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AUTODIF MK II Latest News

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OVERVIEW

After the live demo we ran during the IAGA workshop in Changchun , China (September 2010), the AUTODIF MKII has been fine tuned and finalized for achieving Observatory grade accuracy and reliability.
We give some results in this newsletter in the form of observatory D & I baseline plots. Pictures of the apparatus are given in Figure 1 and Figure 2.

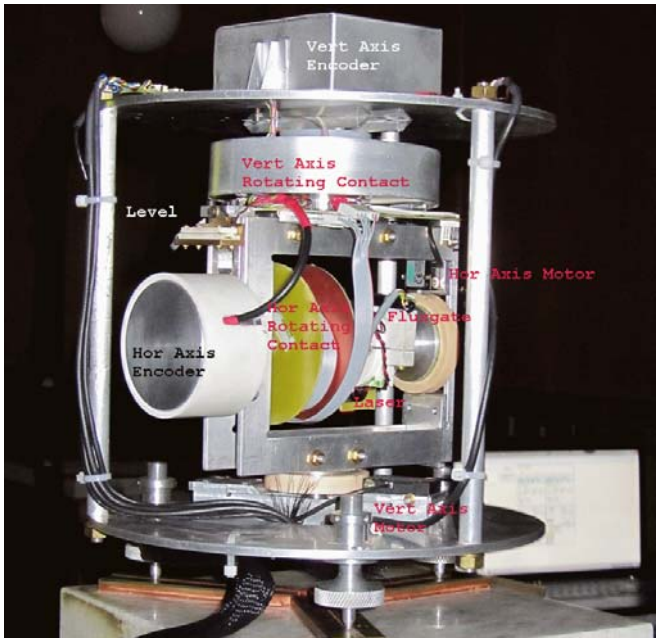

Figure 1 **AUTODIF MKII on the D02 absolute pillar in the Dourbes geomagnetic Observatory. The different elements are indicated**

Fine Tuning for Accuracy

Firstly, the accuracy of a Diflux is originating in the accuracy of its angle reading encoders, the mechanical rigidity, and the ability to orient itself with respect to the Geographic North and the horizontal.
As the angle encoder accuracy has been established previously at the level of 1 " (arc second), the fine tuning involved mainly the laser pointing of the target.

The rigidity of the instrument is excellent as witnessed by the level readings, which are repeatable at 0.3" over full alidade rotations.
In order to fine tune the precise orientation with respect to geographic North, a study was made to estimate the uncertainty caused by the returned laser light from the corner-cube, affected by the spot shape and light interference. Therefore, an improved light receiver using more photocells has been devised as seen on the Figure 2. The effect of this can be seen on the Dourbes variometer declination baseline improvement (Figure 3) as from February 5th 2011 (day 400).

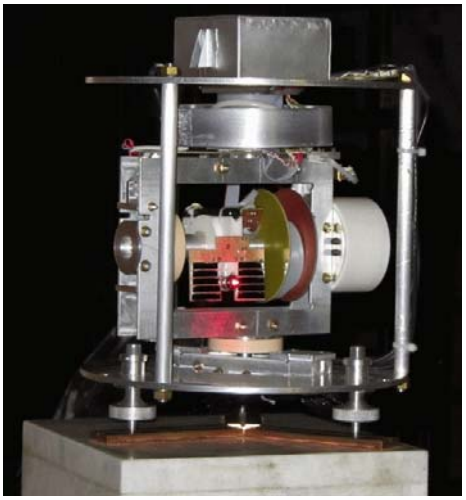

Figure 2

Here the alidade of the MKII is showing its other side with the emitting laser and receiving photocells. The reflected light returning from the corner-cube – situated 50m away – is visible on the cells and frame. Note the increased number of photocells allowing a better analysis of the returned light.

Secondly, the accuracy comes from the absence of any distortion by the instrument itself of the geomagnetic field to be measured. If a distortion is taking place, then a way of taking it into account must be devised.
We try to eliminate or severely reduce the magnetic pollution coming from its constituent mechanical and electronic parts by selecting the materials and minimizing the currents and the coil topology of current carrying wires. Two procedures help us:
1. measuring the magnetic signatures of the elements entering in the manufacturing of the MKII and
2. reference variometer baselines comparisons (mainly inclination where errors from target pointing are absent) with trusted absolute instruments like the Observatory Diflux.
This is a slow and painstaking process. Moreover it is sometimes difficult to find non-magnetic electronic or mechanical elements.
However, as seen on Figure 4, we were successful in eliminating small residual magnetic effects as from April 6th 2011 (day 460) when we started to have excellent agreement with the Observatory Diflux based on manual measurements with a ZEISS010.

" an improved light receiver using more photocells has been devised as seen on the Figure 2 "

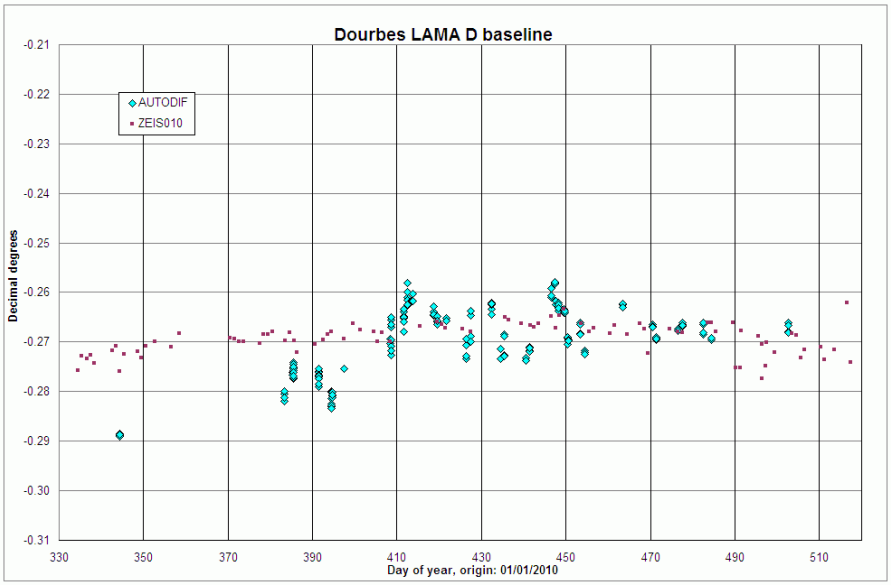

Figure 3

The Dourbes LAMA DFI variometer declination baseline as measured by the AUTODIF MKII and the manual observations using a ZEISS010 Diflux. A satisfactory accuracy finetuning was achieved on April 6th 2011 (day 460).

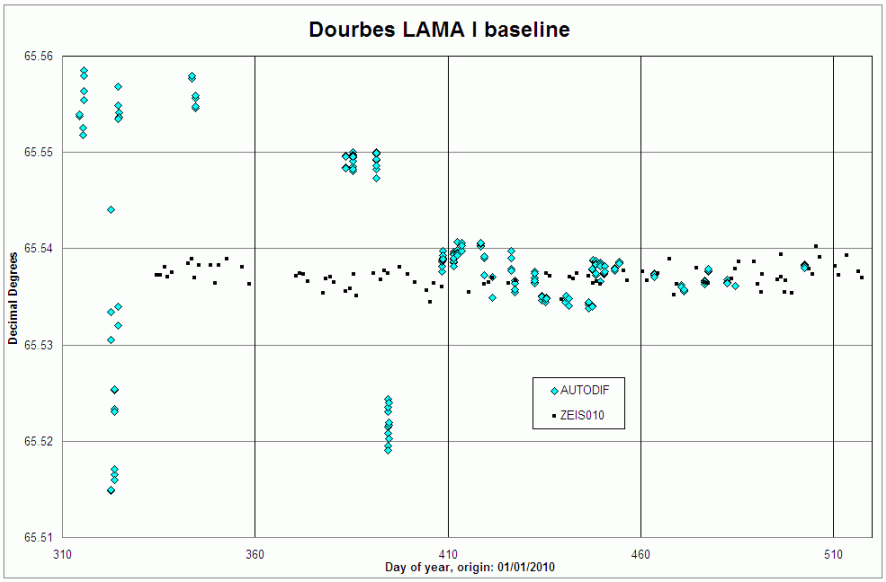

Figure 4

The inclination baseline as measured by the AUTODIF MKII and the manual observation using a ZEISS010 Diflux. This graph shows the improvement over time regarding the agreement with the ZEIS010. A satisfactory accuracy fine tuning was achieved on April 6th 2011 (day 460), after elimination of small magnetic residual currents and elements.

... " we were successful in eliminating small residual magnetic effects as from April 6th 2011 (day 460) "

Reliability

The AUTODIF MKI, discontinued in November 2009, was plagued by an unreliable operation, mainly due to the low lifetime and rapidly evolving characteristics of the used ultrasonic motors. Their lifetime was specified as being not more than 500 hours.

Our new MKII was completely redesigned in order to use another brand and kind of ultrasonic motor, manufactured by the NANOMOTION company. This motor has a MTBF specification of more than 20000 hours, even in its nonmagnetic version.

Our experience with the new motor shows that it is indeed very reliable. After one year of the intense motor activity encountered in our test runs, the device shows no sign of wear and performs perfectly. Consequently, we do not expect that the motor reliability will be a problem anymore. As there are no other short term wear parts in the MKII, reliability will depend on good workmanship in the construction of the device.

Therefore, while we continue testing activities on the AUTODIF MK II, we currently develop our production (CNC tools) & control facilities.

... " we do not expect that the motor reliability will be a problem anymore "

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