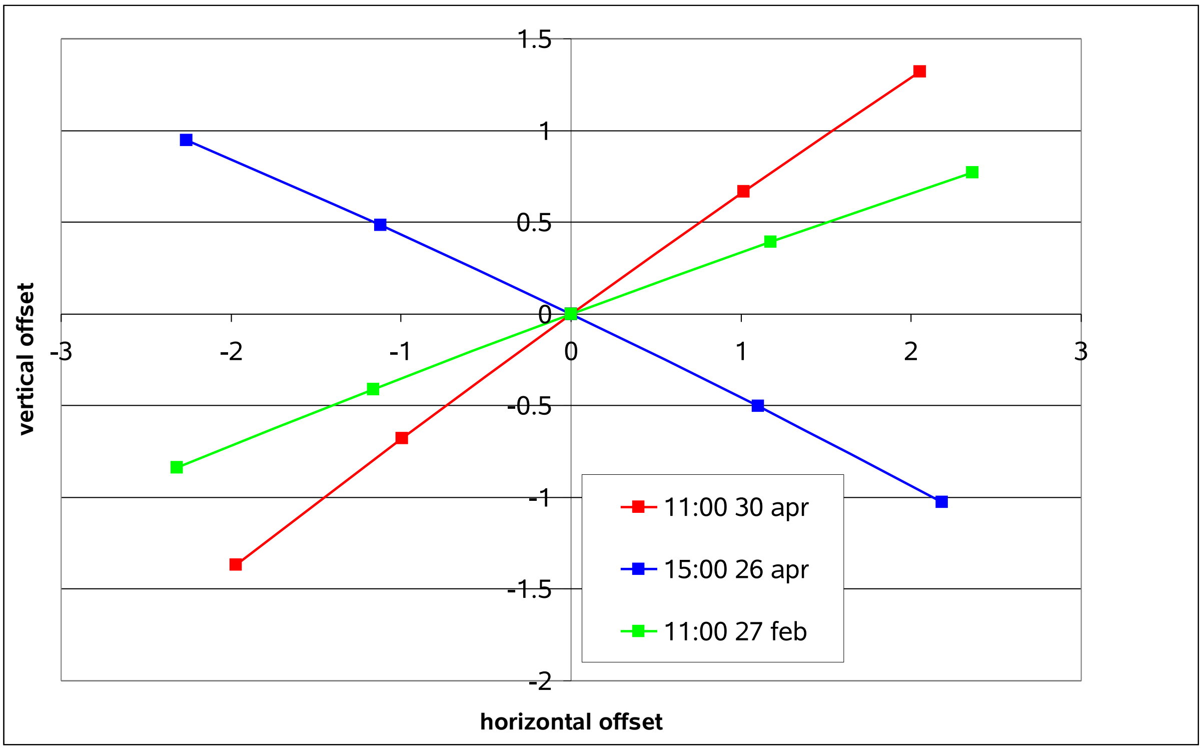
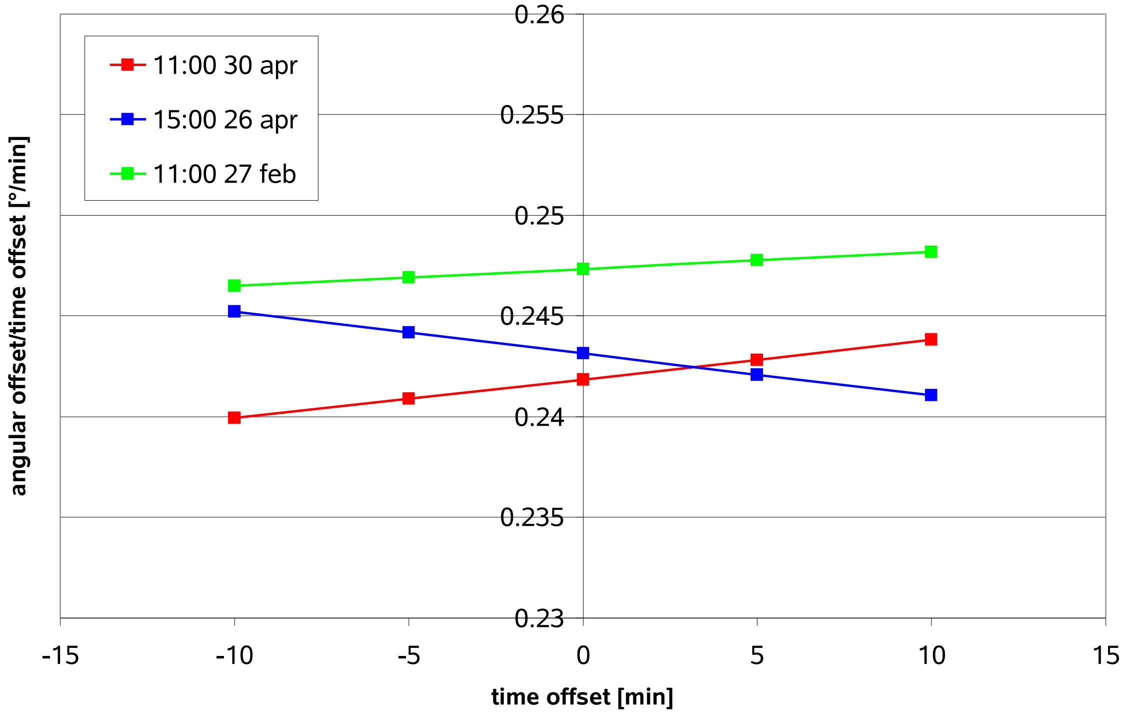
Antenna pattern

The transformation of time into offset angle is not as simple as simply putting 4 time minutes into one degree of angle … depending of the time and season, the sun passes through the antenna beam in different directions. This path can be computed with a program which outputs the azimuth and elevation of the sun. I use the Java applet ORRERY, written by S.Poirier, which has also been checked against GorbTrack and Cartes de Ciel.
The vertical offset is equal to the elevation offset, but the horizontal offset is equal to the azimuth offset multiplied with the cosine of the elevation!

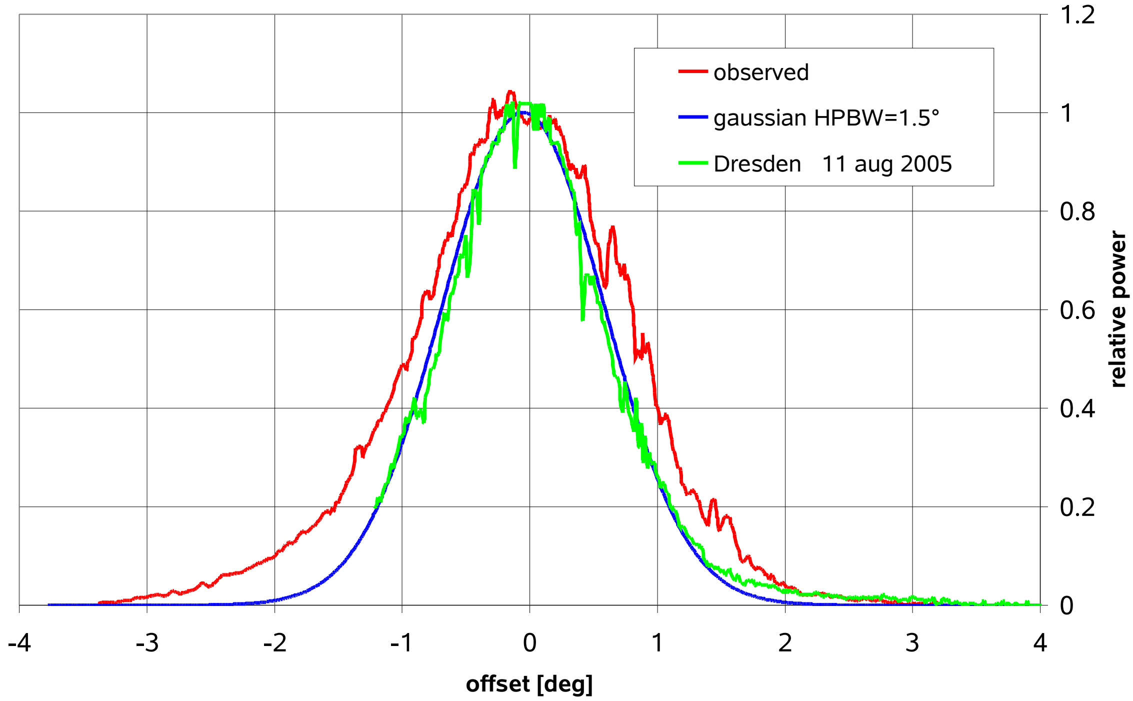
An example of the passages (in 5 min intervals) is show here:



The following figure shows for the three observations the ratio of the total angular offset (quadratic sum of azimuth and elevation offsets) and the time difference w.r.t. the passage through the beam centre. These ratios are only slightly different from the value of 0.25 which neglects all corrections. The ratio is very close to 0.25 * cos(DEC_sun), so it is maximal (0.25) at the equinoxes and smallest at the solistices (0.2295). We note that we assume that the antenna pattern is rotationally symmetric, which one might perhaps expect from the circular dish, even though it is an offset antenna. (this needs to be looked at …)

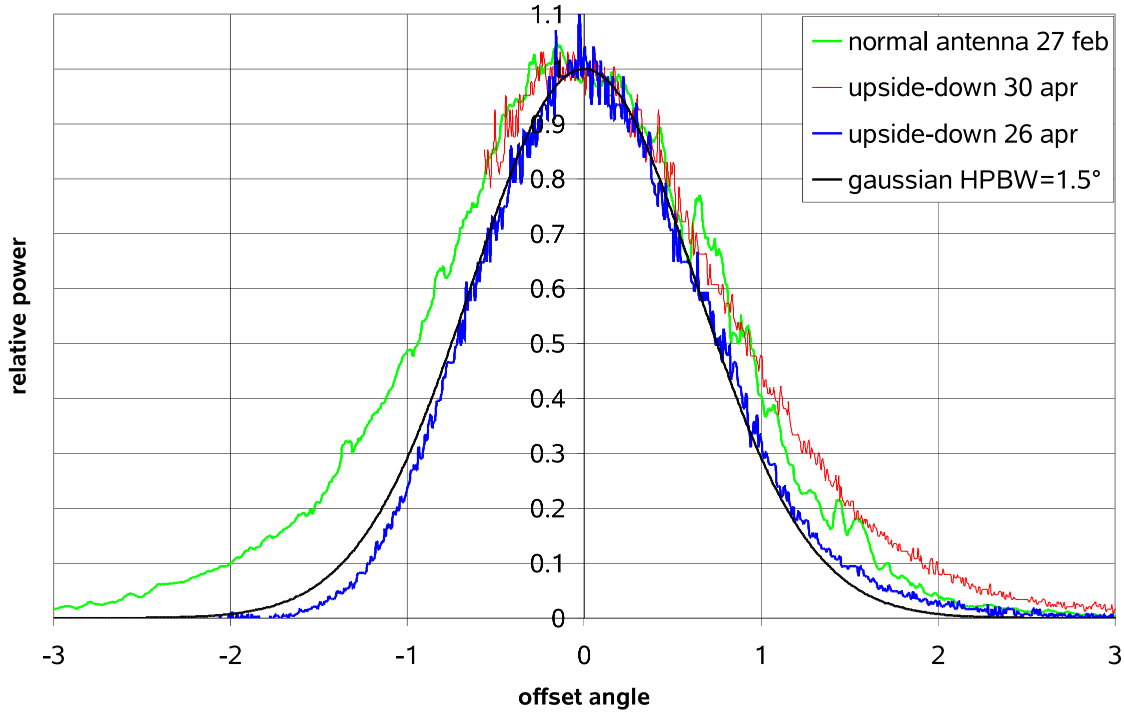


Since these conversion factors are quite constant, we apply the central value to the data of the solar drift scans, in order to get the true HPBW of the antenna. The results from our repaired telescope show that indeed we obtain a slightly larger beam width (HPBW = 1.8°) than the prototype instrument whose HPBW is 1.5°. This is larger than the theoretical value for a 1.2 uniformly illuminated circular dish of 1.2°. Evidently, only some part of the dish is illuminated. Furthermore, one notes that the eastern part (left hand side) of the pattern for angles larger than about 2° is more sensitive than the western part.



In the figure below the same data are shown, but without making this correction for the true angular speed of the Sun; we simply assumed a movement of 4°/min. Apart from giving an erroneous impression of narrower beams, the two instruments appear to have differently wide beams.

In late April 2007 the dish was mounted upside-down, in order to be able to point the antenna below the horizon and hence use the thermal radiation from the ground and the nearby Holiday Inn hotel building as a flux calibration source. A comparison of the antenna patterns before and after the mounting indicates that the antenna pattern is slightly asymmetrical, with the eastern part (in normal orientation) exhibiting a “wing”, i.e. the sensitivity decreases less rapidly with offset angle than the western side does. Since it is the eastern side which received a slight deformation from the antenna’s falls in its provisional installation, we see here another consequence of the wind guts blowing over the antenna last autumn. However, this effect is rather slight and does not influence the performance of the instrument.



One notices that the observations of Apr. 30th do not give the same profile as the data from Apr. 26th, but that the lobe is as wide as of Feb. 27th when the dish was in conventional orientation. Since these data are only a half-scan, due to the limited accuracy and stability of the positioning system, this kind of variation might just be what one has to accept.
But this aspect is under investigation…