Notes on PPAP Flavour-changing physics + QCD Day: 13th July 2009

(2) Summary of discussion issues

NB: These notes do not represent a verbatim transcript of everything said on the day, but rather provide a brief summary of the main points which came up in the discussions. For details of the presentations please see the slides on the agenda page at

http://conference.ippp.dur.ac.uk/conferenceDisplay.py?confId=273 .

Approximately 50 people present

Summary of discussion during/after presentations

[PPAN Context]: Are the communities of the right size? (Group leader responses for ECFA survey should be available to PPAP). Knowledge of costs necessary to avoid small projects getting squeezed out. (SoIs not available 20-30 years in advance). Some items cross subpanels. (Chairs of advisory panels will discuss).

[Flavour-changing physics beyond the Standard Model]: New experiments should be ambitious (factor of 100 in precision ?) and concentrate on clean and rare processes. The scale that can be reached in flavour physics is ~100TeV, well beyond the current high energy frontier. LFV in charged leptons could be the most interesting search in the flavour sector! (GUTs suggest effects close to present bounds – MEG has a chance for a big discovery). B(tau->mugamma)/B(mu->egamma)>1 in most models, but not arbitrarily so – hence if MEG fails to see anything then hopes fade for tau LFV (in many models). The chance of the tau->mumumu rate being enhanced into the explorable sensitivity range is, in general, more model dependent than tau->mugamma. Rare kaon decays good place to look for non-SM effects since SM-suppression is largest. B->mumu another good example -- more Higgs doublets give big changes in helicity suppressed B and K decays (also leptonic decays with neutrinos). Lattice can help to improve theory uncertainties on several modes. B->K*mu+mu- is another very interesting mode.

[CKM matrix elements and CP violation]: Nobel prizes have been awarded for mixing+CPV in 2 out of 4 neutral meson systems! CPV in either Bs or D0 mixing would be NP signal. Either could be very hot topic in 2014. Advantages of LHCb upgrade vs. SuperB depends on which channels you choose to prioritise. Systematics limitations of LHCb unknown, but (i) with large statistics you can cut harder to get cleaner measurements and (ii) data control samples can be used to study many of the potential systematic biases. Evolution of theory errors not always clear. ATLAS (and CMS?) will concentrate mainly on rare decays with dimuons.

[Lattice QCD]: Further improvements in lattice calculations are necessary to keep pace with the expected developments in experiment (eg. form factors, structure constants, epsilon_K, V_us, V_cb, V_ub, B->K*gamma, K*mumu). For the last year or so the UK reputation in lattice QCD has largely been driven by 'people-power' with the computational power in main coming from abroad. This is not a sustainable model in the medium term. A 7M GBP bid by UKQCD was recommended for approval by PPRP almost 2 years ago, but the final outcome has still not been announced. The UK lattice community does not restrict itself to dedicated facilities. For example, it was one of the first users of the HECToR facility. UK leading, but many international groups. Would it matter for the field if the UK dropped out? Yes – field would lose the UK leadership (which has been behind many of the theoretical developments) in many areas that we are contributing to (eg. those listed above). Lattice provides KE opportunity – for example development of IBM Blue-Gene machines (Edinburgh).

[Rare decays]: Limitations of exclusive analyses (theory error, eg. In B->K*mumu at LHCb) could be improved by inclusive analyses (SuperB) but requires huge statistics. Bs->mumu a clear golden mode (LHCb + ATLAS & CMS) but requires a normalisation mode, and will be already limited by 2014. Bd->mumu/Bs->mumu ratio can go further (this measurement will be very challenging though, and requires accurate knowledge of either the ratio of B_d and B_s production fractions or of normalisation channel branching fractions). Some B_s normalisation channels could be measured at e^+e^- machines.

[Lepton universality and lepton flavour violation]: muon g-2 one of most constraining for NP (eg. SUSY) models. Universality tests in kaons can be pushed to ~0.3% by NA62. Universality can also be tested in

Upsilon decays (one of possible signatures of a light Higgs (as in eg. NMSSM model)). Anomalous results seen in leptonic D decays at CLEO – can be improved by BES and/or by SuperB. Many limits for tau LFV set by B factories – not clear if LHC will improve on these, even for 3mu, but SuperB would do better.

[Required technologies]

[LHC Upgrades (LHCb + GPDs)]: Baseline upgrade for RICH as now but faster readout photon detectors. Pixels for vertex detector? Cost to UK is O(10M). Synergies on silicon detectors with LHC GPDs, also on photodetectors with NA62. There is critical mass on the LHCb upgrade and expertise on technologies .

[e+e- machines (SuperB, Belle upgrade, tau-charm factories)]: SuperB: two sites are now on the table: Tor Vergata and LNF. Questions over which is more likely. Possible UK involvement in the silicon detector. Potentially relevant for linear colliders (partially dependent on timescales). Questions over likely size of UK participation in SuperB, and apparent current lack of interest in SuperKEKB if this were the only machine that went ahead. How will SuperB be funded? A statement is expected from the Italian Government towards the end of 2009. New money would be needed. Could there be EU funding? Is the 2015 start date realistic? – later start up would mean SuperKEKB could lead on integrated luminosity until later than 2017. Will LHCb measurements influence decision? If decision is soon, LHCb measurements will be too late; if LHCb sees nothing, this does not assist the case for SuperB (likewise if MEG sees nothing) – though unique science opportunities of e+e- machine remain.

[NA62 + kaons at JPARC/FNAL]: UK interest on NA62 on CEDAR (PID), computing, trigger. Possible roadmap for future kaon expts. at CERN following SPS upgrade (part of LHC injector chain upgrades). KOTO technique could be used at SPS. Kaon programme has attractive features in terms of cost (value for money), timing and adding diversity.

[COMET + muons at FNAL]: mu2e at FNAL and COMET at JPARC share much in common and are discussing together. Second stage FFAG based PRISM/PRIME at JPARC will gain another factor 100. Clear synergies with UK technical interests. UK is involved in COMET and PRISM/PRIME. SoI to STFC imminent. Total cost unclear at present – maybe O(10M) over 10 years.