considered by his US colleagues as a "hands-on rocket guy." He brought with him the German rocket tradition that stressed close, vertical integration of all parts of the process of designing, fabricating, preparing, testing, and firing rockets. Debus's initial in-house approach allowed close working relationships among designers, builders, testers, and operators. But as rockets became bigger, missions more complex, and schedules tighter, even Debus included elements of the air force model of program management. From 1963 to 1968, leading up to *Apollo 11*, the workforce of 8000 launch-operations workers and 10 000 support workers were contractors, supervised by 800 civil servants. The need for government workers to be the continuing thread in the fabric of the operations workforce continues to this day.

The book begins with the most important launch ever from KSC: *Apollo 11*, the first US manned lunar landing mission, viewed by a million people onsite and by a worldwide television audience. Preceding that event were many rocket firings, from the 24 July 1950 successful launch of the *Bumper-8*, a *V-2* combined with a WAC (Women's Army Corps) Corporal second-stage rocket, through the many launches of *Redstone*, *Jupiter*, *Delta*, and *Atlas* rockets from Cape Canaveral. While the operations at Cape Canaveral were taking place nearby, engineers and technicians were constructing the infrastructure of KSC and designing and building the ground-support equipment for the huge *Saturn* rockets, with the US Army Corps of Engineers managing the actual facilities construction.

Before KSC became NASA's independent operations center in 1962, it was the Marshall Space Flight Center's launch operations directorate. The center was responsible for the planning and supervision of the integration, test, checkout, and launch of vehicles. President Lyndon B. Johnson renamed the center the John F. Kennedy Space Center on 29 November 1963, just a week after Kennedy's assassination. A communications satellite, *Relay I*, launched into orbit from Cape Canaveral the year before, covered Kennedy's funeral as the world's first real-time television event.

Debus has been succeeded by eight KSC directors, several of whom were instrumental in the back-and-forth shifts in management approach from the German hands-on method to the air force project management system as resources, programs, and missions changed. The loss of the space shuttle *Challenger* in January 1986 occurred on Richard Smith's watch (September 1979–August 1986), and Forrest McCartney (August 1986–December 1991), an air force lieutenant general, came in to return the shuttle fleet to flight. Morale was very low, but McCartney, an R&D engineer who had headed the US Air Force Space Command, restored the confidence of the workforce, and flights resumed.

Jay Honeycutt (January 1995–March 1997), the sixth KSC director, was the most successful in having KSC engineers and technicians participate in the design and manufacturing processes of both the space shuttle and payloads. Honeycutt finally got operations requirements back in the design centers and factories by having KSC personnel stationed at those locations to insist that operations needs be met. He also made a strategic placement by putting John "Tip" Talone in charge of the ISS effort at KSC. Talone was most successful in penetrating the design and manufacturing processes and in using the Apollo and space shuttle facilities and equipment so that elements of the ISS could be connected, checked out, and tested on the ground before being flown into orbit. Talone was also successful in refuting the ship-and-shoot mentality.

Other key players who were instrumental in successes at KSC were Rocco Petrone, Apollo launch director, and George Page, the first space shuttle launch director. Both were brilliant, driving managers. The chief design engineer, Don Buchanan, not only designed most of the ground support equipment and facilities but also solved many real-time operations problems with innovative thinking.

Few other books have been written about KSC. *Moonport: A History of Apollo Launch Facilities and Operations* by Charles D. Benson and William Barnaby Faherty, published by NASA in 1978 and available for free online (http://history.nasa.gov/SP-4204/contents.html), is very detailed and technical, but is limited to the Apollo program. *The Kennedy Space Center Story* (1972) by Gordon Harris and published by KSC is also limited and does not address the evolution of the center's management systems.

In preparing *A History of the Kennedy Space Center*, Lipartito and Butler conducted many interviews at KSC, other NASA centers, and NASA headquarters in Washington, DC, to flesh out their research of archives and personal papers of Debus and others. They bring alive and personalize the trials and frustrations, and the joy and excitement, of the launch operations crew at the center.

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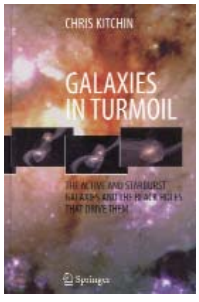
Galaxies in Turmoil

The Active and Starburst Galaxies and the Black Holes That Drive Them

Chris Kitchin
Springer, New York, 2007. $29.95 (298 pp.). ISBN 978-1-84628-670-4

Stars are the primary energy source of normal galaxies. Hundreds of billions of them account for most of the light that can be detected from a typical galaxy. In contrast, accretion of material onto a supermassive black hole at the galactic center is the energy source for active galaxies; the resulting radiation often outshines all the stars in the galaxy. The exceptional feeding monsters at the centers of active galaxies are called active galactic nuclei, or AGNs. Active galaxies, and the extremely luminous starburst galaxies, which exhibit unusually high rates of star formation, are the subject of *Galaxies in Turmoil: The Active and Starburst Galaxies and the Black Holes That Drive Them*, by Chris Kitchin.

Although they are distinct phenomena, AGNs and the intense star formation of starbursts together make a coherent subject for a topical book. Recently measured relationships between the mass of a central black hole and the total stellar mass in its host galaxy indicate that black hole accretion and star formation may be physically related and fundamental to galaxy evolution.



The text is written at a level appropriate for undergraduate students, and its intended audience also includes amateur astronomers. Kitchin, professor emeritus of astronomy at the University of Hertfordshire in the UK, is the author of several practical and technical observing guides. After lucidly explaining the physical processes of the tumultuous galaxies featured in his book, he devotes a chapter to observations that can be made with binoculars or a small telescope. His account of beaming in

AGN jets and the apparent superluminal motion of jet particles proceeds from the aberration of starlight, a phenomenon that is familiar to observers.

A great contribution of the book is its clear description of the many types of AGNs. Both the text and an appendix set out the defining features of the multiple and often overlapping classifications astronomers use. Despite the common underlying nature of AGN activity as described in unified models, differences in intensity and viewing geometry lead to a variety of observational characteristics. A central feature of the models is the presence of a toroidal distribution of dust in the nuclear region. Although the text makes it clear that differing views relative to the torus are responsible for many of the observational distinctions, the corresponding figures erroneously suggest that the torus is necessarily aligned with the disk of the host galaxy.

Overall, the text is direct. A few stories of key episodes in understanding galaxies reveal the path of scientific discovery. For example, the book's first chapter tells of Edwin Hubble's confirmation that there exist galaxies outside the Milky Way. Unfortunately, the development of main ideas is sometimes lost when the straightforward writing becomes choppy. Even before the reader has learned the significance of Hubble's discovery, the text is diverted for a seven-page box on spectroscopy. More significantly, the connections between chapters are often weak. For example, some outstanding problems in the field are identified, but with no indication of likely solutions. Other chapters, though, describe recent developments that may answer those very questions. The book's coherence would be further strengthened if the author more deeply explored the relationship between starburst and accretion activity, a subject occasionally hinted at in the text.

The scarcity of equations is intentional, but a few more would be helpful, particularly for use in a college course—even one geared toward nonscientists. Equations could succinctly describe the quantitative information that is listed in tables, such as the aberration angle as a function of velocity or the Schwarzschild radius as a function of black hole mass. The topics covered are of interest to students, and to the best of my knowledge, no other book provides a similar focus at a comparable level. Although the concepts may be familiar to amateur observers, university students need an explicit introduction to angular sizes and the relationships between angular and physical dimensions.

AGNs and starbursts are areas of vigorous ongoing research, and Kitchin's book contains current results. Many controversies and questions, however, are not yet resolved conclusively, so more information about the latest work would be useful. In a general-interest book, references to professional publications are not necessarily appropriate, but identifying the key researchers by name would allow the reader to keep up with their results. Graduate students are not Kitchin's intended audience, but with the addition of specific supplemental references, *Galaxies in Turmoil* would make an excellent introduction for beginning research students.

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new books — astronomy and astrophysics

Annual Review of Nuclear and Particle Science. Vol. 57. B. Kayser, B. R. Holstein, A. Jawahery, eds. Annual Reviews, Palo Alto, CA, 2007. $197.00 (503 pp.). ISBN 978-0-8243-1557-3