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**JUN-CHENG WEI**, University of British Columbia

*Traveling Waves to Gross-Pitaevskii Equation, Adler-Moser Polynomials and Kadomtsev-Petviashvili Lump*

In this talk, we will consider traveling wave solutions to the Gross-Pitaevskii equation

$$icu_{x_1} = \Delta u + u - |u|^2 u$$

in  $R^2$  or  $R^3$ , where the speed  $c \in (0, \sqrt{2})$ . When  $c$  is close to 0 we show that the roots of Adler-Moser polynomials govern the locations of vortices or vortex rings, while when  $c$  is close to the sound speed  $\sqrt{2}$ , the Kadomtsev-Petviashvili-I lump arises naturally in some rescaled limit. We establish an almost one-to-one correspondence between traveling waves of GP and Adler-Moser polynomials and KP-I. Central to the analysis is the nondegeneracy of roots of Adler-Moser polynomials and KP-I lumps.