# ID23-2 Present and Future

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ESRF User Meeting, 2015

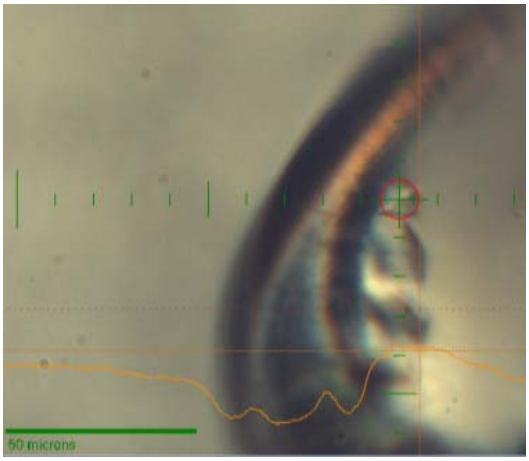
EMBL

## The ID23-2 microfocus beamline

- Why microfocus?
- ID23-2 (brief) history
- Current status
- ID23-2 future

# Why do we need a smaller beam?

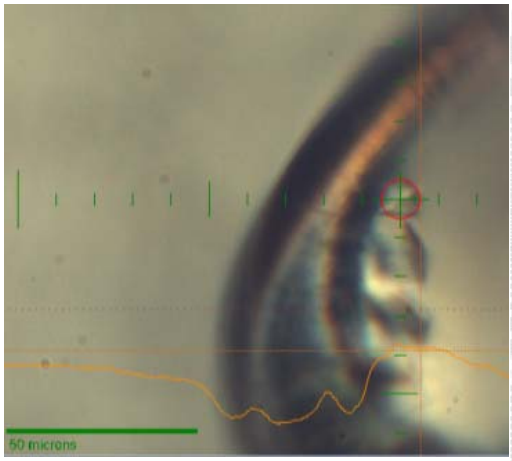
- Collection from microcrystals



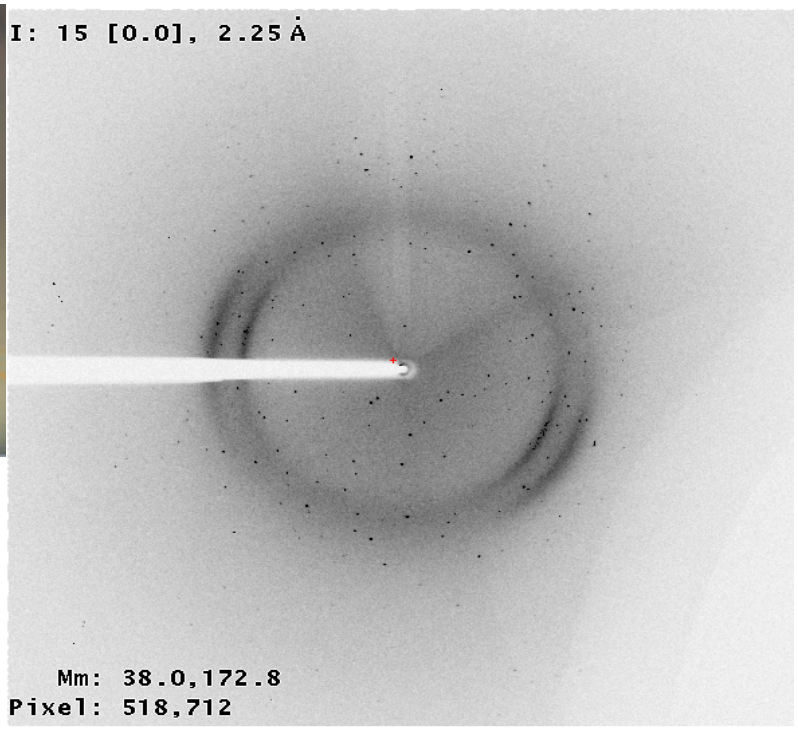

Rotation axis



# Why do we need a smaller beam?

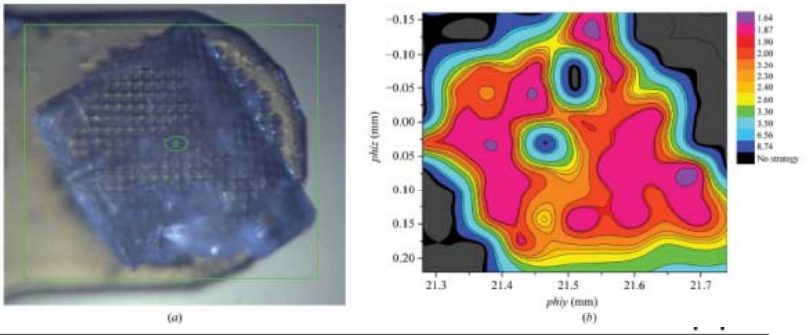



Rotation axis



# Why do we need a smaller beam?

- Characterize the diffraction of a crystal (or multiple crystals) at high resolution

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**Diffraction cartography: applying microbeams to macromolecular crystallography sample evaluation and data collection**

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Crystals of biological macromolecules often exhibit considerable inter-crystal and intra-crystal variation in diffraction quality. This requires the evaluation of many samples prior to data collection, a practice that is already widespread in macromolecular crystallography. As structural biologists move towards tackling ever more ambitious projects, new automated methods of sample evaluation will become crucial to the success of many projects, as will the availability of synchrotron-based facilities optimized for high-throughput evaluation of the diffraction characteristics of samples. Here,

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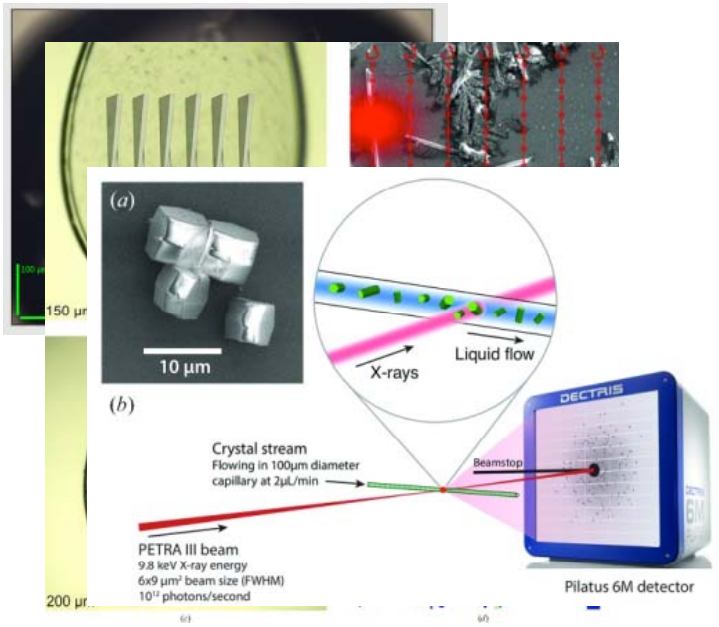
# Why do we need a smaller beam?

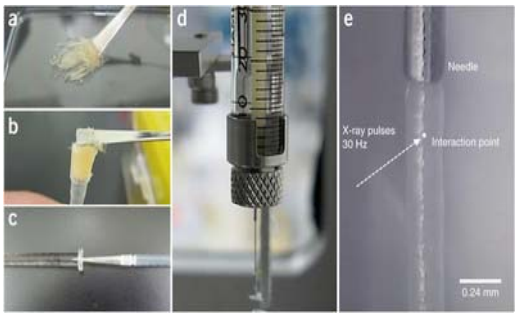
- Rastering or serial microcrystallography experiments



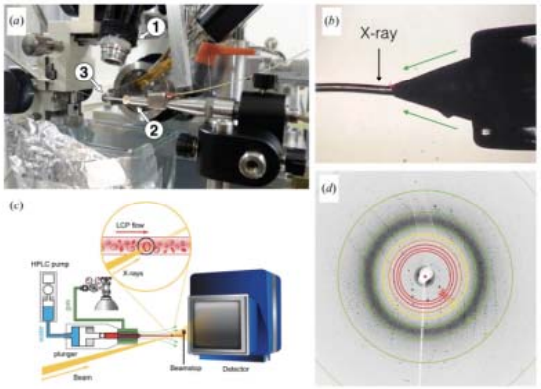

Gati *et al*. 2014

Stellato *et al.* 2014

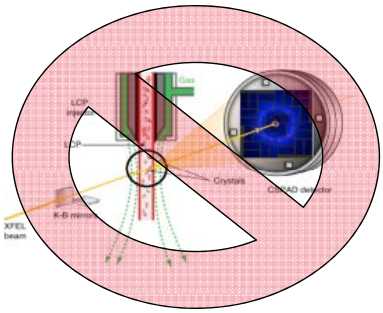
# Not all injectors are the same



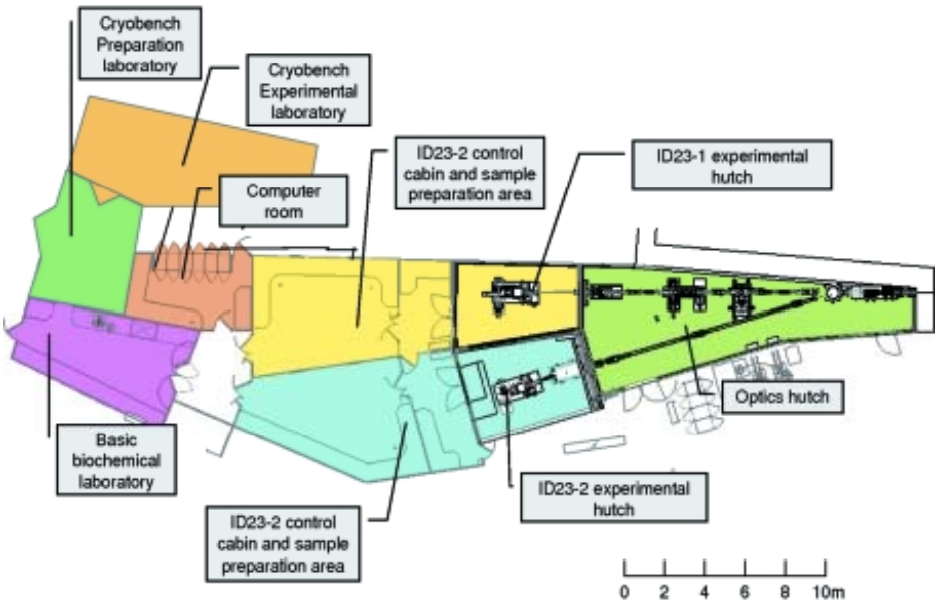

Sugahara *et al*. 2015




Nogly *et al.* 2015







# ID 23-2 Early History

+Stability
+No microfocus expertise required
+Consistency with other MX beamlines

- **July 2001**: start of the ID23 project (E. Mitchell, T. Mairs, S. McSweeney, P. Lindley)
- **January 2002**: ID23 received first round funding
- **27th October 2004**: very first beam
- **28th November 2004**: first data
- **2006**: full « user mode » and first PDB depositions

→ highly productive with 699 PDBs (officially)

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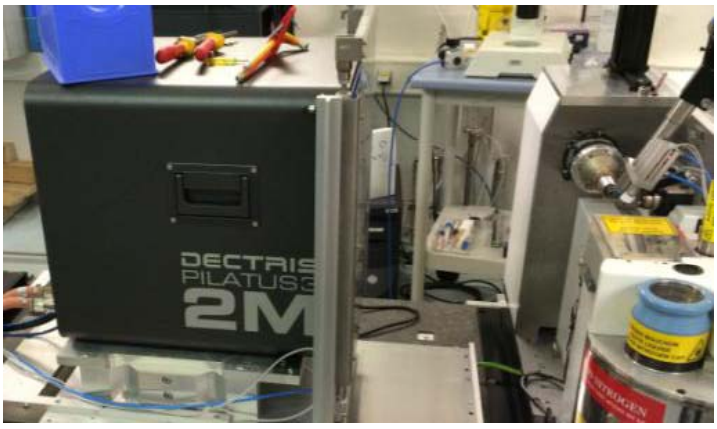
# Pilatus3 2M: January 2014

- New detector translation
- Pilatus3 2M, 250 hz data collection possible



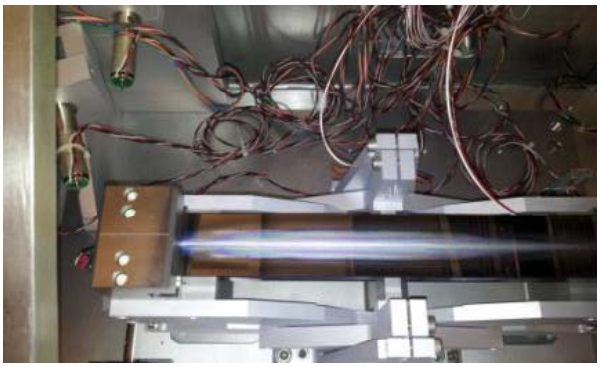

However…. More flux needed for high speed readout

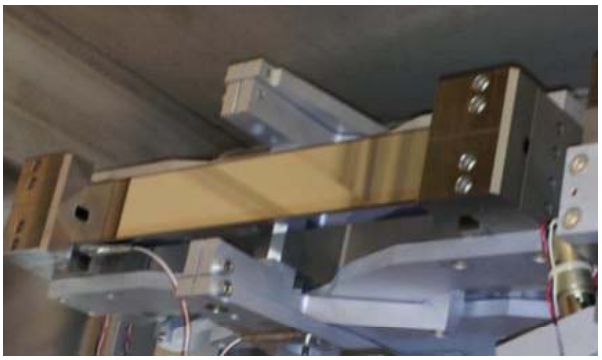
# Once upon a time …



# Mirror replacement

- New ML HFM and single coated VFM installed
- Table moved laterally





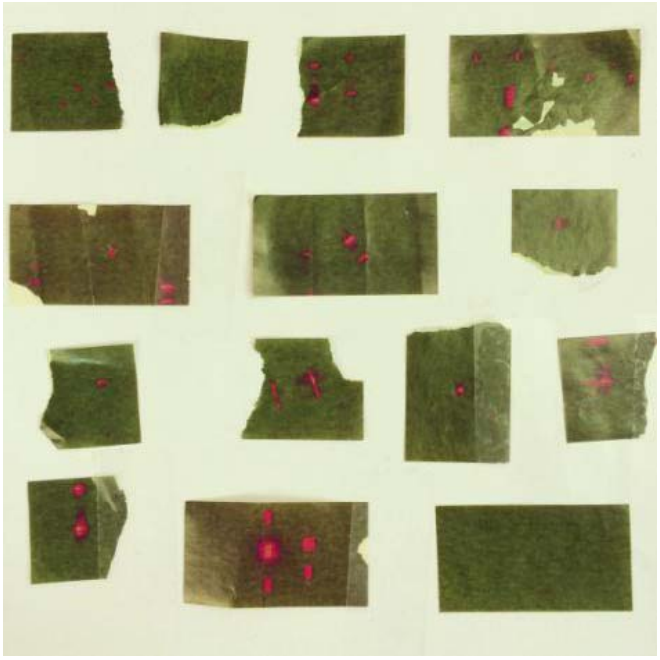
Photos: C. Clavel

Carole Clavel
Ray Barrett
Christian Morawe
David Flot
Amparo Vivo
Marc Lesourd
Alignment group
Fabien Dobias
John Surr

# Mirror replacement

- New ML HFM and single coated VFM installed
- Table moved

2.5E11 → 1E12 ph/s





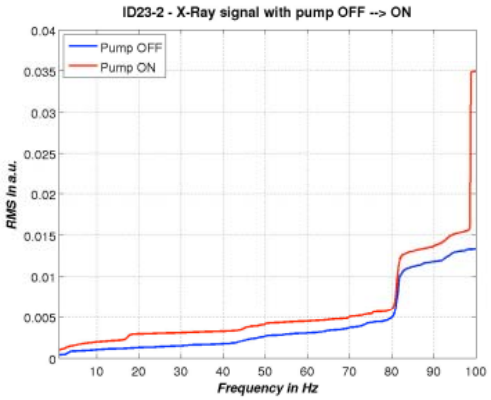
# Finding the vibration source

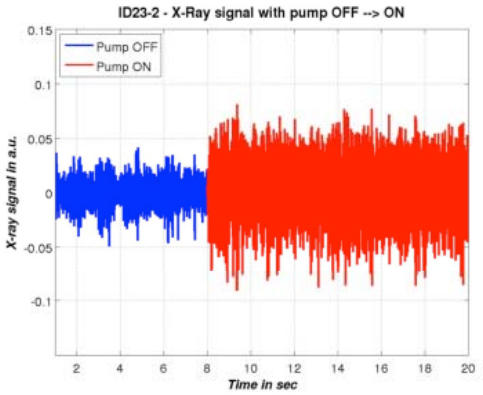
- Turned off pumps
- Turned off chillers
- Turned off A/C
- Turned off computers
- Turned off motors
- Turned off electronics racks



# Vibration Measurement (by Marc Lesourd)

- Major vibration identified: A primary vacuum pump near the hutch →
  - Replaced with a different model
  - Replaced tubing with longer stretches
  - Decoupled out of service pumps
  - → Almost no vibration remaining

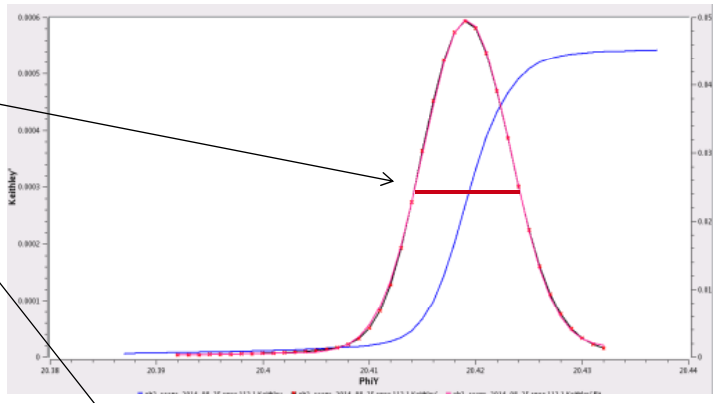


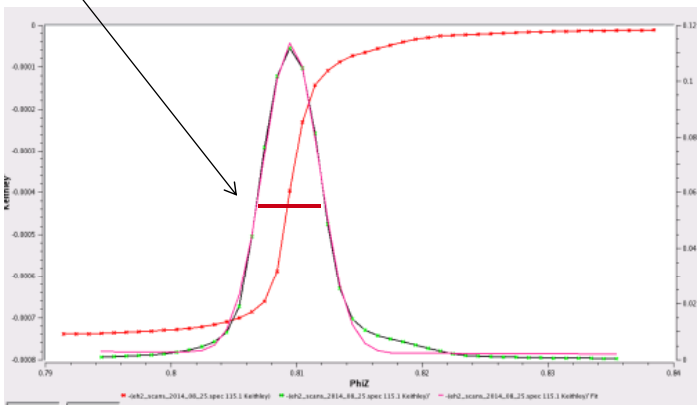






Beam size:
~9.5 (h)µm
~5.5 (v)µm

~1e12 ph/s




Measured by scanning a tungsten wire through the beam

# What do all these photons mean for crystal lifetime?

- Full data rate
- ~7 MGy/s → 4.2 seconds for a 10x10 um crystal



# Plans for the future

- A smaller beam → 1x1 micron$^2$ + 5.5x9.5 micron$^2$ selectable
- Currently exploring optical layouts
  - Stability
  - High flux
  - Effects of new lattice studied in detail
- TDR by late spring
- Completed in 2016(ish)

## A final note: Getting the most from your microcrystals

- *Use a minimum of cryo*
  - *Increased background*
  - *Centering more difficult or at least time consuming*
- *Make sure the beam is where you think it is*
- *Use EDNA to determine the best strategy*
- *Use helical data collection, if you know your crystal is uniform*
  - *There is no law stating that helical has to be over a long distance – it can be over a short distance!*