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leptonic decays of charged pseudoscalar mesons revised september 2019 by j l rosner chicago u s l stone syracuse u and r van de water fnal 71 1 introduction charged mesons formed from a quark and antiquark can decay to a lepton neutrino pair when these objects annihilate via a virtual w boson pure leptonic decays are the simplest weak decays involving the charmed mesons fig 1 in principle these decay rates can be well predicted by the standard model of the muon is a lepton which decays to form an electron or positron the fact that the above decay is a three particle decay is an example of the conservation of lepton number there must be one electron neutrino and one muon neutrino or antineutrino in the decay the lifetime of the muon is 2 20 microseconds leptonic decays can be described by the most general local derivative free and lepton number conserving four fermion point interaction hamiltonian 2 it contains ten complex coupling constants corresponding to 19 independent parameters to be determined the in general the purely leptonic decays with a final lepton neutrino pair or lepton lepton pair are considered as rare decays which have relatively simpler physics than hadronic decays in signal decays the lepton ℓ originates from the decay leading to a final state with three neutrinos and resulting in a broad distribution while in normalization decays the lepton the τ lepton has a significant lifetime 1 2 compared to the w boson and undergoes a multi body decay to a muon and neutrinos this leaves two distinctive signatures in the detector the lepton decays furnish our first example of a second order decay that proceeds via a virtual particle and so provide a good motivation for a full description of the feynman rules of the theory leptonic decays of d s are used to extract decay constants and the semileptonic processes d klν πlν constrain form factors golden mode branching ratios for d0 k π d k π π ds k k π solidify the overall normalization of charm decays the study of the purely leptonic decays of the ground charged vector mesons is very interesting and significant in determining the ckm matrix elements obtaining the decay constant of vector mesons examining the lepton flavor universality and searching for new physics beyond the standard model π ν why not to an electron and a neutrino charged pion lifetime the matrix element for the weak decay is gf m f 2 π q u γ 1 γ5 u ν 2 μ where f is the charged pion π decay constant probability that quark antiquark annihilate inside pion the matrix element squared in the rest frame of the pion is lepton decays involve either only leptons for example j l ii e ve or a neutrino and hadrons e g r it 7r 7r0 semileptonic modes mesons can decay into only lepton pairs for instance k j l 11 or into hadrons and a pair of leptons semileptonic such as do p e ie or into pure hadrons rare decays of b flavored mesons are a promising avenue to look for new physics the b rightarrow s flavor changing neutral currents which are strongly suppressed in the standard model sm have gathered a lot of attention in the past few years prominent examples of lepton flavor conservation are the muon decays μ e ν e ν μ and μ e ν e ν μ in these decay reactions the creation of an electron is accompanied by the creation of an electron antineutrino and the creation of a positron is accompanied by the creation of an electron neutrino the measured leptonic branching fractions correspond to a tau lifetime of 3 0 zt 0 2 x 10 13 s which is slightly longer than the average measured tau lifetime of 2 8 rt 0 2 x io l3 s uv complete models inevitably also induce nucleon decays into tau neutrinos which provide far better limits in ref 3 we have quantitatively explored and confirmed this argument for operators involving left handed tauons two body τdecays compete directly with two body neutron decays such as n π0ν τ extremely well constrained by leptons are a group of fundamental elementary particles this means they are not made up of any other particles no quarks leptons interact with other particles via the weak gravitational or electromagnetic interactions they do not interact via the strong nuclear force the most common leptons are the electron e the electron neutrino v e comparing the measured leptonic decay widths of the τand the μ one can test the flavour universality of thewcouplings i e that g e g μ g τ g complementary tests can be obtained from the hadronic decay modes τ ν τπand τ ν τk from leptonic and semileptonic pion and kaon decays and from the direct leptonic decays of feynman diagram of the decays of the tau by emission of an off shell w boson the tau is the only lepton that can decay into hadrons the masses of other leptons are too small like the leptonic decay modes of the tau the hadronic decay is through the weak interaction the branching fractions of the dominant hadronic tau decays are open access semileptonic and nonleptonic weak decays of Λ0 b jie zhu zheng tao wei and hong wei ke phys rev d 99 054020 published 25 march 2019 more pdf html export citation abstract the recent experimental developments require a more precise theoretical study of weak decays of heavy baryon Λ0 b

71 leptonic decays of charged pseudoscalar mesons *Apr 30 2024*

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pure leptonic decays are the simplest weak decays involving the charmed mesons fig 1 in principle these decay rates can be well predicted by the standard model of

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the muon is a lepton which decays to form an electron or positron the fact that the above decay is a three particle decay is an example of the conservation of lepton number there must be one electron neutrino and one muon neutrino or antineutrino in the decay the lifetime of the muon is 2 20 microseconds

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leptonic decays can be described by the most general local derivative free and lepton number conserving four fermion point interaction hamiltonian 2 it contains ten complex coupling constants corresponding to 19 independent parameters to be determined the

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in general the purely leptonic decays with a final lepton neutrino pair or lepton lepton pair are considered as rare decays which have relatively simpler physics than hadronic decays

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in signal decays the lepton ℓ originates from the decay leading to a final state with three neutrinos and resulting in a broad distribution while in normalization decays the lepton

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the τ lepton has a significant lifetime 1 2 compared to the w boson and undergoes a multi body decay to a muon and neutrinos this leaves two distinctive signatures in the detector the

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lepton decays furnish our first example of a second order decay that proceeds via a virtual particle and so provide a good motivation for a full description of the feynman rules of the theory

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leptonic decays of d s are used to extract decay constants and the semileptonic processes d klν πlν constrain form factors golden mode branching ratios for d0 k π d k π π ds k k π solidify the overall normalization of charm decays

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the study of the purely leptonic decays of the ground charged vector mesons is very interesting and significant in determining the ckm matrix elements obtaining the decay constant of vector mesons examining the lepton flavor universality and searching for new physics beyond the standard model

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π ν why not to an electron and a neutrino charged pion lifetime the matrix element for the weak decay is gf m f 2 π q u γ 1 γ5 u ν 2 μ where f is the charged pion π decay constant probability that quark antiquark annihilate inside pion the matrix element squared in the rest frame of the pion is

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lepton decays involve either only leptons for example j l ii e ve or a neutrino and hadrons e g r it 7r 7r0 semileptonic modes mesons can decay into only lepton pairs for instance k j l 11 or into hadrons and a pair of leptons semileptonic such as do p e ie or into pure hadrons

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rare decays of b flavored mesons are a promising avenue to look for new physics the b rightarrow s flavor changing neutral currents which are strongly suppressed in the standard model sm have gathered a lot of attention in the past few years

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prominent examples of lepton flavor conservation are the muon decays μ e ν e ν μ and μ e ν e ν μ in these decay reactions the creation of an electron is accompanied by the creation of an electron antineutrino and the creation of a positron is accompanied by the creation of an electron neutrino

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the measured leptonic branching fractions correspond to a tau lifetime of 3 0 zt 0 2 x 10 13 s which is slightly longer than the average measured tau lifetime of 2 8 rt 0 2 x io l3 s

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uv complete models inevitably also induce nucleon decays into tau neutrinos which provide far better limits in ref 3 we have quantitatively explored and confirmed this argument for operators involving left handed tauons two body τdecays compete directly with two body neutron decays such as n π0ν τ extremely well constrained by

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leptons are a group of fundamental elementary particles this means they are not made up of any other particles no quarks leptons interact with other particles via the weak gravitational or electromagnetic interactions they do not interact via the strong nuclear force the most common leptons are the electron e the electron neutrino v e

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comparing the measured leptonic decay widths of the τand the μ one can test the flavour universality of thewcouplings i e that g e g μ g τ g complementary tests can be obtained from the hadronic decay modes τ ν τπand τ ν τk from leptonic and semileptonic pion and kaon decays and from the direct leptonic decays of

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feynman diagram of the decays of the tau by emission of an off shell w boson the tau is the only lepton that can decay into hadrons the masses of other leptons are too small like the leptonic decay modes of the tau the hadronic decay is through the weak interaction the branching fractions of the dominant hadronic tau decays are

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