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UNIVERSITY  
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Faculty of Physics, Astronomy  
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# Progenitors of LGRBs: Are single stars enough?

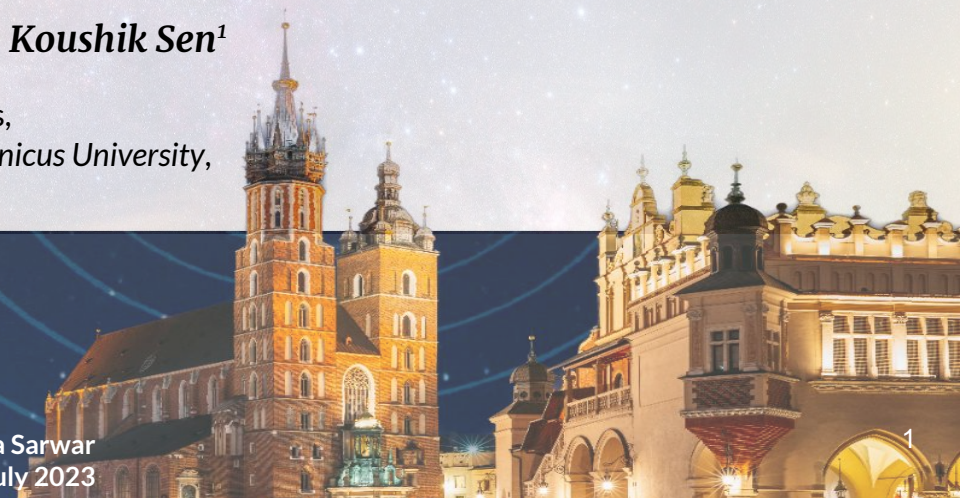
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Astronomy and Informatics, *Nicolaus Copernicus University*,  
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EUROPEAN ASTRONOMICAL  
SOCIETY ANNUAL MEETING

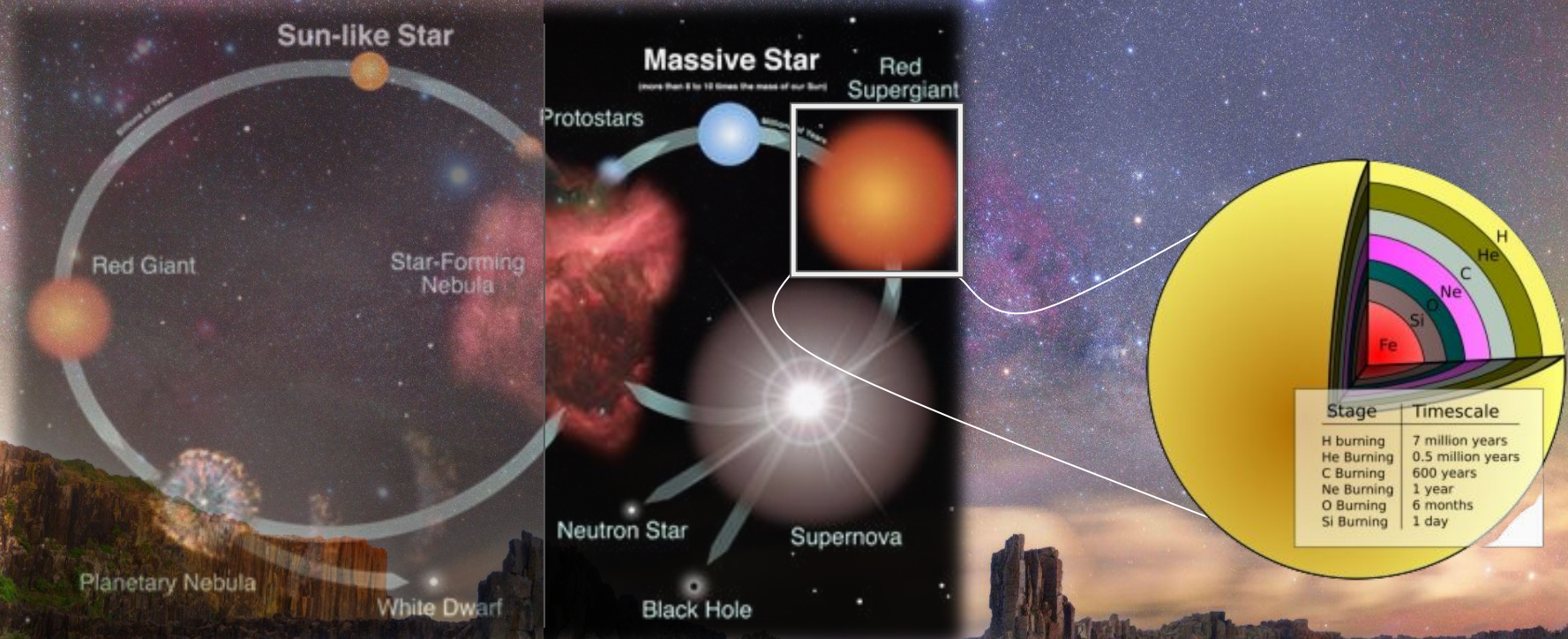
Rafia Sarwar  
10 July 2023







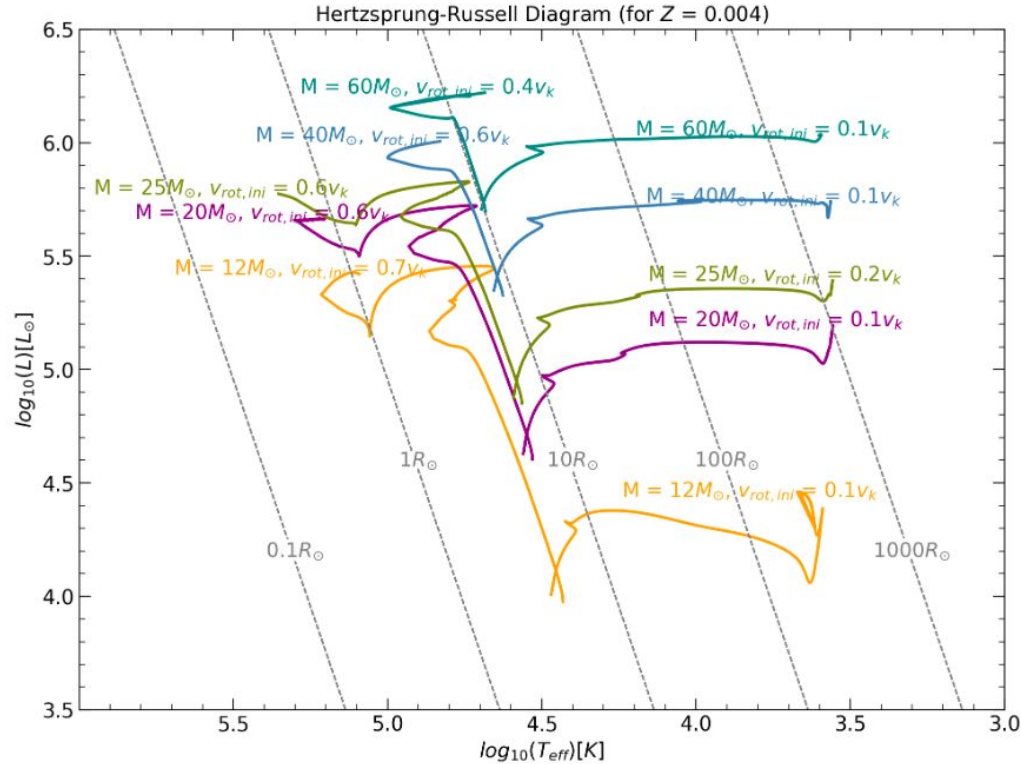
# Massive stars





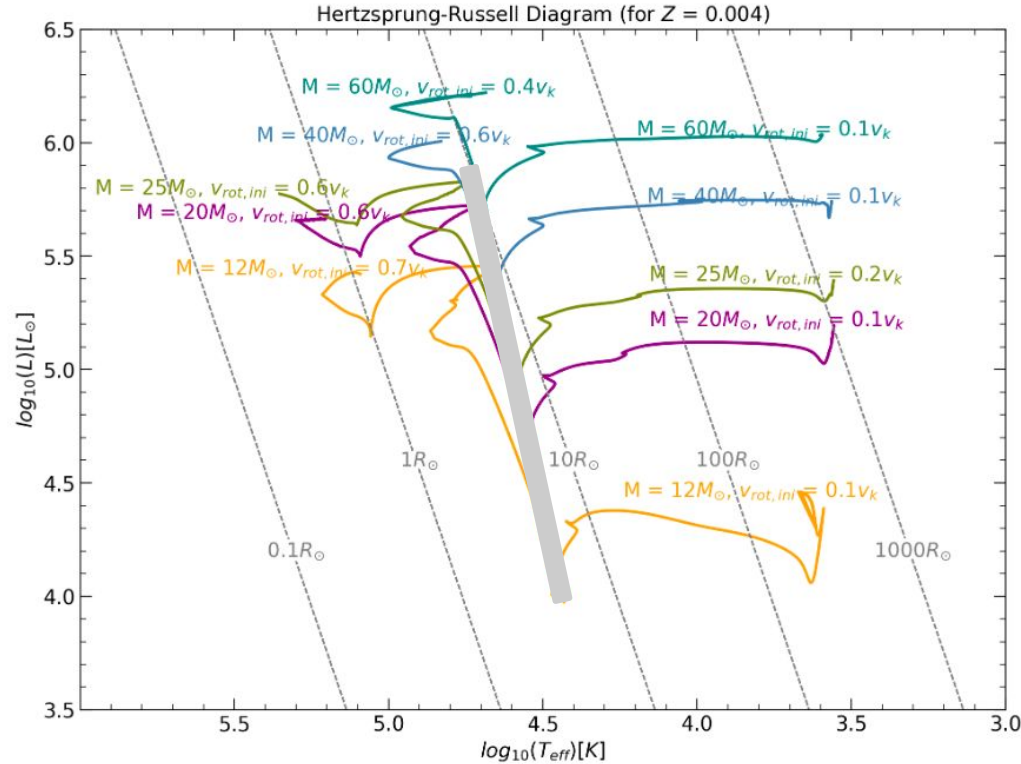


# Evolution of massive stars





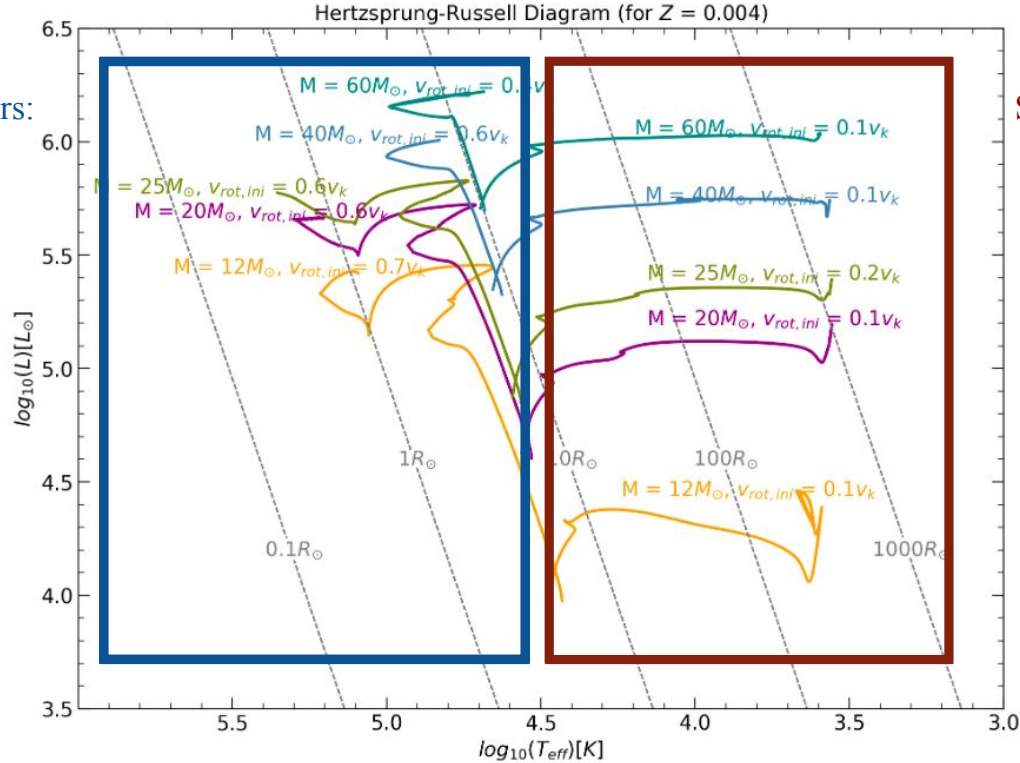
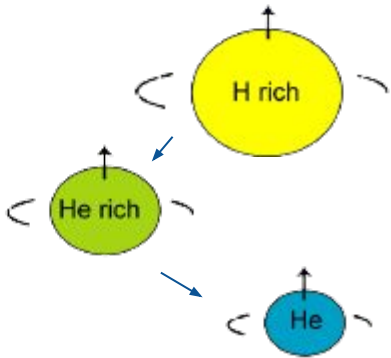
# Evolution of massive stars



# Evolution of massive stars

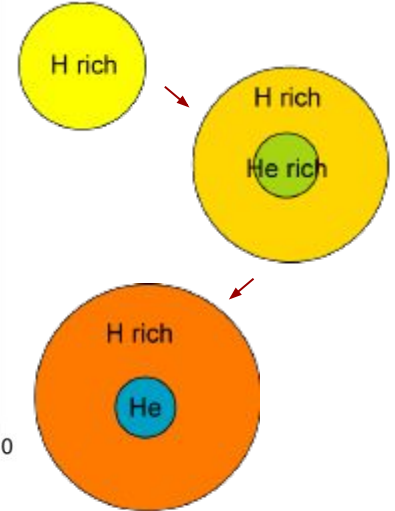
Rapidly rotating massive stars:

- rapid rotationally-induced chemical mixing
- quasi-chemical homogeneity



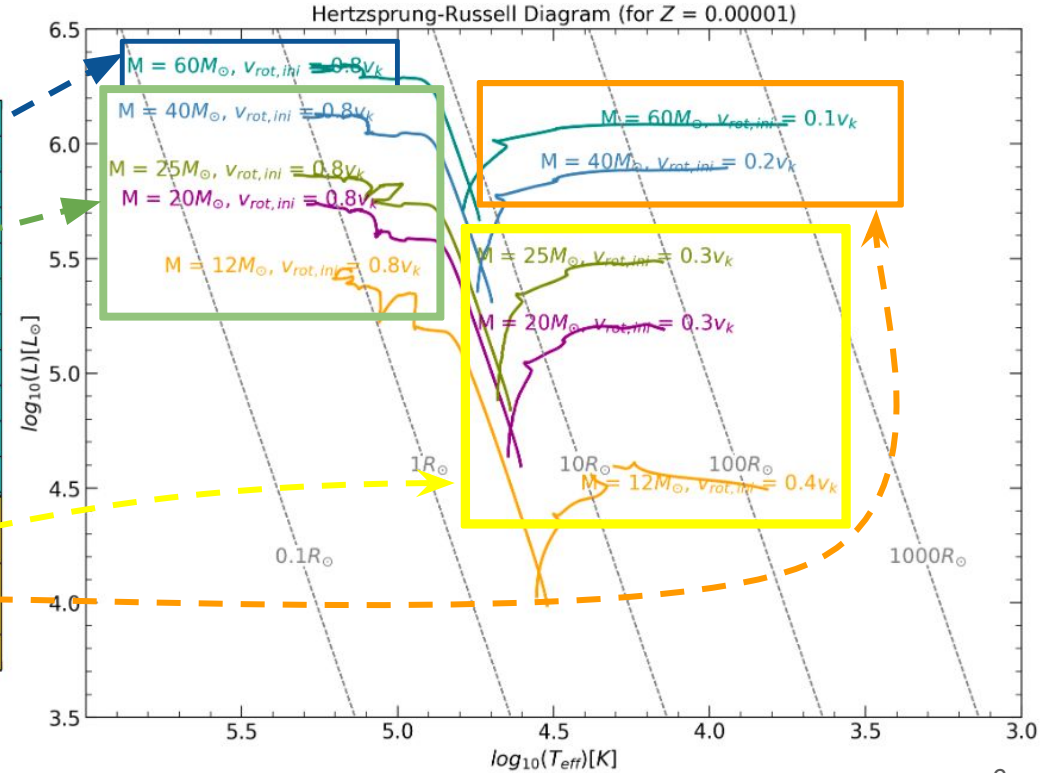
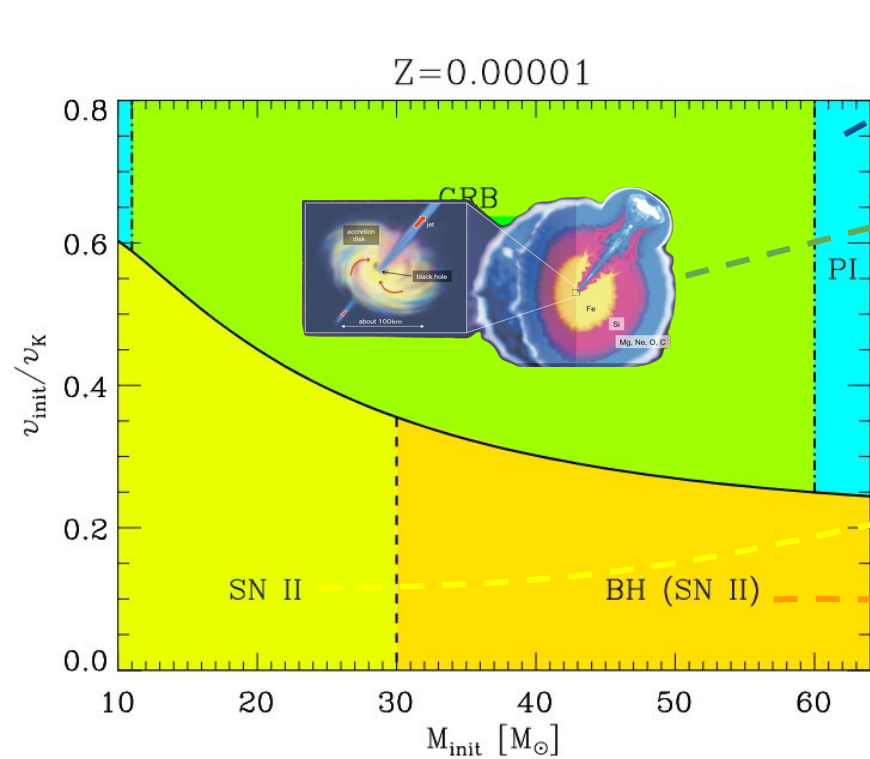
Slowly rotating stars:

- classical
- core-envelope
- red-supergiant





# Fate of massive stars



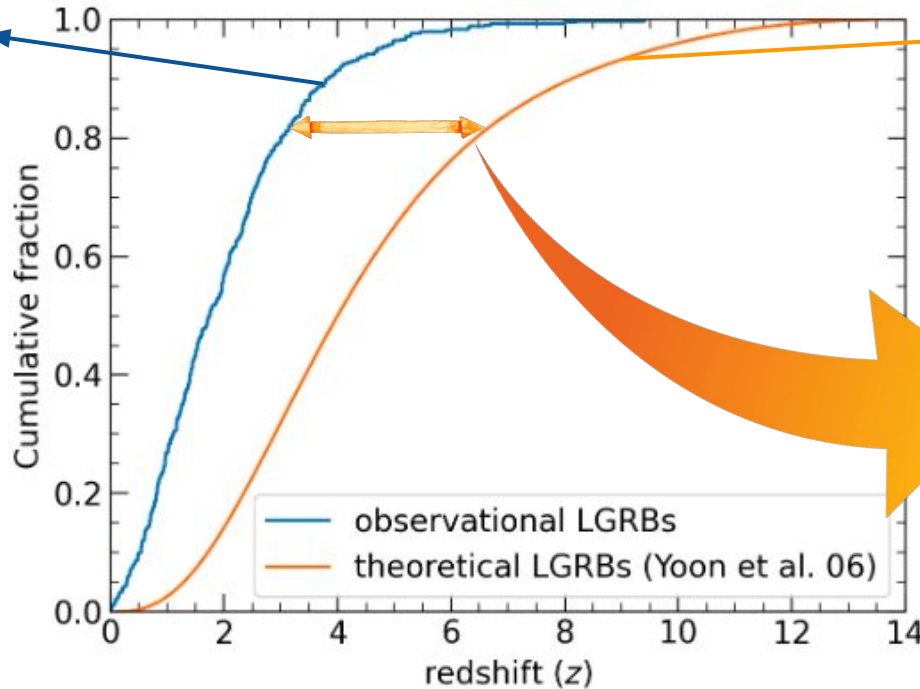


# Single star models vs observation

Observational LGRBs

Data:

475 GRBs  
447 LGRBs  
28 SGRBs



LGRBs based on theoretical  
single star population from  
S.-C. Yoon et al. (2006)



<https://sites.astro.caltech.edu/grbox/grbox.php?starttime=700101&endtime=181231>

*I Horvath et al., (2020)*



# New stellar evolutionary models: Expanding the BoOST Project



Hanno Stinshoff

