

Curriculum Vita

Ray A. Lucas

Current Employer:

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Research Interests in Astronomy:

Interacting and merging galaxies, galaxy evolution, galaxy clusters, galaxy pairs and groups, luminous and ultraluminous infrared galaxies, galaxy morphologies, extragalactic deep surveys, radio galaxies, quasars and active galactic nuclei (AGN), extragalactic star clusters and globular clusters, virtual observatories, CCD optical and other infrared detectors.

Experience (Astronomy):

- PI: National Virtual Observatory Program - Multiwavelength Survey of Texas Survey Radio Sources (incorporating VLA A-Array snapshots I took in 1990).
- CoI: HST GO 11082 (PI: Conselice) – NICMOS Imaging of GOODS: Probing the Evolution of the Earliest Massive Galaxies, Galaxies Beyond Reionization, and the High Redshift Obscured Universe
- CoI: HST GO 10632 (PI: Stiavelli) – Searching for Galaxies at $z > 6.5$ in the Hubble Ultra Deep Field
- CoI: HST CAL/ACS 10378 (PI: Biretta) – ACS Polarimetry Calibration
- CoI: HST DD 9978, 10086 (PI: Beckwith) – The Ultra Deep Field with ACS
- CoI: HST DD 9979 (UDF NICMOS Parallels), 9980 (UDF WFPC2 Parallels), 9981 (UDF STIS Parallels) (PI: Beckwith)
- CoI: HST GO 9425 and 9583 (PI: Giavalisco) – The Great Observatories Origins Deep Survey: Imaging with ACS (GOODS)
- CoI: STScI DDRF (PI: Arribas, 2 programs): Imaging of Very Luminous Infrared Galaxies with the Nordic Optical Telescope (NOT) and Andalucia Faint Object Spectrograph and Camera (ALFOSC)
- CoI: HST DD 9260 (PI: Noll) – Hubble Heritage Observations of Hoag's Object
- CoI: HST DD 8394 (PI: Beckwith) – HST Service Observations of GRB 990123
- CoI: HST DD 8058, 8073, 8074, 8075, 8076 (PI: Williams) – HDF-South Observations
- CoI: HST DD 8071 (PI: Williams) – HDF-South Flanking Fields
- CoI: HST DD 7633 (PI: Williams) – HDF-South Test Observations

- CoI: HST GO 7896 (PI: Borne) – A NIR Snapshot Survey of Ultraluminous IR Galaxies
- CoI: HST GO 6346 (PI: Borne) – Snapshot Survey of the Ultraluminous IRAS Galaxy Sample
- CoI: HST DD 6340 (PI: Williams) – The HDF Experiments: Flanking Fields
- CoI: HST DD 6337 (PI: Williams) – The Hubble Deep Field
- CoI: HST DD 6313 (PI: Williams) – The HDF Experiments: A Test
- CoI: HST AR 5818 (PI: Whitmore) – An Archival Search for Young Globular Clusters in Galaxies
- CoI: HST GO 5410 (PI: Borne) – Shock Morphology In Star-Forming Ring Galaxies
- CoI: (PI: Borne) – Synoptic Observations of ULIRGs by USNO-Flagstaff
- PI: VLA A-Array Observations of a Complete Sample of Texas Interferometer Survey Sources. Created the observe file and made the observations at the VLA.
- Helped early development of ERO observations of Abell 2218 galaxy cluster with gravitationally-lensed arcs, of Eskimo Nebula, and later, ERO observations of IRAS 19297-0406, a multiple-merger ULIRG from a sample on which I was a CoI.
- Helped develop and implement observing strategies for some STIS ERO GRB observations.
- Helped develop observing strategy for GO/CAR 5701 (PI: Couch) and suggested arrangement of Abell 2218 (galaxy cluster with gravitational lenses) fast-track data release for CoI Richard Ellis at request of Director in order to facilitate HST awareness in Britain and Europe. I helped develop the program, implemented it in the ground system and flight database, arranged for the fast-track data release, and tested it by using similar galaxy cluster data from Abell 851, and told coI how to align and combine the data while eliminating cosmic rays. This was probably the very first example (and still probably one of the very few, if any) of anyone taking a HST program and supporting it completely from “cradle” to “grave” by implementing all facets and giving instruction to observers from end-to-end for program design, scheduling, and data reduction. I had the idea to do it this way in order to satisfy the Institute’s desire to help CoI Richard Ellis while not being unfair and moving the scheduling of the observations earlier and bumping someone else’s observations. It was an ideal compromise.
- Developed observing strategy and wrote program HST DD 5190 for SM1 WFPC2 ERO of CL0939+4713 (Galaxy Cluster Abell 851) by Alan Dressler, Gus Oemler, and Bill Sparks. Was made co-author by Dressler on the ApJ paper and AAS presentations, etc. WFPC2 commanding personnel (Glenn Schneider) declared it the “best-written program they had ever seen.” This was to ensure viability of the observations and inclusion of a $z=2.5$ quasar and possibly very distant cluster as seen through the midst of the $z=0.4$ Abell 851, despite all the vicissitudes of technical details, scheduling issues, nature, and astro-politics surrounding Early Release Observations (EROs). These observations helped inspire the HDF and lead to my working on all the subsequent “community service” deep fields observed by HST. I was first author on the HDF-South Flanking Fields paper, which covered data from 3 different instruments, WFPC2, NICMOS, and STIS,

and required the assistance and coordination (with help) of the work of a number of other people who had more expertise in NICMOS and STIS data, while I drizzled the data for all the 10-11 WFPC2 flanking fields.

- Served as panel member on peer review of EPO portions of proposals for 3 different reviews at request of NASA, including one at NASA HQ, and served as Panel Chair for one held here at STScI, at the request of NASA and STScI. The latter was an IDEAS grant program review.
- At request of STScI E/PO Office, served as the “scientist” advisor for a lesson plan on the Hubble Deep Field developed by middle school teachers for middle school students. This lesson plan is available both in printed and electronic form, and has also been distributed in both English and Spanish by the Astronomical Society of the Pacific, as well as by NASA and STScI. Also gave public talks on various topics in astronomy at colleges and schools here and in various other states and abroad. Serve as scientist/media contact for Hubble Heritage Hoag’s Object observations.
- Did ground-based CCD observing at CTIO and at La Palma (NOT+ALFOSC). Observed photometric sequence stars for GSPC at CTIO, and observed interacting and merging galaxies at CTIO. Wrote iraf scripts to calibrate NOT+ALFOSC imaging data while a visitor at IAC-Tenerife and working with Santiago Arribas.
- Ran galaxy morphology codes such as CAS and GALFIT as part of GOODS project, working with Chris Conselice (CAS) and Swara Ravindranath (GALFIT) for guidance. Participated in numerous papers as part of this and related work. Investigated effects of CAS code results on different choices of center in galaxies of various morphologies, relative sizes, and separation distances in pairs and groups of interacting and merging galaxies in the VLIRG sample I observed at La Palma.
- Used programs such as DOMAIN to work on Polar Ring galaxies data and to create luminosity profile plots for them. Found galaxies for inclusion in the Polar Ring galaxies catalog, made other environmental measurements from plates and new CCD frames while helping investigate the merger rate.
- Used iraf daofind, apphot and associated packages and tasks in studying globular cluster system of M87 and searching for turnover of the cluster luminosity function.
- Worked with HST TAC panels for first 5 Cycles, helping to develop support procedures, etc. for recording panel discussion, comments to proposer, votes on grades, and proposal rankings, etc. Wrote and modified SQL queries to generate exposure catalogs for duplication checking by proposers and to generate statistics for various reports on proposal pool, and etc.
- Suggested/requested/advocated for improvements such as development of ACS/WFC WFCENTER aperture. Served as Project “Scientist” for Visual Target Tuner (VTT) for several years, suggesting improvements to programmers and helping them set priorities for improvements. Also helped advise on APT (the GUI tool for Phase I and Phase II proposals) for several years, though not primarily responsible for it other than VTT.
- From 2004 to present (2009): Worked on ACS calibration, especially routine biases and darks. Worked with programmers to automate the process and make it

much less labor-intensive and mistake-prone. Tricked the automated system into producing superbias and superdarks for other non-standard instrument settings. Wrote internal documentation (Technical Instrument Reports) for publication on all of these matters, as well as on regression testing of coronagraphic spot files and on creation of moving target bright object protection (BOP) charts using IDL scripts written by Charles Proffitt. Helped investigate failed observations as needed, and served as liaison for issues regarding CALACS, the Archive, and ACS pipeline processing, reference files in general, and OTFR, etc. Initiated development with ITSD of a General Help Desk macro for better, more fool-proof reporting and tracking of help desk calls for all INS platforms while serving on the General Help Desk staff. Also did two extended periods of support of WFC3 Thermal Vacuum testing at GSFC, and was the first to spot the big glint in the UVIS2 detector, having seen a somewhat similar effect in deep ACS exposures. I also provided information to WFC3 staff on ACS scripts (and the scripts themselves) for making CCD superbias and superdarks and gave input to them on other calibration files such as MDRIZTABS. I helped investigate failed ACS observations, and ACS-related OPUS pipeline and Archive problems. I performed analysis on HST 2-Gyro testing and helped test and select suitable targets for 1-Gyro testing. I also did extensive research and calculations into providing new BOP limits for ACS/SBC, including advancing previous work on K and M stars and combining them to calculate new ACS/SBC BOP limits which I derived from IUE spectra and models, while taking into account a red leak in some SBC filters and other spectral elements. This included identifying a typo or misclassification of MK spectral type in a 1945 paper by Keenan himself! (This was confirmed by Nolan Walborn.) I have since also provided extensive information on how I did this to the COS/STIS team in support of their efforts to improve BOP processes and calculations for their instruments. Using MultiDrizzle software, I also aligned and combined ACS/WFC data of the NICP34 field from the USD05 program on which I was a co-I. This involved aligning and combining roughly 250 ACS/WFC images in 3 filters which were taken over a span of two years, and which had few stellar sources with which to use the more standard methods of alignments, and which also suffered from the well-known phenomenon of time-dependent geometric distortion and from a lack of overlap between some frames and others by which to align in the extended mosaic. In the end, I used a non-standard technique of my own involving the bright nuclei of AGN as best I could to provide a reference frame, and this was sufficient to identify several securely identified $z \sim 7$ high-redshift galaxies, a major research result. This effort was a similar level of effort to the aligning and MultiDrizzling of the original Hubble Ultra-Deep Field, and as such (and physically being adjacent to it on the sky in such an important region for follow-up research) was a major accomplishment which took a lot of effort and insight and persistence. I served on the ACS-R SM4 EVA Support Team at GSFC, undergoing extensive training and practice at both STScI and GSFC, becoming familiar with processes and protocols in the ACS Group's support of the astronauts' EVAs there, and spending enough time in these various SIM/JIS activities to become qualified or certified for duty in such roles at GSFC. I learned from and helped inform others in the group of what I

had learned in order to share knowledge as well as acquire it in this high-stakes, high-visibility role. I trained for supporting the ACS Functional Test initial data analysis, and supported it as a backup, testing it in advance, and also being physically present at both GSFC and later at STScI for a time to help others and remind them of things about the analysis. I also trained for, tested software and processes, and performed assigned data analysis work and contributed to discussions etc. during the more extensive ACS-R Optimization campaign which followed SM4. Earlier, in preparation for SM4, with input from Marco Sirianni, I developed new ATODTAB, BPIXTAB, CCDTAB, and dummy superbias and superdark files to cover the case of new floating-point CCDGAIN values which would be used by ACS-R after SM4, and delivered those to CDBS for inclusion in the pipeline so processing of new files in the post-SM4 era would not crash it until we could deliver better ones derived on-orbit. Jointly with Max Mutchler, I used the old ACS Superbias and Superdark scripts and others related to it to produce the first calibration files for ACS-R post-SM4, hacking the code myself to account for the new CCDGAIN values and related changes. I also modified, prepared, and tested new superbias and superdark files for delivery by CDBS into the OPUS pipeline, catching some problems and forestalling delivery of bad files, while helping to search through scripts and test for production problems and how they got that way as well as what needed to be done to fix them. I produced new CCDTAB files, collecting input from a number of different people, modifying it, and combining it with other data from other people to calculate more new values for the CCDTABs, and then tested and delivered these files to CDBS as well. While in the INS/ACS and INS/RIAB groups, I also attended a major JWST review and provided input and comments based on my experience with earlier HST development, both verbally in a meeting at STScI, and later in emails to local STScI JWST staff, as well as in the JWST Town Hall Meeting held at the AAS in Long Beach, California in January 2009. After that, I attended a course on detectors at STScI, on both ITAR-restricted and non-ITAR-restricted technology. At the request of the NVO, I gave a talk on my funded NVO proposal involving radio galaxies from the Texas Interferometer Survey at the General Assembly of the IAU in Prague, Czech Republic, in 2006, and I subsequently provided the reduced radio data (reductions done by Neal Miller, of NRAO and JHU) and ancillary informational documents and metadata by me to MAST at STScI for inclusion in MAST and the NVO. My NVO program and the associated data from my earlier VLA program on the Texas Survey Radio sources was also the subject of a poster I presented at the AAS in Honolulu in 2007. I regularly attended the STScI Science Staff meetings on behalf of the RIAB, and reported on them, including reporting on opportunities for suggesting “fill-in” observing programs using WFPC2 and/or FGS in early 2009 while we were waiting for SM4. It turned out that one of my suggestions, UV observations of the SINGS survey galaxies, was in fact later proposed for, accepted, and executed, and I also helped to work out the observing tiling strategy with Norman Grogin for the Lockman Hole WFPC2 project which was also accepted. In addition to this, I worked extensively with (mainly) Norman Grogin and others on a program to measure extended source CTE effects in WFPC2 data on the HDF which was

taken over the years from 1995 to 2008. I helped Norman get started with MultiDrizzle and also ran SExtractor and the CAS morphology code on the data, and analyzed results. During the course of this, I found a subtle but crucial problem with the CAS results which necessitated Norman developing a dual-CAS mode of the software, much like the dual-mode of SExtractor. I supported work on WFPC2 legacy archive calibration files for the WF4 Gain correction and for the 34-row effect in both regular and AREA mode of WFPC2 data, using and tricking CALWP2 and MultiDrizzle to create processed files and to check results. And with Matt McMaster's and Shireen Gonzaga's advice and help, I also worked on header modifications for the WF4 Gain correction files and got them tested through CALWP2 pipeline processing. I managed the ACS+WFPC2 Help Desk staff and process in 2007-2009, setting up schedules and publishing policies and helping set the web pages up to make Help Desk support easier. As well as serving as the ACS+WFPC2 Help Desk Lead, I initiated discussions between INS User Support Staff and the head of the North American ALMA Science Center with respect to possible commonality between JWST, ALMA, Herschel, and possibly HST. I requested, supported, and facilitated the transition of ACS and WFPC2 TIRs and ISRs to an all-electronic format. I also served in the regular AWT Help Desk rotation myself, and answered many questions, particularly on MultiDrizzle, as well as other subjects, and when necessary, also tested or performed MultiDrizzle runs myself to work out requestors' MultiDrizzle problems, or test methods to solve issues they were having, when necessary, benefiting also from my own experience and from the programmers such as Warren Hack. I read the new (late 2008-early 2009) MultiDrizzle Handbook cover-to-cover and provided feedback to the authors, and especially to the lead author, Andy Fruchter. Setting up cron jobs and getting them to automatically run and perform difference reports from the previous day, I successfully completed the design and implementation of a system to inform the ACS and WFPC2 group of any changes to review status for observing programs. I trained in INS User Support with Diane Karakla in order to take over the technical support side of her position, and began suggesting improvements which were implemented. I began writing SQL queries (a function I had done 20 years earlier in the old User Support Branch) in response to INS instrument group requests, and shepherded INS instrument group requests through the PR process to installation in the CS Toolbox software interface, as well as soliciting INS instrument groups for inputs and improvements to the CS tools for the next HST observing cycle – began work on a training document for my successors-to-be about doing that job. Serving as ACS web pages Web Master was another of my duties during this time. At the request of the HST Mission Office, I also used my knowledge and experience from HST Planning and Scheduling Operations and from INS science instrument operations to suggest issues of concern related to safings and BOP for ACS/SBC when HST SIC&DH glitches were involved. Last, but not least, I also was a member of the SM4 ACS-R ERO Team, and I was the one who suggested the two targets which were selected for different times of the year - the galaxy cluster Abell 370 with its gravitationally-lensed arcs, and the polar ring "Helix Galaxy" NGC 2685 from the Hubble Atlas. Abell 370 was the

target ultimately observed, and I was invited to NASA HQ to help represent STScI and the ACS-R ERO Team for the public unveiling of the image.

- From March 1989 to October 2004: Worked as User Support Technical Assistant and then Program Coordinator. Supported observing program development and implementation and served as primary contact for observers whether external or internal. Was the first Senior (non-management) TA in the old Science Programs Division. The position was created for me and then opened to others at the same time since I was asked if I wanted to go into management but said that I wanted to continue to do science instead with any time that I could buy back from my functional time. (This later evolved into a Senior Program Coordinator position and then a Senior Data Analyst position.) Worked with Long Range Planners and weekly Calendar Builders to assure schedulability of observing programs. Wrote SQL queries and DEC control language scripts to perform various activities and chain together different processes in automated fashion, such as calling and running IDL scripts (though I am not yet an IDL programmer) and other tasks, sequentially. Tricked POMS parallels system (with Massimo Stiavelli and with input on its workings from Calendar Builder Allan Patterson), into helping us produce the deepest IR images ever taken, as parallels to the ACS UDF optical observations. The WFPC2 parallel UV observations we took in a similar way were probably also the deepest UV observations ever taken. Helped design and implement numerous other tricky and difficult observations, as well as many more simpler ones. Helped users try out our software in field trials in California (UCLA, Caltech, IPAC, etc.) and met with IPAC people about adaptability of our HST and NGST tools to SIRTf (Spitzer), and other purposes, along with the tool developers, etc. In 2003-2005, worked with Larry Petro, Massimo Stiavelli, and others on JWST Design Reference Mission (DRM) proposals, testing and modifying them to estimate resources, schedulability, and time required for observations, other observing constraints, and signal-to-noise (S/N) achieved in various JWST science instruments on various types of targets for a given exposure time, etc. In the early 1990s, served on several major process improvement committees which advocated better graphical observing tools for proposers and observers, and which advocated and later planned the restructuring of pre-observation processes in the ground system and flight database, and the subsequent reorganization of STScI to create the PRESTO Project which implemented the new work flow and organization, and which created the Program Coordinator Team as well as many other organizational changes.
- From July 1985 to March 1989: Worked in the Guide Star Selection System and helped create the original Guide Star Catalog-I (GSC-I) and all-sky digital image archive of the UK Schmidt and Palomar Quick-V Digitized Sky Survey scans. Used (but was not programming in) IDL and many VAX DCL commands running Guide Stars software programs, generating image object classification training sets and doing image QA for object classifications, astrometric and photometric calibration quality, and for PDS microdensitometer scan quality. Also served as “user support” contact for people wanting pieces of our digitized survey before it was released on the many-CD sets and via the web. Also helped test and operate

- the first versions of the HST Archive via the archiving of the GSSS digitized Schmidt plates to optical disks, etc. Began scientific astronomical research work in 1985 also, working on the Polar Ring Galaxies Catalog being compiled by Brad Whitmore and other collaborators, as well as working on new CCD observations of some of the best candidates. (I was eventually second author after Brad on the paper when it was finally published in the AJ in 1990.) Did all this work as a member of the CSC staff, though I was thoroughly integrated into the AURA day-to-day GSSS operation. Switched to AURA in March 1989.
- Morehead Planetarium, Chapel Hill, NC: From 1979 to 1985, I did a variety of tasks including giving live lectures on astronomy, writing and recording radio features on astronomy and astrophysics (I was also simultaneously a volunteer and sometimes paid music programmer/radio announcer at WUNC-FM, a flagship 100,000-watt NPR radio station, so I didn't need a recording engineer), assisting in planetarium projector maintenance (a Zeiss Model VI, the same as the Smithsonian's National Air and Space Museum Planetarium at the time), building and operating special effects as well as operating the planetarium projector during my live lectures, helping install a computer system to automate the projector and the special effects, and writing small computer programs to test it, helping install a new sound studio and using it for production of planetarium show sound tracks, doing artwork for the staff artist, and conducting Open House nights at the observatory on top of the planetarium building since I had used it extensively in my astronomy coursework there, and for 9 years afterwards, making observations with the 60cm telescope for my own interest and edification, as well as testing various pieces of equipment from time to time on a volunteer basis for the professors in the Physics and Astronomy Department. Because of the planetarium's budget problems, I did all this while officially being paid as the clerk and after late 1983 or early 1984 on an honorarium basis for the lectures.
 - Several other jobs in various areas at UNC-Chapel Hill: Pulmonary Medicine lab research assistant on grant; clerical work and dealing with international health officials at INTRAH (International Program for Training in Health), a Near East-North Africa Public Health Training project of UNC Medical School with ties to USAID, JHU international public health programs, and many national and international agencies, and at UNC Chemistry Department, etc., as well as the radio announcing and music programming and astronomy writing/broadcasting at WUNC-FM, as mentioned above.

Most Relevant Awards, etc.

- First Prize for Science for project on radio galaxies which I conceived and directed at the first National Virtual Observatory Summer School at the Aspen Center for Physics, Aspen, Colorado, September 2004. This carried with it an invited talk and stipend for funding for it at the AAS Meeting in San Diego in 2005. I delegated this talk and funding to a graduate student who was in my group but helped him in the preparation of the talk. This also later developed into a funded NVO grant on which I am the PI, won via competitive scientific peer review on the basis of the science in an oversubscribed pool of proposals.

- STScI Individual Achievement award for extraordinary support of observers in reviewing proposals and for finding and resolving problems in HST observing programs which would affect the data quality and ease or difficulty of data reduction. It was also and perhaps primarily for my role in designing very-high profile SM1 ERO observations by Alan Dressler of CL0939+4713 at $z=0.4$, some of the deepest observations ever obtained at that time, which clearly demonstrated that the refurbished HST with the new WFPC2 was an excellent tool for studying the morphologies of distant galaxies, and which were also a primary source of inspiration for the original Hubble Deep Field which followed soon thereafter, and in which I subsequently participated. Dressler also made me a co-author on the very high-visibility AAS talk and poster presentation and made me a co-author on the resulting ApJ article. This award was made in Fall of 1994.
- Numerous group achievement awards from STScI and NASA between 1985 and 2007 for Guide Star Catalog and digital image archive work (several), for TAC and observing support as a USB TA and later as a Program Coordinator, and for Two-Gyro and One-Gyro tests and ACS recovery operations etc. as a Data Analyst in the ACS instrument group in INS. Also received a number of service awards for longevity.

Education:

- Special Non-degree Graduate Student – Johns Hopkins University, Spring 1987; Studied Galaxies and Cosmology with Allan Sandage (Edwin Hubble's younger protégé who later took up his work), Colin Norman, George Miley, and Alex Szalay. This was a formal upper-level undergraduate and graduate astrophysics course in the Physics and Astronomy Department at JHU for which I was officially registered, and was not a “general interest” course for non-majors or the public.) Also, with permission of the professors, later informally audited several other JHU astrophysics courses in subsequent semesters, all while employed at CSC/STScI, before switching to AURA in 1989.
- BA Zoology/Psychology UNC-Chapel Hill, December 1976. Included other coursework in many areas of science, with several semesters of chemistry and physics, and two astronomy courses, including a small upper-level observational astronomy course using 60cm reflector telescope with imaging (plates), spectroscopic, and photoelectric photometry (1P21 photometer) instruments, and working in small groups with assigned nights on the telescope and doing development of astronomical observing proposals and projects, implementation of the observations, data reduction and analysis, and subsequent write-up of the results. Also included many varied courses in humanities and sciences, from Classical Archaeology, and Chinese Literature in Translation, Biological Oceanography, Geological Oceanography, Geology, Comparative Anatomy and Paleontology, Physiological Psychology, Botany, and Ecology, to Canadian History as an inter-institutional student concurrently studying at Duke University and UNC-Chapel Hill. Later, as a UNC-Chapel Hill employee, took upper-level courses in Climatology, Remote Sensing, and introductory Computer Science for CS majors (two semesters in one intensive course, using Pascal).

Skills, etc.:

- Use Unix, Mac OSX, Windows (to a lesser extent), and VAX/VMS. Also use Citrix and MS Word, Excel, and Powerpoint, and some other commonly-available tools on such platforms with varying degrees of experience. Also use LaTeX some for scientific paper writing. Use IRAF/STSDAS and many of their different packages and tasks for astronomical data calibration, reduction, and analysis. Have experience with original drizzling and wrote well-documented scripts which were used as templates for instruction of some STScI summer students and others for a time before the invention of Multidrizzle. Have experience running Multidrizzle and tweakshifts, as well as related software such as SExtractor and tasks such as daofind, starfind (better than daofind, I think), xyymatch, geomap, etc., and other similar tasks. Write simple brute-force iraf scripts for data processing of both HST and ground-based astronomical data. Minimal IDL (mainly commands and simple editing of small pre-existing scripts), minimal Python and XML in scripts for regression testing, minimal use of awk, etc. Have minimal experience using NRAO's AIPS and have used their Observe program in the past, creating a large snapshot program in it on which I was the PI and went to the VLA site to be there for the observations. (Found subtle but bad bug in their Observe program when checking my own program, corrected my file, and notified them of the bug.). Wrote SQL queries in the past, as well as DCL (DEC/Vax control language) scripts to call other software such as IDL routines, etc., but in the late 1980s and early 1990s (and hardly anyone uses DCL now!) and have again written SQL queries for INS more recently. Use Remedy help desk software interface. Some experience with Zope on ACS web pages, and with simple html which I have used before for my own web page and similar pages, etc. Conception, design, and implementation of PhI proposals and PhII observing programs in HST ground system and flight database and helping advise proposers and observers about them is one of my greatest strengths. Used JWST Mission Simulator software etc. for work on resource testing of schedulability and scientific and technical feasibility of JWST DRM programs.

Astronomy Publications by Ray A. Lucas

- Please see attached pages.