The imprint of a symbiotic binary progenitor on the properties of Kepler's SNR

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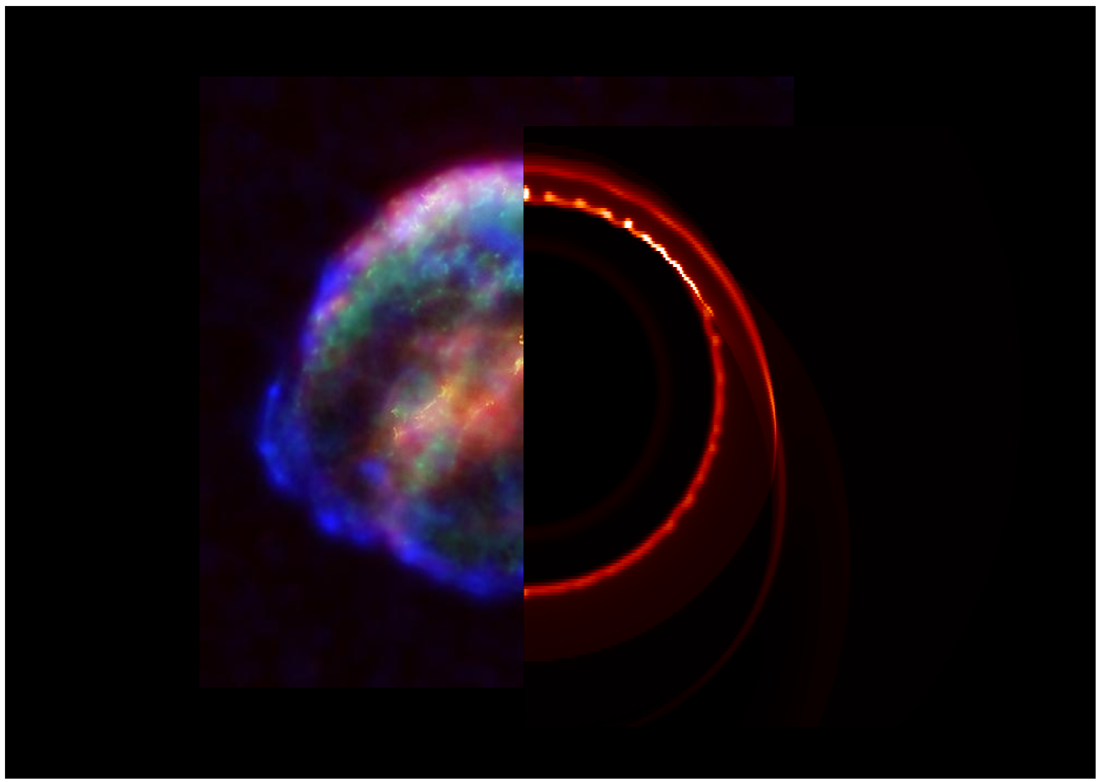
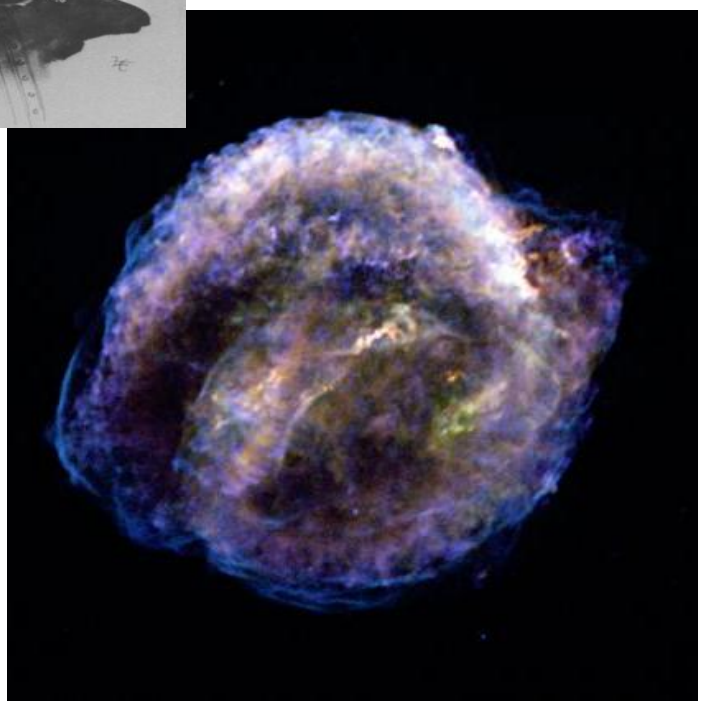


"XXVIth IAP Annual Colloquium"

The discovery

- In 1604 J. Kepler observed “De Stella Nova”.
  Nowadays **SN1604** or **Kepler’s SN**



- It is located 600 pc above the Galactic plane

- Current observations:

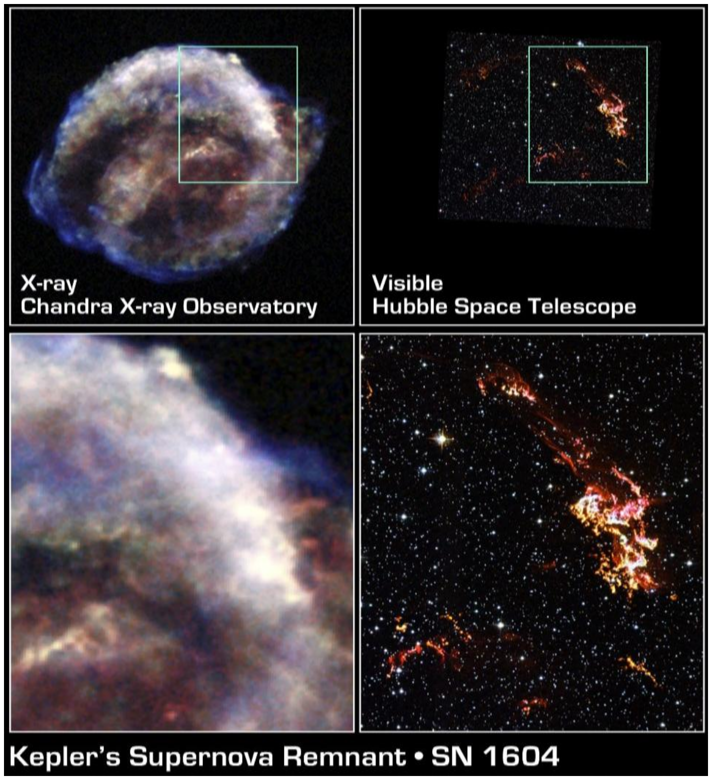
  Type Ia

  (Reynolds et al. 2008)

Why Kepler's SN is important?

The progenitor system left its imprint to the SNR

<u>Northern Region</u> :



Northern Shell:
CSM by the outflows
of the progenitor system

Hα narrow component: Blueshifted → **u_* ≈ 250 km s^{-1}**

(Bandiera & van der Berg 1991; Sollerman et al. 2004)

The purpose of this research

Possible progenitor's history :

SN Ia explosion + CSM properties = Kepler SNR

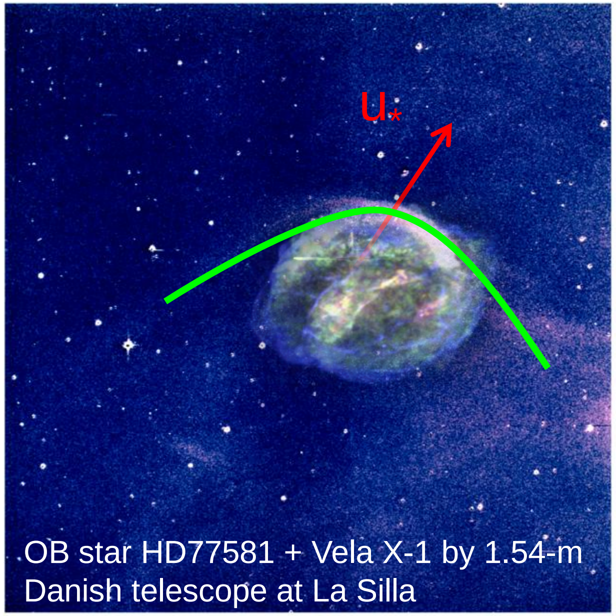
The model needs to explain:

- $> 1M_{\odot}$ ejected to CSM→ mass transfer not 100% efficient
- Donor needs to produce nitrogen
- Asymmetric shell
- Binary system high above Galactic plane + its systemic velocity
- Observed expansion rates

The proposed model:

1. Chemical composition of the shell: *The donor is an 4-5 $M_{\odot}$ AGB star* (Karakas & Lattanzio 2007)

2. Type Ia + shell formation: *accretion through the stellar wind of the donor*



3. High Galactic latitude + one sided shell: *supersonic systemic motion of the progenitor system* (Bandiera 1987)

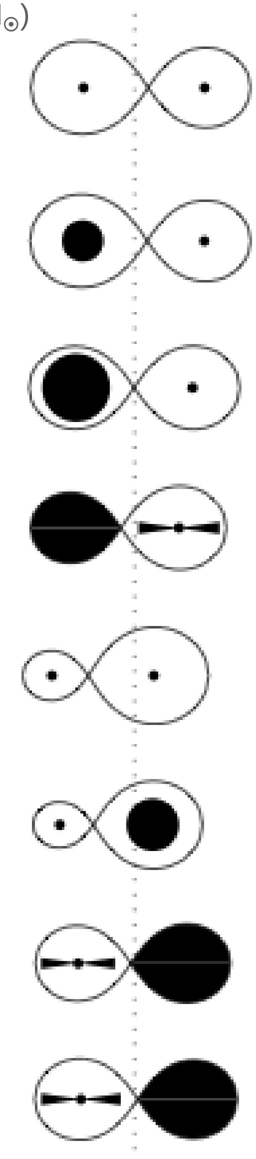
$u_* \approx 250$ km/s

Does it work?

Type Ia SN in a > 1$M_\odot$ shell

Hurley et al. 2000 & 2002 BSE code:

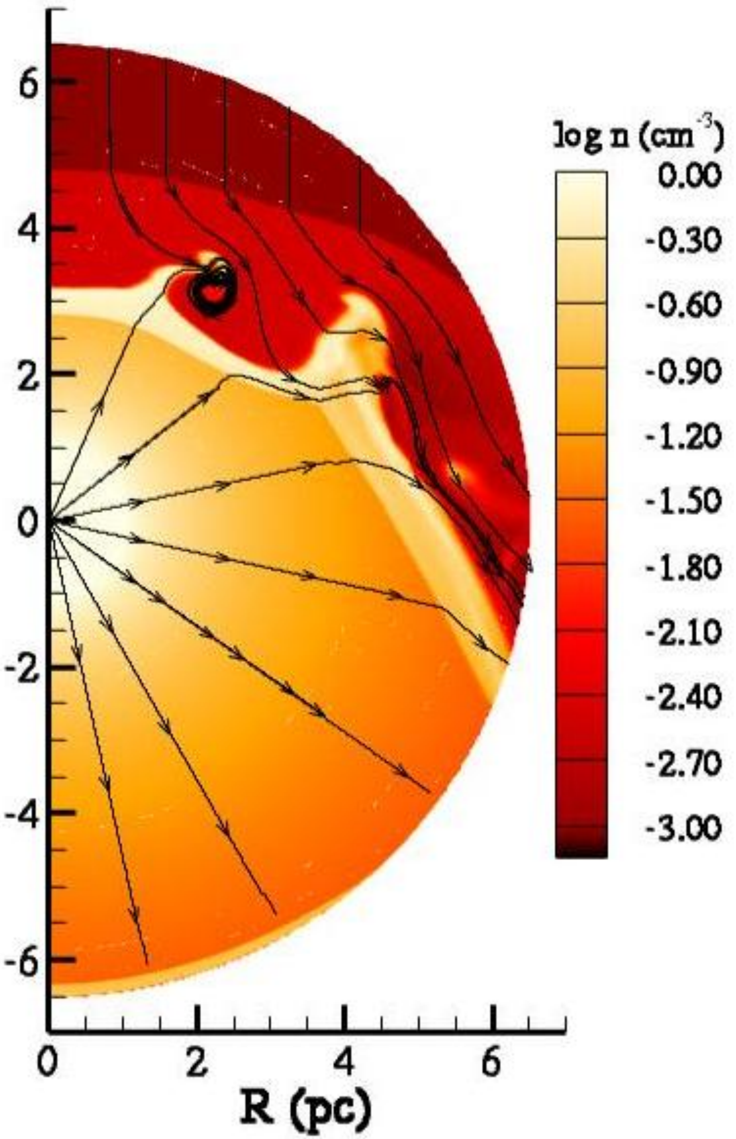
Time (Myr)		Mass ($M_\odot$)	Mass ($M_\odot$)		Period (days)
0.0	MS	6.2	4.5	MS	4911.4
72.5	TPAGB	6.1	4.5	MS	4979.5
72.8	TPAGB	4.6	4.7	MS	4945.4
72.8	TPAGB	3.5	5.0	MS	4658.5
72.8	CO WD	1.2	5.0	MS	5011.2
138.8	CO WD	1.2	4.8	TPAGB	4434.4
138.9	CO WD	1.3	1.5	TPAGB	8071.9
138.9	CO WD	1.4	1.3	TPAGB	8553.3



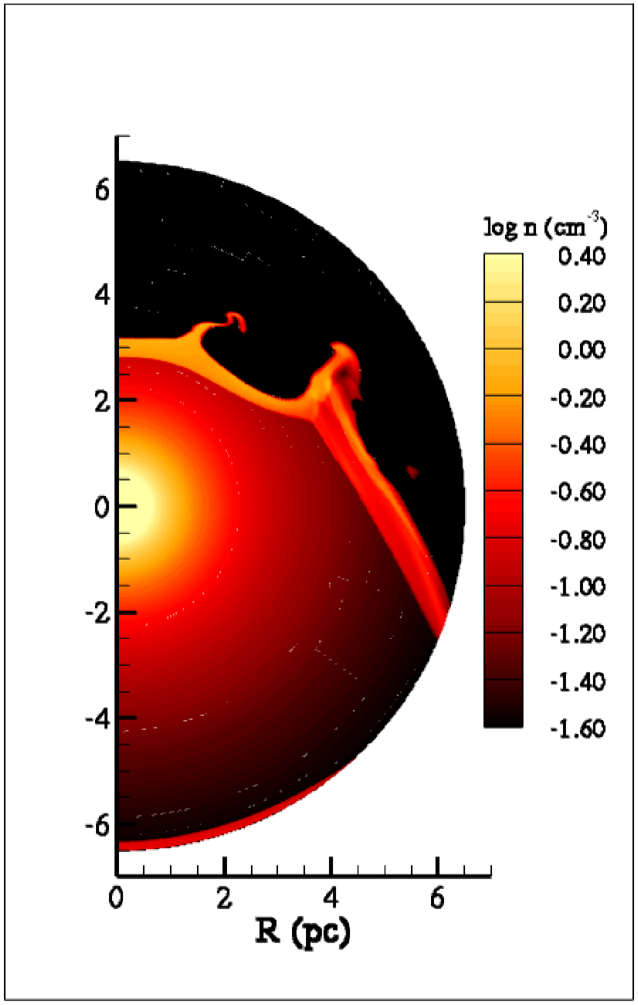
Symbiotic Binary
τ ≈ 0.4 Myr

Mass ejected out of the system: ≈ 3.5$M_\odot$

Morphology and dynamics of the remnant- Hydrodynamic modeling using AMRVAC (Keppens et al. 2003)



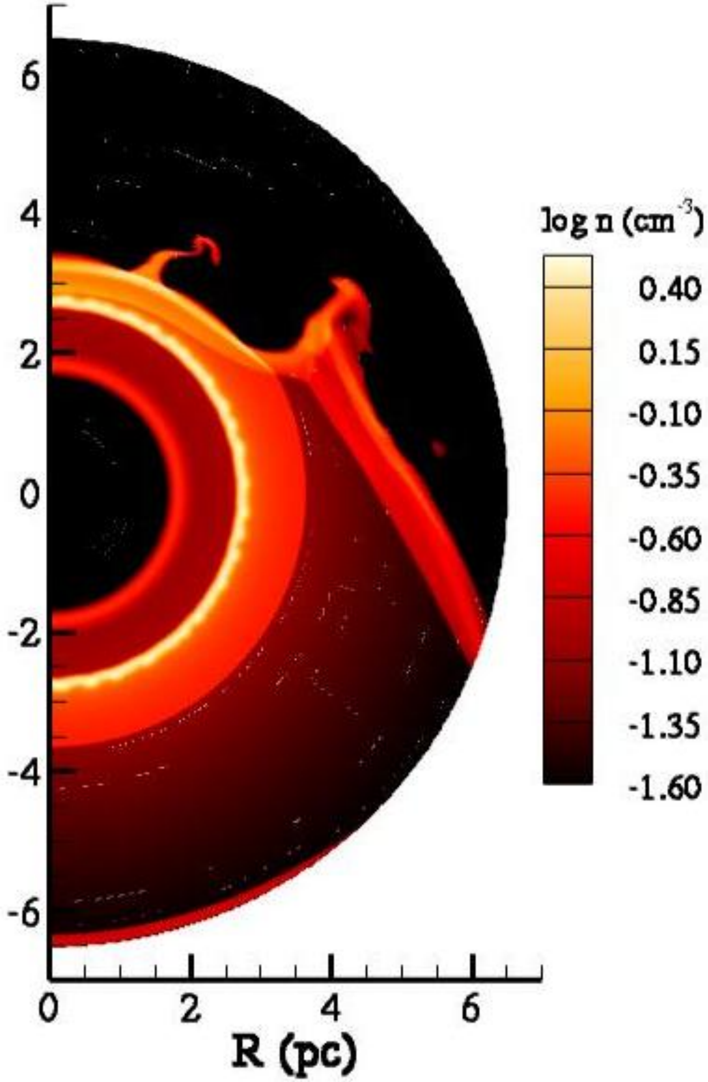
SNR evolution



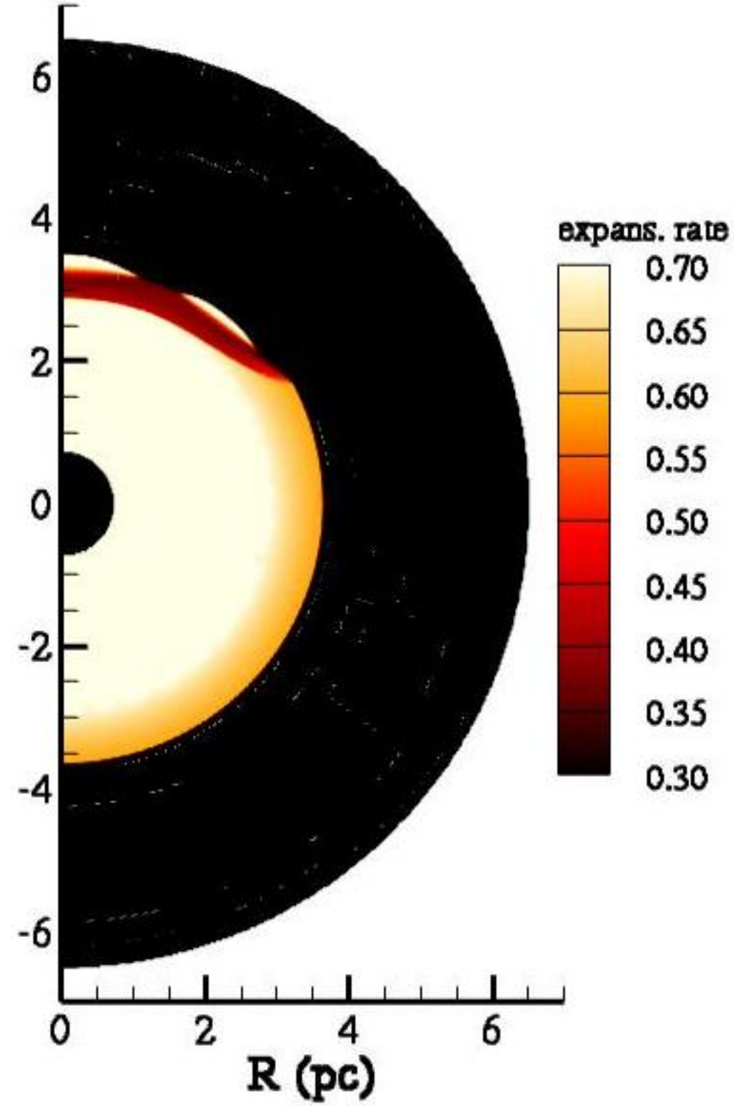
t = 0 → 412 yr Δt = 64 yr

Current Kepler's snapshot

Number density



Expansion rate



Conclusions

- *A supersonically moving binary of a WD and a 4-5$M_\odot$ AGB star appears a promising progenitor for SN1604:*

I. Ignition of a Type Ia SN in a > 1$M_\odot$ wind shell

II. Asymmetry and the chemical abundances of the shell

III. Expansion rates of the remnant and its northern part

- *Why it escaped at the end of its life?*

- *Typical channel for Type Ia SNe ?*