Title
The impact of realistic red supergiant mass-loss on stellar evolution: consequences for producing stripped stars via winds

Abstract
The mass loss rates of red supergiants (RSGs) govern their evolution towards supernova (SN) and dictate the appearance of the resulting explosion. Particularly important in how stars appear in the run-up to core-collapse, and in how the explosion will appear, is the amount of mass lost through stellar winds in the RSG phase that immediately precedes SN. Specifically, there have been many recent claims in the literature that stars with masses >17Msun must experience an extended period of enhanced mass-loss before SN in which the envelope is entirely lost. To study how mass-loss rates change with evolution, we focus on measuring the mass-loss rates of RSGs in a sample of clusters in the local Universe. The results indicate that there is little justification for substantially increasing the mass loss rates during the RSG phase. In fact, I have shown that for the more massive RSG the mass-loss rates used in evolutionary simulations must be *decreased* by up to a factor of 20. Implementing this new mass-loss rate equation into stellar models shows stars < 30Msun cannot have their envelopes stripped through quiescent winds prior to core-collapse. I will also discuss the potential for extreme mass-loss rate phases that have been proposed to take place over a short amount of time, but with the potential to peel away many Solar masses of material. Ultimately, I will discuss prospects for the single star evolutionary pathway for the formation of Type Ibc SNe.
RESEARCH POSITIONS

NASA Hubble Postdoctoral Fellow
NOIRLab

September 2019 - present
Arizona, USA

EDUCATION

Astrophysics PhD - Thesis title: The Progenitors of Type IIP Supernovae
Liverpool John Moores University

June 2019
Liverpool, UK

Astrophysics MPhys

University of Liverpool/Liverpool John Moores University

July 2015
Liverpool, UK

ATTENDED CONFERENCES AND TALKS

Collaboration meeting
Munich, Germany

October 2015
Talk

Bridging the gap: from massive stars to supernovae
Chicheley Hall, UK

June 2016
Contributed talk

The lives and death throes of massive stars
Auckland, NZ

November 2016
Contributed talk - prize for best student talk

UK National Astronomy Meeting
Hull, UK

July 2017
Contributed talk

The Progenitor-Supernova-Remnant Connection
Ringberg, Germany

July 2017
Contributed talk

University of Arizona weekly group meeting
Tucson, AZ

September 2017
Talk

University of Sheffield weekly colloquium
Sheffield, UK

October 2018
Invited seminar

NHFP Hubble Symposium
Washington DC, USA

October 2019
Invited talk

NASA Ames weekly colloquium
Moffett Field, CA

February 2020
Invited seminar

University of Leicester weekly seminar
Remote

May 2020
Invited seminar

Trinity College Dublin weekly seminar
Remote

July 2020
Invited seminar

SOFIA Science Center
Remote

July 2020
Invited teletalk

NSF’s OIR Lab/Steward Observatory weekly colloquium
Tucson, AZ

September 2020
Invited seminar

NHFP Hubble Symposium
Remote

September 2020
Invited talk

Florida State University weekly seminar

November 2020
Remote Invited seminar
UCSBs stars group meeting
Remote Invited talk
Massive stars near and far - preview meeting
Virtual Invited talk
GAPS 2021 - unsolved problems in red Giants And suPergiantS
Virtual Invited talk
EAS Symposium S16 - Massive stars
Remote Invited review talk
Rochester Institute of Technology
Remote Invited seminar
NHFP Hubble Symposium
Remote Invited talk
Carnegie Observatories
Remote Invited seminar
Massive stars near and far
Ballyconnel, Ireland Invited talk

AWARDED GRANTS
Hubble Fellowship Research Award HST-HF2-51428 $426,036
RAS travel grant £1000
IAU Travel grant 400 NZD
LJMU PGR travel fund £300

ACCEPTED OBSERVING PROPOSALS
As PI:
ESO Period 103 10 hours, Very Large Telescope, X-SHOOTER
HST Cycle 29 AR proposal, $TBD, est. $100,000
As Co-I:
SOFIA Cycle 5 7.5 hours, SOFIA-FORCAST
PI: Nathan Smith

OBSERVING EXPERIENCE
Very Large Telescope (2.5 nights, KMOS) April 2016
Program ID: 0096.B-0078 - A Stellar View of the Mass-Metallicity Relation

RESEARCH SKILLS
- Using radiative transfer codes (e.g. DUSTY) to model stellar winds
- Spectral fitting
- Modelling spectral energy distributions
- Stellar population synthesis, stellar evolution modelling (using e.g. MESA)
- IDL (fluent), Python (basic), L\LaTeX
TRAINING

STFC Introductory Summer School  
*Atomic Processes and Spectral Modelling in Astrophysics*  
Queens University Belfast  
August 2015

MIAPP  
*The Chemical Evolution of Galaxies*  
Garching, Germany  
August 2016

ICIC Data Analysis Workshop  
Imperial College London  
September 2016

Lorentz Centre Workshop  
*Weighing stars from birth to death: how to determine stellar masses?*  
Leiden, The Netherlands  
November 2018

MESA Summer School  
Virtual  
August 2021

TEACHING EXPERIENCE

Demonstrating in undergraduate problem classes  
2015-2018

Demonstrating in undergraduate labs  
2016-2018

Co-supervision of Masters students, one of which resulted in publication  
2017-2018

Co-supervision of PhD student Sarah McDonald (LJMU)  
2020-present

OUTREACH

- Running and assisting with educational sessions for primary school children (e.g. ‘The scale of the Solar system’ workshop)
- Giving physics demonstrations to high school students and their parents
- Assisting at public outreach events within Liverpool (e.g. at the ‘Light Night’ arts festival)
- Representing Kitt Peak National Observatory at the Tohono O’odham Nation annual rodeo
- Organiser of NOIRLab’s Diversity & Inclusion Journal Club series. Monthly discussions of papers on DEI issues in astronomy and academia.
- Authored blog post for NASA.gov website (general audience)

MEDIA EXPERIENCE

- Interview on BBC Radio Merseyside
- Featured on ‘365 Days of Astronomy’ podcast
- Interview on BBC Radio 4’s ‘Today’ programme, discussing the Hubble Space Telescope

SERVICE

Referee for MNRAS  
2019-present

Referee for Science  
2021-present

Organiser of NSF’s OIR Lab weekly lunch talks (FLASH)  
2019-present

Reviewer/panelist for NSF grant proposals (binary/massive stars panel)  
2020

Reviewer for FINESST  
2020-2021

Hubble off-site panel member - Cycles 28 & 29  
2020-2022

NASA ADAP 20 panelist  
2020

NASA ATP 2021 panelist  
September 2021
REFEREES

Dr. Ben Davies (Liverpool JMU)
b.davies@ljmu.ac.uk

Prof. Nathan Smith (University of Arizona)
nathans@as.arizona.edu

Dr. Selma de Mink (Max Planck Institute for Astrophysics)
sedemink@mpa-garching.mpg.de
15. McDonald, S., Davies, B., Beasor, E. R., "Red Supergiants in M31: The Humphreys-Davidson Limit at high metallicity", in press, arXiv:2111.13716

14. Beasor, E. R., Davies, B., Smith, N., "Implementing realistic red supergiant mass-loss rates in MESA", 2021, ApJ, 922, 55B

13. Beasor, E. R., Davies, B., Smith, N., Gehrz, R., Figer, D. F., "The Age of Westerlund 1 Revisited", 2021, ApJ, 912, 16

12. Davies, B., Beasor, E. R., "'On the red supergiant problem': a rebuttal, and a consensus on the upper mass cut-off for II-P progenitors", 2020, MNRAS, 496 L142

11. Eldridge, J. J., Beasor, E. R., Britavskiy, N., "On ageing star clusters using red supergiants independent of the fraction of interacting binary stars", 2020, MNRAS, 495, L102

10. Beasor, E. R., Davies, B., Smith, N., van Loon., J, Gehrz, R., Figer, D. F, "A new mass-loss rate prescription for red supergiants", 2020, 493, 468

9. Davies, B., Beasor, E. R., "The Red Supergiant Problem: the upper luminosity boundary", 2020, MNRAS, 493, 468

8. Beasor, E. R., Davies, B., Smith, N., Bastian, N., "Discrepancies in the ages of young star clusters; evidence for mergers?", 2019, MNRAS, 486 266

7. Davies, B., Beasor, E. R., "The distances to star clusters hosting Red Supergiants: χ Per, NGC 7419 and Westerlund 1", 2019, MNRAS, 486 L10

6. Beasor, E. R., Davies, B., Cabrera-Ziri, I., Hurst, G., "A critical re-evaluation of the Thorne-Żytkow object candidate HV 2112", 2018, MNRAS, 479 310

5. Davies, B., Crowther, P., Beasor, E. R., "The luminosities of cool supergiants in the Magellanic Clouds, and the Humphreys-Davidson limit revisited", 2018, MNRAS, 478 3138

4. Beasor, E. R., Davies, B., "The evolution of red supergiant mass-loss rates", 2018, MNRAS, 475 55B

3. Davies, B., Beasor, E. R., "The initial masses of the red supergiant progenitors to Type II supernovae", 2018, MNRAS, 474 2116

2. Davies, B., Kudritzki, R-P., Lardo, C., Bergemann, M., Beasor, E. R., Plez, B., Evans, C., Bastian, N., Patrick, L. R., "Red Supergiants as Cosmic Abundance Probes: Massive Star Clusters in M83 and the Mass-Metallicity Relation of Nearby Galaxies", 2017, ApJ, 847 112

1. Beasor, E. R., Davies, B., "The evolution of red supergiants to supernova in NGC 2100", 2016, MNRAS, 463 1269

In prep/submitted

2. Beasor, E. R., Smith, N., "The extreme scarcity of dust-enshrouded red supergiants: consequences for producing stripped stars via winds", submitted to ApJ (available on request)

1. Jencson, J. E. et al. (incl. Beasor, E. R.,) "An Exceptional Dimming Event for a Massive, Cool Supergiant in M51", submitted to ApJ, arxiv:2110.11376
1. Beasor, E. R., Davies, B., "The evolution of red supergiants to supernovae", 2016, IAUS 329, "The Lives and Death Throes of Massive Stars"

2. Beasor, E. R., "The Age of Westerlund 1 Revisited", 2021, SOFIA Spotlight (Scientific audience), URL: https://www.sofia.usra.edu/multimedia/science-results-archive/age-westerlund-1-revisited

1. Beasor, E. R., "The Age of Westerlund 1 Revisited", 2021, NASA Blog (General audience), URL: https://blogs.nasa.gov/sofia/2021/08/25/the-age-of-westerlund-1-revisited/