

**W0272**

**Automated Structure Refinement in PHENIX: Recent Advances and New Algorithms.** Pavel V. Afonine, Ralf W. Grosse-Kunstleve, Peter H. Zwart, Paul D. Adams, Lawrence Berkeley National Laboratory, One Cyclotron Rd, Berkeley, CA 94720.

The advent of new computational technologies (hardware and software) makes it possible to rethink the algorithms for crystallographic structure refinement and to increase the level of automation. The ongoing development of structure refinement tools in the PHENIX project [1,2] has led to a comprehensive suite of algorithms covering a variety of refinement scenarios. A robust bulk solvent correction with anisotropic scaling, rigid body refinement with a large convergence radius, refinement of individual atomic coordinates and atomic displacement parameters (ADPs) using gradient-driven minimization, grouped ADP refinement, simulated annealing, and NCS restraints are readily available. All optimization steps, including bulk solvent modeling and scaling, can be performed using a variety of least-squares and maximum-likelihood target functions. Under active development is the generalization of ADP refinement combining isotropic, anisotropic, grouped and TLS algorithms in a uniform framework suitable for integration of automated decision making to determine the best parameterization. We have also implemented automatic twinning detection and the development of suitable target functions is under way. Robustness of the PHENIX refinement tools was tested by automatic re-refinement of all models in the Protein Data Bank (PDB) for which unambiguous experimental data and cross validation flags are available.

[1] Adams PD, Gopal K, Grosse-Kunstleve RW, Hung L-W, Ioerger TR, McCoy AJ, Moriarty NW, Pai RK, Read RJ, Romo TD, Sacchettini JC, Sauter NK, Storoni LC, Terwilliger TC: Recent developments in the PHENIX software for automated crystallographic structure determination. *J. Synchrotron Rad.* 2004, 11:53-55.

[2] Afonine PV, Grosse-Kunstleve RW, Adams PD: The Phenix refinement framework. *CCP4 newsletter*, July 2005; Contribution 8.