Highlights of the 17 September 2009 SPIN@COSY Teleconference Meeting

ATTENDEES:
M A Leonova (Moscow); A M Kondratenko (Novosibirsk); Y S Derbenev (J-LAB); A D Krisch, J Liu, V S Morozov, R S Raymond (Michigan).

A.D. KRISCH: Papers, etc.
1. The KC Test PRL was published in June 09. The Narrow Deuteron Resonance PRL was accepted in only 30 days; the proofs had some typesetting problems but they were resolved.
2. We are working on a paper about the widening of a proton spin resonance; we decided to make the paper purely experimental because calculations did not seem practical.
3. We decided to revisit the April 04 higher-order spin resonance data; we did a lot of studies then but only one curve was published in SPIN 04 Proceedings. We will work on reanalyzing the existing data since no more running is expected at COSY.
4. The SPIN 08 Proceedings were published. Leonova, Morozov and Raymond will check their articles and then inform the coauthors whether the articles came out okay. Morozov e-mailed Leonova her article since she did not yet have a copy of the book.
5. Krisch and Morozov discussed two unpublished draft papers on old IUCF results: spin flipping with an exactly 100% snake and higher-order spin resonance studies. Morozov will put together a file with the relevant information for each paper and e-mail it to Krisch and Leonova.
6. Derbenev noted that spin flipping with an exactly 100% snake is not simple since two spin harmonics are present. This problem is solvable only in special cases; publishing any experimental results would be interesting.

V.S. MOROZOV: Wide Proton Resonance Paper
1. He said that because calculations for protons proved very difficult, our paper is purely experimental. We plan to publish the data, describe its features and note that its resonance broadening is opposite to the deuterons' narrowing.
2. Morozov read the paper and discussed the figures. Krisch said that the reanalyzed unbunched fixed-frequency map data is very different than online data. Morozov said that it is not clear if the dip is there.
3. Krisch said that we would probably submit the paper to PRL, since we recently had a better experience publishing there. He asked everyone, especially the authors, for their comments or suggestions.

M.A. LEONOVA / A.M. KONDRAIENKO: Derbenev et al. 1971 JETP
1. Derbenev noted that one should distinguish between the resonance width measured by a map and the width associated with the resonance strength $\varepsilon$. When studying a map, one should account for the spreads in energy and synchrotron frequency. Krisch agreed.
2. Leonova asked whether the Derbenev et al. 1971 JETP paper is directly relevant to our Narrow Deuteron Resonance PRL and whether we should add a reference to it. She added that she could not find in Derbenev et al. any explicit statement about narrowing of a spin resonance due to bunching.
3. Krisch said that Derbenev et al. is not referenced in the Narrow Resonance PRL because we did not know about it at the time the PRL was submitted. Bukin et al. did mention narrowing of a resonance due to bunching; but it did not provide any derivation. When we asked about this, Kondratenko referred us to Derbenev et al.
4. Kondratenko said that Derbenev et al. deals with the case of large synchrotron oscillations; it is valid for both protons and deuterons. He added that the synchrotron motion causes synchrotron sidebands, which are widened by the synchrotron frequency spread. But the central resonance is always narrow for both protons and deuterons; this follows from Eqs. (5.8) and (5.9); he said that he tried to explain this in his e-mail of April 20.
5. Derbenev noted that the bunching narrows the resonance from the larger resonance frequency spread, which exists at any instant. Derbenev and Kondratenko discussed the importance of the values of the spin manipulation and measurement times; they must be much greater than the synchrotron oscillation period for resonance narrowing to occur with protons. This narrowing should occur due to averaging by the synchrotron oscillations.
6. Kondratenko said that studying the central resonance allows precise measurement of the beam energy. Derbenev said that the synchrotron oscillations reduce the resonance map’s width so that it corresponds exactly to the resonance strength. He added that Derbenev et al. might not have discussed this specifically; however, it contains the general theory and the narrowing follows from it.
7. Krisch said that Eq. (5.9) gives a “resonance region”, which is probably related to the resonance width. He asked Leonova [or, perhaps, Morozov] to try to understand this part of the Derbenev et al. paper.
8. Derbenev said that the theory from Derbenev et al. was applied in the Bukin et al. 1975 paper. He agreed that Orlov discussed the synchrotron oscillations’ effect on the spin earlier. Derbenev et al. gives a reference to some other Orlov papers but not his 1969 unpublished letter to Picasso, which he was not aware of. Krisch noted that Orlov’s letter was focused on the muon g-2 experiment and not on accelerator physics; he added that he will contact Picasso regarding Orlov’s unpublished letter and will then distribute it if it is available.

V.S. MOROZOV / J. LIU: 2008 Data Reanalysis
1. Morozov said that Liu reanalyzed the November 08 data, by using only the good channels and applying the new time-cuts. The data was shown at the previous teleconference, but some typos and mislabeling were fixed.
2. The online and reanalyzed data are consistent for all studies far from the resonance; they differ only when $\nu_{\gamma}$ was close to the first-order resonance. The reanalysis did not significantly change the resonance strength $\varepsilon$, the data crossed “0” at the same place.
3. The bottom left plot on page 9 compares the online and reanalyzed data for the unbunched fixed-frequency map. Krisch said that most reanalyzed points agree with the online points within error bars, except for one point, where
they disagree by more than 3 sigma. He asked Liu and Morozov to check this point very carefully. Morozov said that the horizontal lines show initial polarization, and the difference between them measures the polarization stability. Krisch asked Liu to re-plot the data vs. the run number to show the order, in which it was taken.

V.S. MOROZOV / J. LIU: Higher-Order Resonance Reanalysis
1. Morozov said that the first page showed the procedure for ramping quadrupoles, the plot it to-scale. This procedure tries to minimize the effect of resonances that are encountered first by going through them fast, and maximize the effect of resonances that fall inside the second very slow sweep.
2. He said that page 2 shows studies with \( \nu_y \) fixed and \( \nu_x \) varied. The left plot is for a quadrupole ramp with fixed time of 0.5 s, and the right plot is for the quadrupole ramp shown on page 1; the right plot better indicates the calculated resonances.
3. He said that page 3 shows similar studies with \( \nu_x \) fixed and \( \nu_y \) varied. The left plot is again for a quadrupole ramp with fixed time of 0.5 s, and the right plot is for the quadrupole ramp shown on page 1.
4. Krisch noted that the procedure shown on page 1 works worst in case of two close-by resonances.
5. Morozov said that page 4 shows on the left plot all data with \( \nu_y \) varied, and on the right plot a study of polarization dependence on time during the measurement. Krisch said that the main observation from the left plot was that the second-order resonance was weaker that third-order resonances.
6. The right plot of page 4 shows a ration of polarizations with time-cuts from 1 to 1.2 s, and from 0.2 to 0.4 s. It indicates that far from the first-order resonance the polarization does not depend on time during measurement, but close to the resonance it shoots up to more than 4, and after crossing the resonance the ratio reverses sign.
7. Morozov said that plots on page 5 show the polarization during measurement for two different runs in April 04. Morozov said that Liu is working on producing similar plots; Krisch said that first these plots should be reproduced, then the time intervals for these plots should be narrowed since the error bars for these data are quite small, and then similar plots for the new data should be produced.

ROUNDTABLE:
1. The next SPIN@COSY Teleconference was scheduled for Thursday, 22 October 2009 at 11:00 EDT.