

JINA AT UNIVERSITY OF CHICAGO



Jim Truran

**Astronomy and Astrophysics
Enrico Fermi Institute
ASC Center for Astrophysical
Thermonuclear Flashes
University of Chicago**

**JINA Advisory Committee Meeting
University of Notre Dame
April 30, 2004**

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- ❑ Overview of JINA Activities:**
 - ❑ Graduate Students, Postdoctoral Research Associates, and Center Visitors**
 - ❑ JINA Research at University of Chicago**
 - Related Flash Center Research**
 - Nucleosynthesis**
 - Early Galactic Chemical Evolution**
 - Stellar Abundance Studies**
 - Novae and Supernovae**
 - ❑ Outreach at University of Chicago**

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- ❑ Graduate students:
 - ❑ **Fang Peng** (third year) is exploring the effects of diffusion on x-ray bursts at low accretion rates.
 - ❑ **Ivo Seitenzahl** (second year) is working on problems of neutrinos and r-process synthesis. Ivo will spend this summer at the ETC Summer School on Neutrino Astrophysics in Trento.
 - ❑ **Anibal Medina** (first year) will work this summer on questions concerning the effects of supernova explosions in forming globular clusters.

- ❑ Undergraduate students:
 - ❑ **Nathalie Boittin** is exploring environmental effects on the luminosities of Type Ia supernovae.

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❑ Postdoctoral Research Associates:

❑ **Edward Brown** (now at MSU) continues to work closely with Truran on problems related to novae, X-ray bursts, and the nuclear physics of Type Ia supernovae.

❑ **Kaori Otsuki** (October 1st) will continue her studies of r-process nucleosynthesis and associated chemical evolution.

❑ **Laurent Piau** (November 1st) will continue his studies of stellar evolution and convection in low mass stars.

❑ **Dean Townsley** (October 1st) will continue his studies of accretion onto white dwarfs and neutron stars and work with Truran on problems related to the identification of the progenitors of Snc Ia.

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- ❑ JINA research in the field of Nuclear Astrophysics addresses a broad variety of questions including:**
 - ❑ the origin of the elements**
 - ❑ the nuclear engine of stellar evolution**
 - ❑ the nuclear triggers and drivers of stellar explosions**
 - ❑ the abundance history of the Cosmos**
 - ❑ the fate of matter at high temperatures and densities**

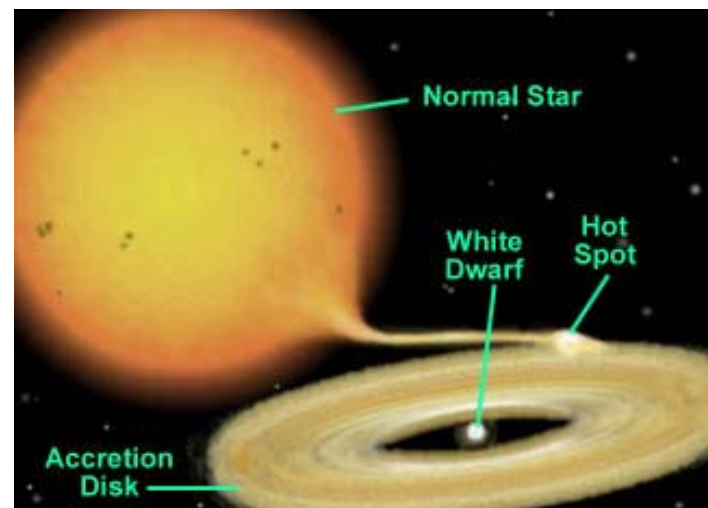
- ❑ JINA researchers at the University of Chicago are currently concerned with many of these issues.**

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❑ The focus of Flash Center research is to simulate accretion onto the surfaces of compact stars, nuclear ignition of the accumulated matter, and the subsequent evolution.

- ❑ Type Ia Supernovae
- ❑ Novae
- ❑ X-Ray Bursts



❑ These events have in common the fact that they involve ignition of nuclear fuels under degenerate conditions, leading to thermonuclear runaways and astrophysical explosions.

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are needed to see this picture.

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Wind Driven Mixing on Nova White dwarfs



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are needed to see this picture.

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YUV420 codec decompressor
are needed to see this picture.

Alexakis et al. (2003, 2004)

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Off-center Deflagration Simulation

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Calder, Vladimirova, Plewa, Lamb, Robinson & Truran (2003)

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Type Ia Supernova Nucleosynthesis

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Microsoft Video 1 decompressor
are needed to see this picture.

Timmes, Brown & Truran (2003)

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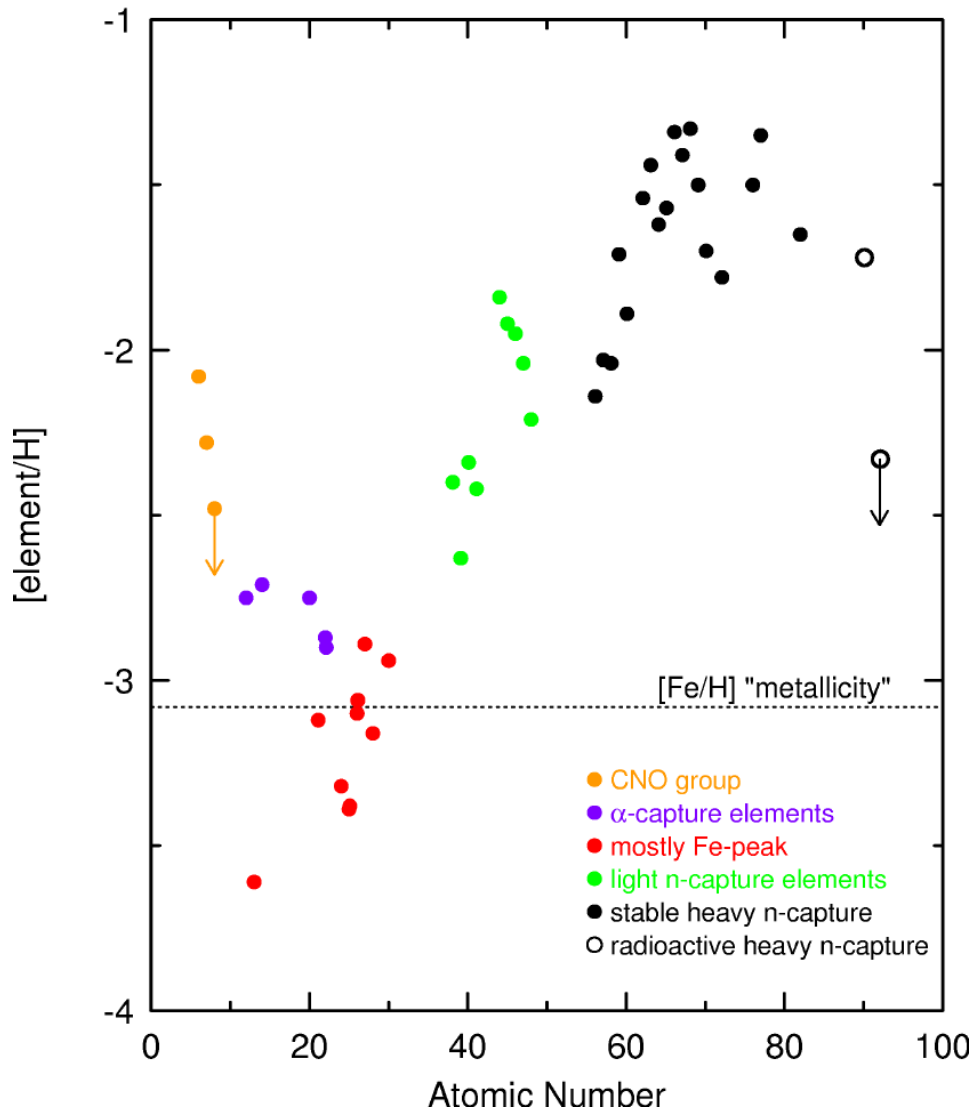


- ❑ JINA research in Nuclear Astrophysics at Chicago includes:**
 - ❑ HST abundance studies of metal deficient stars (Beers, Cowan, Primas, Sneden, Truran)**
 - ❑ examination of the robustness of the r-process that is reflected in these patterns**
 - ❑ exploration of models for SN Ia progenitor systems**
 - ❑ studies of early stellar/supernova activities in galaxies**

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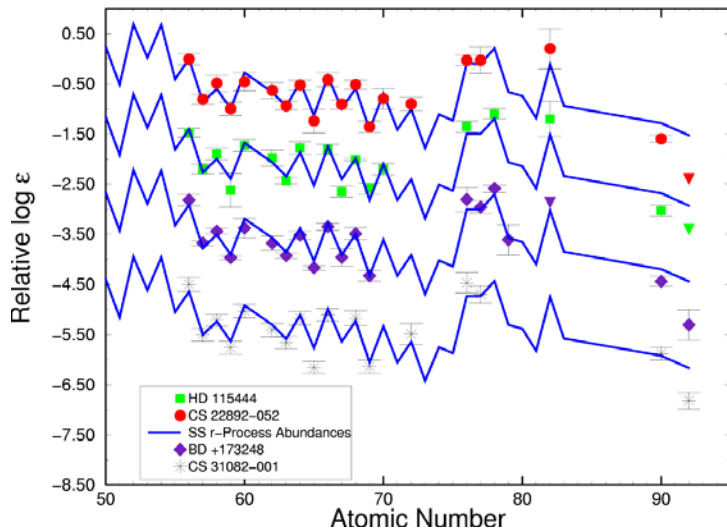
Abundance Summary for CS 22892-052



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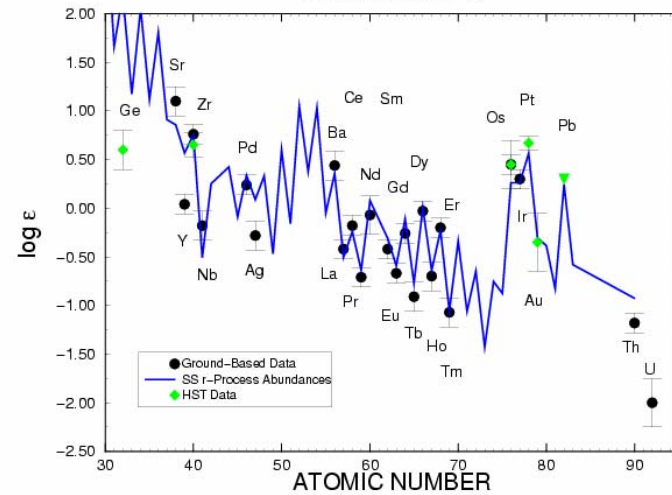


r-Process Abundances in Halo Stars

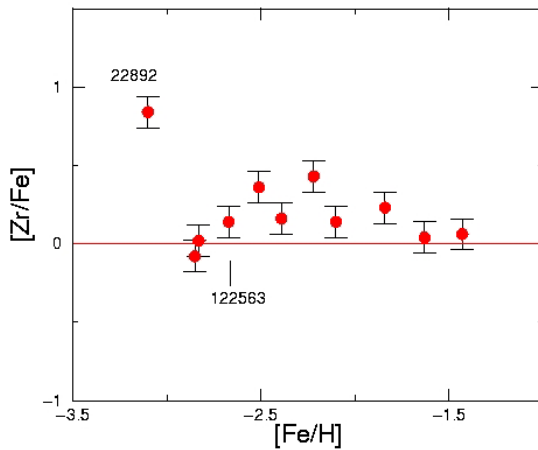


r-Process Abundances in BD+17 3248

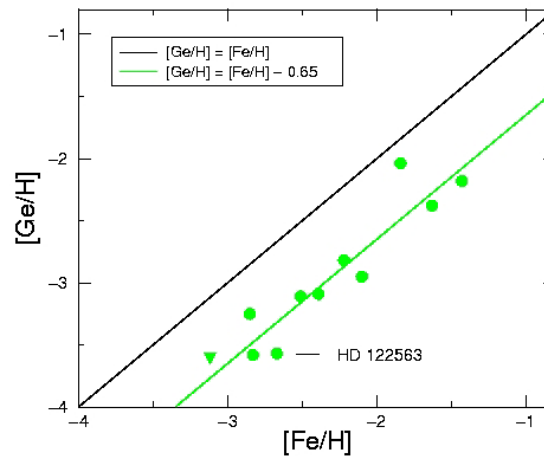
(Cowan et al. 2002)



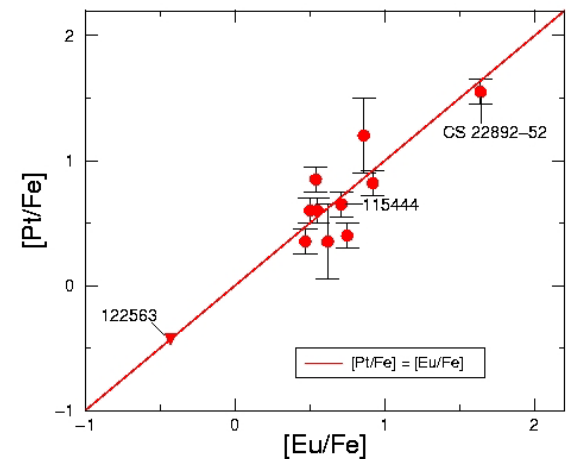
Zr vs. Fe



Ge Trends with Metallicity



Pt vs. Eu



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Education and Outreach



□ The University of Chicago is actively involved in programs of outreach, led by Randy Landsberg, our Director of Education and Outreach. Active programs with which JINA is becoming involved include the following:

□ **Space Explorers** constitutes a multi year commitment to inner-city middle and high school students. It includes weekly hands-on laboratories (Saturdays on campus) and residential institutes at Yerkes in August and September. This program has seen 100% of its students graduate from high school and college bound over the past three years. JINA will provide partial support for a research assistant for the summer program 2004.

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Education and Outreach



❑ **Short Courses** (three day weekend courses) aimed at introducing ~30 planetarium staff personnel are offered yearly and provide a model for a new mode of professional development. JINA will participate in a course on High Energy Astrophysics September 24-26, 2004, where Truran will present lectures on Type Ia supernovae.

❑ JINA will participate in **adult education programs** at the Adler Planetarium - in the form of a series of evening lectures in Fall 2004 by Truran on the subject of Supernova Explosions and Nucleosynthesis.

❑ JINA will work with programs at Adler and the University of Chicago using **electronic media** to develop animations for key concepts in nuclear astrophysics.

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- Visitors: Wolfgang Hillebrandt, Aparna Venkatesan, Dean Townsley, Kaori Otsuki, Ami Glasner, Peter Hoeflich, Ed Brown, Ken Nollett, Martin Lemoine, ...**

- Interaction with the Kavli Institute for Cosmological Physics: Outreach and Education**

- Interaction with the Center for Astrophysical Thermonuclear Flashes**

- Interaction with Argonne National Laboratory**

- Interaction with Chicago Center for Cosmochemistry**

- Discussion // Future Plans**

JINA Activities at Argonne (ANL)

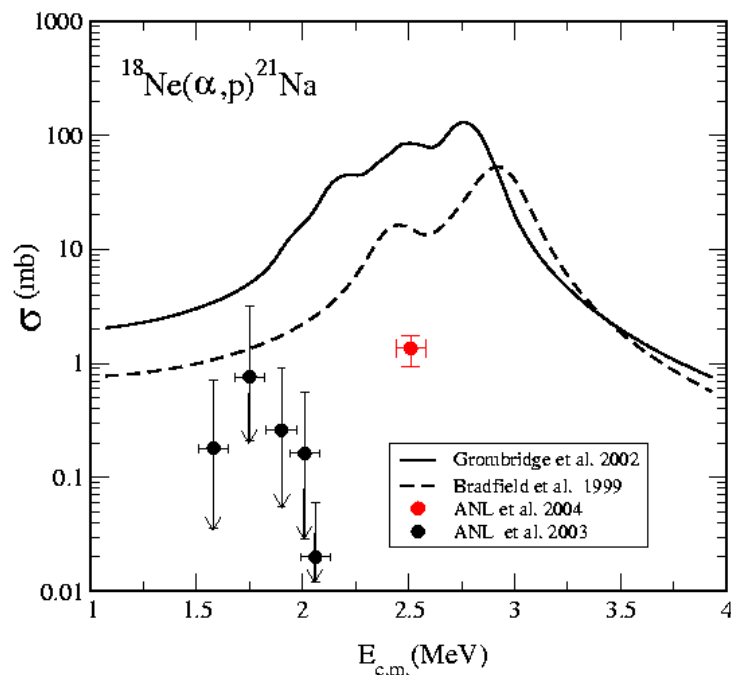


Postdoc: Masahiro Notani (RIKEN) will arrive May 24

□ Study of $^{18}\text{Ne}(\alpha, p)^{21}\text{Na}$ via the time-inverse $^{21}\text{Na}(p, \alpha)^{18}\text{Ne}$ reaction

- This is one of the possible breakout paths from the hot CNO cycle to the rp process.**
- Problem: earlier measurements indicated several 2^+ states in the compound nucleus ^{22}Mg with spectroscopic factors of ~ 1 at $E_x \sim 11$ MeV**
- We remeasured one of these resonances which decays to the ground state of ^{21}Na and got a cross section which is a factor of 50 smaller, corresponding to a spectroscopic factor of ~ 0.02 .**

JINA Activities at Argonne (ANL)



❑ The solid lines are the results from earlier measurements (Louvain) averaged over the target thickness used in the ANL experiment.

❑ The black points represent upper limits. No $^{18}\text{Ne}-\alpha$ coincidences have been observed at these energies.

❑ Plan to repeat this run with better statistics and extend to lower energies.

