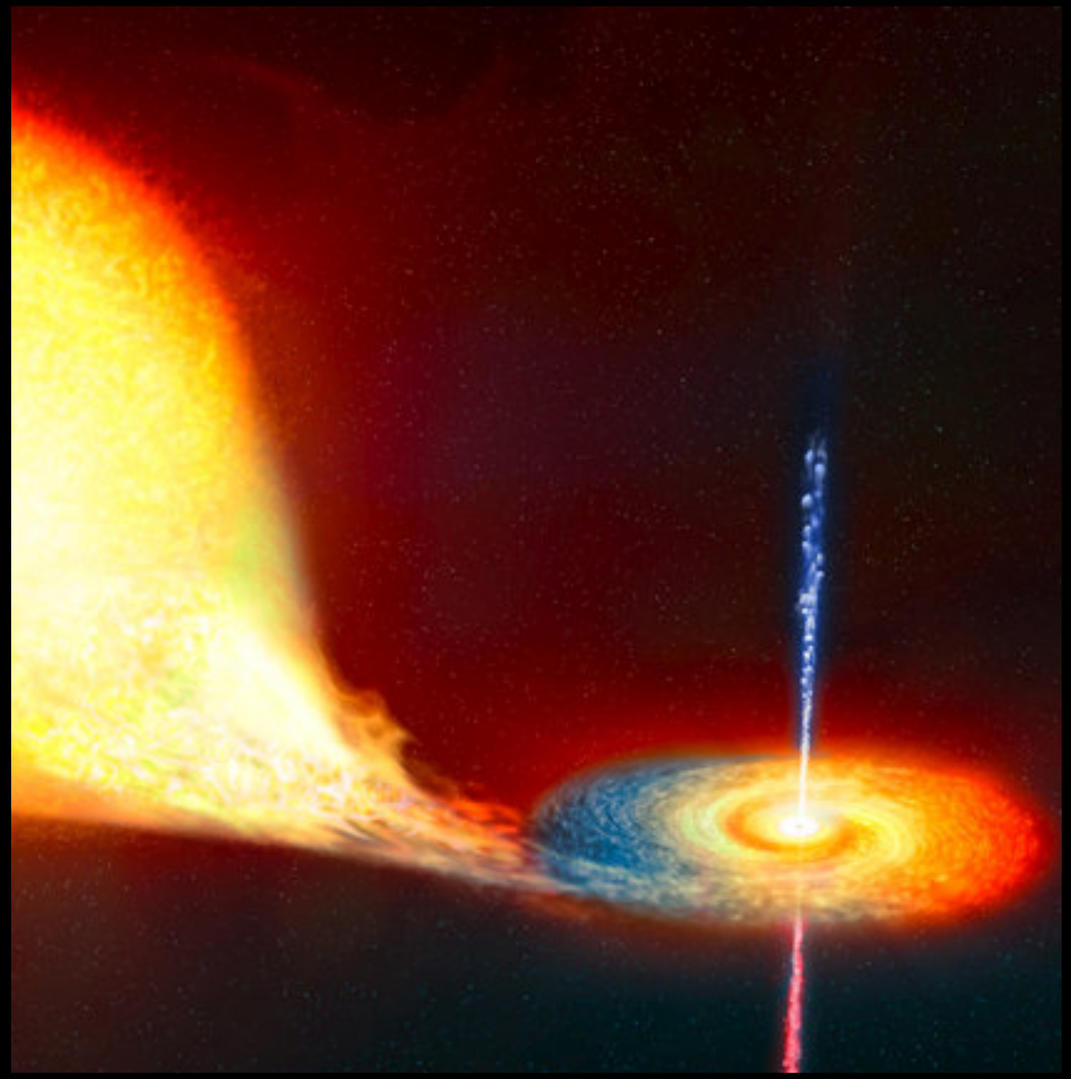
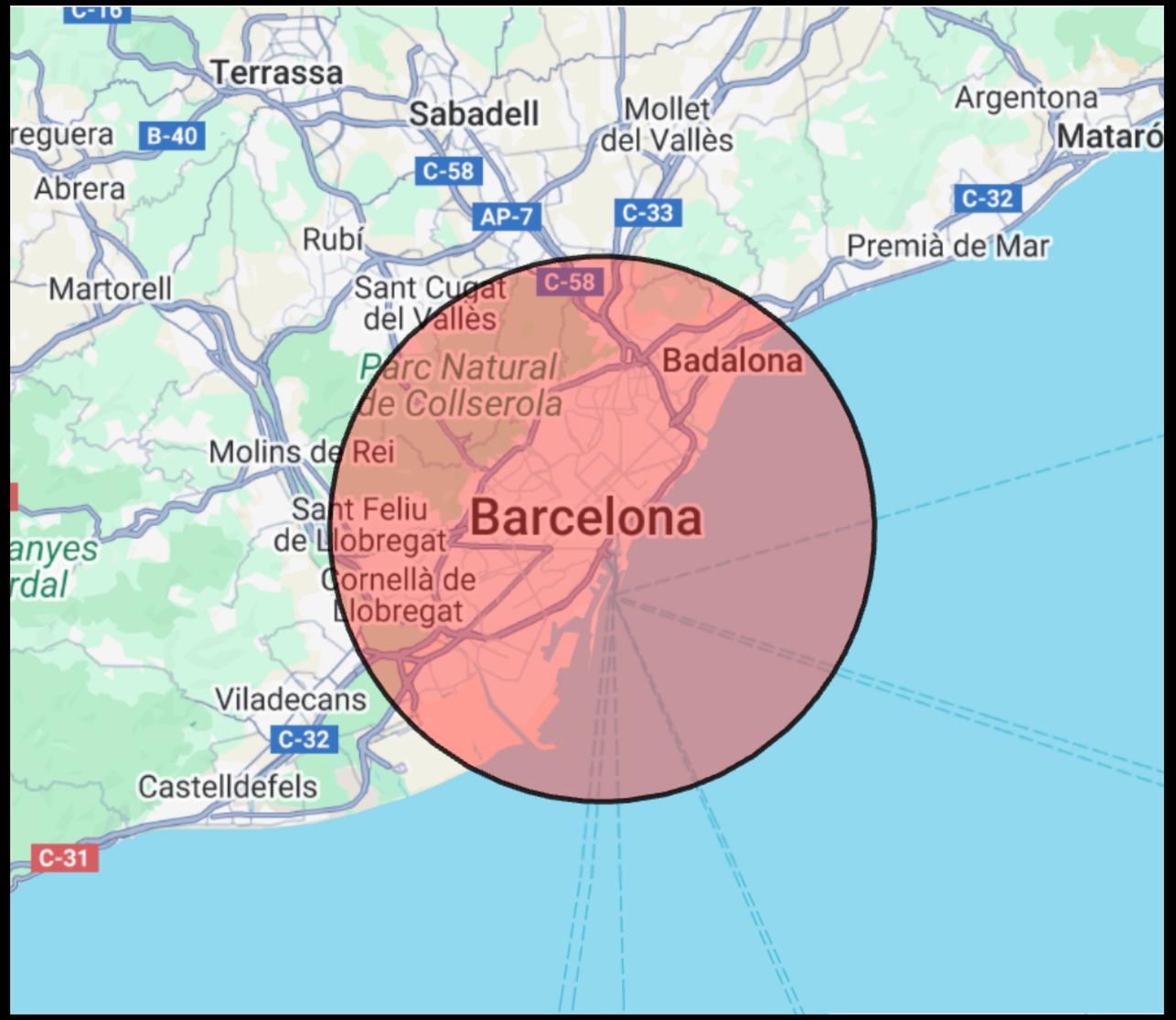


H-triggered X-ray Bursts on Slowly Accreting Neutron Stars

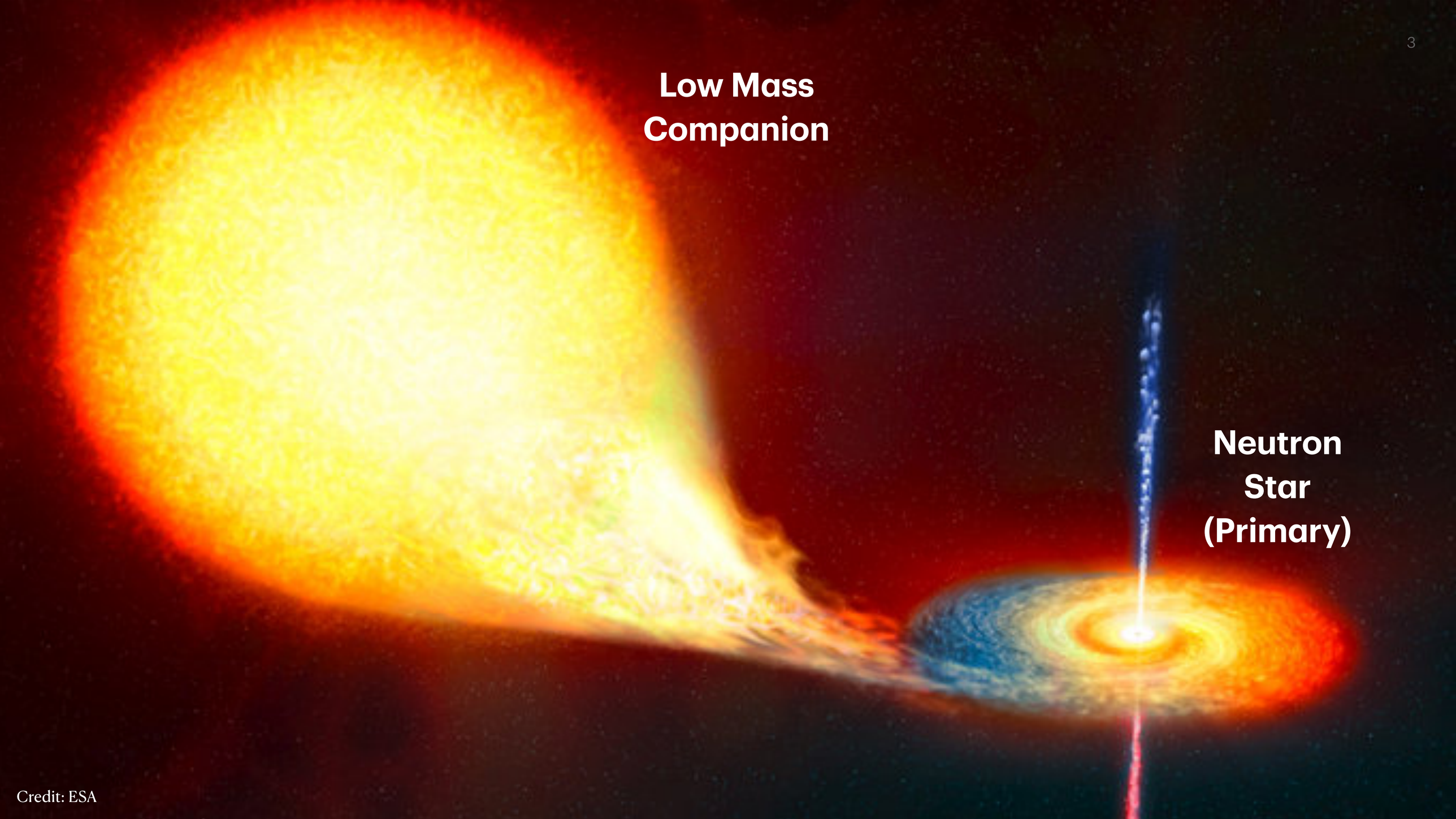
NIC 2025

Sierra Casten

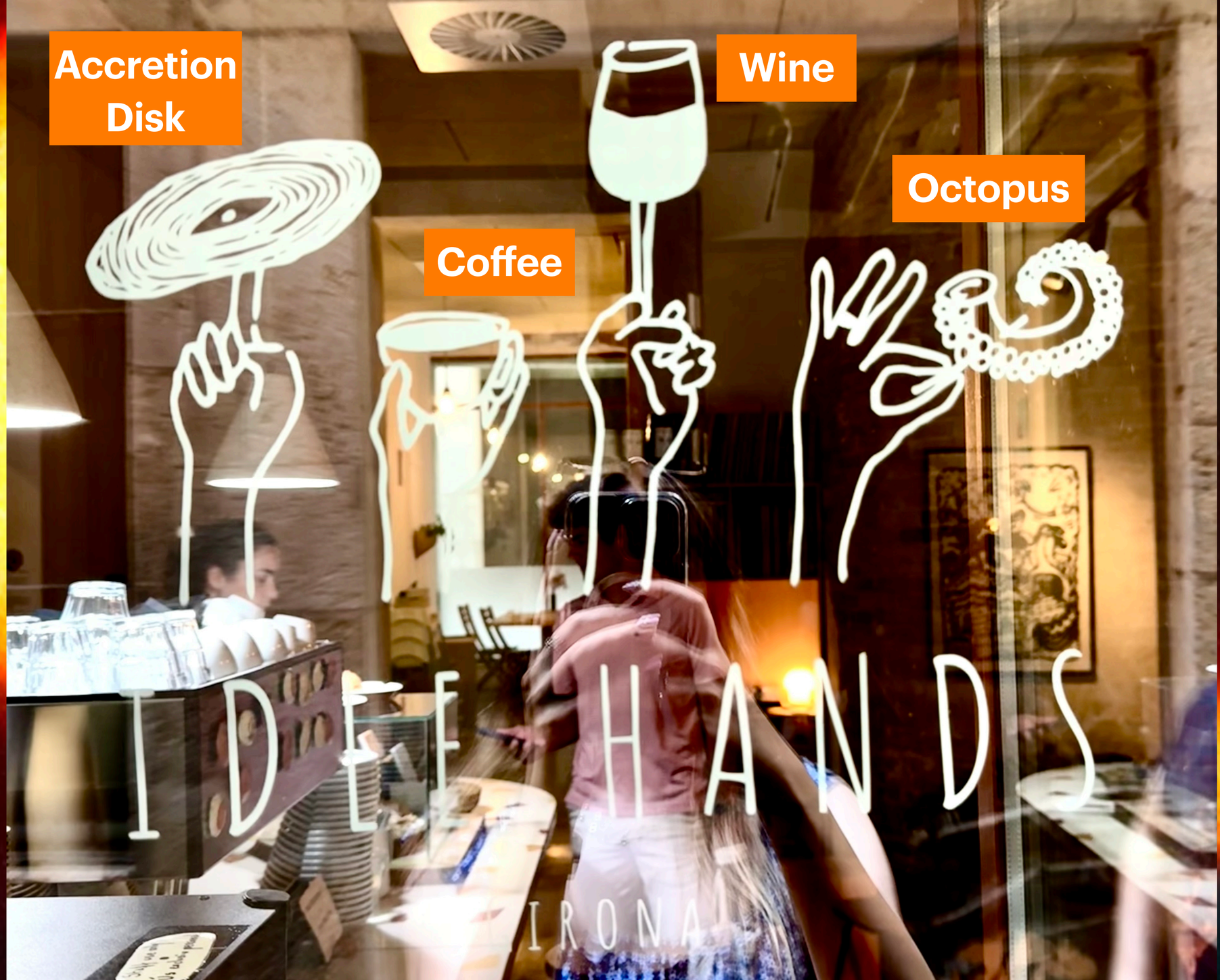


$$M = 1.4\,\mathrm{M}_\odot$$

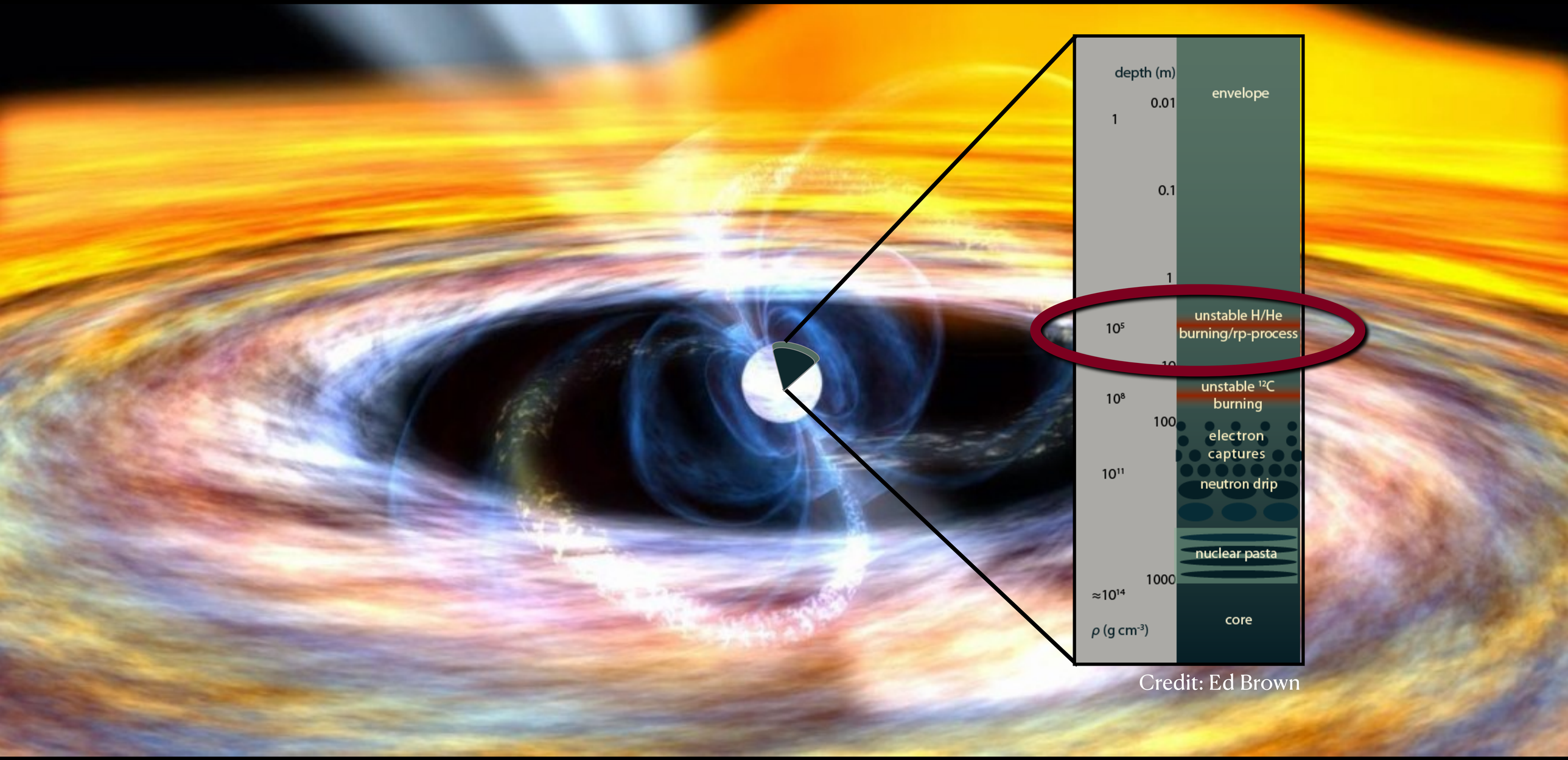
$$R = 12\,\mathrm{km}$$



Credit: ESA



Credit: ESA



Credit: Ed Brown

Credit: NASA/GSFC/Dana Berry

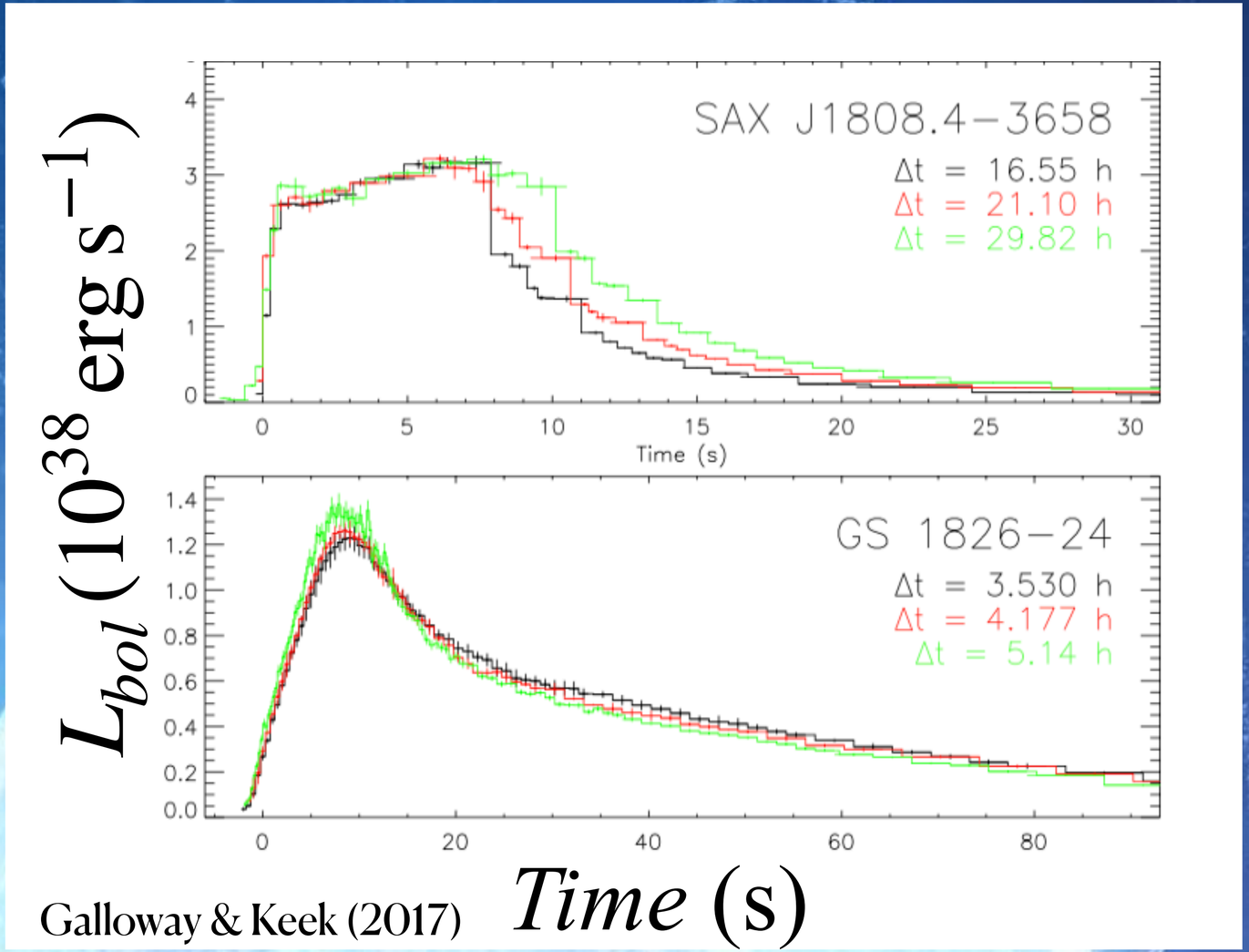
Credit: NASA/GSFC/Chris Smith

lower $\dot{M}$

He-rich burst ignited (after the accreted H has been exhausted)

high $\dot{M}$

Mixed H/He burst



Galloway & Keek (2017)

Credit: NASA/GSFC/Chris Smith

He-triggered

lower $\dot{M}$

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high $\dot{M}$

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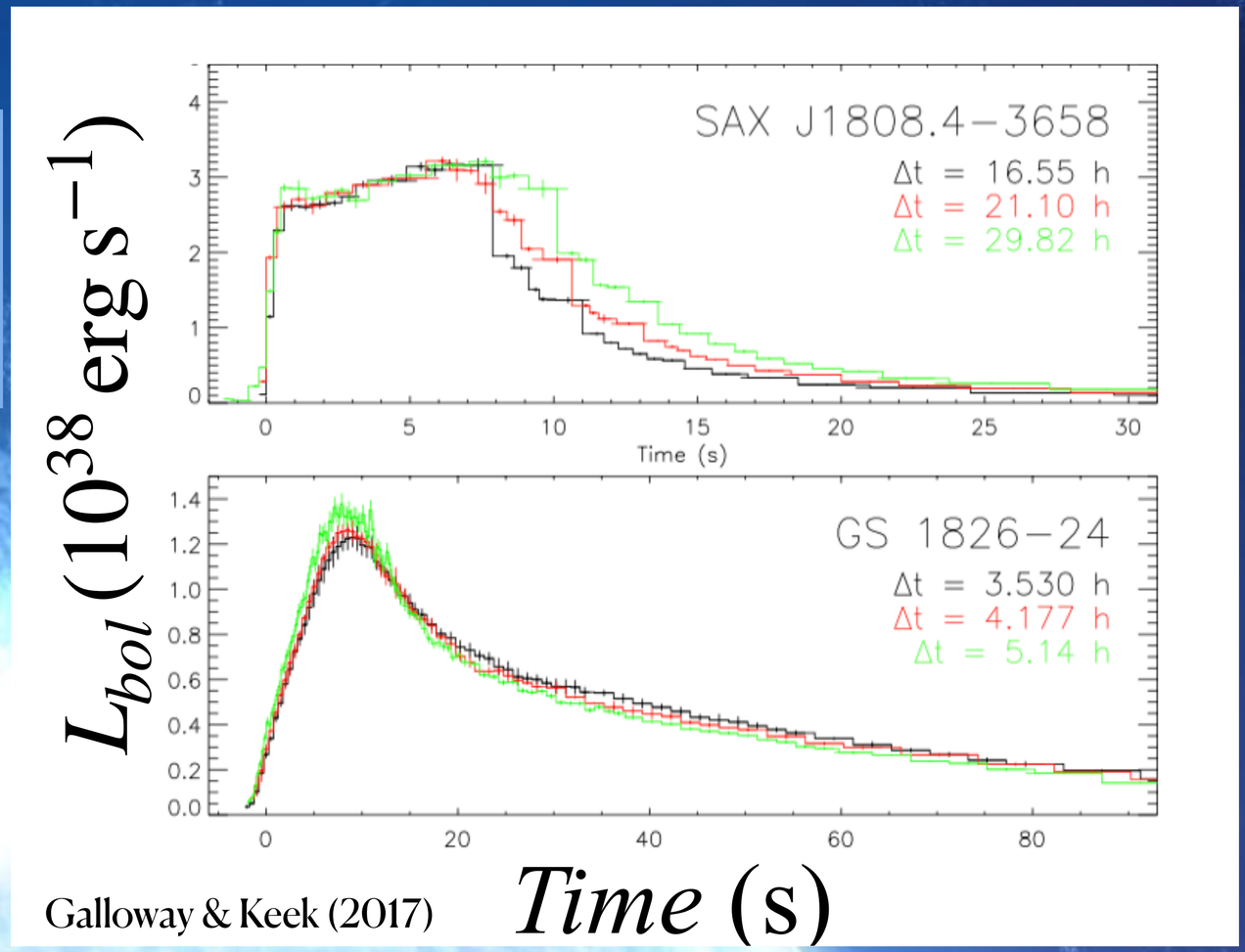


Galloway & Keek (2017)

H-triggered

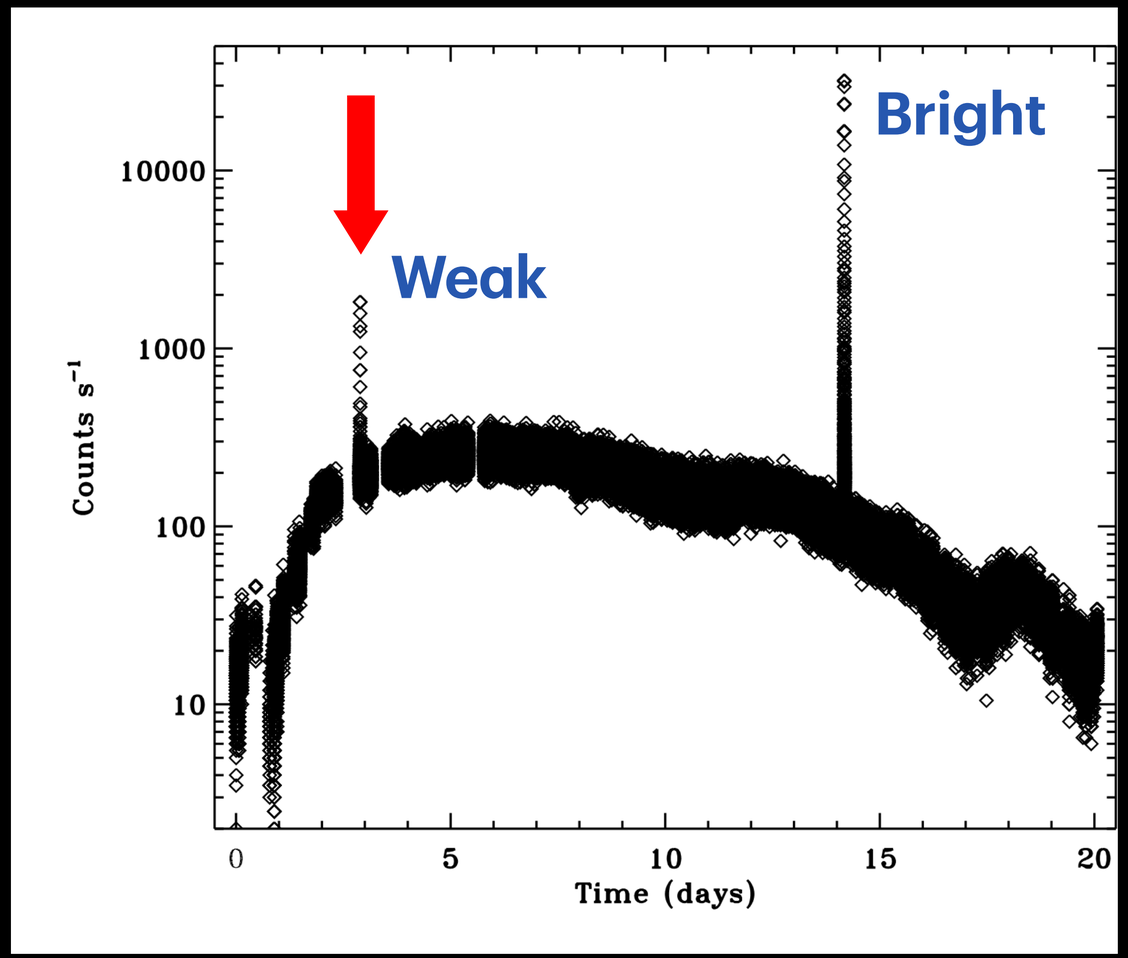
???

Credit: NASA/GSFC/Chris Smith

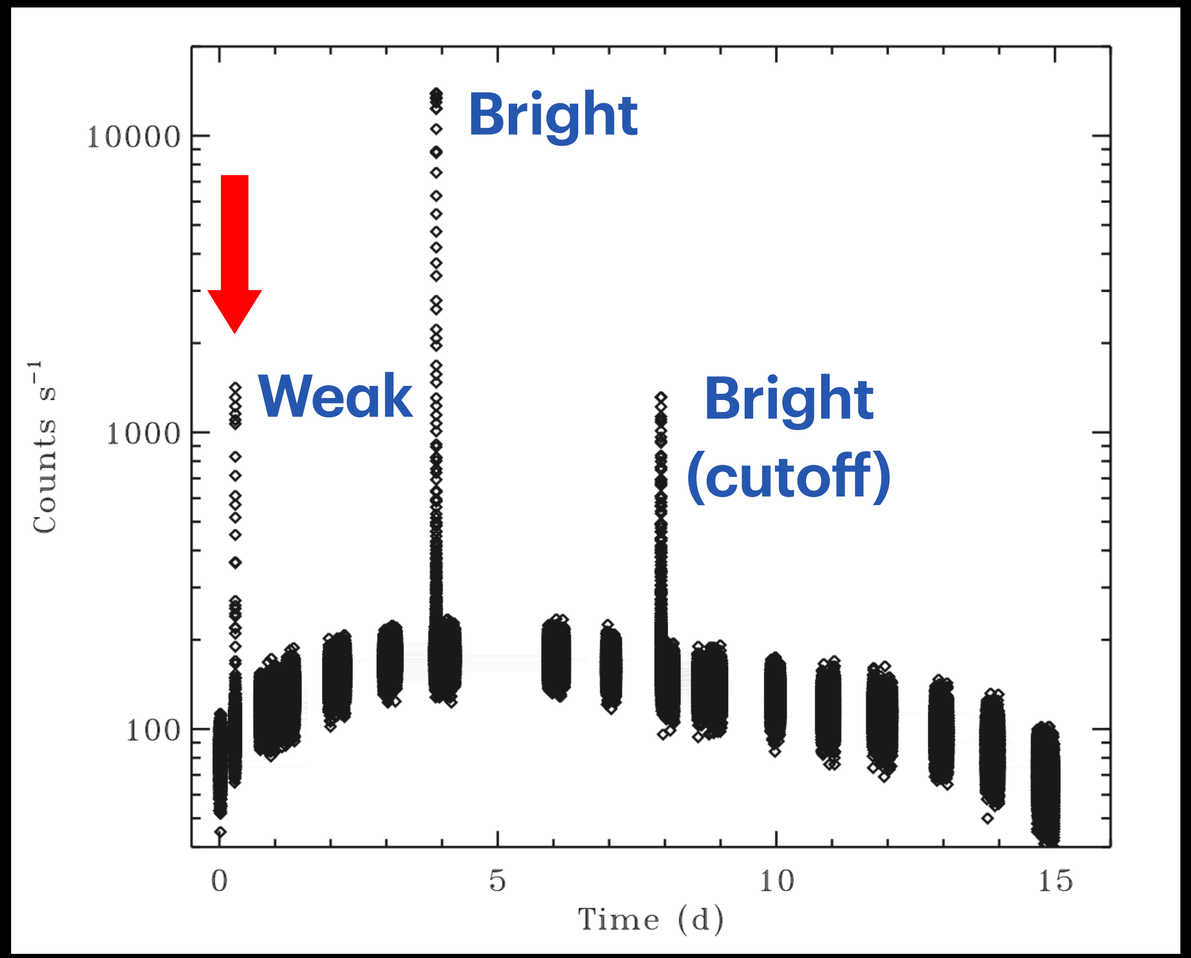
Weak Bursts from SAX J1808.4-3658

H-triggered bursts?

NICER (2019)



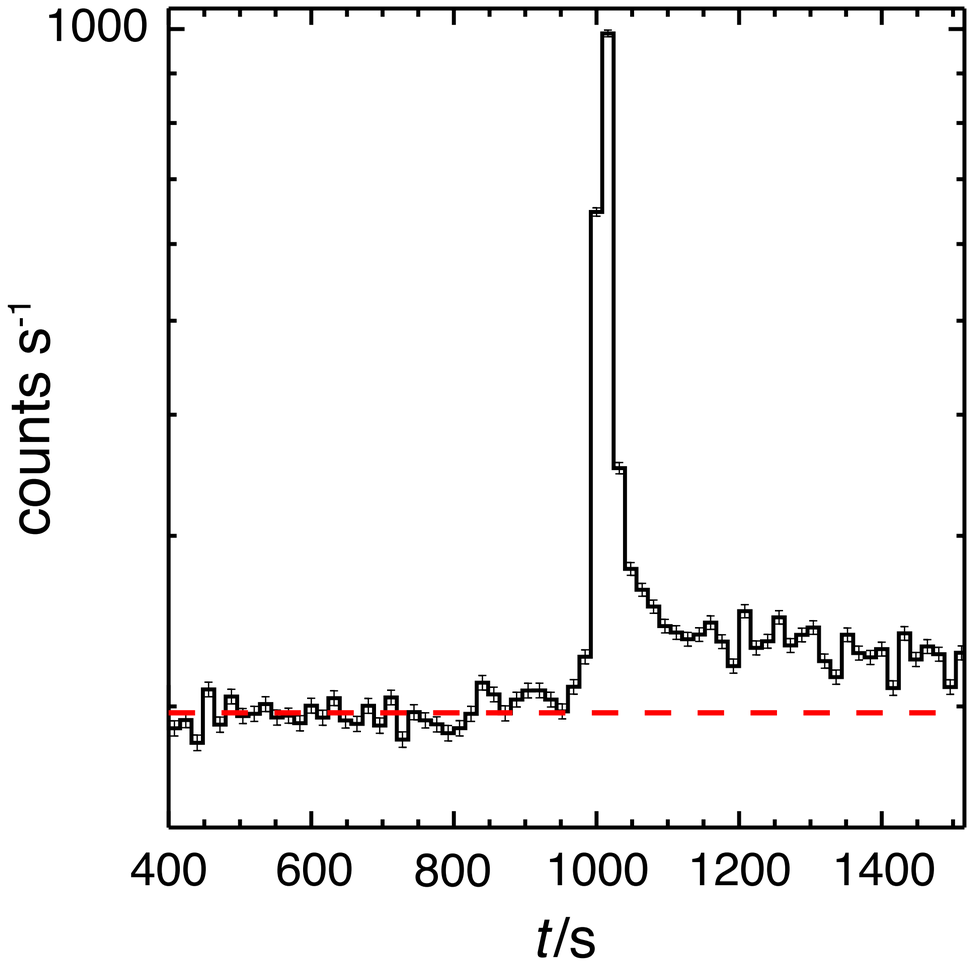
RXTE (2005)



Casten, S., Strohmayer, T., Bult, P. (2023)

lowest $\dot{M}$

H-triggered Burst



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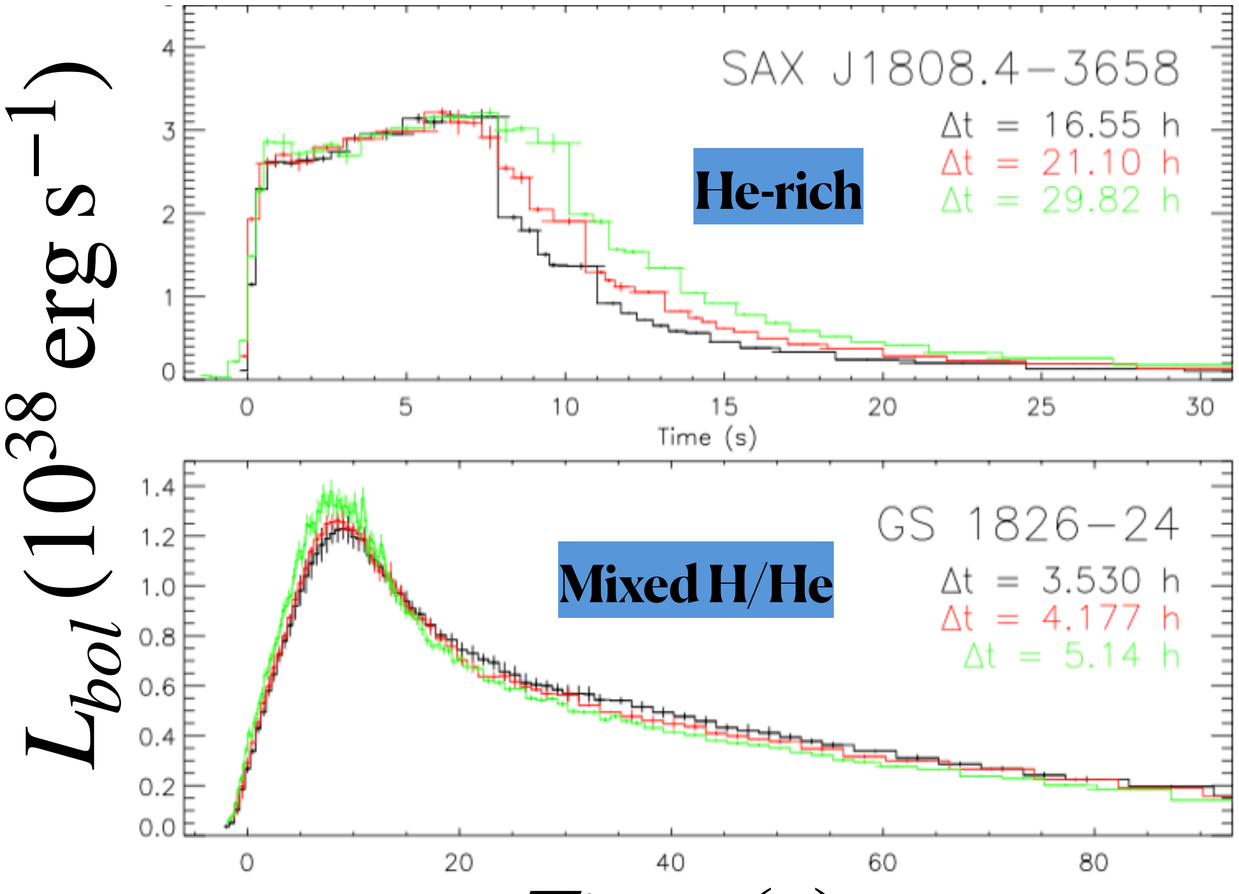
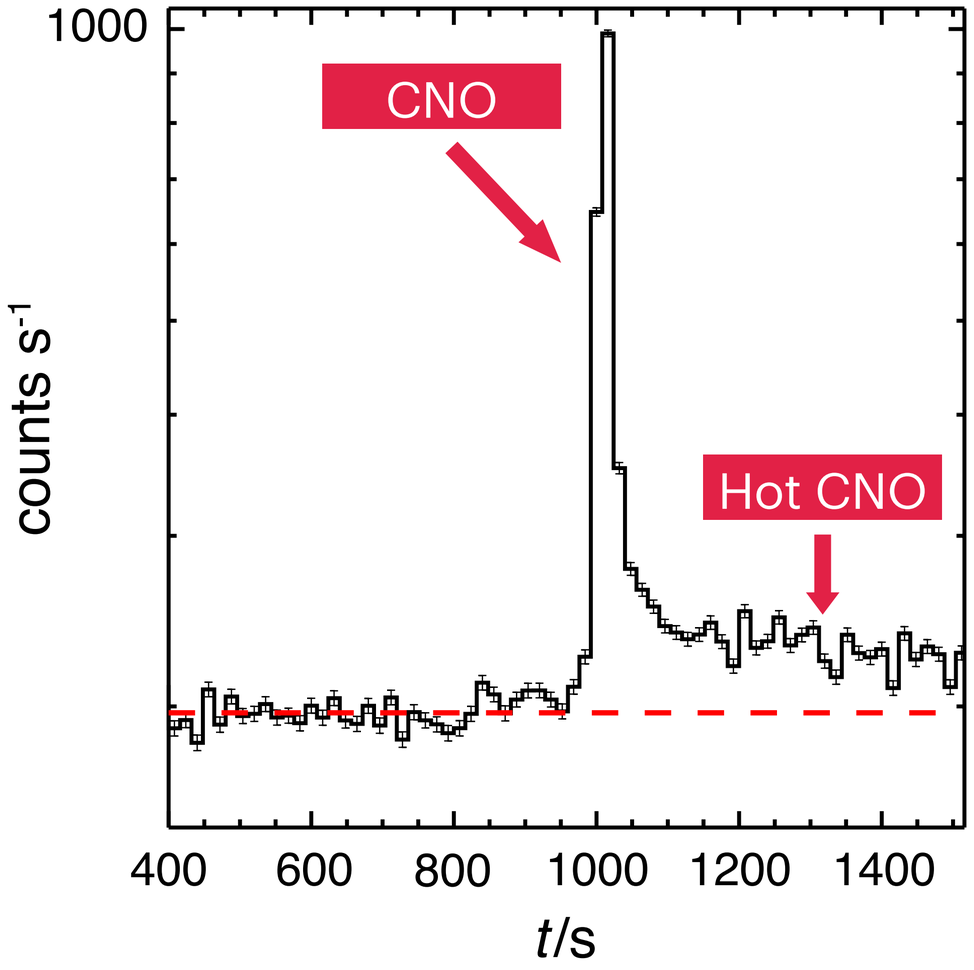


Galloway & Keek (2017)

Credit: NASA/GSFC/Chris Smith

lowest $\dot{M}$

H-triggered Burst



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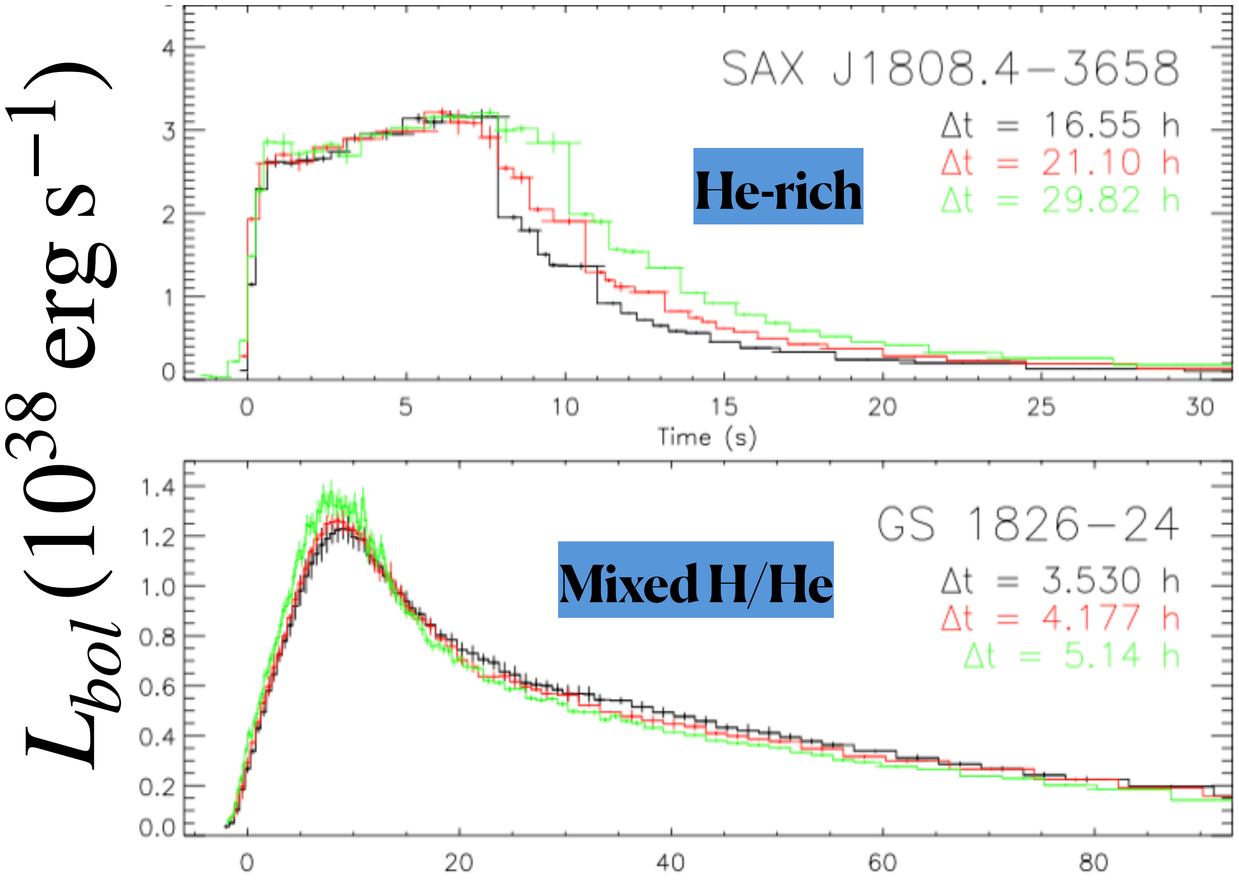


Galloway & Keek (2017)

Credit: NASA/GSFC/Chris Smith

Low $\dot{M}$

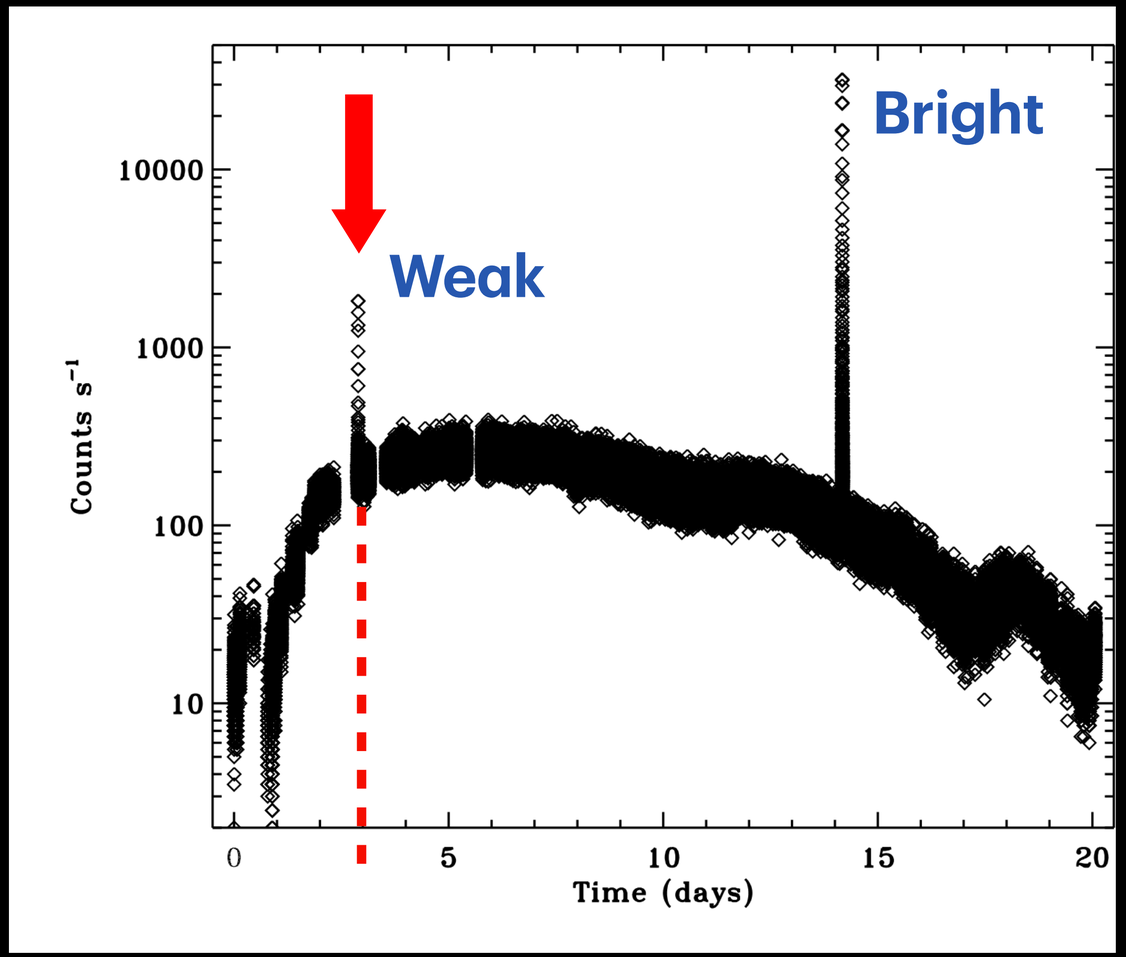
$\sim 10^{-10}\,M_\odot\,yr^{-1}$

+

"Cool" Neutron Star

Low $\dot{M}$ + "Cool" Neutron Star + Confined to early onset of active accretion?

NICER (2019)



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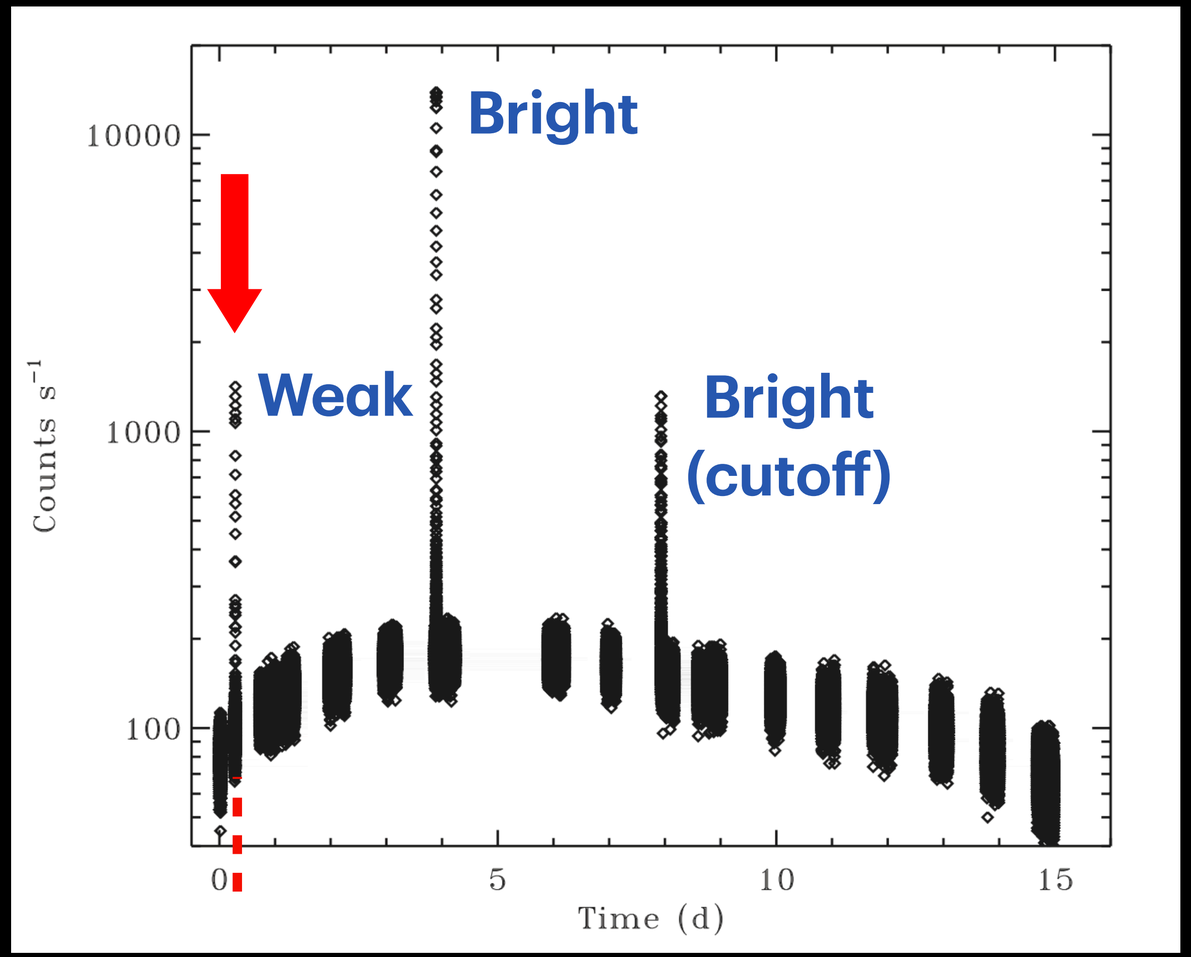
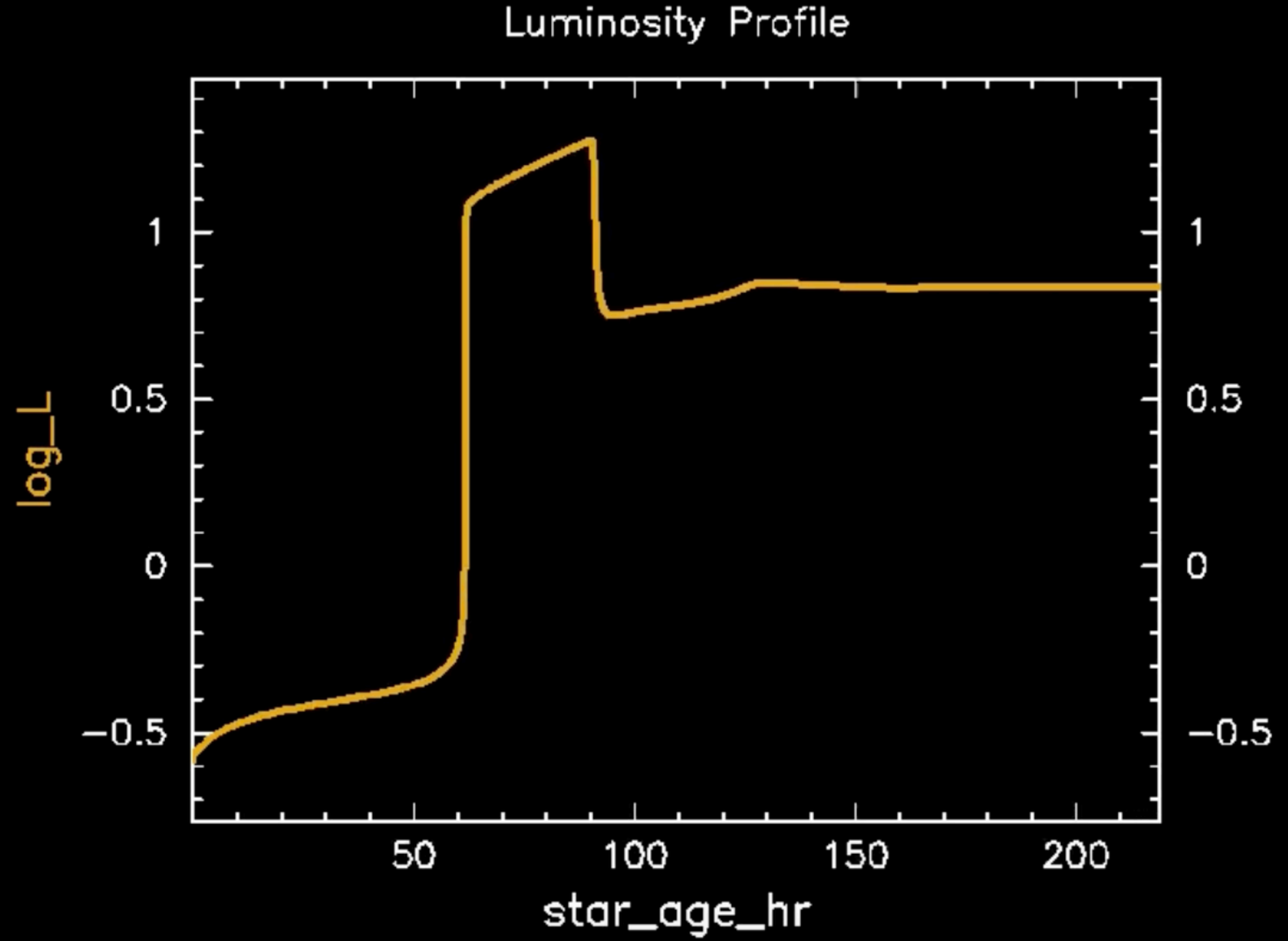


Casten, S., Strohmayer, T., Bult, P. (2023)

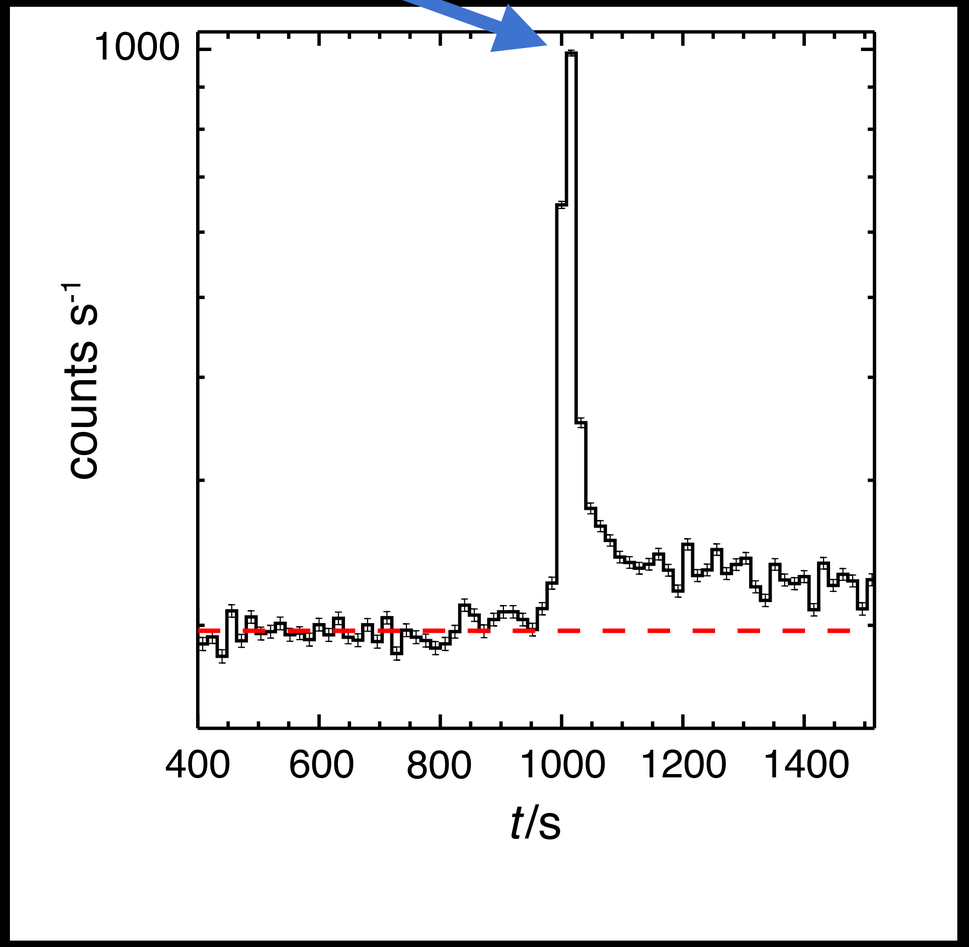
MESA

Solar Metallicity, 1e-10 $M_\odot\ \mathrm{yr}^{-1}$



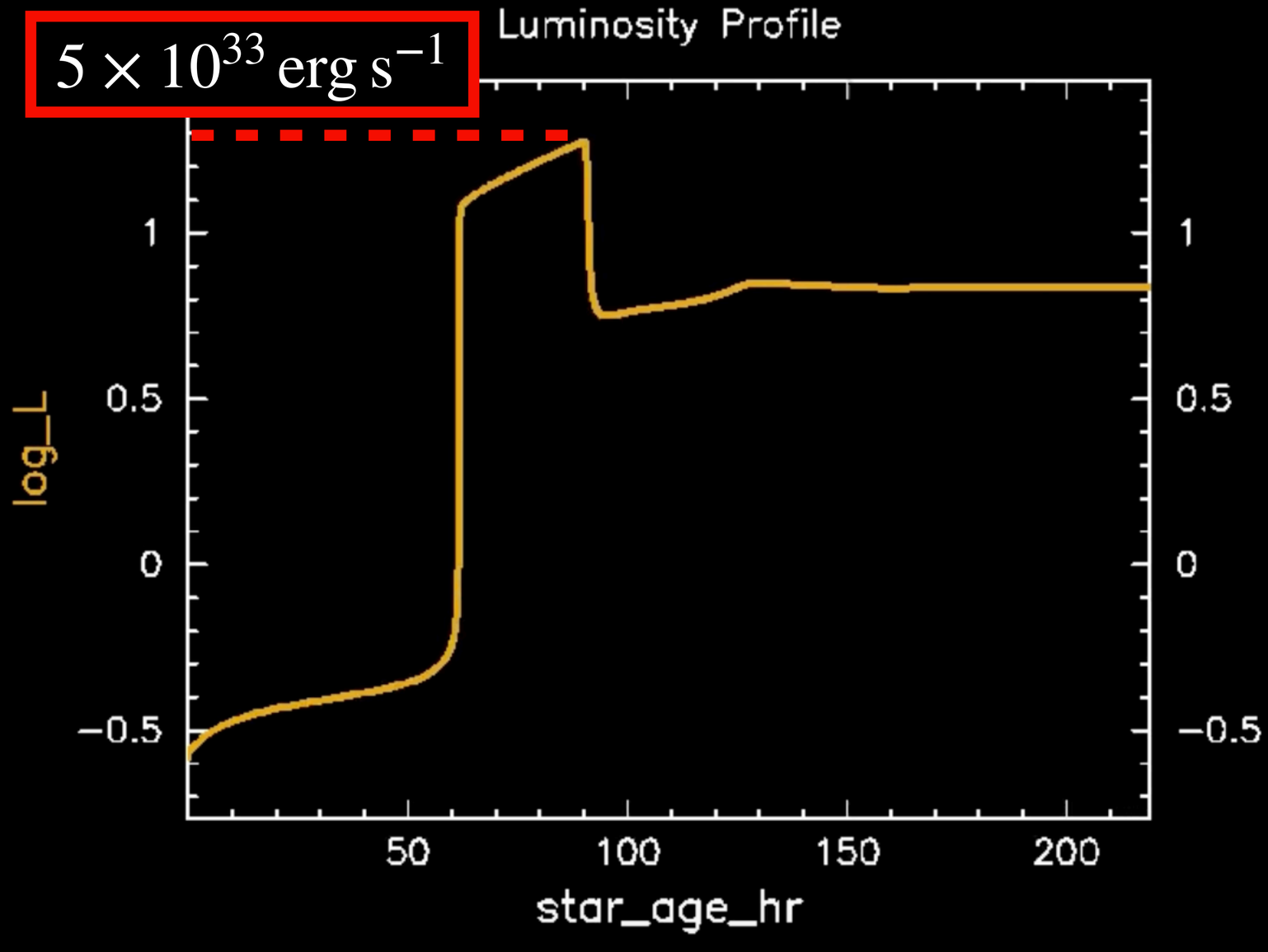
MESA

$L_p \approx 10^{37}\ \mathrm{erg\ s^{-1}}$



Solar Metallicity, 1e-10 $M_\odot\ \mathrm{yr}^{-1}$

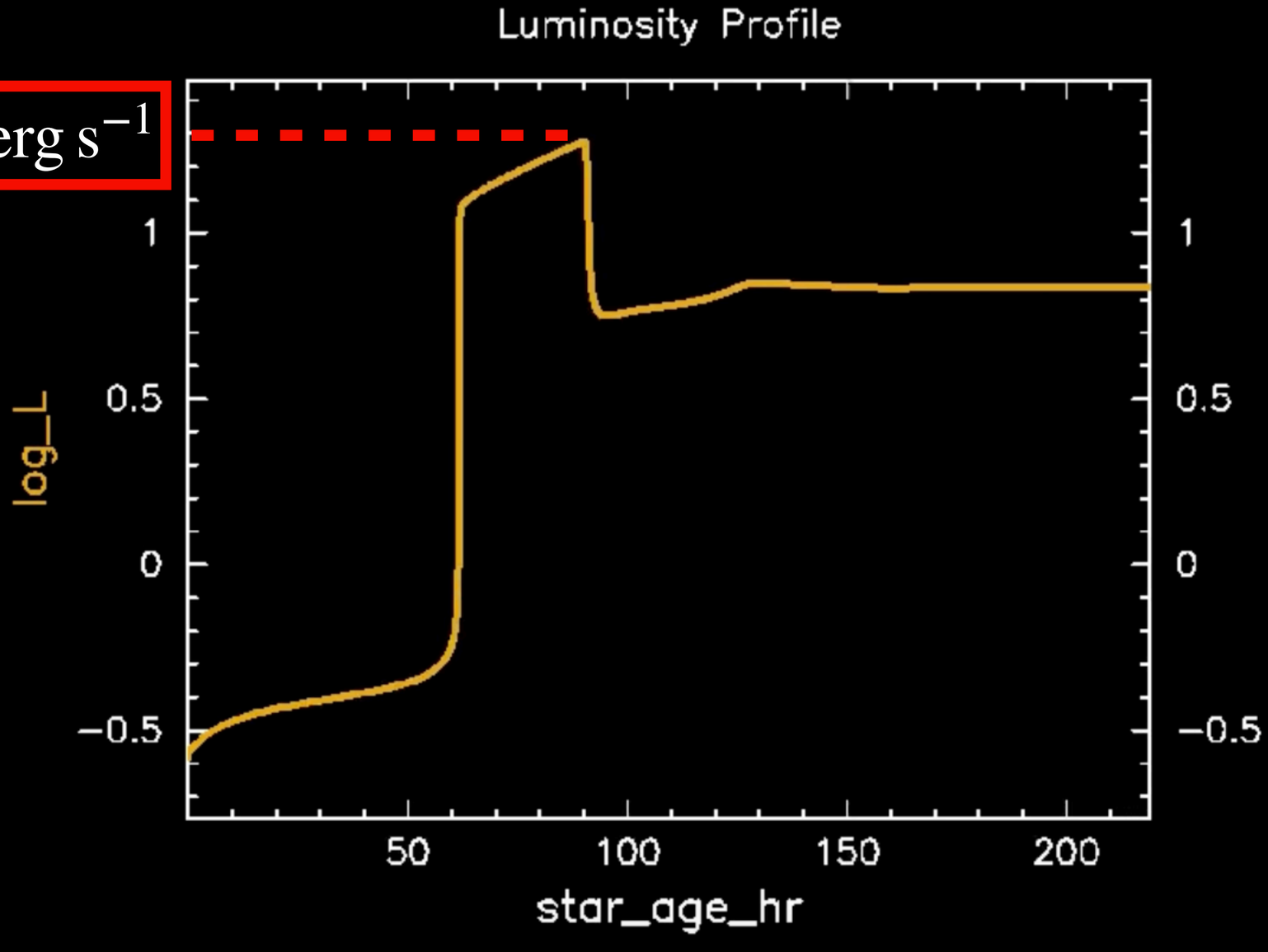
$5 \times 10^{33}\ \mathrm{erg\ s^{-1}}$



MESA

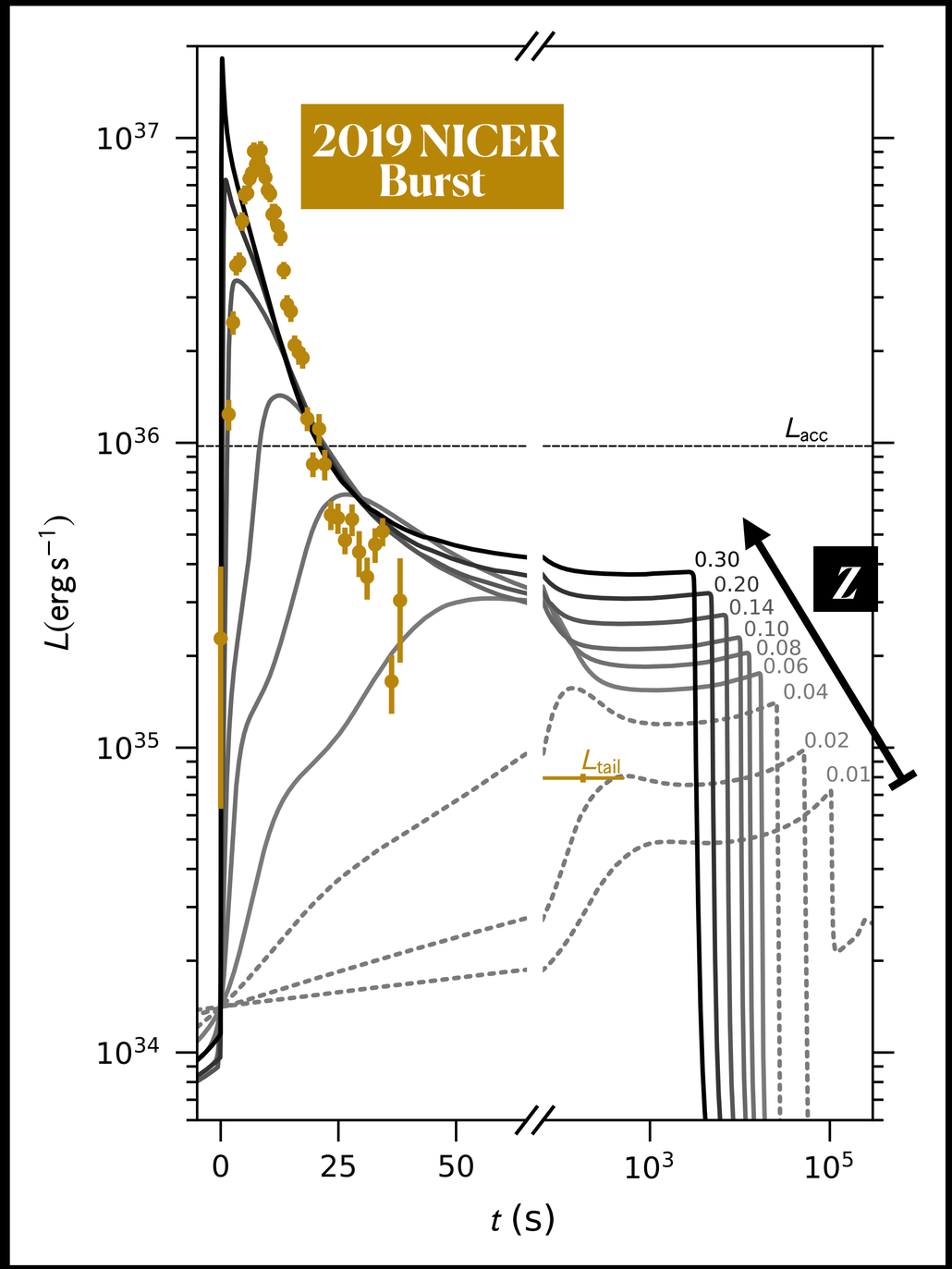
Solar Metallicity, 1e-10 $M_\odot\,\mathrm{yr}^{-1}$

$$5 \times 10^{33}\,\mathrm{erg\,s^{-1}} << L_{acc} = 10^{36}\,\mathrm{erg\,s^{-1}}$$



Modeling Weak Bursts with MESA

Enhanced CNO in Accreted Material

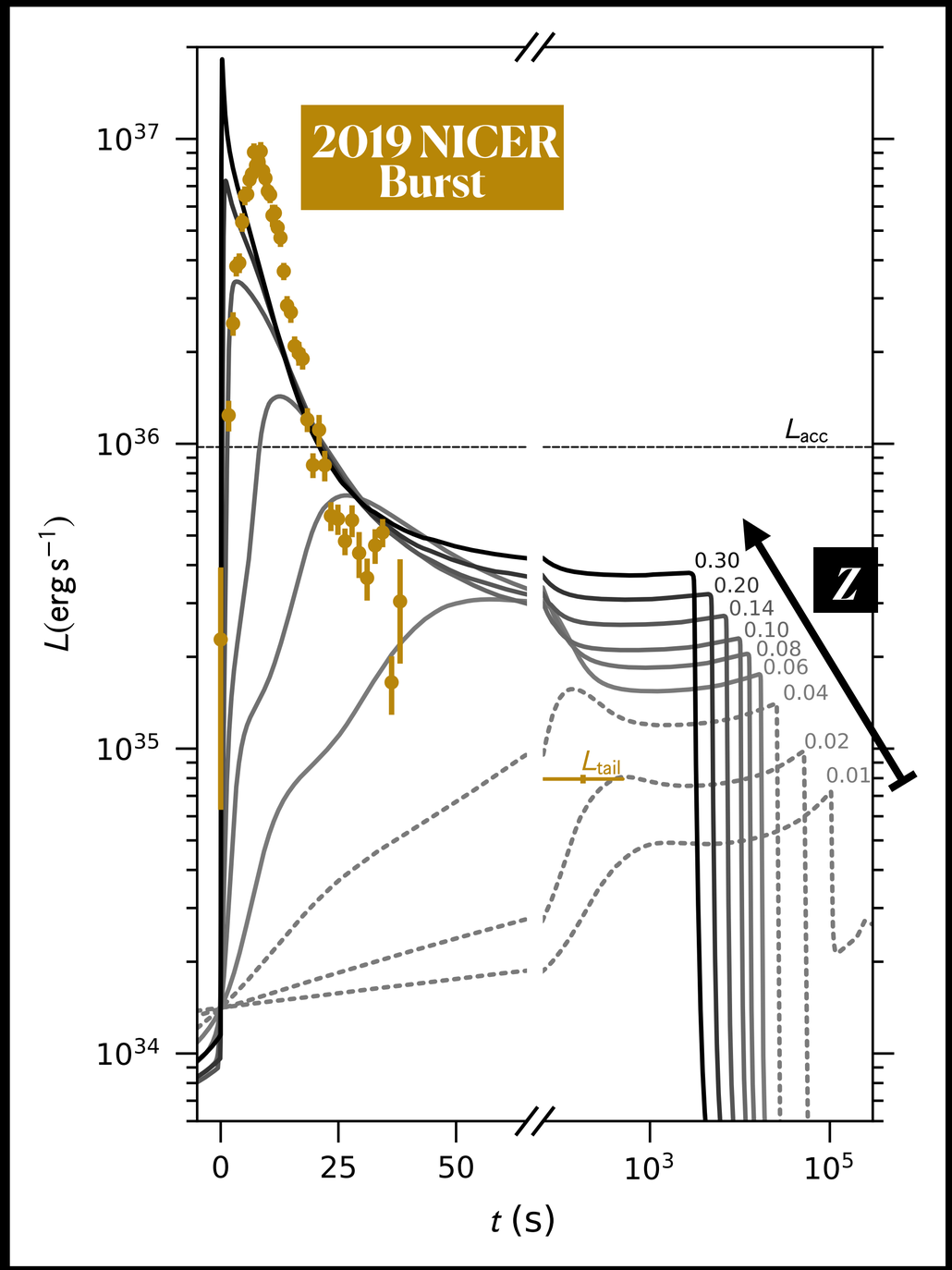


Casten, S., Guichandut, S., Cumming, A., Brown, E. F. (Submitted to ApJ 2025)

Modeling Weak Bursts with MESA

Enhanced CNO in Accreted Material

- ✳ **Burst Profile Shape & Nuclear Burning**



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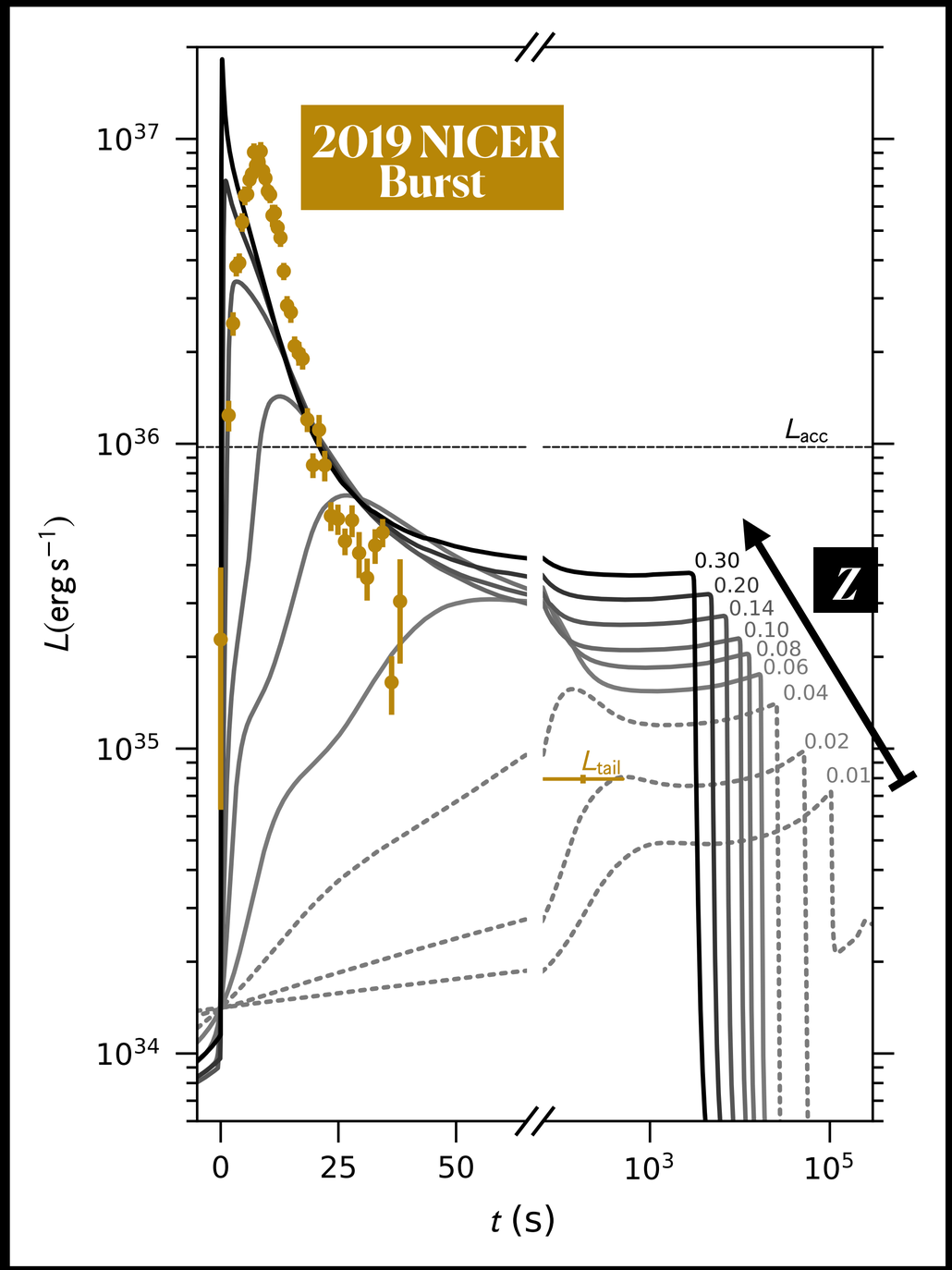
Modeling Weak Bursts with MESA

Enhanced CNO in Accreted Material

- Burst Profile Shape & Nuclear Burning
- Produced Observable H bursts



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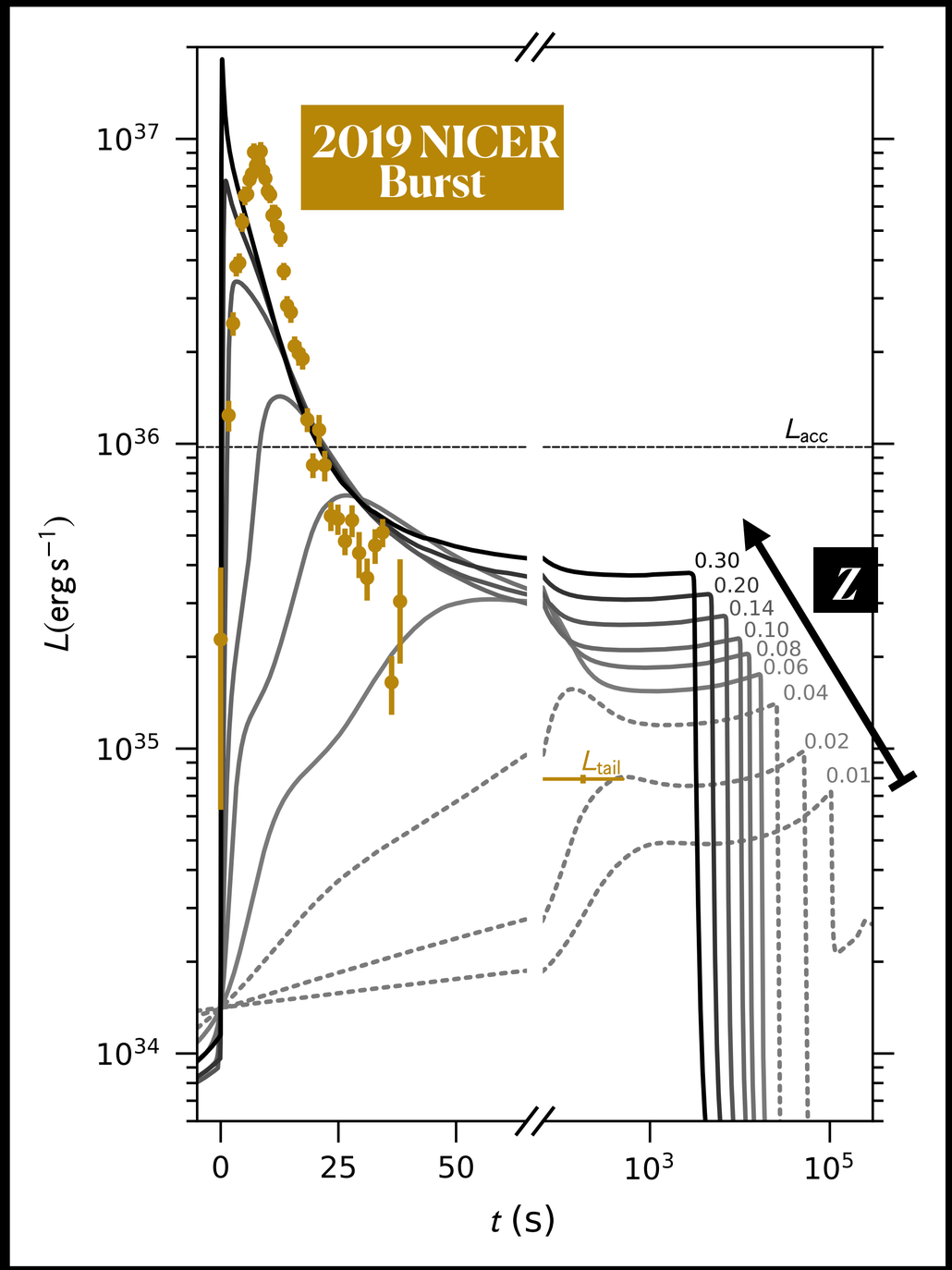
Modeling Weak Bursts with MESA

Enhanced CNO in Accreted Material

- Burst Profile Shape & Nuclear Burning
- Produced Observable H bursts
- L_{peak}/L_{tail} discrepancy



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Research Takeaways

Conditions for H-triggered Bursts:

- Low Accretion Rates
- "Cool" Neutron Star
- Confined to early onset of active accretion? (need more observations!)

Simulations Indicate:

- Must Be Enhanced Metallicity
- Sedimentation and Mixing ?

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This work was enabled by the National Science Foundation under grant PHY-1430152 (JINA Center for the Evolution of the Elements), and supported by NASA under grant 80NSSC20K0503. A special thanks and acknowledgment to AAS for international travel support for this conference.

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