

Placing the Cosmic Background: The Ghana Radio Astronomy Observatory as an Ambient Infrastructure

James Merron

Recent years have seen an acceleration and proliferation of space science initiatives across the African continent. Ghana and Kenya established official space programs in 2012 and in 2016 Ethiopia and the African Union adopted a Space Policy (Asabere et al. 2015). These add to existing initiatives in South Africa and Nigeria, inscribing them in both continental and international networks (Camilo 2018; Pović et al. 2018). Notable among these big space science projects is the Square Kilometre Array (SKA), based in South Africa and extending across the continent. Comparable to the human genome project in its scale (Benoit 2018), the network of telescopes exceeds the sensitivity and size of large particle-accelerating machines (Hoeppe 2014). In 2017 Ghana became the second African country to participate in this network, anchoring the African Very Long Baseline Interferometry Network (AVN). As the station most distant from the SKA core site in South Africa, the Ghana facility – because it is close to the equator – is able to cover both the northern sky and underexplored southern sky. Operating alongside the SKA, although at different frequencies, the AVN will train radio astronomers to sense and make sense of hyperobjects as vast as the center of the Milky Way galaxy.



The Ghana Radio Astronomy Observatory, part of the Square Kilometre Array (SKA).
 Photograph: James Merron, June 2018.

Lisa Messeri (2016) has argued that producing science is producing place. Bringing the extra-terrestrial ambitions of astronomy down to Earth therefore needs to be understood within worldly concerns and local contestations (Twidle 2019: 6). In terms of the SKA/AVN, radio frequency interference (or RFI) exposes the contextual relations surrounding these big space science infrastructures (Agar 1994: 12–13). Every time a person living near a telescope uses a microwave or cell phone, they emit a signal that distorts the astronomers’ data. One solution is to locate radio observatories in remote locations. When this is not feasible, negotiations between astronomers and residents about electromagnetic interference index a sensorial politics that is often enmeshed within other local conflicts. Based on my account, the SKA/AVN can be read as part of an “ambient infrastructure” (Larkin 2016), shaping the way space is produced, organized and experienced.

The SKA/AVN are radio astronomy projects based on the technique of interferometry, which – simply put – is the scientific practice of linking together a network of individual telescopes in order to create a single large (virtual) dish. The future SKA/AVN infrastructure will be composed of over 3,000 fifteen-meter telescopes and thousands of receivers, making it the world’s “largest telescope and the largest science project in Africa” (Gastrow 2015: 2), not to mention the “largest scientific structure on the planet.” Its design is similar to the collaboration that produced the first image of a black hole in April 2019, which involved transporting tons of hard drives from observatories in Hawaii, Antarctica and Chile to central correlators in Massachusetts (USA) and Bonn (Germany) where the data was processed and translated into an image (Doeleman 2017).



A student in the Development in Africa with Radio Astronomy program detecting radio frequency interference near the Ghana Radio Astronomy Observatory. Photograph: James Merron, June 2018.

Interferometry – like other techniques of multi-wavelength astronomy – is directed at producing data that is made accessible for combination with other data from instrumentation elsewhere in the world (Hoeppe 2012: 1149). As a thing and a relation between things, the SKA/AVN infrastructure provides the grounds upon which other objects operate – in this case, radio telescopes in Africa. And when they operate, they operate as a system, mediating the exchange of information over distance and bringing people, objects, and spaces into interaction with one another (Larkin 2013). Besides the central correlators and high-performance computers that are usually located in the global north, another contact zone of this exchange is the rhizomatic networks of cables that transport power and signals to and between individual telescopes. In the process of cleaning data, the humming of cables indexes another local trace that is erased, since interferometry relies on clean inscriptions.



Cable wraps that transport data and power from the receiver to high-performance computers in the laboratory below.
Photograph: Andrea Zimmermann, August 2019.

The SKA will progress in two phases. Phase One, which ended in 2019, involved the establishment of a network of telescopes in South Africa and Australia. Phase Two is premised on developing radio astronomy science, technology and infrastructure across the African continent. But unlike the individual telescopes built in South Africa, those in the African partner countries will not be built from scratch. Rather, the telescopes are (and will be) constructed from recycled materials sourced from ground-based telecommunications satellite dishes (Hoare 2012), made redundant through the advancement of fiber optics across the African continent (Emmanuel et al. 2014). This idea was conceived by the late Michael Gaylard who, during two years of repair to the Hartebeesthoek Radio Astronomy Observatory in South Africa, used Google Maps to scour the continent for old telecommunications dishes that could be converted into radio telescopes (Gaylard 2013; Thondikulam et al. 2013).

West Africa's first radio telescope is located on the periphery of Ghana's rapidly urbanising capital city, Accra, at a site called Kuntunse. In its previous existence, the device had already made possible the exchange of information over long distances. In 1981, President Hilla Limann of Ghana used the facility to make a phone call to Margaret Thatcher, which was the first call made by international direct dial in Ghana and one of the first in Sub-Saharan Africa (Amoah 2014). Dr. Abdul Ibrahim – lecturer in Geographic Information Systems at the University of Ghana – recalled during a conversation we had in 2018 that the commissioning of the satellite dish also coincided with Princess Diana's wedding in 1981 (which, like the call to Thatcher, was broadcast throughout Ghana to all who could receive the signal). In 2008 the satellite receiver was sold to telecommunications giant Vodafone, which temporarily made use of the facility until 2015, when the company handed it back over to the Ghanaian Government.

Before the ground-based telecommunications satellite receiver became a radio telescope in 2017, residents of Kuntunse had already occupied the unused land surrounding the facility. The afterlife of this space infrastructure has now intensified a land dispute between Vodafone (which still owns the land), the Ghana Atomic Energy Commission (which oversees the facility's operations), and the people of Kuntunse. Based on my observations though, the farmers and residents living adjacent to the telescope do not threaten it in any material sense. The trouble only begins once they turn on their cell phones, televisions or microwaves, since these devices interfere with the cosmic signals that the scientists are trying to detect with the telescope. Devices that emit electromagnetic signals produce a local trace that astronomers construct as "noise," an impurity and a threat to their ability to make authoritative claims. Thus, while premised on producing and sharing "clean" data within transnational networks, the interferometry infrastructure is emplaced within distinctly local conditions constituted by this unwanted interference.¹

There are, broadly stated, two kinds of astronomy: optical and radio.² Optical astronomy is mediated by lenses through which galactic sources are tracked and interpreted. In this format, interference is generated by light pollution, mostly originating from nearby cities. On the other hand, radio astronomers "see" beyond the visible spectrum of light, transducing invisible radio waves into images. Somewhat paradoxically, this vision is achieved by telescopes that "listen" to radio waves (Twidle 2019).

*The Ghana Radio
Astronomy Observatory
from a distance.*

Photograph: James
Merron, June 2018.



In this sense, Jon Agar (1994: 13) has posited that while optical astronomers are concerned with “dark skies,” radio astronomers seek “quiet skies.” However, alluding to interference in this way confuses the form and function of radio astronomy and the exact type of sensorial politics it makes possible. Do astronomers “hear” radio waves, “listen” to the cosmos, or “see” images? Addressing these ambiguities would lead to a better understanding of the relationality of outer space and the ambient conditions it produces on Earth, particularly in terms of the radio frequencies that technologies compete over.

The “encroachment” of Kuntunse residents around the Ghana Radio Astronomy Observatory is defined in relationship to the electromagnetic spectrums they inhabit, which construct them (and their devices) as ambient. Brian Larkin (2016) defines ambience as “a bodily reaction to lived reality and a cognition achieved through taste, touch, hearing, seeing and smell.” This account, however, is limited to the human body, whereas the sensorial politics of radio astronomy emerges when technologies and frequency interfere with one another. Inspired by Larkin’s analysis, my account takes a different approach in order to highlight conceptual entanglements at the intersection of astronomy, infrastructure and senses that go beyond human eyes, ears, mouths and noses. Of course, there is a diversity of ways through which to conceive of and analyse infrastructures, and the act of defining something as an (ambient) infrastructure is ultimately a categorization moment through which certain epistemological, methodological and political commitments become important (Larkin 2013: 330).

Treating radio astronomy in terms of its ambient conditions places outer space infrastructures, bringing their ambitions down to Earth and situating them in the context of local conditions and competing claims over space, on and off Earth (see Chinigò 2019; Walker 2019).

Notes:

¹ This also includes instrumentation and modes of usage (Hoeppe 2012: 1149). For instance, non-cosmic noise helps maintenance workers find and repair problems in the devices they use, as Stephan Helmreich (2016) has pointed out apropos the large interferometer used to detect a gravitational wave for the first time in 2015.

² This is a simplification, since doing astronomy at any wavelength – from x-rays, ultraviolet light and infrared to gamma rays – can be considered another “kind” of astronomy. The rendering of astronomy as either radio or optical simply serves my purpose of highlighting different sources of interference (credit to Götz Hoeppe for making this clear to me).

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