ARDESIA

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1 Summary

The ARDESIA (ARray of DEtectors for Synchrotron radIation Applications) project, for the development of a new detection system for synchrotron radiation XAFS measurements in fluorescence mode, based on arrays of SDD (Silicon Drift Detector) with high energy resolution and able to handle high count rates was approved in 2014 by the INFN National Scientic Committee V and started the 1^{st} of January 2015. The responsible of the project is Prof. Carlo Fiorini from the Politecnico di Milano and INFN. ARDESIA is effectively a collaboration between the Politecnico di Milano, INFN-LNF and TIPFA-FBK at Trento. The LNF DAΦNE-Light laboratory is clearly involved in the project because the final goal will be the realization of a detector to be installed at the DXR1 soft x-ray beamline to perform absorption measurements using synchrotron radiation. Also the realization of some important parts of the detector directly involves technicians of the LNF Synchrotron Radiation Service.

2 Activity

The first part of 2016 has been spent to define the mechanical design of the first ARDESIA detection module, as well as its cooling system and in vacuum insertion in the experimental chambers of synchrotron beamlines. Once the designs were ready the INFN mechanical workshop (Sezione di Milano) started the realization of the main components. The LNF contribution was concentrated on the definition of the mechanical designs, in collaboration with the group at the Politecnico di Milano, and on the realization of the masks needed to separate the signals of different SDDs and windows needed to work in vacuum conditions. At the beginning of 2016 the first tests on different monolithic detector chips composed by 4 SDD channels started. The detectors were produced by Fondazione Bruno Kessler (FBK, Trento, Italy) with low-leakage process (a resolution of 135.5eV at 21°C for a 10 mm^2 SDD) which allows to achieve good energy resolution even at relatively high temperatures. The monolithic arrays composed by 2x2 SDDs were produced with two options: squared with SDDs having a 5x5 mm^2 area or circular with SDDs having 19.6 mm^2 areas (Fig. 1). The area of the detectors was chosen after ballistic deficit simulations in order to achieve low dead areas and high count rates with still good resolution at short processing times.
Signals coming from the detectors are read out by CUBE charge preamplifiers. In order to keep the module as compact as possible, reducing the number of required bonding wires a 4-channel monolithic CUBE preamplifier has been realized for the ARDESIA detection module at the Politecnico di Milano. Tests on some ARDESIA chips have been performed at LNF, using the high brightness x-ray conventional source, to check the energy resolution as a function peaking time and also the signals of the different SDD detectors. On the other hand, in order to avoid charge sharing between SDDs channels and also improve energy resolution at short processing times, a collimator mask to be placed placed in front of the detector, thus slightly reducing active area as been designed at LNF and realized using electrical discharge machining. In 2017, tests of the ARDESIA detector using synchrotron radiation and the possibility to develop thicker SDD chips are foreseen.
The ARDESIA detection module has been presented by G. Bellotti (Politecnico di Milano), at the IEEE-NSS conference (Strasbourg, 29 October 6 November 2016) invited to give an oral

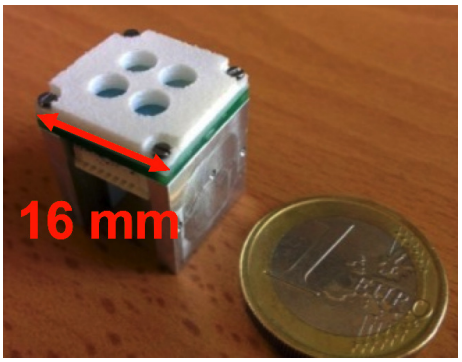

Figure 1: ARDESIA detector module here represented with 4 circular SDD detectors and circular low energy collimators.

presentation on: *The detection module of ARDESIA: a new versatile array of SDDs for X-ray spectroscopy synchrotron applications*; Prof. C. Fiorini (Politecnico di Milano) at the ATTRACT Symposium (31 June 2016), dedicated to the development of new detectors, gave a talk on: *A new High-Rate and High-Resolution X-ray Spectroscopy Detector for Synchrotron XRF and XAFS Applications.*

In 2016, LNF part of the ARDESIA project has contributed in the following activities:

1. *Detector mechanics design, including cooling and vacuum parts (Fig. 2).*
2. *Digital DAQ tests with first ARDESIA chips using the DAFNE-L conventional x-ray source.*
3. *High energies shielding realization.*
4. *MOXTEK Be and AP5 vacuum windows support design and realization.*

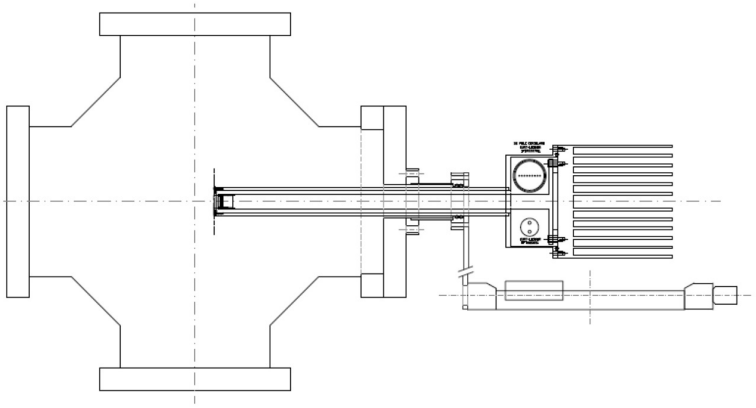

Figure 2: ARDESIA detector module and the experimental chamber.

At the beginning of 2015, a logo and a website (http://ardesia.lnf.infn.it/index.php/en/) for the experiment have been created and in 2016 the website has been constantly updated.