Draft Highlights of the 11/12 July 2005 SPIN@J-PARC Teleconference Meeting

ATTENDEES:
M Bai, H Huang, T Roser (BNL); E D Courant (NYC); Ya S Derbenev (J-Lab); D G Crabb (Virginia); M A Leonova, V S Morozov, R S Raymond, V K Wong (Michigan); K Yonehara (Fermilab); D W Sivers (Portland); A D Krisch, A Molodojentsev, S Nagamiya, S Onuma, H Sato (J-PARC); N Saito, K Imai (Kyoto); H Enyo, M Okamura (RIKEN).

A.D. KRISCH: Introduction.
1. This first meeting with dial-in and a password started 15 min late; perhaps the next meeting may go better.
2. He noted that we have two subjects to discuss; both are timely because they might require some hardware to be installed in J-PARC. One is the study of the 3 GeV Booster resonance strengths just started by BNL. The 2nd is the best snake plan for the 50 GeV Main Ring. He proposed that we focus on two possibilities for the Main Ring:
   - the two 30% partial snakes recently suggested by BNL;
   - one full or nearly full snake.
   He also suggested considering slightly stronger snakes to allow safety for unknown depolarization problems.
3. He said that the Proposal from KEK to the Japanese Society for Promotion of Science (JSPS) for funds for this study was rejected along with both other proposals from KEK. He said that he would meet with Prof. Nagamiya later in the day to discuss other funding options.

H. SATO: Status & Design of J-PARC.
1. He said that there were no changes to the J-PARC design since our March 2005 Teleconference.
2. He reviewed the highlights of the recent Accelerator Technical Advisory Committee (ATAC) and the International Advisory Committee (IAC) meetings. They focused on a timely completion of the project, an operational budget for J-PARC, and its organizational structure.
3. Next he gave an update on accelerator construction; everything seems to be on schedule.
4. Roser asked if there is space in the 3 GeV Rapid Cycling Synchrotron (RCS) for an AC [rf] dipole. Krisch said that Sato e-mailed the 3 GeV ring layout, just before the previous Teleconference; Bai said that the dipole is small and the layout shows straight sections that should be adequate.
5. Krisch asked about the dates for Day-one experiments and for the first primary beam experiments that might need a polarized beam. Nagamiya said that the first secondary-beam hadron experiments should probably start in Fall 2007. He said that the date of the first experiments with primary polarized or unpolarized beam depends on the proposals, but his guess was not before 2010.

M. BAI: Booster Resonance Strength Calculations.
1. She used the MAD file that Molodojentsev sent to calculate the $\beta$-functions and Q-values for the 3 GeV RCS. As expected, they were different from Hatanaka’s values, which Sato showed in March; she also found higher dispersion function values. Using the MAD file and DEPOL, she calculated the intrinsic resonance strengths in the RCS ring by using the Froissart-Stora equation and assuming a $10\pi$ mm mrad emittance, sinusoidal ramping and a 25 Hz repetition rate; she showed the depolarization for each intrinsic resonance in the range 400 MeV to 3 GeV. Three cause more than 10% polarization loss; the strongest causes ~50% loss. She proposed using an AC [rf] dipole to drive a spin-flip at these resonances. She discussed the calculated amplitudes of the coherent oscillations driven by an AC dipole needed for each resonance; they should not be a problem for the ring’s 300$\pi$ acceptance beam pipe. She summarized their suggestion of using harmonic corrections for the imperfection resonances and an AC dipole for the three non-negligible intrinsic resonances in the 3 GeV ring.
2. Krisch said that the imperfection resonances plan seems straightforward, but the intrinsic resonances are rather weak at 3 GeV; thus, a fast Q-jump may be a better and cheaper solution; he noted that COSY uses it quite successfully at 3 GeV. Bai said that a resonance causing a 50% polarization loss may be too strong for a Q-jump correction; also, a Q-jump requires 3 magnets, while an AC dipole requires only one magnet, so it may be cheaper. Roser agreed that 3 large-aperture quadrupoles would be expensive. Krisch noted that a single Q-jump quadrupole seemed adequate at COSY and suggested considering both possibilities. Sato said that Q-jumping at RCS may be difficult because it must be fast; he asked about the approximate length of a dipole. Bai said ~1m. Krisch said that based on experience at COSY, either a pulsed quadrupole or rf-dipole could probably be shorter.
3. Morozov asked about the accuracy of the DEPOL calculations; Bai said that based on their experience at the AGS it is ~10%. Courant asked if it was 10% for the resonance strength; Bai said yes. Saito asked if a polarimeter was needed at RCS; Krisch said that it was desirable and rather straightforward at 3 GeV.
V.S. MOROZOV: Review 50 GeV Resonance Strength Calculations.

1. There had been two calculations for the 50 GeV ring: one by Hatanaka, for a \(150\pi \text{ mm-mrad}\) emittance using the JHF design parameters, and one by Bai, using the J-PARC parameters and a \(10\pi \text{ mm mrad}\) emittance. Thus, he made two calculations with both emittances using DEPOL and the MAD file sent by Molodojentsev; his last slide shows all four calculations on one plot. He said that his calculations for \(10\pi \text{ mm mrad}\) emittance and the J-PARC betatron tunes agree with Bai’s calculations almost exactly. The small differences are probably due to getting her numbers by measuring her plot. Krisch asked Bai to send her results to him and Morozov to check this. [NOTE: She sent them.] Morozov said that his and Hatanaka’s results do not agree because they used different Q values.

2. Derbenev asked why \(10\pi\) and \(150\pi \text{ mm-mrad}\) emittances were used. Morozov said that he used them to compare his results to Bai’s and Hatanaka’s. Molodojentsev said that the emittance should be \(8\pi \text{ mm mrad}\) (not normalized). Morozov said that one could calculate imperfection resonances using DEPOL by adding errors to the elements. Molodojentsev agreed to send him a file with these errors.

M.A. LEONOVA: Review: 1, 2 or 3 Snakes.

1. She said that her talk was mostly a review of the previous meeting. She showed \(\nu_s\) and the stable spin direction (SSD) components for 1 snake, 2 snakes with parallel axis and 3 snakes with two parallel and one anti-parallel axes. She said that a single snake has to be rather strong, and spin matching was needed to inject a beam with horizontal SSD. The 2-snake plan with equal snakes, of at least 30%, does not require spin matching since the beam can be injected with a vertical SSD. Three snakes give a result similar to one-snake case.

2. Courant asked if other axis orientations were considered. Leonova said yes, but the ones she presented were the most promising. Roser said that it was most practical to build longitudinal-axis partial snakes. Derbenev said that then one should only consider parallel or anti-parallel orientations.

3. Krisch suggested that we should also consider slightly stronger partial snakes. Roser agreed that even if we want to operate at 30% we should consider building a snake capable of going to 40% or 45%. He noted that the stronger the snake, the more difficult it is to build, and the bigger optical distortions it would introduce; thus, one would want to operate at lowest strength needed to overcome the resonances. Courant said that AGS has a correction scheme for perturbations that could probably be adopted for J-PARC.

4. Krisch concluded that since 3 snakes seem to give no advantage; thus, we should now focus on: the 1-snake and 2-partial-snakes plans. He also suggested studies of the 2-snake plan with 30%, 35%, 40% and 45% snakes to evaluate the benefits and problems of slightly stronger partial snakes. He asked if BNL could look into orbit distortions for these cases. Roser noted that a correction scheme for perturbations should also be designed. Krisch asked if the scheme that Courant developed could be used for a different strength snake; Roser replied that the scheme depends on the particular snake design. Derbenev asked if a helical snake introduces h-v coupling; Roser said that their 30% partial helical snake has a built-in solenoid to correct for coupling.

ROUND TABLE:

1. Derbenev had earlier agreed to briefly discuss the paper by Kondratenko that he recently e-mailed to everyone. He promised to get this paper translated into English and then send it to everyone. [NOTE: Morozov and Leonova are now doing the Draft-1 translation.] He said that the paper proposes a technique for preserving a beam’s polarization by crossing a resonance in a special way. The paper first discusses fast resonance crossing [Eq.(1)]. It gives an equation for general depolarization during fast resonance crossing [Eq.(2)] and then gives a condition on the crossing rate that gives no depolarization [Eq.(3)]. Fig.4 and Eq.(4) give an example of a function that satisfies the condition in Eq.(3). Sivers said that this is a realization of an idea he presented at the 2002 AGS workshop in Ann Arbor, but he never calculated that explicitly. [NOTE: Krisch found and e-mailed to Derbenev a file of Sivers’ talk; Derbenev will e-mail it to Kondratenko.] Derbenev noted that an earlier reference [11] also had similar ideas and that Kondratenko might present this paper at SPIN 2006, but he may need financial support.

2. Krisch said that Haeberli decided not to join this teleconference because the topics were outside his areas of expertise, but he plans to join us, when we start discussing the polarized source.

3. He also said that, since J-PARC is unlikely to use a polarized beam before 2010, having these Teleconference meetings about once every three months seems appropriate; no one disagreed. The date of the next Teleconference will be set after J-PARC is able to find appropriate funds to support these studies.