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Fully Non-inductive 2nd Harmonic Electron Cyclotron Current Ramp-up with Focused Polarized Beams in the QUEST Spherical Tokamak

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A transmission line and a launcher system have been newly developed to conduct the second (2nd) harmonic electron cyclotron (EC) plasma ramp-up with an eXtra-ordinary mode wave in the QUEST spherical tokamak. The incident elliptical polarizations were controlled with two corrugated (quarter/one-eighth wavelength) polarizers. The launcher system with two quasi-optical mirrors produced a sharply focused incident beam with a waist size of 0.05 m at the 2nd electron cyclotron resonance layer. The obtained electron density was one order of magnitude higher, compared to the previous experiments with no polarized focusing-beam. As a new record of non-inductive plasma ramp-up with EC-waves, a highest plasma current of 86 kA was achieved with a focused 230 kW 28GHz-beam. The record plasma current ramp-up efficiency on the incident power in the 2nd harmonic EC scenario was also achieved.

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