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Early history of Arecibo Observatory FREE

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paper quoted by Giddings[3] in his response to Mottola and Vaulin, in the case of a massive object like SgA* the thermal radiation is far below the limits of reference 3 because the specific heat of compact objects with a quantum critical surface is enormously larger than the conventional values the researchers assumed.

References

1. D. Tournear et al., *Astrophys. J.* **595**, 1058 (2003).
2. J. Barbieri, G. Chapline, *Phys. Lett. B* **590**, 8 (2004); **709**, 114 (2012).
3. A. E. Broderick, A. Loeb, R. Narayan, *Astrophys. J.* **701**, 1357 (2009).

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■ **Giddings replies:** George Chapline's letter accurately notes that in the quantum context one must be careful about what one means by the horizon. Those working on quantum black holes have well appreciated that distinction. While true event horizons may be ill-defined in the quantum theory, an important, well-defined, semiclassical notion is that of an apparent horizon, or trapped surface, where light rays begin to converge. This surface demarcates a region from which information cannot escape by local field theory propagation. The distinction between apparent and true horizons is a detail whose proper treatment in my article was precluded by space constraints.

Gravastars and other massive remnant variants replace the apparent horizon by a new kind of physical interface. Chapline fails to recognize that the admitted unpopularity of such scenarios stems from significant objections to their underlying physics. Those include, as outlined in my response to Mottola and Vaulin, the extreme form of nonlocality they apparently require—in contrast with the "minimal" nonlocality I have been recently exploring.

Although one would need more of a theory of such an interface to make sharp predictions, clearly, if stationary just outside the would-be horizon, that interface would be very highly boosted with respect to freely infalling matter. Thus it is a significant problem to explain why collisions of infalling matter with the interface don't lead to substantial outward scattering. Reference 3 of Chapline's letter places an observational bound that less than 0.4% of the infalling energy is reradiated from a putative surface of Sagittarius A*, assuming surface thermalization. This illustrates how strong such bounds are, and the possibility of extending them to other radiation spectra. In particular, in Chapline's outlined scenario, one might also expect a significant fraction of accreted energy to be emitted. Although improved data are clearly welcome, I respectfully disagree with Chapline's statement that the bounds on observed energy radiated from a presumed surface present "no astrophysical evidence" for horizons.

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Early history of Arecibo Observatory

Thank you for the article "The Arecibo Observatory: Fifty astronomical years" by Daniel Altschuler and Chris Salter (PHYSICS TODAY, November 2013, page 43). I'd like to add a historical note.

The first publication to discuss using a spherical reflector set in the ground and steered by a line source, as illustrated in the article's figure 2, was published in May 1951 by engineers at the Air Force Cambridge Research Laboratories (AFCRL).[1] The Department of Defense was interested in using what would become the world's largest antenna to better understand the ionosphere for long-range radar and communications. Thus in 1959 officials from the AFCRL and Cornell University, home to Arecibo designer William Gordon, signed a contract to build the observatory. The project was funded by the Advanced Research Projects Agency, with Philipp Blacksmith of the AFCRL named as the project officer.

Reference

1. R. C. Spencer, C. J. Sletten, J. E. Walsh, *Correction of Spherical Aberration by a Phased Line Source*, Air Force Cambridge Research Laboratories, Cambridge, MA (1951); http://www.dtic.mil/dtic/tr/fulltext/u2/a800275.pdf.

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■ **The article on** the Arecibo Observatory did not properly credit the facility's origins. The authors briefly discuss research concepts by William Gordon, whose brainchild became the Arecibo Ionospheric Observatory (AIO); however, most of the work of its first 10 years under Gordon and his colleague Gordon Pettengill is not mentioned.

Initial sponsorship by the Advanced Research Projects Agency (ARPA) made construction of the AIO—and the ability to aim it—possible. In the early 1960s, the Department of Defense needed a detailed map of the ionosphere throughout a sunspot cycle to understand the background in which space and missile assets operated. The Arecibo Observatory accomplished that and several other unanticipated objectives during the period of its initial operation, from 1964 to 1970.

Under the guidance of a select advisory committee chaired by Ronald Bracewell of Stanford University, ARPA shared the AIO with radio and radar astronomers. After AIO had completed the mapping of the ionosphere through a sunspot cycle, I worked out its transfer to NSF through the advisory committee. That transfer was made after ARPA had finished plans for the first upgrade of the AIO reflector.

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■ **Altschuler and Salter reply:** We thank both correspondents for their interesting comments. To Michael Dowe we note that the directors of the Arecibo Observatory through the 1960s were William E. Gordon (1960–65), John W. Findlay (1965–66), Frank D. Drake (1966–68), and Gordon H. Pettengill (1968–71). We emphasize that our article concentrated on major astronomical contributions from the observatory over its 50 years of operations. For an excellent account of its contributions to atmospheric and ionospheric physics, we recommend John Mathew's article "A short history of geophysical radar at Arecibo Observatory."[1]

Reference

1. J. Mathew, *Hist. Geo. Space Sci.* **4**, 19 (2013).

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Venerable Virginia science academy welcomes new one

This letter is in response to the news of a new Virginia Academy of Science, Engineering, and Medicine (VASEM), which has recently been formed in the Commonwealth of Virginia (see PHYSICS TODAY, January 2014, page 22). That new academy is not affiliated with the Virginia Academy of Science (VAS), an organization that has been in place for the past 92 years. The membership of VAS is open to all scientists and people interested in science in Virginia, from faculty and research scientists to postdocs and graduate and undergraduate students, as well as business professionals and others who support our mission. We also welcome middle school and high school students and their teachers as members of our Virginia Junior Academy of Science.

The mission of VAS is to promote research and education in science, technology, engineering, math, and health (STEMH) in Virginia through grants, publications, and meetings. We welcome VASEM as a new academy in Virginia and look forward to working with them to increase STEMH activities in the state.

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