

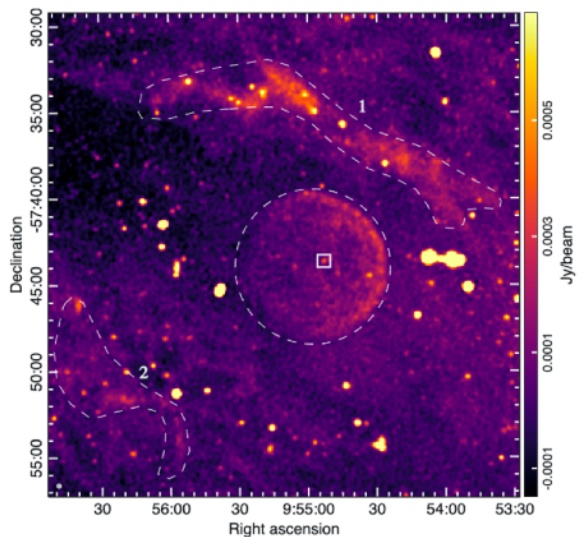
# Evolutionary Map of the Universe: Detection and Analysis of the Shell Surrounding the Runaway Wolf-Rayet Star WR16

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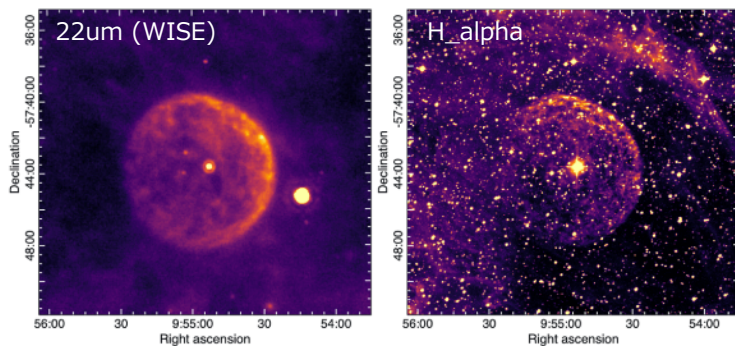
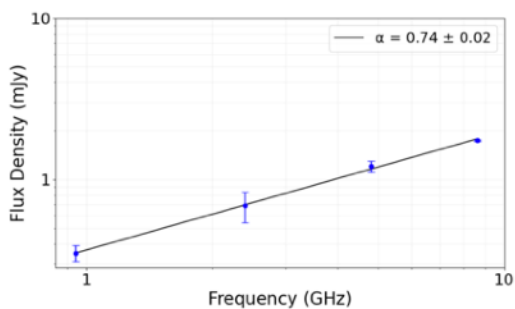
## Abstract

- the first radio-continuum detection of the circumstellar shell around the well-known WN8 type Wolf-Rayet star WR16 at 943.5 MHz
- the Australian Square Kilometre Array Pathfinder (ASKAP) Evolutionary Map of the Universe (EMU) survey
- The latest Gaia parallax is used to determine a **distance of  $2.28 \pm 0.09$  kpc**.
- shell size to be  $5.57 \pm 0.22$  pc using the distance and an **angular diameter of  $8.''42$** .
- a peculiar tangential velocity to be  $50.7 \pm 6.9$  km s<sup>-1</sup>, moving in a north-west direction
- estimate an age of  $\sim 9500 \pm 1300$  yr, and determine its average expansion velocity to be  **$280 \pm 40$  km/s**
- This average expansion velocity suggests that the previous transitional phase is a **Luminous Blue Variable (LBV) phase**
- mass-loss rate of  $1.753 \times 10^{-5} M_{\odot} / \text{yr}$  (at 943.5 MHz)
- lower-limit on ionising photons of  $N_{\text{uv}} > 1.406 \times 10^{47} / \text{s}$ .

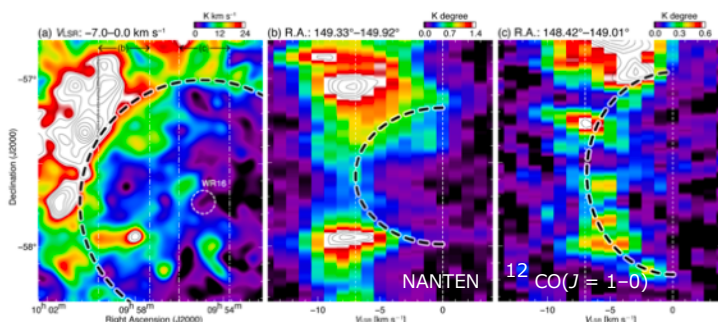
## Geometry



	$S_{944}^a$ (mJy)	$S_{240}^b$ (mJy)	$S_{4.80}^c$ (mJy)	$S_{8.64}^c$ (mJy)	$\alpha$ $\alpha \pm \Delta\alpha$
WR16					
Star	$0.35 \pm 0.04$	$0.69 \pm 0.15$	$1.21 \pm 0.09$	$1.75 \pm 0.09$	$0.74 \pm 0.02$
Shell	$72.2 \pm 7.2$	-	-	-	-



## Expansion Age



The dynamical time scale of the expanding bubble is estimated to be [bubble radius] / [expanding velocity]  $\sim 30\text{pc}/7\text{km/s} \sim 4\text{Myr}$ .

## Spectral Index

The radio spectral index is defined as  $S \propto \nu^\alpha$

→  $\alpha \sim 0.74$

→ the canonical spectral index of an **isothermal, spherical stellar wind**

## Shell Expansion

- the tangential peculiar velocity of the star passes through the geometric center of the  $8.''42$  circle
- The distance of the star to the center of the nebulosity is 44.81 arcsec.
- yearly velocity of  $1.58 \times 10^9$  km/yr =  $5.12 \times 10^{-5}$  pc/yr

→ travel time of WR16  $\sim 9500 \pm 1300$  yr

→ the average expansion velocity of the circular shell to be  **$280 \pm 40$  km/s**

→ the shell originated in a **previous LBV phase**

(cf : typical expansion speed of LBV shells of  $\sim 50$  km/s, the faster ejecta of Eta Car (600 km/s))

