

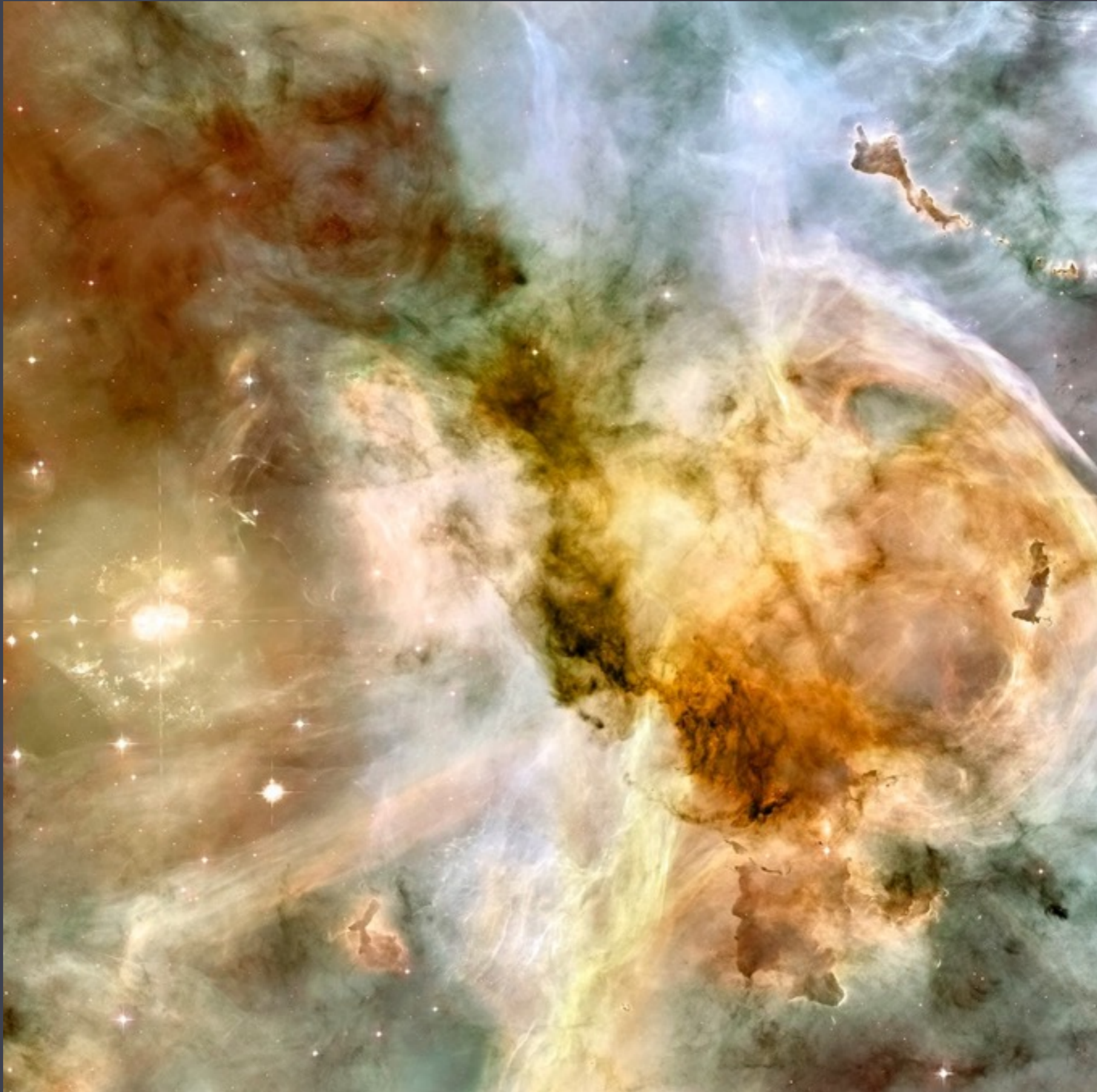
Carina Nebula: star formation region, 7000 light years away



HST: Carina Nebula

Prof. David Cohen: SC 125/124

energized by the few dozen most massive & luminous stars



HST: Carina Nebula

massive stars produce heavy elements and return them to the Galaxy via their stellar winds

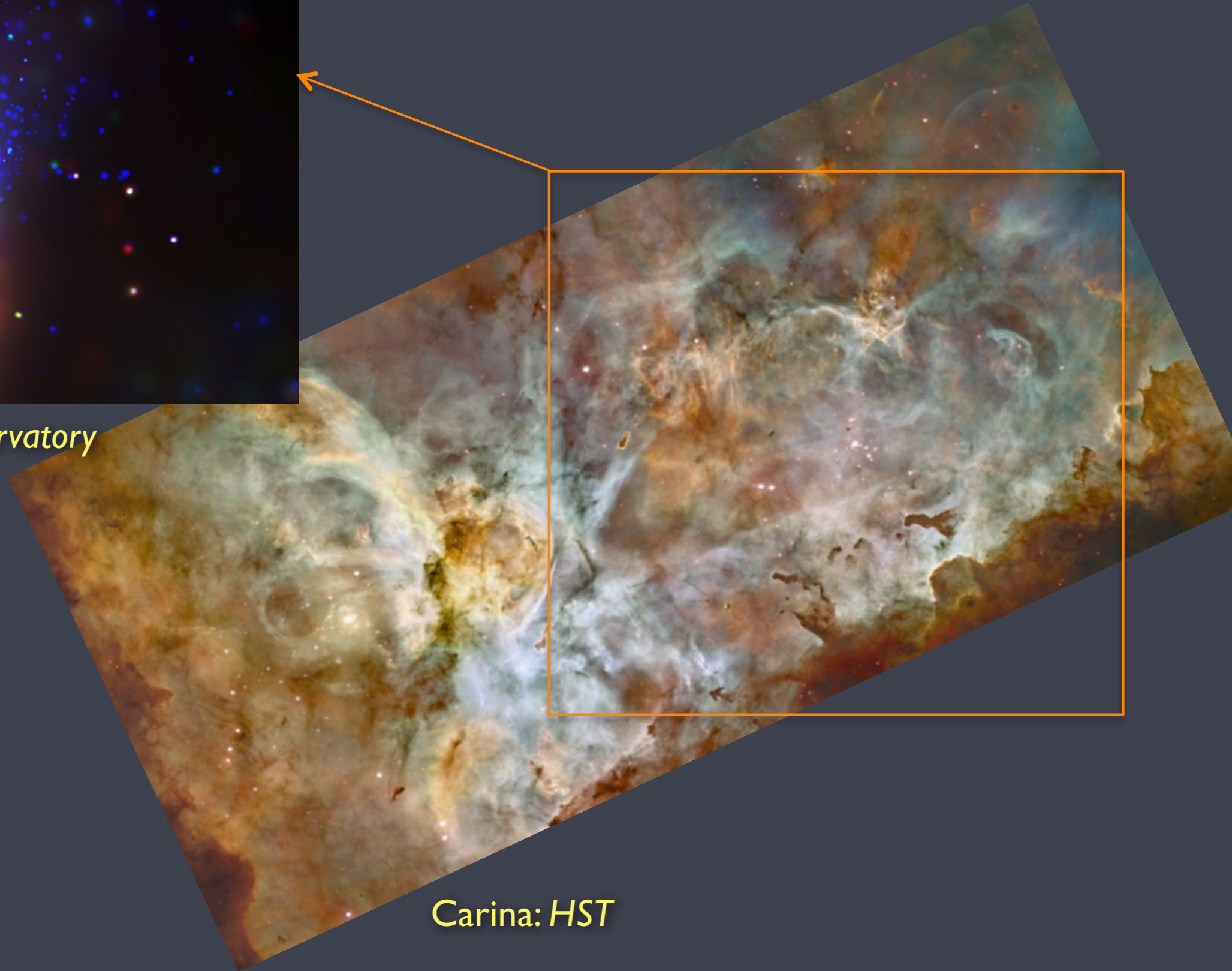


eta Carina

The massive stars are also
strong X-ray sources



Tr 14: *Chandra X-ray Observatory*



Carina: *HST*

Chandra X-ray spectroscopy of the very early O supergiant HD 93129A: constraints on wind shocks and the mass-loss rate

David H. Cohen,^{1*} Marc Gagné,² Maurice A. Leutenegger,^{3,4} James P. MacArthur,¹ Emma E. Wollman,^{1,5} Jon O. Sundqvist,⁶ Alex W. Fullerton⁷ and Stanley P. Owocki⁶

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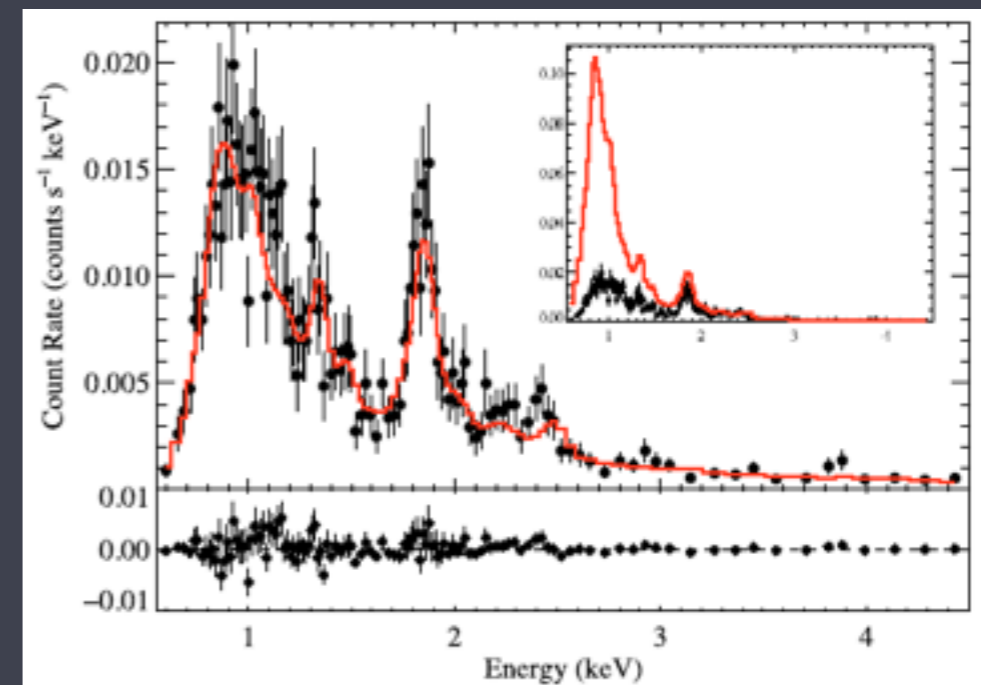
⁵Department of Physics, Caltech, 1200 East California Boulevard, Pasadena, CA 91125, USA

⁶Bartol Research Institute, University of Delaware, Newark, DE 19716, USA

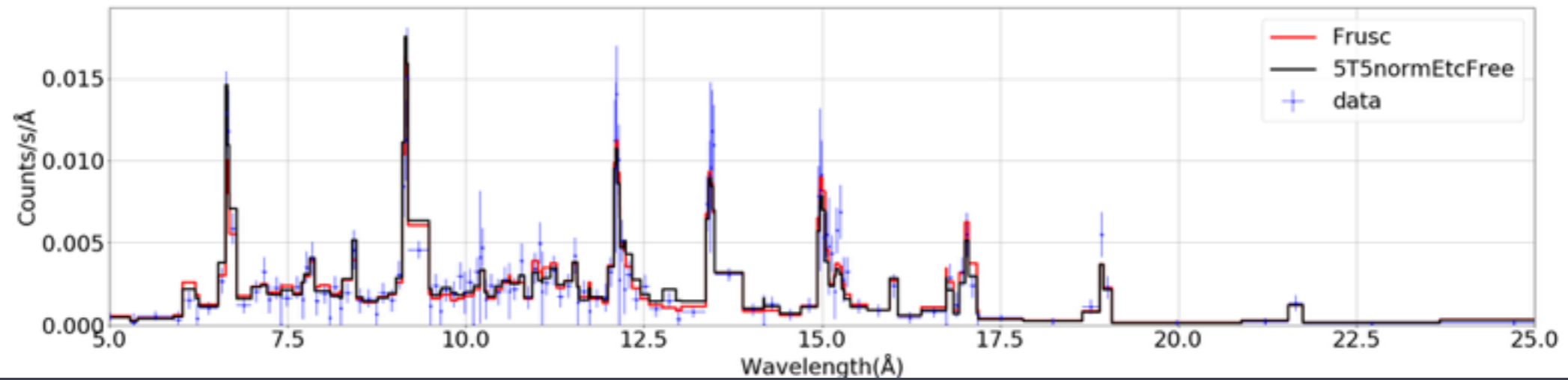
⁷Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA



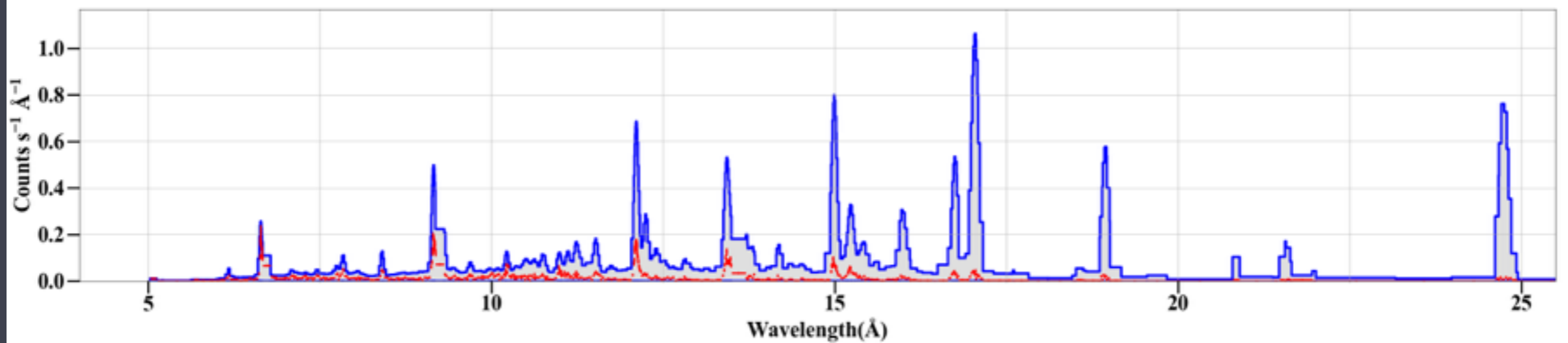
X-ray spectroscopy of the most massive star in the cluster provides information about this star's wind



Tr 14 in Carina: Chandra X-ray Observatory

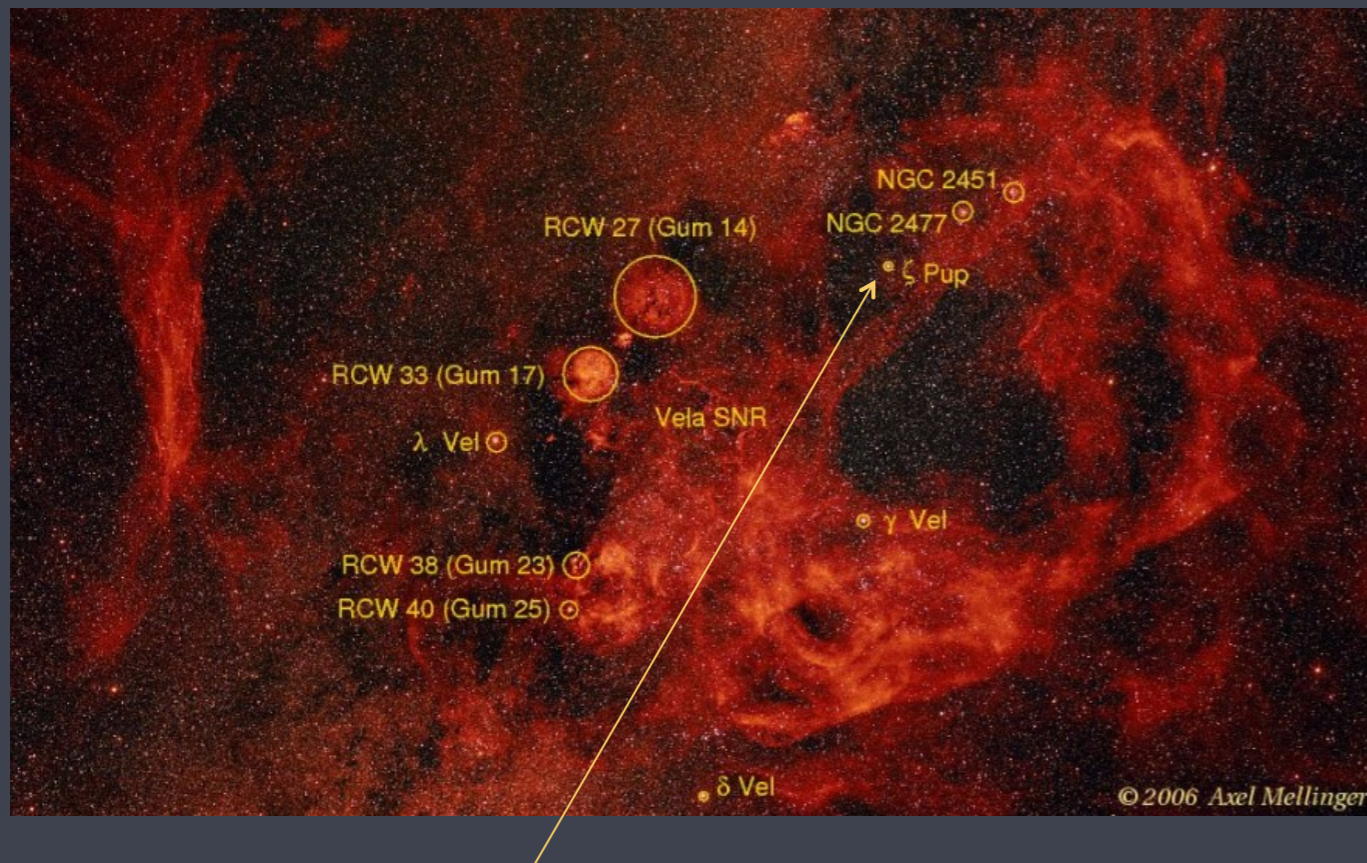


Now we (including Vaughn Parts and Graham Doskoch) are making high-resolution spectral models and fitting them to high-resolution Chandra data



We will start working with new time-series spectral observations of two important massive stars

Do the wind properties change with time? Are those changes correlated with changes in other properties of the stars?



I work with a medium-sized group of scientists and students
(Swarthmore, U. Delaware, Goddard Spaceflight Center,
Space Telescope Science Institute, U. Leuven)

We have group meetings to do our work, we go to
professional meetings to present our work



Erin Martell, Emma Wollman '09

more information on my website

astro.swarthmore.edu/~cohen

all faculty websites are listed on the dept site

this presentation

Student Research Group



In November 2018, I gave a presentation about my group's massive star research to inform students about our research and about opportunities to join the research group. I will likely be taking new students for the summer of 2018, with work to start during the spring semester. Come and talk to me if you think you might be interested.

In summer 2018, Vaughn Parts and Graham Doskoch began working on X-ray spectral modeling of O star winds and Erin Snoddy observed more than fifty exoplanet candidates for the KELT collaboration and presented her results at the KNAC Student Research Symposium at Middlebury College in September 2018. And Graham gave a talk at the symposium.

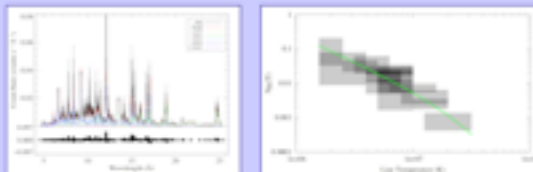
Sophia Lin ('19) joined the massive star X-ray group in spring 2017 and Jackie Pezzato ('17) has graduated and will be attending the Astronomy PhD program at Caltech in the fall.

Zack Li and David Lazere graduated in 2016, going on to grad school at Princeton and to work for an anti-hunger non-profit, respectively. Jackie Pezzato ('17) and Sarah Rubinstein ('19) are continuing to work on projects involving X-ray spectroscopy of massive stars, and they are joined by new group members Nathaniel Peters ('18) and Li Tian ('18) for the 2016-17 academic year.

In the summer of 2014, Jackie Pezzato ('17) and Randy Doyle ('16) worked with me on projects involving the interpretation of X-ray spectra of massive stars. I presented some of their preliminary results at a meeting in 2014.

Summer Research 2013

Zack Li and Kelley Langhans, both rising sophomores, are working on different aspects of the problems of measuring and modeling the plasma temperature distribution in the shock-heated winds of massive stars.



Summer Research 2012

Astrophysics major Jake Neely ('13) has been working on a project to analyze the X-ray line emission in the O stars ζ Ori and ζ Pup, as measured with the Reflection Grating Spectrometer on the XMM X-ray Telescope. Jake is using these data to derive elemental abundances in these

Research Information

Astrobetter – lots of useful information about the nitty-gritty of astronomical research and many aspects of being an astronomy student and astronomer

Astrobits – very short summaries of interesting research papers, written for undergraduates by graduate students; an excellent way to browse the literature or find articles on a given topic

Astronomy Image Explorer – images from refereed papers; browsable and searchable; a good (fun) way to browse papers

AAS Nova – image-based research highlights from AAS journals

Practical, for Group Members

Local computing information

ADS
astro-ph
SIMBAD
Astronomical Catalogs
Chandra X-ray Center
XMM Guest Observer Facility
HEASARC

ATOMDB atomic database

XSPEC manual

Tutorial on thermal radiation processes, by J. Kaastra.

A good (but somewhat technical) place to start answering the question *Why do these X-ray spectra look the way they do?*

Graphics

Historical graphics

Edward Tufte
Visualizing Astronomy at the CfA
Information Aesthetics
Flowing Data

Student Travel and Research Funding

HHMI travel funding
Sigma Xi travel funding
(these two will fund travel to meetings)

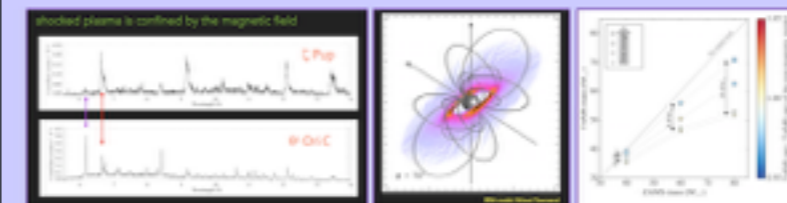
Soffen Memorial Fund
(they fund travel to meetings)
Sigma Xi grants in aid of research
National Geographic Young Explorers
(things like travel to an observatory are eligible)

Recent Presentations

Many of these presentations involve student research. You can get information about student research in the Department of Physics and Astronomy here at Swarthmore College. You can also see what else my research group is up to.

Refereed papers are archived here.

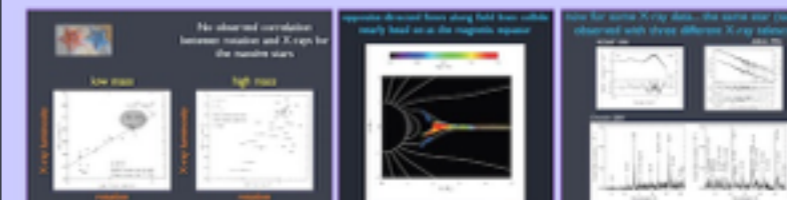
I gave the department colloquium in November 2016, "The Radiation-Driven Winds and X-ray Emission of Massive Stars" [pdf].



In March 2016, I gave a talk on massive stars and their X-ray emission [pdf] to the Delaware Valley Amateur Astronomers.



I gave the physics colloquium at the Royal Military College of Canada, in Kingston, Ontario in February 2016. My talk was titled, "X-rays from the Winds of Massive Stars" [pdf].



In fall 2015, I gave a talk at the Department of Physics and Space Sciences at Florida Tech. The talk was an overview of massive star X-ray emission: X-ray production via embedded wind shocks, X-ray mass-loss diagnostics, and magnetic massive stars [pdf].

I gave an invited talk on X-ray spectroscopy of stellar winds [pdf] at the *Universe in High-Resolution X-ray Spectra* at Harvard in August 2015.

