PHZ 4316/5315
Nuclear Astrophysics
Spring 2009

Instructor: Peter Hoeflich
614 Keen Bld. (850-644-5597)
E-mail: pah@astro.physics.fsu.edu
Office Hours: Tuesday 1-2pm
(but feel free to drop by at any time)

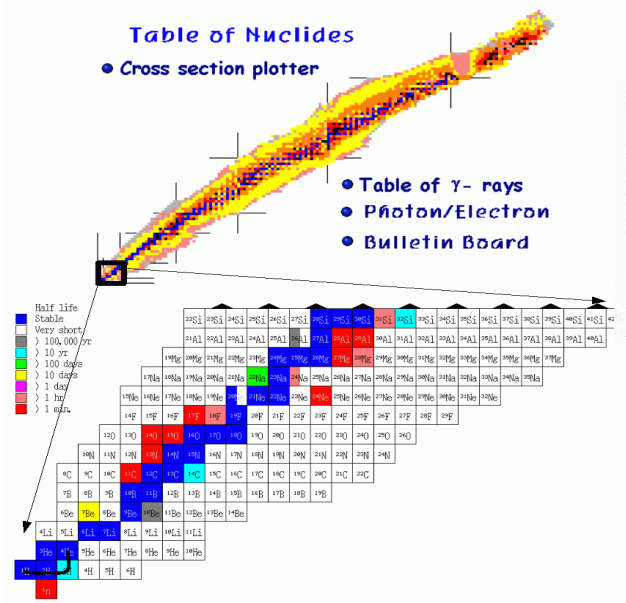
Time: MF 1:15pm-2:30pm
Location: HCB 309

PHZ4316/5315: Course Description

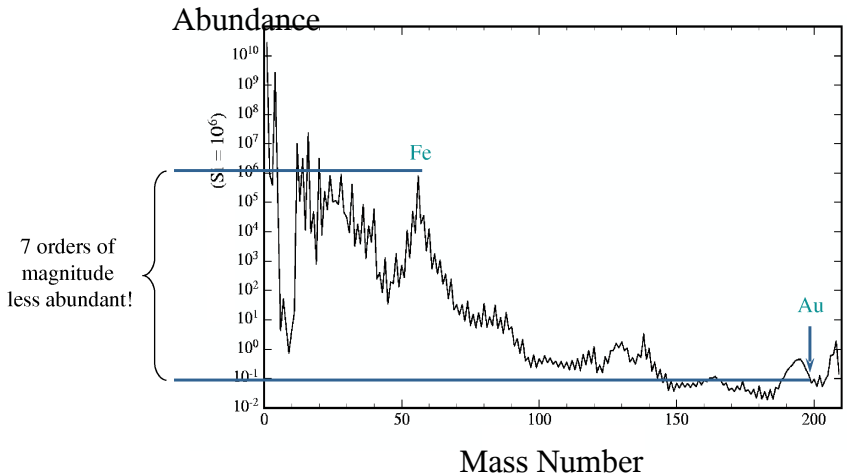
- Nuclear Processes in Astrophysics
- Origin and Creation of Elements
- Nuclear Properties of Elements
- Nuclear Physics as Tool in Astrophysics
- Astrophysical Methods

- For physics majors on a senior undergrade or graduate level

Isotopes



Element abundances in the universe

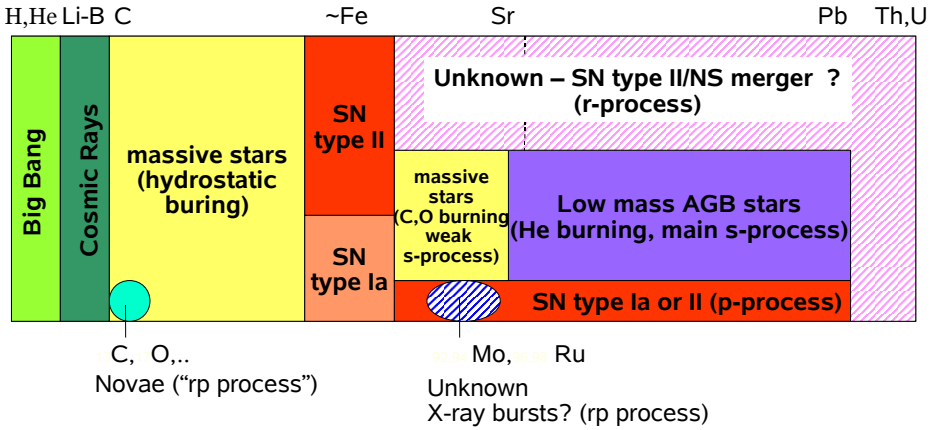


Question 3
How were the elements from iron to uranium made?

"The 11 Greatest Unanswered Questions of Physics"
based on National Academy of Science Report, 2002

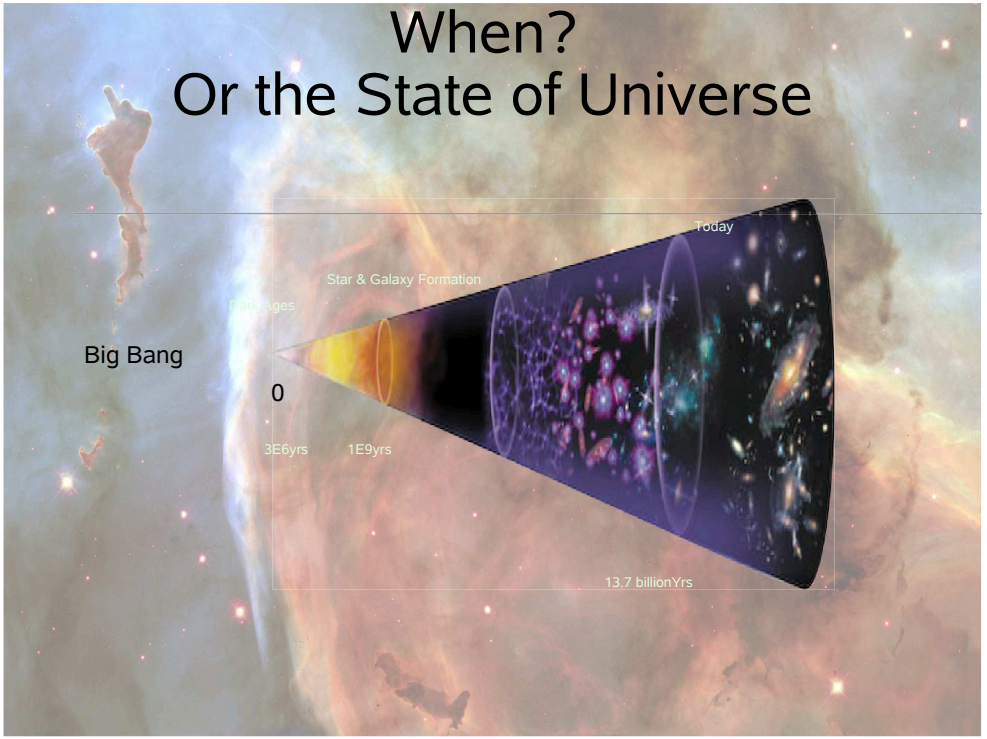
[Committee for the Physics of the Universe (CPU)]

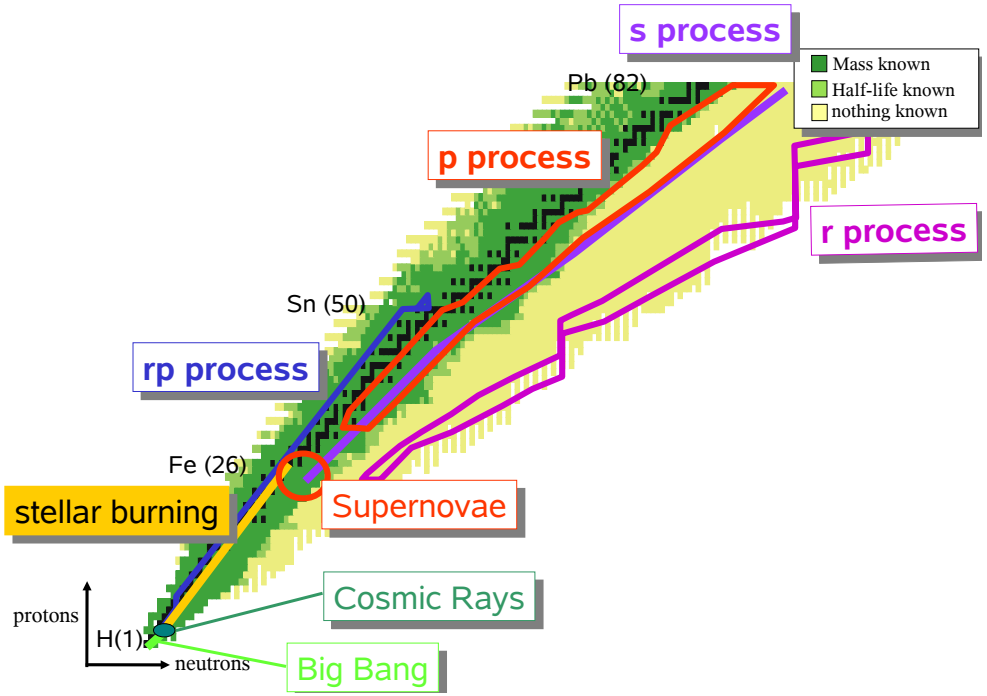
Where ? Or The Origin of the Elements



Possible type II SN (ν-process) contribution to ….

Note: yellow-red all related to massive stars (>8-12 solar masses at ZAMS)





PHZ4316/5315: Course Outline

- Introduction

- Methods to measure abundances

- Thermodynamics of Quantum Systems, EOS and Implication for Astrophysics

- Basic Nuclear Physics: Nuclear Reactions and Networks, NSE, etc., and the Role of Time Scales

- The Big-Bang and the Early Universe

- Stellar Burning Stages and Non-Explosive Nucleo-synthesis

- Astrophysical Sides of Slow Neutron Capture (s-process)

- Explosive Burning in Various Environments

- The rp-, p-, r-processes

- Nuclear Processes far from Stability

Pre-Requisites

- AST4110/5211: Introduction to Astrophysics
- PHY 4604: Quantum A (and its pre-requisits)

or equivalent knowledge and skills

Homework

- **Homework is the essential ingredient for learning !!!**
- Weekly summary on chapter of book
- Bi-weekly homework problems will be posted on BLACKBOARD
- (some derivations and applications)
- Results will be submitted on paper in class
- Due dates are Monday at 1:15pm

Course Content:Textbooks & Articles

- The primary source of information for the course is the **textbook, articles ...**

Primary:

Nuclear Physics of Stars, Christian Iliades, 2007, WILEY-VCH,

ISBN: 978-3-527-40602-9

Stellar Evolution and Nuclear Astrophysics, Don Clayton, (1984)

An Introduction to Nuclear Astrophysics}", J. Audouze & S. Vauclair, Springer (1980)

The Hispalensis Lectures on Nuclear Astrophysics, K. Langanke, Springer (2004)

Particle & Nuclear Astrophysics, E.W. Kolb and R.D. Peccei (eds), World Scientific Pub Co Inc. (1996

Big-Bang and Other Explosions, D.N. Schramm, World Scientific (1996)

Big-Bang Nucleosynthesis, D.N. Schramm & M.S.Turner, Reviews in Modern Physics 70, 303 (1998)

How Your Course Grade Will Be Calculated

Examinations (60% of final grade)

- Two midterm exam (15%), and one final exam (30 %).
- If you miss a midterm or the final for a valid reason, it is your responsibility to arrange for a makeup!

Homework (30%)

- Roughly 10 to 12 summaries, and 5-6 problem sets

Participation/Attendance record (10%).

Letter Grades Are Assigned on an Absolute Scale

- See the table in the course description or on the web site.

The ... Story: Grades

A (90-100%)

A- (80-84%)

B+ (76-79%)

B(71-75%)

B- (67-70%)

C+ (63-66%)

C (58-62%)

C- (54-57%)

D+ (50-53%)

D (46-49%), F(<48%)

Course Content: Lectures

- The **lectures** will generally be devoted to the most important, most difficult, and most interesting subjects.
- Attendance at the lectures not required, but…

Misc

- For course information, please visit the Web-page on the FSU Blackboard
- If you have questions or need help, don't hesitate to drop by during the office hours, or send and e-mail.
- You are encouraged to discuss the topics/homework with your colleges at any time (but during the exams and don't copy results)

Academic Honor Code:

Students are expected to uphold the Academic Honor Code published in he Florida State University Bulletin and the Student Handbook. The first paragraph reads: The Academic Honor System of Florida State University is based on the premise that each student has the responsibility (1) to uphold the highest standards of academic integrity in the student's own work, (2) to refuse to tolerate violations of academic integrity in the University community, and (3) to foster a high sense of integrity and social responsibility on the part of the University community.

ADA Statement:

Students with disabilities needing academic accommodations should: a) register with and provide documentation to the Student Disability Resource Center SDRC; b) bring a letter to the instructor from SDRC indicating that you need academic accommodations. Please do this during the first week of class.