Single-particle delivery at SACLA

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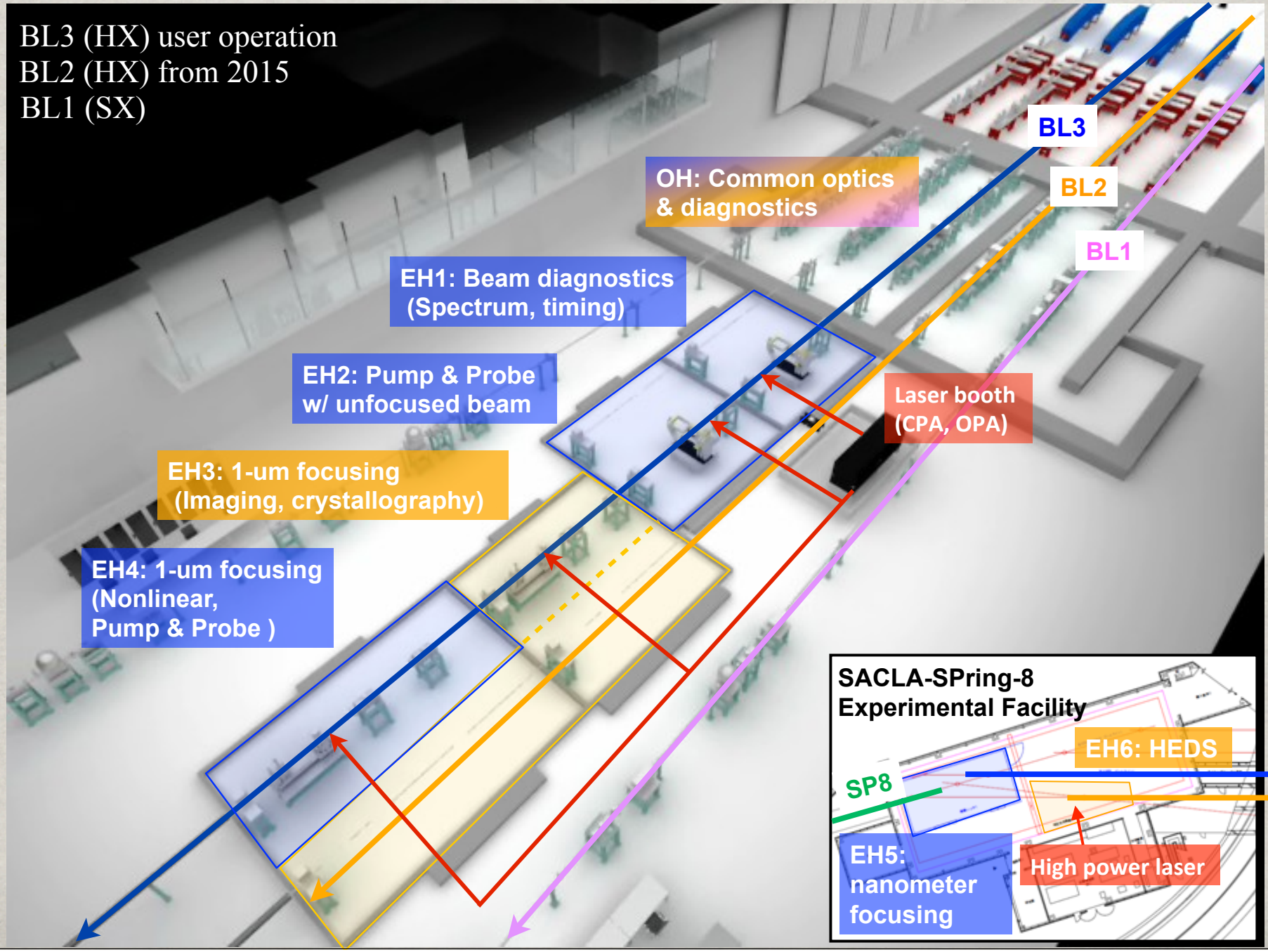
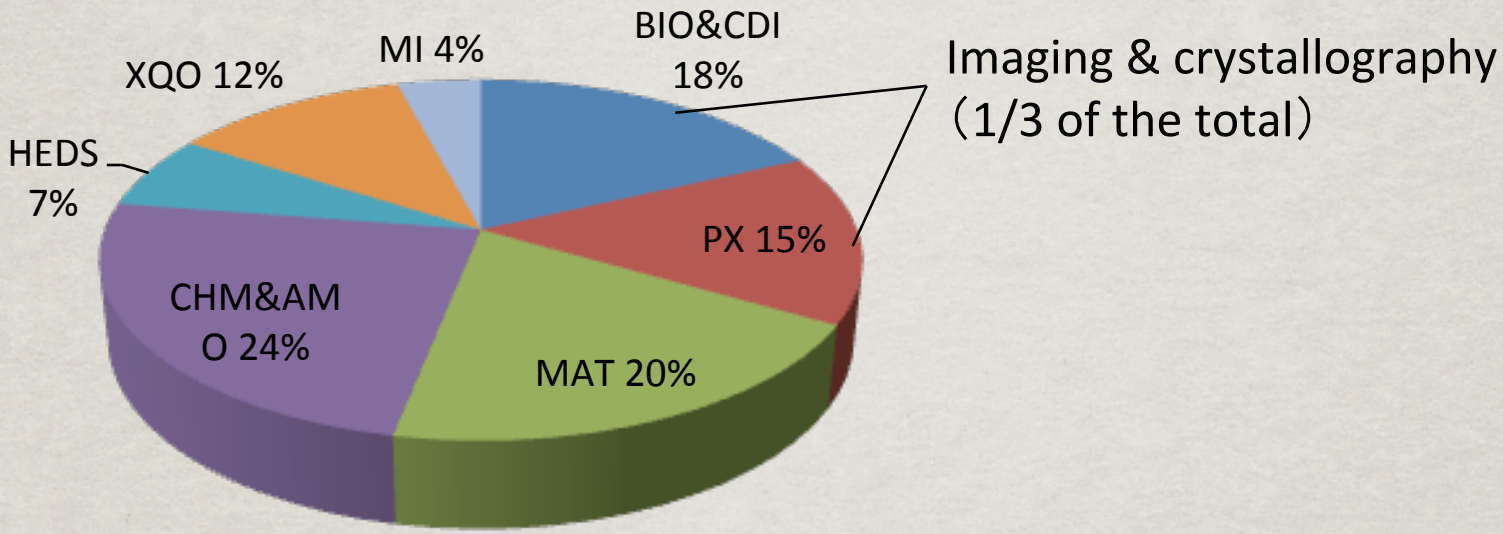
SACLA beamline overview



2013 SACLA user experiments



BIO: **Imaging biology**

CDI: **Coherent diffraction imaging**

PX: **Protein crystallography**

MAT: **Ultrafast materials science**

CHM: **Ultrafast chemistry**

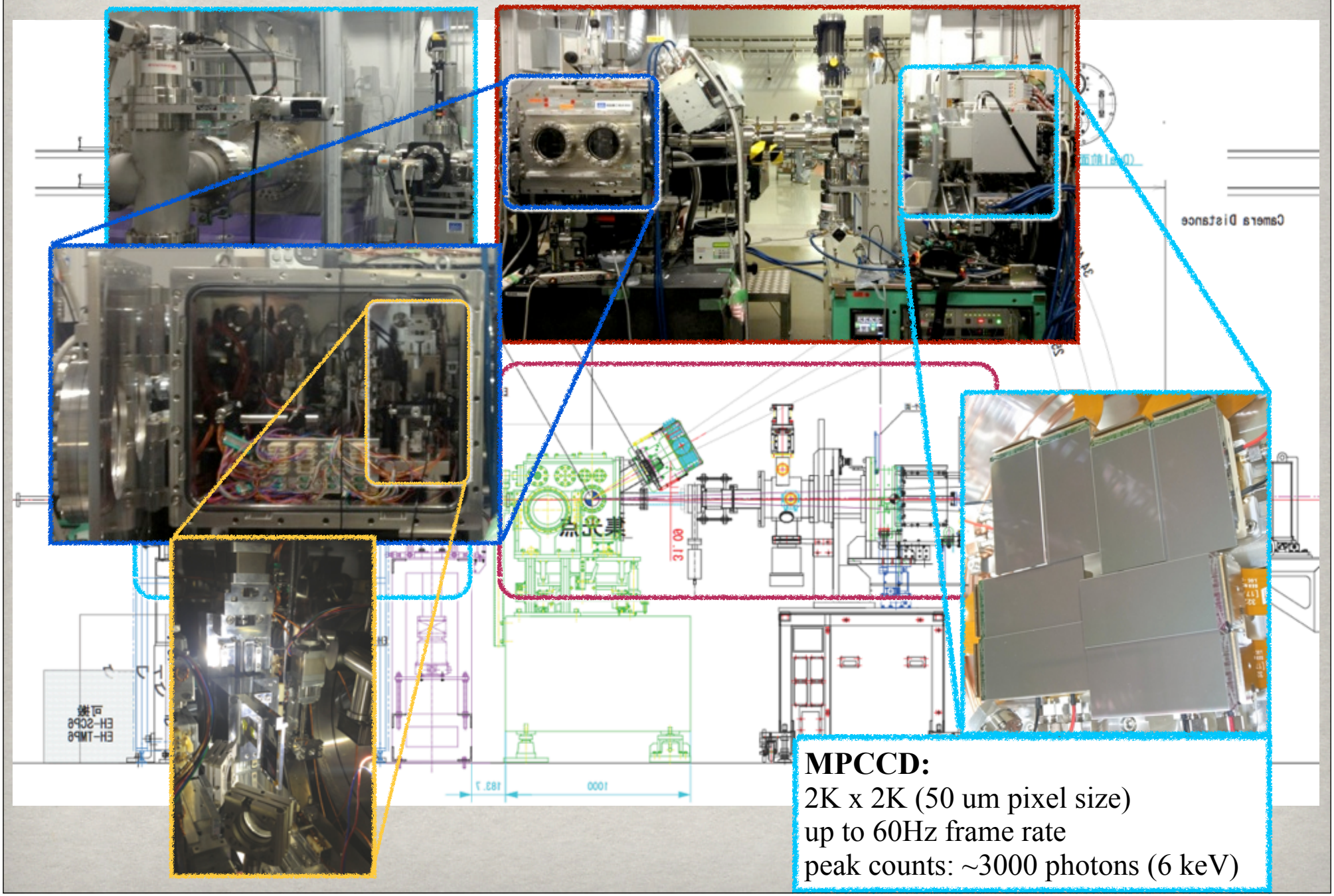
AMO: **AMO science**

HEDS: **High energy density science**

XQO: **X-ray quantum optics**

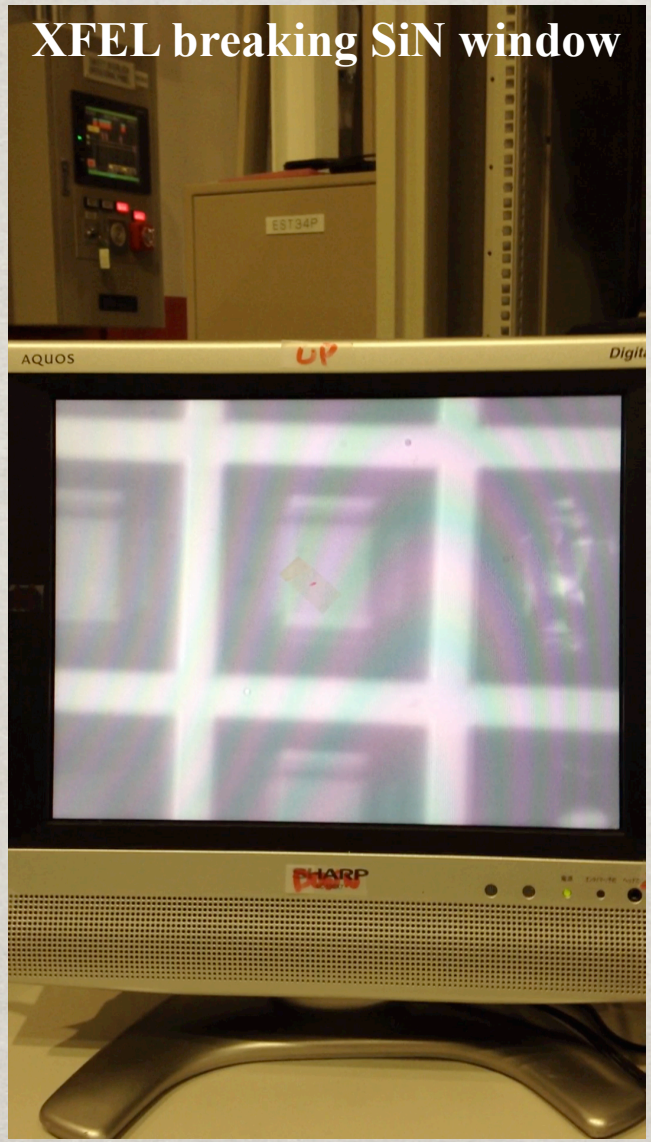
MI: **Methods and instrumentation**

Experiments at SACLA: MAXIC



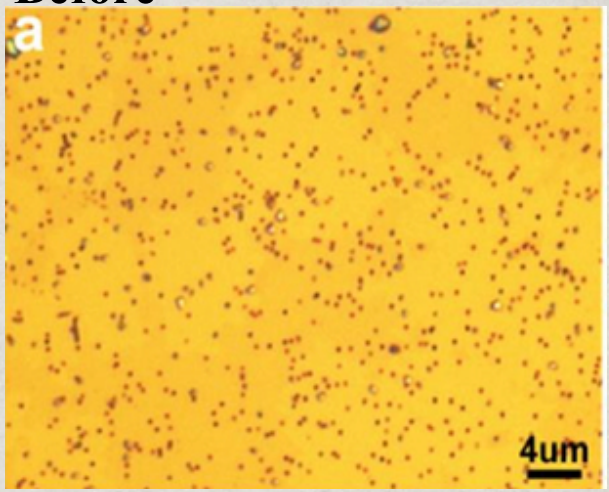
Sample delivery: X-ray pulse is destructive

Single X-ray pulse breaks a membrane window or leaves a burning hole

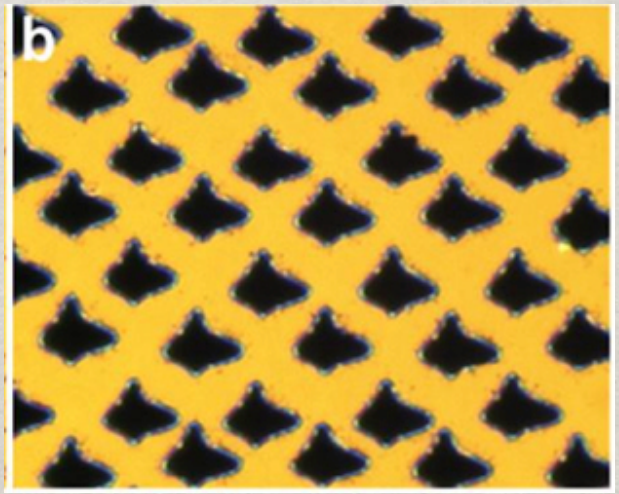


Breaking a window

Before



After: x-ray raster scan



Leaves a burning hole

To be considered for fixed target schemes

0. Sample mount
   - breaking a whole window?
   - leaving a burning hole only?

1. Sample preservation
   - sample (physiological) conditions
   - vacuum/He (detector compatibility?)

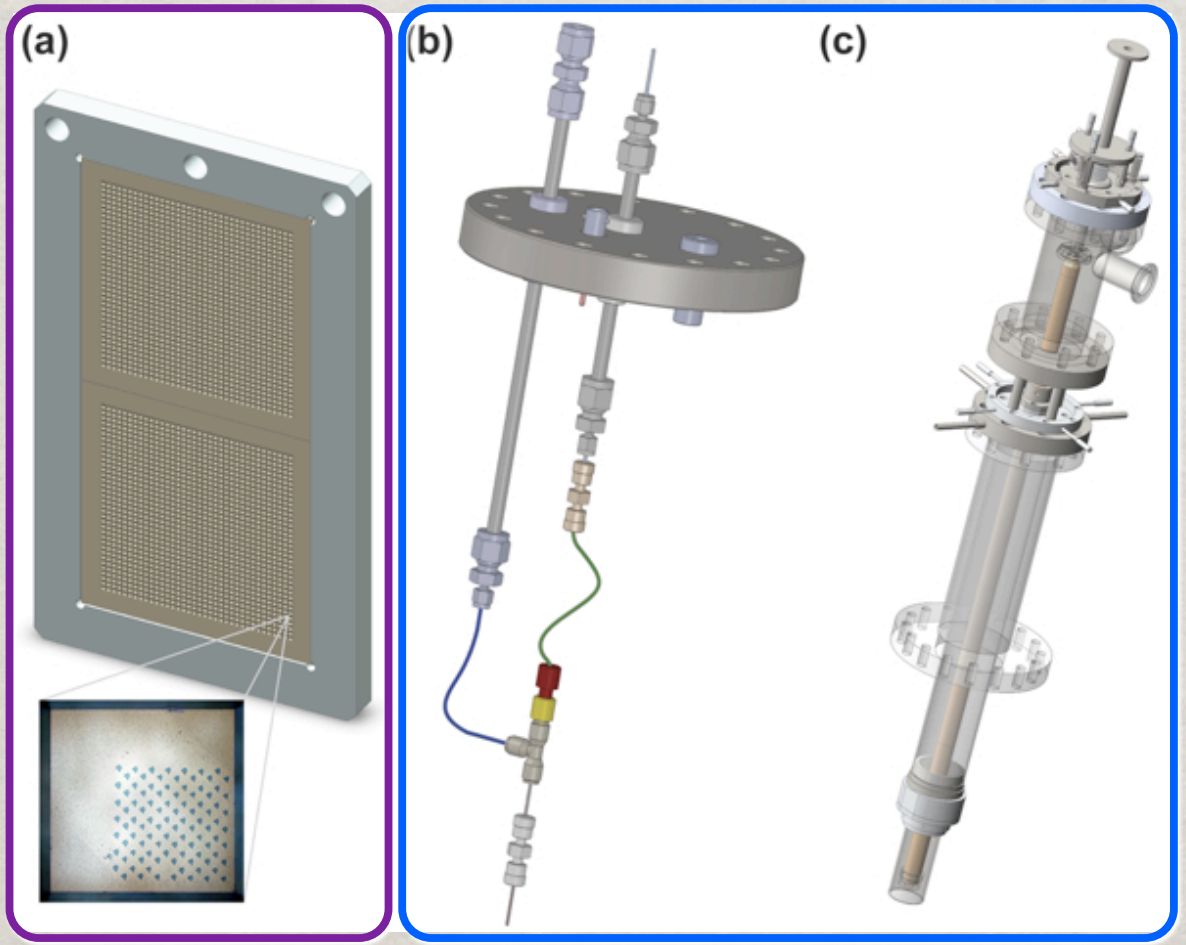
2. Raster scan speed
   - make full use of all XFEL pulses ?
   (demonstrated 30Hz raster scan with MAXIC recently)

3. Hit rate (efficiency)
   - maximum rate is almost decided..

4. Propagation of radiation damage?
   - minimum distance between X-ray exposures

Single-particle loaders

Three types of single-particle loading systems for single-shot diffraction



Flying target

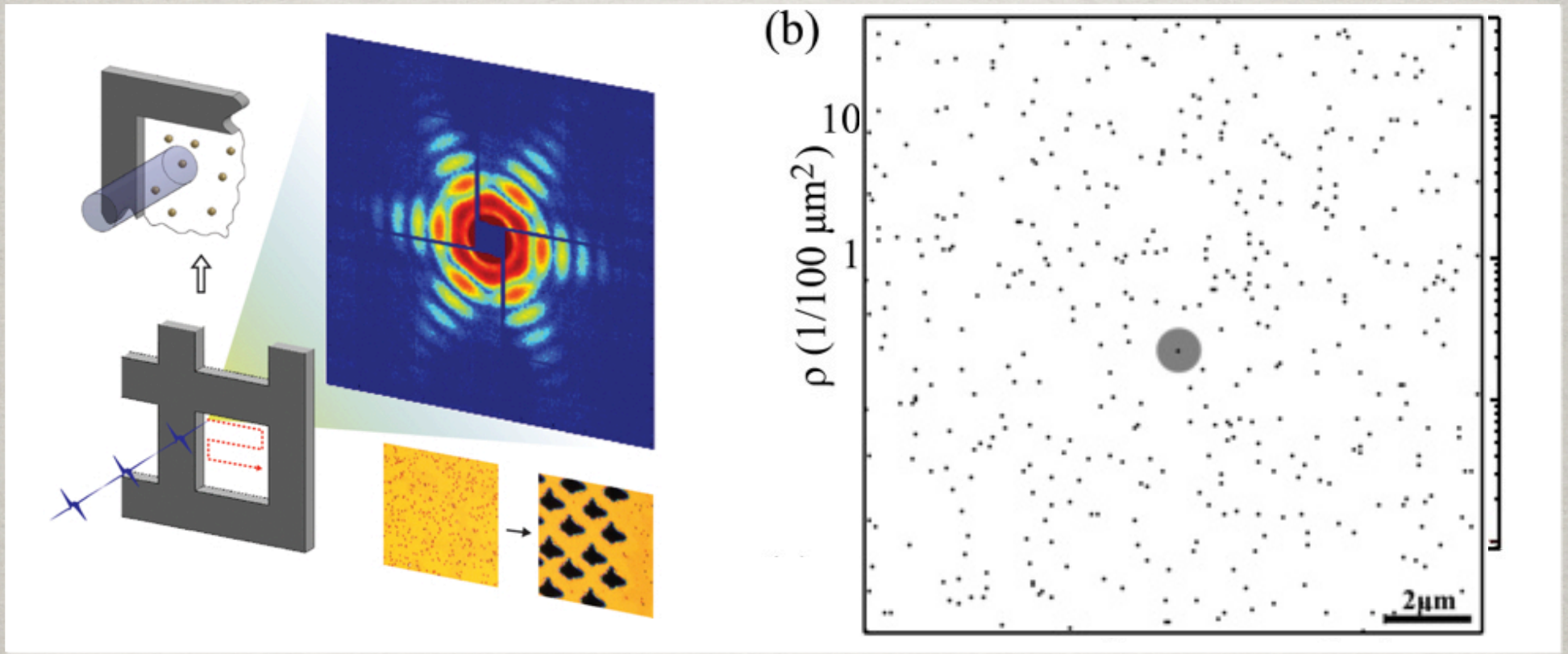
Fixed target

a. Solid membrane: samples mounted on thin membranes
b. Liquid injector : samples in several microns diameter liquid flow
c. Aerosol injector: focused stream of samples

Song C, *et al*, J. Appl. Cryst. (2013)

Optimal conditions for single-shot diffraction-I

The fixed target scheme using Si3N4 membranes



<u>Samples are mounted (randomly) on solid membranes</u>

- Advantage: easier sample control

- Advantage: less sample consumption

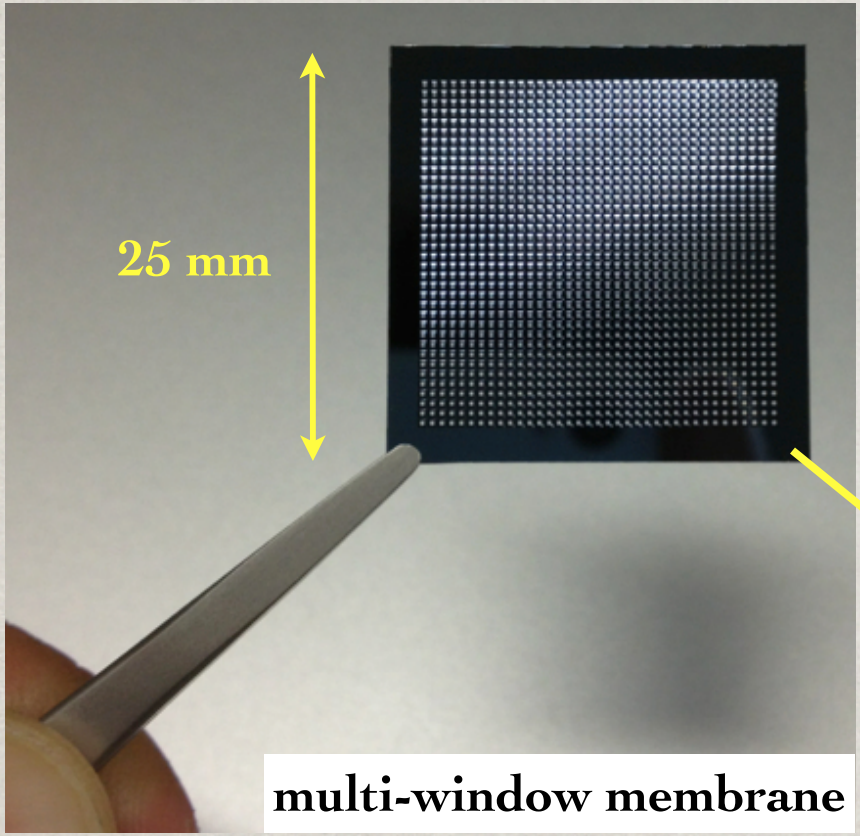
- Challenge: native? samples get dehydrated

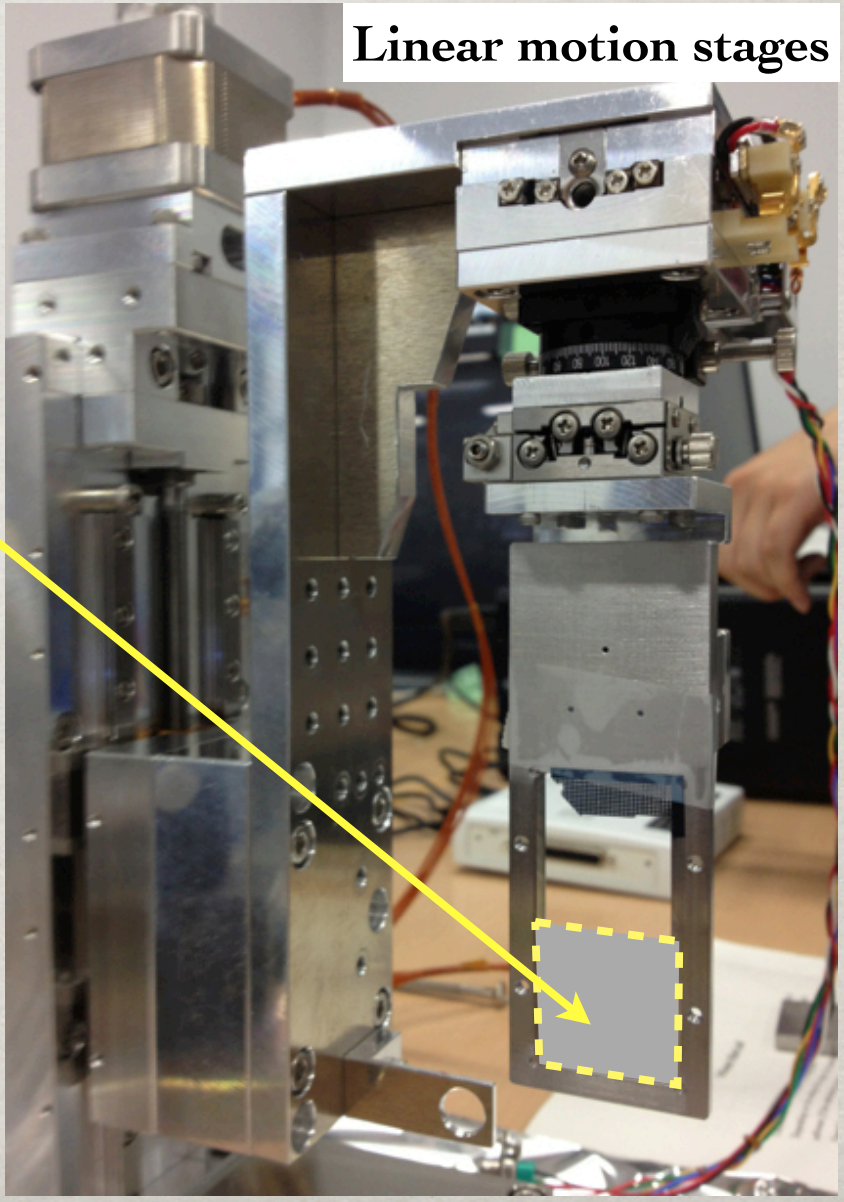
*** can now perform 30Hz raster scan (~50 um interval)**

Park, J. *et al*, Appl. Phys. Lett. (2013)

Systems for fixed target experiments

The flying target scheme using a liquid injector

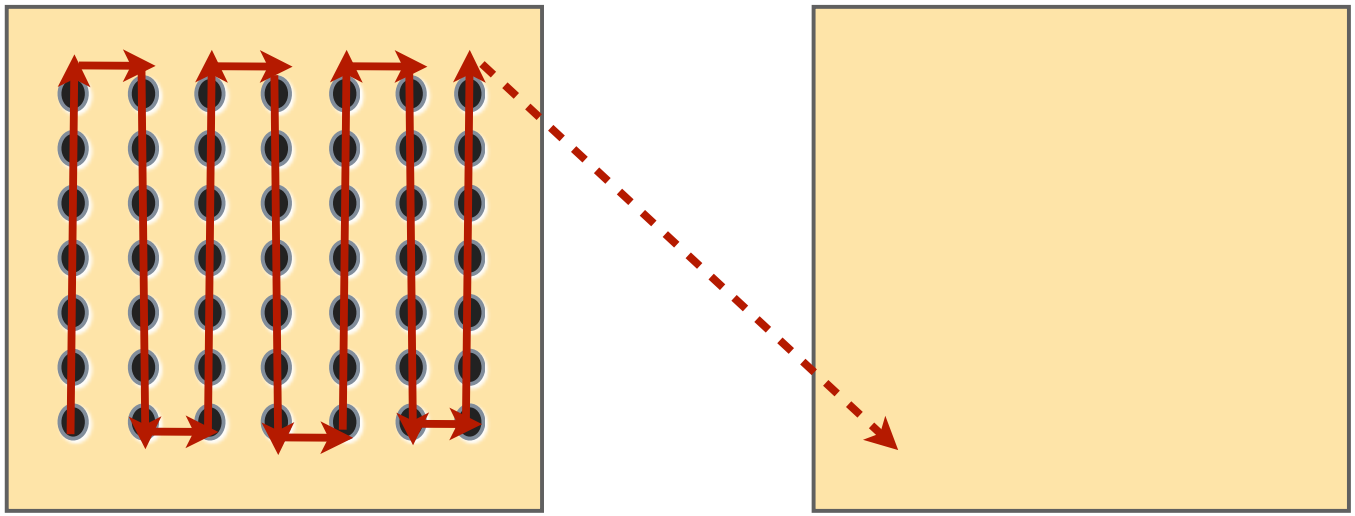




- Membrane: 100 nm thickness Si3N4
  200 um window (36 x 36 array)
- Linear motion stage (<1 um precision)
  (can mount four of 25 mm membrane)

Raster scan - high scan rate

7 x 7 in 200 um x 200 um window
25 microns separation
fly scan (30 Hz)



Raster scan up to 30Hz demonstrated (25 um intervals)
One window ~ 3 sec (36 x 36 windows ~ 1 hr)
More than 63,000 shots (49 x 36 x 36) for 25 um interval
Window positioning : automatic