The Axioma experiment is an R&D project for the development of a novel class of particle detectors based on solid crystals of inert gases such as Neon, Xenon, para-Hydrogen and others. We exploit ultra-pure and doped crystals combined with laser spectroscopic technique to improve the actual standard of the detectors’ energy threshold. The final goal is thus to reach an innovative technology for Dark Matter searches as well as for the investigation of feeble interacting phenomena characterized by low energy deposition events.

In order to reach a suitable low energy threshold scheme, we are investigating three different possibilities:

**A. Undoped matrices**
- Incident particles ionize the undoped matrix
- Band gap energy is tens of eV
- Electron extraction
- Charge signal

We measured electrons extraction from a solid crystal of Neon (1 cm) at 5.5K [in the figure the charge signal]. For our tests, photoelectrons are injected into the crystal when UV laser pulses impinge on a gold substrate.

**B. Recycling scheme**
- Laser-assisted transition 1 → 3
- Fluorescence signal 2 → 1
- Recycling mechanism 1 → 3 → 2 → 1
- One single transition 0 → 1 triggers the emission of N photons

We are interested in schemes that involve both the vibrational bands of the undoped matrices [in the figure, the cathodoluminescence emission spectra of solid nitrogen @ 20K], and the energy levels of RE doped crystals.

**C. Doped crystals**
- Zeeman splitting of ground state level
- Very small energy transition (meV)
- Laser induced ionization (LI)
- Charge signal

We did initial tests with 1% Nd-doped solid Neon. Emission spectra was recorded when the crystal was excited with 266nm UV pulses. We found a long-lifetime emission band centered at ≈500nm.