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Low energy S- Band Linear Accelerator(s) for Radiography and Cargo Scanning as a tool for Cultural Heritage Management

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The design & development of low energy electron LINAC(s) for non-destructive radiography and cargo scanning applications is reported. The industrial radiography and cargo scanning play a vital role in cultural heritage management and preservation with potentials of non-destructive testing, identification and restoration of works of art and other monuments of cultural heritage for a country having rich cultural sites and commodities like Pakistan.

In the first phase of development, a 6 MeV standing wave side coupled, $\pi/2$ mode LINAC has been designed and fabricated and converted to a Non-destructive testing (NDT) Radiography system which will be discussed in detail with the focus on characteristics that dictate the ability to resolve small artefacts in objects including cultural art and other monuments. These X-ray imaging characteristics are also required for Cargo scanner and will be discussed. The indigenously developed accelerator-based cargo scanners can fulfil the country' s need of safe trade and control any illegal movement of cultural goods. Pakistan's accelerator program not only focuses on industrial application but medical and food irradiations as well. An in-house accelerator test facility has been established, which comprises of 10 MW klystron powered by solid state modulator and the compatible RF transmission system. The research and development on various aspects of accelerator technology including electron gun, HV pulsed modulators, accelerator cavity design & manufacturing, e–beam dynamics and diagnostics, X–rays target, RF conditioning, accelerator operation and control systems will be presented. The progress on transformation of the developed accelerators into radiography, medical, cargo scanning and food irradiation systems shall also be presented.

The characterization of radiography LINAC will be discussed in detail including the development of exposure chart of the machine. The effective energy is estimated through half value layer method and beam quality index is measured by Tissue Phantom Ratio (TPR20/10). Other radiography characterizations include penetration measurement as a check of energy of x-rays, spatial resolution and contrast sensitivity measurement. Simulations in Monte-Carlo based software GEANT4 have been carried out to design and develop collimators and filters for radiography, cargo and medical applications and will also be presented.

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