A-UR -83-2329

Conf-8305133--1

LA-UR--83-2329

DE83 017304

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36

TITLE: A REVIEW OF ASTROPHYSICAL RESEARCH AT LOS ALAMOS

AUTHOR(S): R. ..patrick, X-2

SUBMITTED TO: Southwest Regional Conf. on Astronomy and Astrophysics
Fort Davis, TX, May 13-14, 1983

DISCLAIMER

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

A REVIEW OF ASTROPHYSICAL RESEARCH AT LOS ALAMOS

Ronald C. Kirkpatrick
Los Alamos National Laboratory

I. INTRODUCTION

Los Alamos National Laboratory is a part of the University of California and is operated under contract to the U.S. Department of Energy primarily for the purpose of research and development related to nuclear weapons. Because the physical regime in which nuclear weapons operate is reasonably described as astrophysical, the chief source for many of the personnel at Los Alamos has been the astrophysical community. Consequently, the astrophysical endeavors at Los Alamos date back to it's earliest days. In recent years there has been an increasing degree of recognition of the benefits of astrophysical research within the laboratory and the astrophysical endeavors have consequently become better organized. Our excellent computer facilities and library are major factors in attracting astrophysicists to Los Alamos. We have no observational facilities.

The majority of astrophysics research is done within three divisions at Los Alamos: T, FSS, and X. The Theoretical Division (T) is the oldest division at the laboratory, dating back to 1943 when it was headed by Hans Bethe. It has spanned many other divisions or parts thereof. The predecessor of the Applied Theoretical Physics Division (X), as well as the computing center (C-Division), were once groups within T-Division. The Environmental and Space Sciences Division (FSS) which combines satellite operations and geosciences is one of the newest divisions. There are a few astronomers in other divisions such as the Physics Division (P), but they are generally not inclined toward astrophysical endeavors. J-Division used to be the focal point for astrophysics at Los Alamos, but a few years ago it was absorbed by three other divisions.

The astrophysics distribution list at Los Alamos includes 148 names with the largest representations from FSS (62), X (34), and T (22), and the most recent Los Alamos "Observatory Report" listed 85 publications by 50 Los Alamos staff members. There are the same number of AAS members in Los Alamos (56 in a population of 20,000) as in New York City. Of course, Los Alamos is also a major physics center in the country. It is one of the few places in the world where astrophysicists can get state of the art information from experts in numerical hydrodynamics, radiation transport, opacities, equations of state, particle physics, nuclear physics, numerical analysis, plasma physics, and many other subjects.

II. SPECIFIC ASTROPHYSICAL ENDEAVORS

There is a rich diversity of research at Los Alamos. Some of the areas in which staff members at Los Alamos have published include:

1. Comets
2. Solar Wind
3. Earth's Magnetosphere
4. Meteorites
5. Planetary and Lunar astronomy
6. Galaxies
7. Star Clusters
8. Star Formation
9. Stellar Structure and Evolution
10. Supernovae
11. Neutron Stars
12. X-Ray and γ-Ray Sources
13. Cosmology
14. Gaseous Nebulae

There is only one astrophysics group at Los Alamos: T-6 headed by Stirling Colgate. It has six full-time staff members and two post-doctorates and is funded internally and by a DOE grant. It supports a large visitor program and has been the focal point of astrophysics activity for the past few years. Table I summarizes the T-Division interests.

TABLE I

NAME	GROUP	SUBJECT
Colgate, S. A.	T-6	Supernovae/Gamma Bursts/Cosmic Rays/Solar
Cox, A. N.	T-6	Stellar Pulsation
Hills, J. G.	T-6	Comets
Kidman, R. B.	T-6	Stellar Pulsation
Kolb, E. W.	T-6	Cosmology
Lapedes, A. S.	T-6	General Relativity/Quantum Gravity
Glatzmaier, G. A.	T-6	Solar Physics
Raby, S.	T-8	Cosmology
Huebner, W. F.	T-4	Equation of State/Opacities/Comets
Keady, J.	T-4	Comets
Goldman, T. J.	T-5	Cosmology

The Equation of State and Opacity Group (T-4) has the responsibility for supporting the data base for weapons development and inertial confinement fusion. It maintains a computer-based EOS and opacity library which has over 50 users in the astrophysics community outside Los Alamos.

ESS-Division astrophysics is conducted mainly in ESS-5 (Geoanalysis) and ESS-9 (Space Astronomy and Astrophysics). ESS-5 has programmatic responsibility for calculations of nuclear weapons effects in the atmosphere, while ESS-9 has a charter to develop instruments to monitor the prohibition against exoatmospheric nuclear explosions. The latter led to the Vela satellite program and the subsequent discovery of Gamma-Ray bursts of astronomical origin. Table II lists the current astrophysics work in ESS.

TABLE II

NAME	GROUP	SUBJECT
Adams, T. F.	ESS-5	Stellar Pulsations
Deupree, R. G.	ESS-5	Stellar Convection
Auer, L.	ESS-5	Radition Transfer/Solar Astronomy
Jones, E.	ESS-5	Supernovae/Hydrodynamics/SETI
Keller, C. F.	ESS-5	Solar Coronae/Pulsating Stars
Kunkel, T. D.	ESS-5	Galactic Structure
Mutschlecner, J. P.	ESS-5	Radiative Line Transfer
Sandford, M. T.	ESS-5	Stellar Formation/Radiation Hydrodynamics
Smith, R. W.	ESS-5	X-Ray Line Transport/X-Ray Astronomy
Whitaker, R. W.	ESS-5	Stellar Formation/Radiation Hydrodynamics
Carlos, R.	ESS-7	Optical Astronomy
Roussel-Dupre, R.	ESS-7	Solar Plasma Physics
Stone, S.	ESS-7	Observational Optical Astronomy
Horak, H.	ESS-7	Radiation Hydrodynamics
Belian, R.	ESS-8	Vela X-Ray Observations
Higbie, P.	ESS-8	Astrophysics
Argo, H.	ESS-9	Astrophysics
Cordova, F.	ESS-9	Cataclysmic Variables
Fenimore, E. E.	ESS-9	Gamma-Ray Bursts
Klebesadel, R. W.	ESS-9	Gamma-Ray Bursts
Laros, J.	ESS-9	Burst Phenomena
Middleditch, J.	ESS-9	Time Series Anal. of Astrophysical Source
Priedhorsky, W.	ESS-9	X-Ray Binaries/Cataclysmic Variables
Strong, I.	ESS-9	Gamma-Ray Bursts
Terrell, J.	ESS-9	X-Ray Observations/Quasars/Gamma-Ray Burst
Bode, M.	ESS-9	Cataclysmic Variables/Dust
Roussell-Dupre, D.	ESS-DO	Radiative Line Transfer/Spectral Lines
Evans, W. D.	ESS-DO	Gamma-Ray Bursts/Vela Data
Conner, J.	ESS-DO	Gamma-Ray Bursts/Vela Data

The level of astrophysics activity in X-Division has grown significantly during the past several years. A major factor in this growth was an agreement struck between T-6 and X-Division whereby some X-Division employees could devote one quarter of their time to astrophysics for an extended period of time. This coupled with the fact that some groups in X-Division get a lion's share of computing time has attracted some very capable astrophysicists to X-Division, who because their astrophysical endeavors are part of their job, have an incentive to publish their work. Table III lists the X-Division astrophysics interests. In addition to those listed in Table III, there are nine people in X-1 engaged in near-earth space plasma physics.

III. CONCLUSION

The preceeding section outlined the major astrophysical endeavors at Los Alamos. There are others, but in many cases programmatic efforts hamper progress and many individuals can manage only one paper every few years. Because change comes rapidly in many astrophysics specialties, whether due to new physical insight or due to new observational data, this is an unfortunate circumstance. Recently a new astrophysics center has been approved by the Laboratory administration, and it is hoped that this will facilitate more timely involvement of the less active astrophysicists at Los Alamos, as well as provide more cross fertilization between astrophysics and the many other disciplines within the Laboratory. However, the funding for this center will not support a vigorous activity in astrophysics, so that more arrangements akin to that struck between X-Division and T-6 may be necessary.

TABLE III

NAME	GROUP	SUBJECT
Becker, S. A.	X-2	2 STARS: Structure & Evolution
Bowers, R. L.	X-2	3 STARS: SN collapse. Numerical Models
Despain, K. H.	X-2	1 STARS: Structure & Evolution, Nucleosynthesis.
Dragon, J. N.	X-2	STARS: Non-LTE Transfer, Opacities.
Kemic, S. B	X-2	STARS: Line Transfer in Strong B-fields
Newman, M. J.	X-2	2 STARS: Struct. & Evol., Nucleosynthesis Nuclear Reactions.
Mercer-Smith, J.	X-2	STARS: Numerical Modeling
Tubbs, D. L.	X-2	1 STARS: Monte Carlo Neutrino Transport. Supernovae.
Wallace, R. K.	X-2	3 STARS: Nuclear Reacts. & Runaways, Nucleosynthesis, XRBs.
Weaver, R. P.	X-2	1 STARS: Radiation Transport.
Goodwin, B. T.	X-4	2 STARS: Neutrino Transport; Neutron Stars
Sparks, W. M.	X-5	9 STARS: Evolution, Hydrodynamics, Novae. XRBs.
Van Riper, K. A.	X-6	2 STARS: Supernova Collapse. Neutron Star Evolution.
Clancy, S.	X-7	STARS: Pulsation
Noerdlinger, P. D.	X-7	5 QSOs : Pair Prodl; STARS: e+ accel.; SS: Impacts.
Olson, G. L.	X-7	2 STARS: Non-LTE Radiation Transfer, Winds.
Gisler, G.	X-8	GALAXIES: Radio Jet Beam Propagation.
Peratt, T.	X-8	GALAXIES: Formation.