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GIST College student Hyerin Cho participates in a paper published in *Science*

- GIST (President Kiseon Kim) GIST College student Hyerin Cho (senior physics major: graduation thesis Professor Keun-Young Kim) participates as an author in a paper published in *Science*, a world-renowned scientific journal.

* A study conducted by University of California, Santa Cruz, astronomy and astrophysics Professor Xavier Prochaska and the Commensal Real-time ASKAP Fast Transients (CRAFT) survey team published a paper on September 26, 2019, in *Science* entitled "The low density and magnetization of a massive galaxy halo exposed by a fast radio burst."

- Hyerin Cho was a member of the Australian CRAFT team while studying physics at GIST College and participated in using Fast Radio Burst (FRB) signals * to explore Halo **.

* The Fast Radio Burst (FRB) signal was first discovered in 2007, several billion light years outside our galaxy, and is difficult to observe because it appears and disappears within milliseconds. So far, more than 100 FRB signals have been observed, but because of its unpredictable and non-repeating nature, only three are known to be from an exact galaxy, two of which were identified by the Australian CRAFT team in this study.

** Halo is unknown space composed of dark matter and gas with little light interaction outside the galaxy. Because of minimal radiant radiation, observational studies are limited, but many astrophysicists have predicted that there will be dark matter with a much larger mass than what is observed.

- FRB signals and halo were not easy to observe due to their characteristics, so they were unknown in astronomy. This paper presents the physical image of the FRB signal observed by the Australian CRAFT team's Australian Square

Kilometer Array Pathfinder (ASKAP) radio telescope, and the 4 billion light-year-old galaxy halo that passed through the FRB 181112 from a galaxy 5 billion light-years away. The characteristics were measured and the results were found to be different from those predicted in previous studies. In other words, one astronomical mystery has been explored with another astronomical mystery.

- Hyerin Cho derives Figure 1, which is the starting point of this paper through two programs she made, and analyzed the polarization of the FRB signal to characterize the electromagnetic waves of the FRB and the magnetic field of the halo through which the FRB has passed and predicted the intensity.
 - The first is a program that uses a signal processing technology called Inverse Polyphase Filterbank to convert the recorded data's time resolution from 1 μ s (microseconds) to 3ns (nanoseconds). This is a new method, enabling the highest time resolution that could not be achieved in previous FRB studies, allowing observations for the first time of the fine details of FRB that disappears in a short period of time.
 - The second is a program that increased the faint FRB signal, which was observed by 12 antennas, by 10 times the intensity as if it were received by a very large antenna, taking into account the position of the galaxy.
- Hyerin Cho said, "I was able to develop my research skills through various international exchange programs at GIST College, such as participation in the UC Berkeley Summer Session * , the GIST-Caltech Study Abroad Program ** , and the GIST-Caltech SURF Program *** . I have also been able to connect with the world's leading researchers was able to join the Australian CRAFT team."

* This program provides tuition for students in their second year to attend summer session classes at UC Berkeley, Boston University, Cambridge University, and other prestigious overseas universities.

** This program sends up to 10 students per year to overseas universities that have signed an exchange agreement with GIST College so that they can enroll as a student for a semester (about 4 ~ 5 months).

*** This program allows GIST and Caltech to exchange up to 2 students to carry out research projects each year from mid-June under the guidance of a mentor professor for about 10 weeks, allowing students to gain experiences by working in the laboratory of the world's best researchers.

- Hyerin Cho's thesis advisor Professor Keun-Young Kim (Department of Physics and Photon Science) said, "This is a successful example of achieving world-class achievements by challenging new fields through GIST College's global student

development program. Hopefully, more undergraduates in the future will endeavor to pursue these programs offered by GIST."

- Hyerin Cho is preparing a more detailed analysis and scientific discussion of FRB 181112, which she observed using her own programs, as a follow-up paper, and is expected to submit it a journal later this year.

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