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Laser Accelerators in Particle Physics

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The science of laser acceleration has matured to the extent that we see routinely GeV electron acceleration over cm distances. On one hand, we at IZEST try to extend the proof-of-principle experiments to the 100GeV level by employing world's large energy lasers. On the other hand ICAN program of IZEST has introduced the fiber laser based concept Coherent Amplification Network (CAN) so that the highly efficient, high rep rated fiber laser may be combined coherently (and digitally) to large energy, large intensity laser pulses. Thus the CAN laser may be able to serve as an ideal driver for high luminosity accelerators such as a future collider, including a gamma-gamma collider. In addition laser accelerators have some advantages such as their compactness, which can serve well in many applications. For example, the CAN laser driver for ADS (accelerator driven systems) makes ADS much simpler system [1].
The laser acceleration is unique in pursuing extremely high energies (up to PeV) (but not necessarily with high luminosity), in which we could investigate extreme high energy phenomena such as the test of the Special Theory of Relativity [2]. Recently the wakefield acceleration mechanism has been also adopted as an acceleration mechanism for the ZeV cosmic ray genesis that is not hampered by the radiation energy loss suffered by the prevailing theory of the Fermi acceleration [3]. Further, the high fluence laser of CAN may be used for exploring to detect weakly interacting 'vacuum fields'such as Dark Matter fields [4].

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