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The National Center for CryoEM Access and Training: Broadening Access to CryoEM Through Centralized Facilities

Edward T. Eng[1]*, Christina Zimanyi[1], Hui Wei[1], Mahira Aragon[1], Eugene Y.D. Chua[1], Elina Kopylov[1], Charlie Dubbeldam[1], Cathleen Castello[1], Clinton S. Potter[1], Bridget Carragher[1]

[1.] National Center for CryoEM Access and Training, Simons Electron Microscopy Center, New York Structural Biology Center, New York, NY United States

* Corresponding author: eeng@nysbc.org

Developments over the past decade have established cryogenic electron microscopy (cryoEM) as a technology capable of generating reliable atomic models of complete and fully functional macromolecular complexes. This technique uses images of frozen hydrated biological specimens to enable high-resolution analysis of previously inaccessible levels of biological organization, ranging from below 100kDa to whole cells and tissues. The NIH Common Fund established the Transformative High Resolution Cryo-Electron Microscopy program to provide access to this technology and support the development of cryoEM training curricula to build a skilled cryoEM workforce. The National Center for CryoEM Access and Training (NCCAT) [1] is one of these NIH sponsored service centers. NCCAT is based in New York and offers the nation access to state-of-the-art cryoEM technology for data collection [2], grid preparation and screening [3,4], and cross-training on the full workflow from sample preparation to on-the-fly computational feedback [5].

NCCAT is housed at the New York Structural Biology Center and is strategically co-located with resources that broadens its outreach, as well as enables users to travel onsite to participate in our local cryoEM community [6]. This environment allows for the use of state-of-the-art equipment for the collection and analysis of high-resolution data, while also providing technical support and cross-training to establish a network of independent users of cryoEM technology across the nation. These services are offered at no cost to non-profit institutions, thus eliminating the high-cost barrier usually associated with cryoEM and structural biology in general. To operate an effective facility with multiple instrument platforms, which serve a user base with varying skill levels, centers need to be at the forefront of software and hardware developments and also be able to make the technology accessible to a broader audience. This system is achieved when there is a thriving local structural biology research community that drives technology development and provides novel opportunities for biomedical research.

The core motivation for establishing cryoEM centers is to have a promotive effect in the field by not only scaling services, but also enabling researchers to perform their own research rather than doing it for them. NCCAT's driving aim is to increase the number of investigators who can independently practice cryoEM and enable researchers in other fields of biomedical research to adopt cryoEM methods. A key component of our access categories is the cross-training program to train a scientist to become an independent cryoEM researcher. A unique opportunity here is our intensive immersion program, where a trainee "embeds" by spending significant time at our facility. This cross-training program is based on modular curricula that enables laboratories from structural biology and other fields to learn all steps of cryoEM technology: the preparation and evaluation of their samples, collection of high-resolution data,

theory, and computational analysis. NCCAT has been working with partner service centers to develop open-access instructional material called “cryoEM merit badges” to expand standards and training efforts. These cryoEM merit badges are proficiency certifications awarded to users of any of the centers in three main skill areas: 1) sample preparation, 2) microscope operations, and 3) data processing. A merit badge authorizes a researcher as an independent practitioner on a particular instrument or in a skill area. Merit badges are cross honored at other national service centers, minimizing duplication of training efforts and ensuring a minimal level of core competency is attained by researchers. Furthermore, our cross-training efforts are always integrated with every access category and intended to serve as a catalyst for increasing research capacity by helping investigators work independently.

National and regional service centers have emerged to support the growth of cryoEM technology by increasing the accessibility of cryoEM throughout the biomedical research community. In support of this, the NIH sponsored service centers have created a joint website to aid in disseminating cryoEM resources from the network [7]. Through cooperation and synergy, these centers form a network of cryoEM resources that accelerate the adoption of best practices for access and training and establish sustainable workflows to build future research capacity [8].

References:

[1] https://nccat.nysbc.org
[2] Cheng et al. Leginon: New features and applications Protein Sci. 2021; 30(1):136-150.
[3] Razinkov et al. A new method for vitrifying samples for cryo-EM. J Struct Biol. 2016;195(2):190-8.
[4] Dandey et al. Spotiton: New features and applications. J Struct Biol. 2018; 202(2):161-169.
[5] Lander et al. Appion: an integrated, database-driven pipeline to facilitate EM image processing. J Struct Biol. 2009; 166(1):95-102.
[6] Zimanyi et al., Broadening access to cryoEM through centralized facilities. Trends Biochem Sci. 2021; S0968-0004(21)00233-4.
[7] https://cryoemcenters.org
[8] Some of this work was performed at the National Center for CryoEM Access and Training (NCCAT) and the Simons Electron Microscopy Center located at the New York Structural Biology Center, supported by the NIH Common Fund Transformative High Resolution Cryo-Electron Microscopy program (U24 GM129539,) and by grants from the Simons Foundation (SF349247) and NY State Assembly.