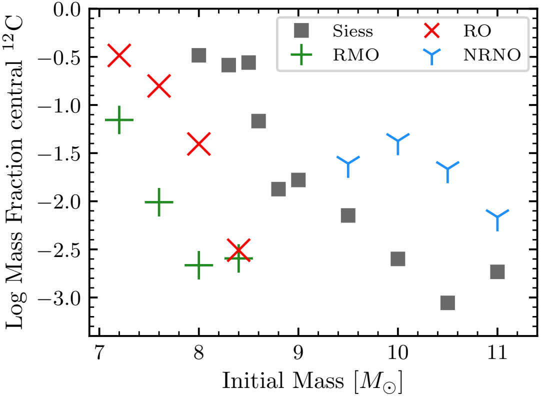


The amount of carbon left over depends on the mass of the star and the amount of overshooting.



e.g., Siess (2007); Fig. from JS & Rocha (in prep.)

As the WD cools, the interior mixes, erasing the initially complicated carbon profile.

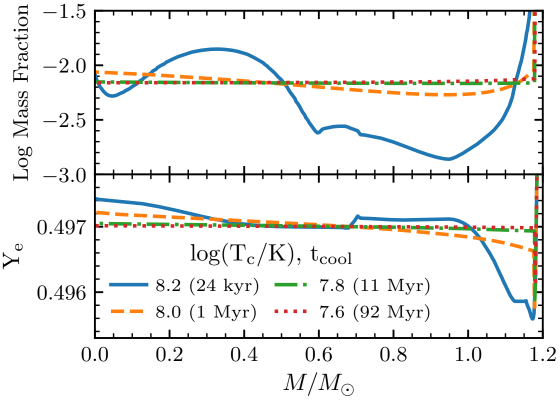
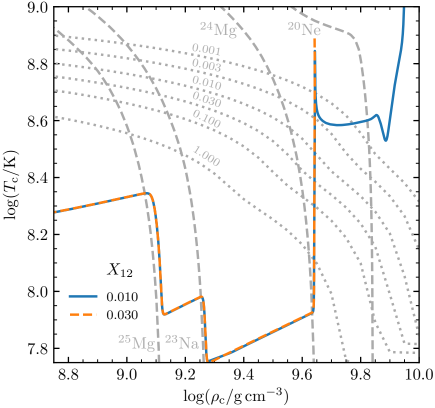


Fig. from JS & Rocha (in prep.)

Urca-process cooling precludes low-density carbon ignitions, but can still cause a significant shift.



c.f. Gutierrez et al. (2005); Fig. from JS & Rocha (in prep.)

Carbon burning can be triggered by exothermic electron captures.

- The presence of Urca-process cooling causes models to become convectively unstable when exothermic electron captures occur.

  JS et al. (2017)

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- The presence of Urca-process cooling causes models to become convectively unstable when exothermic electron captures occur.

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- The additional entropy generation from carbon burning makes the models even more unstable.
- Convection under these conditions is challenging to model due to the operation of the convective Urca process.

  e.g., Lesaffre et al. (2005)

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- One important way to push this question forward is to use ONe WD models generated self-consistently from SAGB star evolution.
- The presence of carbon can have an important effect and the expected range of carbon abundance variation is such that one might expect it to lead to a diversity of outcomes.