Warsaw ELHEP Group

Research Visit Summary

at DESY, TESLA

02 - 30 June 2003

Electronics for High Energy Physics Experiments; tel. 8998-1955;
http://nms.ise.pw.edu.pl/elhep; email: rrom@ise.pw.edu.pl

CONTENTS

ELHEP Warsaw Group for TESLA, 1-30, June 2003

DESY, Hamburg, 26.06.2003

Warsaw ELHEP Group for TESLA Test Facility

Institute of Electronic Systems (ISE), Warsaw University of Technology
Institute of Experimental Physics (IFD), Warsaw University

VISIT SUMMARY in DESY/TESLA on 1 - 30 June 2003

I Persons:

Ryszard Romaniuk (30 May-29 June), Krzysztof Pozniak (07 - 22 June), Wojciech Zabolotny (15 - 22 June), Tomasz Czarski (26 May – 05 July), Piotr Rutkowski (26 May -14 June, 22 June – 27 July), Tomasz Jezynski (permanent stay - paid by - half Tesla – half BAC/ZEUS), Zbigniew Luszczak (permanent stay – paid by Zeus/BAC till end of May), Krzysztof Kierzkowski (09 – 14 June), Dominik Rybka (ELHEP student, 14-29 June and 07 July – 31 August) and Piotr Pucyk (ELHEP student, 14-29 June and 07 July – 31 August).

II Purpose and Tasks

1. General purposes of visit:

1. TESLA Cavity LLRF Controller and Simulator
2. TESLA RF Gun Controller
3. DOOCS interface
4. Radiation hardness of electronics in TESLA Linac

2. General Tasks:

Tesla Cavity Simulator and Controller modeling by modern tools (MatLab, Simulink, etc.)

Tesla Cavity Simulator and Controller Description in VHDL

TESLA RF Gun controller – preliminary considerations
Hardware and software development program
Prepare equipment to be ready for TESLA Linac operation (all persons involved)
Preparations of hardware for first trial to mount equipment at the liniac (all)
Prepare background set-up for radiation investigations of electronics at Linac II
Preparations for hardware implementation in VME crates
Initial tests of radiation hardness of electronics for TTF
Tests of cavity simulator
Integration with cavity controller
Preparing Xilinx development boards for tunnell installations
Set-up of all necessary auxiliary equipment
Further Xilinx development boards and software tests
Start design of VME development board

III Particular Projects

1. Tesla Cavity Controller and Simulator

Hardware and software development program. The tasks which are under realization now:

1.1. Tests of FPGA cavity controller

Task definition:
Preparing of laboratory set-up for tests of cavity controller and cavity simulator,
set up enables control,
setting parameters of cavity controller
testing of cavity controller with analog cavity simulator
integration of Mat-Lab with hardware cavity controller at step-like work mode;

Results and deliverables:
Two Tesla Notes published 2003-20 and 2003-21 concerning development in cavity ontroller modeling and FPGA model implementation
FPGA based cavity controller was excited with Chechia input signal and gave output comparable to that from MatLab model.
MatLab model was excited with real cavity signal too.
Preparations go for on-line work of the FPGA controller and short term reliability tests.

Near term plans:
Implementing of the Xilinx Development Boards in the live LLRFC

1.2. Design and testing of FPGA cavity simulator

Task definition:
Design of digital model under Xilinx core generator was performed.: main parameters - 64bits of accuracy at 40MHz clock
New version of cavity simulator is under development.
The model bases more on VHDL.

Model design is shifted from Xilinx core generator to own VHDL solutions.
The aim is to minimize the size of the design.

Results and deliverables:
One Tesla Note was published 2003-23 concerning DSP realization within FPGA for Cavity simulator.
Parameters of the simulator were calculated.
Simulator was tested with cavity controller in a control loop.

Near term plans :
Apply the simulator in the whole model of the working factory

2. RF Gun Controller

Task definition:

Tasks for FPGA based RF gun controller were defined preliminarily.

The experiences with LLRF control system for Tesla cavity will be adapted and reworked for Gun purposes.

Results and deliverables:
Preliminary control algorithm was suggested.
Works started on gun modeling in MatLab

Near term plans :
Repeat and adapt efficiently the design pathway of cavity controller for the RF gun

3. Development test board design

Task definition:
Xilinx development board would be used for the next couple months.
There is a need to consider dedicated test board containing FPGA chip and PC chip.
The requirements for this board just started to be discussed.
ELHEP strongly advices to do this board.
This board will be a precursor of the first generation of experimental development board with embedded PC, DSP and FPGA.

Results and deliverables:
Design of a simple PC-VME board was performed with description.
The board is an interface between XC2V3000, PC and VME crate.
It may be ready in September and will essentially facilitate usage of Xilinx Development PCB.

Near term plans:
Making a simple board being a precursor for advanced development boards

4. Radiation hardness investigations of LLRF electronics for TTF II

Task definition:

Subject of the effort is using Liniac II as a test bed for gamma radiation (and perhaps neutron) influence on LLRF electronics for TTF II

Additional person from ELHEP to be involved in the program;
Needed hardware, software and experimental set-up to be assessed;
Experimental program details to be established.
Participation in preparation of experiments on radiation hardness of electronics in LINIAC II
Assembling of parts of experimental set-up.
Experiment operators defined.

Results and deliverables:
Video server initially established.
Started gatheruing images from the camera on the first vehicle
The need for second vehicle and its armament defined
Signal connected Xilinx board inserted in the tunnel of Linac II
First measurements just started

Near term plans:
Second vehicle with blind camera
Possibly third vehicle with FPGA board
Systematic data acquisition system has to be implemented

5. TESLA DOOCS and LLRFC system database

Task definition:
The Distributed Object Oriented Control System http://tesla.desy.de/doocs/
Participation of ELHEP in DOOCS System, Considerations to prepare Doocs server-client for Cavity Controller
Work just started by P.Rutkowski, P.Pucyk, D.Rybka
Meeting with dr Kay Rehlich and dr S.Simrock , R.Romaniuk and Zbigniew Luszczak. Dr S.Simrock prepared LLRF database concept document. Z.Luszczak of ELHEP is considered as a person participating in database preparations and development.

Results and deliverables:
Defined work force for the task.
Participation in DOOCS course
Starting of writing of own DOOCS server – client network for the FPGA electronics designed by Elhep.

Near term plans:
Participation in DOOCS development.
Building own DOOCS resources.

6. ELHEP Publications

Three new papers and technical notes are under preparation concerning cavity simulator and controller in MatLab and FPGA/VHDL. 1- DSP procesor; 2-Test set up; 3-Modelling and step connection model in MatLab/FPGA
Three Tesla Reports are considered for publications, being extended versions of prepared papers; http://tesla.desy.de/new_pages/Reports/2003

7. Meetings and tutorials participation in DESY of ELHEP members

7.1. General meetings

1. DESY meeting on future linear collider in the USA, 5-6 June, R.Romaniuk participated
2. Tutorial on DOOCS; ELHEP participants: P.Rutkowski, T.Jezynski, D.Rybka, P.Pucyk, R.Romaniuk, T.Czarski;

7.2. Internal meetings

The following meetings were held by the group (TTF Controlroom, bldg. 28, Hall 3):
1. Radiation tests at Liniac II, program document preparation,
2. Preparation of requirements for third generation of LLRF cavity control system using FPGA,
3 Cavity simulator and controller, development stages of FPGA/VHDL Implementation

8. Other activities:

1. ESGARD Joint Research Program
CARE financed by UE within FP6 (JRP - SRFCAV and SRFTECH); Participation of ISE in ESGARD within DESY group; Waiting for reviewers decisions

2. DESY TESLA contributions to the Proceedings of SPIE, WILGA Symposium 2003

3. IEEE-SPIE WILGA Symposium on Electronics for High Energy Physics Experiments, 21-25 May 2004

4. Dr S.Simrock Visit to IEEE-SPIE ELHEP conference in WILGA on 21-25 May 2003

Invited Paper at IEEE-SPIE sponsored WILGA Symposium on Electronics for High Energy Physics.

5. Video Conference facilities for ELHEP Warsaw Laboratory
Facilitate cooperation between Warsaw Tesla Laboratory and DESY/TESLA
Enable participation of Warsaw ELHEP Laboratory in VC on LLRF&C Systems
The VC was tested between DESY and ELHEP Warsaw and next multiconference additionally with Jefferson Lab, Los Alamos and DESY using ISDN connection.
The problem was Not yet resolved

9. Contributions of individual members of ELHEP Group (summary)

Tomasz Czarski: cavity controller modeling, trials to combine MatLab model with hardware, cavity simulator, step model integration with hardware

Krzysztof Pozniak: VHDL internal interface, hardware set-up and internal interface advancements

Dominik Rybka: radiation tests program for FPGA control boards; preparations for a seminar on radiation tests of Tesla electronics at LINIAC II

Piotr Pucyk: DOOCS study and cooperation with Dominik Rybka
Krzysztof Kierzkowski: hardware set-up, design of prototype test board

Wojciech Zabolotny: MatLab/FPGA model of cavity simulator, cavity controller checks and tests with simulator

Piotr Rutkowski: C++, software for TTF electronics

Tomasz Jezynski: laboratory set-up, hardware tests; diagnostic system for Bac detector – the system may be adapted in case of need for TTF purposes. The system features channel calibrations, efficiency mapping, configuration, graphical visualization.
Zbigniew Luszczak: LLRF database, GUI interface, Database software BacNavigator+BacViewer, now available on zwalab5.desy.de may be adapted in the future for TTF purposes. This software is modular and reconfigurable and allows to view all detector resources

Ryszard Romaniuk: Electronics radiation in Linac II, Cavity controller modeling, hardware set-up, own test board design, team effort coordination, publications preparation, team report coordination and edition, M.Sc. and Ph.D. students supervision, ELHEP TESLA Reports edition;

IV. ELHEP PLANS

1. Short and intermediate term plans

1.1. Immediate tasks

No change yet with respect to the purposes and tasks defined in chapters I-III.

1.2. Suggested Plans of ELHEP Group for the nearest future

Pre-next-visit activities (in Warsaw):
Cavity controller and simulator
Further design of simulator
Compillable and synthesizable model of cavity simulator
Hardware for Warsaw ELHEP laboratory needed
New cavity simulator is under consideration, done under pure VHDL. Comparison with MatLab model would then be possible.
Decision on own test board design
The board should consist of:
mother control board – control small Xilinx or Altera chip (Spartan, Acex, Cyclon, etc.)
two daughters boards per one control board - possessing fast Xilinx Virtex or Altera Stratix with DSP modules, and additional components like - SRAM memory, multichannel DAC, ADC, fiber optic Gbit data links, etc, and ETRAX PC.
Full development costs of two test boards at ITR/Warsaw are approx. 5kEuro.
VME crate is needed to test the own development boards

1.3. Next planned visit of ELHEP to TESLA

Suggested visit of a few Elhep members to TTF in September 2003

Tests of cavity simulator
Integration with cavity controller
Preparing Xilinx development boards for tunnel installations, auxiliary equipment, fitting of voltages, supplies, packages, VME crate
Xilinx developments board and software tests
Hardware tests on liniac (XDB).
Option: Laboratory (and on site) tests of own development board

1.4. Following ELHEP visit is planned in November 2003

Predicted tasks:
Tests of PC-VME board.

2. Long term tasks and plans

2.1. Personal development of ELHEP at DESY
New students and senior experts: Maciej Radtke, Michal Zaczek, Michal Husejko,

2.2. Laboratory resources: laboratory space; More permanent laboratory space has to be predicted for ELHEP. Some considerations are necessary how to use this space efficiently, because ELHEP Group members are not always present in DESY.

2.3. Laboratory resources: equipment. The Group needs more permanent laboratory hardware set-up. The hardware should include – oscilloscopes, signal generators, a few PCs,

2.4. Major directions of electronics development: FPGA, fiber optics, new analog (mixdes) solutions. Consequent shift to own FPGA/VHDL development environment

2.5. General directions (and evolution of these) of ELHEP involvement in TESLA and DESY**; Especially in view of Tesla Liniac postponing. How does DESY management see the future long term involvement of such a Group like ELHEP?**

/compiled by dr hab. R.S.Romaniuk/
ELHEP, ISE, Warsaw University of Technology