Asymmetric Planetary Nebulae 5
(Ebrary, Cambridge, USA),
A.A Zijlstra, I. McDonald, eds.

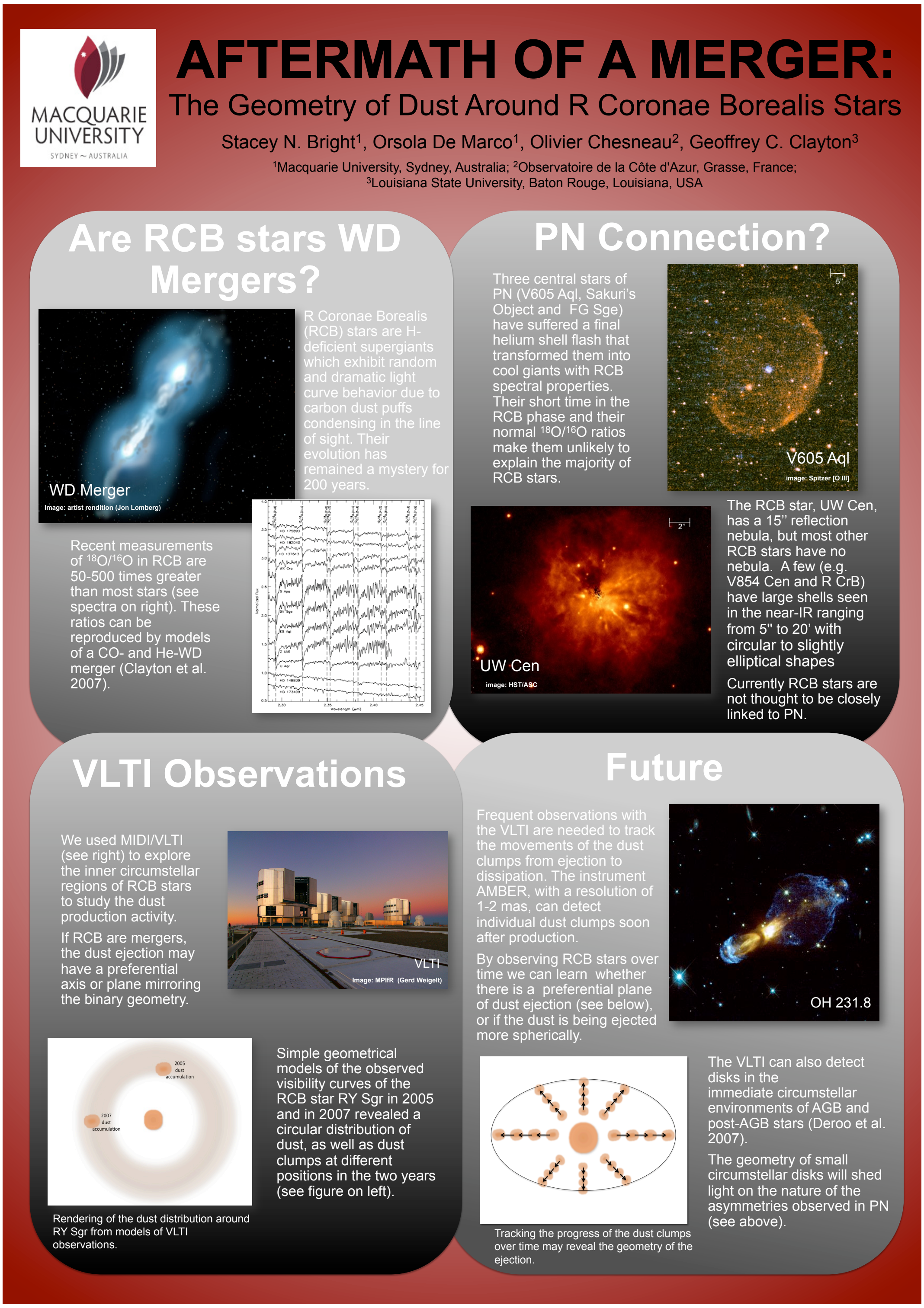
Aftermath of a merger: The geometry of dust around R Coronae Borealis stars

Stacey N. Bright

Dept. of Physics & Engineering, Macquarie University, Sydney, NSW 2109, Australia

O. De Marco, O. Chesneau, G.C. Clayton

R Coronae Borealis (RCB) stars are H-deficient supergiants that exhibit random and dramatic light curve behavior due to carbon dust puffs condensing in the line of sight. Their evolution has remained a mystery for 200 years. Recent measurements of extremely high $^{18}O/^{16}O$ in RCB can be reproduced by models of a CO- and He-WD merger. If RCB are mergers their dust ejection may have a preferential axis or plane mirroring the binary geometry. We used MIDI/VLTI to explore the inner circumstellar regions of RCB stars to study the dust production activity. Simple geometrical models of the observed visibility curves found asymmetries in the circumstellar material. By observing RCB stars with the VLTI over time we can learn whether there is a preferential plane of dust ejection or if the dust is being ejected more spherically. The VLTI can also detect disks in the immediate circumstellar environments of AGB and post-AGB stars. The geometry of small circumstellar disks will shed light on the nature of the asymmetries observed in PN.



MACQUARIE UNIVERSITY
SYDNEY ~ AUSTRALIA

AFTERMATH OF A MERGER:
The Geometry of Dust Around R Coronae Borealis Stars

Stacey N. Bright[1], Orsola De Marco[1], Olivier Chesneau[2], Geoffrey C. Clayton[3]

[1]Macquarie University, Sydney, Australia; [2]Observatoire de la Côte d'Azur, Grasse, France; [3]Louisiana State University, Baton Rouge, Louisiana, USA

Are RCB stars WD Mergers?

WD Merger
Image: artist rendition (Jon Lomberg)

R Coronae Borealis (RCB) stars are H-deficient supergiants which exhibit random and dramatic light curve behavior due to carbon dust puffs condensing in the line of sight. Their evolution has remained a mystery for 200 years.

Recent measurements of $^{18}O/^{16}O$ in RCB are 50-500 times greater than most stars (see spectra on right). These ratios can be reproduced by models of a CO- and He-WD merger (Clayton et al. 2007).

PN Connection?

Three central stars of PN (V605 Aql, Sakuri's Object and FG Sge) have suffered a final helium shell flash that transformed them into cool giants with RCB spectral properties. Their short time in the RCB phase and their normal $^{18}O/^{16}O$ ratios make them unlikely to explain the majority of RCB stars.

V605 Aql
image: Spitzer [O III]

UW Cen
image: HST/ASC

The RCB star, UW Cen, has a 15'' reflection nebula, but most other RCB stars have no nebula. A few (e.g. V854 Cen and R CrB) have large shells seen in the near-IR ranging from 5'' to 20' with circular to slightly elliptical shapes

Currently RCB stars are not thought to be closely linked to PN.

VLTI Observations

We used MIDI/VLTI (see right) to explore the inner circumstellar regions of RCB stars to study the dust production activity.

If RCB are mergers, the dust ejection may have a preferential axis or plane mirroring the binary geometry.

VLTI
Image: MPIfR (Gerd Weigelt)

2005 dust accumulation
2007 dust accumulation

Rendering of the dust distribution around RY Sgr from models of VLTI observations.

Simple geometrical models of the observed visibility curves of the RCB star RY Sgr in 2005 and in 2007 revealed a circular distribution of dust, as well as dust clumps at different positions in the two years (see figure on left).

Future

Frequent observations with the VLTI are needed to track the movements of the dust clumps from ejection to dissipation. The instrument AMBER, with a resolution of 1-2 mas, can detect individual dust clumps soon after production.

By observing RCB stars over time we can learn whether there is a preferential plane of dust ejection (see below), or if the dust is being ejected more spherically.

OH 231.8

Tracking the progress of the dust clumps over time may reveal the geometry of the ejection.

The VLTI can also detect disks in the immediate circumstellar environments of AGB and post-AGB stars (Deroo et al. 2007).

The geometry of small circumstellar disks will shed light on the nature of the asymmetries observed in PN (see above).