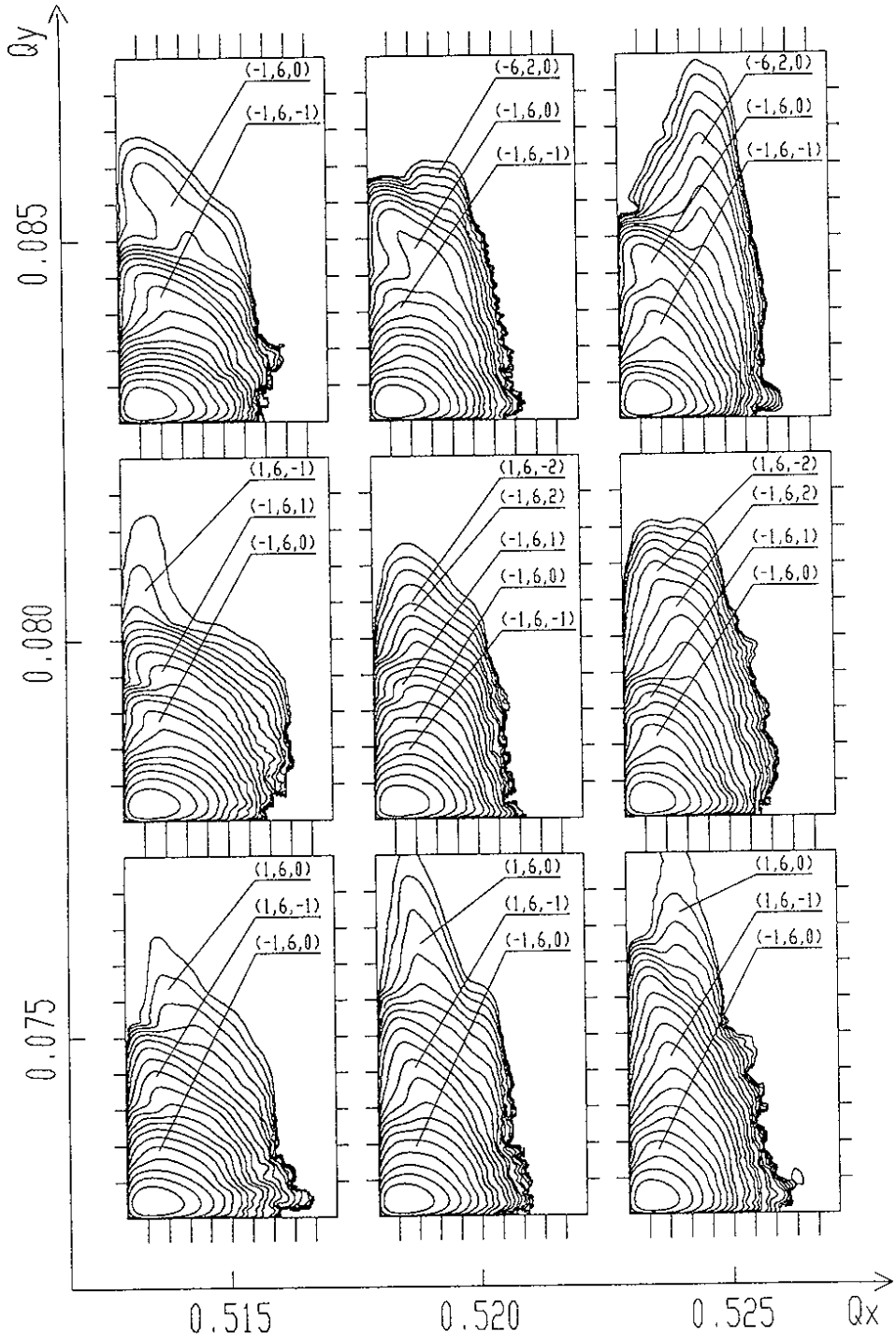

Figure 4: The contour plots ($10\sigma_x$, $25\sigma_y$) for the working points, shifted by 0.005 from the designed one (see Fig. 2, big square). The successive contour levels are at a constant ratio e below each other. The resonances $l \cdot Q_x + m \cdot Q_y + n \cdot Q_z = k$ are shown as (l, m, n).

of the resonance location from the betatron tunes. On the other hand, in the core the widths of high order resonances become very small, and besides the sensitivity to the betatron tunes decreases due to high nonlinearity. So, the optimization of the parameters (here we vary the betatron tunes only) can be reduced to two steps. First, one should find the area far from the strong low-order resonances, where the beam core is not significantly disturbed. Second, within this area one should test the beam tails and choose the working point more accurately.

As is seen from Figures 3 and 4, the beam core remains actually the same for the tested points, while the tails change significantly. The working resonances, which affect the beam tails, are located in the tunes' plain near the working point (see Fig. 2), in contrast with the resonances affected the beam core, which are shifted from the working point almost by ξ. The synchro-betatron resonances are emphasized due to a crossing angle at the IP, but nevertheless the situation with the tails seems to be quite acceptable. The only advice is to avoid the shift of the betatron tunes in "right-down" direction.

4 CONCLUSION

We have compared two tracking codes: LIFETRAC (author D. Shatilov) and BBC (author K. Hirata). The comparison has shown a good agreement between them and validity of the acceleration algorithm, which is used in LIFETRAC and allows to simulate beam tails much faster. After that, we scanned the plain of betatron tunes near the KEKB working point. The simulation results have convinced us the feasibility of a scheme with a crossing angle at the IP, since it was not detected a significant beam tails growing.

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References

[1] J. Irwin, *Simulation of Tail Distributions in Electron-Positron Circular Colliders* (Third Adv. ICFA Beam Dynamics Workshop, Novosibirsk, 29 May - 3 June, 1989)

[2] T. Chen et al., *Simulation of the Beam Halo from the Beam-Beam Interaction*, Phys. Rev. E, 49, 2323 (1994)

[3] D.N. Shatilov, *Beam-Beam Simulations at Large Amplitudes and Lifetime Determination* (INP 92-79, Novosibirsk, 1992, in Russian)

[4] D.N. Shatilov, *Beam-Beam Simulations at Large Amplitudes and Lifetime Determination*, Part. Acc. 52, 65 (1996).

[5] K. Hirata, *Crossing Angle Issues in KEKB*, to appear in the Proc. of the 7th Advanced ICFA Beam Dynamics Workshop on *Beam-Beam Issues for Multibunch, High-Luminosity Colliders*, Dubna, Russia, 18-20 May 1995

[6] M. Bassetti and G. Erskine, CERN ISR TH/80-06 (1980)

[7] K. Hirata et al., *A Symplectic Beam-Beam Interaction with Energy Change*, Part. Acc. 40, 205 (1993)

[8] M. Furman et al., *Comparisons of Beam-Beam Code Simulations*. CBP Tech Note-59 (1995)

[9] K. Hirata, *Analysis of Beam-Beam Interactions with a Large Crossing Angle*, Phys. Rev. Lett. 74, 2228 (1995)