Iowa State University
Department of Physics and Astronomy
Erwin W. Fick Observatory
Ames, Iowa 50011

This report covers the period from September 2001 through August 2002. We limit the research descriptions in this report to brief summaries, along with specific internet addresses, and selected publications. For more information on facilities, personnel, and research programs, see the astronomy and astrophysics group web site,

http://www.public.iastate.edu/ astro

1. PERSONNEL AND EDUCATION

Faculty and staff active during this period were G. H. Bowen (emeritus), D. A. Carter-Lewis, J. J. Eitter (Observatory Manager), G. Gonzalez, S. Kawaler, F. Krennrich, R. C. Lamb (emeritus, resident in Pasadena, CA), C. Struck & L. A. Willson. At the end of this period, associate professor P. Appleton left to take a position at IRS Support Team at the SIRTF Science Center at Caltech. Dr. Sydney D'Silva joined the group as a visiting assistant professor through mid-2003.

Graduate students in astronomy included A. Bischoff Kim, J. Brown, S. Hostler, M. Reed, M. Vuckovic, & G. W. Turner. During this period. M.D. Reed earned The Ph.D. degree, and accepted a position of assistant professor at Southwest Missouri State University in Springfield, MO.

Undergraduates involved in astronomical research during this period were B. Cohanim, A. Fox, K. Marasinghe, and several students working on summer projects under the NSF funded REU program.

Kawaler began his term as AURA member representative for ISU. He also continues as Director of the Whole Earth Telescope (WET) collaboration. Willson completed her current term on the AURA Board of Directors. She is also the Past President of the AAVSO.

Dr. Reed Riddle continued as Associate Director of Whole Earth Telescope Operations. There are normally two postdoctoral fellows working in particle astrophysics at ISU. At present we have Dr. Stephane Lebohec who will be joined by Dr. Michael Daniels on November 1, 2002. Dr. Dirk Petry was with us two years and left at the end of August 2002 to accept a staff position at Goddard Space Flight Center.

Visitors included many WET collaborators during the operation of the WET Headquarters at ISU for an extended campaign in May 2002. Kawaler spent the Spring 2002 term on leave at the University of Sydney (Australia) and at Victoria University (Wellington, New Zealand).

Willson, with several undergraduate and graduate students, continues developing a series of web-based astronomy modules, collectively known as the Polaris Project. These cover basic concepts that often prove difficult to teach, such as diurnal motion, seasonal variations, and coordinate systems. Aimed at the freshman non-scientist, several modules has been tested by students with backgrounds ranging from none to senior in physics/astronomy. The presentation material is open for use by anyone at http://www.polaris.iastate.edu

2. FACILITIES

At the beginning of this period, our long-term radial velocity program at was discontinued. This program was established in 1976 and used a Griffin type photoelectric spectrometer. This instrument has lower accuracy than modern day instruments and, with the mechanical and electrical problems that were developing, we decided to no longer continue with this effort. In its place, we have begun construction of a precision radial-velocity spectrograph (m/s resolution) which should begin operation this coming year.

CCD observations were obtained on 53 nights with the new Andor detector. On 05-14-02 the vacuum window failed on the detector. After 08-03-02 CCD observations were resumed with a contingency detector similar to the above. On 08-29-02 the mechanical speed reducer that controls the roof failed. This is a difficult repair – we expect to complete work on the roof in the fourth quarter of 2002.

High-speed photometric observations of pulsating compact stars, using a two-channel WET-style photoelectric photometer, were obtained on approximately 20 nights during this period. We are developing a high-speed CCD photometer (based on the Apogee AP-7) with custom software to allow online light curve analysis.

3. RESEARCH PROGRAMS

3.1 Galaxies & ISM

C. Struck continues research using dynamical models of star/ gas dynamics and induced star formation in early stages of galaxy collisions. This includes work on a bridge-plus-ring sample (with B. J. Smith, Eastern Tenn.), and specifically on the Arp 284 system. A paper on this system, containing some of the most detailed models ever produced for a colliding galaxy system has been submitted. Similar work is underway on the NGC 2207/IC 2163 ocular galaxy system (with an extensive collaboration). Molecular observations of a related systems NGC 5394/95 were published in this period by this collaboration.

Numerical hydrodynamical models of ram pressure sweeping and induced spiral instabilities in cluster galaxies, done with former student S. Schulz, were published in this period. Additional work in this area is continuing with grad. student Jason Brown. See http://www.public.iastate.edu/∼curt

Appleton (SSC/IPAC), Eitter and Struck continue to explore the properties of the COLA (Compact Objects in Low-luminosity AGNs) North sample through CO line, radio continuum and optical V and I-band imaging of the galaxies. This work is in collaboration with V. Charmandaris (Cornell), T. Marston (Caltech), A. Zezas (CfA), R. Norris (ATNF), M. Dopita and L. Kewley (MSSSO). The first major data paper of this project was published in this period (see below).

3.2 Stars and Planets

Gonzalez obtained spectroscopic observations of stars hosting planets in December 2001, March 2002, and April 2002 at McDonald Observatory. This is a continuation of a long-term program started in late 1995 to derive the basic properties of stars with planets. Graduate student Chris Laws (University of Washington, Seattle) is using these data for his Ph.D. dissertation work. REU student Kyle Walker (Ohio State) assisted with measurement of the spectra during summer 2002. A search for the ^{6}Li isotope in stars with planets in collaboration with D. L. Lambert and B. E. Reddy at the University of Texas in Austin and C. Laws found no ^{6}Li in any of 8 stars with planets. This effort is continuing with observations of additional stars with planets. Work with E. Gaidos (University of Hawaii) on a study of the abundances of a sample of nearby young solar analogs was completed in 2001. Work with G. Wallerstein (University of Washington) and S. Giridhar (Indian Institute of Astrophysics) on the abundances of very metal-poor cool giants continues; the work is based on observations obtained in 2000 and 2001 with the KPNO 4-m and Apache Point 3.5-m telescopes.

In collaboration with graduate students J. Armstrong and L. Wells (University of Washington), Gonzalez is continuing a study of the Moon as a source for evidence of early life on Earth. The first paper from this study presents an estimate of the concentration of Terran material in the lunar regolith. The second paper considers the possibility of re-seeding the Earth following a sterilizing impact. The third paper will examine search strategies for Terran meteorites on the Moon.

Struck, Willson and undergraduate B. Cohanim have been modeling the effects of accretion onto giant stars and planets caught in the extended atmospheres and winds of stars like the Sun in their late evolutionary stages (AGB, Mira phase). Bowen and Willson's earlier work on the environment surrounding Mira variables provided the basis for predictions of observable effects (described in a JAAVSO paper published in this period), and for new numerical models to study the bow shock, wake and accretion hydrodynamics in more detail. First results of these models were published in an ApJ Letter in this period. A more detailed paper is in preparation. Related material appeared in print during this interval; see references below and http://www.public.iastate.edu/~lwillson

Under Kawaler's direction, the Whole Earth Telescope obtained data on several targets during the 22nd extended coverage campaign, held in May 2002. The primary target was the pulsating DB white dwarf star PG 1456+103, with G. Handler (Vienna) as the principal scientist. The WET also observed the hot pre−white dwarf PG 1159-035, obtaining simultaneous observations with the Hubble Space Telescope - M. S. O'Brien (Yale) is the principal scientist for that data set. As part of Xcov22, the WET collaborated with a multisite spectroscopic time-series campaign on the pulsating sdB star PG 1605+072. Kawaler, D. Kurtz (U. Central Lancashire), Cunha (U. Porto), Riddle, and the WET team published a preliminary analysis of WET data on the rapidly oscillating Ap star HR 1217. The WET collaboration met at the 6th WET workshop, held in Naples, Italy, in June 2002.

Additionally, graduate student M. Reed completed his Ph.D. program. Along with Kawaler, Vuckovic, Riddle, and members of the WET team, Reed completed analysis of five years of time-series photometry of the pulsating sdB star Feige 48, placing (among other limits) strong constraints on any planetary system around this evolved star. For more details about work in these areas, as well as links to the Whole Earth Telescope project and Kawaler's teaching activities, see http://www.public.iastate.edu/~sdk

In addition to his work with the WET, Riddle continued his collaboration with the massive star group at Georgia State University. With W. G. Bagnuolo (GSU) he continued upgrading and improvement to the Multiple Telescope Telescope, a novel 1 m spectroscopic telescope; enhancements included a new tracking system, upgraded spectrograph software and hardware and improved hardware for mirror alignment. Riddle assists in development of the spectrograph for the CHARA Array. Studies of ''microquasars, with McSwain and Gies (GSU) produced interesting results, with more underway. Riddle continues to pursue his studies of the Struve-Sahade Effect, a wind interaction phenomenon seen in short period massive binary systems.

3.3 TeV Gamma-ray Astronomy

Ground-based gamma-ray astronomy has opened up a new observational window for TeV (10^{12} eV) photons from active galactic nuclei (AGNs), supernova remnants and pulsars. D.A. Carter-Lewis and F. Krennrich and their group at ISU, as part of the Whipple collaboration, helped pioneer the technique of detecting TeV gamma-rays via Cherenkov radiation detected using large ($\sim$ 10 m), ground-based optical telescopes. The collaboration is presently working to build an array of telescopes based on the Whipple design. The VERITAS array (Very Energetic Radiation Imaging Telescope Array System) will have dramatically improved sensitivity, energy threshold, and angular and energy resolution. It will take Cherenkov astronomy forward a generation. These telescopes will also be located at Whipple Observatory, but down the mountain from the present 10 meter telescope. ISU has responsibility for focal plane instrumentation, and we have designed, constructed and instrumented the focus box for the first of the telescopes. The ISU focus box is presently at the University of Chicago for integration with data acquisition electronics before it is moved to Whipple Observatory. We are also presently investigating analysis methods for best utilizing the array.

The science issues currently being addressed at ISU include the measurement of energy spectra of AGNs and the study of particle acceleration in the vicinity of a supermassive black hole. (See publications below.) In addition we have developed a unique trigger system to be attached to the Whipple and then VERITAS telescopes to search for burst phenomena on time scales of 20 ns through 10 μs.

PUBLICATIONS

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Steven D. Kawaler