

Extracts:

The First INP Publications on Muon Colliders

From the Budker's talk at the International Accelerator Conference, Erevan, 1969:

“On the other hand, of obvious interest are the lepton collisions at energies of a few hundred GeV (in the center of mass system). For this, the most convenient particles are mu-mesons. One can consider two variants:

1. The mu-mesons injected into a storage ring make some certain number of turns during their lifetime independent on energy: 400 turns in a 20 kG field and 4000 turns in a field of 200 kG. Using accelerators of very high intensity as the injectors of mu-mesons one can attempt to realize mu-meson collisions in a special accelerator. The small cross-section of the event and low factor of conversion for protons into mu-mesons with a low spread of energy and angles make this problem very complex even with the presence of a proton accelerator at very high energy.
2. Another method currently under development in Novosibirsk suggests the long time storing of a very large number of protons of rather low energy (25 GeV), slamming them into a target, obtaining a large number of mu-mesons of both signs of low energy and in a good phase volume, and their further acceleration in a special coreless pulsed accelerator up to high energies in the range where the reactions with mu-meson interactions are being studied. Because of an increase in the mu-meson lifetimes with an increase in energy, the acceleration can be performed practically with no loss.”

From the Budker's talk at the International High Energy Physics Conference, Kiev, 1970:

“Therefore we are seriously considering the somewhat exotic but quite real project of mu-meson accelerators and mu-meson colliding beams. The relativistic effects enable one to accelerate mu-mesons in cyclic accelerators with practically no loss at a sufficiently high growth rate of the magnetic field. Therefore, for mu-meson accelerators with fixed targets and colliding beams, we plan to use the short-focus ironless magnets developed at INP. The magnets accurately form fields due to their thin skin current distribution. For obtaining a large current of mu-mesons, which is very important for colliding beams, we expect to use the proton accelerator VAPP as well as the whole megagauss focusing instrumentation being developed at the VAPP-NAP installation for focusing of antiprotons.

In order to decrease the phase volume of mu-mesons from the decay of pi-mesons generated prior to their entrance into the storage ring we expect to build an intermediate pulsed storage ring with a field of 200 kG with the damping of the mu-meson beam due to the energy losses on a target installed inside the ring.

At present, two stages are under consideration: the installation of a 12-15 m radius ring with an energy of 7-100 GeV and the installation of a 160 m radius ring at 1000 GeV. It should be noted, that these installations can be used both as the proton and antiproton accelerators up to these energies and as the installations with the proton-anti-proton colliding beams. The low duty factor of the pulse accelerators is practically entirely compensated for by the high particle current and this gives them experimental possibilities compatible with the iron magnet at the corresponding energy. Their much lower cost makes their construction feasible for small laboratory having reasonably low funds such as the Novosibirsk Institute of Nuclear Physics. One should note, that the possibility of using these accelerators for protons provides us with the decisiveness to start their construction. Though we hope to get a lot of experimental data with the mu-meson colliding beams, it does not exclude the possibility that it might be an installation of a single experiments, namely, the discovery of the form-factor at the lepton interactions. If the cross-section of the weak interaction stops to grow with energy, the installation's luminosity is not sufficient for any observation. Whatever interesting result could it be, however, this does not justify the decisiveness for such a complex project."