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## High-gradient and short-pulsed X/S-band Linacs and the application to Medicine, Industrial/Social Infrastructure Inspection and Fukushima Fuel Debris Analysis

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Portable 950 keV / 3.95 MeV X-band (9.3GHz) electron linac X-ray sources has been successfully applied to medicine and industrial/social infrastructure inspection. After the serious accident of old-tunnel wall collapse 5 years ago, the Japanese government has forced the bridge holders to perform regular inspection by eyes and hammering once for every 5 years. However, our X-ray sources have found several cases where the inner re-inforced steel wires were corrupted or thinned or cut even the near surface looked healthy. Not enough filling of grout to tubes of PC (Pre-stressed Concrete) bridges were also detected. The Japanese government is going to form a new technical guideline for safer maintenance using our X-ray sources. As for the industrial infrastructure inspection, we have visualized the dynamic images of the surfaces of liquid and fluid in a chemical reaction chamber and tube, and melted steel in a converter furnace. It can contribute to not only monitoring maintenance but also upgrade of production yields. 3.95 MeV X-band linac neutron source is going to be governmentally approved to be a radiation source after checking the possibility of moister inspection in bridge and short-length TOF (Time of Flight) measurement of neutron resonance absorption. We are verifying dual energy X-ray CT and neutron resonance absorption for on-site U/Pu quantitative evaluation for melted fuel debris in Fukushima.

35 MeV 25 kW S-band (2.856GHz) electron linac 🛛-ray source and 99Mo/99mTc supply system is under detailed design. 10 and 100 systems may be able to meet the medical demands in Japan and world, respectively. We are joining the IAEA international collaborating benchmark task on medical RI production and use beyond fission and cyclotron. This type of linac can be used for a short-pulsed neutron source and a variety of new neutron applications at the Yayoi research reactor room of University of Tokyo after its decommission is completed in a couple of years. 35/18 MeV electron linac facility of University of Tokyo for open uses on radiation chemistry/physics has 40 years anniversary. As you see, "35"MeV is a magic number for S-band electron linac, which would be optimum for scientific uses and neutron/🗠-ray sources. There are such tens 35 MeV linacs in the world. If we can apply high gradient technologies, it can consist of one accelerating structure and one klystron with a RF pulse compressor. Hence, the high gradient technologies can contribute to their downsizing and renewal. This could be one of the important issues in our society.

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