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The Locarno Gregory Coudé Telescope after 1984 A short history and a summary of the most important results

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Abstract. Since 1988 the Locarno solar observatory is operated by a private Foundation (FIRSOL) which took it over after the dismantling of the institute by the Deutsche Forschungsgemeischaft (DFG) and the Universitäts Sternwarte Göttingen (USG). The instrument has been rebuilt, equipped with new electronics and already several scientific projects were successfully carried out.

Key words: telescopes

1. Introduction

The Gregory-Coudé Telescope GCT installed in Locarno was inaugurated in 1960 and operated by the Universitäts Sternwarte Göttingen until 1984 (Brückner et al. 1967; Schröter 1975; Wiehr et al. 1980; Wiehr 2003). To optimise the development of the new observatories in Tenerife, the Locarno station was closed and the optics and electronics of the old instrument were used for the new GCT.

The private association AIRSOL (Associazione Istituto Ricerche Solari Locarno) was convinced that the work performed in Locarno by Göttingen needed to be pursued for scientific as well as for cultural motivations. Representatives of the Deutsche Forschungsgemeinschaft and H.H. Voigt, director of the Göttingen observatory at that time, decided during a discussion with the association council in 1984 to sell the observatory to AIRSOL. The FIRSOL was then constituted in 1987 with the following members: the Canton Ticino, the city of Locarno and the AIRSOL. The goals were: the reconstruction of the instrument and the continuation of the scientific work. The first step was to recover the instrument and the collaboration with the Universitäts Sternwarte Göttingen allowed to perform this in an ideal way. We are thankful to K.H. Duensing, head of the mechanical workshop at that time, for the design and the construction of the most critical mechanical parts, to E. Wiehr for giving us the know-how and for the adjustment of the optics, to A. Wittmann for the know-how and his help for the computer system. We are grateful to H.H. Voigt and to his successor F. Kneer, who supported this collaboration. In 1990 the Locarno Telescope saw its second first light. The optics of the instrument is basically the same as that of the now dismantled one at Tenerife.

The collaboration with G. Küveler (Fachhochschule FHS Wiesbaden) permitted to develop most of the electronics needed, e.g. the control of the spectrograph and the automatic guiding system (Küveler et al. 1998, 2003).

Besides the reconstruction of the instrument we had to carry out negotiations with the federal and cantonal political institutions to be recognised and financed, lastly successful thanks also to the interventions of J. Stenflo (ETH Zurich) in critical moments.

2. Scientific works

Once the instrument was almost reconstructed, the engagement for the development of the institute shifted more and more to the scientific work. We analysed the advantages and disadvantages of the instrument. The Locarno sky is in average less good than that at optimal places like the Canary Islands, thus it is not ideal for observations requiring high spatial resolution. Nevertheless, the first scientific works were related to solar semi-diameter measurements (Wittmann et al.1991, 2000), to the observation of oscillations in prominences (Sütterlin et al. 1996) and to the detection of shock-waves in the granules (Solanki et al.1996).

The IRSOL advantages are: the telescope's low and constant over the day instrumental polarization, the quality of the

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spectrograph and the possibility to perform projects requiring long observing time. The collaboration with the Institute of Astronomy in Zurich permitted to profit from these positive premises. The project to measure the second solar spectrum, i.e. the scattering polarization close to the limb, started by using a Semel type polarimeter. This beam exchange device, developed in collaboration with J. Stenflo and S. Solanki, was first used to study the SrI 4607 Å line (Stenflo et al. 1997). We found a good agreement comparing IRSOL with ZIMPOL data registered in Kitt Peak. This confirmed the reliability of the IRSOL instrument. Already in former times scattering polarization was successfully measured in Locarno (Brückner 1963; Stenflo 1974; Wiehr 1977).

As the ZIMPOL version at that time was not yet sensitive to the blue and the violet part of the spectrum, it was decided to use an improved version of the two-beam polarimeter to study the scattering polarization in short wavelengths like the CaI 4227 Å line. This topic was not a new subject for the Locarno telescope. The scattering polarization of this line was discovered here (Brückner 1963), see also Stenflo (1974).

The new CaI 4227 Å observations permitted for the first time to detect the Hanle effect in the quiet chromosphere in terms of depolarization of the scattered light in the line core. This effect is a new tool to detect and study turbulent magnetic fields (Bianda, Solanki & Stenflo 1998). Further observations in the SrII 4078 Å line allowed to detect, besides the line core depolarization, the rotation of the polarization plane too, which is another aspect of the Hanle effect (Bianda Stenflo & Solanki1998). The same behaviour was detected in the CaI 4227 Å line. This allows to compare data with Hanle histograms (Bianda Stenflo & Solanki 1999).

A significant work was performed in Locarno by A. Gandorfer (2000, 2002). He registered here the ZIMPOL data for two volumes of his "Atlas of the second solar spectrum". The time required to adjust the instrument and to record the data, the need of a low instrumental polarization, the spectral resolution of the instrument were arguments in favour to choose the IRSOL for this work.

Recent observations in the CaI 4227 Å line with the new ZIMPOL2-UV, which is sensitive to the blue and the ultraviolet, showed an unexpected behaviour: the Hanle effect is not confined to the line core as predicted by the theory, but extends in the line wings too (Bianda et al., 2002).

Observations (Stenflo work in progress) in the same CaI line with ZIMPOL in Locarno confirmed the theory and the HeI 10830 observations of the forward Hanle effect at the disk center (Trujillo Bueno 2001, 2002) .

Impact polarization in flares was investigated with ZIMPOL2 and with the Hα registration system developed at the FHS Wiesbaden (Küveler et al 2002), which allows high time resolution. This collaboration involves the ETH, the FHS Wiesbaden and the University of Bern. The first results are quite surprising: all observed events showed no sign of the expected impact polarization (Bianda et al. work in progress).

Other collaborations involve A. Cacciani (University of Rome), A. Magun (University of Berne), M. Semel (Meudon Observatory), E. Wiehr and A. Wittmann (USG). In 2000 G. Sonnabend and D. Wirtz (University of Köln) tested the heterodyne spectrometer THIS in Locarno.

3. Scheduled works

Further projects are planned in close collaboration with the Institute of Astronomy in Zurich. The second solar spectrum promises to be a rich field of investigation, even for molecular lines. An important project is related with the development of a filter based on lithium niobate Fabry Perot etalons in Zurich. It should work together with ZIMPOL to get 2D polarization images in narrow spectral windows.

It should be pointed out that the IRSOL is open to new collaborations, moreover instruments developed to work with first class solar telescopes can be tested at Locarno.

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