From real regular multisoliton solutions of KP-II to finite-gap solutions

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The real regular mutlisoliton solutions of the Kadomtsev-Petviashvili-II equation are parametrized by the points of totally non-negative Grassmannians. Using the Postnikov's classification of the of totally non-negative Grassmannians in terms of Le-networks we associate to each positroid cell a canonical rational reductive M-curve, and the points of the positroid cell are parametrized by real divisors on these curves satisfying the regularity conditions.

By perturbing these curves one naturally obtains real regular finite-gap solution of KP-II, which are quasipariodic structures formed by solitons. The first nontrivial example is $Gr^{\text{TP}}(2,4)$, i.e. the set of points in $Gr(2,4)$ with all Plücker coordinates positive. We explicitly construct the corresponding spectral curve and its regular perturbation. The last one is a regular M-curve of genus 4.