Type Ia supernova remnant tomography

Ivo Seitenzahl

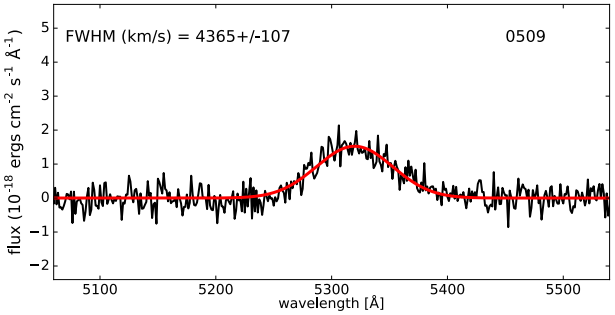
UNSW Canberra

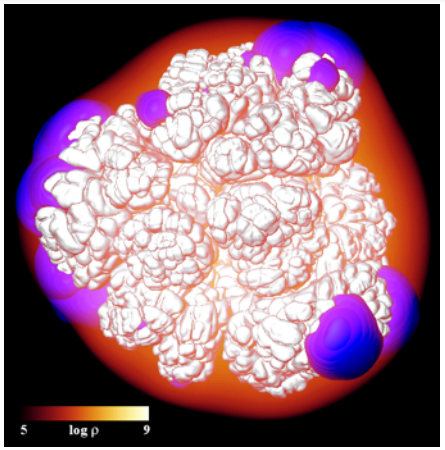
main collaborators for this work:

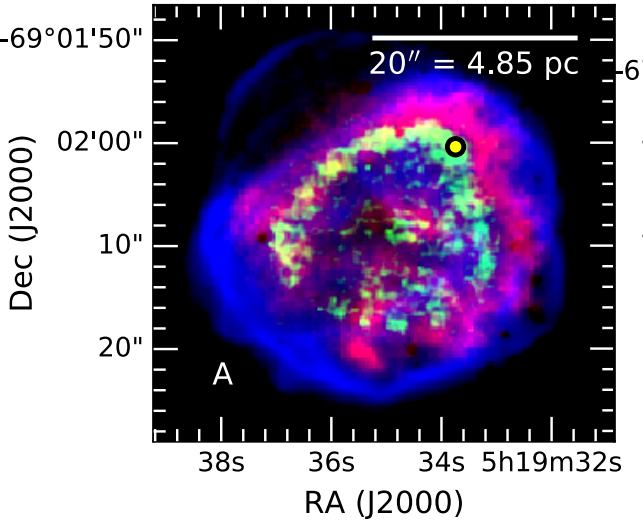
P Ghavamian

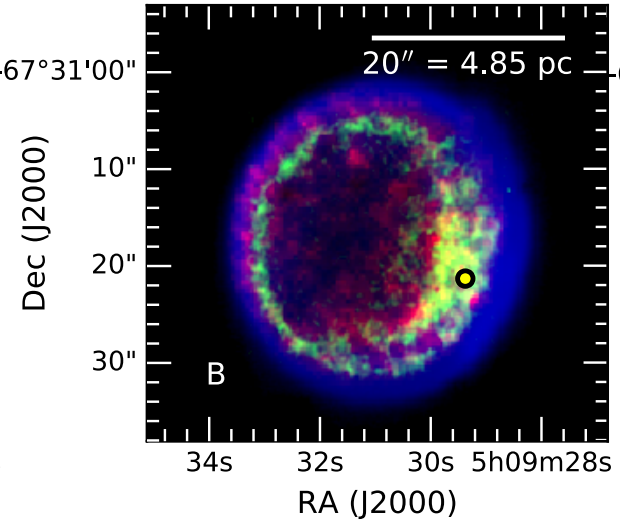
JM Laming

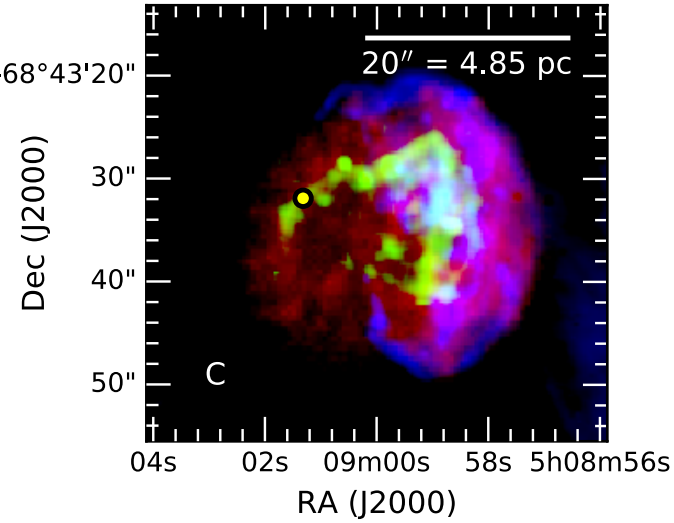
FPA Vogt











Adelaide, SA

29 November 2019

University of New South Wales Canberra at the Australian Defence Force Academy

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Canberra
Tell me if you want to visit

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http://www.world-guides.com/images/sydney/australia_map2.jpg

prelude

mixed bag of optical/IR IFS tidbits

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extragalactic NS in 1E0102.2-7219

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nature astronomy

LETTERS

https://doi.org/10.1038/s41550-018-0433-0

Identification of the central compact object in the young supernova remnant 1E 0102.2–7219

Frédéric P. A. Vogt[1*], Elizabeth S. Bartlett[1], Ivo R. Seitenzahl[2,3], Michael A. Dopita[3], Parviz Ghavamian[4], Ashley J. Ruiter[2,3] and Jason P. Terry[5]

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extragalactic NS in 1E0102.2-7219

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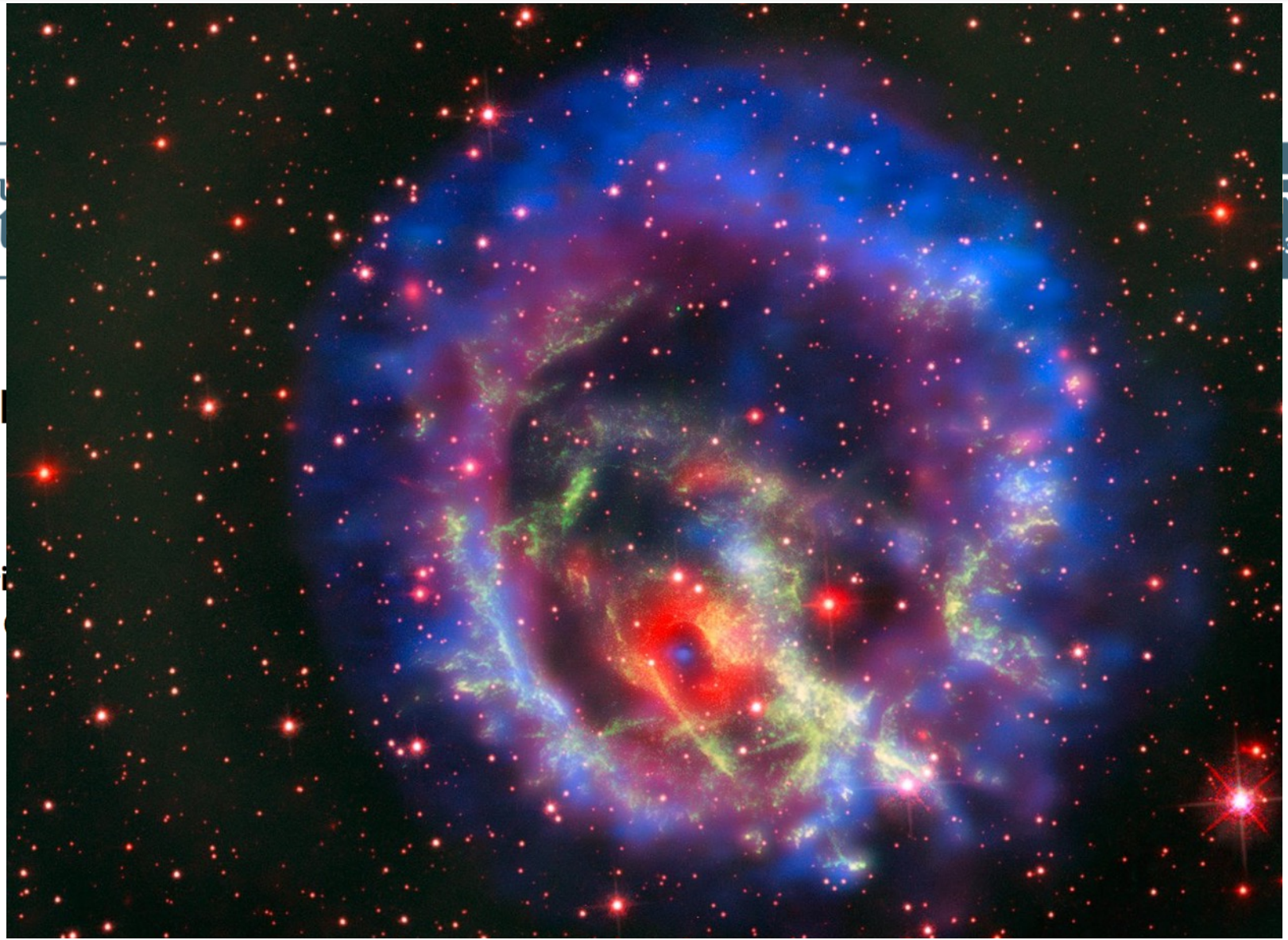

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extragalactic NS in 1E0102.2-7219

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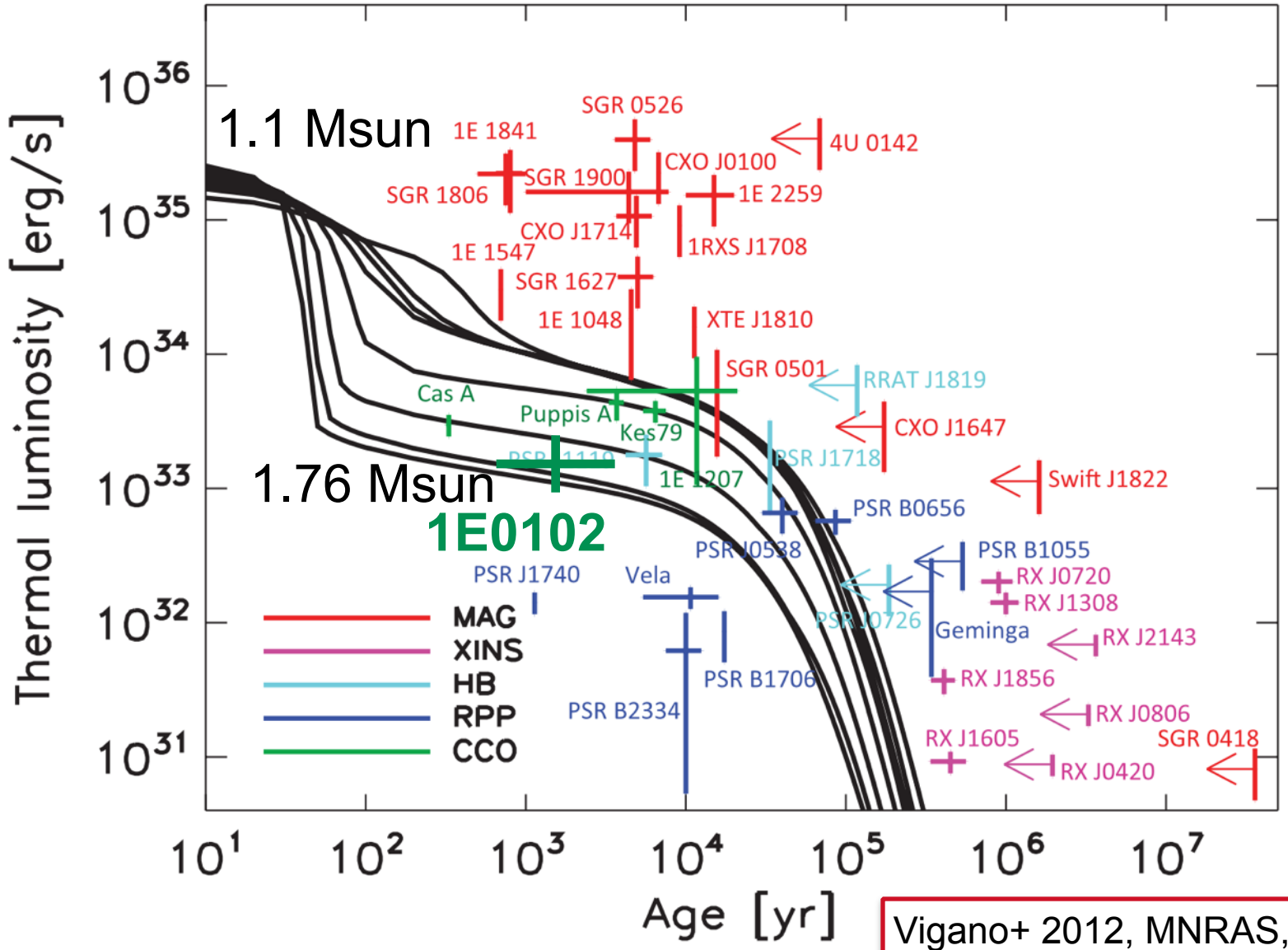
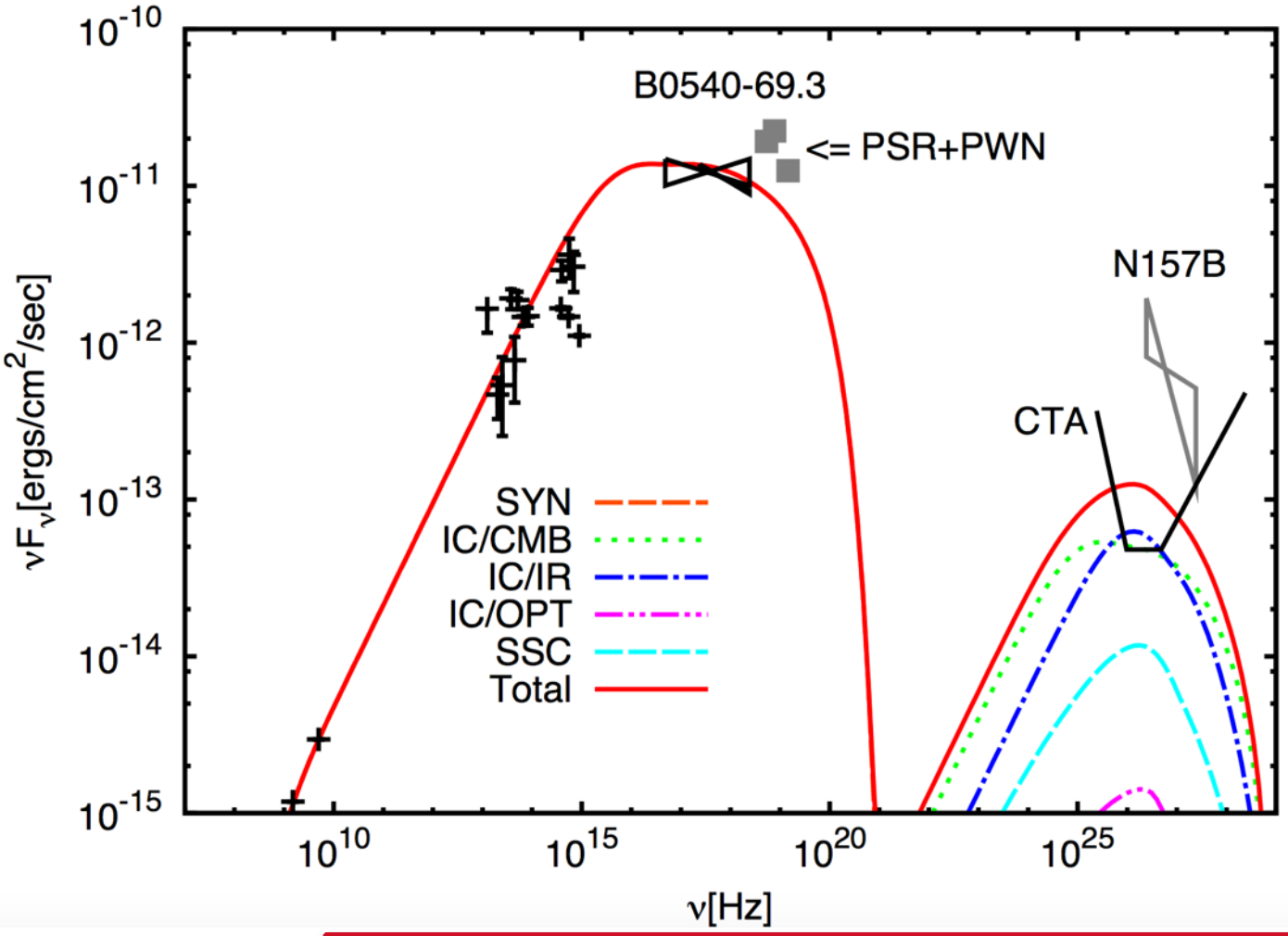


Vigano+ 2012, MNRAS, 434, 123

SNR B0540-69.3



Tanaka & Takahara (2013) MNRAS, 429, 2945

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B0540–69.3

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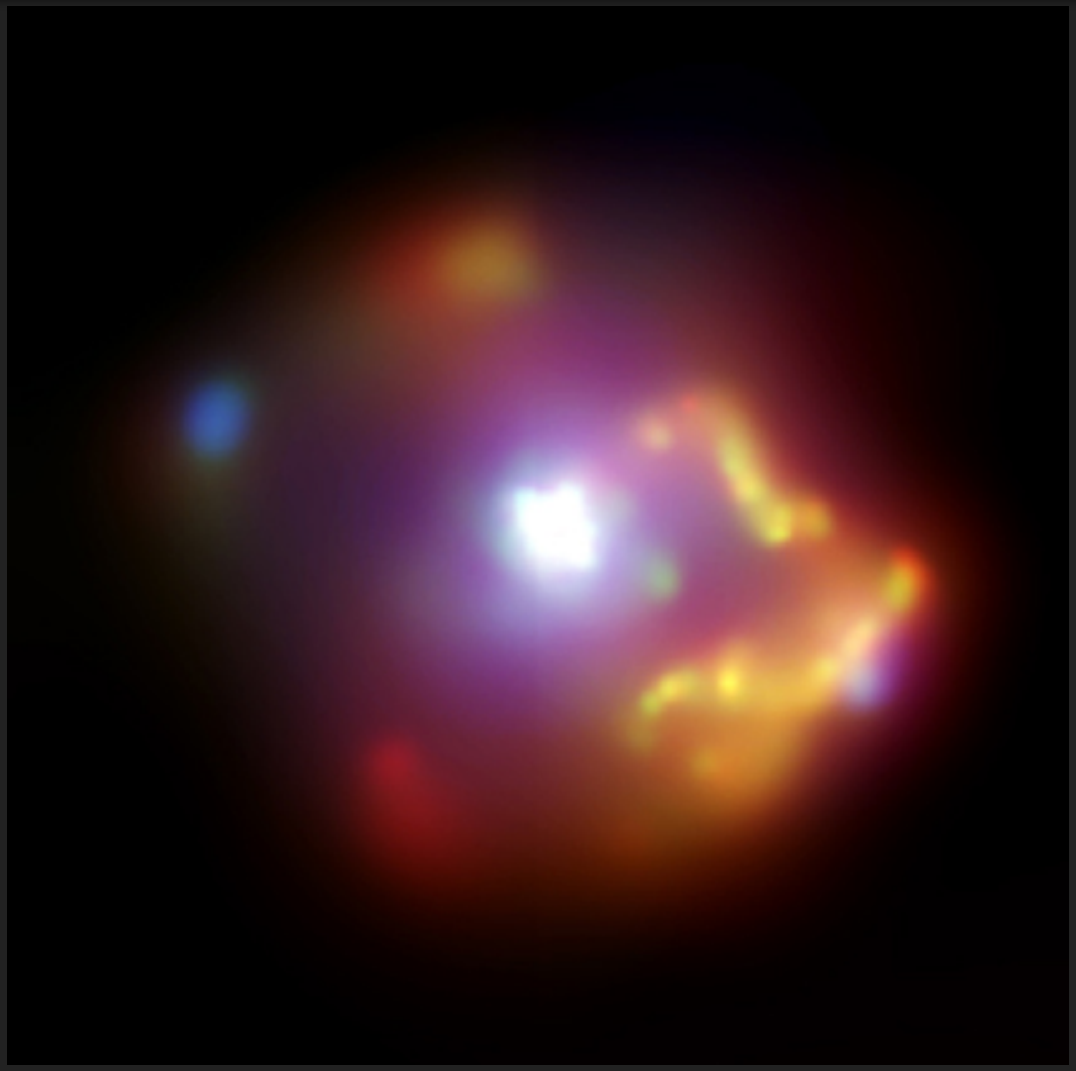

Chandra ACIS RGB Credit: NASA/CXC/SAO

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B0540–69.3
PWN sweeping up ejecta

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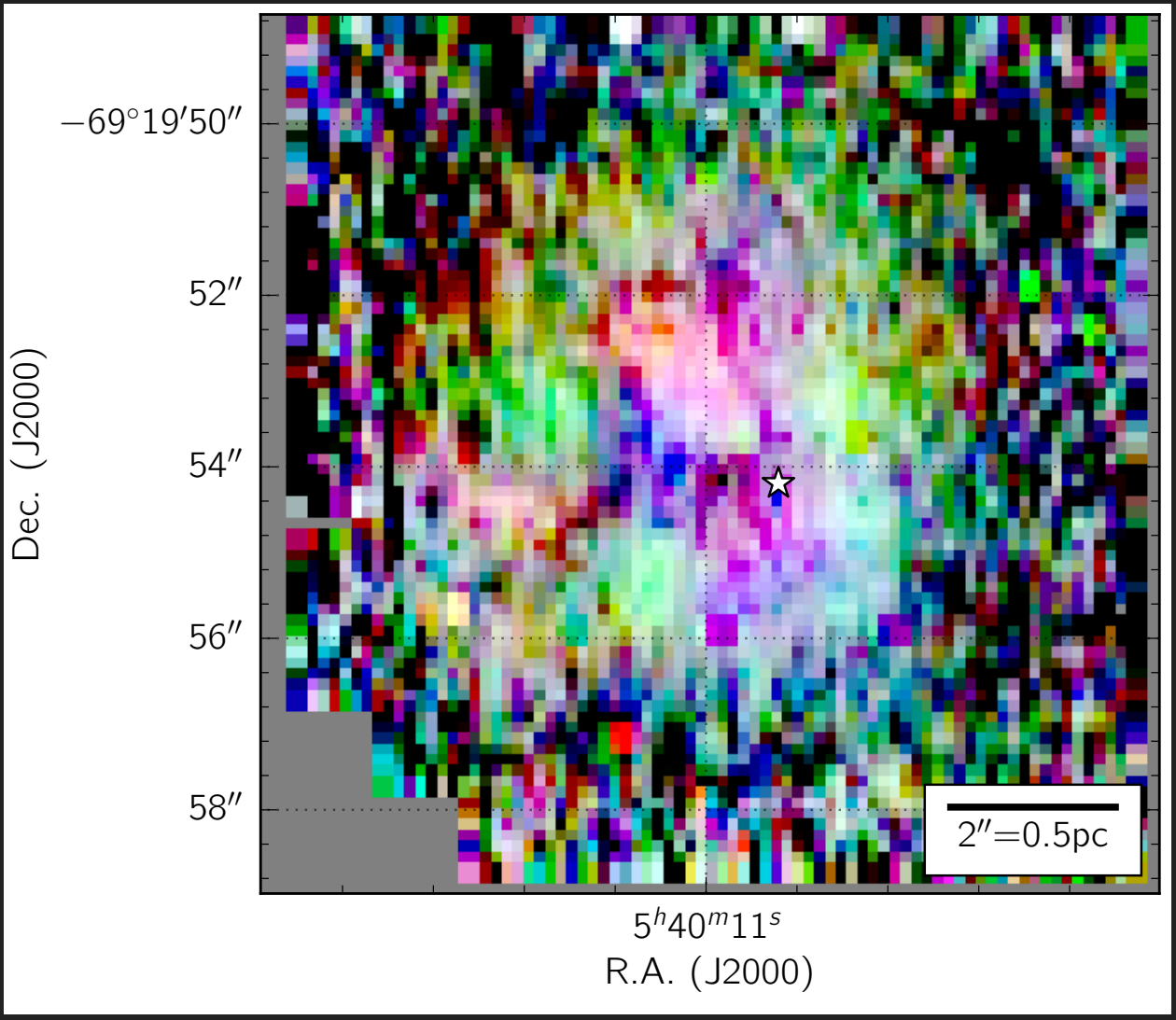
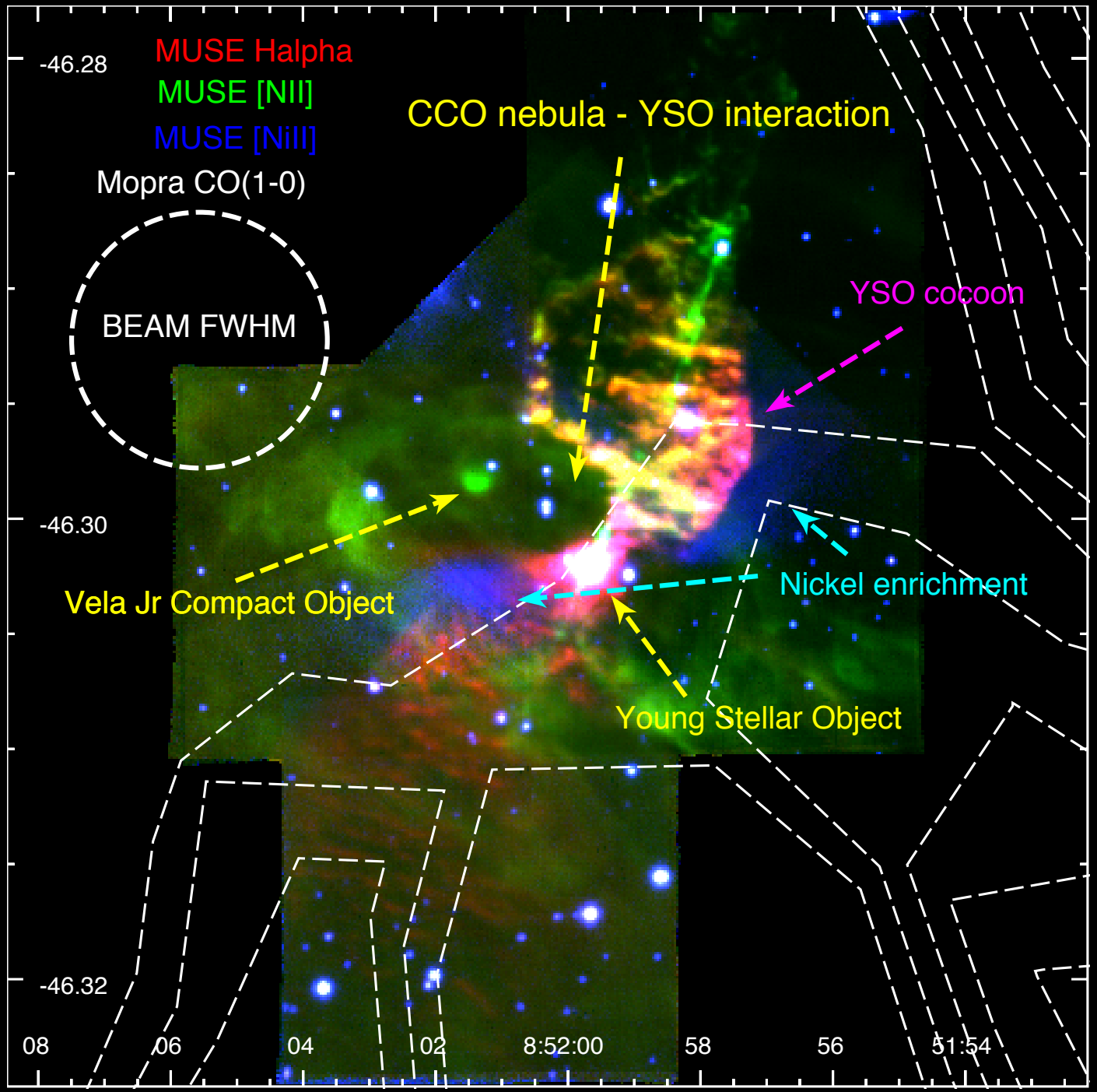


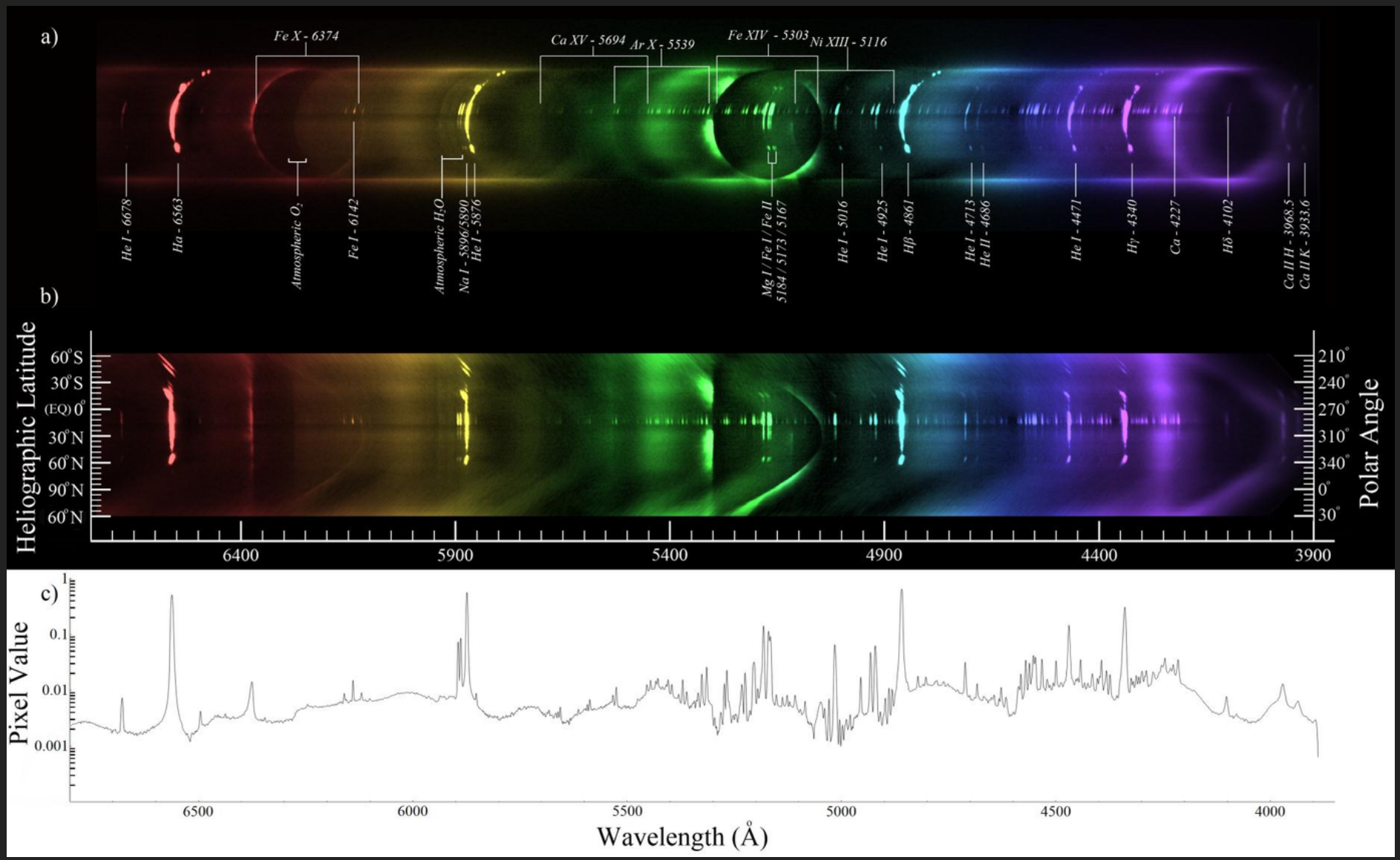
UT4 VLT Sinfoni [Fe II], Vogt, Seitenzahl et al., unpublished


MUSE Halpha
MUSE [NII]
MUSE [NiII]
Mopra CO(1-0)
BEAM FWHM
CCO nebula - YSO interaction
YSO cocoon
Vela Jr Compact Object
Nickel enrichment
Young Stellar Object
-46.28
-46.30
-46.32
08
06
04
02
8:52:00
58
56
51:54
image: N. Maxted

supernova remnant tomography
with
coronal lines in the shocked ejecta

Coronal lines

Voulgaris et al. 2012, Solar Physics, 278, 187



Coronal lines

Voulgaris et al. 2012, Solar Physics, 278, 187

Low lying forbidden transitions, collisional excited, of highly ionised atoms emitting in the optical.

[Fe XIV] 5303

[Fe X] 6374

T ~ 10 - 20 MK


http://www.cielaustral.com/galerie/photo95.htm


http://www.cielaustral.com/galerie/photo95.htm

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SNR 0509-67.5

R: X-ray, G: Fe XIV, B:Ha

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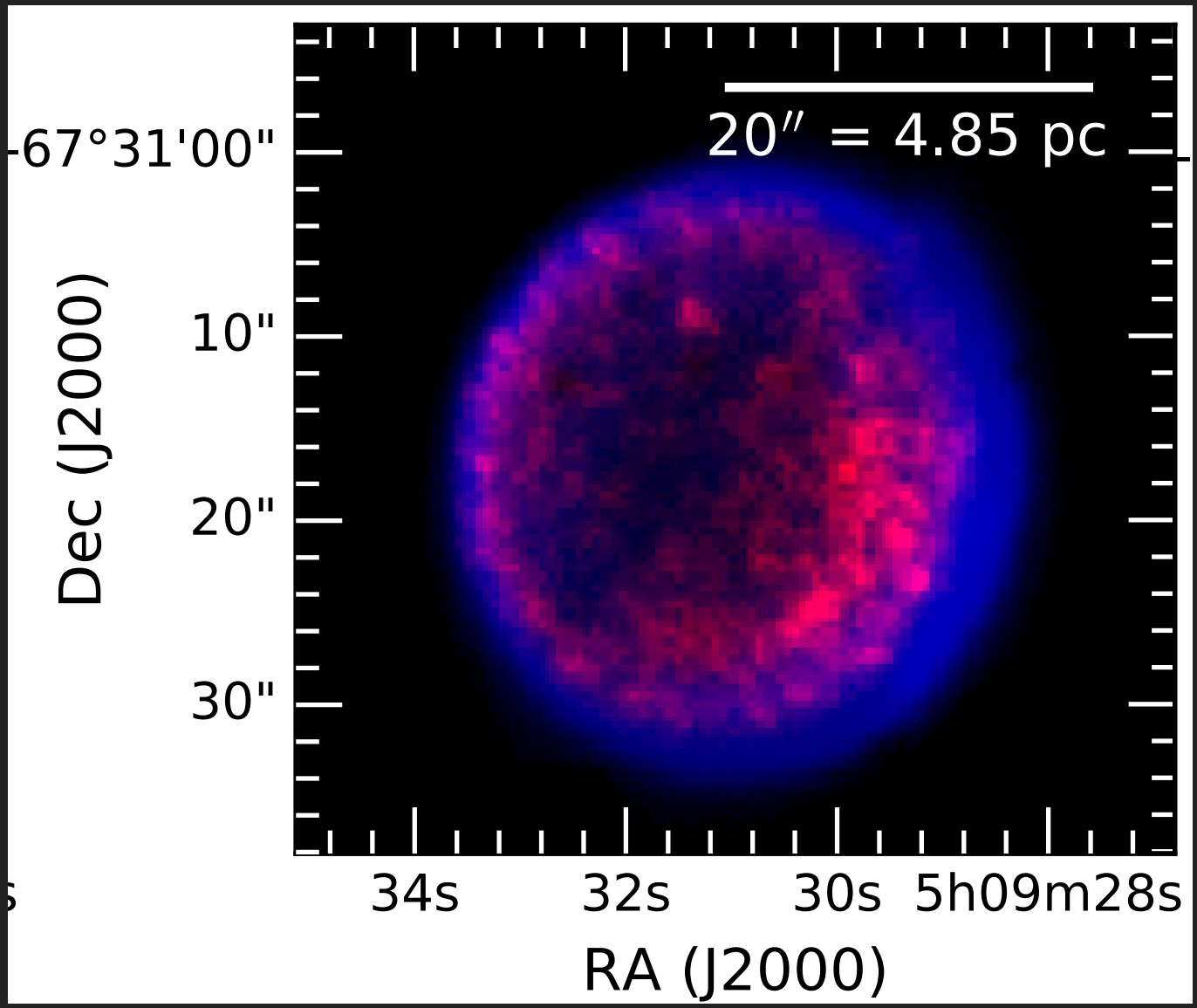

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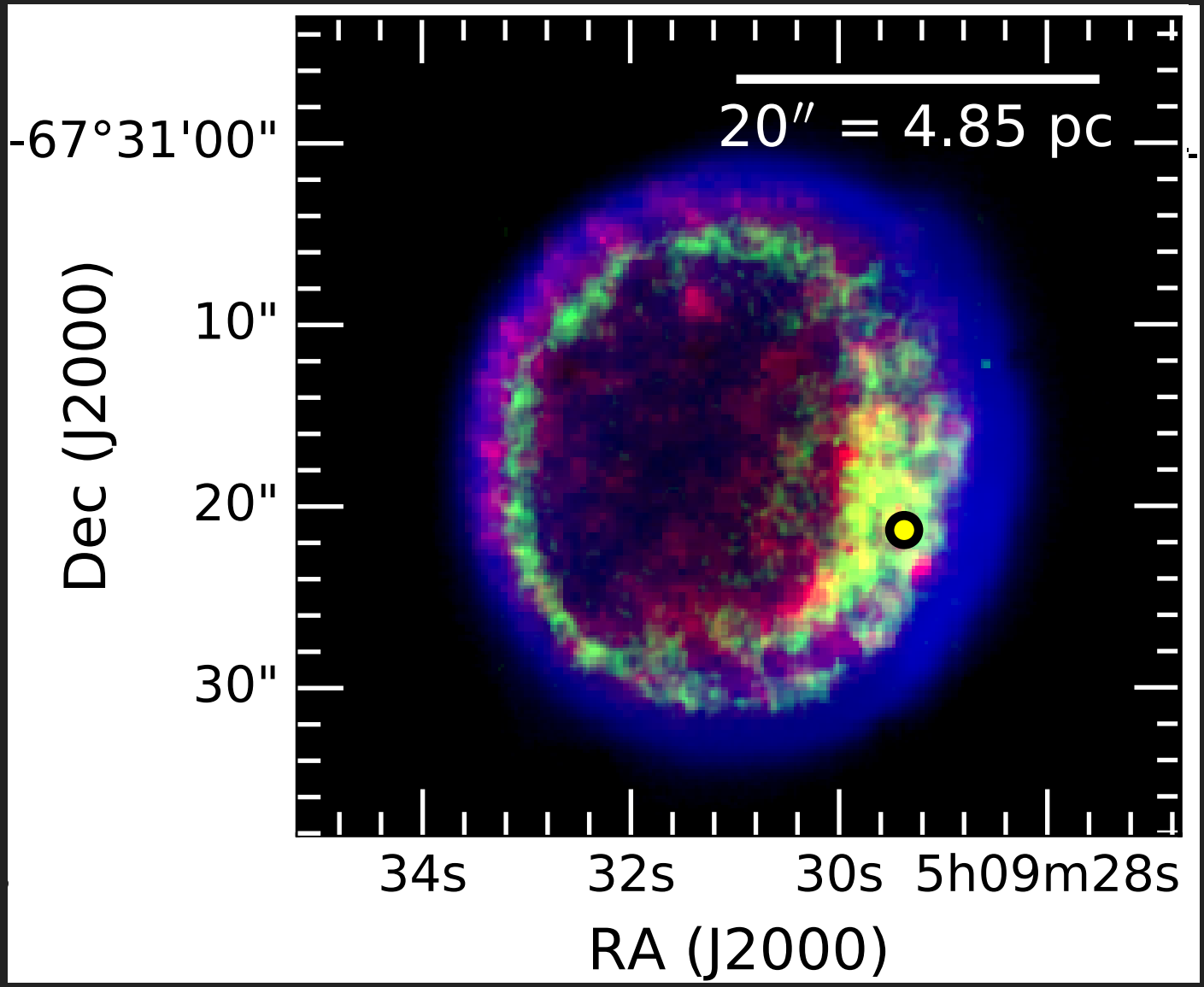

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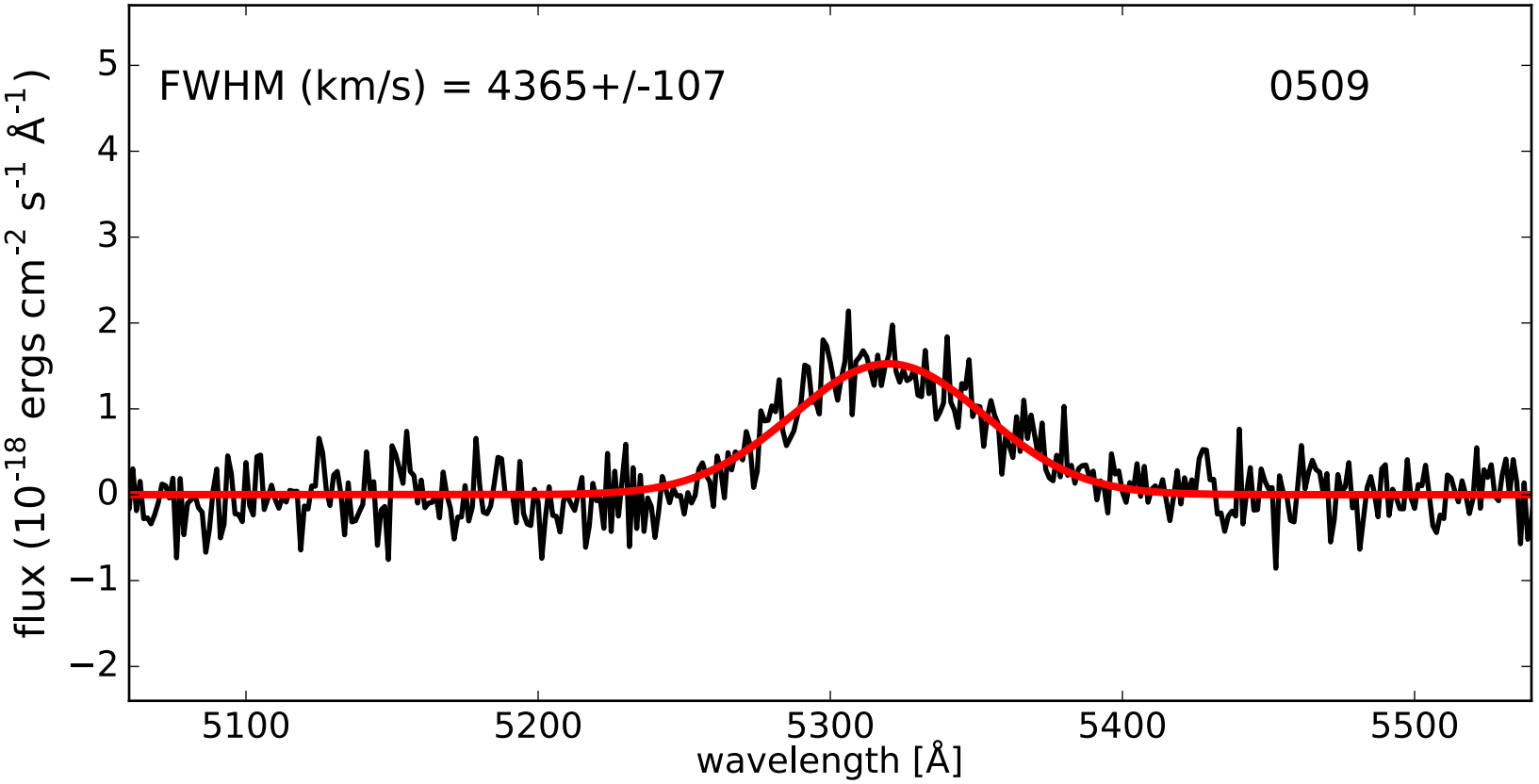

RA (J2000)

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SNR 0519-69.0

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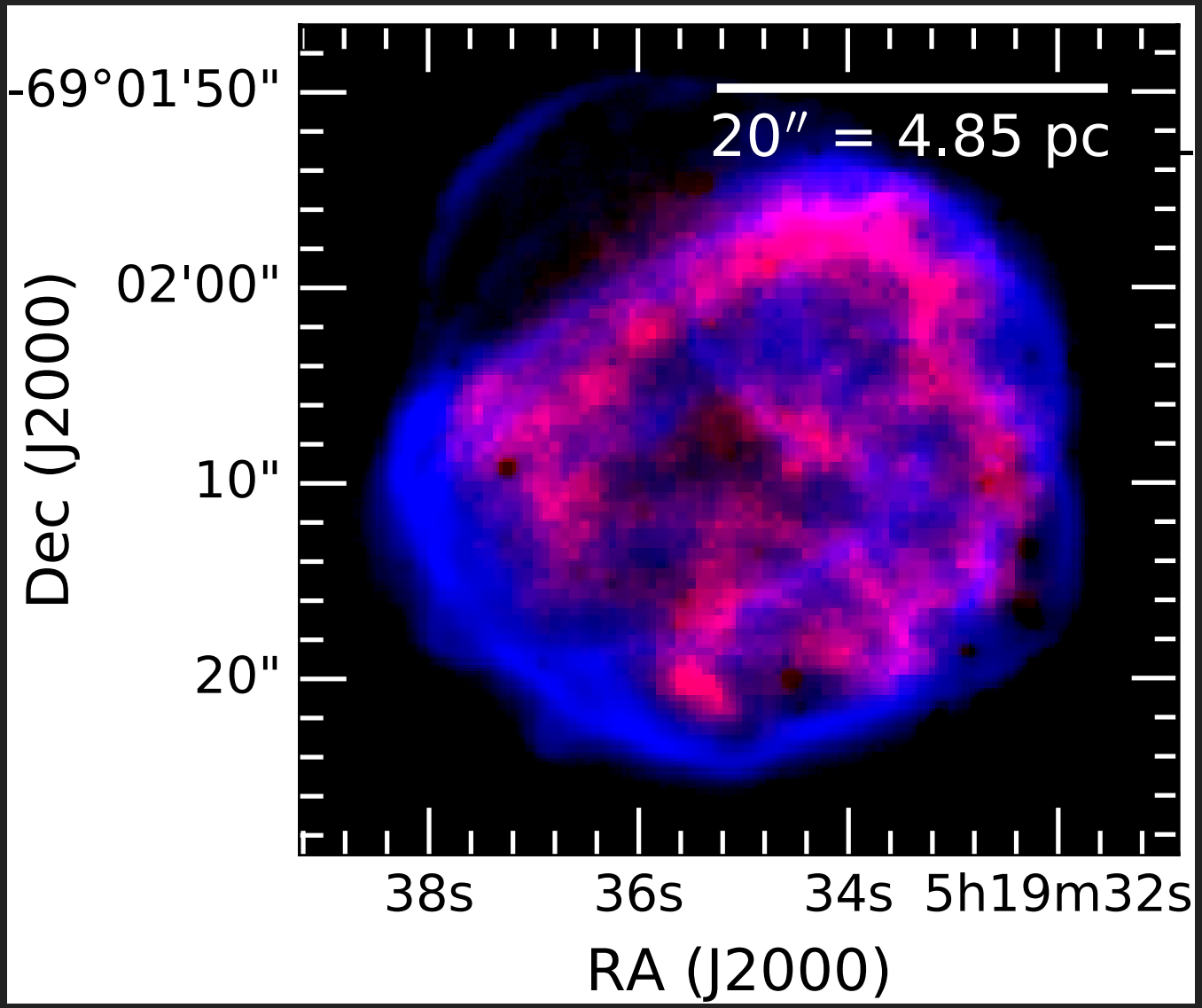

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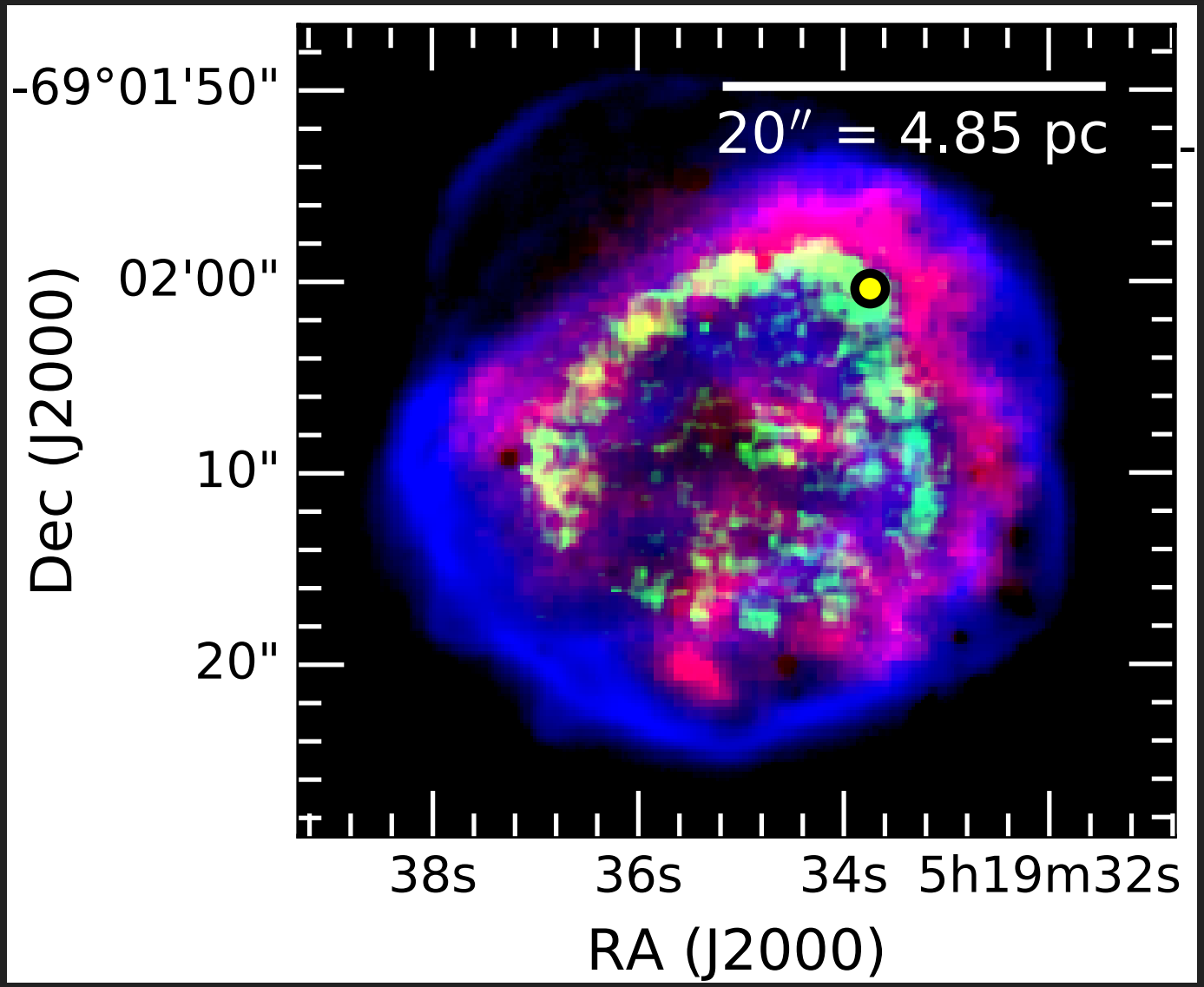

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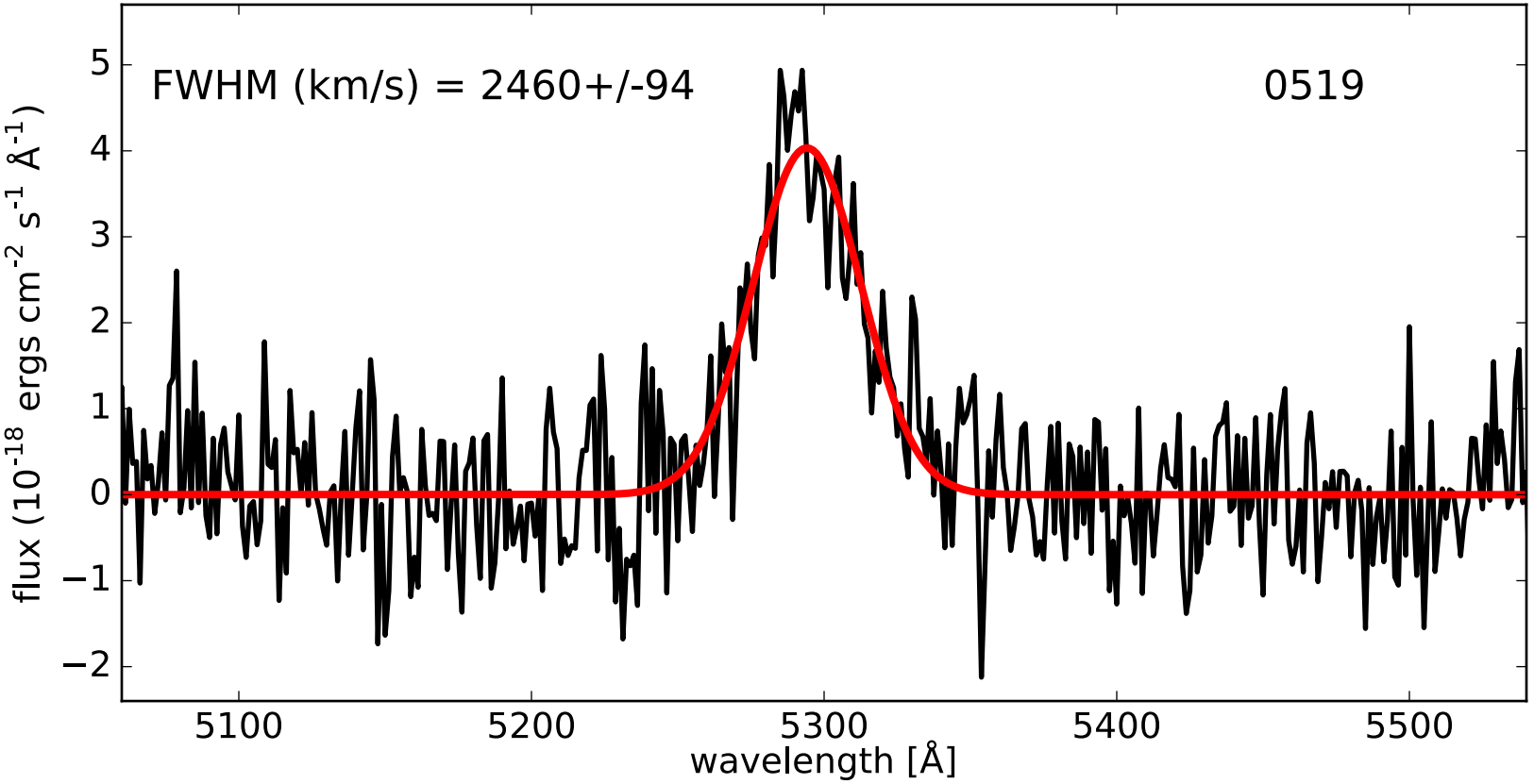

RA (J2000)

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N103B

R: X-ray, G: Fe XIV, B:Ha

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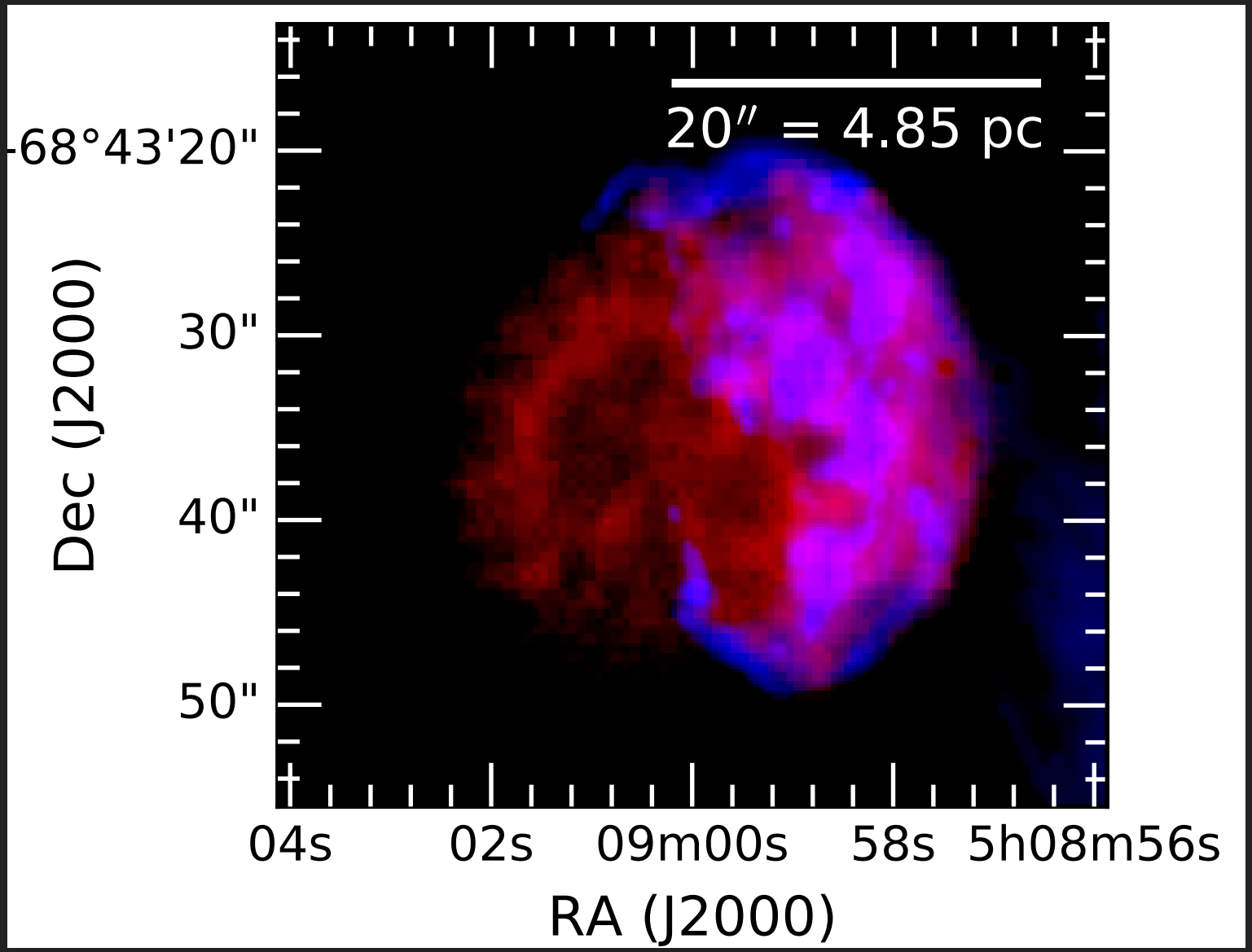

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N103B

R: X-ray, G: Fe XIV, B:Ha

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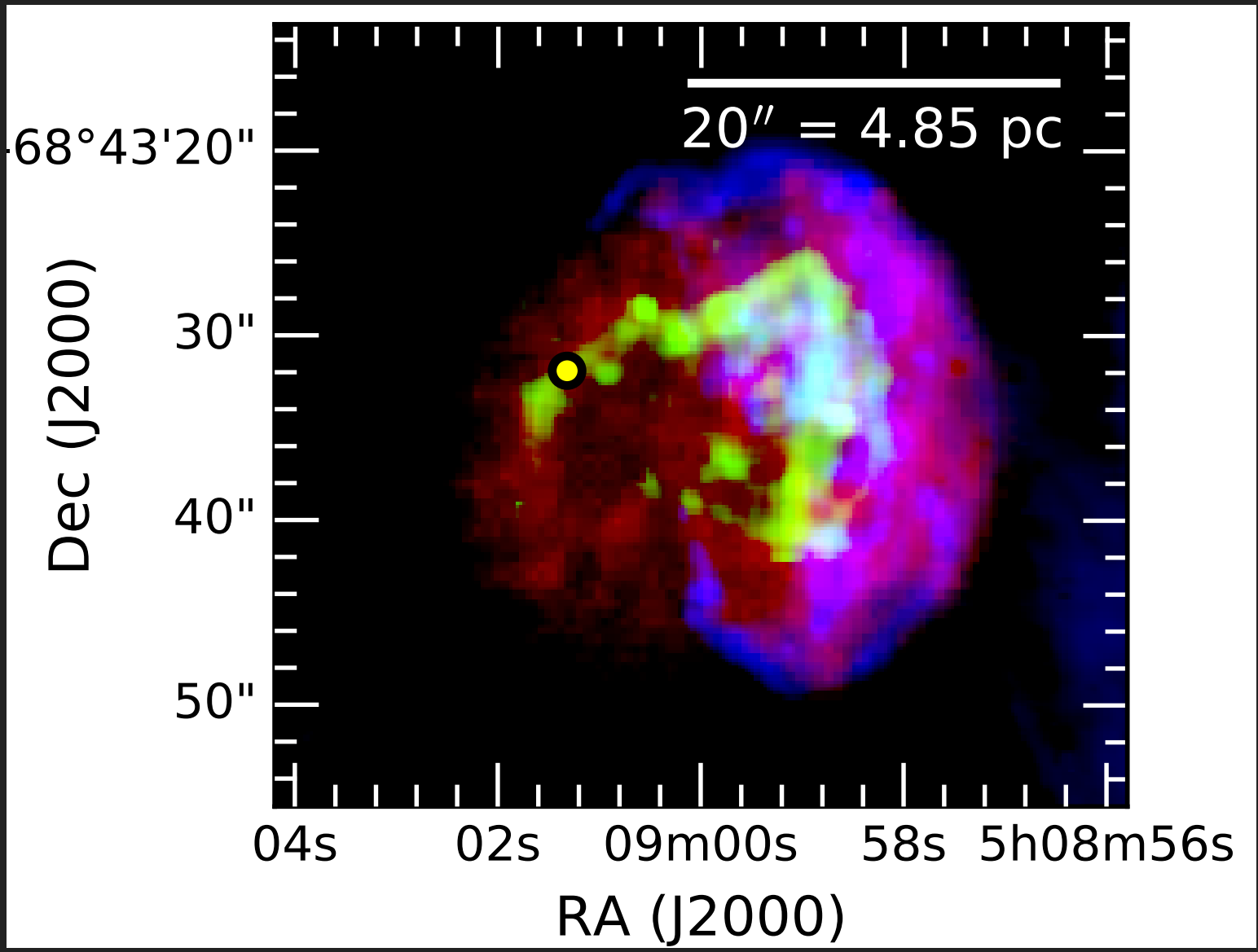

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N103B
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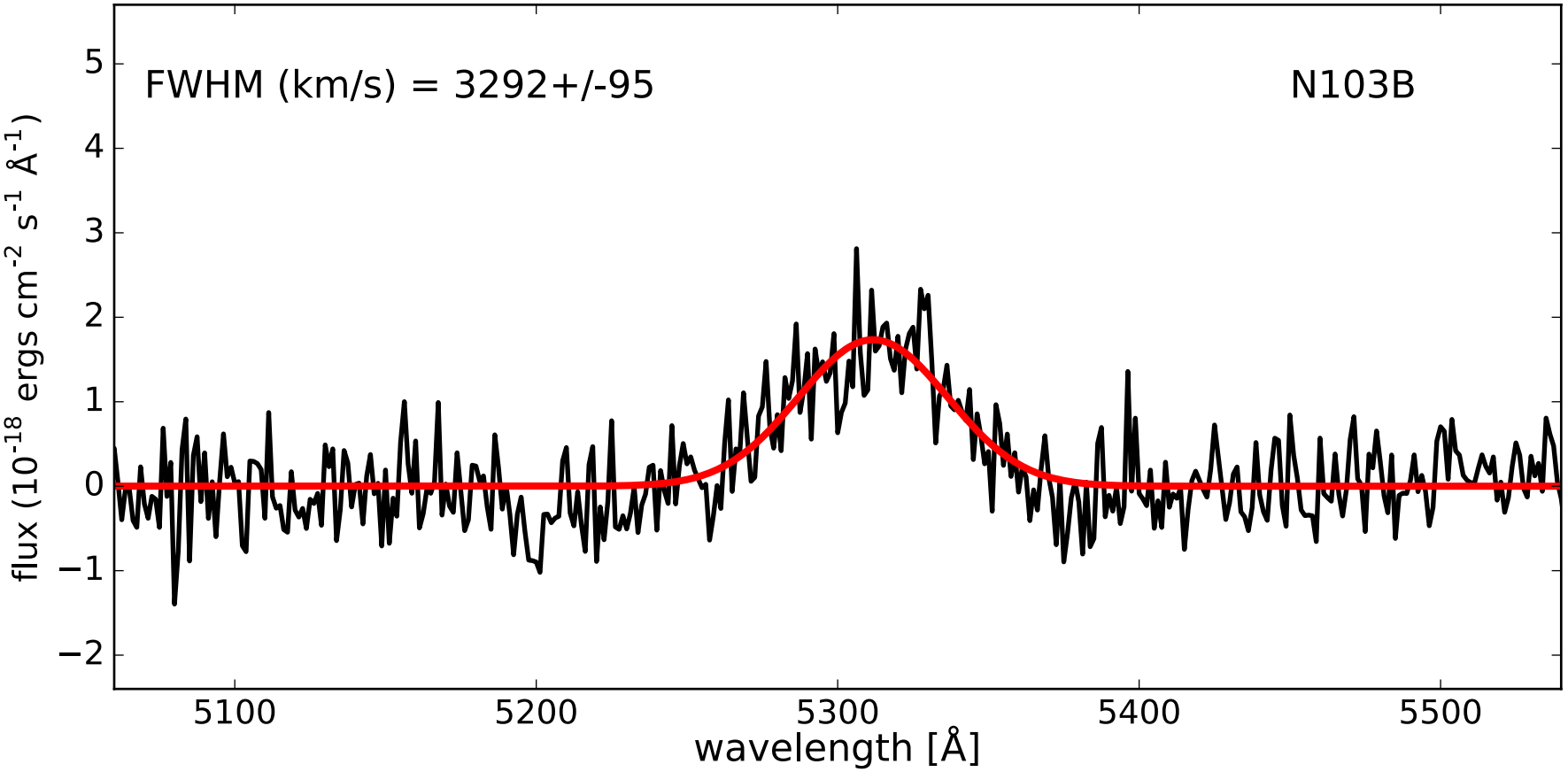

RA (J2000)

Type Ia (thermonuclear) supernova remnants

Accelerate CRs at forward and reverse shocks!

(but probably most are TeV dark)

What's the mass

of the exploding WD?

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Back of the envelope estimates

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Back of the envelope estimates

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- Collisionless shock, from strong shock jump conditions:

Back of the envelope estimates

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- Ion-ion equilibration would modify

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[S XII] 7613.1 (red)
[Fe IX] 8236.8 (blue)

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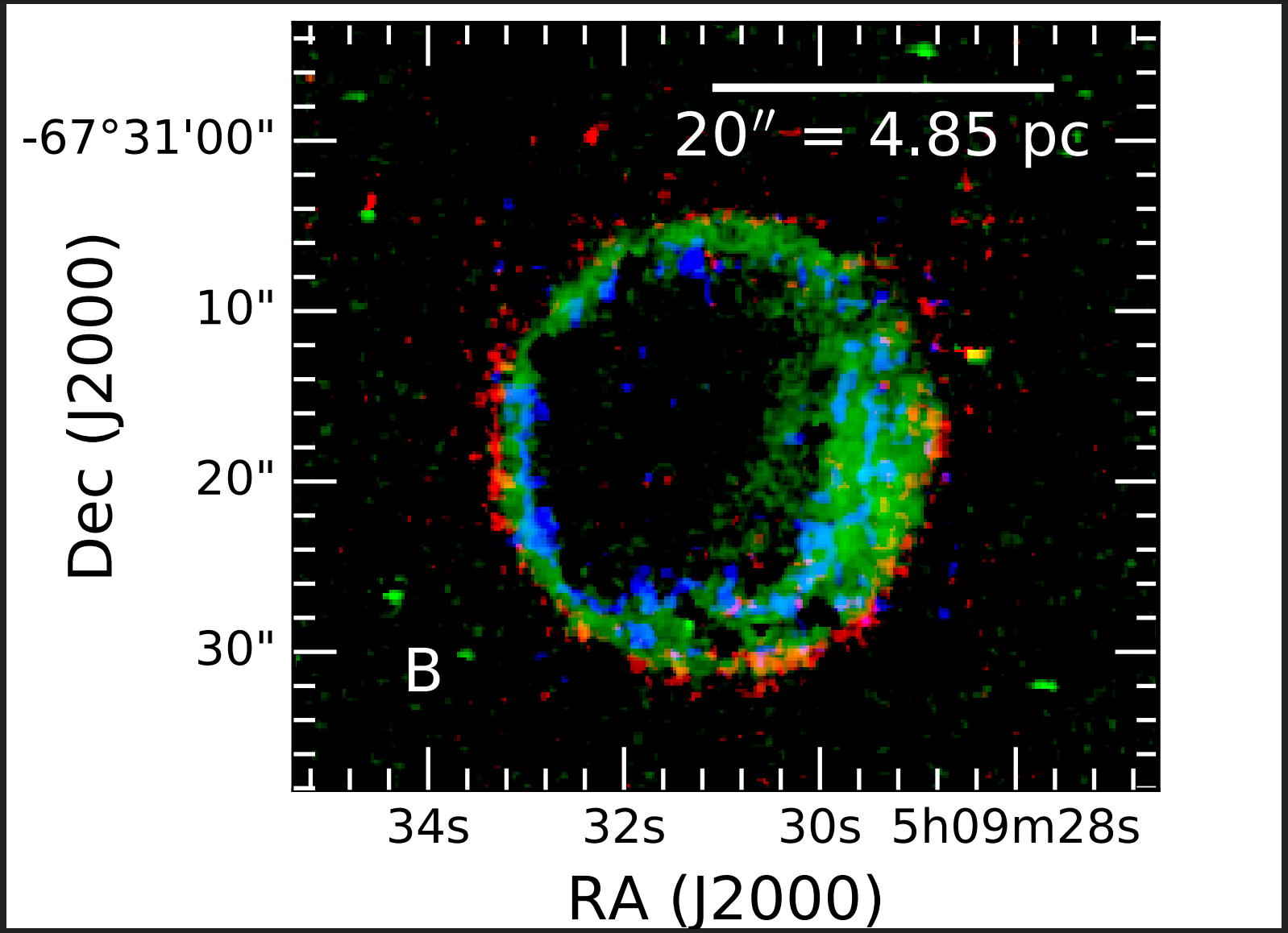
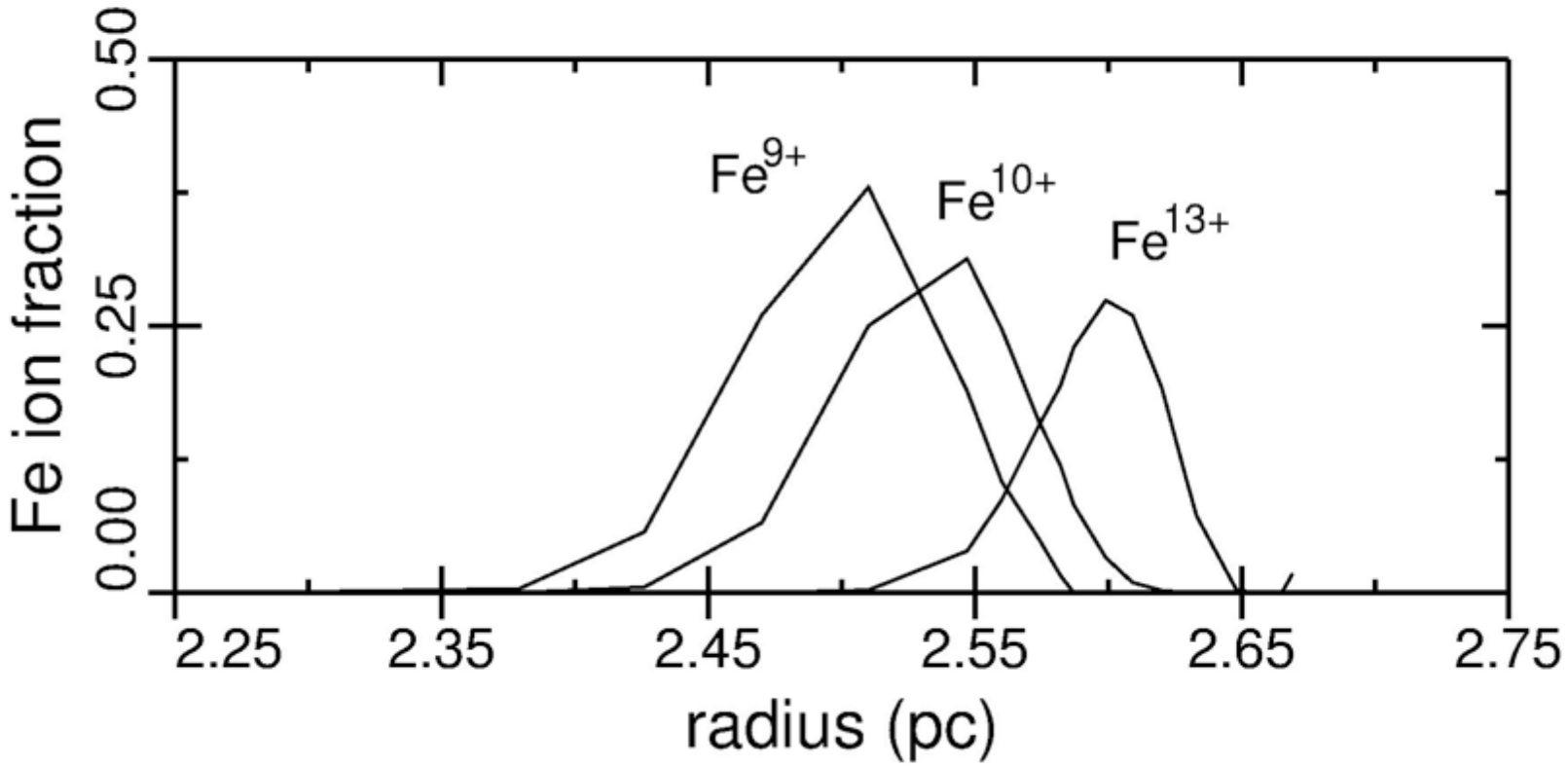


BLASPHEMER models

BLASt Propagation in Highly EMitting EnviRonment

by Martin Laming



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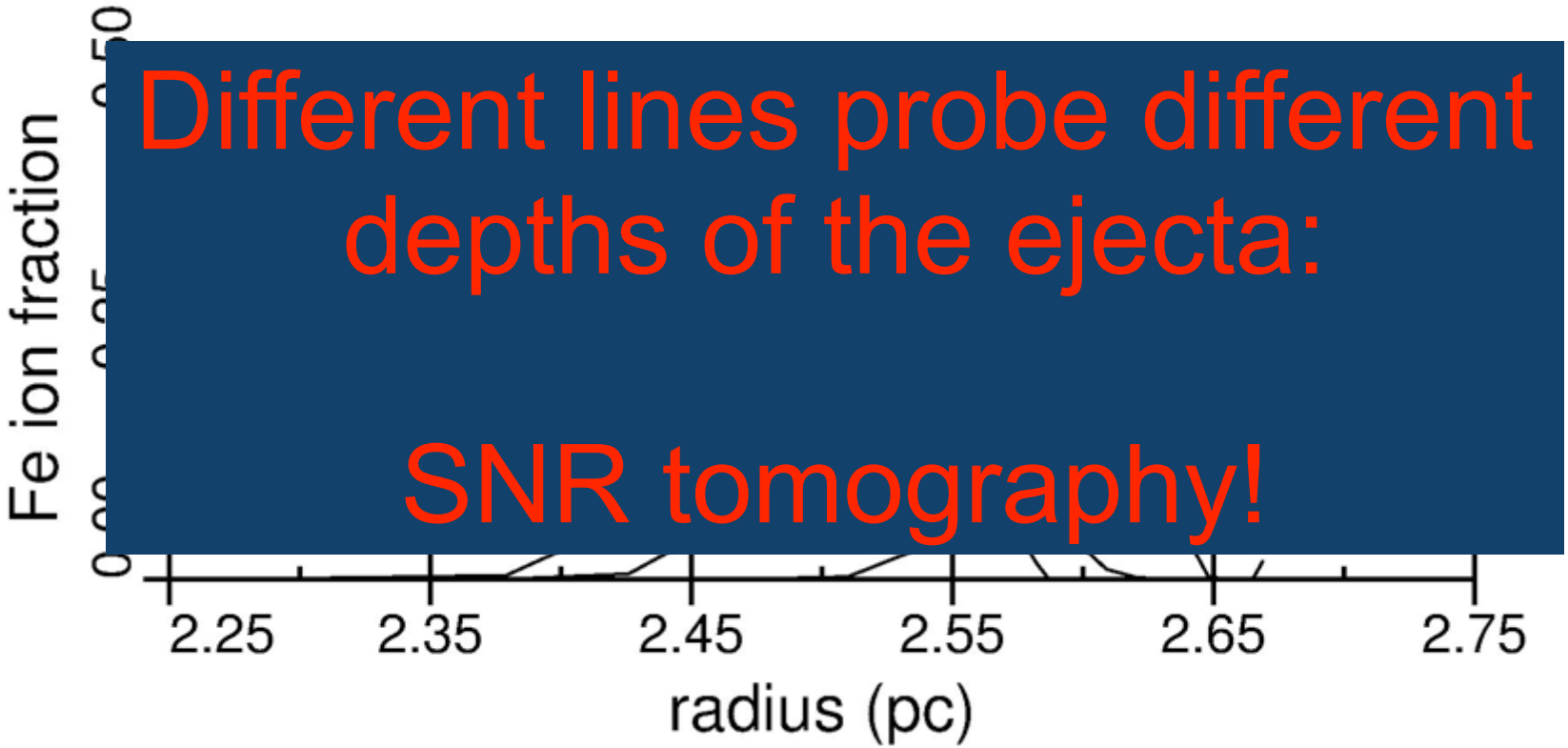

Different lines probe different depths of the ejecta:

SNR tomography!

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Shock velocities time-dependent

Leahy & Williams, ascl:1703.006

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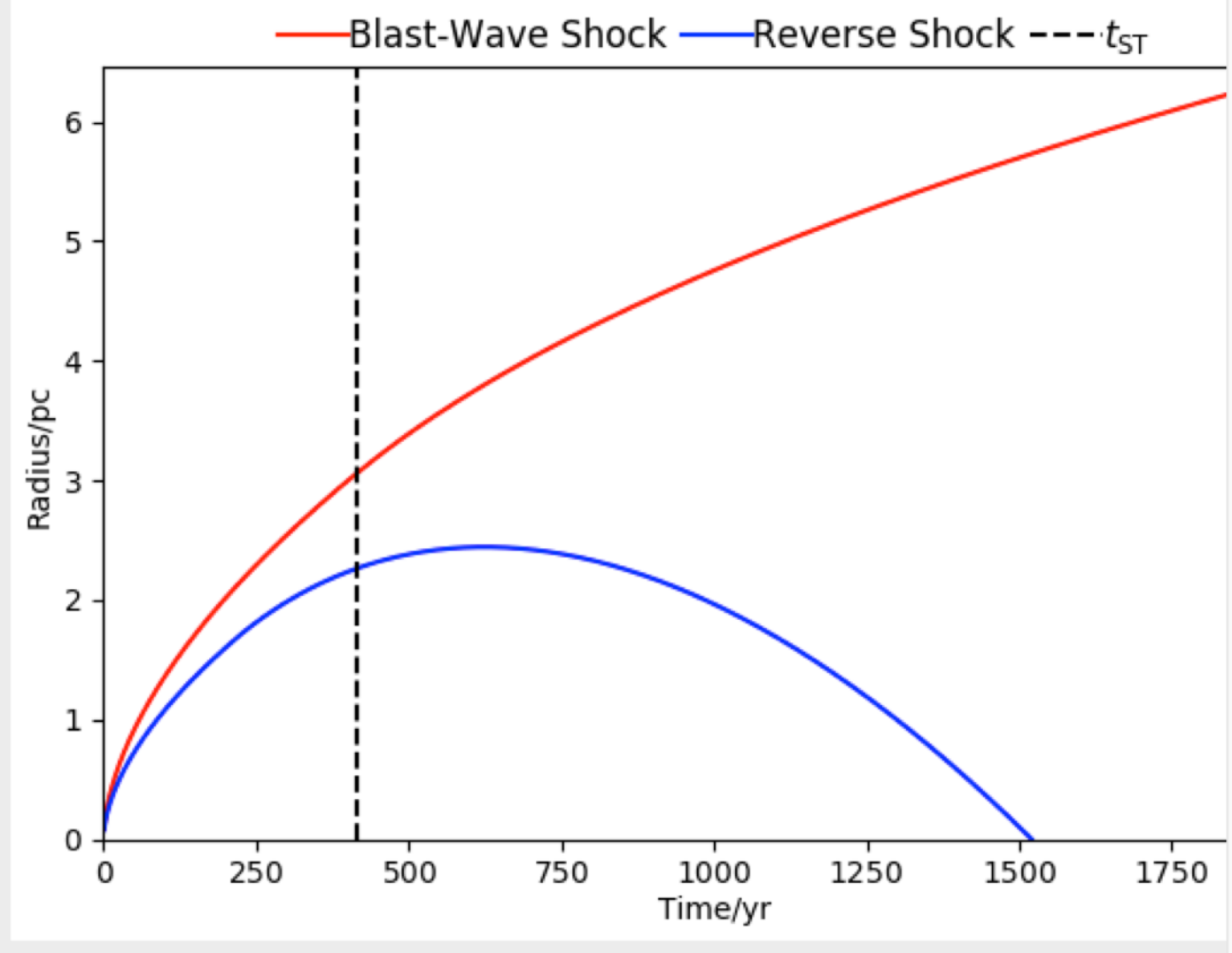

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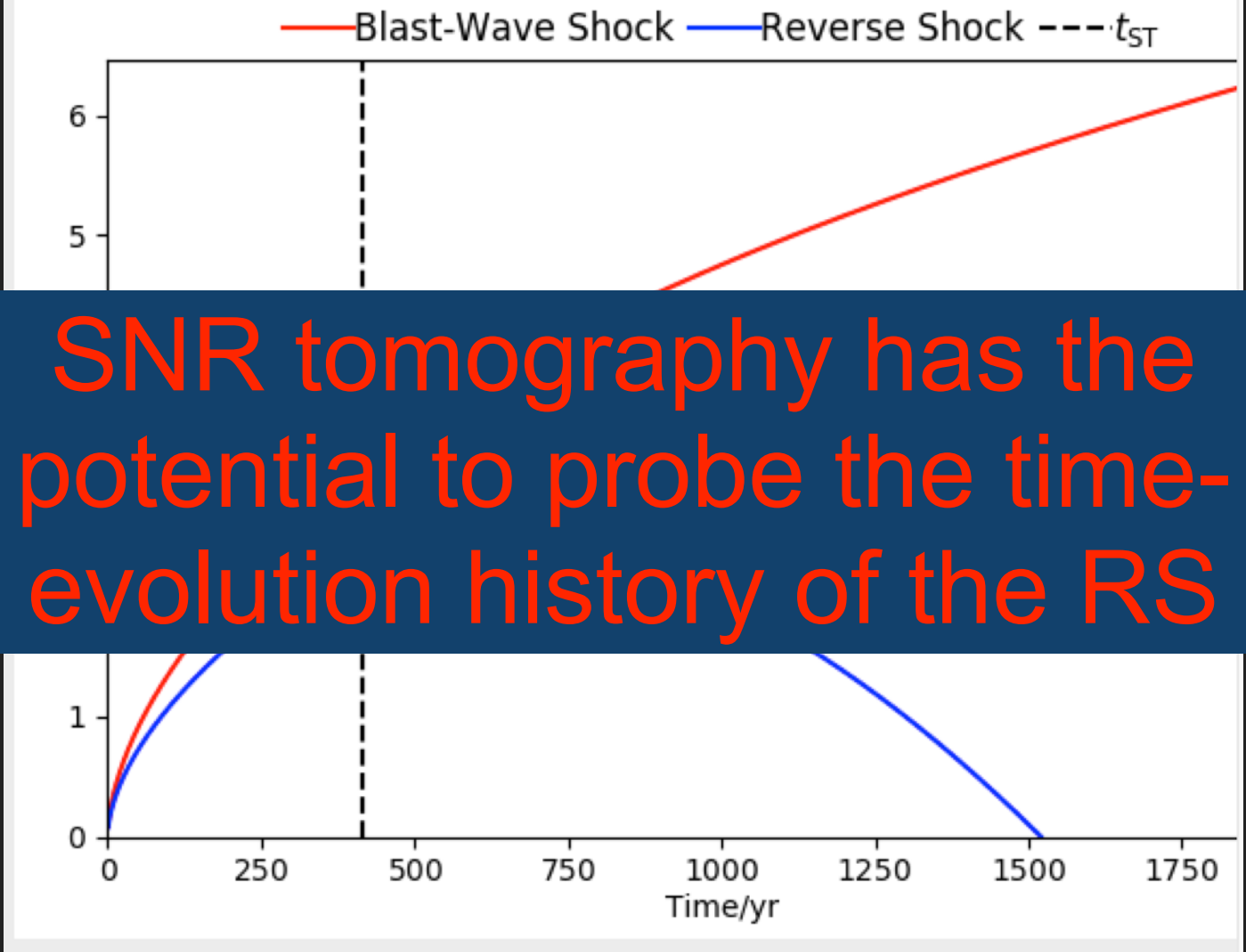

SNR tomography has the potential to probe the time-evolution history of the RS

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Final thoughts

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Final thoughts

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  - (mass, ambient density, explosion energy)
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  - **0509-67.5 (1991T-like) best matched by 1.0 Msun**

(Seitenzahl, Ghavamian, Laming & Vogt, PRL 123, 041101)

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PRL and MCN *covers*

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PHYSICAL REVIEW LETTERS

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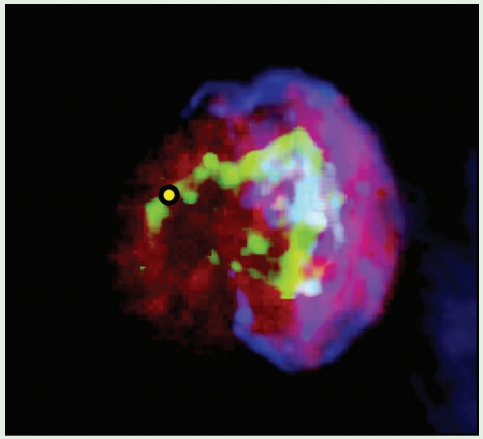

PRL 123 (4), 040401–049602, 26 July 2019 (302 total pages)

4

Published by
American Physical Society

APS physics

Volume 123, Number 4

THE MAGELLANIC CLOUDS NEWSLETTER

An electronic publication dedicated to the Magellanic Clouds, and astrophysical phenomena therein

No. 161 — 1 October 2019

https://www.astro.keele.ac.uk/MCnews

Editor: Jacco van Loon

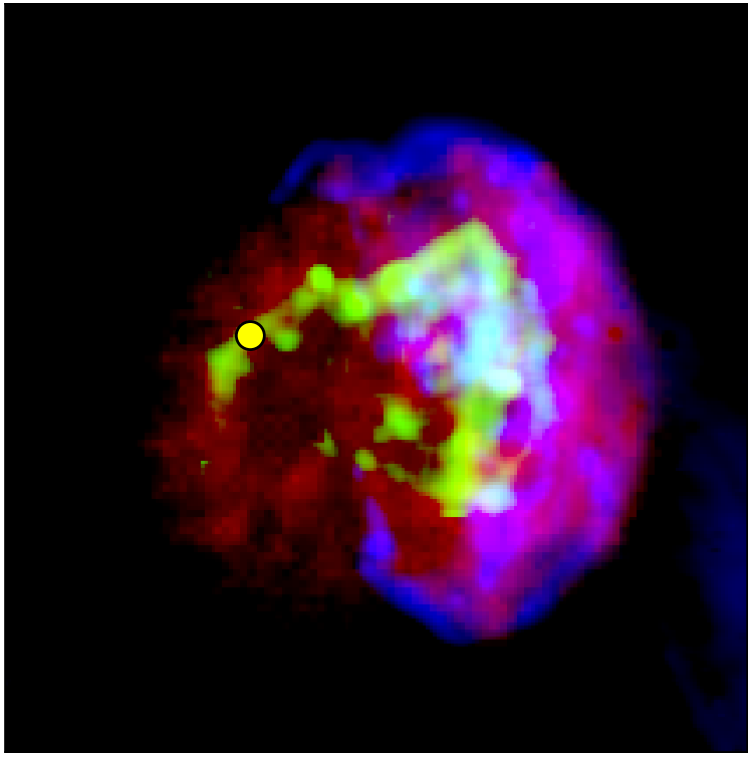

Figure 1: Type Ia supernova remnant N 103B with coronal [Fe XIV] emission showing up as a fluorescent green triangle. This image was generated using a new tomographical technique, based on a spectrum extracted from the position of the yellow dot. See Seitenzahl et al., 2019, Phys. Rev. Lett. 123, 041101.

ANITA 2020

Australian National Institute for Theoretical Astrophysics

2020 workshop and school. 3 - 7 February, 2020, Canberra

https://asa-anita.github.io/workshop2020/

ANITA 2020 workshop and `Cosmic explosions' summer school

The 14th annual Australian National Institute for Theoretical Astrophysics science workshop will be held on 6th-7th of February 2020 at the School of Science at UNSW Canberra. The workshop aims to provide a review of theoretical astrophysics in Australia, facilitate collaboration and build the community of theoretical astrophysicists. Read more about ANITA here.

It will be preceded by the ANITA summer school - "Cosmic explosions" on 3rd-5th of February 2020, which will also occur at the School of Science at UNSW Canberra.