Syllabus for Astro ___: Stars and the Atomic Age

University of Michigan, term TBD

About this course: This course invites you to explore how ancient stardust became the key ingredient in the nuclear arms race in the 20th century, and how this story might impact our expectations on the search for extraterrestrial life.

Section: Astro ___ (lecture/discussion)
Dates: TBD (a total of 14 sessions)
Times: TBD
Location: TBD

Credit: 1 credit
Prerequisites: None
Credit Exclusions: None

Instructor: Dr. Ian U. Roederer
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Office: West Hall 306H (West Hall is located at 1085 S. University Ave.)
Office hours: TBD, or by appointment

Course texts: There is no course text to purchase. All readings are open-access and available online. Links will be posted on the Canvas site.

Learning objectives: By the end of the course, you should be able to

(1) Describe the methods that astronomers use to determine what objects in space are made of.
(2) Explain the basic mechanics of how stars produce heavy elements and how they were transported to Earth's crust.
(3) List the basic properties of protons, neutrons, and electrons; the principle of radioactivity; and the process of nuclear fission.
(4) Summarize and describe the key individuals and events in the 20th century that led to the development and proliferation of nuclear weapons.
(5) Articulate the central role uranium played in the development of nuclear weapons.
(6) Defend, using evidence and reasoning, your understanding of why humanity's search for extraterrestrial life is worthwhile or futile.
(7) Assess and articulate the extent to which your worldview has changed in response to the concepts and information covered in this course.

Attendance: I will follow the established LSA attendance policy (http://lsa.umich.edu/lsa/academics/degrees-requirements/academic-policies/class-attendance.html) regarding religious holidays, illnesses, representation of the University, etc. Other personal reasons not covered explicitly by this policy should be discussed with me well in advance (two weeks or more) of the absence. Documentation (e.g., doctor's note from U.H.S.) may be requested in accordance with this policy to count as an excused absence.

Much of the synthesis of concepts in this course is expected to occur during our weekly class meetings. Some portion of each class may be a lecture component, but in-class group discussions and activities will feature prominently, and points will be awarded for submitting written work associated with these in-class activities. It will be extremely challenging for you to pass this course without regular attendance and participation. With that in mind, I strongly encourage you to attend all class meetings, and so I offer this additional incentive to attend and engage.

Homework assignments and writing reflections: There will be preparatory work for each class meeting. The nature of this work will vary from week to week, and you will always have at least one week to complete it. Assignments will be posted on the Canvas site and discussed in class as needed.

Exams: None. We will not use the period scheduled for the final exam.

Extra credit: No opportunities for extra credit are included.

Grades: I use high standards to evaluate your work in this course. I do so because I believe that each of you is capable of meeting those standards. Grades will be calculated by summing scores on the weekly assignments. The total number of points you can earn in this course is 100. Grades will be assigned to the point score as follows:

99+:	A+	87-90: B+	77-80: C+	67-70: D+	0-60: E
93-99:	A	83-87: B	73-77: C	63-67: D	
90-93:	A-	80-83: B-	70-73: C-	60-63: D-	

I reserve the right to lower the cutoffs for each letter grade, but I will not raise the cutoff marks (e.g., under no circumstances would 90 points receive a B+ or below). If you wish to contest a score on an assignment (for example, you think something was graded incorrectly), let me know of your intent to contest this score within 48 hours of the assignment being returned to you. We can later find a mutually-convenient time to discuss the matter.

Content notice: Portions of this course, particularly classes 6, 7, and 8, will include short discussions of death and radiation sickness resulting from the use of nuclear weapons. If you are concerned that these discussions may adversely affect your ability to participate in the course, please contact me.

Credit: This is a one-credit course, and I will expect a commensurate level of out-of-class effort on your part (i.e., ~2 hours per week) on your part.

Drop/add deadline: TBD is the last day to withdraw for regular drop/add or to change to pass/fail status.

Office hours: My office hours are a time that I reserve for you. Please feel free to stop by, ask questions about the classes, course materials, homework assignments, etc., or anything else of interest. If you cannot attend the posted hours (maybe because you have another class then), send me an email, and we'll schedule a meeting that works for each of us. I have other responsibilities in my schedule, so I may not always be present in my office at other times of the day.

Academic integrity: The LSA community, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. The "LSA Community Standards of Academic Integrity" statement (http://www.lsa.umich.edu/academicintegrity) outlines the principles we will follow in this class, and the "LSA Procedures for Resolving Academic Misconduct" (http://www.lsa.umich.edu/academicintegrity/procedures) will be used to resolve any issues that arise. Graded material deemed, after due process, to be plagiarized will receive a zero.

Devices in the classroom: You are more than welcome to use laptops, smart phones, or other devices in my class if they are used responsibly and do not pose a distraction to me, you, or your neighbor. These devices must remain silent. In the interest of common curtesy, if you find yourself in need of your phone (perhaps in the case of an emergency), please quietly excuse yourself from class and do what you need to do in the hallway.

Accommodations: If you think you need an accommodation for a disability, please let me know at your earliest convenience. I am happy to help. Some aspects of this course—the assignments, the in-class activities, and the way the course is usually taught—may be modified to better enable your participation. As soon as you make me aware of your needs, we can work with the Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (http://ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

Contacting me: Email is the best way to contact me. Please write "Astro ___" in the subject line. Typically I will respond to email only during normal business hours. The phone number listed is a desk phone that cannot receive text messages, and it is only answered during normal business hours. As a matter of policy, I decline LinkedIn or facebook friend requests from students. I am happy to discuss course material or other matters with you during my office hours, via email, before or after class, or at other times by appointment.

This course is taught by a member of the Lecturers' Employee Organization, AFT Michigan Local 6244, AFL-CIO.

Course Schedule for Astro ___: Stars and the Atomic Age

University of Michigan
Term/Year (Dr. Roederer)

No.	Date	Topic	Readings to complete before today	Assignments to complete before today
1		Course introduction		
2		Introduction to atoms and spectroscopy	DOE Handbook, p. 1-16	Written reflections/ responses (4 points)
3		Relative abundances of the elements	Online reading set “A”	Written reflections/ responses (5 points)
4		Nucleosynthesis, the r-process, and radioactive decay	DOE Handbook, p. 22-25, 27, 30-35. Online reading set “B”	Written reflections/ responses (5 points)
5		Nuclear physics and nuclear weapons	DOE Handbook, p. 17-21, 48-51, 56-62	Homework 1 (10 points)
6		Uranium in the 20th century	NYT articles	Homework 2 (10 points)
7		The Manhattan Project	(as needed)	Homework 3 (10 points)
8		The world after Trinity	(as needed)	Homework 4 (10 points)
9		The reactions of scientists	watch movie: “The Day after Trinity”	Written reflections/ responses (4 points)
10		The reactions of humanity	—	Homework 5 (14 points)
11		Exoplanets	NASA websites	Homework 6 (12 points)
12		The Drake Equation	Online reading set “C”	Written reflections/ responses (3 points)
13		Contact scenarios	Baum et al. paper - contact scenarios	Written reflections/ responses (5 points)
14		Uranium is everywhere; course reflections	Physics Today article	Homework 7 (8 points)

Where to find these readings:

DOE Handbook: "*Department of Energy Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume 1 of 2*". January, 1993. https://www.standards.doe.gov/standards-documents/1000/1019-bhdbk-1993-v1

Online reading set "A":
- Wikipedia: "Abundance of the chemical elements"
- Blog: http://blog.sdss.org/2017/01/09/origin-of-the-elements-in-the-solar-system/"

Online reading set "B":
- Wikipedia: "Nucleosynthesis"
- Wikipedia: "r-process"

Online reading set "C":
- Wikipedia: "Drake Equation" (sections "equation," "usefulness," and "estimates" only)
- Canvas: fermiparadox.pdf
- Canvas: howclose.pdf

New York Times articles: PDFs posted on Canvas

The Day After Trinity (1981): https://www.youtube.com/watch?v=Vm5fCxXnK7Y

https://exoplanets.nasa.gov: "Exoplanets 101" and "Habitable Worlds"

"Would Contact with Extraterrestrials Benefit or Harm Humanity? A Scenario Analysis," S.D. Baum et al., *Acta Astronautica*, **68**, 11 (2011) available at https://arxiv.org/pdf/1104.4462v2.pdf
Which sections do I need to read?
- surnames A-E: 1, 2, 3, 6
- surnames F-M: 1, 2, 5
- surnames N-S: 1, 2, 4
- surnames T-Z: 1, 2, 3

"On the belated discovery of fission," *Physics Today*, **68**, 6-40: PDF posted on Canvas