Practical 1

Aurora Borealis

Bastian Hacker & Nikhil Madduri

April 30, 2012

1 Aurora classification

1.1 First observation

Figure 1: Aurora in Kiruna at March 12, 2012

a_2fHB3b

form = B
Qualifying symbol = f
Structure = H
condition = a_2
Brightness index=3
color class=b

The figure (1) is of the classification a_2fHB3b. The form is 'B' because in the lower border, U shapes are observed. The Qualifying symbol doesn't seem to be coronal as there is no rayed form in it. There are no multiple parallel forms either and only one suitable seems to be 'f'. There is no internal structure and the brightness is uniform. The boundaries are diffuse. This leads to a conclusion that the structure is homogeneous, H. As observed on the day of aurora, it was bright and was changing rapidly. This implies it is active. The lower border changed rapidly. This leads to the condition 'a_2'. It was definitely very bright with more visible green color than mere perception which means the brightness index should be greater than '2'. However, it did not cast any discernible shadows which means the brightness index is '3'. Finally, the red lower border indicates a color class of 'b'.

1.2 Second observation

Figure 2: Aurora in Kiruna at the end of March 2012

Our second observation is shown in figure (2) from a long-time exposure image. The aurora was rather active at the time of viewing and is therefore classified as a. The movements were readily discernible and even during the exposure time some parts of the aurora seem to have moved. This corresponds to an a_2 condition. The aurora has very distinct rays that fade away towards the top, which corresponds to an R_1 structure.

The form is clearly a band (B) at the bottom, but some patches (P) appear also on top. The brightness is rather intense, so despite the strong magnification through the camera it could still be taken as brightness 4. This aurora has a beautiful red upper region, which is classified as a.

The total classification is a_2R_1B4a.

2 IRF data and aurora prediction

On our aurora hunting tours in the first two months of Kiruna we extensively relied on IRF data to determine good days to leave the appartments. The aurora prediction from the Geophysical Institute of Alaska turned out to be of little help, since it mostly showed the same intensity on the scale (3) and the aurora activity in Kiruna depends more on local conditions.

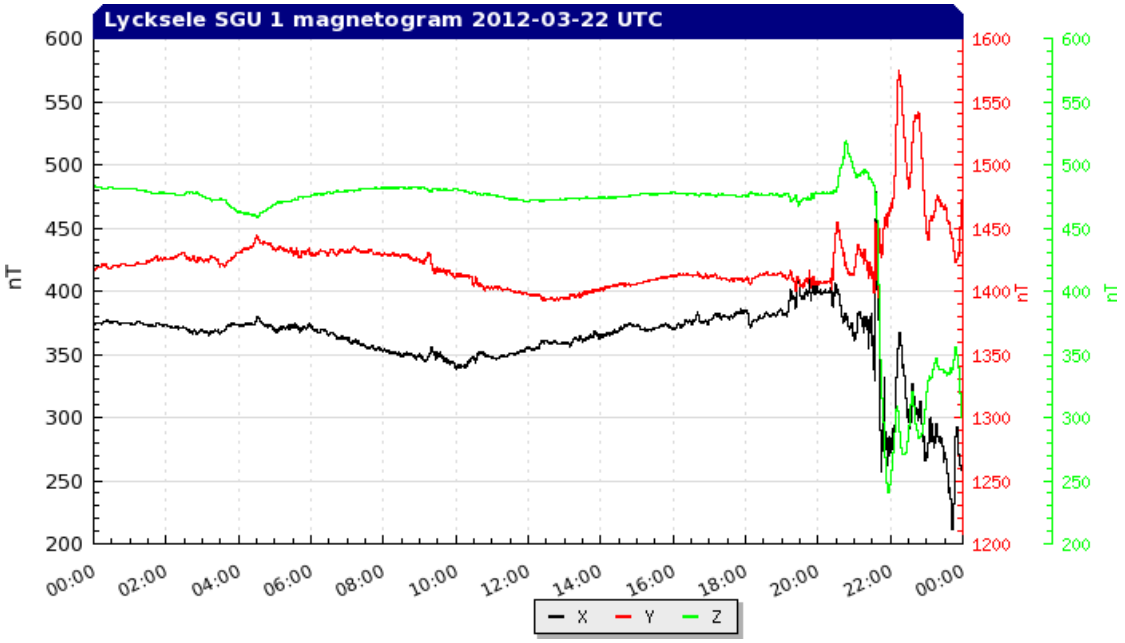

Figure 3: Magnetometer diagram at IRF on March 22 2012.

The most useful tool for finding good auroras was the allsky camera at the IRF (`http://www.irf.se//Observatory/?link=All-sky_sp_camera`). The camera shows the sky a bit brighter than the naked eye would see, so the aurora becomes visible even earlyer and we had time to go out before culmination.

A somewhat even earlier warning system was the magnetometer (`http://www.irf.se//Observatory/?link=Magnetometers`). A calm progression on the order of 50 nT is a clear sign of no significant auroral activity. Shaking values on timescales down to

minutes and magnitudes up to hundrets of nT on the other hand turned out to be a good indication of auroral activity. So if the magnetometer was shaking and the sky was dark and clear we had good reasons to expect to see something. When the progression was calm however there was always still a chance it would begin shaking on short notice. Therefore we never knew what would happen hours ahead, but when something was goint to happen we were warned directly before. It was really helpful for us to have this system available.

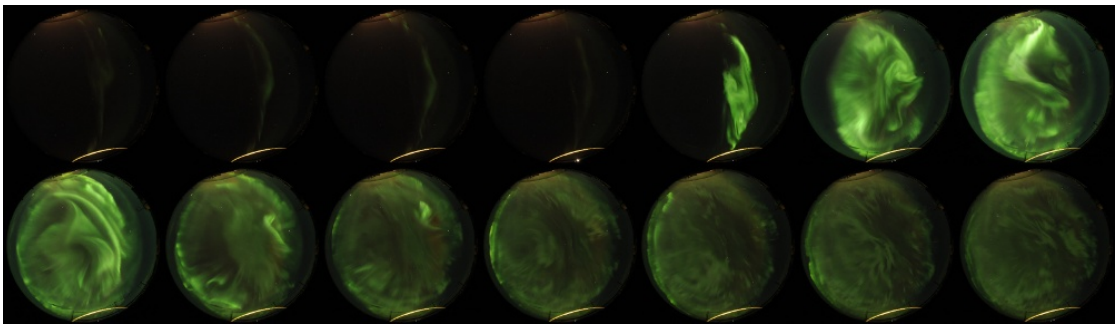

Figure 4: Image sequence of Kiruna Allsky camera pictures taken in timesteps of one minute. The sequence starts at March 22 2012 21:30 UTC.

Figure 3 shows the progression on March 22, which was one of the last big events we were to witness. On this day the magnetometer showed no clear indications for aurora until 19:00 UTC. Then there was one hour of medium activity until strong activity came out of a sudden. When we were in the field, we thought about going back home at that point when the strong activity suddenly showed up. The all-sky camera (figure 4) shows the progression nicely. After some weak aurora the whole sky lit up within minutes. Then the strong glow spread all over the sky and became diluted after some more minutes. This was a really nice demonstration of a solar substorm, where a huge bunch of energetic particles suddenly arrives at earth and then spread out after some minutes.

Unfortunately the aurora period seems to approach its end already now at the end of april. The night only lasts for a few hours now and even at midnight complete darkness is not reached. Therefore we haven't seen auroras for weeks despite watching the monitors regularly. Luckily we used most of our chances when the time was right.