**Introduction:** Hayabusa2 is the second asteroid sample return mission following Hayabusa. Hayabusa2 was launched on December 3, 2014, and just one year later, it came back to the Earth to perform the Earth Swing-by. Now it is on its way to its target asteroid (162173) Ryugu. It will arrive at Ryugu in June-July 2018, and return to the earth at the end of 2020. Related to the mission, we have been doing many educational and outreach activities. In this paper, we report recent two successful events: Earth swing-by-observation campaign and Ryugu observation campaign.

**Swing-by observation campaign:** When Hayabusa2 approached the Earth for the Earth swing-by on December 3, 2015, we carried out "Swing-by-observation campaign", because it might be possible to observe Hayabusa2 by telescopes from Japan in the evening of the day of the Earth swing-by. Hayabusa2 approached the Earth at the distance of 3090 km above the Hawaii Islands at 19:08 JST (10:08 UTC) on December 3, 2015 (Fig. 1). This time corresponds to the time just after the sunset in Japan.

We had similar swing-by-observation campaigns three times before this. The first and second one were for Japanese Mars Explore Nozomi. Nozomi performed Earth swing-bys on December 20, 2002 and on June 19, 2003. The third one was the Earth swing-by of Hayabusa on May 19, 2004. However the successful observation was only once in the second Earth swing-by of Nozomi, because the weather was not good for all of these Earth swing-bys. The weather is key to this campaign.

Another difficult point is the estimation of brightness of Hayabusa2 at the Earth swing-by. In principle, we can calculate the brightness of Hayabusa2 by using the information of its orbit, attitude, shape, characteristics of its surface materials. But this calculation is rather complicated and even the slight change of the attitude of the spacecraft can cause the large difference of its brightness. It can occur that Hayabusa2 does not become bright. For example, in the successful observation of Nozomi Earth swing-by, the brightness of Nozomi was about magnitude of 15 or 16. Therefore, for this Hayabusa2 case, we stressed that Hayabusa2 might not be seen so brightly in order to people would not think it easy to watch Hayabusa2. Moreover, Hayabusa2 would move in the sky in rather high speed, so it is not easy to track Hayabusa2 by telescopes.

There were 82 sites registered to the campaign. We provided the data of positions where Hayabusa2 would be observed from each site. As a result, the observations of Hayabusa2 were successful from 30 sites. We heard that the observations were also successful from nine sites other than the campaign sites. Therefore the observations from 39 sites were successful. This number is really unexpected. One of the observed images of Hayabusa2 is shown in Fig. 2, which was taken in...
Bisei Spaceguard Center. We plotted the positions of Hayabusa2 observed by many people on the star chart. The plotted points line up and we can see the trace of Hayabusa2 in the sky (Fig. 3).

One of the reasons of this great success is the weather. In the morning of the day of the swing-by, the weather was not good in almost all the parts of Japan. However, the weather became good in some parts of Japan in the evening. Another reason was that the brightness of Hayabusa2 became as bright as magnitude 9. Fig. 4 shows the change of the apparent magnitude of Hayabusa2 obtained by four observatories. At first, Hayabusa2 was seen in about magnitude 15 or 16, but finally it became as bright as magnitude 9 or more bright. So it was relatively easy to observe Hayabusa2 by small telescopes.

This outreach was rather high level for public people, but we thought it was very nice that many amateur observers tried to observe Hayabusa2. And many local observatories organized the events to watch Hayabusa2, so many people were able to see Hayabusa2 passing through the night sky. This campaign was broadcasted by several news programs on television.

Ryugu observation campaign: Following the swing-by observation campaign, we carried out much higher level observation campaign, which is Asteroid Ryugu observation campaign. The summer of 2016 is the good period for the observation of Ryugu, because it approached the Earth and it was brighter than usual. However the brightness is about magnitude of 18.5 at the maximum. This is not easy for amateur observers to detect such faint object. So for this case, we carried out the campaign mainly for high-end amateurs or professional observers.

We set the campaign period from July 1 to August 15, 2016, because in this period, the brightness of Ryugu is brighter than magnitude 19.5. As a result, about 14 observatories and amateur observers were able to take the image of Ryugu, although it was very small and faint. Fig. 5 shows one of the images of Ryugu. This campaign was not so widely spread out, but it was nice that Ryugu was observed by some public people. The next time that we see Ryugu is when Hayabusa2 arrives at it in 2018.

Summary: The observation campaigns of Hayabusa2 Earth swing-by and Asteroid Ryugu were not easy for public people. But the number of people who attended to these campaigns was much more than we expected. This means that public people have potential to try to high level things. We think it is important to carry out educational and outreach activities not only in easy level but also in advanced level.