



# IFMP Seminar

**Date** Monday, December 11, 2023, at 14:50

**REC/C213**

**BigBlueButton:** <https://bbb.tu-dresden.de/b/dar-mbs-me8-gsc>

**Speaker** **Artem Korshunov**

*ESRF*

**Title** **Charge density wave (CDW) transition in Eu(Ga,Al)<sub>4</sub> series studied by diffraction and inelastic x-ray scattering**

**Abstract** The intermetallic Eu(Ga,Al)<sub>4</sub> system has recently attracted attention due to its nontrivial magnetic transitions and the emergence of a CDW state [1]. Its crystal structure adopts the BaAl<sub>4</sub> structure type with tetragonal symmetry of *I4/mmm* space group. As an example, EuAl<sub>4</sub> undergoes an incommensurate CDW transition with propagation vector  $q_{\text{CDW}} \approx (0, 0, 0.18)$  below  $T_{\text{CDW}} = 145$  K [2]. Remarkably, external pressure can entirely suppress this state in EuAl<sub>4</sub>, while the CDW in EuGa<sub>4</sub> can only be induced by pressure. The CDW modulation is associated with atomic displacements within the *ab* plane; however, the localization of the CDW remains unclear. Concurrently, the Fermi surface does not exhibit a clear instability at  $q_{\text{CDW}}$  that is responsible for the CDW. Recent density functional theory calculations [3] suggest that strong electron-phonon coupling may be the driving force for the CDW, but this awaits experimental evidence. In this study, we aim to shed light on the origin of the CDW in the Eu(Ga,Al)<sub>4</sub> series. We have traced changes in crystal structure and diffuse scattering during the CDW transition by means of single crystal synchrotron diffraction at the ID28 beamline (ESRF). Additionally, using inelastic x-ray scattering, we measured phonon dispersions for several temperatures. Our findings reveal a pronounced softening of a transverse acoustic phonon near  $q_{\text{CDW}}$  over a broad temperature range, providing crucial insights into CDW formation in isostructural compounds.

[1] Nakamura, Ai, *et al.*, *Transport and magnetic properties of EuAl<sub>4</sub> and EuGa<sub>4</sub>*, JPSJ **84**(12), 124711 (2015)

[2] Ramakrishnan, S., *et al.*, *Orthorhombic charge density wave on the tetragonal lattice of EuAl<sub>4</sub>*, IUCrJ **9**(3), 378 (2022).

[3] Wang, L, *et al.* *Origin of Charge Density Wave in Topological Semimetals SrAl<sub>4</sub> and EuAl<sub>4</sub>*, arXiv:2306.15068 (2023).

Host: M. Rahn