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ALSA: Automatic Laue Sample Aligner

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The co-alignment of multiple individual single crystals is a common practice in mass-sensitive techniques like μSR and inelastic neutron scattering, particularly when limited by the ability to grow larger crystals. This alignment process has historically been labour-intensive and often not very precise (e.g. [1]).

The ALSA device aims to revolutionize this procedure by automating the co-alignment process by integrating machine learning and cutting-edge technologies. Utilizing a state-of-the-art X-Ray Laue diffractometer, **robotic manipulators**, real-time **camera recognition**, and bespoke **neural network software** for crystal placing and Laue pattern solving [2], ALSA promises to be a game-changer in the field of sample preparation. It will significantly accelerate the sample preparation process, offering a substantial leap forward in efficiency and precision. To glue small crystals as close to each other as possible, we have developed an online algorithm for **irregular polygon stacking**; with a series of benchmarking tests proving that it is the most efficient online algorithm available. The whole robotic device uses **Bayesian optimization** to find the best parameters for achieving the given tasks. In this presentation, we will focus on the design of the device, as well as practical tests on an inelastic neutron spectrometer IN12, where more than **200 irregular single crystals** of Na₂BaMn(PO₄)₂ were automatically coaligned with **mosaicity below 2 degrees**.

[1] Duan, C. Et al. Nature 600, 636–640 (2021). doi:10.1038/s41586-021-04151-5
[2] See abstract “Tackling Laue pattern solving using neural networks”

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