DAFNE-BTF

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During year 2012 a number of improvements of the BTF facility have been implemented:

BTF electron beam: a full beam transport study was performed. A new setup for the LINAC pulse was prepared, triggered by the requirement of the AMY experiment of a very short beam: 1.5 and 10 ns are now selectable as BTF electron beam pulse durations. 3 ns pulses will also be possible with a small modification of the Linac gun driving signal. The shape of the "long" pulse is approximately flat, while the shorter pulses have a distribution rather triangular in shape, i.e. with a peak of particles followed by a falling edge with lower intensity.

BTF facililty improvements and upgrades

A number of improvements and modifications were performed in order to have better services and easier user experience with the BTF beam(s):

- **Gas system**: the gas lines in the BTF area have been upgraded and fully tested. Now four different gas lines are fully operational: low pressure hydrocarbons, high pressure hydrocarbons, two lines for CO_2/Ar/N/He and similar gases.
- **Vacuum system**: the pumping system has been improved and now we are able to get a stable value of (average) $2\ 10^{-9}$ mbar on all the sections of the BTF vacuum pipes. Now there are no more vacuum breaks, an important improvement, since it reduces the amount of multiple scattering and energy loss due to small sections in air (and the presence of corresponding entrance/exit windows). A new straight section has been designed, realized and installed. Now a vacuum can be produced in the straight section separable from the rest of the pipe with a manual valve. This allows the speed-up of user operations during installation of experimental setup in vacuum. The pipe is equipped with a KF flange for pre-vacuum operations, an independent pressure gauge, a ionic pump, a YAG flag with its remote controlled pneumatic movement, a Basler CCD camera with its own black-box. A new passive protection system for the thin vacuum exit window of the bent line has been designed in order to house the wall current monitor (WCM) detector as well as protecting the ceramic pipe and the Berillium window with a removable polycarbonate window spacer.
- **General services and safety**: the main air ducts of the experimental hall have been sanitized. This improves the air quality and allows to reduce the problems related to the outgassing of BTF vacuum, as well as improving safety levels. The safety rules have been updated in accordance with Radiation Safety guidelines in the BTF experimental hall and in the control room for high-intensity operations. A dedicated neutron and gamma monitor has been installed in the BTF area.

- **Detector and DAQ improvements (related to the AIDA project)**:
    - **GEM trackers**. A dedicated run has been done to determine the future operative modes of the GEM and we started and completed the tests in July. These were comforting on the GEM operative status and the instrument seems appropriate to the specific experimental beam diagnostics in the three axes. More tests will be needed for integration with the BTF data acquisition. To have a glance to the !CHAOS framework, we study for future development of the control of GEM virtual machine through the use of responder CAN bus over Ethernet. We start to develop an engineered support frame (gas, electronics and remote position control) for the GEM structure, toward a runtime beam diagnostics on demand.
    - For the DAQ topics we have resolved problems related to the data format, improving time correction routine check on the existing DAQ. Moreover, user-friendly BTF environmental sensors have been implemented. New sensors for the radioactive background in BTF control room (Berthold manufacture) have been implemented.
    - Related to the !CHAOS project: a CU is now operational on the installed environmental sensors from four months in a synchronous fetching development of CU. A new prototype of oscilloscope users with mode of fetching and synchronous control. We start to think about future definition of software coupling mode between DAQ and users.

BTF user access

During 2012 the BTF has been running for 316 days, hosting many different experimental groups. Beam was delivered quite successfully to all the users, with an excellent degree of satisfaction.

A list of experiments running at the BTF during year 2012, to which 6 weeks of maintenance/dedicated runs for BTF use should be added (used for diagnostics improvements and developments and for characterization of background, improvement of the beam characteristics, etc.):

- VIRHIS (3 runs)
- K2HET (KLOE2 high-energy taggers calorimeters)
- SuperB-DCH (prototype of the SuperB drift chamber)
- SuperB-LSO (LSO calorimeters prototype)
- QCAL-CCAL (KLOE2 small angle calorimeters, 2 runs)
- Siddharta/Amadeus
- VIPIX (Silicon pixel detector test)
- JLAB12-Genova (PbWO calorimeter and hodoscope for CLAS12)
- AMY (one month in total, including the complex setup of anechoic chamber, complex experiment for detection of GHz radiation from electron beam) [1,2,3]
- K2-IT (KLOE2 GEM inner tracker)
- NRCA (neutrons)

- JLAB12-RICH
- ATLAS-Muon-upgrade (2 runs, micro-megas detectors)
- ANSI (positron channeling)
- K2-CCALT
- MAMBO (low energy scan of calorimeter)
- Gamma-neutron (neutrons/gamma background)
- UA9-quartz fibers

BTF neutron source
A pulsed neutron source has been realized at the BTF sending full energy (510 MeV) electrons on an optimized Tungsten target. Neutrons with an energy spectrum that spans over more than 9 decades of energy (from few meV up to hundred of MeV) are produced, even if most of them have energy around 1 MeV. This source may be suitable for calibrating neutron sensitive devices with response in the MeV region, as well as it could be efectively used for material and nuclear science investigations. Neutron and photon rates and their spectra have been measured along well designed extraction lines, by using a Bonner Sphere Spectrometer (BSS). The tests and measurements performed in the framework of the n@BTF project in year 2011 for the development of the neutron source were analysed and the main results were also published [1,2].
Additional measurements of the gamma field were performed and data analysis is under way in order to estimate the neutron/gamma ratio at different positions and distances from the optimized target.

A list of publications of experimental groups running their test-beams at the BTF can be found in the Reference section [R-1 to R-4]

Publications

[1] L. Quintieri *et al.*, *A Photoneutron source at the DAFNE Beam Test Facility of the INFN National Laboratories in Frascati: design and first experimental results*, Physics Procedia **26**, 249-260 (2012).

[2] J.M. Gòmez-Ros *et al.*, *Designing an extended energy range single-sphere multi-detector neutron spectrometer*, Nucl. Instrum. Meth. **A677**, 4-9 (2012).

[3] M. Bassan *et al.*, *Measurement of the thermal expansion coefficient of the Al5056 alloy in the 0.3<T<2 K temperature range*, arXiv:1212.0368 (2012).

[4] L. Catani *et al.*, *Introducing a new paradigm for accelerators and large experimental apparatus control systems*, Physical Review Special Topics – Accelerators and Beams **15** (11), 112804 (2012).

[5] P.W. Cattaneo *et al.*, *On-ground calibration of AGILE-GRID with a photon beam: results and lessons for the future*, SPIE Astronomical Telescopes+ Instrumentation, 84434D-84434D-12 (2012).

[6] P.W. Cattaneo *et al.*, *Characterization of a tagged gamma-ray beam line at the DAFNE Beam Test Facility*, Nucl. Instrum. Meth. **A674**, 55-66 (2012).

[7] B. Buonomo *et al.*, *Remote test bench equipped with service movable platform in two axis: Manual instruction and warnings* (2012).

References

[R-1] J. Alvarez-Muñiz *et al., The Air Microwave Yield (AMY) experiment to measure the GHz emission from air shower plasmas*, Journal of Physics, Conference series, ECRS 2012 Conference, in press.

[R-2] J. Alvarez-Muñiz *et al., Air Microwave Yield (AMY): An experiment for measuring the GHz emission from air shower plasma*, Nuovo Cimento, Year 2013 - Issue 1 - January-February.

[R-3] G. Eigen *et al.*, *A LYSO calorimeter for the SuperB factory*, Nucl. Instrum. Meth. **A** (in press).

[R-4] M. Bazzi *et al.*, *Experimental tests of the trigger prototype for the AMADEUS experiment based on Sci-Fi read by MPPC*, Nucl. Instrum. Meth. A671, 125-128 (2012).