

Hadronic Probes of Fundamental Symmetries Workshop
March 6-8, 2014

Summary Notes:

March 6:

1. What is the physics impact of prospective JEF $\eta \rightarrow 3\pi$ measurement?
 - More precise value for $\Delta m_q / \text{mbar}$: fundamental parameters of SM that can be determined (note individual quark masses not accessible)
 - Improve interpretation of low energy BSM tests (eg, V_{us})
 - Theory-experimental joint analysis including radiative correction (e.g., in dispersive framework) promising direction
 - Right now: value and quoted uncertainty of $\Delta m_q / \text{mbar}$ not “robust”?
 - Benchmark for improvement needed
 - Global context as cross check on systematics
 - Interesting to consider the charged pion final state as well; improve BR?
2. What is the physics impact of prospective JEF $\eta \rightarrow \pi\gamma\gamma$ measurement?
 - Probe interplay of VMD & scalars \rightarrow impact for predictions/interpretation of other processes? ($\gamma\gamma \rightarrow \pi^0\eta$) [linking the two kinematic regions for a_0 dynamics]
3. Are there other prospective measurements that should be considered to address the QCD questions pertaining to η decays?
 - $\eta \rightarrow \pi\pi\gamma$ precise Dalitz: anomaly driven & not completely well described by ChPT?
 - Similar decays for η' : clarify η - η' mixing (radiative decays);
4. What additional theoretical work is needed to advance progress in this area?
 - $\eta \rightarrow \pi\gamma\gamma$: comprehensive & updated theory study/overview
 - Clarifying the importance of beyond order p^6 / VMD-Scalars interplay
 - Also help address convergence of three flavor ChPT

March 7

1. What are the possible new opportunities for probing physics beyond the Standard Model (BSM) with low-energy hadronic probes
 - P-even, T-odd correlations in neutron beta decay

- Baryonic dark photon, B, as seen in eta decay
 - P-even, C-odd decay channels in eta decay (e.g., $\rightarrow 3g$)
 - Take another look at C violation in eta $\rightarrow \pi^+\pi^-\pi^0$
 - Decay of eta' $\rightarrow \rho^+\pi^- + \text{c.c.}$
2. What are the prospective implications of JEF and elsewhere tests of P-conserving C-violation and C-conserving P-Violation?
 - Mainz LOI for $\pi^0 \rightarrow 3\gamma$
 3. What are the constraints from other tests? Are there loopholes...
 - Could there be conspiracy/symmetry at high scales?
 - Is the neutron decay measurement mentioned above also subject to EDM constraints?
 4. What theoretical and/or experimental work needed as follow up to these questions?

March 8 & Close Out

1. How can refined tests of chiral symmetry sharpen the theoretical interpretation of other low-energy BSM probes?
 - HLBL likely to dominant theoretical error: goal is to reduce the model-dependence of the prediction through judicious combination of theory and new measurements of photon-pion reactions
 - (HVP: what can help clarify experimental discrepancy in the region just below and just above the rho?)
 - New development: dispersive framework for the two pion intermediate state and the pion transition form factor(s)
2. For HLBL, what specific measurements would help sharpen the SM prediction?
 - $\gamma^*\gamma^* \rightarrow \pi\pi$ and $\gamma\gamma \rightarrow \pi\pi$ (polarizability) both in and away from the chiral regime: J Lab & KLOE? (charged channel)
 - Singly $\gamma^*\gamma P$ & doubly off shell $\gamma^*\gamma^*P$
 - $V \rightarrow \pi^*\gamma^*$ -- also ratio of FF for one and both off shell photons
 - $\omega \rightarrow 3\pi$
3. What additional theoretical work needed to provide guidance to experiment?

- Quantifying impact of prospective future measurements on HLBL
- Classifying other channels that could be measured
- Delineate the theoretical constraints in various kinematic regimes (eg, OPE/asymptotic constraint)
- How to agree with KTeV $\pi^0 e^+e^-$; also background subtraction for experimental determination? Implementation of radiative corrections?

Going Forward?

1. White paper for global effort? New theory section for JEF proposal?
Working groups (eg, $\eta \rightarrow 3\pi$, BSM, HLBL....)
 - Gilberto, Bastian dispersive analysis phenomenology road map
 - Possible new focus group on BSM symmetry tests to develop workshop ideas
 - Support from/network with European meson physics network
2. Additional participation/people?
3. Time scales? JEF proposal possibly due May 1: sufficient time to develop a robust case?
4. Co-ordination?