Gravity is the force we experience most directly in everyday life, yet from the standpoint of particle physics it is a peculiar one, and that is exactly what makes it so intriguing. In this talk, I will briefly outline what makes gravity distinctive. I will then introduce an experimental effort to test, within the framework of quantum mechanics, the equivalence of inertial and gravitational mass (the equivalence principle) on which general relativity is founded.The experiment uses ultracold neutrons confined in quantum bound states by the Earth's gravitational field. By measuring the time evolution of these states, we aim to determine the ratio of inertial to gravitational mass for a quantum system. The key enabling technology is a time-resolving neutron imaging sensor, which we have developed by adapting a CMOS pixel sensor for neutron detection with a thin boron conversion layer. I will present the current status of the sensor development, together with ongoing R&D at Los Alamos National Laboratory (LANL) in the US and the Paul Scherrer Institute (PSI) in Switzerland.

[1] "Assessment of the Imaging Performance of the CITIUS High-Resolution Detector for Heavy Charged Particles and Neutrons", Y. Kamiya, H. Nishino, and T. Hatsui, Nucl. Instrum. Methods A1090, 171677 (2026).

[2] "Development of Two-Dimensional Neutron Imager with a Sandwich Configuration", Y. Kamiya, R. Nishimura, S. Mitsui et al., Nucl. Instrum. Methods A1064, 169390 (2024).

[3] "Development of a Neutron Imaging Sensor using INTPIX4-SOI Pixelated Silicon Devices", Y. Kamiya, T. Miyoshi, H. Iwase et al., Nucl. Instrum. Methods A979, 164400 (2020).