sponds to a temperature between four and six degrees greater. In the latest experiment Houck and Harwit used a slightly altered telescope, launched by the same type of rocket as before, to produce an identical result. No increase in signal is detected when the telescope scans across such features as the Crab and Orion nebulae, or across the ecliptic and galactic planes. And neither telescope scanned the goings-on at the centre of the Galaxy which are known to be a prolific source of infrared. The indications are that the radiation is in fact isotropic.

By underpinning the earlier measurement, Houck and Harwit give support to the views of Cowsik and Pal (*Phys. Rev. Lett.*, **22**, 550; 1969) and of Shen (*ibid.*, **22**, 568; 1969) who say that the anomalous infrared radiation may be the cause of a flux of high energy gamma rays which Clark, Garmire and Kraushaar claim to have detected (*Astrophys. J. Lett.*, **153**, 203; 1968). What happens is that electrons in interstellar space give some of their energy to infrared photons by collisions, lifting the photons into the gamma ray part of the spectrum.

Indeed, Houck and Harwit show signs of accepting the high energy gamma rays as indirect support for the existence of the anomalous infrared flux.

But explanations of the origin of the infrared are hard to come by. One possibility is that transitions in ions of abundant elements such as carbon, nitrogen and oxygen boost the background radiation at wavelengths shorter than 0.5 mm (Petrosian, Bahcall and Salpeter, *Astrophys. J. Lett.*, **155**, L57; 1969). Another idea, of Houck and Harwit, is that infrared radiation from galactic nuclei may be responsible.

Yet doubt has been cast on the infrared measurements by Bortolet, Clauser and Thaddeus who argue that if the abnormal flux is real it will be absorbed by interstellar material, and excited states thus produced will lead to optical absorption lines (*Phys. Rev. Lett.*, **22**, 307; 1969). Measurements of the absorption lines allow upper limits which are compatible with the standard 3 K background to be placed on the infrared flux at two points in the band covered by the Cornell measurements. So far the only way to surmount this obstacle seems to be to say that the infrared flux is concentrated into spectral lines—certainly Bortolet *et al.* rule out a continuum.

Clearly the background radiation at wavelengths shorter than the 2 mm peak of the 3 K black body spectrum needs more observations. It would be good, for example, to see a verification of the infrared peak with different equipment, and to check the observation of high energy gamma rays. Otherwise the house of cards which is building up may collapse.

NUCLEAR PHYSICS

Electron-Muon Universality

from a Correspondent

IN a recent publication (N. V. Baggett *et al.*, *Phys. Rev. Lett.*, **23**, 249; 1969), the University of Maryland bubble chamber group reports observation of more than fifty examples of the decay of the negative Σ hyperon to a negative muon, a neutron and an antineutrino. Combining their data with a similar result from a Heidelberg group they make a comparison between the probability for this decay and the prob-

ability for negative Σ decay into an electron, a neutron and an antineutrino. These two processes, known as the leptonic decays of the Σ because electrons, muons and neutrinos are all leptons, occur with about one-thousandth of the frequency of the usual Σ decay into a neutron and a negative pi-meson. The observed ratio of the leptonic decay probability with a muon to the frequency with an electron is consistent with that expected from the currently accepted $V-A$ theory, with the assumption of "electron-muon universality".

So far the only well established difference in properties between the muon and the electron is in their masses, the muon having a mass more than two hundred times that of the electron. Their electric charges are, of course, identical, and recent work at CERN on the muon magnetic moment (*Nature*, **221**, 125; 1969) has shown that any difference there may be between the observed moment and that predicted by quantum electrodynamic theory is extremely small. This theory also gives an accurate value for the electron magnetic moment. In the weak interactions there are several cases, including the Σ decays, in which electrons or muons can take part in similar processes. For example, capture of K -shell electrons by nuclei, a form of inverse β -decay, is closely related to the capture by nuclei of negative muons. In all the tests involving non-strange particles, protons, neutrons and pi-mesons, or in the decay of the muon to an electron and two neutrinos, the universality assumption with the $V-A$ theory has given successful predictions. Universality means that the coupling constant, a scale factor (closely analogous to electric charge) which fixes the strength of the interaction, is the same whether electrons or muons are involved.

When strange particles are concerned in leptonic processes, the coupling constant has a different value from that which it has in neutron β -decay or in the decay of the muon. In addition, some anomalies in leptonic strangeness-changing K -meson decays have led to the suggestion that the universality assumption may not hold when a change of strangeness occurs. The Σ hyperon has a strangeness of minus one and all of the final state particles in the decays reported by the Maryland group have no strangeness. Their recent result thus establishes that in at least one strangeness-changing decay, universality holds at the 10 per cent level in the decay rate.

The Λ hyperon has leptonic decays of a very similar kind to those of the Σ . Experiments so far have given results consistent with universality, but the precision is not as good as in the Maryland and Heidelberg Σ experiments. Improvements in both these tests of universality may continue to be made by bubble chamber experiments for some time yet, but many pictures have to be scanned for a handful of rare events. It seems, however, to be well within the capability of modern counter and spark-chamber techniques to make considerable advances in the precision of such tests. This would be worthwhile, especially if it turns out that the three-body leptonic K -meson decays (to pi-meson, muon or electron, and neutrino) cannot be explained by a theory which assumes universality.

If the universality is not upheld, then physicists will need to adjust one of the few theories in elementary particle physics which can give precise predictions. But there may then be a clue to the basic question of why the muon is different from the electron.