

Making Black Women Scientists under White Empiricism: The Racialization of Epistemology in Physics

Who is allowed to be an observer in physics, and who is fundamentally denied the possibility? In this article, I propose that race and ethnicity impact epistemic outcomes in physics, despite the universality of the laws that undergird physics, and I introduce the concept of *white empiricism* to provide one explanation for why. White empiricism is the phenomenon through which only white people (particularly white men) are read as having a fundamental capacity for objectivity and Black people (particularly Black women) are produced as an ontological other. This phenomenon is stabilized through the production and retention of what Joseph Martin calls *prestige asymmetry*, which explains how social resources in physics are distributed based on prestige. In American society, Black women are on the losing end of an ontic prestige asymmetry whereby different scientists “garner unequal public approbation” in their everyday lives due to ascribed identities such as gender and race (Martin 2017, 475). White empiricism is one of the mechanisms by which this asymmetry follows Black women physicists into their professional lives. Because white empiricism contravenes core tenets of modern physics (e.g., covariance and relativity), it negatively impacts scientific outcomes and harms the people who are othered.

White empiricism comes to dominate empirical discourse in physics because whiteness powerfully shapes the predominant arbiters of who is a valid observer of physical and social phenomena. Based primarily on their own

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experiences, white men, who are the dominant demographic in physics, construct the figure of the observer to exclude anyone who does not share the attending social and intellectual identities and beliefs. These beliefs can limit investigations of what constitutes a reasonable physical theory, whether the scientific method should be brought to bear on this physical theory, and the capacity to understand how incidents of racism disrupt the potential for objective discourse. Essentially, white empiricism involves a predominantly white, predominantly male professional community selectively failing to apply the scientific method to themselves while using “scientific” evaluation to strengthen the barriers to Black women’s entry into physics. White empiricism is therefore a form of antiempiricism masquerading as an empirical approach to the natural world. By denying agency to Black women in discussions of racism, white empiricism predetermines the experiences of Black women in physics.

To provide an example of the role that white empiricism plays in physics, I discuss the current debate in string theory about postempiricism, motivated in part by a question: why are string theorists calling for an end to empiricism rather than an end to racial hegemony? I believe the answer is that knowledge production in physics is contingent on the ascribed identities of the physicists. Contingentists focus on top-down social forces, or the contingency associated with laboratory instrumentation; in this way, they challenge any assumption that scientific decision making is purely objective.¹ Scientists are also typically monists—believers in the idea that there is only one science—who, rather than feeling burdened to prove there is only one science, expect contingentists to prove that there can be more than one (Soler 2015b). This monist approach to science typically forecloses a closer investigation of how identity and epistemic outcomes intermix.

Yet white empiricism undermines a significant theory of twentieth-century physics: General Relativity (Johnson 1983). Albert Einstein’s monumental contribution to our empirical understanding of gravity is rooted in the principle of covariance, which is the simple idea that there is no single objective frame of reference that is more objective than any other (Sachs 1993). All frames of reference, all observers, are equally competent and capable of observing the universal laws that underlie the workings of our physical universe. Yet the number of women in physics remains low, especially those of African descent (Ong 2005; Hodari et al. 2011; Ong, Smith, and Ko 2018). The gender imbalance between Black women and Black men is less severe than in many professions, but the disparity remains (National Science Foundation

¹ See Forman (1971), Pickering (1981), Shapin and Schaffer (1985, 78), Martin (2013), and Soler (2015a).

2018). Given that Black women must, according to Einstein's principle of covariance, have an equal claim to objectivity regardless of their simultaneously experiencing intersecting axes of oppression, we can dispense with any suggestion that the low number of Black women in science indicates any lack of validity on their part as observers. It is instead important to examine the way the social forces at work shape Black women's standpoint as observers—scientists—with a specific interest in how scientific knowledge is dependent on this specific standpoint. As Jarita Holbrook notes, Black students have their capacity for objectivity questioned simply because their standpoint on racism is different from that of white students and scientists who don't have to experience its consequences.²

Joseph Martin's concept of *prestige asymmetry* provides a helpful foundation for looking at the way epistemic outcomes are contingent on the identity of physicists (2017). This concept delineates the asymmetry between the prestige accorded to different regimes of physics. Martin coined the term specifically to describe the asymmetry between the public value placed on results in high energy physics (and adjacent fields such as early universe astrophysics/cosmology) compared with the value placed on results in condensed matter. Martin compellingly argues that high energy physics is often reported in terms of intellectual achievement while condensed matter is simply reported as technological evolution—whereas in reality, per Sharon Traweek, prestige in physics is determined by finely tuned social dynamics through which scientists' identities are made (e.g., Traweek 1992, 90).

For these reasons, the area of quantum gravity, a physics subdiscipline considered by many to be the pinnacle of physics prestige, objectivity, universality, and culturelessness, is a natural starting point for a discussion about how social prestige asymmetries affect epistemic outcomes in physics. Ultimately, the discourse about the quantum gravity model of string theory provides an example of how white supremacist racial prestige asymmetry produces an antiempiricist epistemic practice among physicists, white empiricism. In string theory, we find an example wherein extremely speculative ideas that require abandoning the empiricist core of the scientific method and which are endorsed by white scientists are taken more seriously than the idea that Black women are competent observers of their own experiences. In practice, invalidating Black women's standpoint is an antiempirical disposal of data, in essence turning white supremacist social structures into an epistemic practice in science. Therefore, while traditionally defined empiricism is the stated practice of scientists, white empiricism—where speculative white, male testimony

² Jarita Holbrook, "On having capacity for objectivity questioned?," private email correspondence with the author, 2018.

is more highly valued than reality-based testimony from Black women—is the actual practice of scientists.

This analysis is motivated by a question that continues to lurk in science studies. Just as Londa Schiebinger wondered about science, Amy Graves (née Bug) once asked, “Has feminism changed physics?” (Schiebinger 1999; Bug 2003). Her answer was, “Not yet,” and although incremental work on this question continues, it seems that the answer is still, at the very least, “not much” (Rolin 1999, 2006; Harrell 2016). There are clear indicators that feminism has changed other scientific fields, particularly the life sciences (e.g., Haraway 1988; Wylie 2003; Arnold 2017). Specifically, although there has been some scholarship on feminist theory and physics, it seems the primary feminist epistemology axiom has been that physics is unusual because the laws that underlie it are universal and not determined by people. Yet Barbara Whitten’s work (e.g., on the Superconducting Supercollider) makes clear that Graves was right to ask the question, which highlights the need to distinguish between universality (a physical phenomenon) and objectivity (an observer phenomenon; Whitten 1996, 2012). In this article, I use a combination of critical race theory, feminist standpoint theory, and contingency theory to show that race and ethnicity do impact epistemic outcomes in physics and that white supremacy in physics produces Black physicists as a permanent ontological Other.

Prestige asymmetry and the manufacture of white empiricism

Social history insists that identity matters, and since science is a social practice, identity is also a factor of scientific knowledge production. Social practices in the regions that were historically part of the transatlantic slave trade occur in the wake of slavery (Sharpe 2016, 8). Thus, Martin’s prestige asymmetry is a phenomenon that occurs in the wake of slavery in the Americas, in the African continent, and in Europe (Sharpe 2016, 14). Yet Traweek’s particle physicists (interchangeably known as high energy physicists) imagine themselves to be unshackled by this history, as participants in a “culture of no culture” (Traweek 1992, 162).

Martin is concerned by a specific aspect of this nonculture: why particle physics and astrophysics are considered to be more prestigious than condensed matter and materials science (2017). He argues that this prestige asymmetry is evident in and is reproduced in science journalism, which treats advances in particle physics as major intellectual achievements, while advances in condensed matter are regarded as mere material, technological achievements. Here I note, too, that minoritized individuals are discouraged from pursuing lines of work that are considered especially intellectually challenging

(Hernandez 2010). Their absence from these lines of work is then proffered as evidence of their lack of adequate preparation or competency.

White empiricism produces a prestige asymmetry between the viewpoints of white scientists and Black scientists, a disparity inscribed by white supremacy. Given the historical construction of Blackness as those who manually labor for free and whose children are destined to do the same and whiteness as those who are not Black, Native, or Asian, the prestige asymmetry between physics specializations runs parallel to that of Black people as manual laborers and white people as intellectual high achievers. Notably, the majority of Black American women who have earned PhDs in physics, astronomy, and related fields have done so in areas on the “wrong” side of prestige asymmetry (see, e.g., Valentine 2018). The most highly esteemed field, high energy physics theory (which covers particles, quantum gravity, and some aspects of cosmology and nuclear physics), has only seen about six completed PhDs by Black American women, with a greater (although still disproportionately low) number going to Black men.

The experiences of Black scientists in professional physics can be described by frameworks developed in the field of social epistemology: epistemic injustice, epistemic oppression, and conceptual competence injustice.³ *Epistemic injustice*, developed primarily with white women’s experiences in mind, is bifurcated into two phenomena: testimonial injustice and hermeneutical injustice (Fricker 2007, 1). *Testimonial injustice* is the act of devaluing a speaker’s word due to prejudices against the identity group to which the speaker belongs. *Hermeneutical injustice* focuses on a lack of access to resources, leading knowers to question their own competence.

Epistemic oppression extends and foundationally reformulates epistemic injustice to focus explicitly on minorities as epistemic agents, rather than victims of epistemically unjust behaviors. Epistemic oppression, then, is “an unwarranted infringement on the epistemic agency of knowers” (Dotson 2014, 115). This idea has roots not only in social epistemology but also in critical race theory, for example in Patricia Hill Collins’s discussion of “the suppression of Black feminist thought” through low citation (2000, 4–8). *Conceptual competence injustice* can be seen as a specific form of epistemic oppression whereby a knower is seen as fundamentally lacking the necessary conceptual or linguistic competence to be regarded as a knower (Anderson 2017).

White empiricism is conceptually distinct from epistemic injustice because it describes a resistance not just to testimony but also to empirical fact. It is

³ See Fricker (2007), Dotson (2014), Anderson (2017), and Kidd, Medina, and Pohlhaus (2017).

strongly linked to epistemic oppression and conceptual competence injustice because it involves a denial of a knower's competence based on ascribed identity (Dotson 2014; McKinnon 2014, forthcoming; Anderson 2017). White empiricism is the specific practice of epistemic oppression paired with a willingness to ignore empirical data. In addition, the presence of white empiricism involves a refusal to acknowledge that white supremacy has limited the scientific community's capacity for knowledge production. A scientist who believes in value-free science—the “culture of no culture” identified by Traweek—can look around and notice a community primarily comprised of white men, instigating an analytic decision (1992, 162). Identity should not matter where there is truly no “culture,” and anyone noticing the homogeneity of the community will then experience a cognitive conflict. How to resolve it? One can admit that a dearly held principle (“culture of no culture”) is wrong, or one can develop a pseudo-naturalistic justification for how it got that way. The latter resolution is common and typically involves denying the role that systemic, value-laden barriers can play in blocking the success of people on the margins.

Feminist standpoint theory has made a strong case for the myriad ways that race and gender affect the praxis of both social science and life science research (Potter 2006, 132). From this perspective, knowledge is rooted in the observer's social location or standpoint, and women are epistemically privileged because survival requires them to not only consider their own perspectives but also the perspectives of those more powerful than them. Arguably this theory, which acknowledges the epistemic asymmetries introduced by the political power relations between observers, is in tension with the principle of covariance. However, proponents have always treated physics as exceptional because its laws are both observer-independent and universal, meaning the standpoint of the observer does not matter (Harding 1991, 77; 2015, 102; Becker 2015).

Earlier I claimed that the theory of General Relativity implies that there is no hierarchy of observers—that the laws of physics are equally accessible from any frame of reference. There are limitations to this: certain empirical measurements require equipment that is not universally accessible. However, given those implements, measurements should be the same regardless of who is making them, and there is no specific physical law that dictates that women, for example, should be epistemically privileged. Yet there is a way in which feminist standpoint theory can help us think about the gulf between epistemic theory and social practice in physics. Standpoint theory correctly identifies that there are contexts in which Black women are epistemically privileged observers, and I argue that a refusal to accept this fact translates into modified epistemic outcomes in physics, not because the laws of physics

are different but because which parts of the universe we understand, and even the very nomenclature we develop to describe our understanding, are impacted by social forces. While Black women are not naturally epistemically privileged when it comes to uncovering universal laws of physics, they are artificially disprivileged by patriarchal white supremacy.

A scientist using white empiricism as an analytic framework might assume that there is no dynamic relationship between the underrepresentation of Black women and knowledge production in physics, choosing to ignore evidence that the culture of physics limits participation via racist and sexist gatekeeping. Yet Helen Longino (1990) has persuasively argued that, even in the physical sciences, science is social knowledge. Janice Moulton's "The Adversary Method" (1983) represents one analysis that shows how culture and knowledge production can come into conflict with concrete epistemic implications. Moulton succinctly notes in a section title that in philosophy there is an "unhappy conflation of aggression with success," and Traweek observes the same among American high energy physicists (Moulton 1983, 149; Traweek 1992, 130). Making aggressive behavior a requirement for academic success is especially harmful to Black women, since Black women are demonized for engaging in behaviors that even hint at aggression (Harris-Perry 2011, 89).

Disentangling physics from the norms of patriarchal white supremacy must begin with an honest accounting of the roots of the Western scientific project in the project of slavery. Slavery is rarely the starting point for discussions of what many of us would call the post-Enlightenment era development of science, which Jonathan Marks helpfully defines as "the production of convincing knowledge in modern society" (2009, 2), but in order to understand the epistemic dismissal of Black women, we must begin with slavery. Science, mathematics, and slavery were intimately connected: whether it was the early evolution of insurance and actuarial science to calculate the value of jettisoned cargo—brutally murdered people—or efforts to minimize the bow wave—the wake—of ships, to make them faster, to speed the movement of kidnapped Africans from the torturous Middle Passage to a tortured lifetime and usually death in the bondage of chattel slavery (Sharpe 2016, 35). Even a century and a half after the end of slavery and with Black intellectuals making inroads in white-dominant academia, they continue to face epistemic injustice, epistemic marginalization, presumed incompetence, and the cognitive dissonance of consciously recognizing the white supremacy that pervades the scientific culture of "no culture" (Traweek 1992, 162).

While Black men in physics face racism-related epistemic challenges, Black women in particular are in a double bind, subject to both racism and sexism. Black women's unique experiences with sexism are *misogynoir*, a misogyny

that specifically targets Black women (Bailey 2010).⁴ Perpetrators of misogynoir can include both Black men and non-Black people, necessarily making Black women's experiences with white supremacist practices in science, including white empiricism, distinct from those of Black men. Misogynoir can take the form of epistemic exploitation, where Black women are expected to educate colleagues and acquaintances about their experiences with sexism and racism (Berenstein 2016; Dancy, Edwards, and Davis 2018). White empiricism is therefore also a tripling down on epistemic exploitation: it involves both exclusion and a demand for labor to explain the experience of exclusion and then disbelief in response to the victim's testimony (Langton 2000; Gutiérrez y Muhs et al. 2012; McKinnon, forthcoming).

Killing empiricism to save quantum gravity but not Black women

To give a very explicit example of how white empiricism operates within the physics community, I must analyze recent debates about the future of string theory. String theory is a proposed model to resolve the problem of quantum gravity (Polchinski 1998, 4). For many people working in particle physics and cosmology, a complete, widely accepted theory of quantum gravity is a holy grail: can one unified theory explain both quantum mechanics and general relativity simultaneously, despite apparent inconsistencies? String theory proposes to succeed at this, but it requires striking new, as yet unobserved features of the universe. Perhaps most controversially, rather than describing a space-time with three spatial dimensions and one time dimension, string theory requires at minimum eleven space-time dimensions in order to be mathematically consistent (Kaku 1995, 155). However, there is no widely accepted empirical indication that there are more than four space-time dimensions. For the first two decades of string theory's existence, this was not a major source of concern, as future particle physics experiments were expected to yield evidence for string theory (Dawid 2013, 16). The discovery of supersymmetric particles, for example, was still on the horizon when construction of the Large Hadron Collider was underway.

Unfortunately for string theorists hoping that the Large Hadron Collider would produce evidence for their model, it has yet to see any evidence for supersymmetric particles. The simplest model of supersymmetry, known as the minimal supersymmetry model, has effectively been ruled out (Wolchover

⁴ To be clear, I am using "double bind" to refer to a situation where one is bound by multiple ascribed identities. While the colloquial use of "double bind" is akin to "damned if you do; damned if you don't," in the literature about women of color in science, it is used in the manner in which I use it here (e.g., Malcolm, Hall, and Brown 1976).

2012). This has caused supersymmetry theory and in relation, string theory, to enter into crisis mode. In the absence of empirical support, should support for research in string theory come to an end? As the dominant line of thought in quantum gravity research, it has eclipsed other approaches such as Loop Quantum Gravity and Causal Sets when it comes to both funding and job searches (Smolin 2006, 345; Woit 2006, 252). Although it has been long argued that this is merely a matter of merit, meritocracy arguments remain difficult to fully accept in the absence of empirical evidence.

Surveying what should happen next, there are at least three distinct possibilities:

1. Patience is required, and evidence is coming.
2. String theory has failed to succeed in expected ways because the community—which is almost entirely male and disproportionately white relative to other areas of physics—is too homogeneous.
3. The scientific method overly constrains our models to meet certain requirements that no longer serve the needs of physics theory.

The trouble with the first option is that because of the theory's structure, parameters could continuously and endlessly change to excuse the absence of evidence: "It is simply in a regime where we can't currently take measurements" (Dawid 2013, 112; see also Ellis and Silk 2014). This never-ending passing of the buck to higher energy scales that require bigger experiments and more funding is suspect, although there is certainly no universal law that says that finding quantum gravity should be an affordable pursuit.

The second option is effectively unconsidered in the literature. Instead, the case for the third option has been made. This is a curious turn of events. Rather than considering whether structural and individual discrimination results in a homogeneous, epistemically limited community, physicists are willing to throw out their long-touted objectivity tool, the scientific method. In its place, they propose that their sense of aesthetics is sufficient, that the theory holds a kind of beauty (such as high levels of symmetry) similar to other, empirically successful theories such as the Standard Model of particle physics (Polchinski 1998).

This reaction must be read in tandem with the epistemic injustice, epistemic oppression, and conceptual competence injustice that Black Americans of all kinds experience when discussing racism. Holbrook holds that Black students are presumed to be epistemically unreliable on the subject of racism, which sends the message that they can never achieve an objective observer status akin to that of their white peers. As Holbrook describes this epistemic dismissal, "When confronted with a racist incident as a person of color, your

objectivity is immediately questioned. Are you sure it happened? Are you sure that it was their intention? to flat out: So and So is not racist! I've known them for years. Thus, your objectivity is being questioned. . . . The internal dialogue is that if they do not believe me in this, what do they think about my science? Thus, it erodes the scientific identity that you are in the process of creating" (see n. 2). Yet it seems that members of the white-dominated string theory community are competent to scrap the foundation of the scientific method, with the understanding that biases do not affect epistemic outcomes in string theory at all.

This double epistemic standard is a specific combination of Dotson's epistemic oppression with antiempiricism (2014). In effect, white physicists are considered competent to self-evaluate for bias against other epistemic agents *and* theories of physics where there is no empirical grounding to assist in decision making, while Black epistemic agents are considered incompetent to bring a lifetime of knowledge gathering about race and racism to bear on their everyday experiences. This empirical adjudication is the phenomenon of white empiricism. It is reflected in string theorists' ability to actively argue for continued investment in their ideas via funding and faculty hiring while at the same time Black people—particle physicists or not—are often considered to be making controversial or "evidently wrong" statements about racism.

Though postempiricist string theorists do not necessarily make up a majority of string theorists and certainly not the overall physics community, it must be clear that this fact is beside the point. What matters is that their arguments are given room to breathe in professional spaces, whether it is publications, conferences, or books. Postempiricists have been given the benefit of a hearing and a substantive call and response with wide investment from the particle theory community (Woit 2014). While many in the community may disagree with such thinkers, their epistemic agency is recognized as legitimate. Black women speaking up about their experiences with discrimination are simply not offered the same platforms or axiomatic acceptance of their agency in discourses about race and gender/sex. Thus, the salient consideration here is not whether postempiricist theorizing has led to a coherent coalescence around postempiricist, rationalist string theory but rather the specific permissiveness of whiteness.

The unconstruction of Black women as physicists

White empiricism has an impact not just on empirical choices on the part of non-Black physicists but also on the choices of Black women physicists, including whether they continue to participate in physics at all. Black Americans

are severely underrepresented among professional physicists, more severely than in most other STEM fields. At every degree level, they are outpaced by nearly every other ethno-gender group except people indigenous to places under US domain (National Science Foundation 2018; Ong, Smith, and Ko 2018). In all of American history, fewer than one hundred Black American women have earned a PhD from a department of physics, a department of astronomy, or a department of physics and astronomy, even though about two thousand PhDs in physics are granted in the United States every year, with half of those going to US citizens (American Institute of Physics 2013; Valentine 2018).

Attending to the relationship between identity construction and epistemology in physics requires a framework competent to analyze the way experiences with oppression can uniquely compound. Black women experience life differently from white women because they experience not just sexism but also racism (Smith 1978). Kimberlé Crenshaw's analysis of the differences between Black women's and white women's experiences confronting sexual violence introduced "intersectionality" into feminist theory (Crenshaw 1989, 1991; May 2015). Intersectionality is the phenomenon whereby women of color's experiences with subordination—that is, racism and sexism—uniquely combine. Crenshaw first showed how this operates in the legal world by explaining that Black women are seen by the courts as nonrepresentative of both the protected class of "women" and the protected class of "Black people," meaning that Black women can never represent either of the protected classes that they are supposedly members of. It has since evolved into a framework that Vivian May describes as "epistemological practice that contests dominant imaginaries," "an ontological project that accounts for multiplicity and complex subjectivity," "a radical . . . political orientation grounded in solidarity," and "a kind of resistant imaginary—a way of intervening in historical memory" (2015, 34; see also Hill Collins and Bilge 2016). Its origins in Black women's feminism, which has an early articulation in Sojourner Truth's words—"I am a woman's rights"—makes intersectionality a natural formalism through which to interpret Black women's experiences within the scientific community (Truth 1851).⁵

Black women's intellectual history is replete with examples that highlight epistemic injustice, epistemic oppression, and conceptual competence injustice across disciplines, including how the construction of a "discipline" can play a role in these epistemic marginalizations.⁶ Science is no exception.

⁵ In context, Truth was speaking to a women's suffrage conference during a time when Black women's place in the suffrage movement was contested.

⁶ See, e.g., Hill Collins (2000), White (2009), Cooper (2017), and Lindsey (2017).

Shirley Malcolm, Paula Quick Hall, and Janet Welsh Brown (1976) have shown that women of color in STEM exist in a double bind, as women who are marginalized due to racism and as people of color who are marginalized due to sexism. A recent study of women in American astronomy and planetary science found that women of color uniquely faced barriers that white women did not (Clancy et al. 2017). Others have investigated survival strategies of women of color in STEM, including in physics and astronomy (Berry and Mizelle 2006; Johnson et al. 2017; Ong, Smith, and Ko 2018). Often, the literature effectively focuses on white women by ignoring race or looks at women of color as a whole, without distinct consideration for Black women (Prescod-Weinstein 2014, 2017). Although the literature rarely attends to race, when it does, it does not disaggregate by gender/sex. The studies of Black women in physics that do exist, contending with a small sample size, are typically qualitative rather than quantitative in nature.⁷

Can a Black woman be a physicist? The question seems ridiculous, but yet historically “no” was widely presumed to be a given, and this answer undergirds the praxis of white empiricism.⁸ Black people were legally defined as subhuman in the 1789 US Constitution, worth three-fifths of a non-Black life (U.S. Const., art. I, § 2 cl. 3 [repealed 1868]). Thomas Jefferson’s 1791 letter to the free Black scientist Benjamin Banneker shows the constitution as emblematic (rather than exceptional) of the period’s circumscribed definitions of humanity ([1791] 2008). Jefferson expresses what would later become a popular view of Africans and Black Americans: as a group they are degraded, but that Banneker represented a possibility that, with assistance from enlightened civilization, enslaved Black people in the Americas and peoples in Africa could be removed from their state of imbecility. The construct of race

⁷ See Ong (2005), Rosa (2013), Rosa and Mensah (2016), and Chambers (2017). Chambers also considers the question of how race and gender together shape epistemology in physics, although it takes a different perspective. Chambers uses (anonymized) interviews with Black women physicists, including this author, to focus on how Black womanhood may shape physics, while the present work is oriented toward explicating the impact of whiteness on empiricism. In my opinion there has been insufficient attention paid to the psychological impact of being a high-achieving Black woman in any field, much less physics, although there is some literature available (e.g., Yang 2014).

⁸ Without distracting too much from the main point of this text, it is worth noting that at the time of this writing, there has been no publication of a history of Black women in physics, and this is a future project potentially of interest to the author. *Hidden Figures* provides some insight into the lives of Black women mathematicians (by training) who became space scientists on the job at NASA (Shetterly 2016; Edwards and Harris 2017). Because these women did not have the opportunity to work as principal investigators, they are not a focus of the text here. But *Hidden Figures* provides a model for future, needed work that analyzes what is nearing a half century of Black women PhDs in physics, since 1972 (Valentine 2018).

was invented to serve this viewpoint; whiteness is antijuxtaposed to Blackness: “The so-called races were believed to be demarcated by biological and psychological differences that went well beyond skin color” (Golinski 2016, 11). It is worth noting here that in Banneker we have an example of an eighteenth-century Black male scientist; he has no female or nonbinary contemporary in the historical literature.

The idea of a scientist and the discipline of physics were coalescing during this same time period. The term “physicist” was coined in 1836, although for most of the nineteenth century “man of science” was the dominant terminology because the suffix *ist* was associated with crass professionalism in the United Kingdom, which was a model for the United States (Baldwin 2014).⁹ The idea of “scientist” was formally conceived after the late eighteenth century when the “fixity” of gender, race, nationality, and class origins became concretized (Golinski 2016, 11). Gender also began to undergo a reinvention: “They [gender categories] were increasingly thought of, not just as anatomical features but as pervasive determinants of personality and intellect. Men and women came to be seen as having entirely distinct intellectual, emotional, and physiological characters” (11). Jan Golinski notes that at this point, a scientist was someone who had “an ability for painstaking research,” a quality only men were believed to have (2016, 19). This masculinist logic conflated intellectual prowess with physical prowess, in the process ignoring the physical prowess associated with childbirth under the conditions of slavery (Wajcman 1991; Morgan 2004, 46–47). The scientific community continues to self-construct as “a world without [white] women,” and this gendered construction has epistemic implications (Code 1991, 59; Noble 1992; Subramaniam 2014, 203). Given that, among women, only white women were legitimately defined as human beings and that even white women were not considered to be intellectual players in the scientific arena, people living at the intersection of these ascribed identities (“Black,” “woman”) were certainly not part of that world either. Specifically for Black women, all personhood was denied legally and geographically, in addition to socially and intellectually (Hartman 1997, 115; Sharpe 2016, 35).¹⁰

⁹ This discourse occurred primarily in England, though the US academy took its cues from Europe during this period.

¹⁰ This does not mean that Black women of the time did not engage in activities that we might today label as scientific or medical. These women were often midwives, herbalists, and agriculturalists (Frankel 1997). There is little concrete evidence of their activities as mathematicians, engineers, or technologists, but it is reasonable to assume that Black women contributed to the intellectual landscape in these vital ways too. One might argue that these activities do not constitute science; they were not intended to uncover reproducible results for the

This racialized subjectivity parallels Sara Hottinger's precept that gendered subjectivity in mathematics plays a role in constructing mathematicians by treating the idea of a woman mathematician as a discursive impossibility or, at best, an aberration (Hottinger 2016, 11; Dotson 2017). Likewise, the concept of a Black woman appears to contravene the idea of "physicist." Per Golinski, "For the account to be as purely factual and objective as possible, the observer had to be autonomous, independent of any inference by preconceptions or passions. The ideal was a 'modest witness,' one who kept him- or herself out of the picture as much as possible. The observer was called on to practice a kind of self-suppression or self-abnegation" (2016, 29). This definition is almost by construction exactly what Black is not, beginning in the seventeenth century, when a social definition of Blackness begins to take shape. Or rather, Black is constructed in opposition to this, in part to justify the demeaning behavior of white people (Painter 2010, xi). Returning again to the example of Benjamin Banneker, while Black men were occasionally empowered to enter into discourse about their humanity, Black women were locked out of the debate entirely and considered to be subordinate to everyone, including Black men.

This asymmetrical social recognition of Black men's and Black women's humanity persists into the twenty-first century. Black men's limited access to patriarchy gives them an in with white supremacist patriarchy that Black women cannot access, while white women's access to whiteness gives them an in with white supremacist patriarchy that Black women cannot access. Naturally, these dynamics follow individuals into their professional spaces. Nadia Brown (2019) describes her harrowing experiences as a Black woman facing regular sexual harassment from Black men in her discipline: "For the first year of my initial tenure-track job out of graduate school, I was subjected to numerous and persistent sexual advances from my Black male colleagues" (166). My own experience with the sexual misconduct rumor mill in science indicates that Brown's experience is not singular, yet there is little research on the way Black women are specifically targeted by men who may not feel safe similarly harassing white women, making it difficult to fully grasp the extent of the problem. Brown describes how her experiences with this misconduct shaped her epistemic choices, which can no longer be simply rooted in the empirical facts of her topic of research but are now also entangled with her subjectivity as a victim of persistent intraracial harassment.

purposes of discovery. But given the never-ending duress of slavery, I argue that enslaved people at least sometimes were attempting to innovate reproducible processes for the purposes of reducing the master's violence.

Thus, the social becomes a feature of scientific activity. Longino makes the case for science as a *practice* framework, not merely an analytic framework rooted in “the scientific method” (1990, 13). Longino explains that scientific inquiry is “a group endeavor in which models and theories are adopted/legitimated through critical processes involving the dynamic interplay of observational and experimental data and background assumptions. Since contextually located background assumptions play a role in confirmation as well as in discovery, scientific inquiry is thus, at least in principle, permeable by values and interests superficially external to it” (13). Race and gender are social constructions laden with social values and interests, and race in particular was specifically developed to serve white supremacist values and interests. Thus, Black women’s identity can become part of a scientific practice, and the exclusion of Black women as observers/scientists shows that science is traditionally a sexist and racist practice. Therefore, ascribed identities function as social un constructions; people become unpeopled and outside of “Enlightened” ontologies (Haslanger 1995). Biography, for Black women especially, is a multiplicity of identities; a life lived is an ongoing synthesizing and integration of social and internal identities, some of which are disclaimed by an ontology that equates “thinker” with “whiteness.” While all people struggle to integrate these features, Black women face unique challenges.

For the descendants of kidnapped and enslaved Africans, responding requires recognizing the way African epistemologies are invisibilized. Jonathan Chimakonam shows that there is a significant injustice associated with the exclusion of African philosophies from global epistemology discourse. Importantly, this marginalizes the contemporary African diaspora (Chimakonam 2017). It also marginalizes the extracontinental diaspora’s relationship with their own history. Returning to Hottinger, note that the figure of the mathematician was invented in part through historical narratives about the math’s origins, a legacy handed down from one academic generation to the next (2016, 91). Traditional Euro-American historiographies are almost exclusively male; even when women factor in, they are almost exclusively white. Thus, Black girls are taught that rather than joining a long tradition that includes their ancestors, they are entering as Black outsiders to white tradition. Further, Hottinger argues that when ethnomathematics is introduced in the classroom, it is posited as an outsider epistemology rather than a thread that constitutes math as we define it, cementing Black people as an ontological Other in mathematics.

This question of labeling some people as ontological Others is significant, not merely because of the impact this has on them but also because of how it shapes conversations about equal opportunity for these groups. In the US context, discussions of equal opportunity have fallen under the

Equal Protection Clause of the Fourteenth Amendment to the Constitution, though its interpretation has varied significantly. Under *Brown v. Board of Education*, the Supreme Court focused the decision on the impact of segregation on Black American children. Twenty-five years later, in *Bakke v. University of California*, the Court focused on the impact of segregation on the white majority as well as equal opportunities for minorities (Kahn 2017, 12; Prescod-Weinstein 2018).

In the time since *Bakke*, the focus on Black access to educational opportunities has shifted away from the question of human rights and toward the needs of the dominant majority in the scientific community. The National Science Foundation (2008) argues that the broader impact of diversity is a worthwhile consideration in granting criteria based on a national need for a strong STEM workforce as the United States undergoes a demographic transition where white-identified people will soon no longer account for over 50 percent of the population. Because white Americans still heavily dominate STEM degree earning and the STEM workforce, American STEM cannot keep up with the demographic changes. These arguments repurpose Black Americans (and other minorities) as tools to serve nationalist needs.

This logic has a distinct similarity to that of the antebellum era, when Black labor was property in the service of national interests. Black humanity, Black curiosity, and the freedom to pursue one's curiosity never factor into the equation. This is first and foremost damaging to the people impacted, but it also serves to damage the science by epistemically marginalizing potentially unique contributions that Black American scientists can make. It is easier to reduce the ontological other to a resource, a choice with epistemic implications. While cultural diversity does have a role to play in widening the field's epistemic reach, we should not need to emphasize Black women's difference in order for them to be accepted as equal observers in the field.

Returning to the question of whether a Black woman can be a physicist, the community now responds more positively while failing to address the structural dynamics that make it difficult for her to become and remain one. Rather than confront this reality, the dominant majority instead persists in a white empiricism that publicly insists that identity fundamentally does not matter while embedding identity into the culture. This is not to say that there has been no attention (from white men in the field) to the experiences of women in physics or astronomy. For example, the celebrated particle physicist Howard Georgi wrote in 2000, "unconscious discrimination [against women in physics] arises because the application of our tools for discrimination between different scientists selects for many things, including qualities that are at best very indirectly related to being a good scientist, and that clash with cultural pressures" (Georgi 2000). In my view, Georgi comes close to

suggesting that the construction of “physicist,” entwined as it is with social pressures and determined by qualities typically only acceptable in white men, has meaning for epistemic outcomes in physics. But instead he proposes what now constitutes a fairly predictable set of solutions to the problems women face, such as avoiding unnecessarily narrowing the search parameters during hiring. Importantly, a search of the literature does not turn up a similar level of attention to discrimination against women in physics by any of the people arguing for a postempiricist approach to quantum gravity.

Implications for theorizing gendered identities: The self-construction of Black women as scientists

An unwillingness to confront social bias contravenes the possibility of strong objectivity (Harding 2015, 43). Evelyn Fox Keller talks about Western epistemic constructions of science as “male” and nature as “female,” leading to what Banu Subramaniam and Mary Wyrer have called “dementoring”—the training of women in STEM by “untraining them as women” and assimilating them as scientists (Keller 1995, 109; Subramaniam and Wyrer 1998; Subramaniam 2014, 182). Effectively, one can argue that Black women, famously in the double bind, experience untraining as women along with efforts to patch up the (constitutionally mandated) two-fifths deficit in our humanity. Here, the wake of slavery is telegraphed by society: by virtue of birth we are unconstructed as potential scientists.

It is difficult to assess the total epistemic impact of white empiricism. The difficulty lies in two areas: the challenges of contingency work, wherein we consider paths that could have been taken in science but were not, and a lack of scholarship on the intellectual history of Black women principal investigators in the physical sciences, particularly physics and astronomy. Little scholarship on Black women scientists exists, although there is some (e.g., Warren 2000). Thus, I look to an example of a white women in astronomy to clarify how, even for white women, the patriarchal aspect of white empiricism has lasting consequences for their epistemic choices. It is important to note that patriarchal empiricism does not function as an adequate total substitute for white empiricism for the simple reason that sometimes white women are part of the problem that Black women face (Savali 2016), which limits the usefulness of white women’s examples in analyzing Black women’s experiences.

Vera Rubin, widely held to be the first astronomer to find widely accepted evidence for the elusive dark matter (which should be called clear matter), pursued this particular research direction when a combination of sexism and masculinist behavior made it difficult for her to work on other lines of

thought (1996, 157). In response, Rubin actively sought out a set of observations that did not interest large numbers of men at the time, leading to one of the most significant astronomical results of the twentieth century. The significance of the discovery is the primary reason that this story has been recorded and openly discussed, but naturally one wonders how often advances in physics and astronomy have been made due to a similar set of considerations (Prescod-Weinstein, Tuttle, and Gunther, n.d.).

Rubin's story represents an example of how epistemic outcomes can be gendered. This is not because dark matter is inherently female or feminine but simply because, per Melissa Harris-Perry's concept of "standing up in a crooked room," individuals who are women (whether due to social assignment at birth or conscious realization later) exist in a sexist world and must make decisions in that context (2011, 29). What is essential here is not the specificity of women's gender or sex but the fact that women must respond both to their own social ideas of gender and sex and also to how the larger society interacts with their gendered and sexed existences.

Therefore, Rubin's articulation of why she chose to look at rotation curves is a gendered story because it was how she stood up straight in a crooked research room.¹¹ For a white woman, however, the room was still less crooked than it might have been for a Black woman. Thus, it is also important to emphasize that at the time Rubin was doing this research, no Black woman had ever received a PhD in physics or astronomy, much less been given access to telescope time to pursue independent research (Valentine 2018). A Black Vera Rubin would have been an impossibility in the 1960s. In relation, Derek Anderson notes that conceptual competence injustice disfavors epistemologies that are in any way associated with disenfranchised people, as certain areas become domains of the "less competent" (2017, 220). One might wonder whether areas of research that Black women did attempt to pursue were also devalued because of it—a form of prestige asymmetry that is rooted in conceptual competence injustice.

Despite an American tradition that began with the idea that Black people could only ever be subhuman slaves; that Black women slaves in particular must compulsorily engage in reproduction; that Black enslaved people

¹¹ The solid state physicist Mildred Dresselhaus described in an interview that similarly her initial goal of having a research position with no teaching duties was primarily because academia was not designed for mothers working outside of the home. She felt she needed "some-what more flexibility, because I didn't have to meet classes at a fixed time every day." Shirlee Sherkow, "Project on Women as Scientists and Engineers: Interview with Mildred Dresselhaus," Massachusetts Institute of Technology, Oral History Program, Women Scientists and Engineers Oral History Collection, MC 86, box 1, 1976, 154, Massachusetts Institute of Technology, Institute Archives and Special Collections, Cambridge, MA.

should never be allowed to read; that even once free, Black people should be denied the right to equal educational opportunities and the right to vote, Black women aspired to participate in higher education, to become students and practitioners of science. Their motivations varied but were often rooted in an idea articulated by novelist Kiese Laymon that when you “Love your people . . . and write and read into your fears,” Black women can simultaneously transform the national political discourse as well as the physics discourse (Laymon 2015). By redefining the physics community as one that includes them, Black women redefine the role a physicist plays in the process of physics—the subaltern not only speaks, she researches (Spivak 1988). There is a meaningful relationship between the questions we ask, who scientists are, and what we come to know. The author, for example, has explored whether our understanding of melanin has been limited by the fact that those researching material science are likely to have very little of it in their own skin (Prescod-Weinstein 2016).

Conclusion

The central argument of this article is that white empiricism limits who is authorized to make claims about physics and that this is damaging to physics and alters its empirical direction. Iwan Rhys Morus’s *When Physics Became King* (2005) shows that our ways of describing physical phenomenology began as a matter of social discourse. White empiricism is the practice of allowing social discourse to insert itself into empirical reasoning about physics, and it actively harms the development of comprehensive understandings of the natural world by precluding putting provincial European ideas about science—which have become dominant through colonial force—into conversation with ideas that are more strongly associated with “indigeneity,” whether it is African indigeneity or another. Sandra Harding’s concept of “strong objectivity,” which proposes dropping the pretense that it is possible for any scientist to be a socially neutral researcher, suggests that instead, all analytic frameworks begin with an understanding of the social forces that may be at work in the lives and minds of scientists. Incorporating strong objectivity into science pedagogy and scientific practice may prove useful as a response to anti-indigeneity (Harding 2015, 43), and the world of physics and astronomy could be a good analytic starting point for testing it. It is here that we recognize the physical sciences as a potential laboratory for feminist theory.

Physics is a useful laboratory for testing the capacity of a feminist theory like strong objectivity to eliminate white empiricism because physics is widely seen as a near-pure exemplification of the Western world’s empirical supremacy:

nothing captures the world so accurately or in such great detail as physics. The idea that white empiricism can play such a significant role in shaping it should seriously undercut this perception while also helping to explain sociological and historical phenomena in physics and the intimately related (sub)discipline of astronomy. The concept can enrich historical analysis of Black women's intellectual history in physics and astronomy, a topic of increasing interest to feminist scholars and the general public alike. However, the idea is not only relevant for physics but should be more broadly useful to those working in feminist epistemology and feminist studies, especially those with an interest in the applications of feminist standpoint theory.

Through the recognition of white empiricism, a bifurcated logic that serves white supremacist traditions in science while deontologizing marginalized Black women physicists, I propose that the Black feminist theory intersectionality should change physics—and not just through who becomes a physicist but through the actual outcomes of what we come to know. As we enter an era where physics and astronomy are both studied and practiced by increasingly larger teams with wide geographic footprints, these social dynamics will become important in new ways. For example, in the debate about the Thirty Meter Telescope on Mauna Kea, Hawaii, the question of which epistemologies merit legitimate consideration is intimately tied to white empiricism (Swanner 2013; Salazar 2014; Kuwada 2015). White empiricism can help explain why the Thirty Meter Telescope was evaluated so differentially by Mauna Kea protectors and telescope-using scientists, resulting in a specious debate over who was for and who was against science. Protectors, who do not subscribe to white empiricism, have been forced to repeatedly challenge press coverage that tends to assign a higher knowledge prestige to the role of nonindigenous scientists than to cultural knowledge holders of indigenous communities (Fox and Prescod-Weinstein 2019). Future work should unpack this phenomenon further in dialogue with decolonization discourse.¹²

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¹² See, e.g., Tuck and Yang (2012).

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