Project Targetscanner – A Status Report

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Introduction: With the Fragment Separator (FRS) at GSI radioactive-heavy-ion beams can be prepared to study properties of and reactions with relativistic exotic nuclei. The quality of this beam depends crucially on the perfection of the energy degraders which are necessary for slowing down the heavy ions according to their mass and charge, and therefore, act as variable ion-optical devices. The accuracy of the energy adjustment and the perfection of isotope separation depends on the thickness of the degrader parts as a lateral function.

The actual cause for the project Target Scanner was the plan to replace the degrader units of the FRS. In a first step S1 will be replaced, the other units will follow little by little. Among others the degraders at S1 consists in the moment of two aluminium wedges with ~230mmx500mm in dimension. Several years ago the thickness distribution of these parts was measured fully manual with about one measuring point every 5 mm. That meant positioning, measuring, reading and writing down the values for about 4000 times per wedge. Since the new degraders have to be made a lot more precisely also the thickness measurement has to be more precise. We have to measure at least once every mm that means at least a 100.000 data points per part.

That is the reason for setting up the Target Scanner, a device for measuring and evaluating the thickness of parts variable in geometry and size as a lateral function fully automatically via a PC. The target scanner works purely mechanically, which means that there are no special requirements concerning the properties of the surfaces to be measured. The only restrictions are for very ductile materials and extremely sensitive surfaces.

Set-up: The mechanical components of the Target Scanner are shown in Figure 1. The whole set-up is mounted on a vibration-

Figure 1: Set-up of the Target-Scanner

damped table from NEWPORT that guaranties a stable horizontal positioning of the table top. The positioning unit consists of two linear positioning stages from Schneeberger with a maximum travel of 300mm and 600mm respectively that are mounted perpendicular to each other and are driven by a 2-axes servo motor controller. At the front end of the upper stage the samples can be mounted with different self-constructed sample holders and can be moved relatively to the fixed thickness measuring unit. This thickness measuring unit consists of two digital length gauges from Heidenhain mounted in vertical position in such a way that the difference of the two length signals gives the thickness of the sample at the respective point, as one can see in Figure 1. Each length gauge has a travel of 60mm in maximum and an accuracy of ± 0.1µm.

Software: LabVIEW was a good candidate for GSI to support developments of small and medium sized control systems and test stands. This project seemed to be a good choice to evaluate LabVIEW. We could make use of the Graphical user interface, the 3D graphics, the advanced analysis, the SQL-Toolkit, the Internet-Toolkit, the VISA interface, the NI hardware, and guidelines of instrument driver developments.

Because no LabVIEW instrument drivers were available for ND231 and SM300 they were developed at GSI. Both instrument driver libraries were developed with respect to the NI recommendations. High level VI's are provided to access all parameters described in the manuals. The details of the communication protocol are not seen by the user.

All data, configuration, measurement and analysis data are stored in a relational database (Oracle). The database design is shown in figure 2. The data is required for experiment analysis. Oracle security is used to control access by the LabVIEW application before any movable devices are initialized.

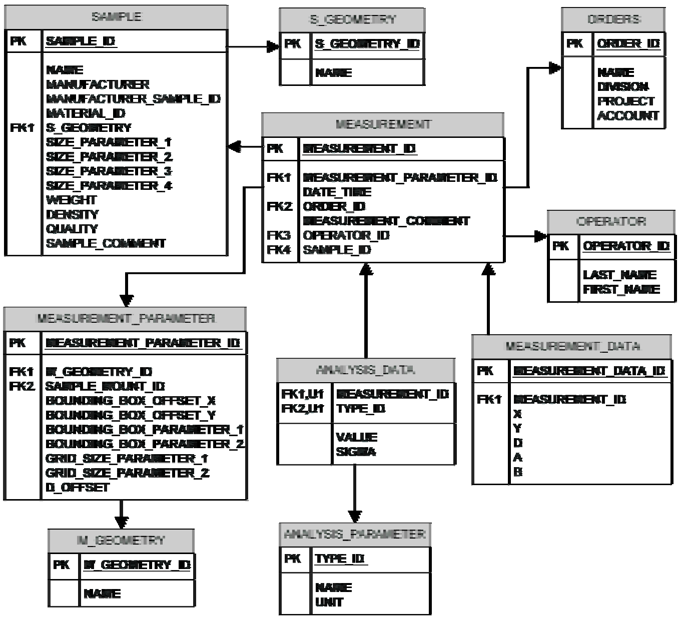

Figure 2: Oracle Database Design

Status: The mechanical components as well as the controlling components and software are ready and tested. The resolution of the thickness measurement is better than half a micrometer and the accuracy of the positioning is ± 2 µm, as expected. During the first measurements we found some critical points that could influence the results considerably, for instance, the exact mounting of the sample, the time-dependent deformation of the soft measuring tips and films or dirt on the surfaces of the sample or tips. These errors have to be eliminated or, at least, have to be taken in account. After the last debugging run in the next step the comfort in software handling will be proved and an automatic report and data evaluation will be implemented.