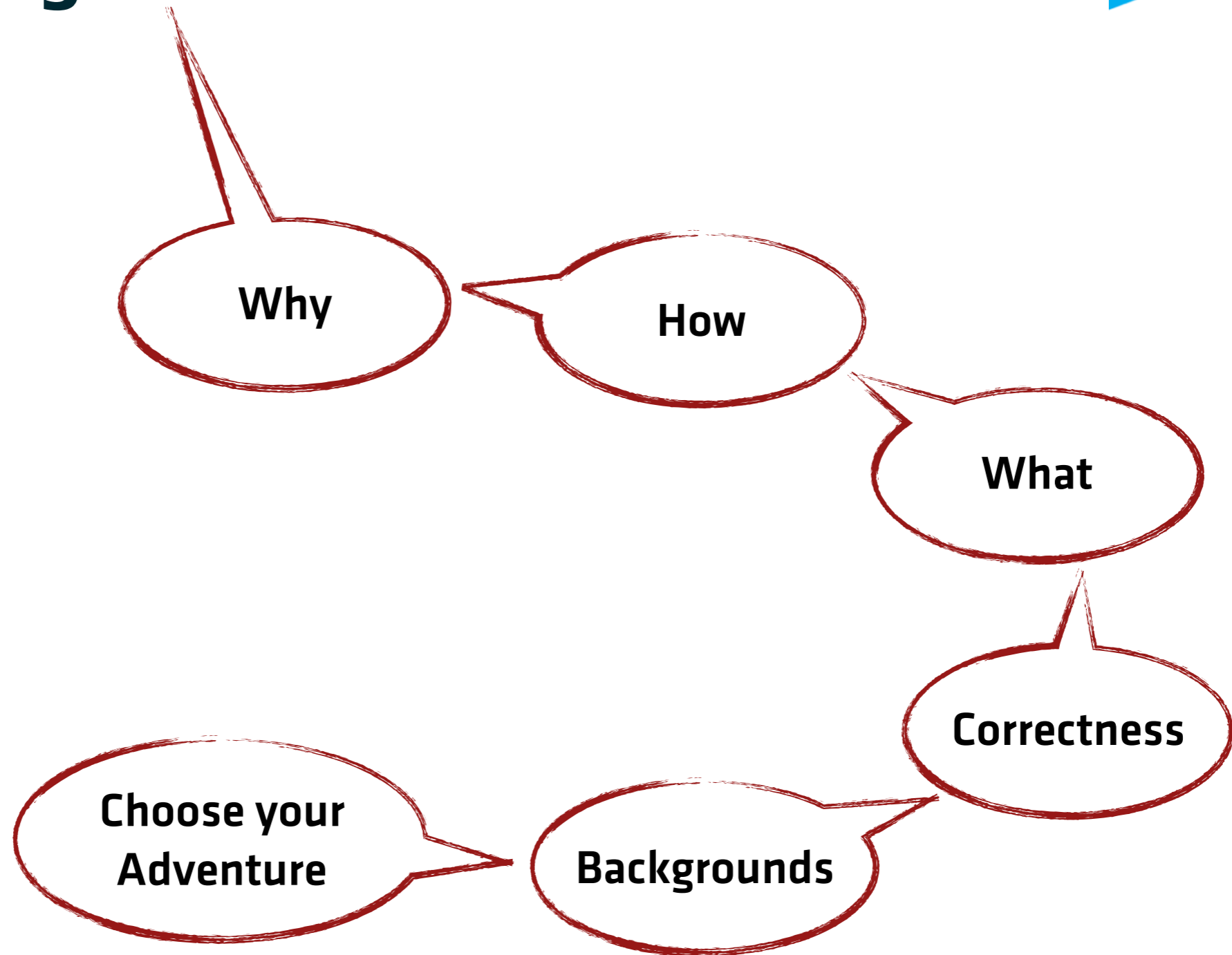


04.06.2019

Everything SAXS

B. R. Pauw

Everything SAXS

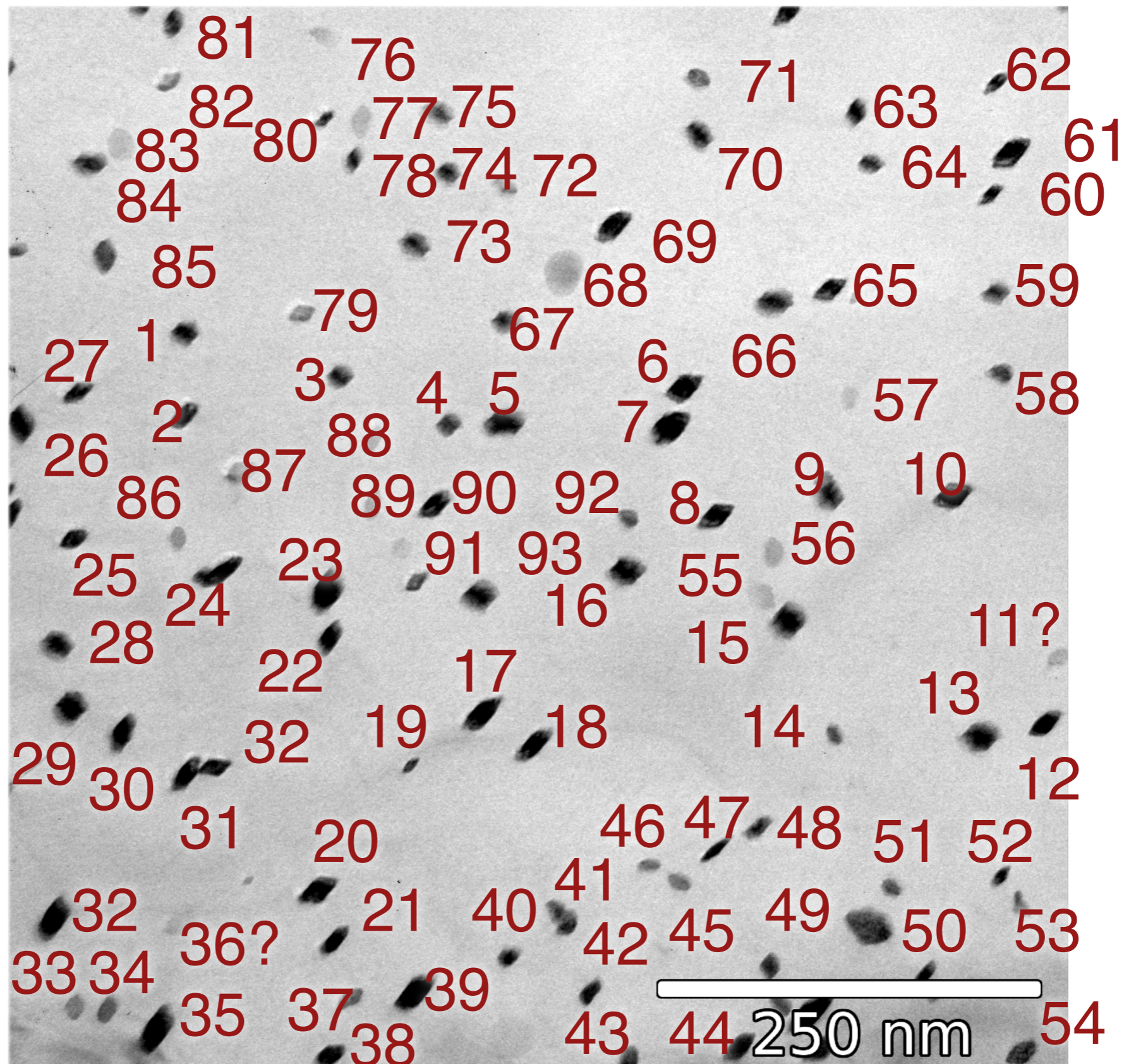


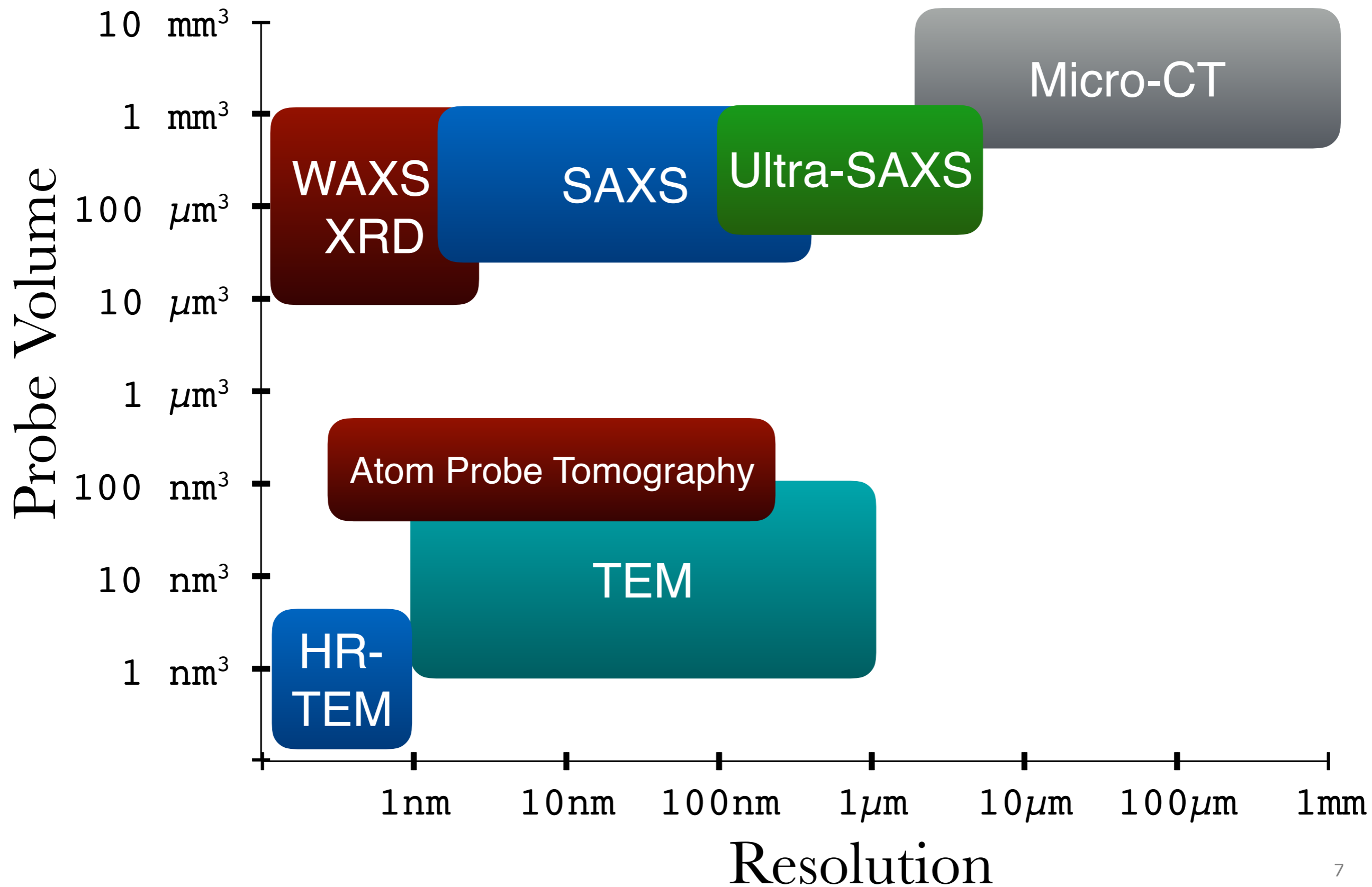
Why

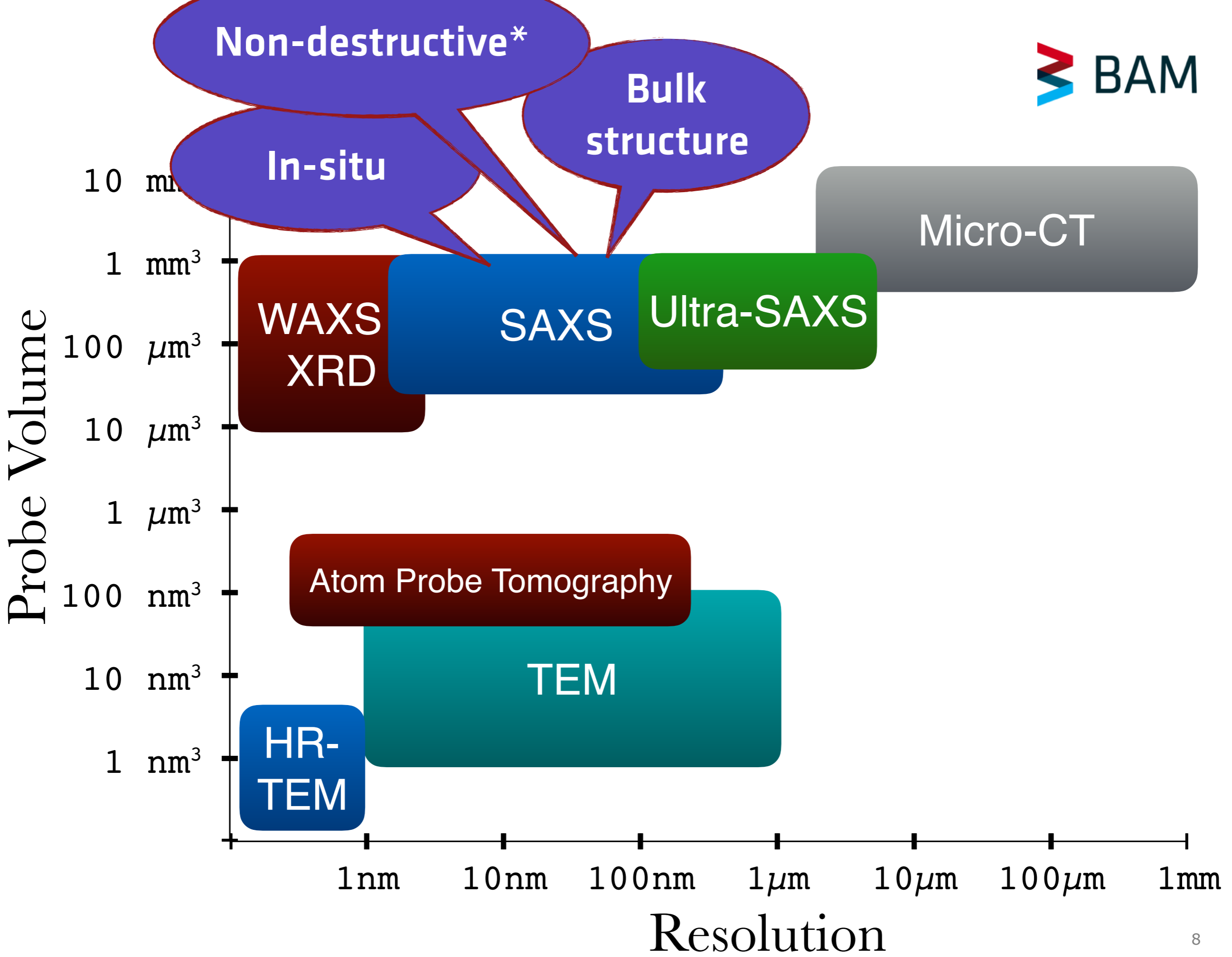
“Nano structures?”



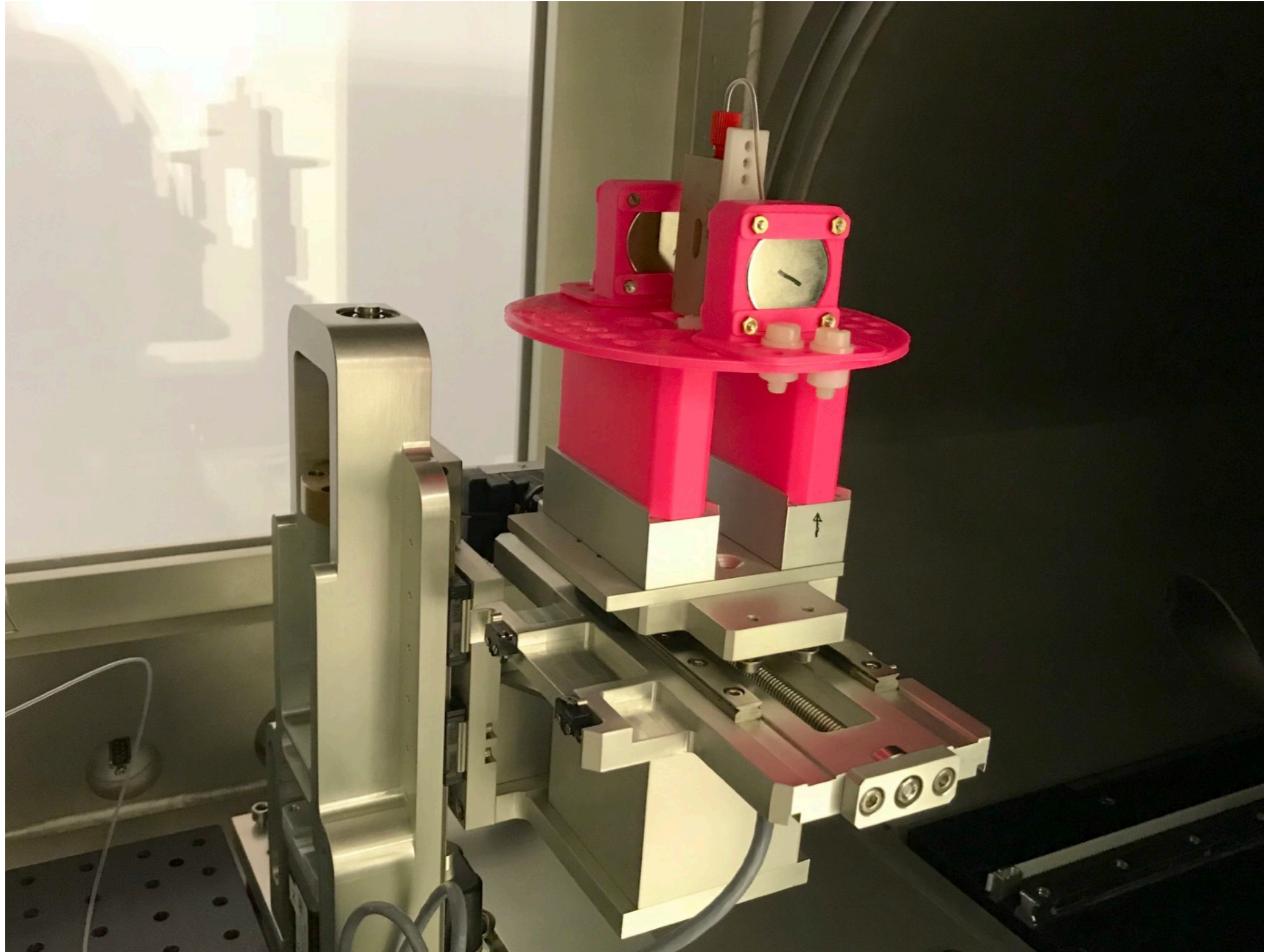
“Ultrafine structures?”



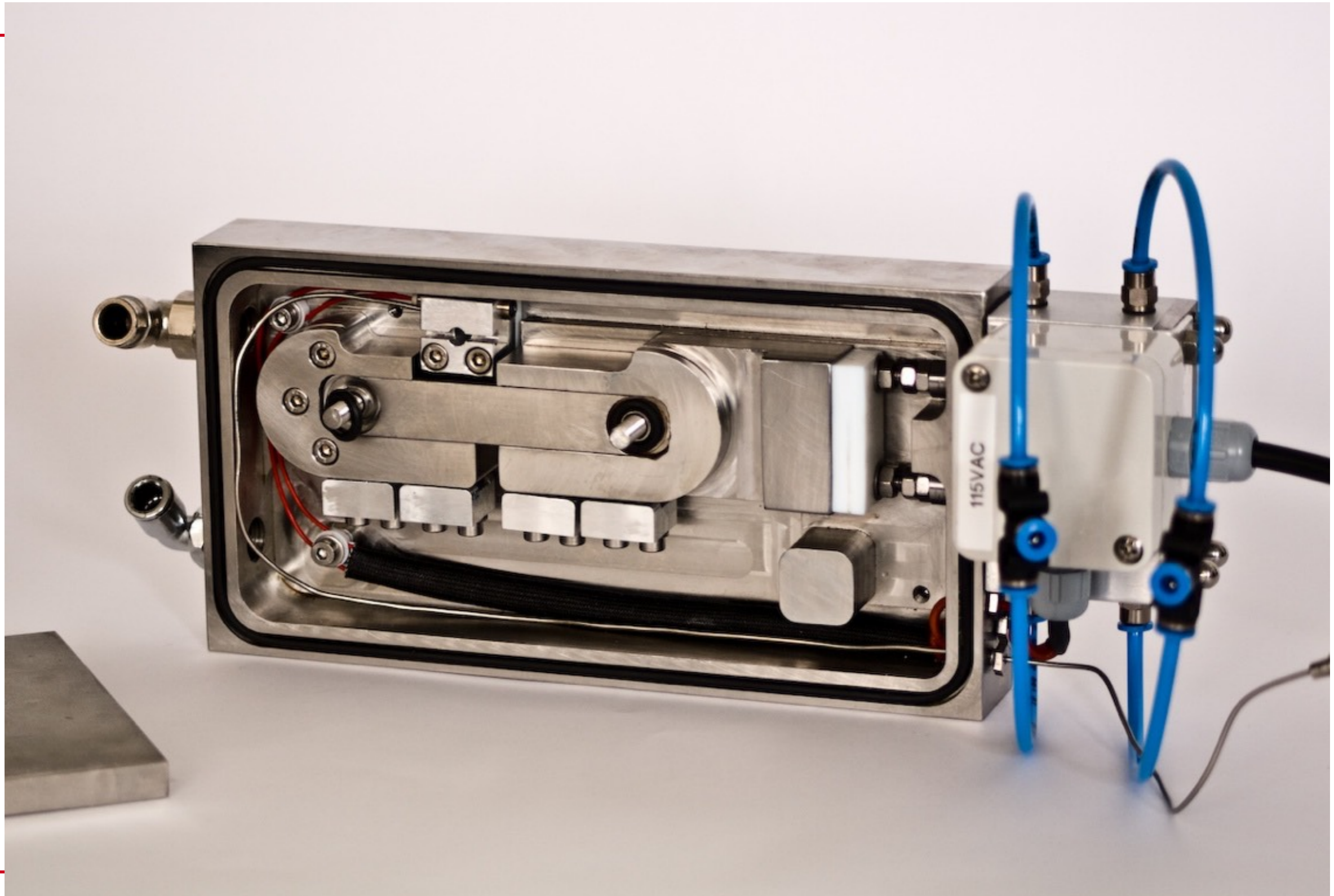




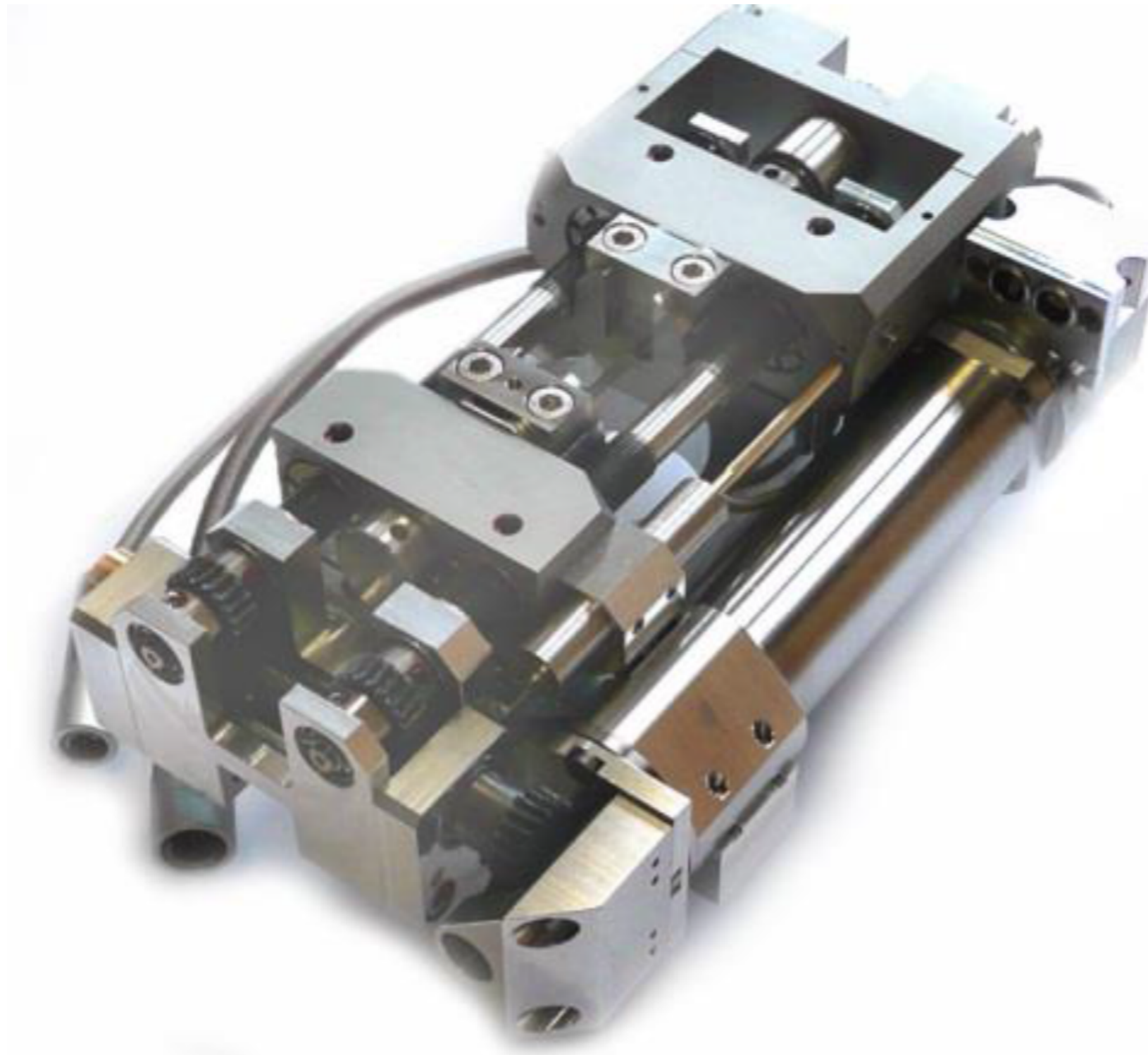
In-situ, nondestructive testing



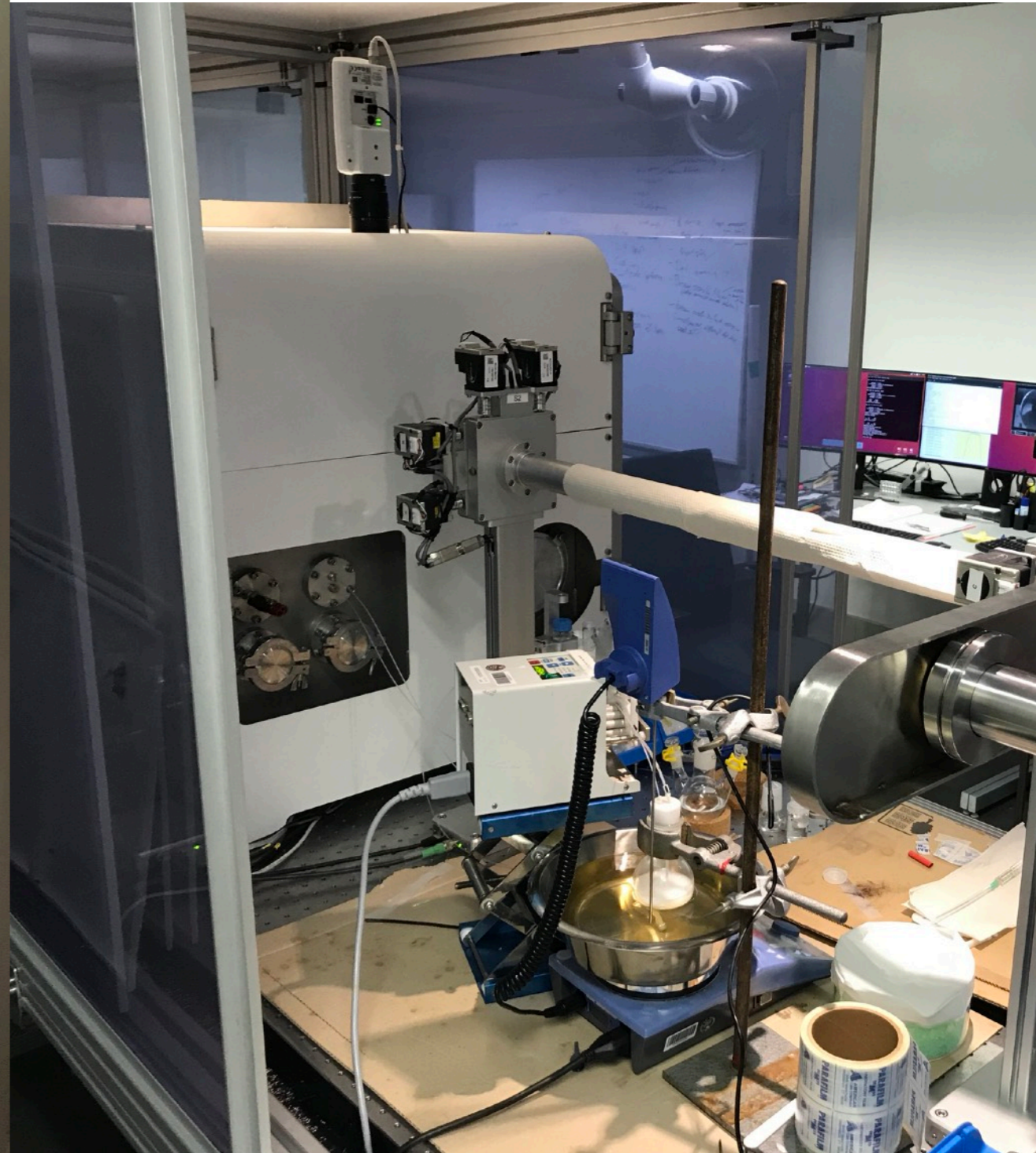
In-situ, nondestructive testing



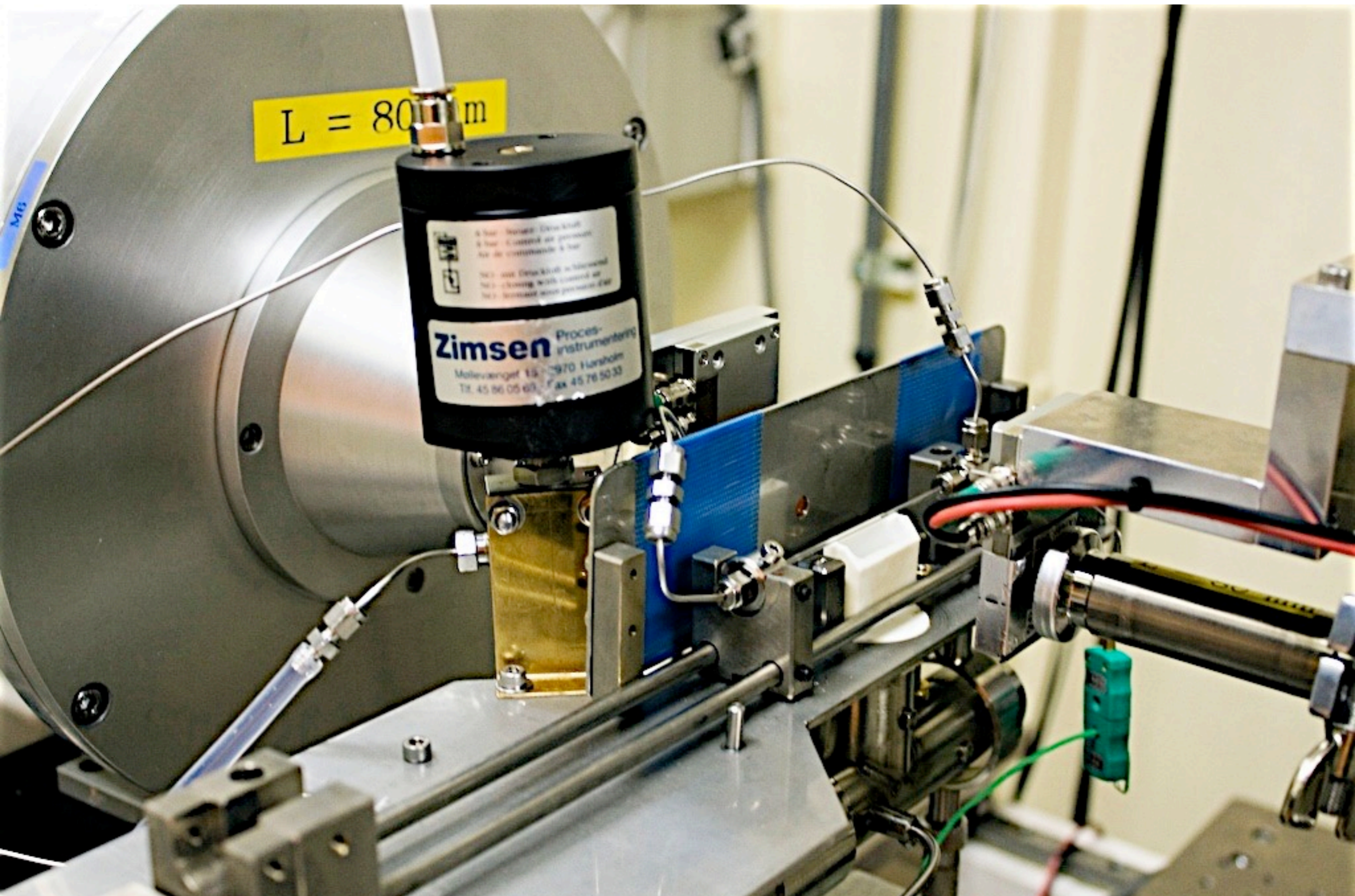
In-situ, nondestructive testing



sting



In-situ, nondestructive testing



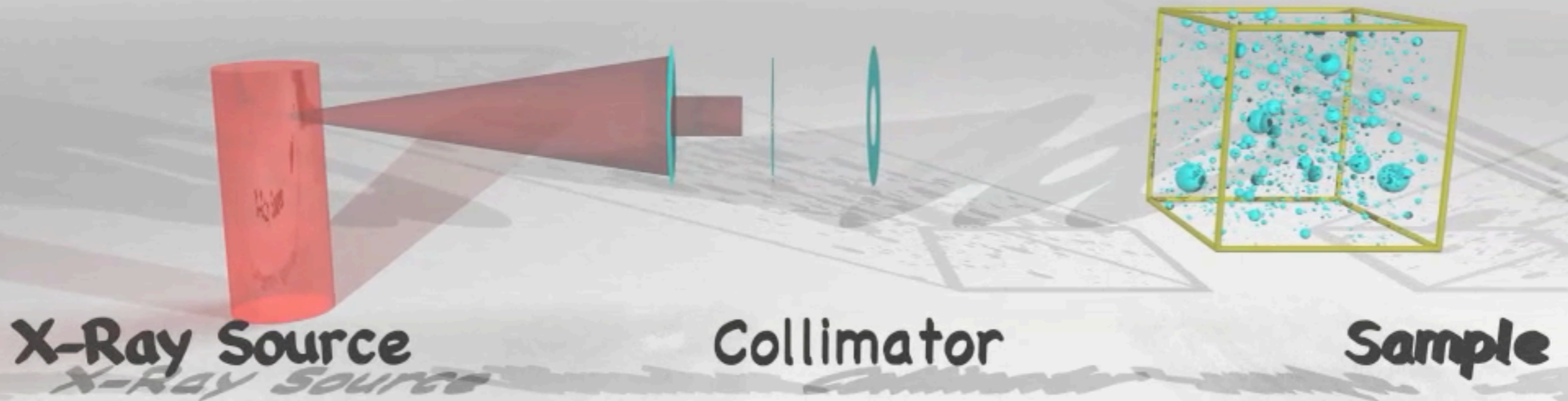
How?

S_{mall} **A**_ngle **X**-Ray **S**cattering

X-Ray



X-Ray Scattering



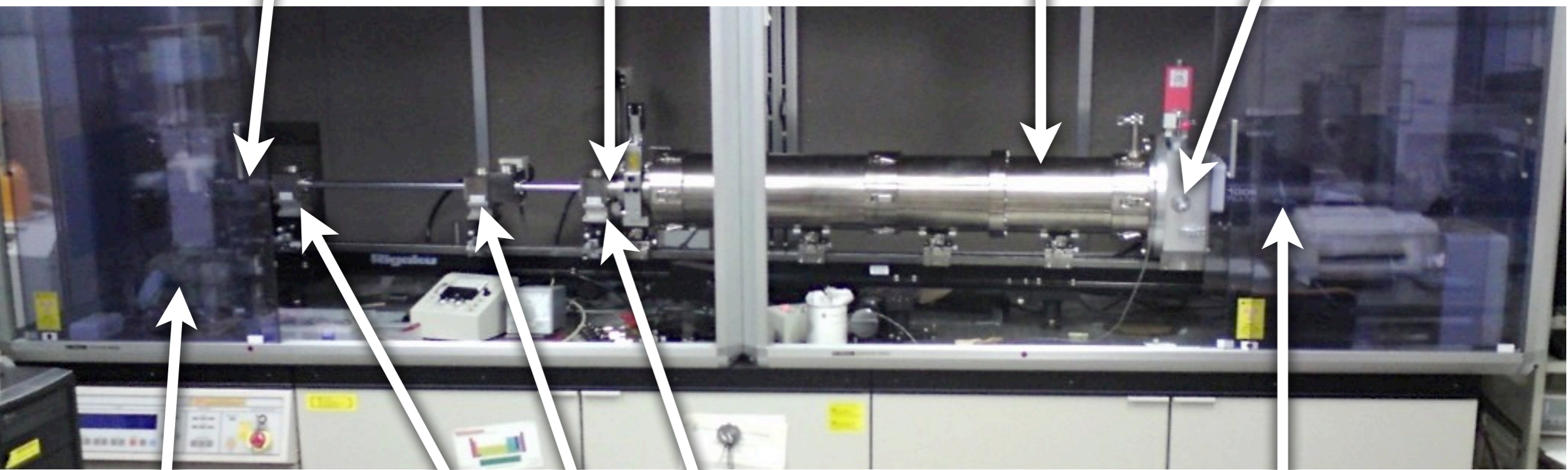
Parts of a SAXS machine

Crystal focusing
monochromator
(<1949)

Sample

Vacuum flightpath
(<1949)

Beamstop
(~30 CE)



Rotating anode
X-ray source
(1950's)

Pinhole
Pinhole
Pinhole
(1939)

Pilatus detector
(2003)

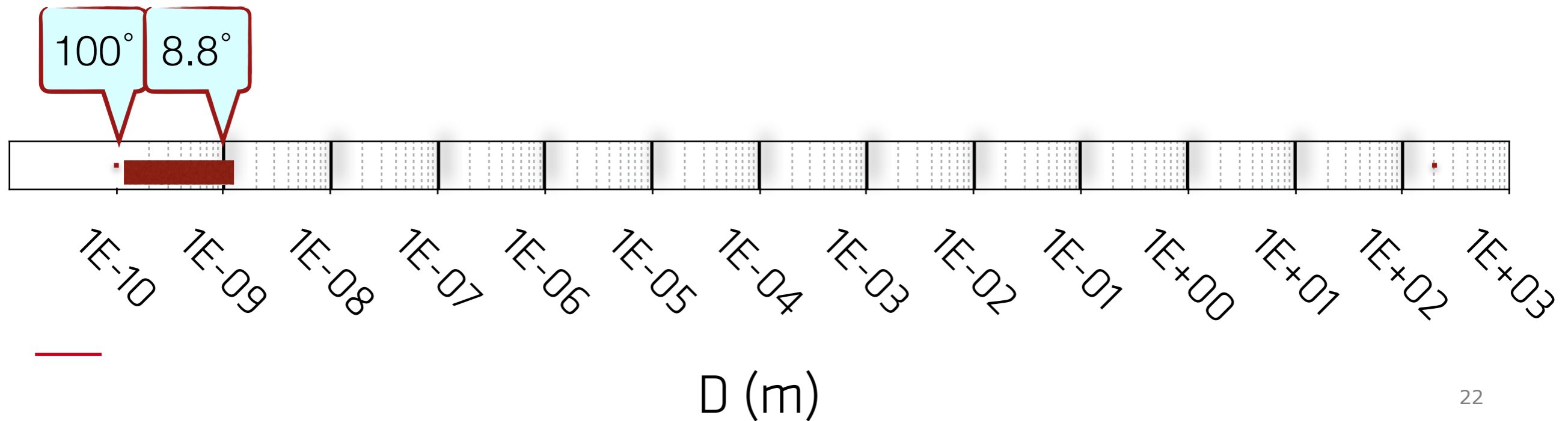
X-Ray Scattering

[Demo]

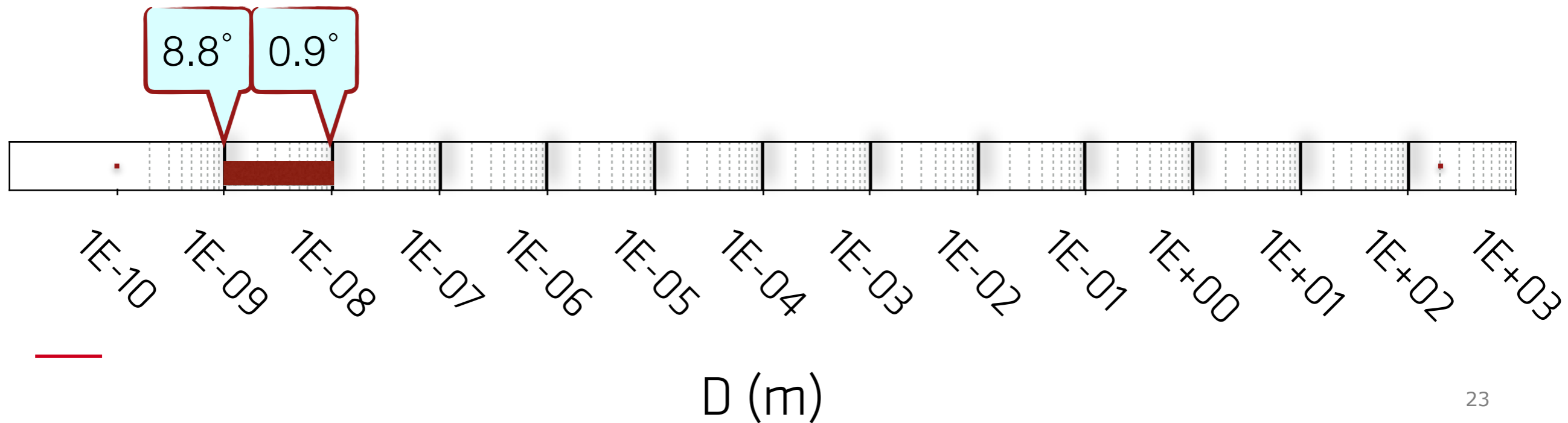
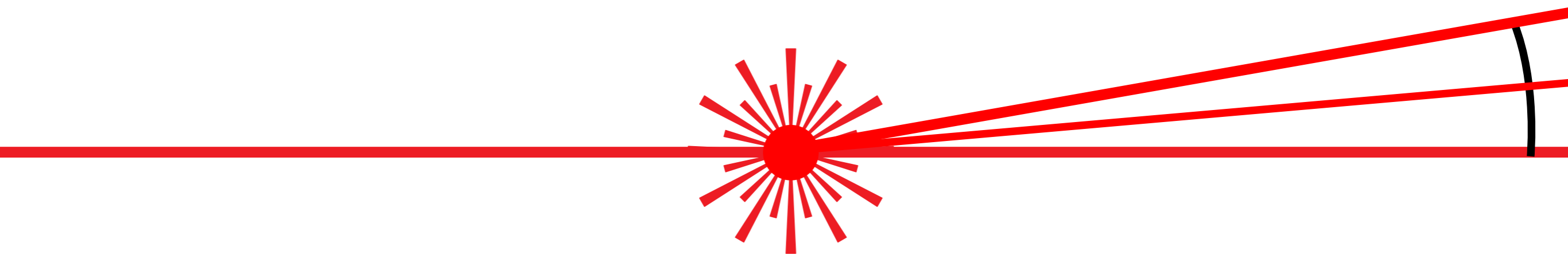
Small **A**ngle

X-Ray **S**cattering

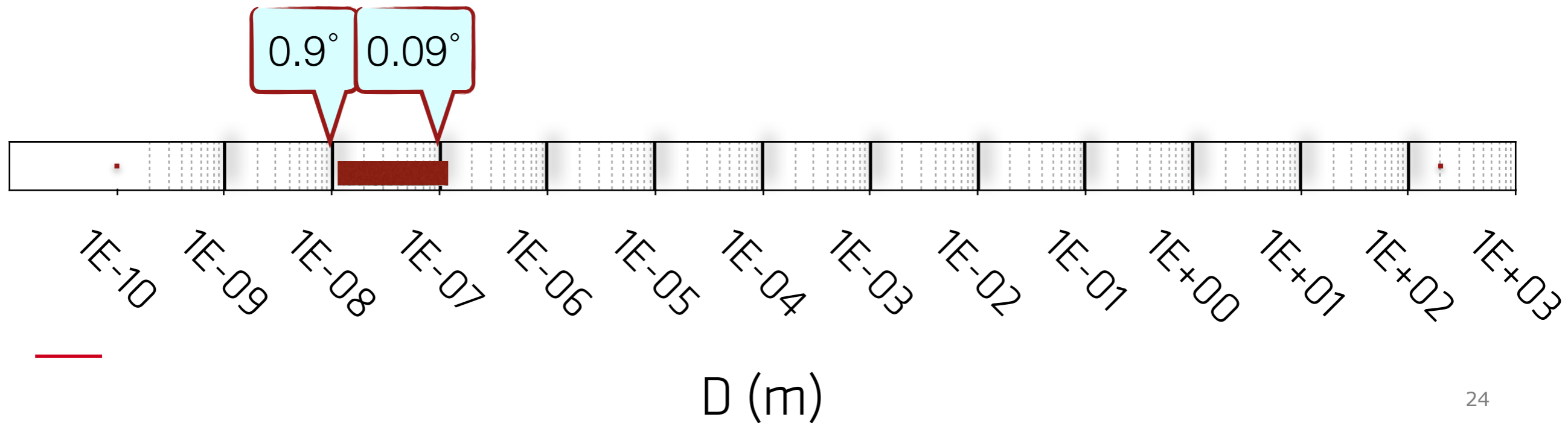
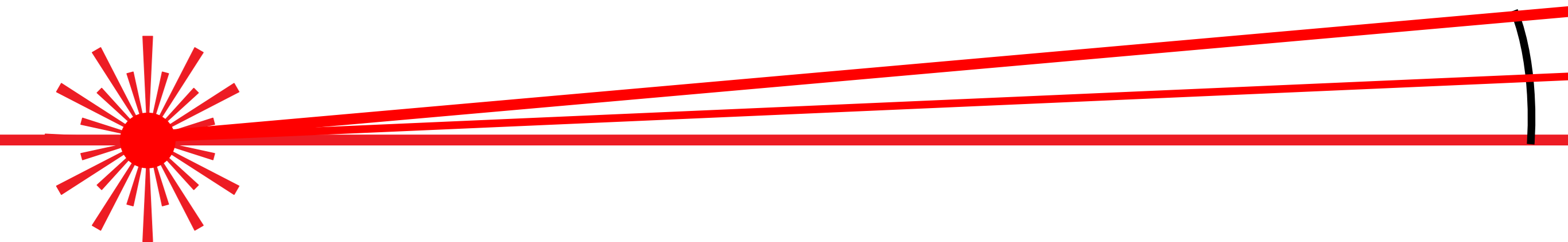
Small Anangle



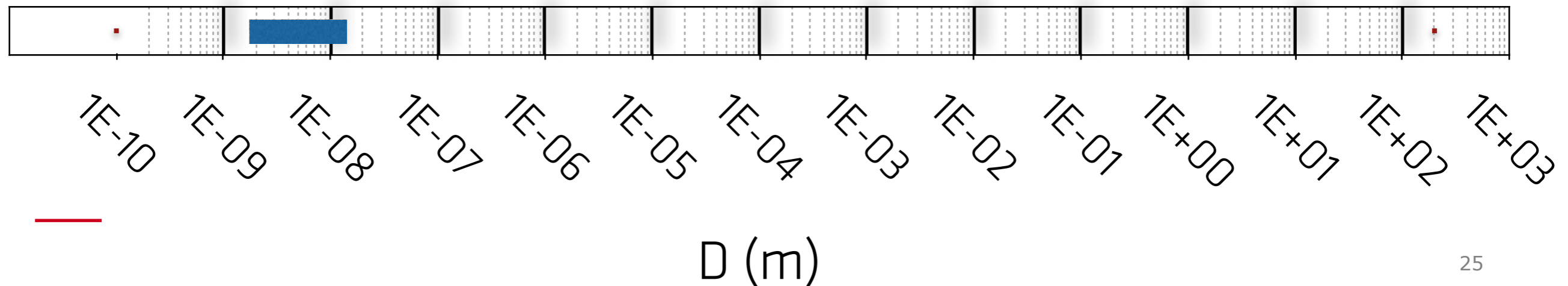
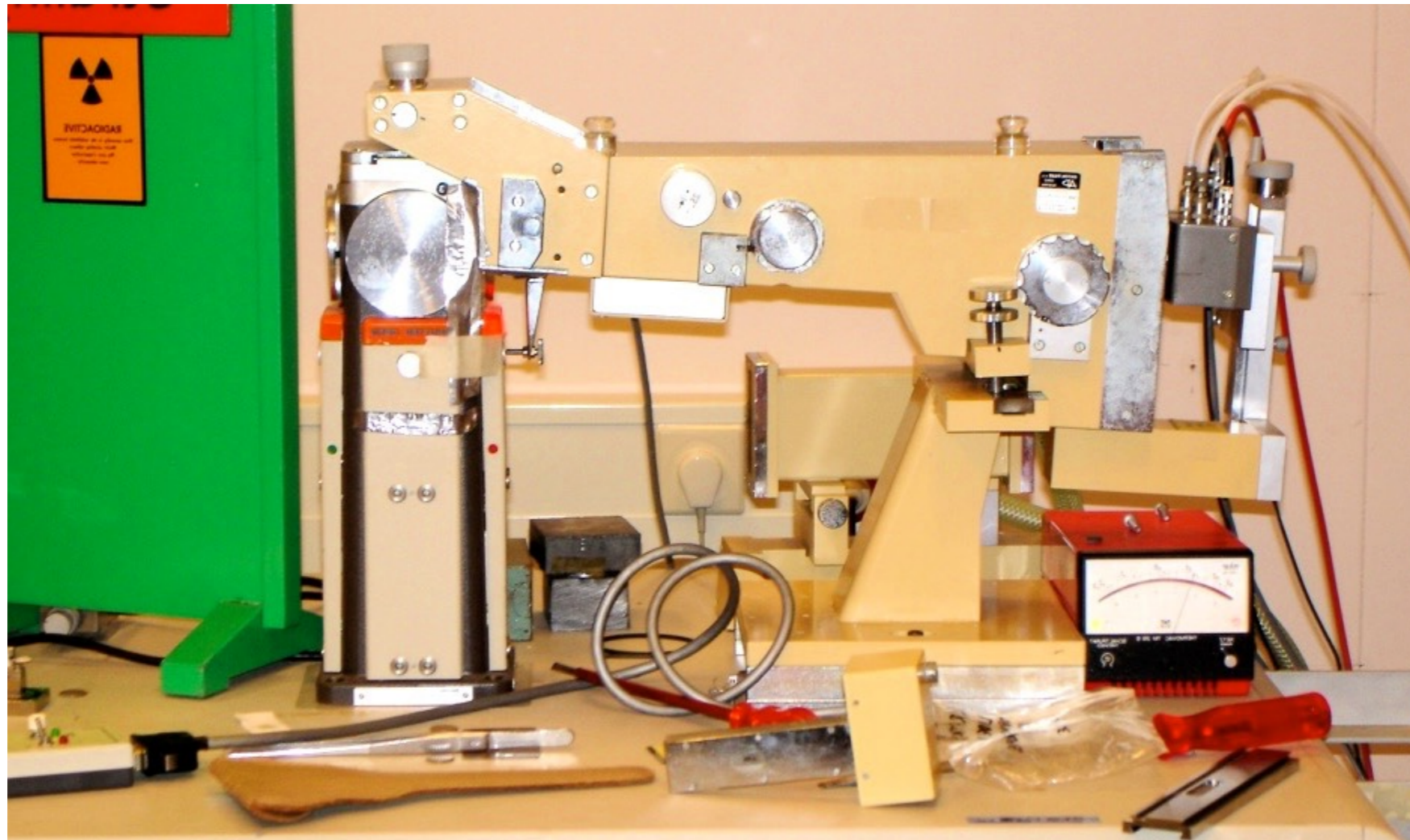
Small Angle



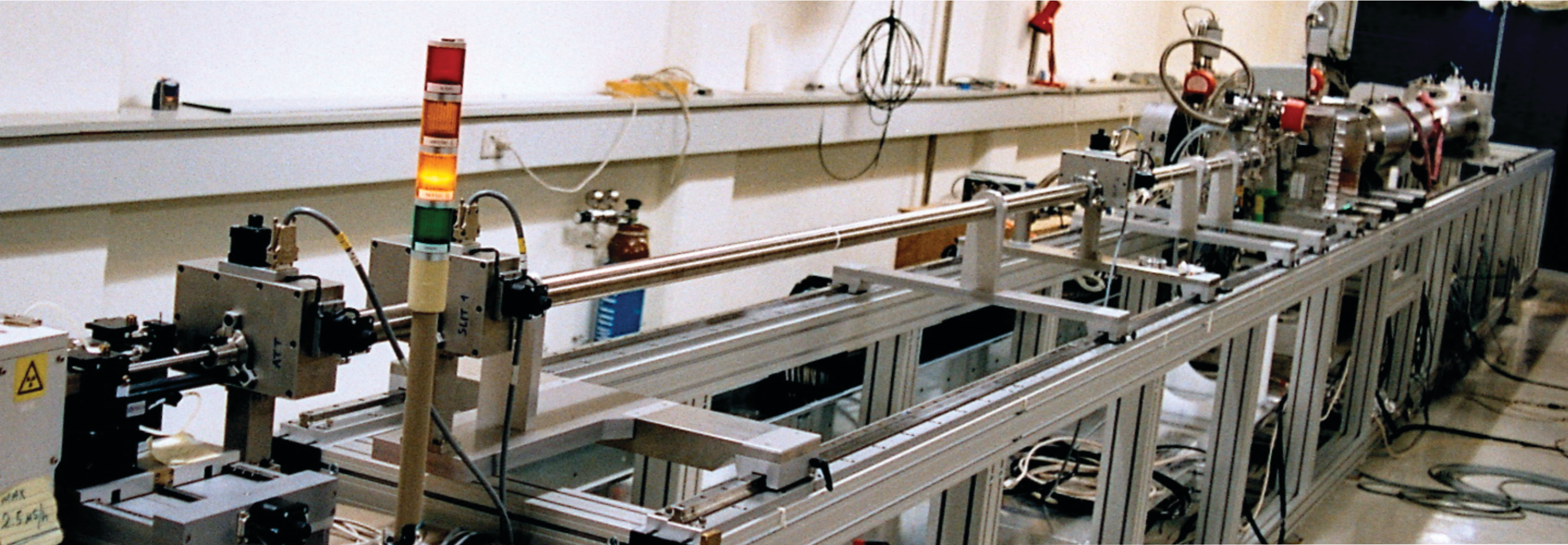
Small Angle



My first SAXS machine (2004)



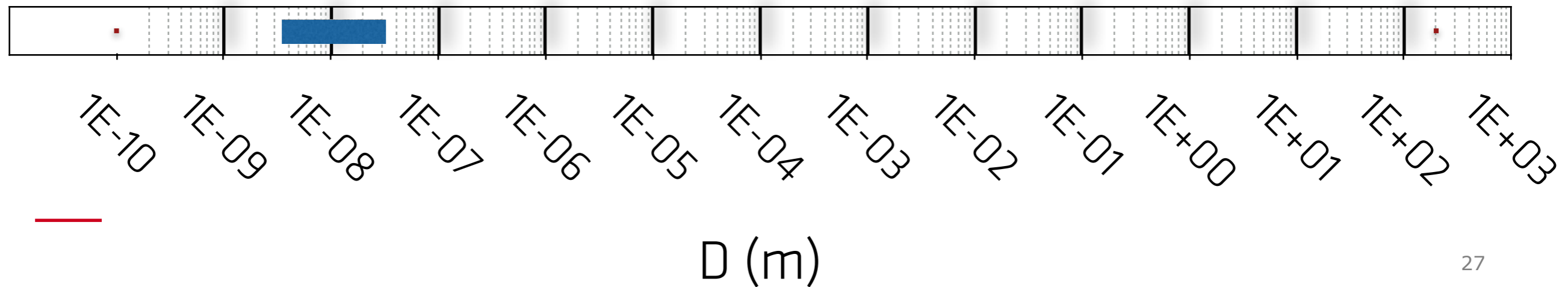
The in-between years (2006-2016)



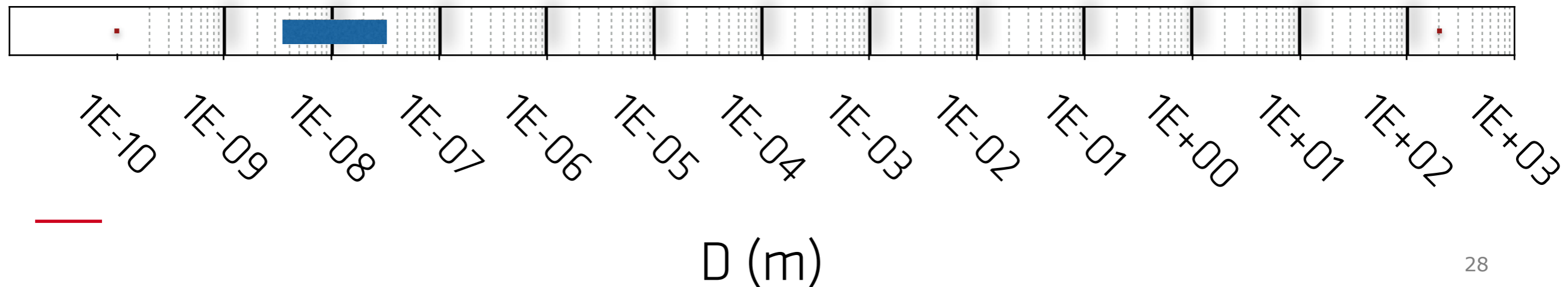
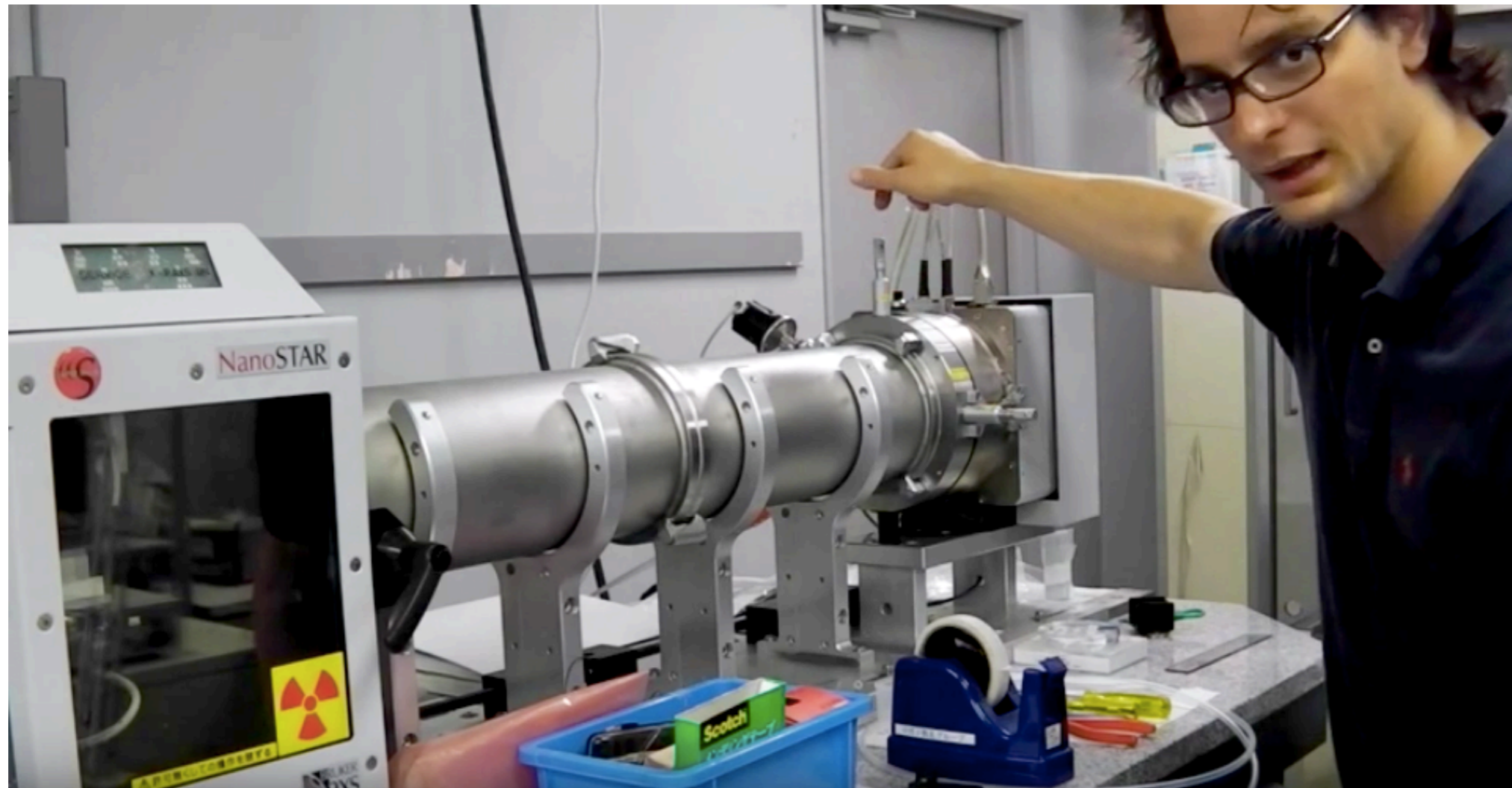
1E-10 1E-09 1E-08 1E-07 1E-06 1E-05 1E-04 1E-03 1E-02 1E-01 1E+00 1E+01 1E+02 1E+03

D (m)

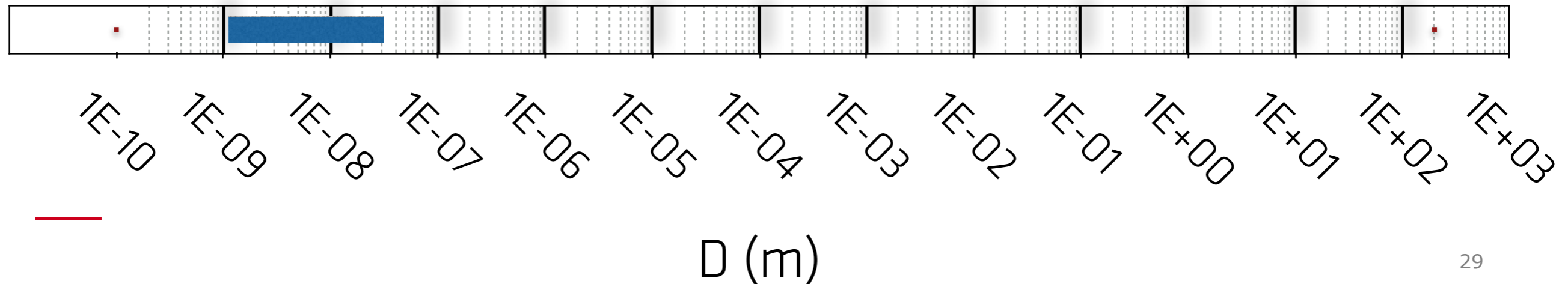
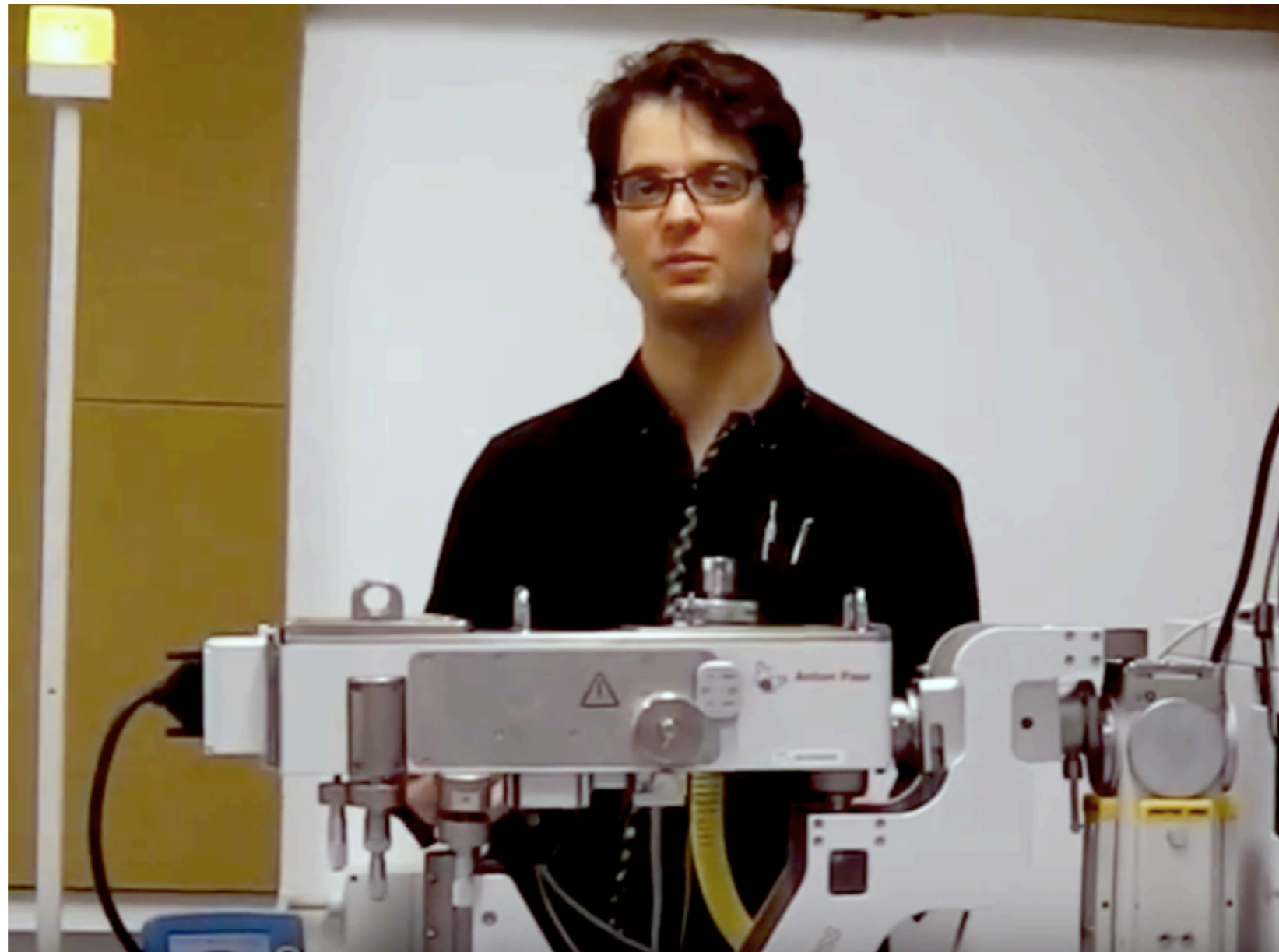
The in-between years (2006-2016)



The in-between years (2006-2016)



The in-between years (2006-2016)





BAM_DE
@BAMResearch

Follow



@drheaddamage @FranEmmerling
@DECTRIS_News Did someone mention
CAKE??? 😊 (jh)



1:19 AM - 19 Jan 2018

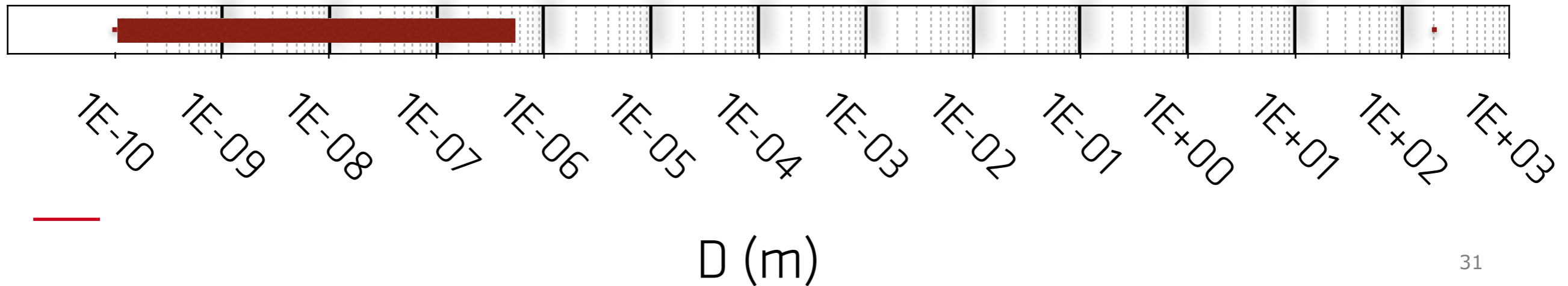
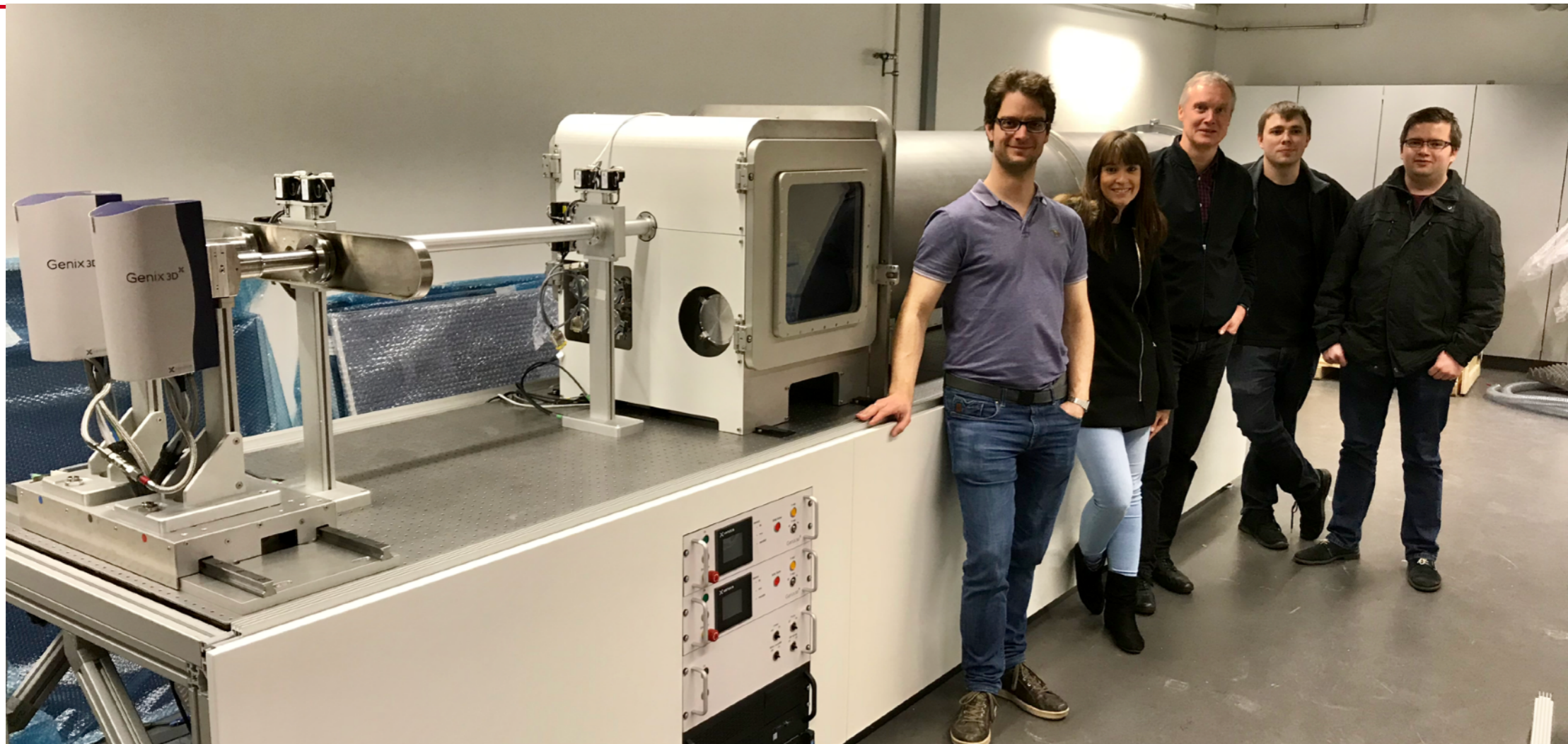


1E-10

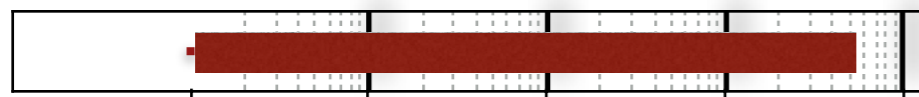
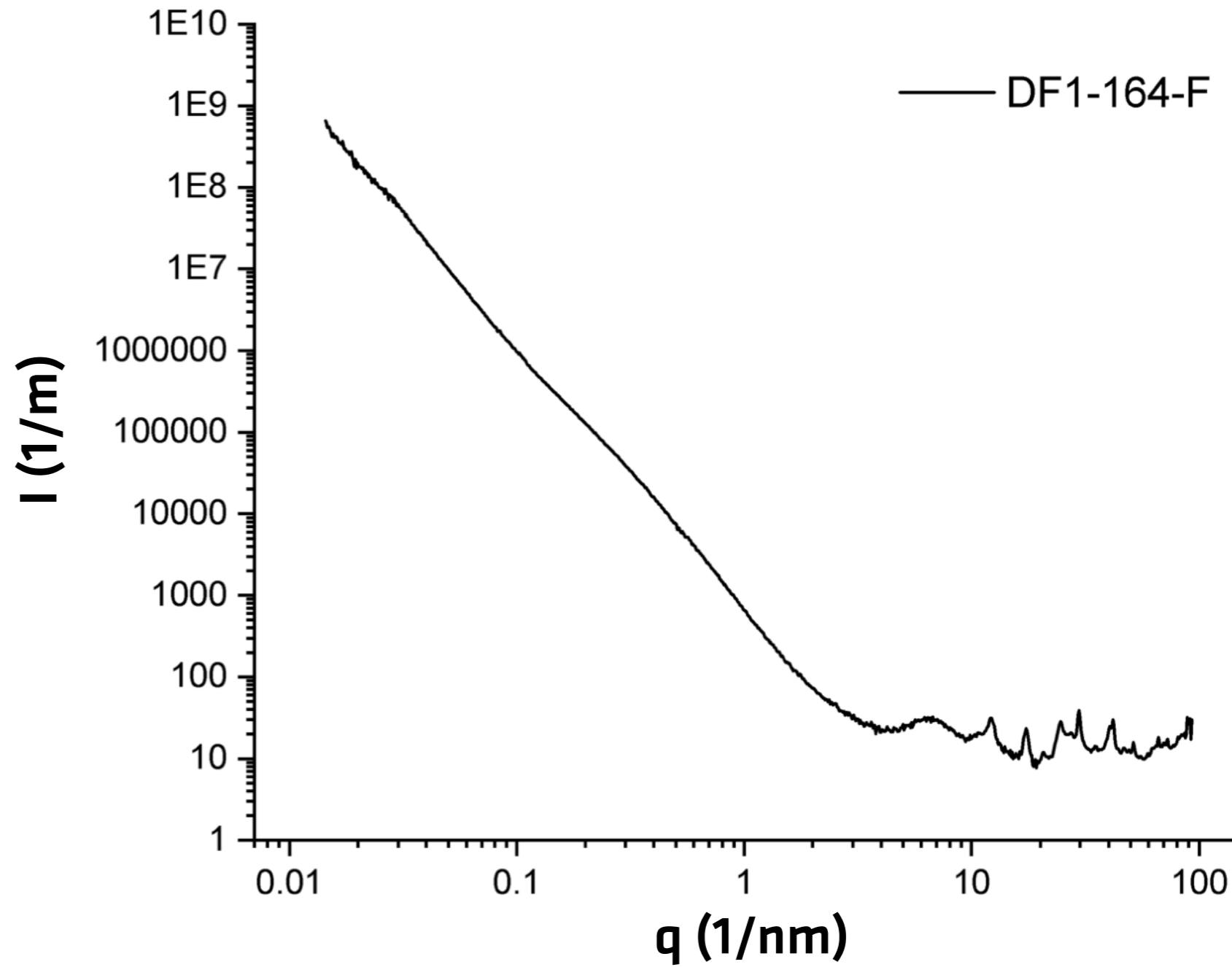
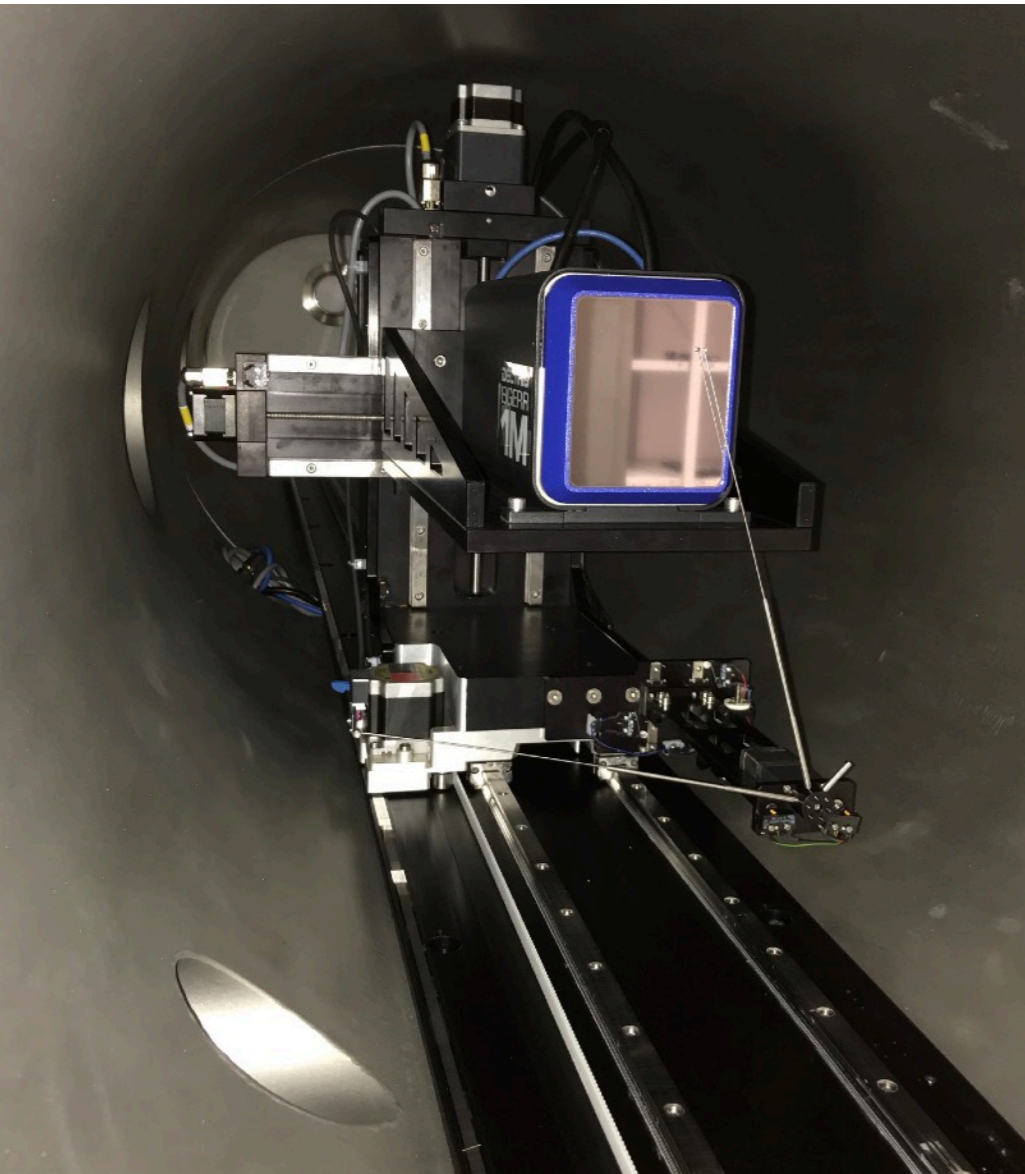


1E+03

The MAUS



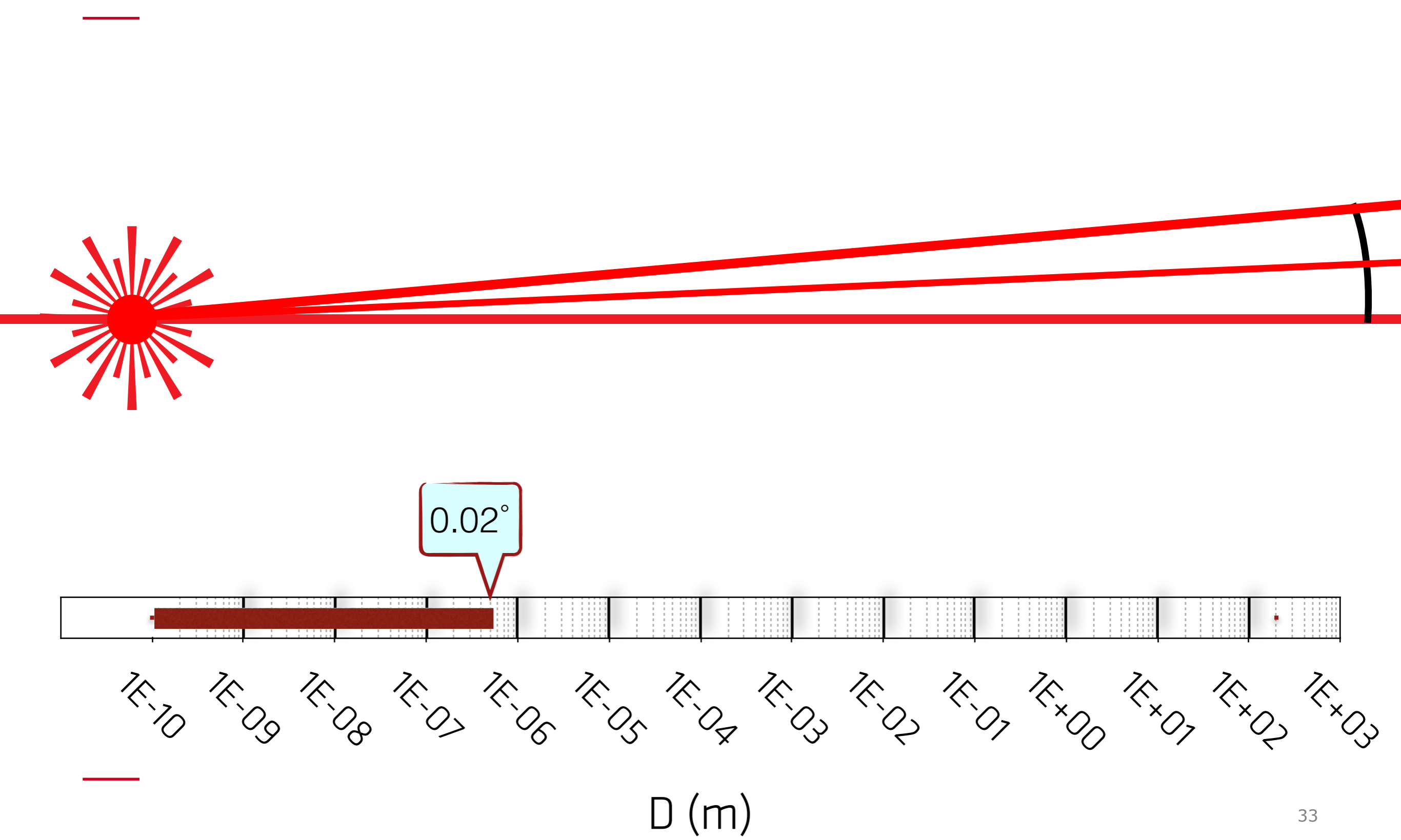
The MAUS



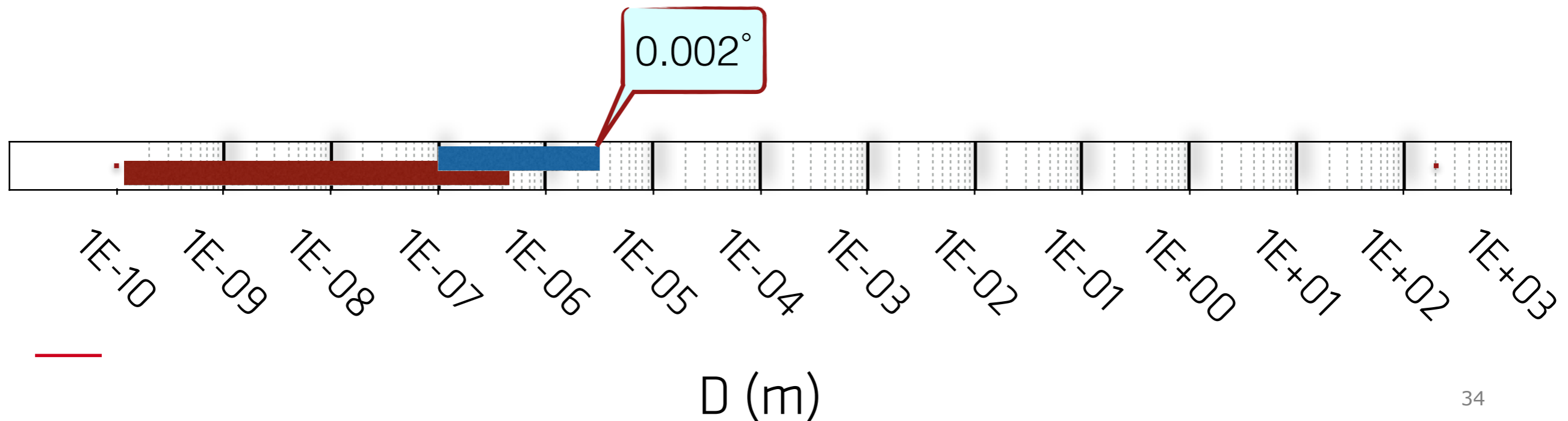
1E-10 1E-09 1E-08 1E-07 1E-06 1E-05 1E-04 1E-03 1E-02 1E-01 1E+00 1E+01 1E+02 1E+03

D (m)

The MAUS

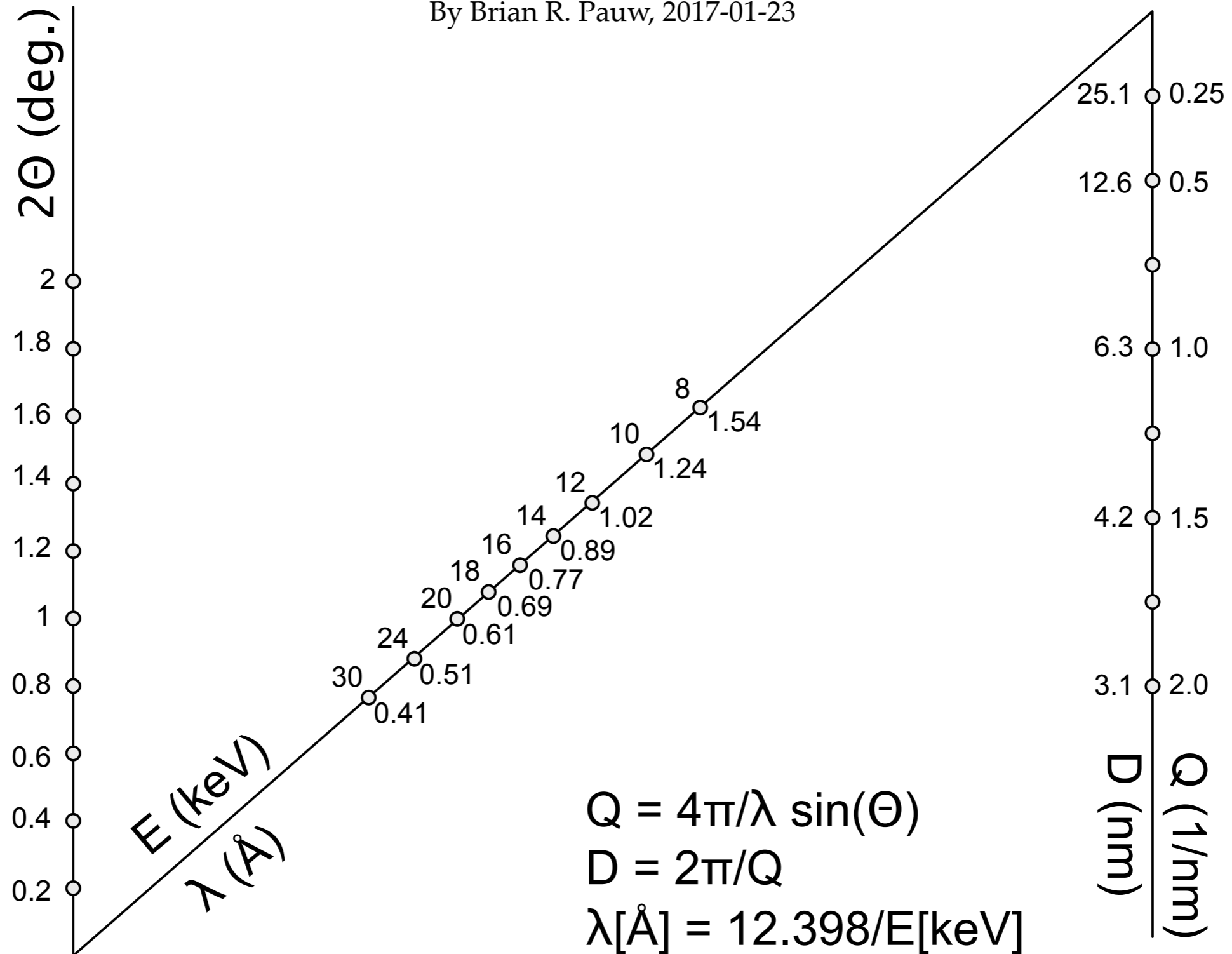


The Ultra-SAXS extension (ask me later!)



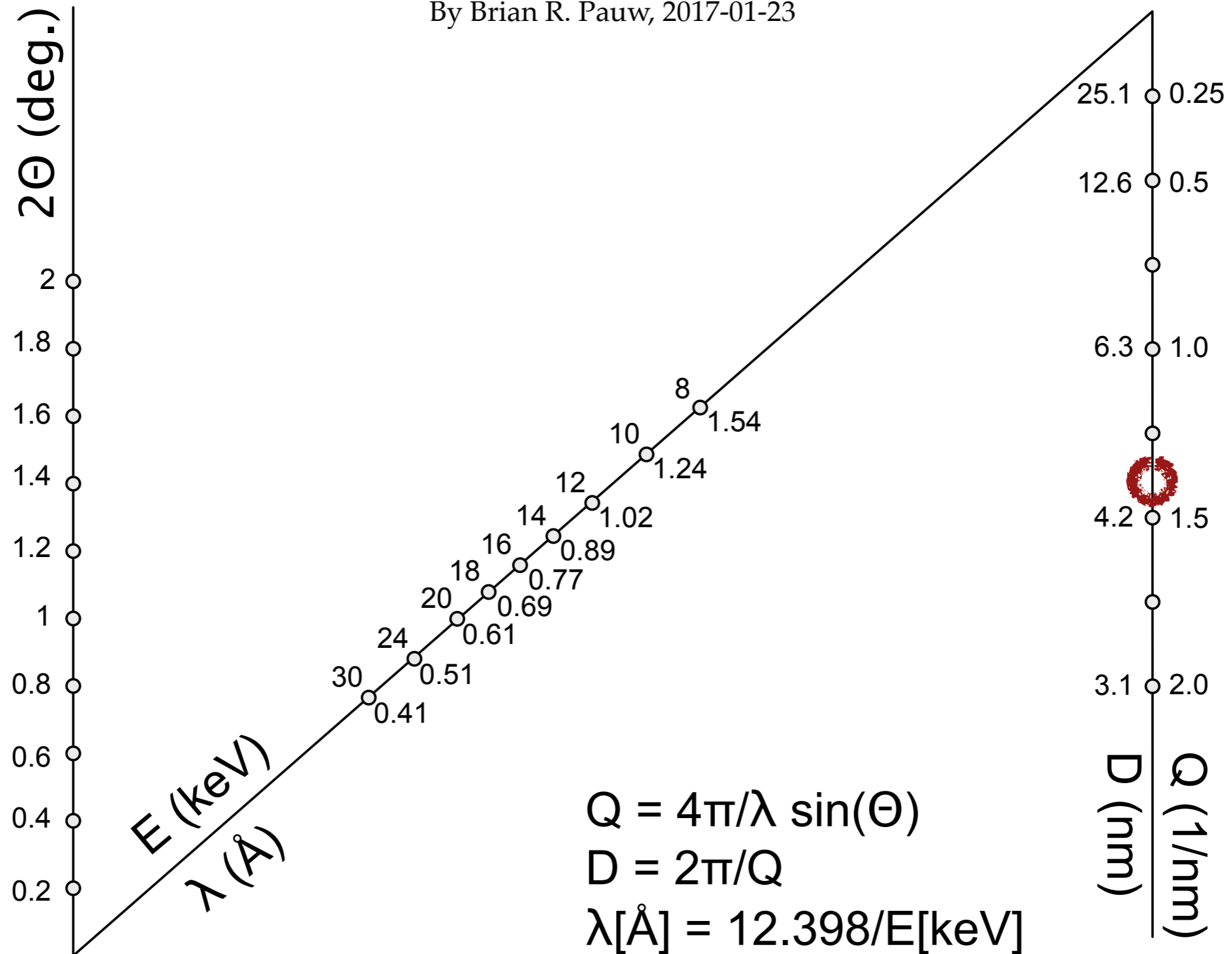
A Nomogram for SAXS and XRD

By Brian R. Pauw, 2017-01-23



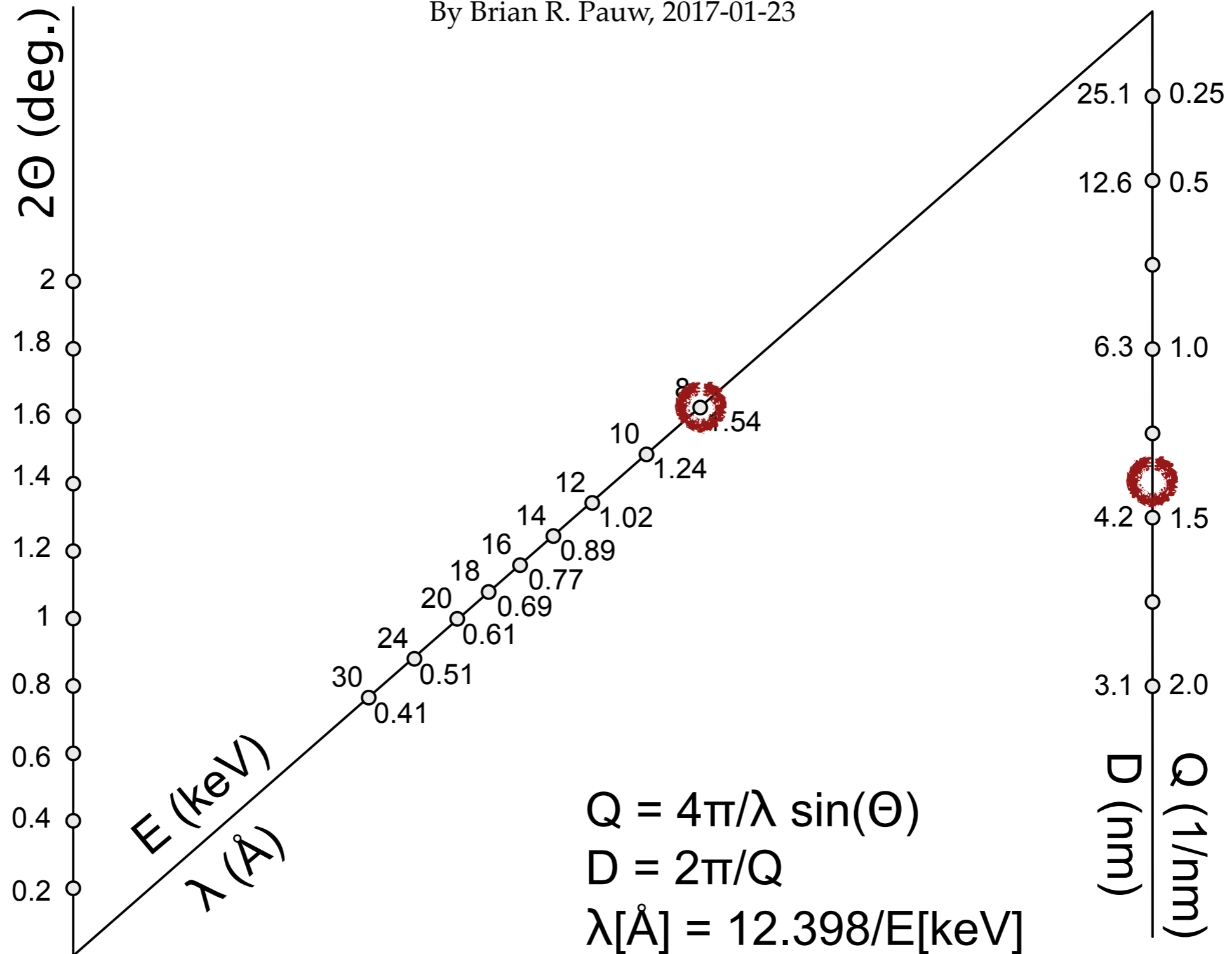
A Nomogram for SAXS and XRD

By Brian R. Pauw, 2017-01-23



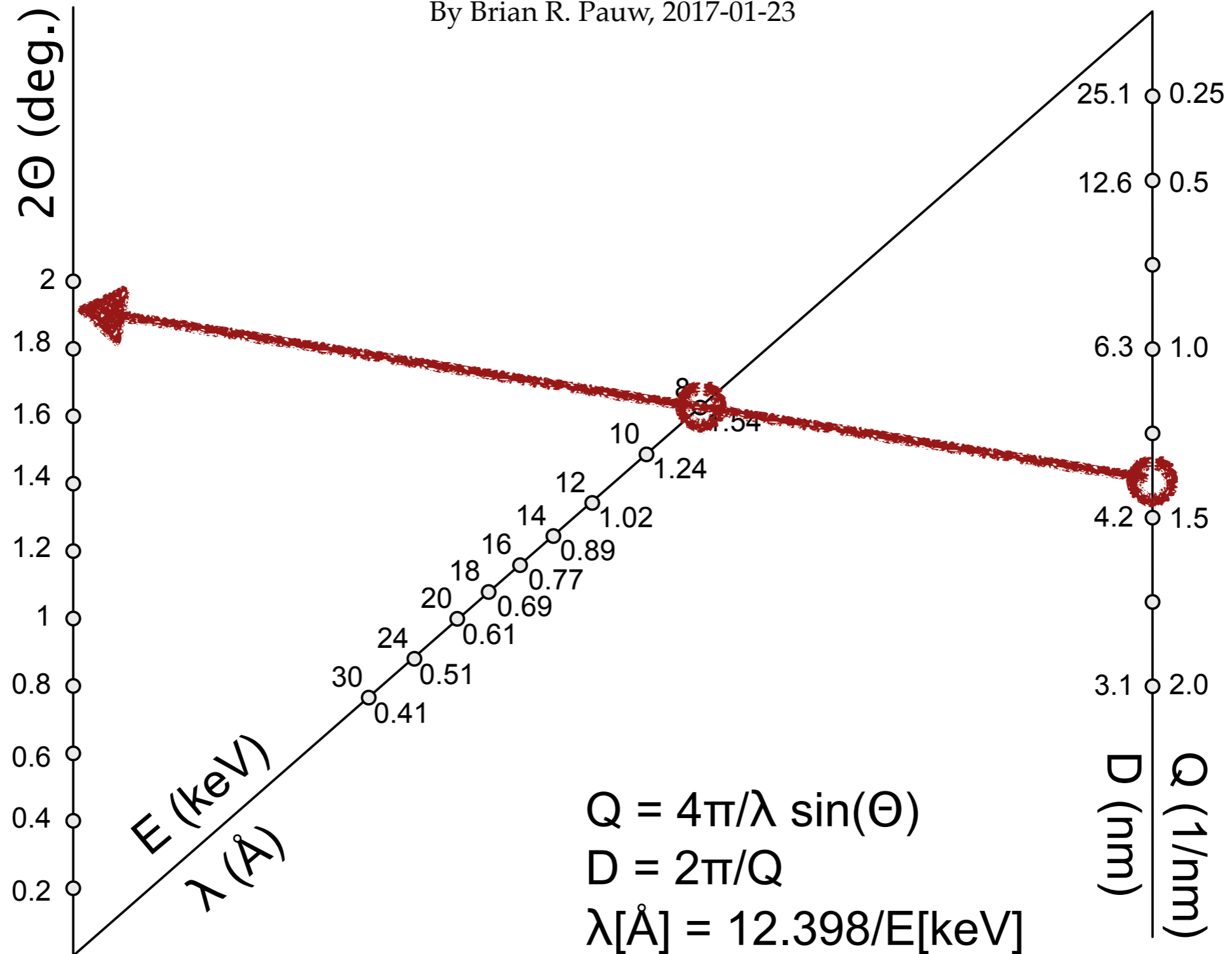
A Nomogram for SAXS and XRD

By Brian R. Pauw, 2017-01-23



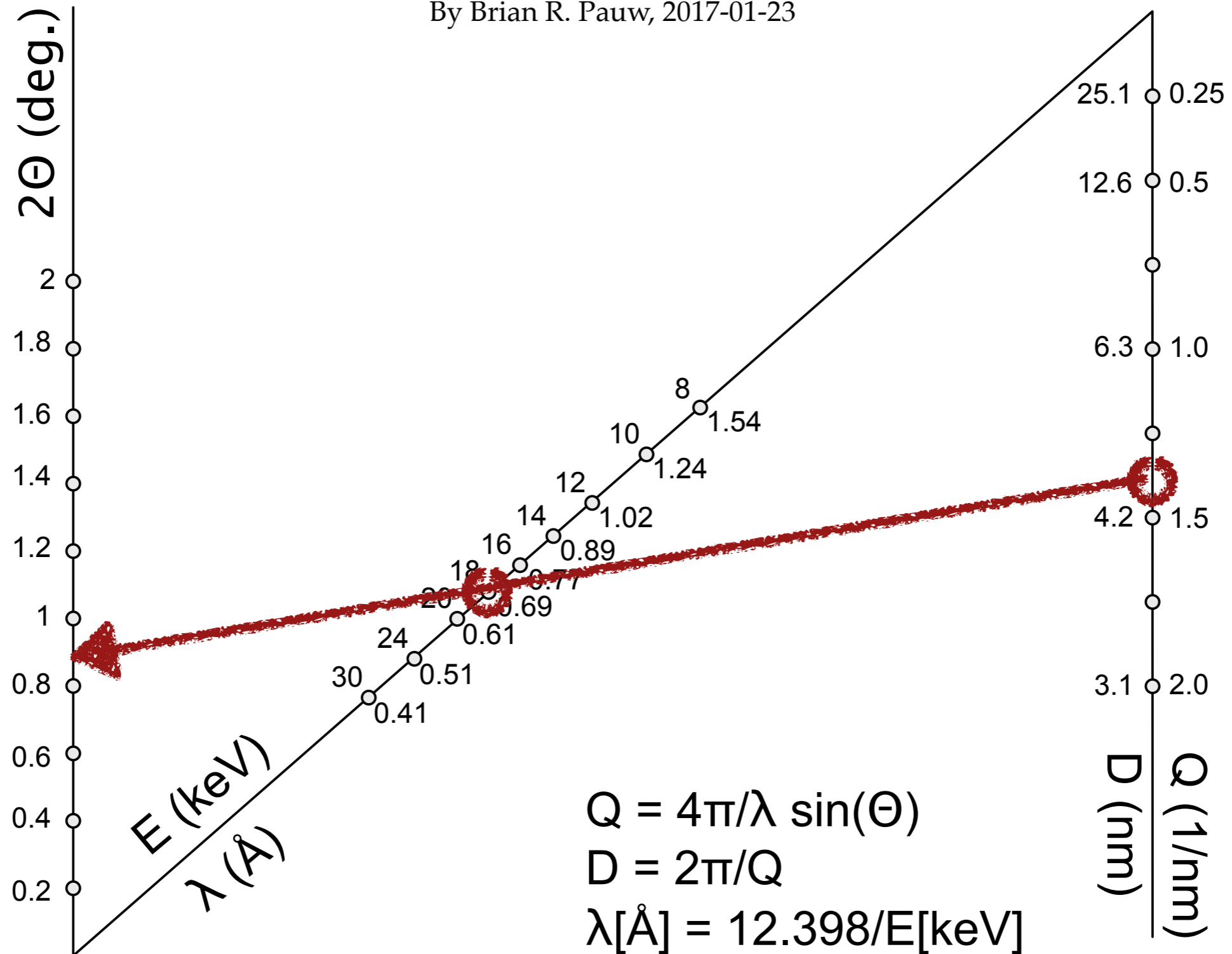
A Nomogram for SAXS and XRD

By Brian R. Pauw, 2017-01-23



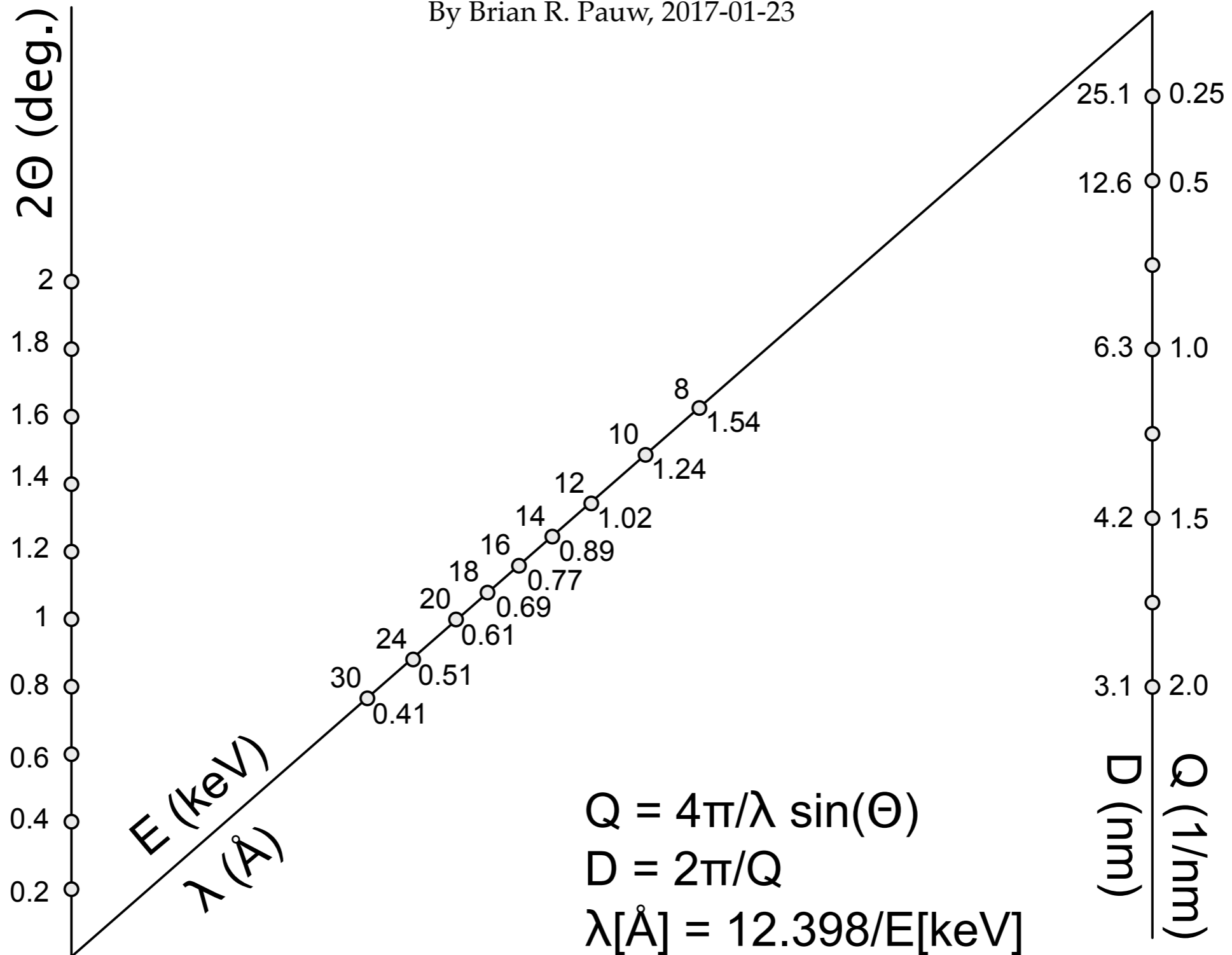
A Nomogram for SAXS and XRD

By Brian R. Pauw, 2017-01-23

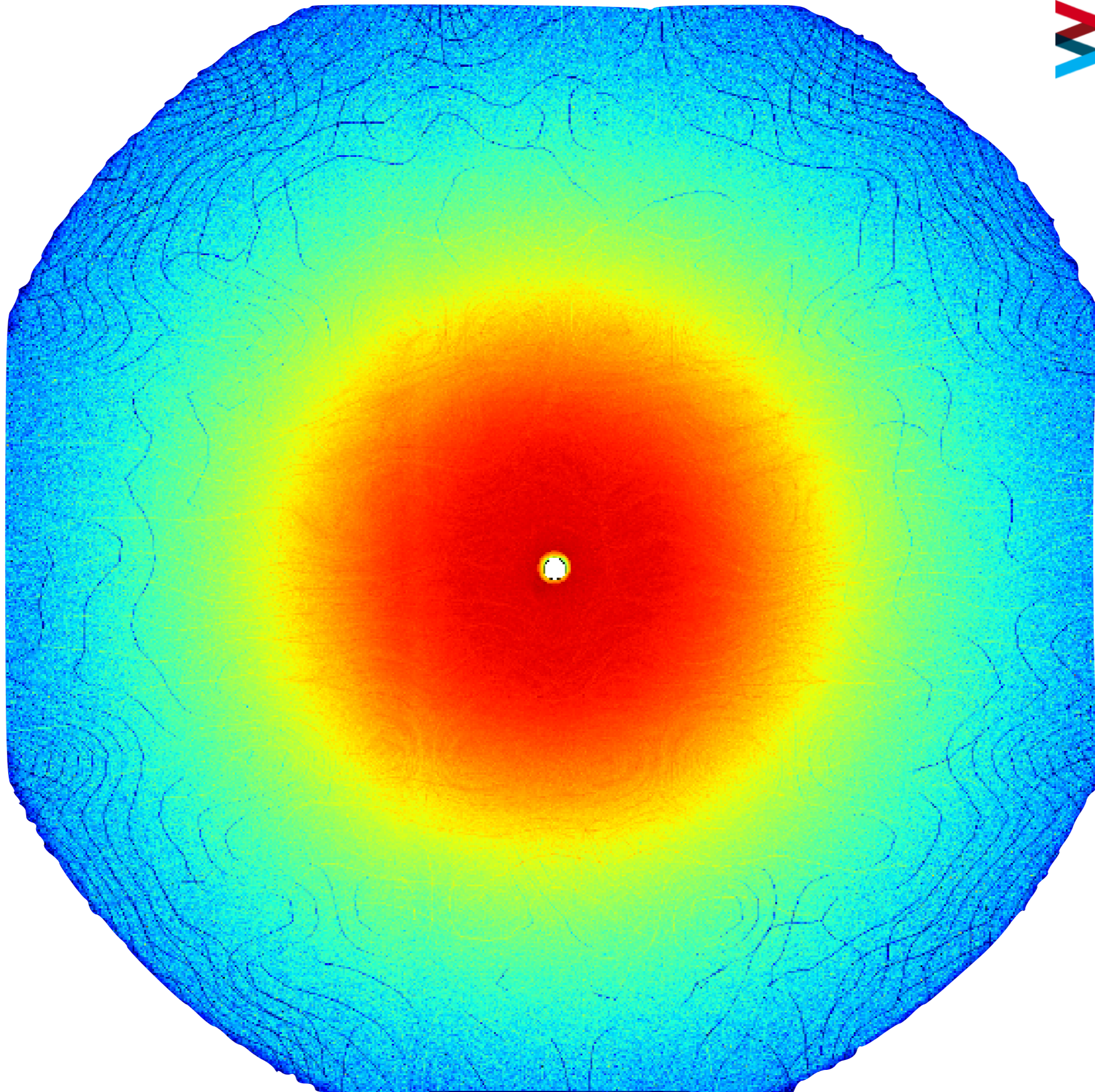


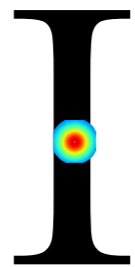
A Nomogram for SAXS and XRD

By Brian R. Pauw, 2017-01-23



What?





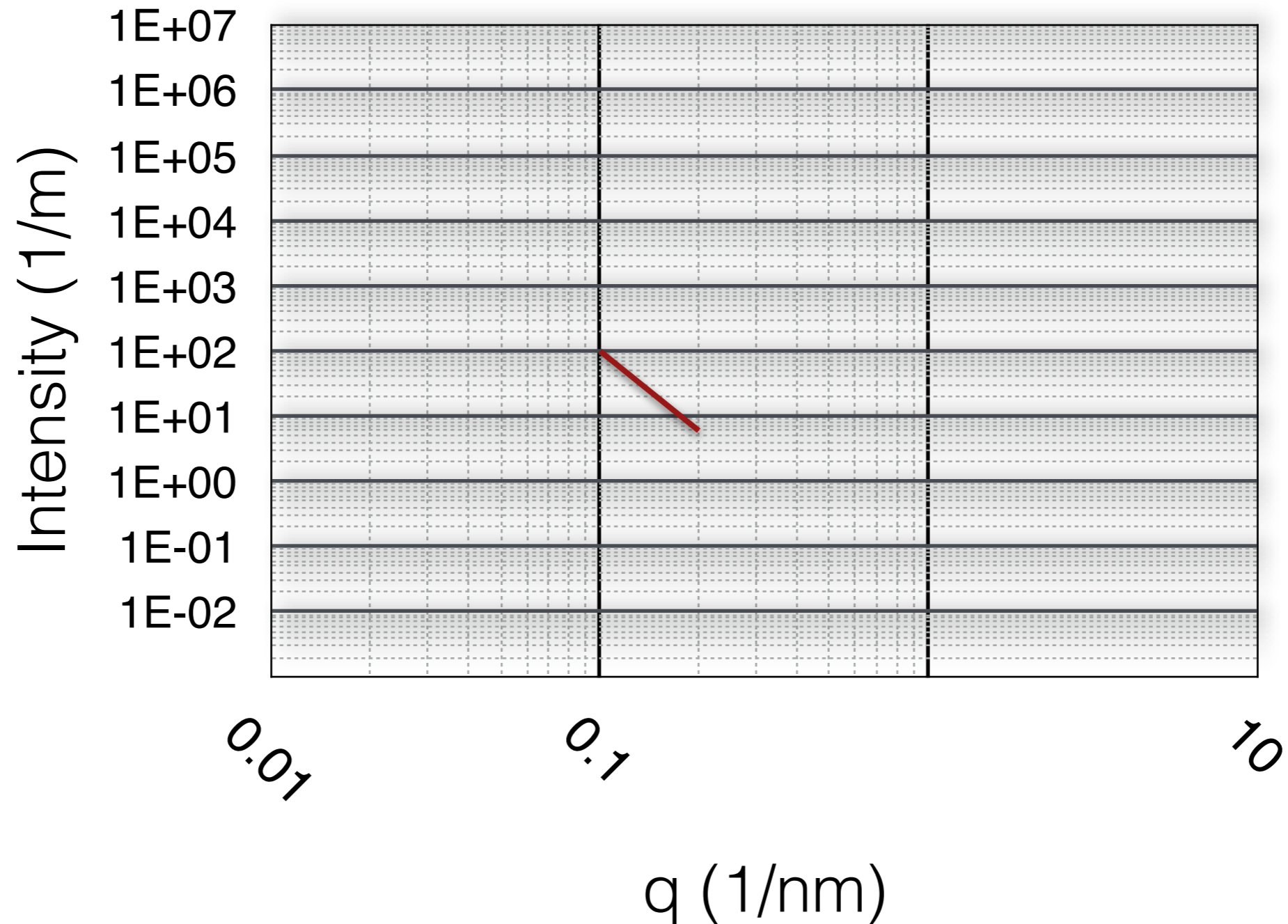
$$\left| \text{FT} \left(\text{img} \right) \right|^2 = I$$

The image shows a grayscale micrograph of a biological sample, likely a tissue section, with numerous small, dark, irregularly shaped spots scattered across a lighter background. The image is used as an input to a Fast Fourier Transform (FT) operation, which is then squared to produce the intensity spectrum I.

[demo]

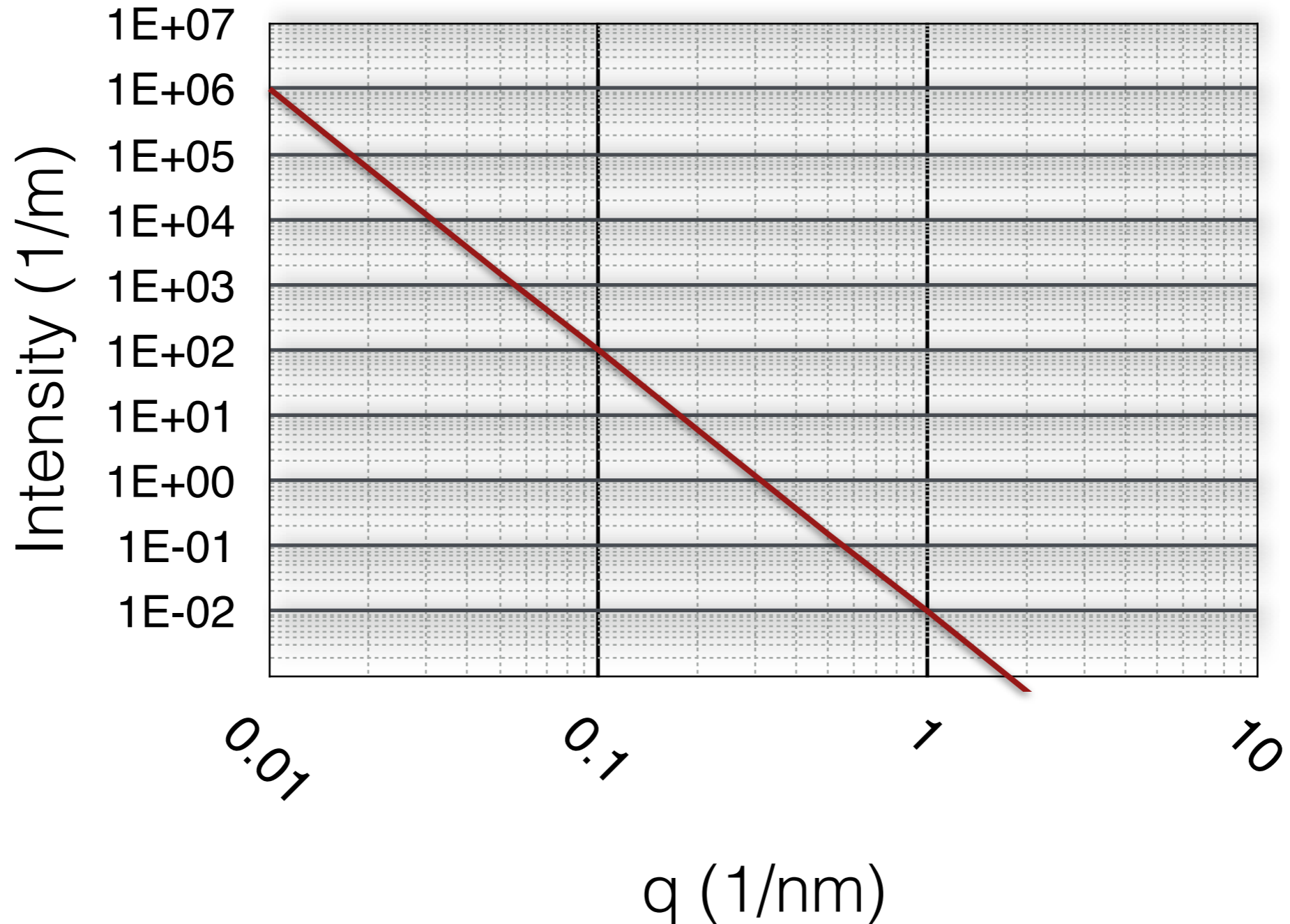
Features to keep an eye on

Case 0: no data



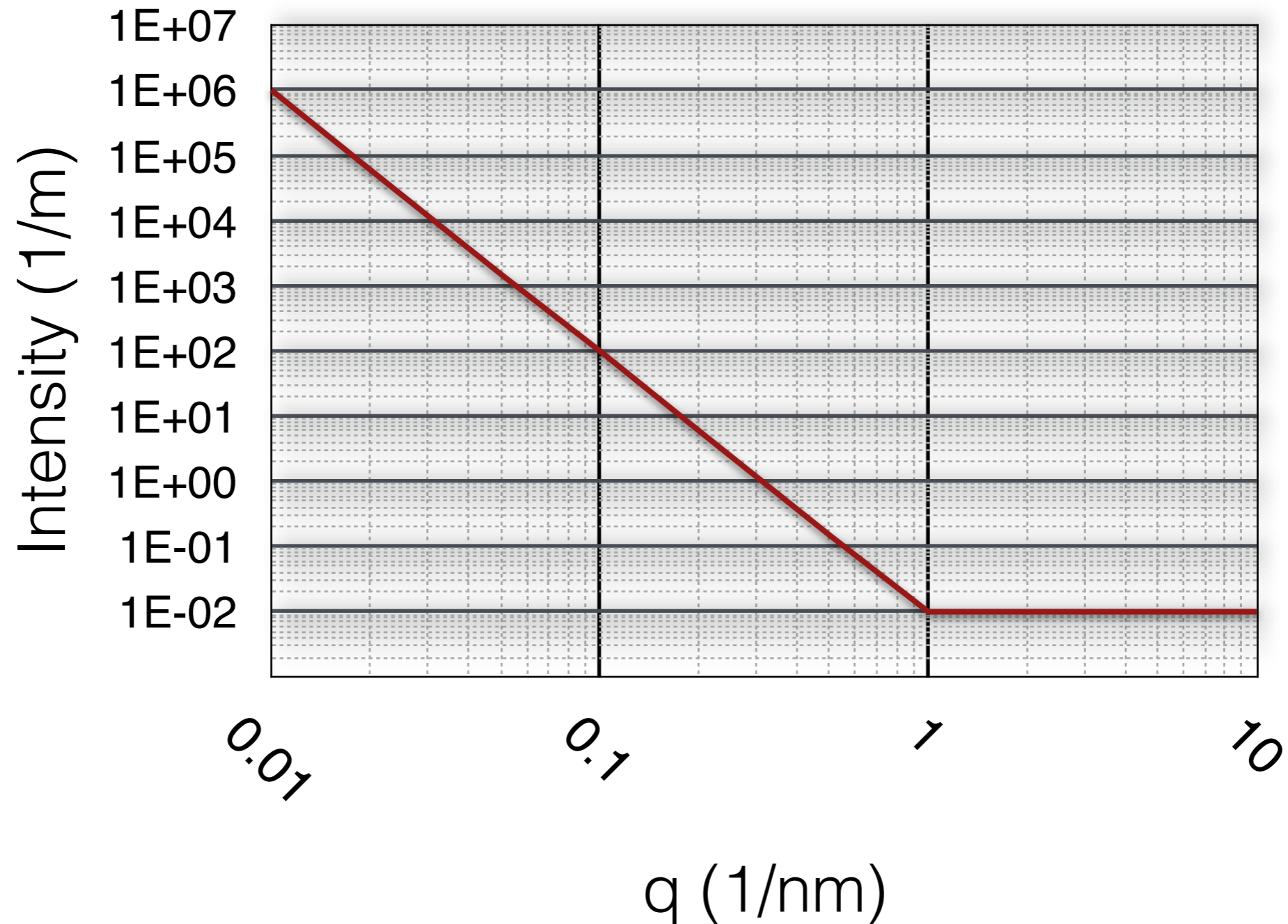
Features to keep an eye on

Case 1: no data



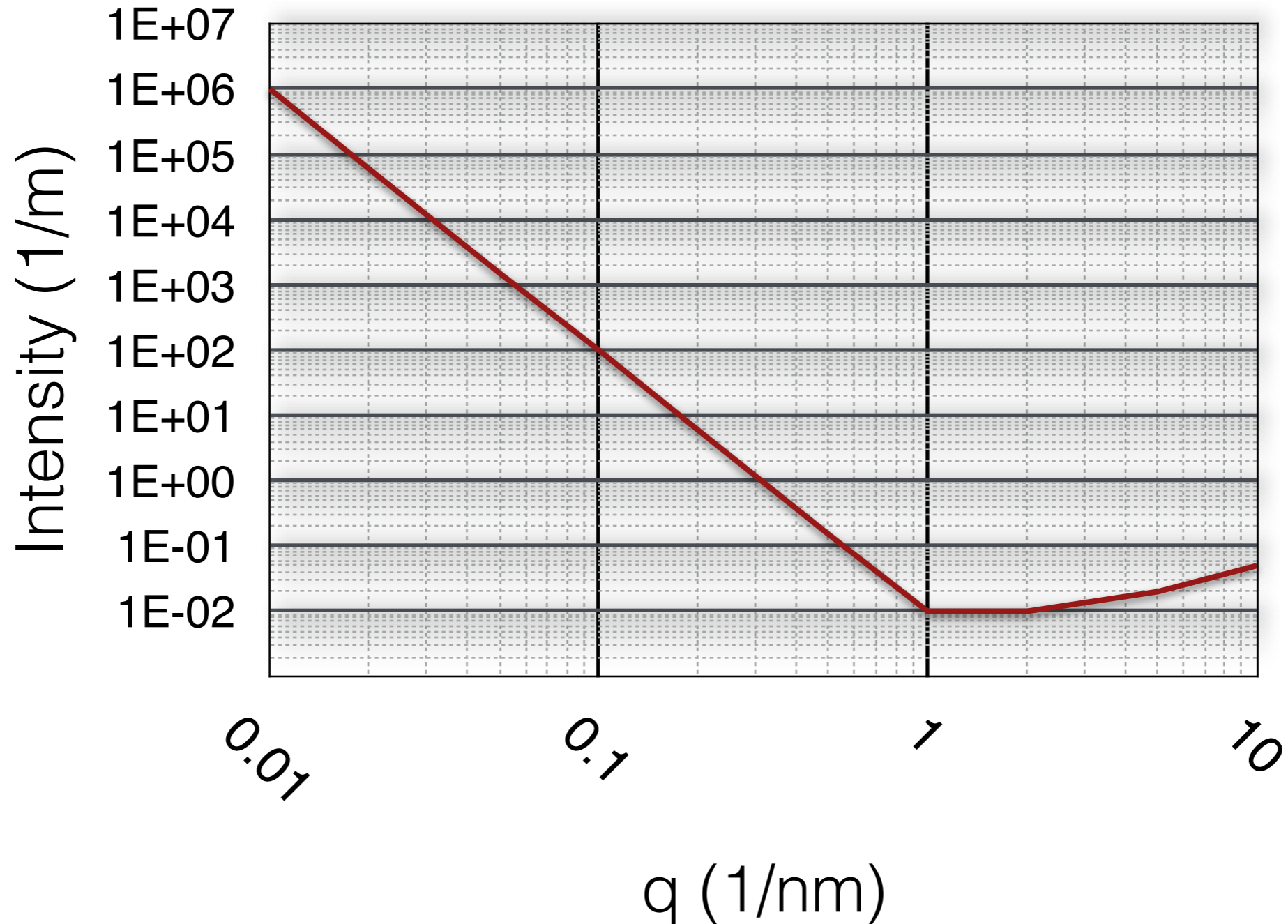
Features to keep an eye on

Case 2: still no data



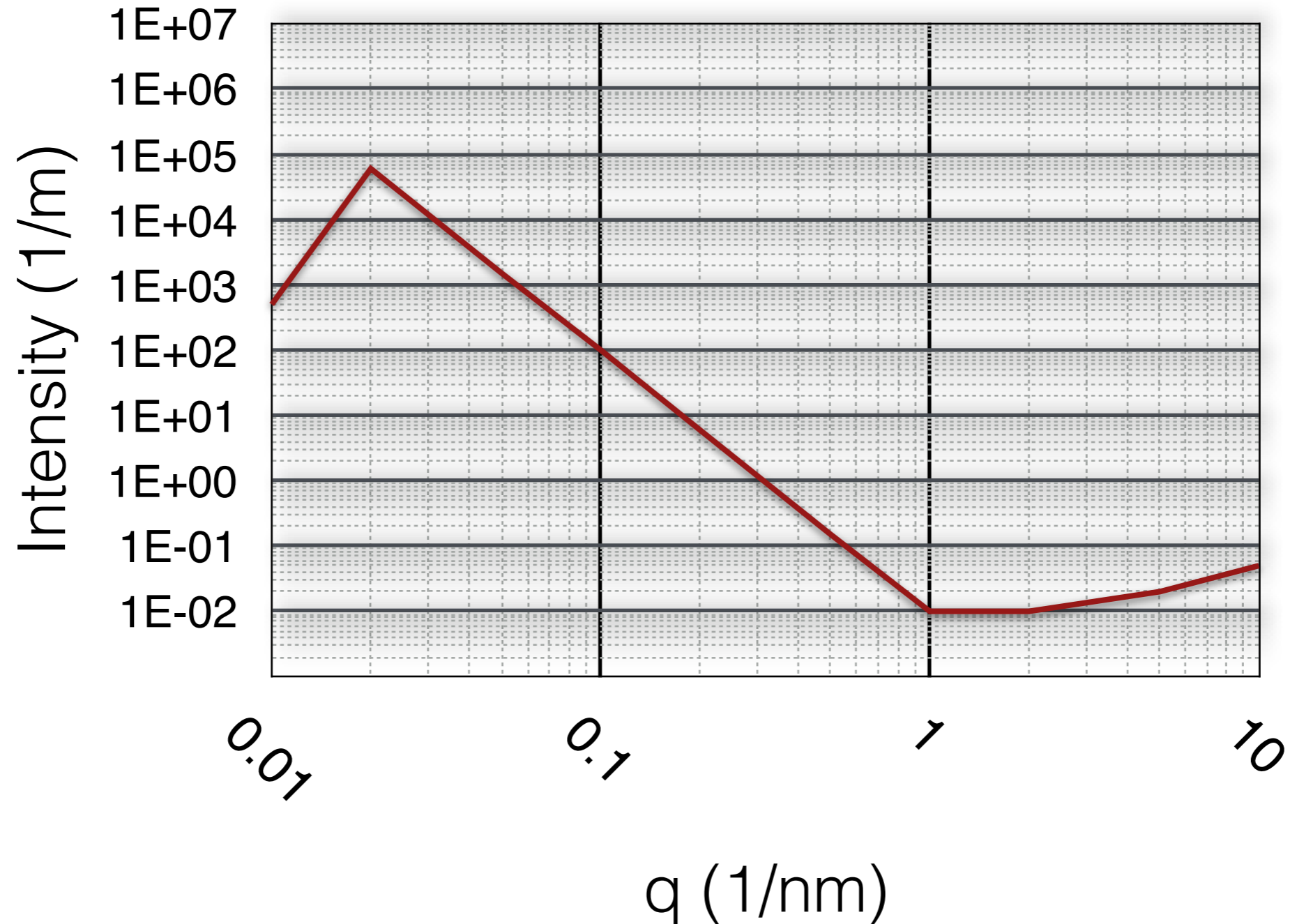
Features to keep an eye on

Case 3: Wide-angle peak



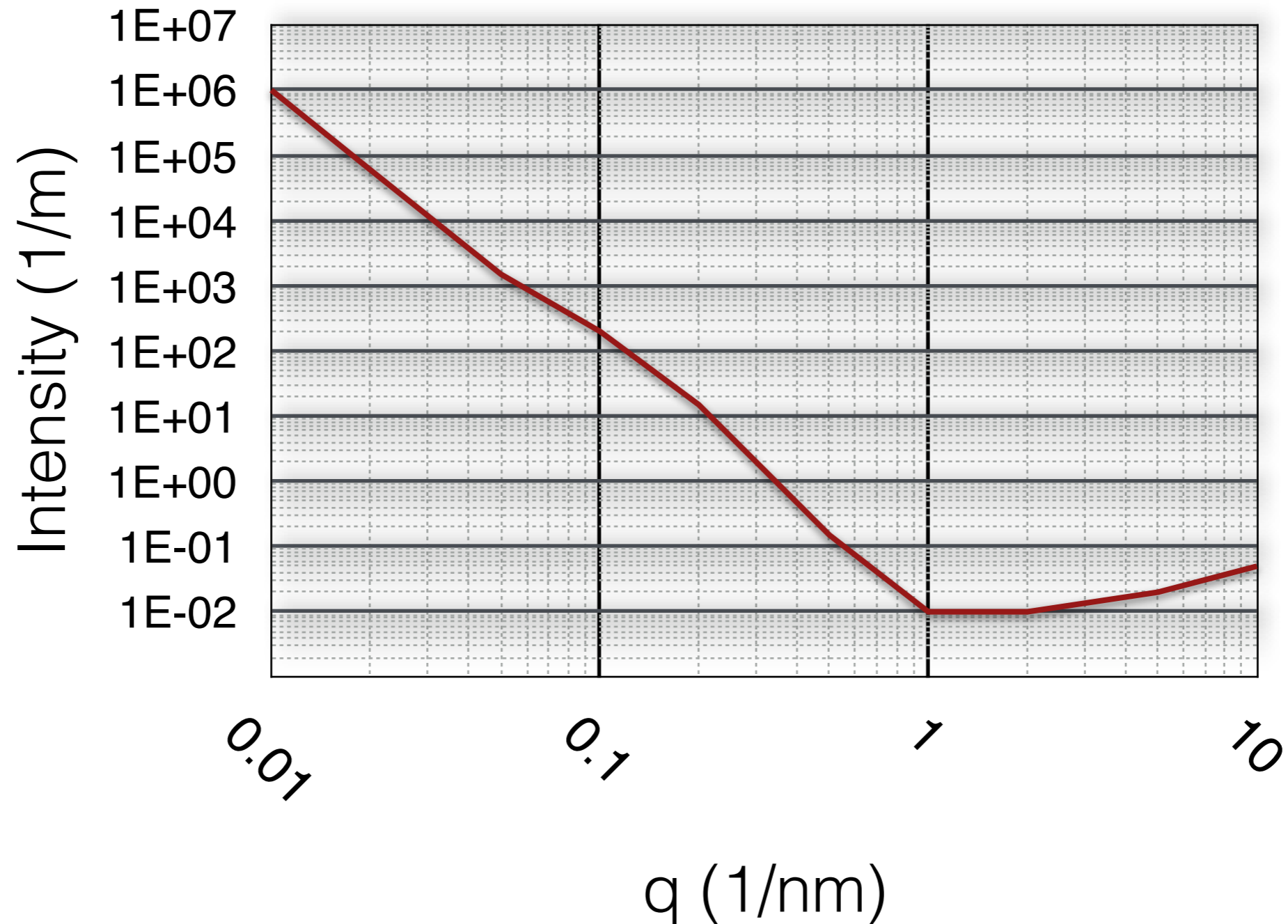
Features to keep an eye on

Case 4: suspicious data

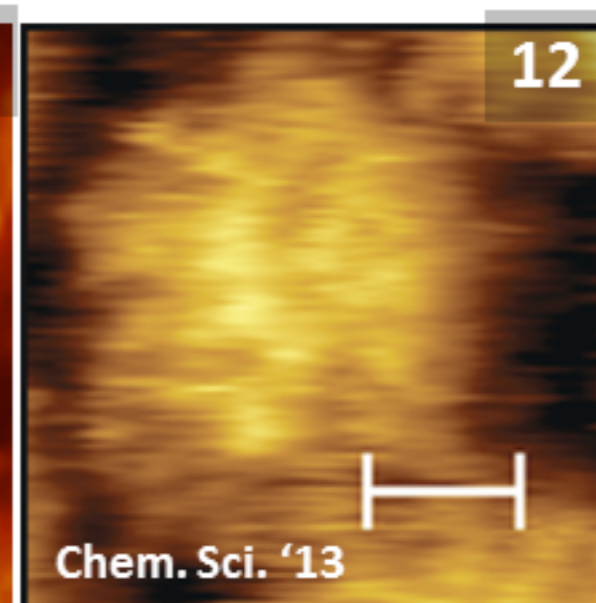
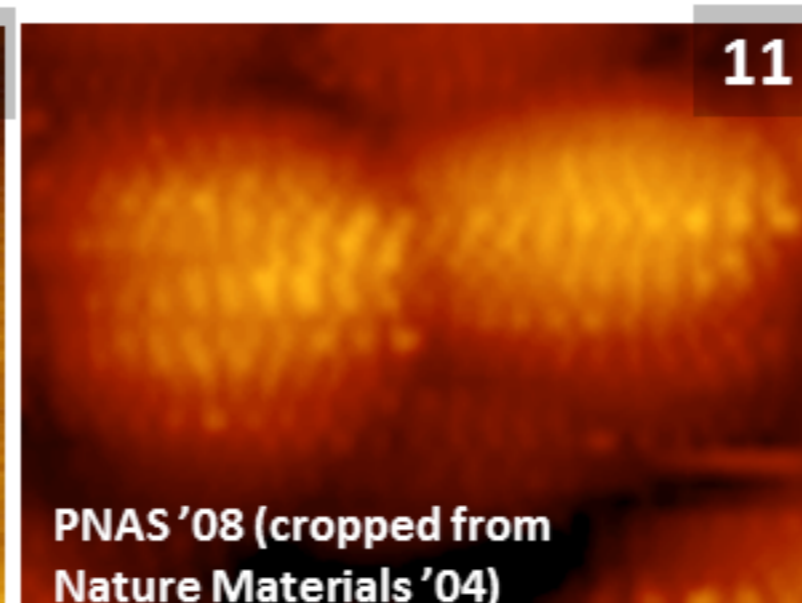
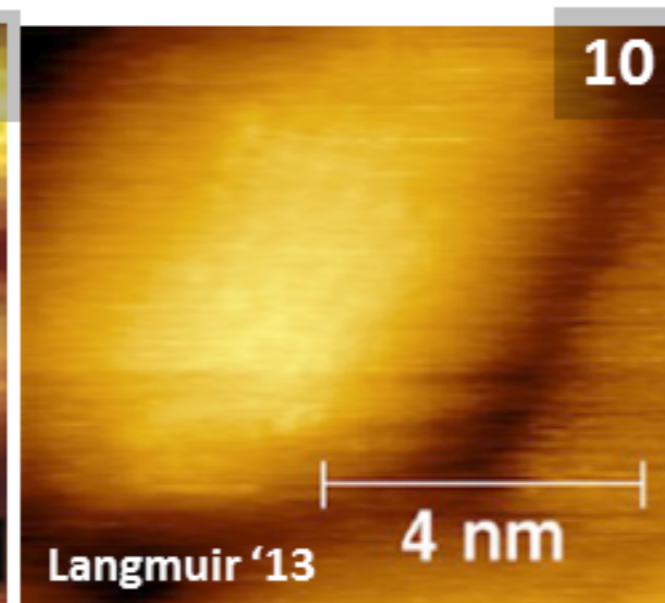
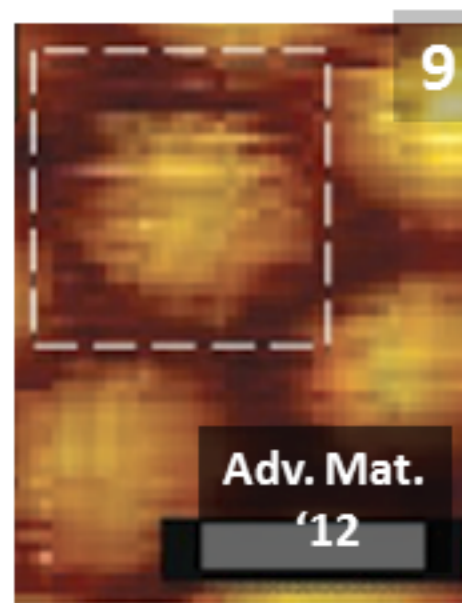
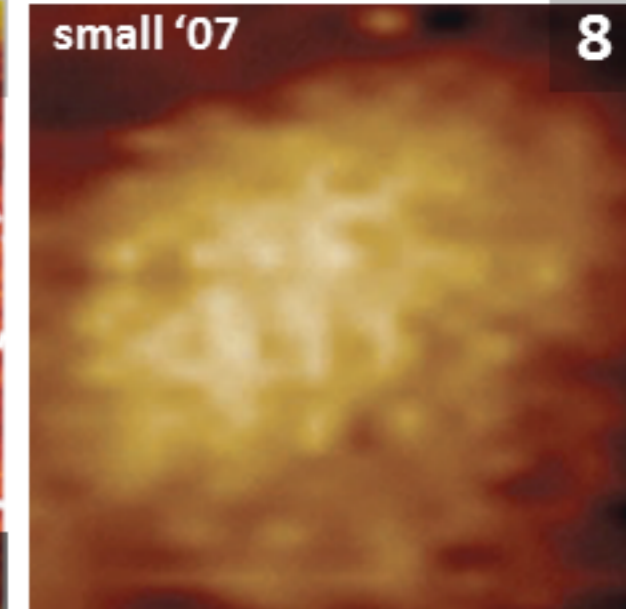
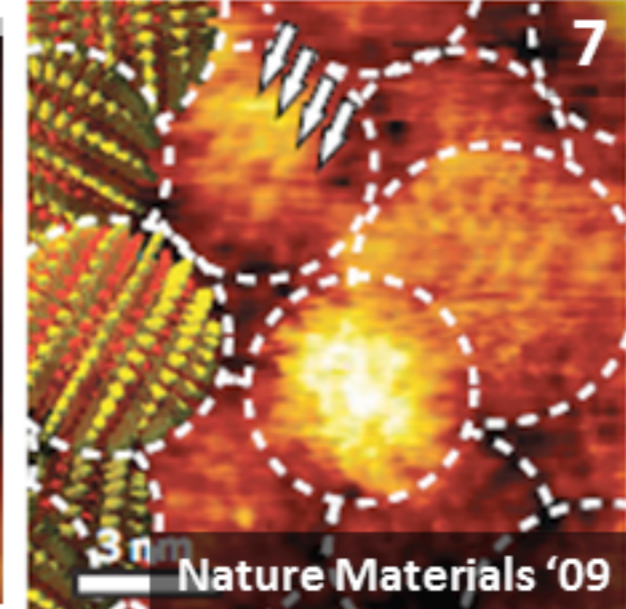
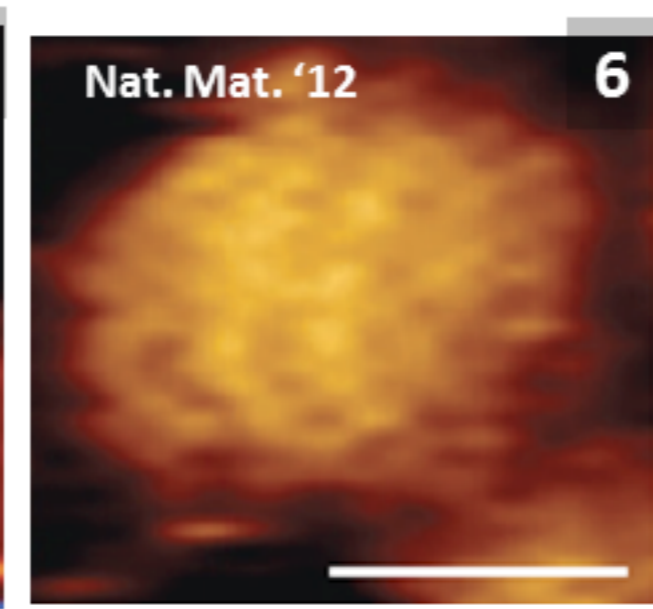
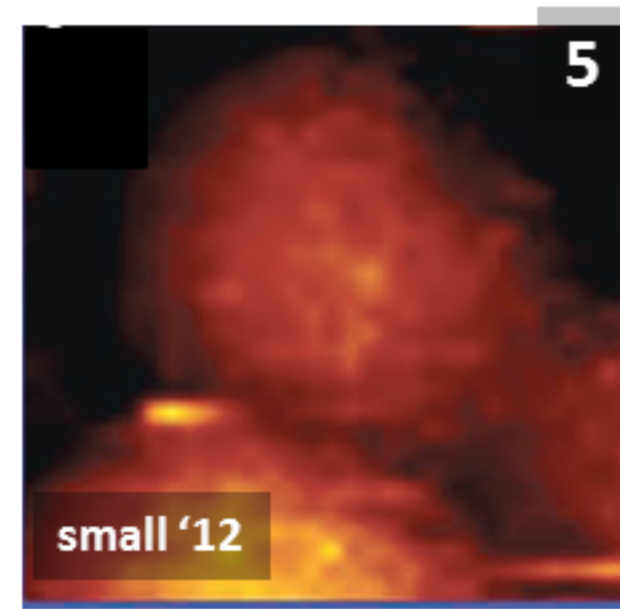
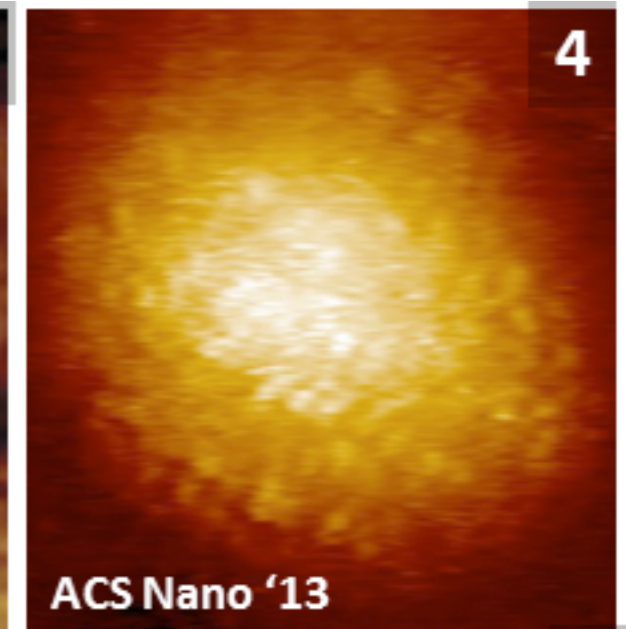
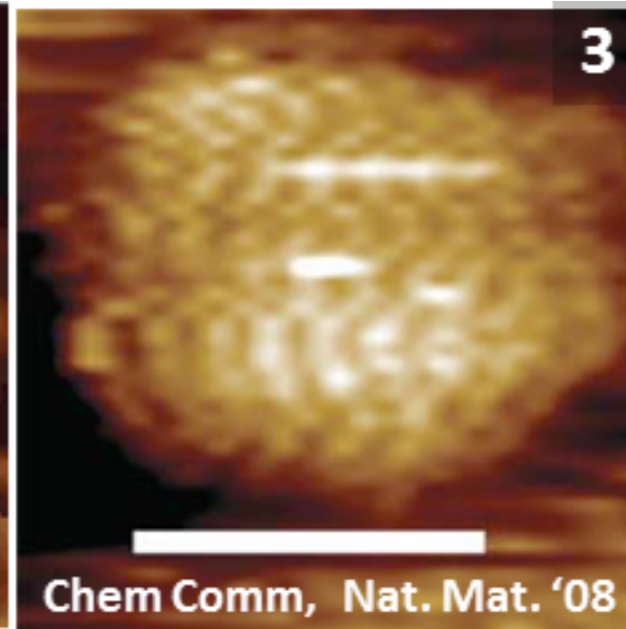
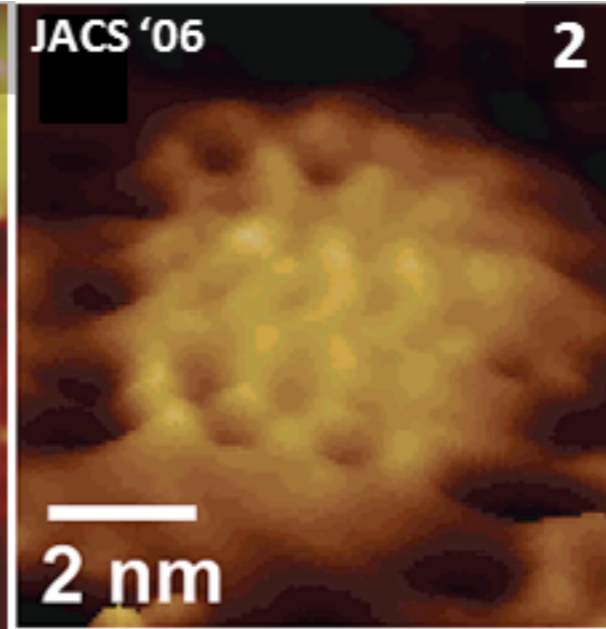
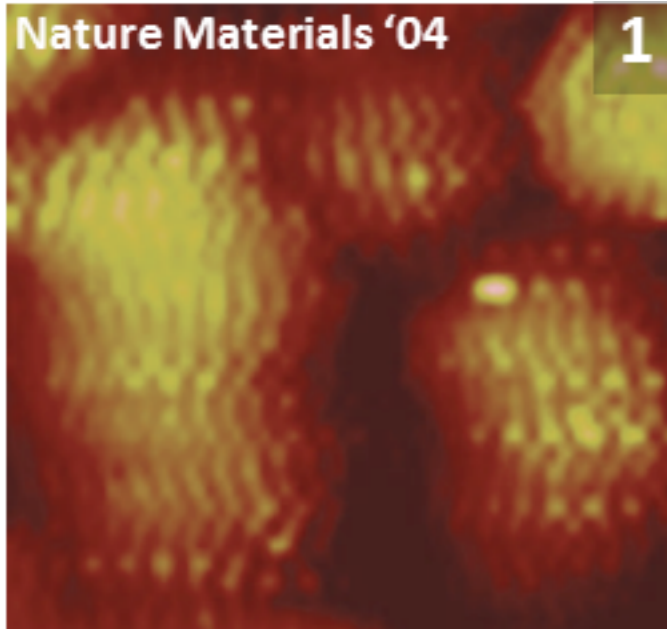


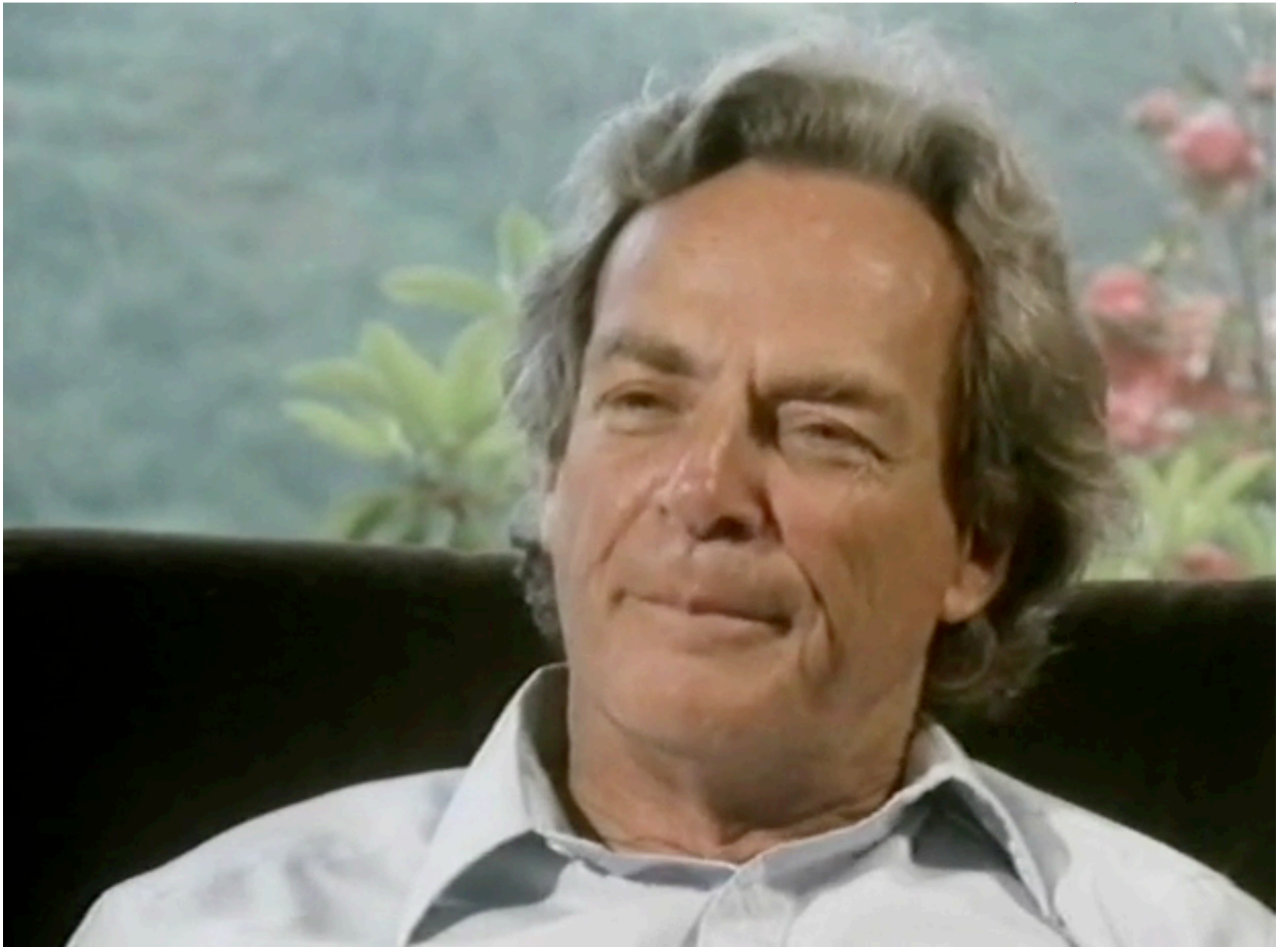
Features to keep an eye on

Case 5: there's data!

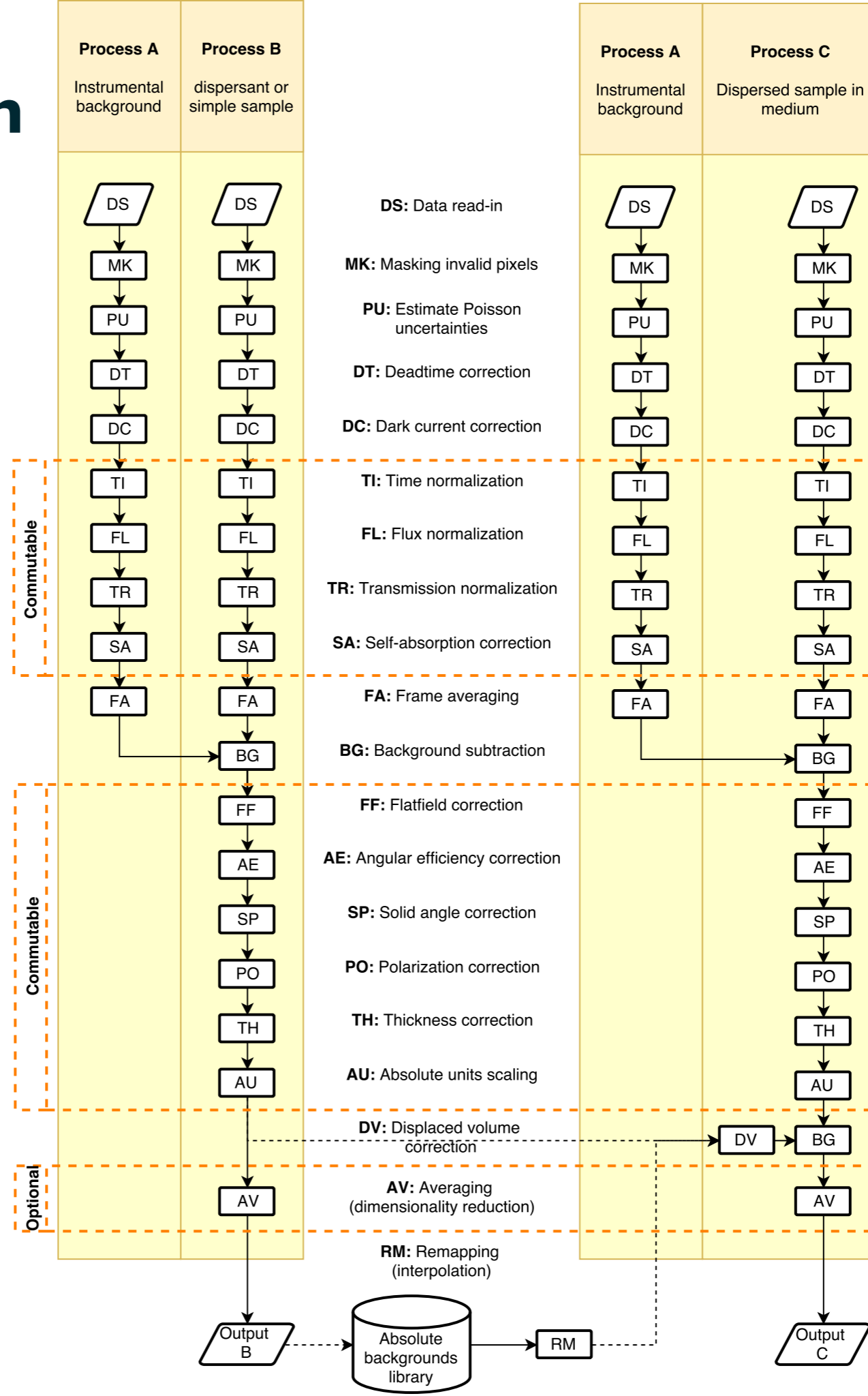


Correctness...





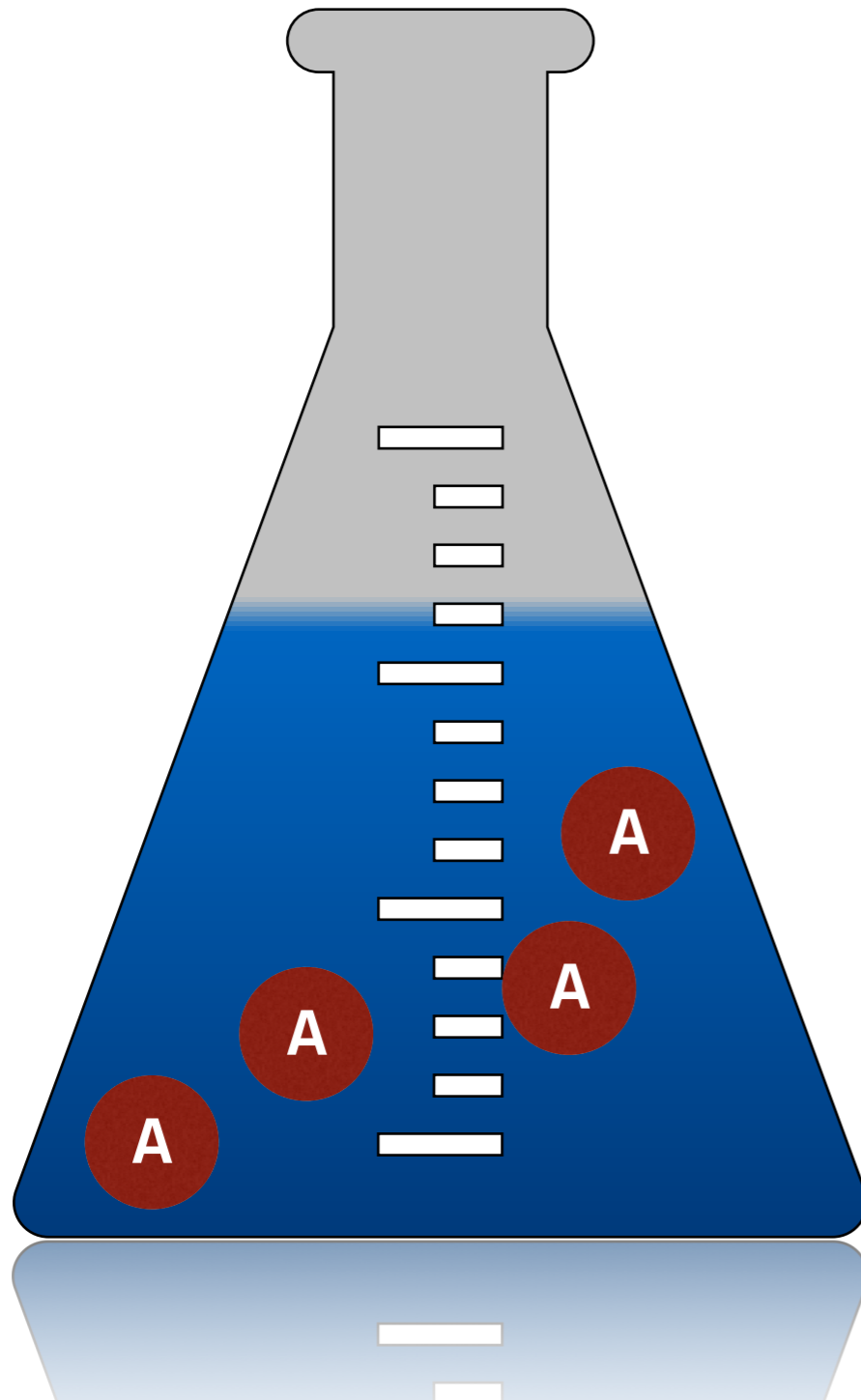
Data correction sequence



Backgrounds:

Backgrounds:

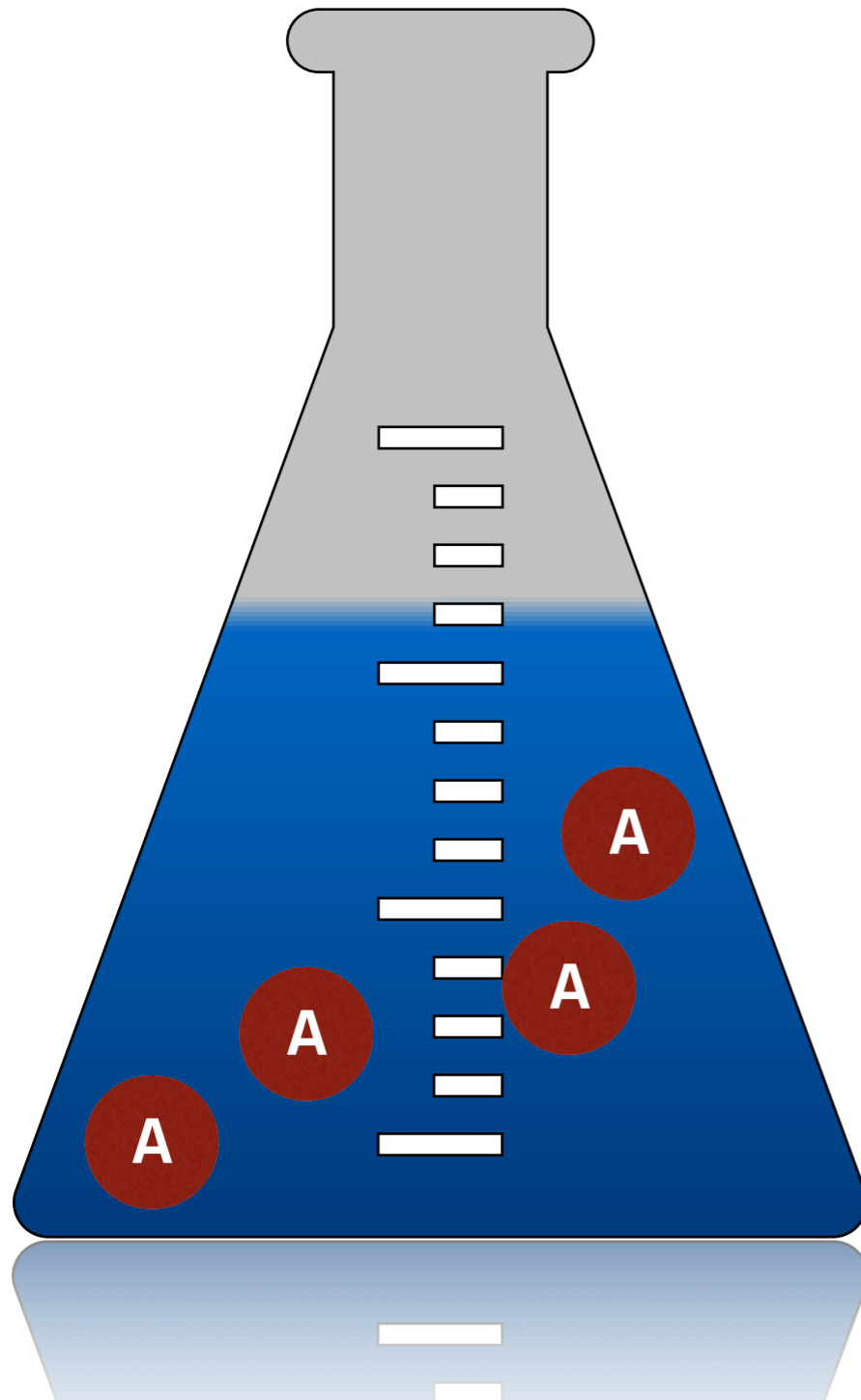
Sample:



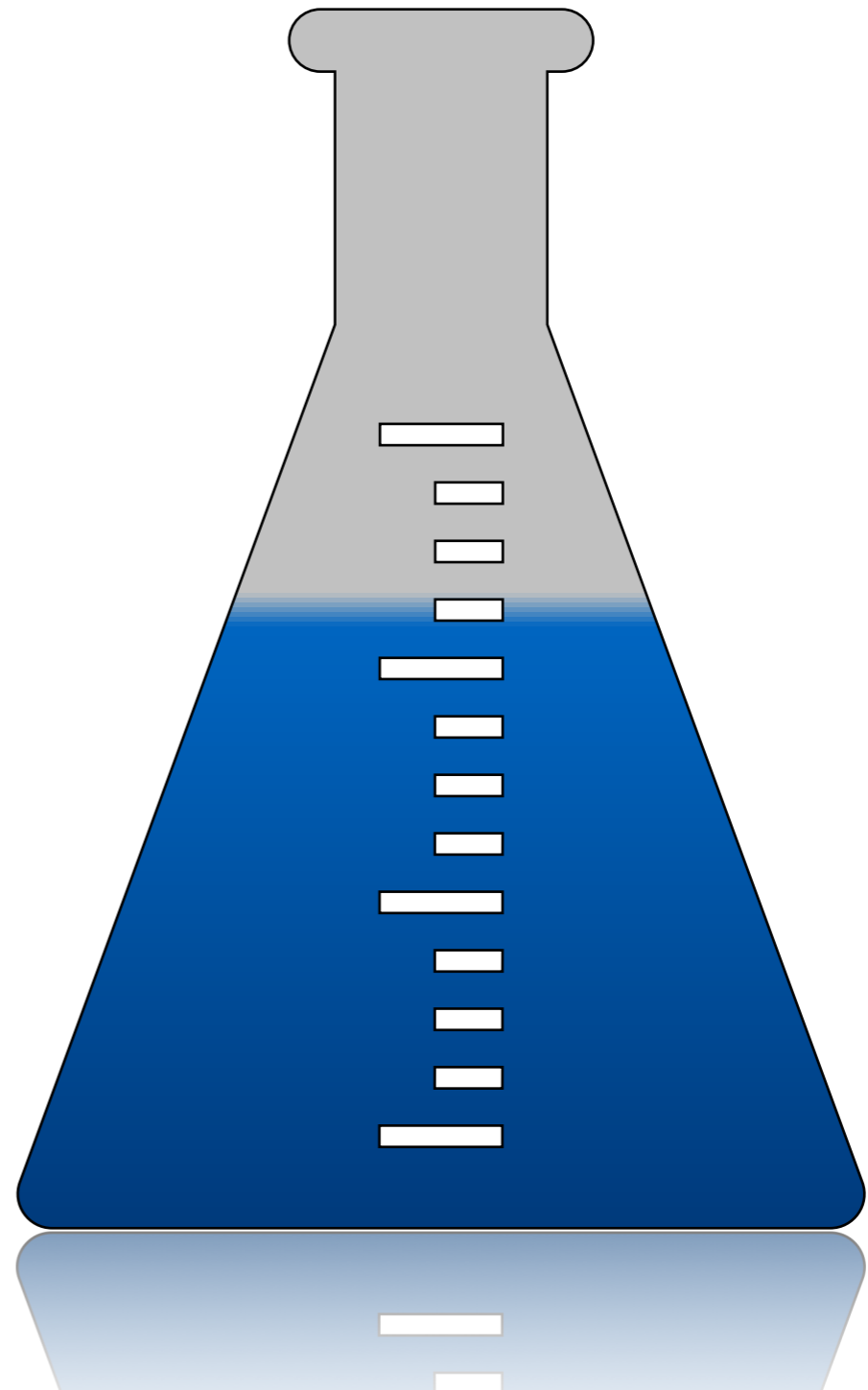
Background:

Backgrounds:

Sample:

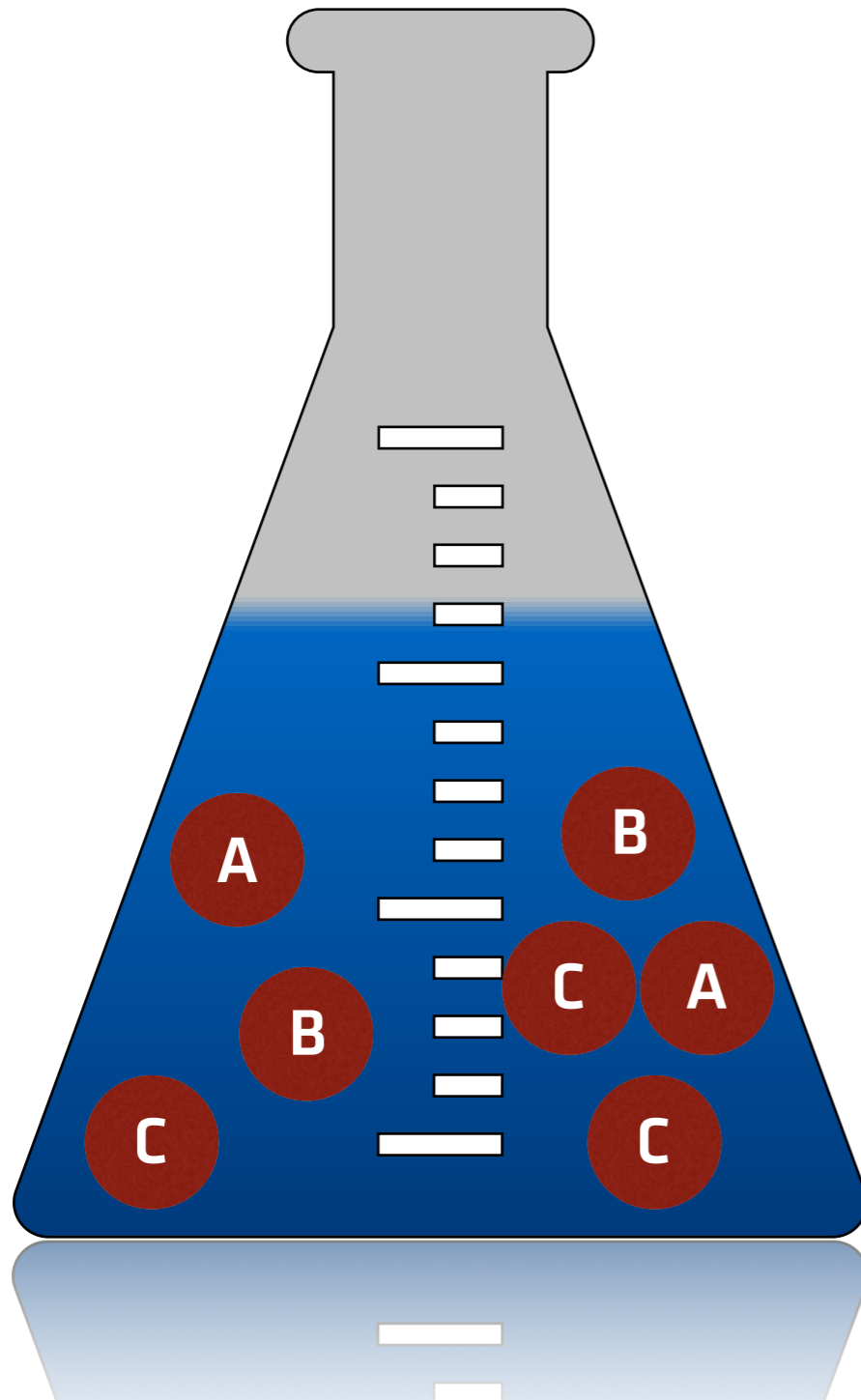


Background:



Backgrounds:

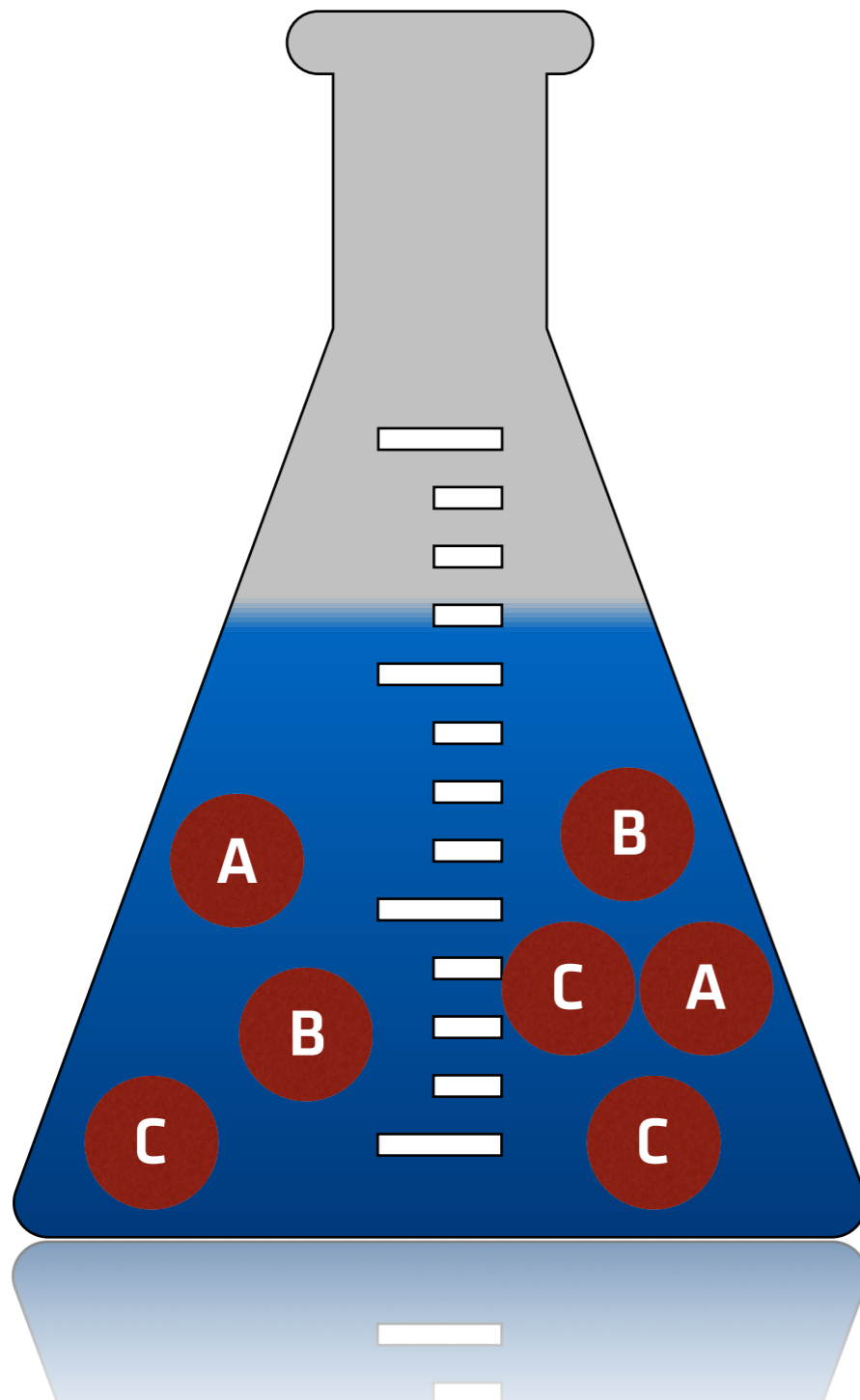
Sample:



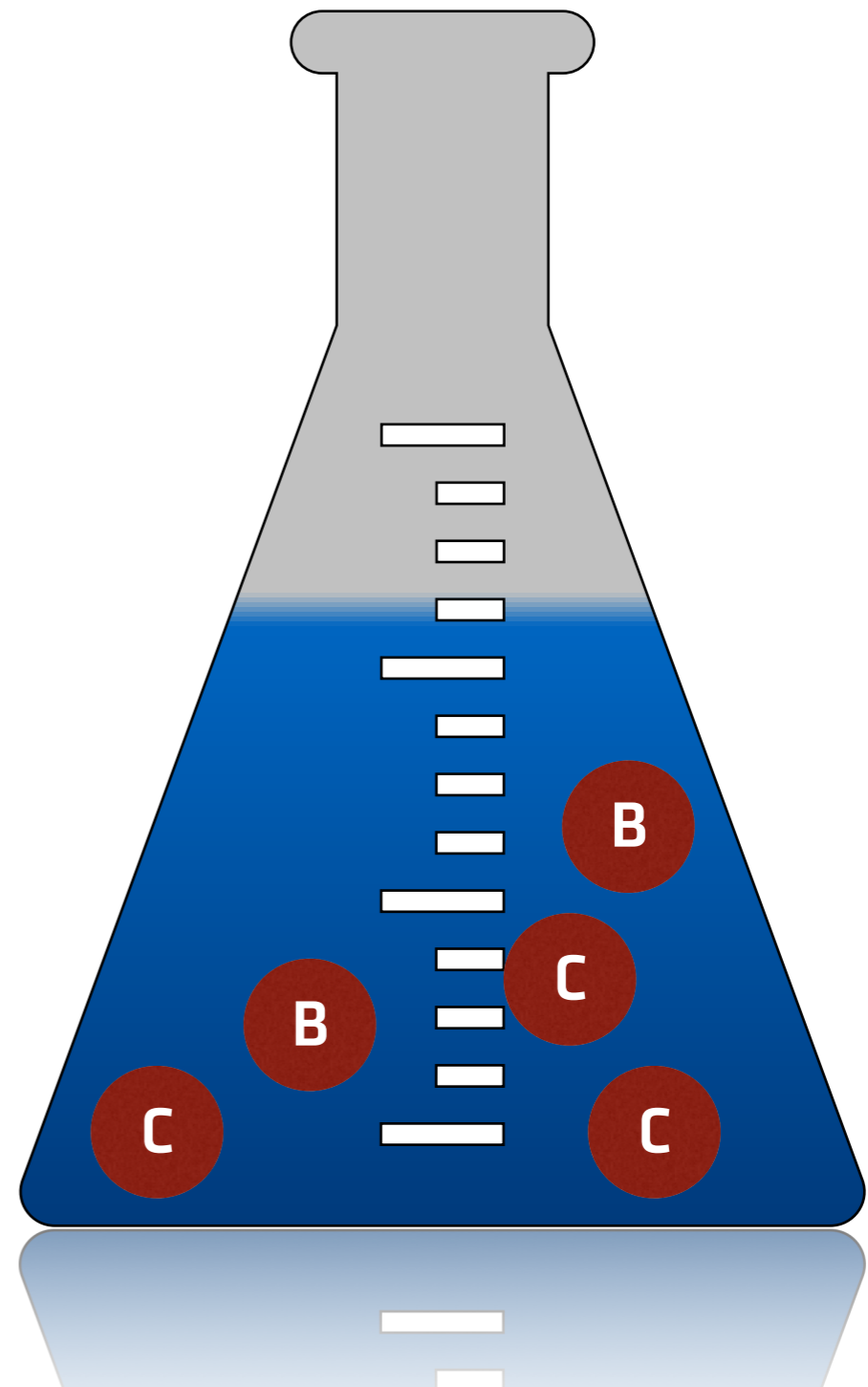
Background:

Backgrounds:

Sample:

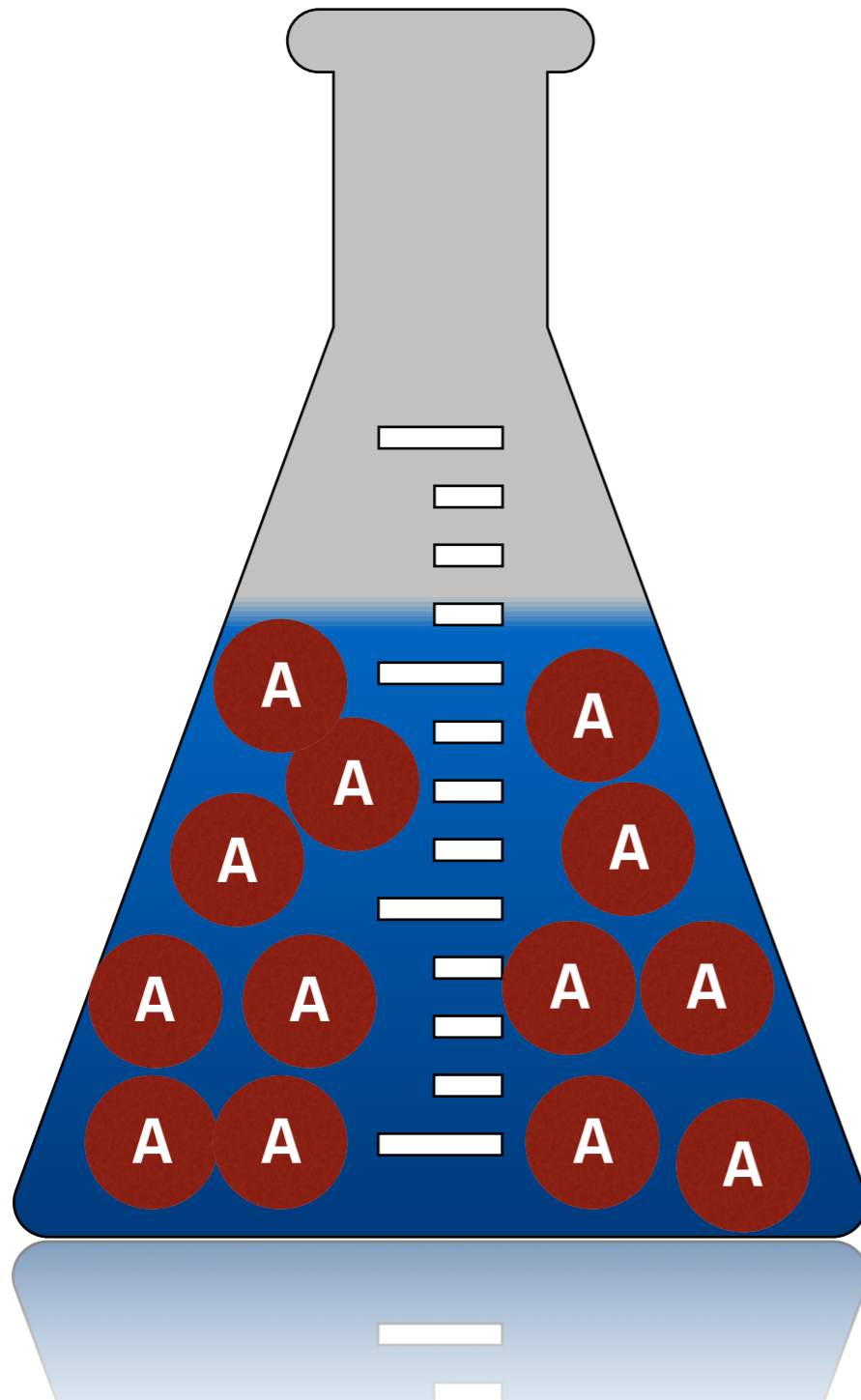


Background:



Backgrounds:

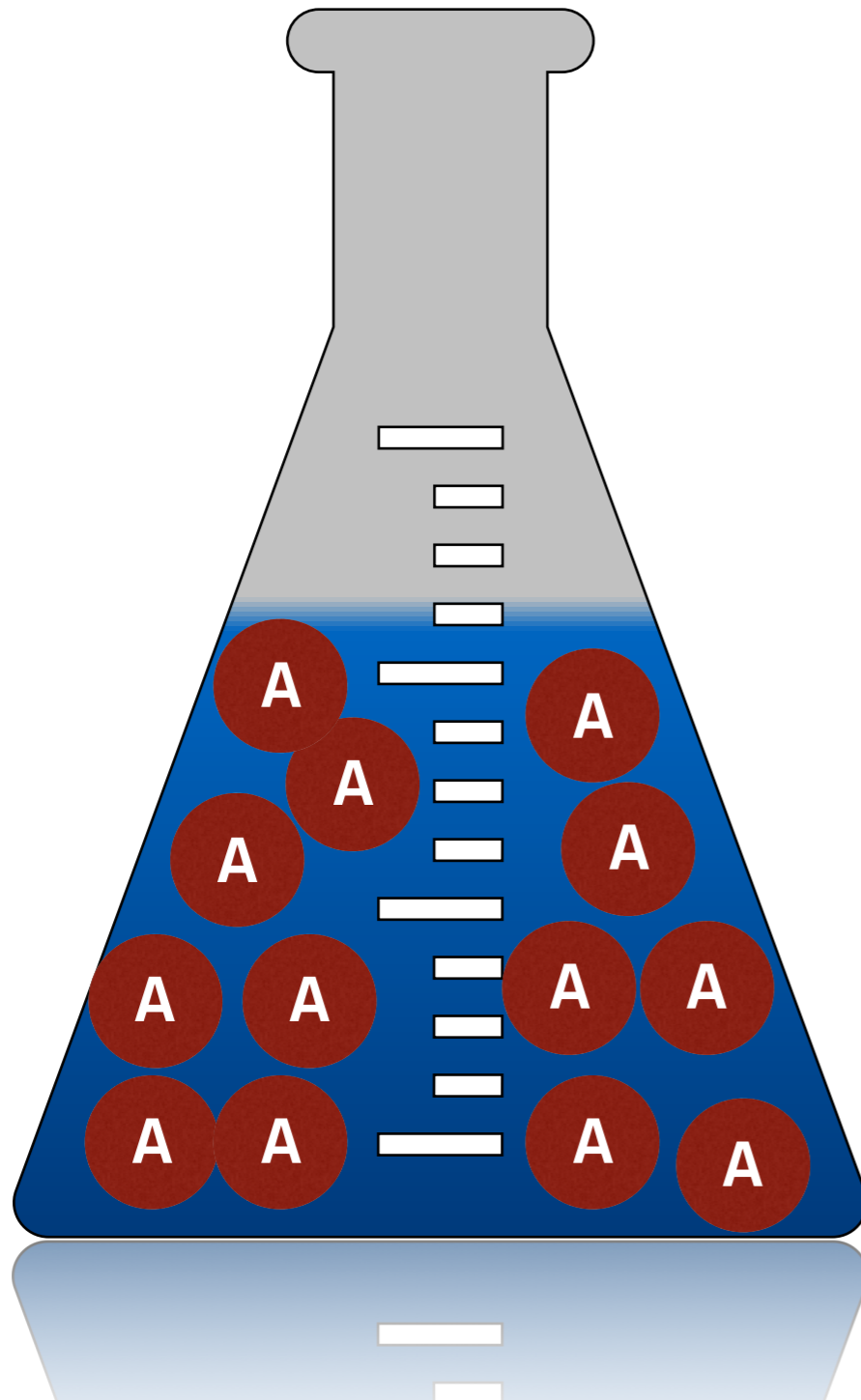
Sample:



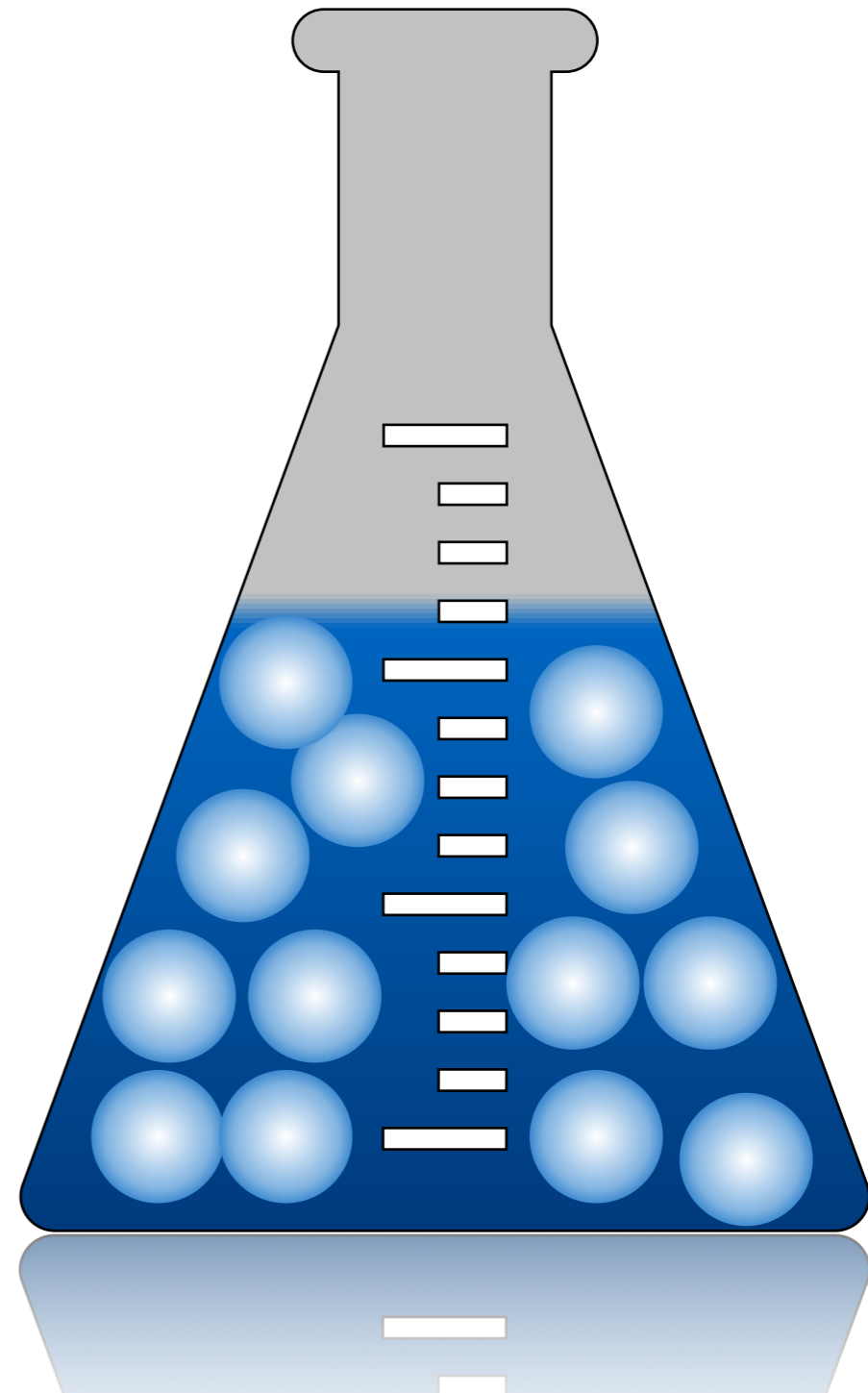
Background:

Backgrounds:

Sample:



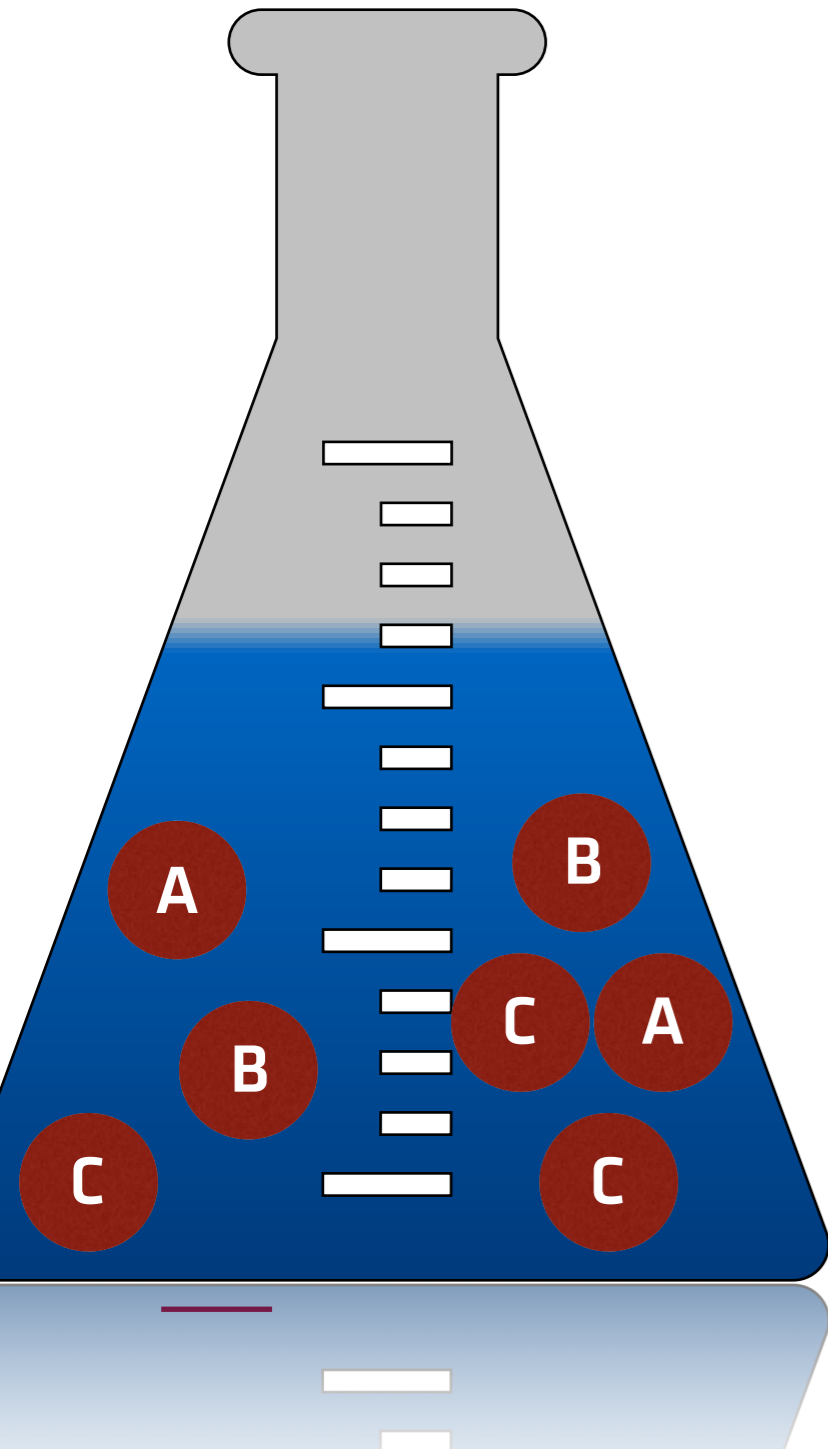
Background:



Backgrounds:

Sample:

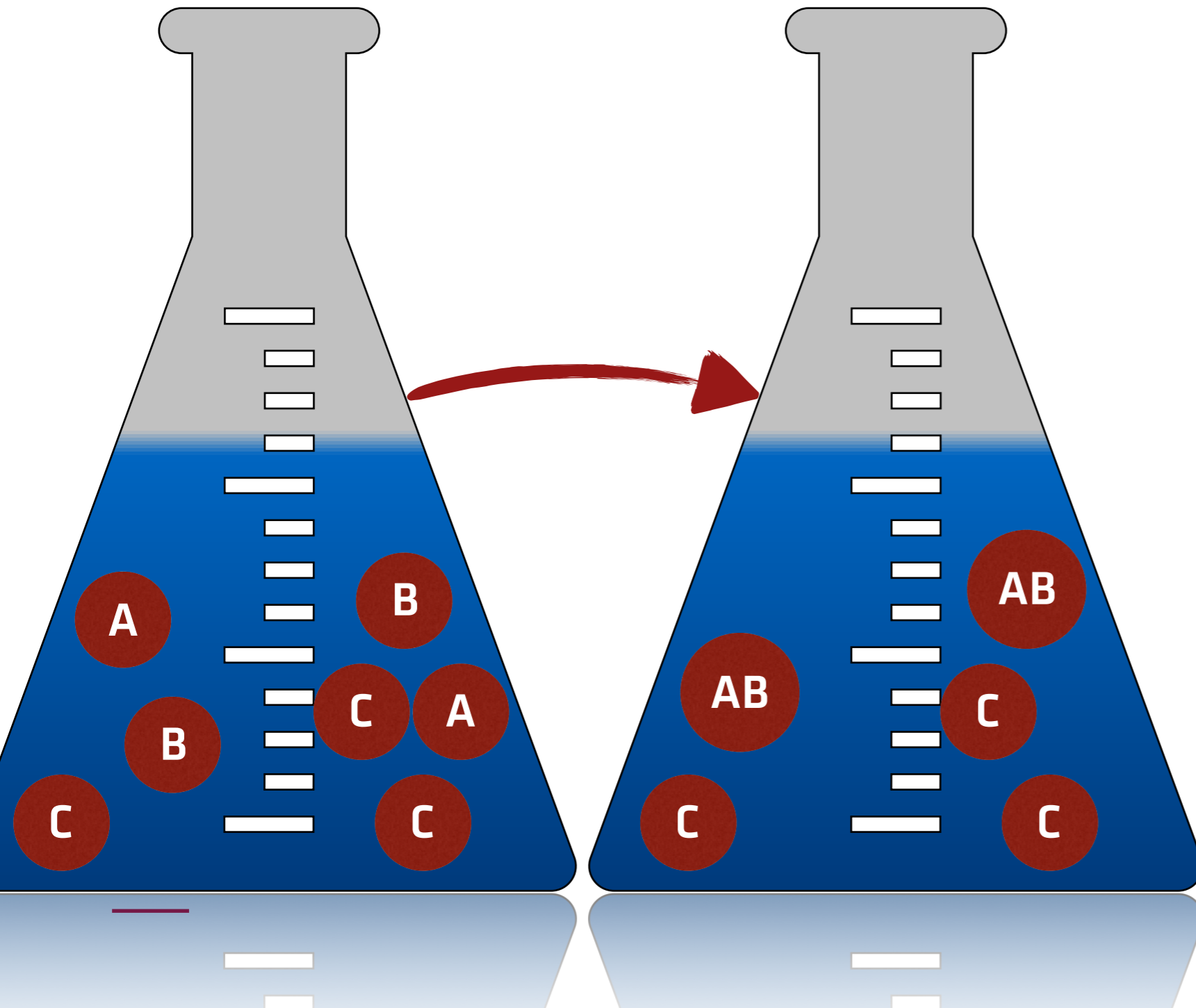
Background:



Backgrounds:

Sample:

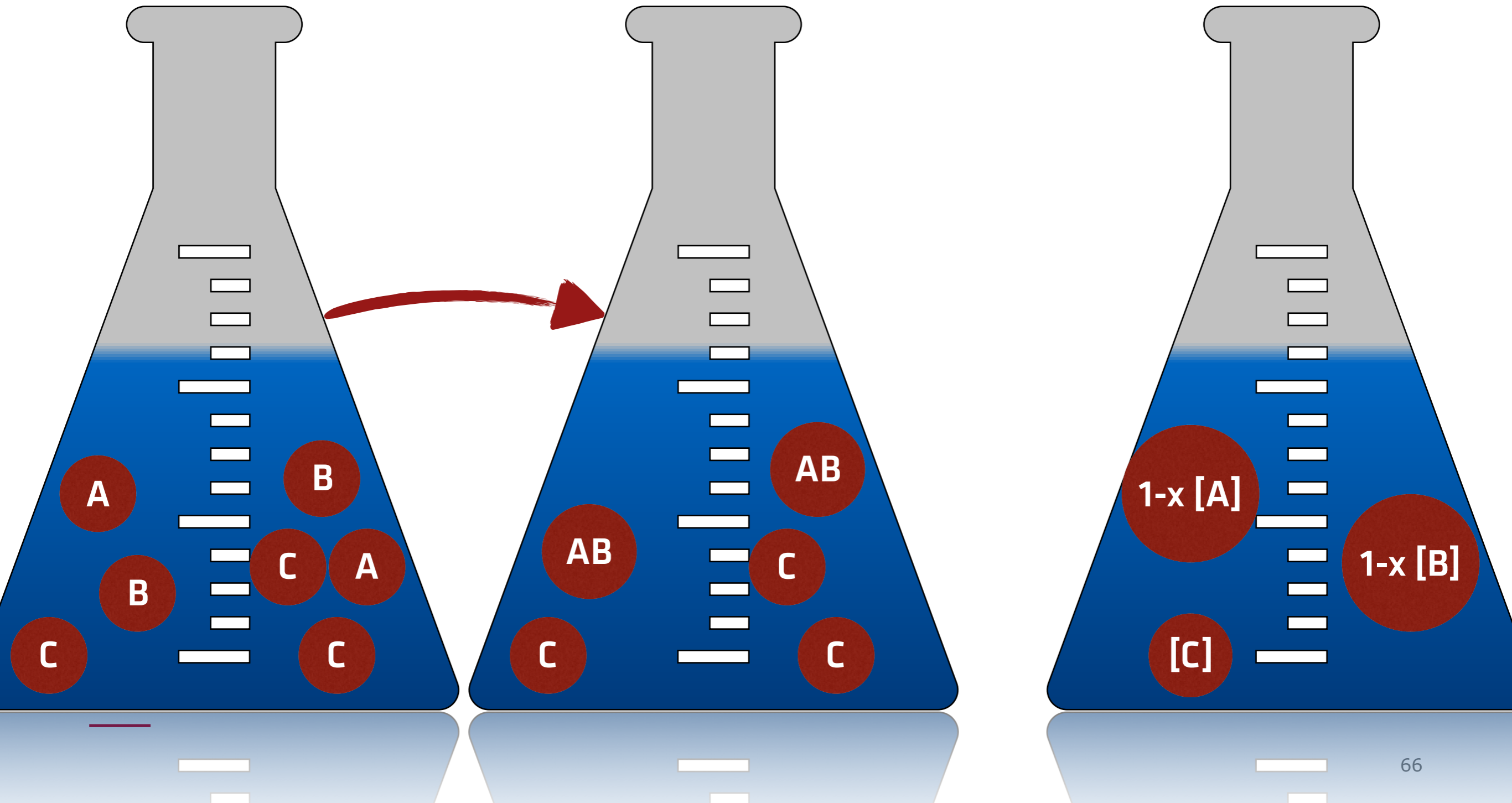
Background:



Backgrounds:

Sample:

Background:



Choose your own adventure
(at your own risk)

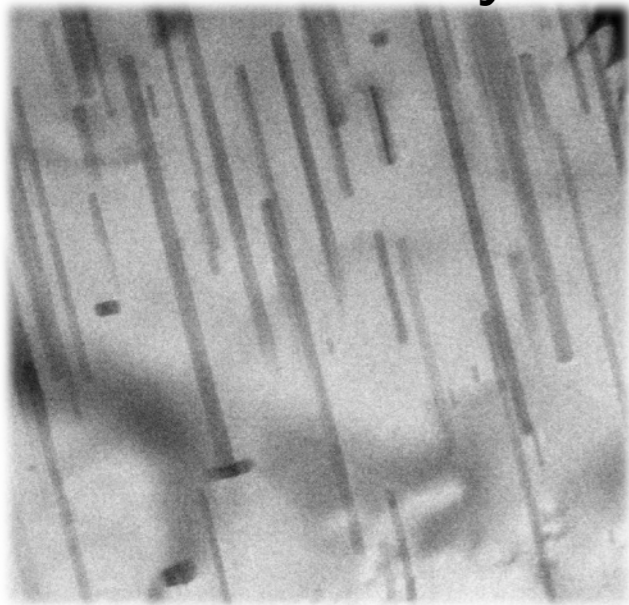
Choose your own adventure
(at your own risk)



Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



Nanoparticles



[Round Robin]

[Ultra-SAXS]

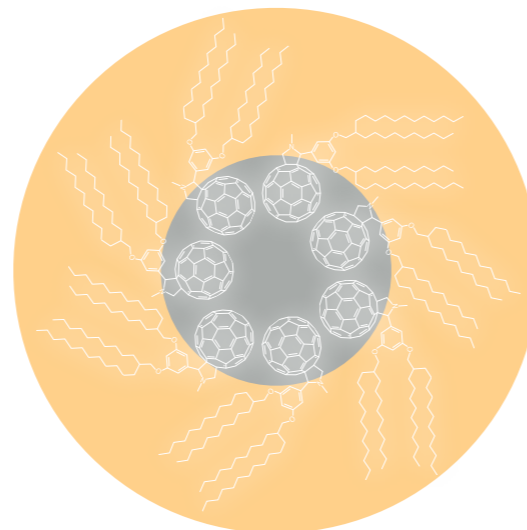
Powders



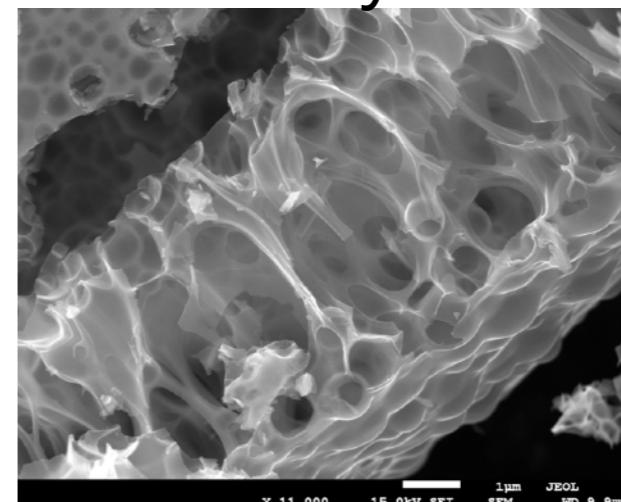
Doughnuts



Micelles



Catalysts



[exit]

Mg-Zn

TEM & SAXS

Julian M. Rosalie

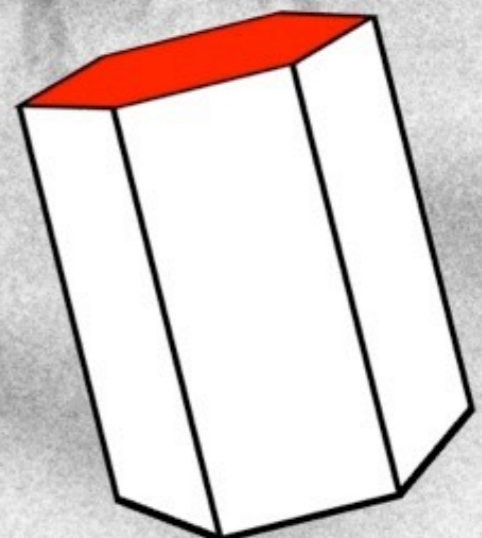
Brian R. Pauw

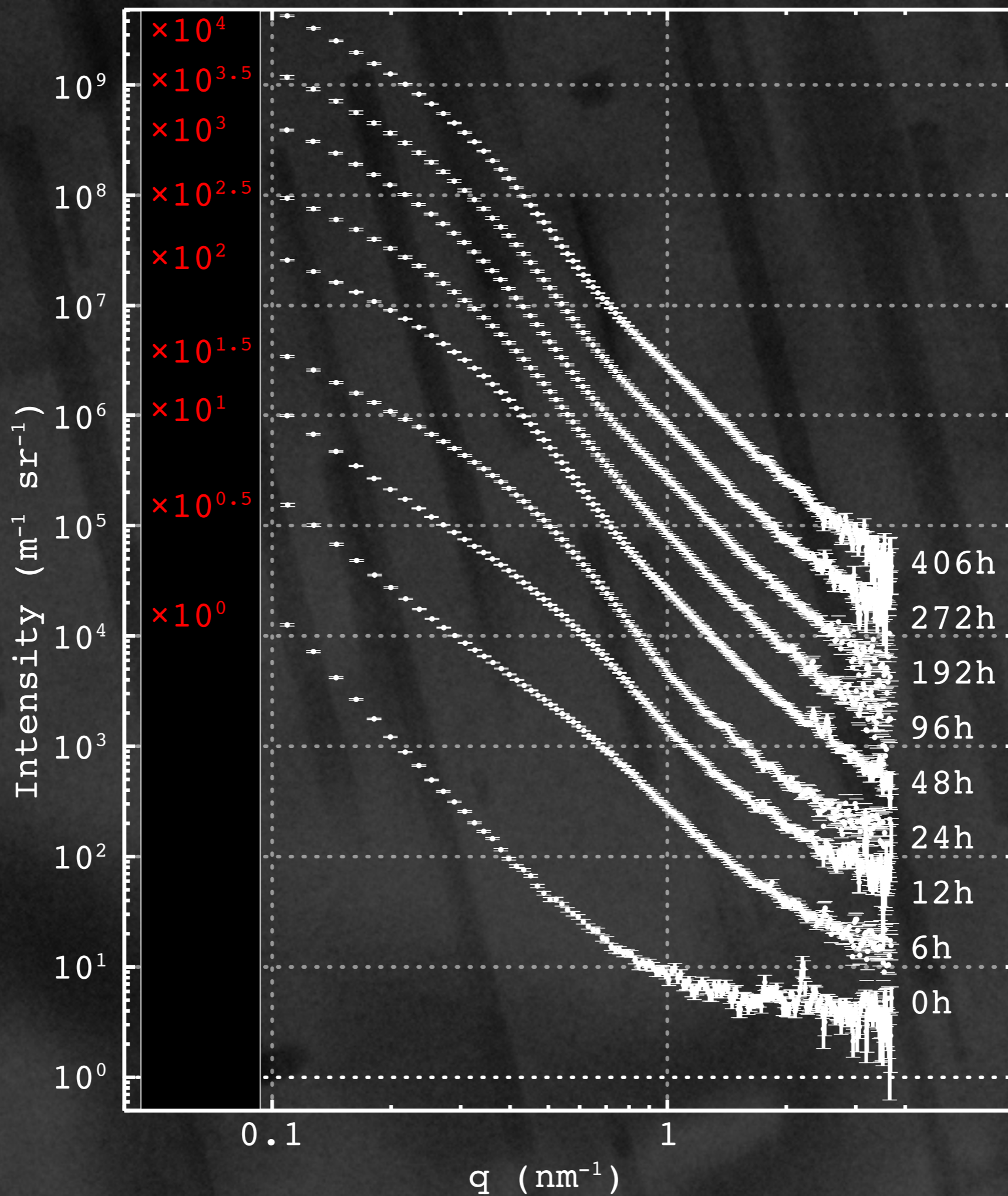


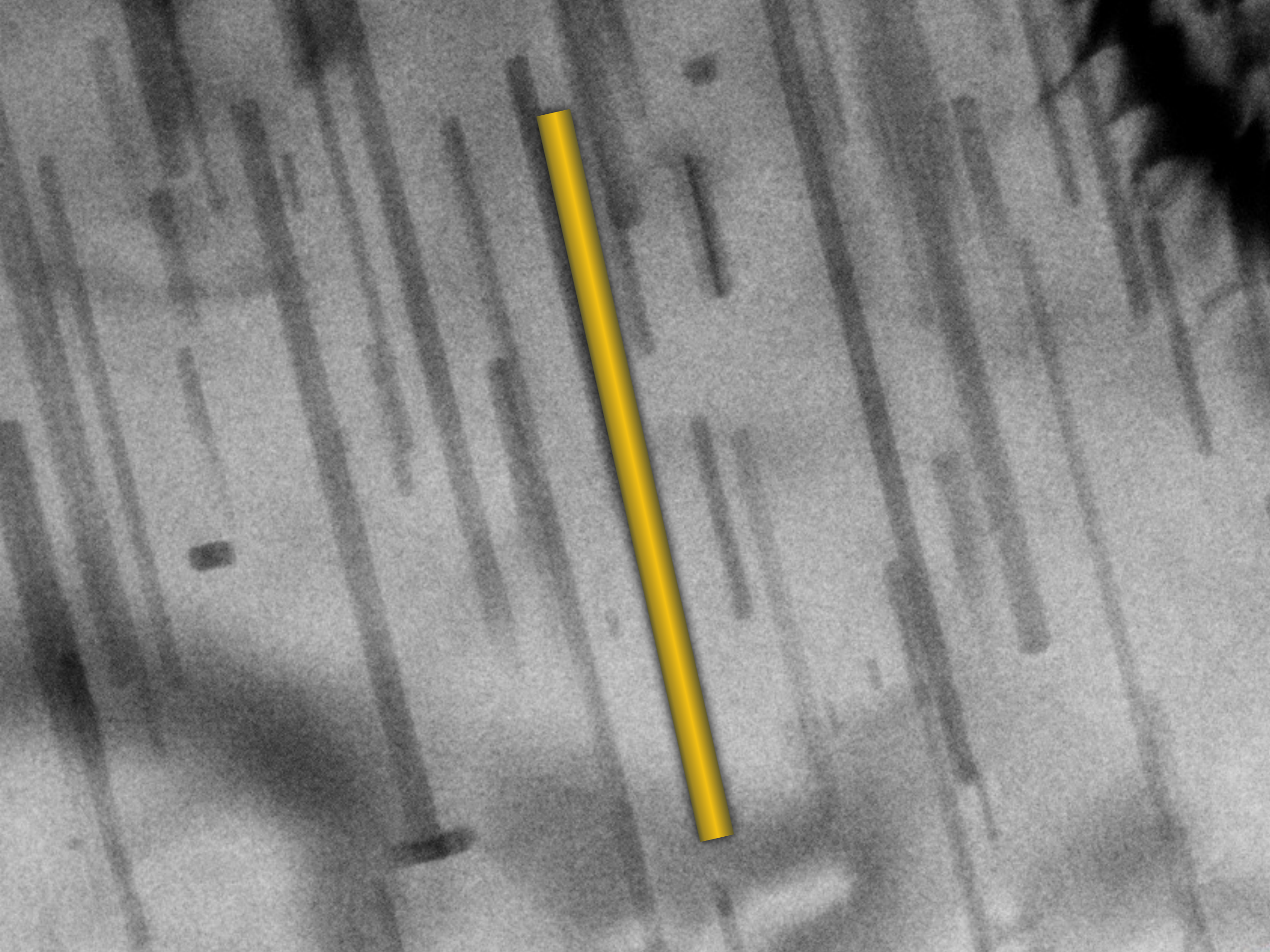
200 nm

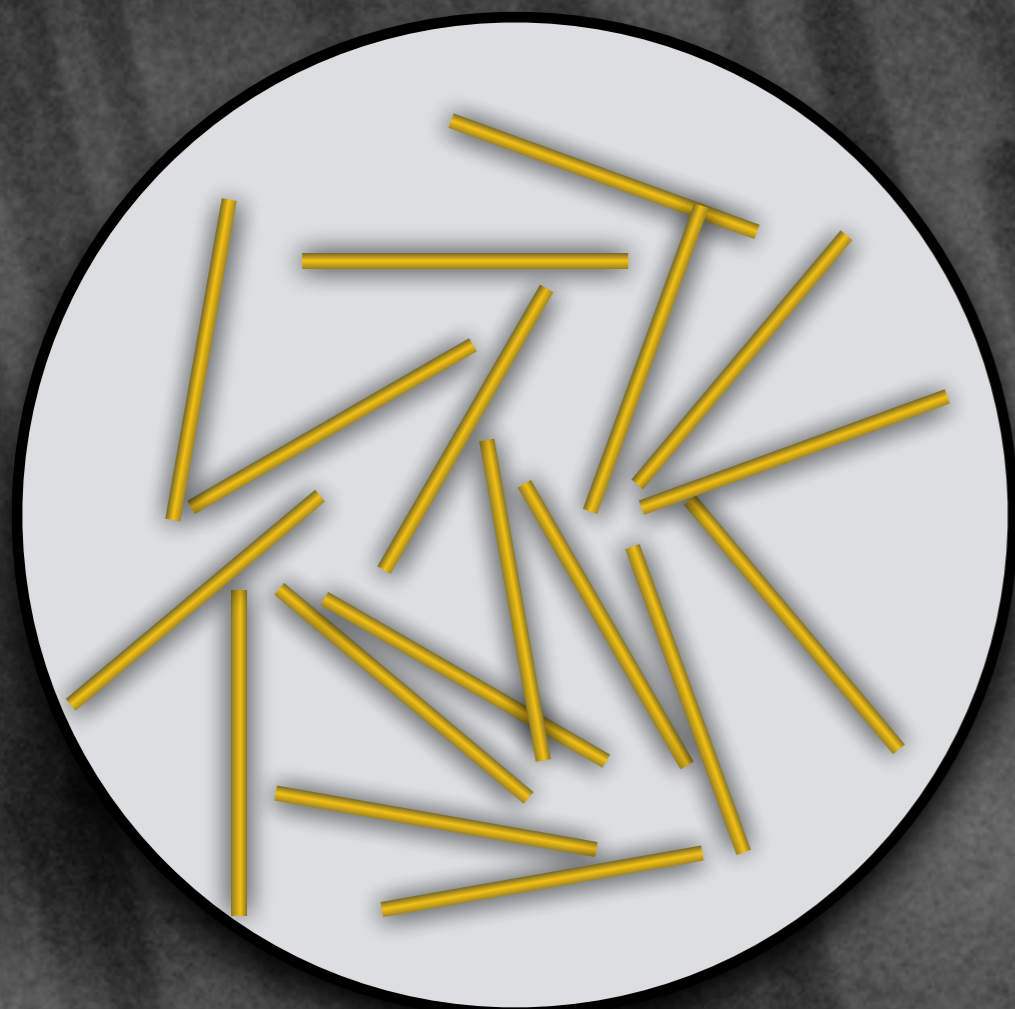
This transmission electron micrograph shows a layered material with a clear periodic structure. The layers are oriented vertically, with alternating light and dark bands. A scale bar in the bottom left corner indicates a length of 200 nm. In the bottom right corner, there is a 3D schematic of a hexagonal prism with a red top surface. A white arrow points upwards from the schematic, labeled with the crystallographic direction [0001].

[0001]





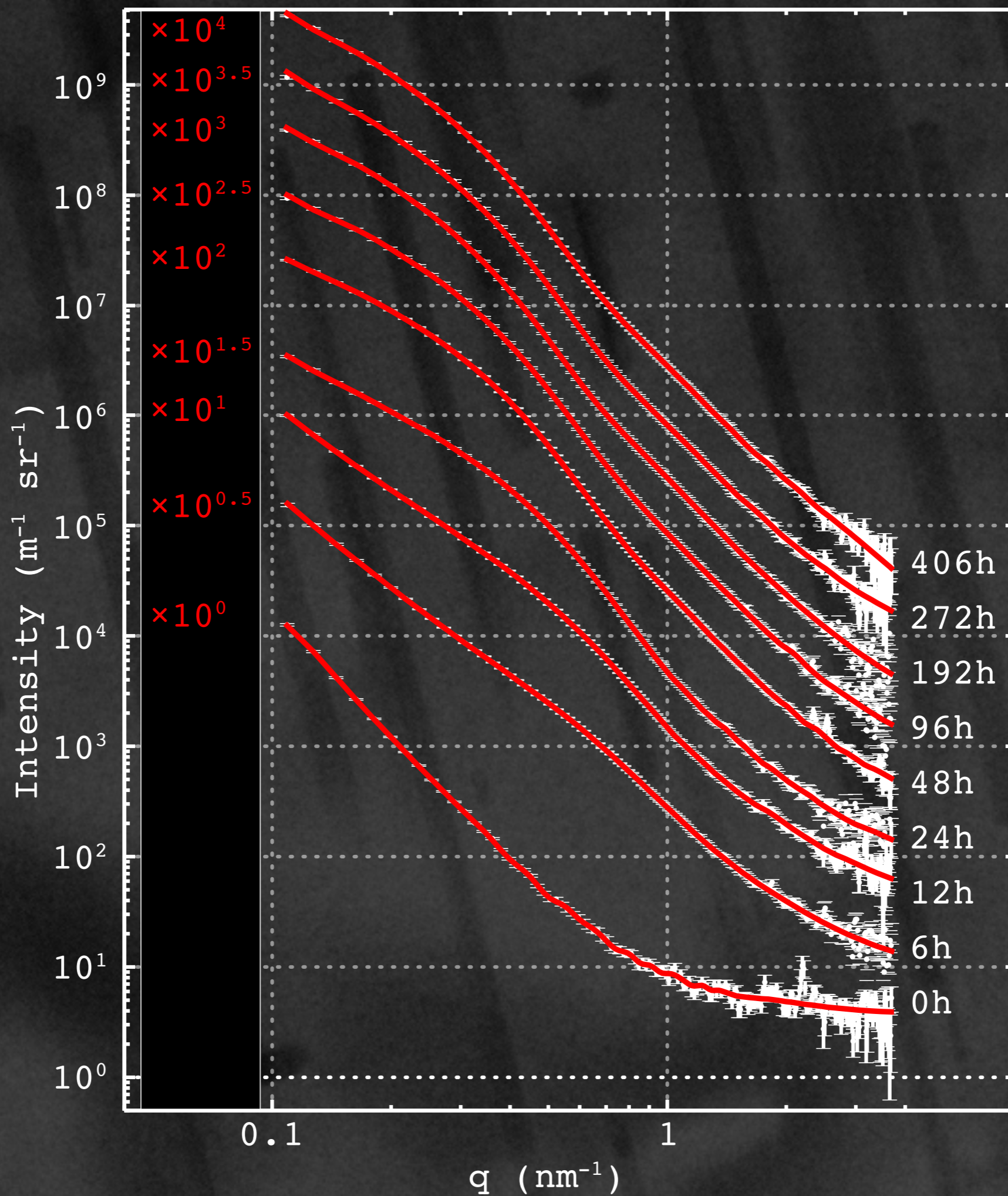


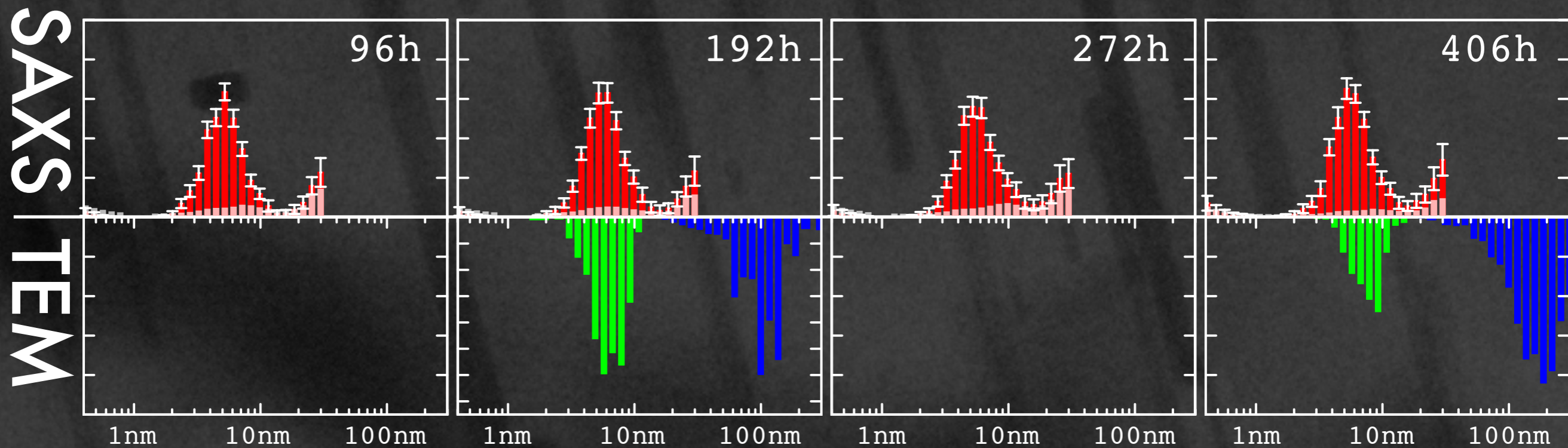
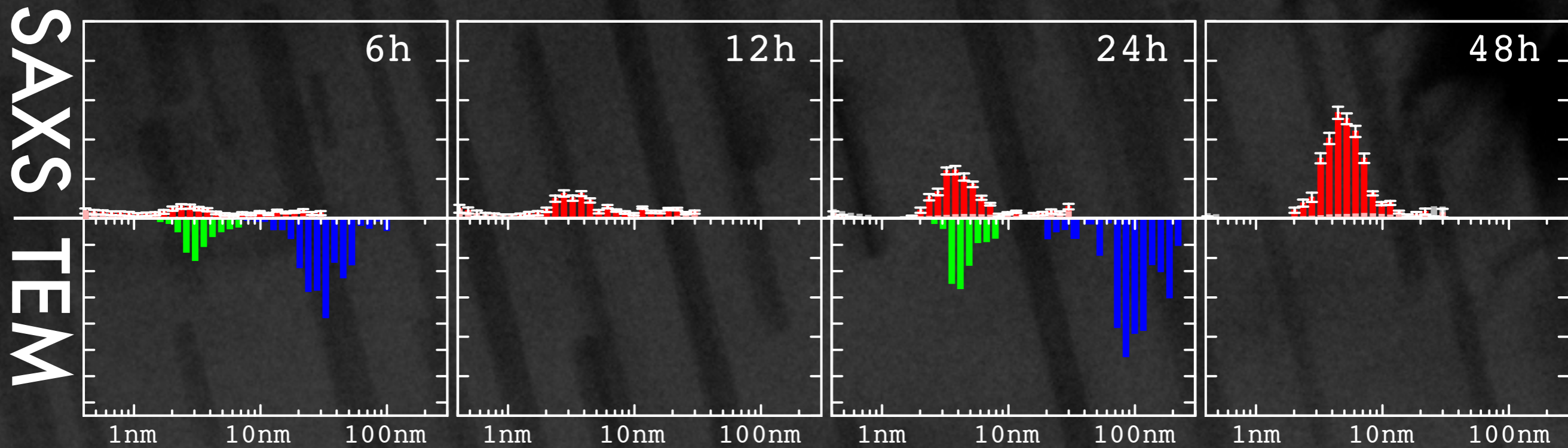


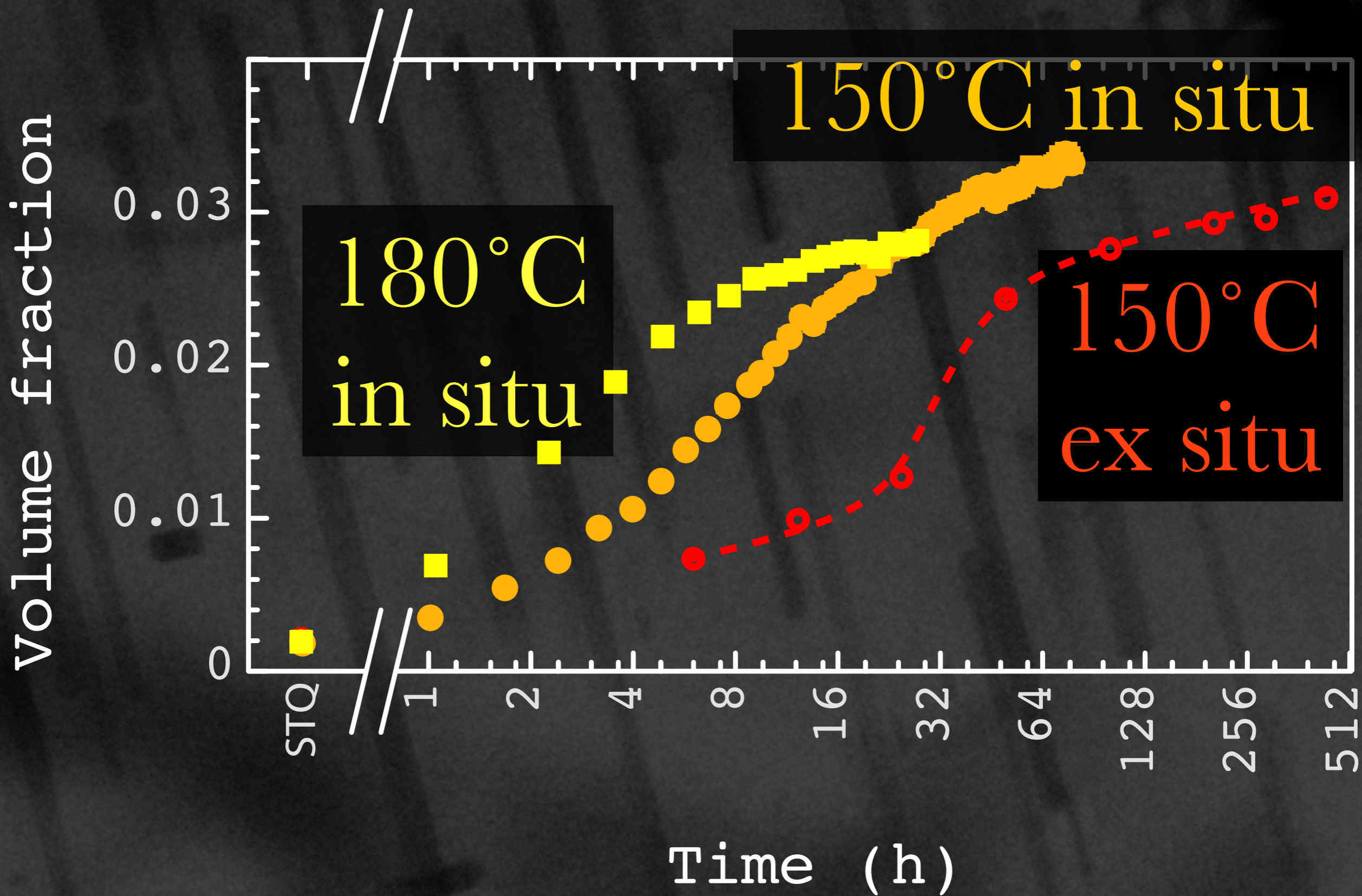
XD •



XD →



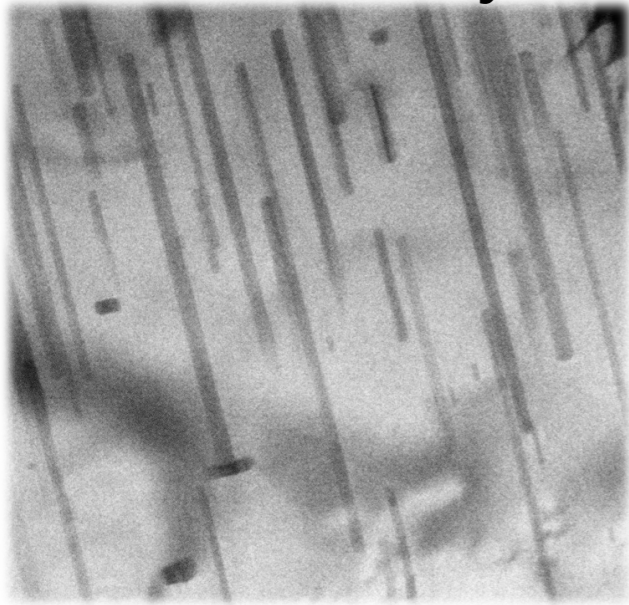




Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



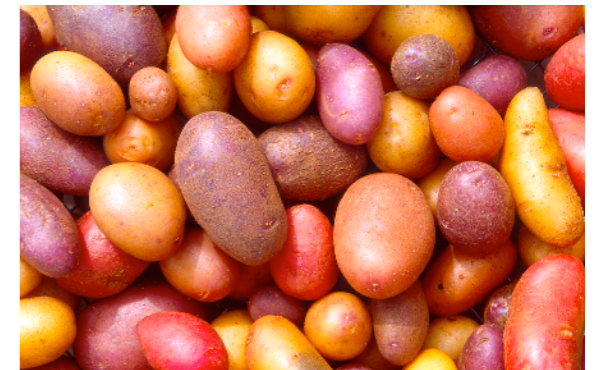
Nanoparticles



[Round Robin]

[Ultra-SAXS]

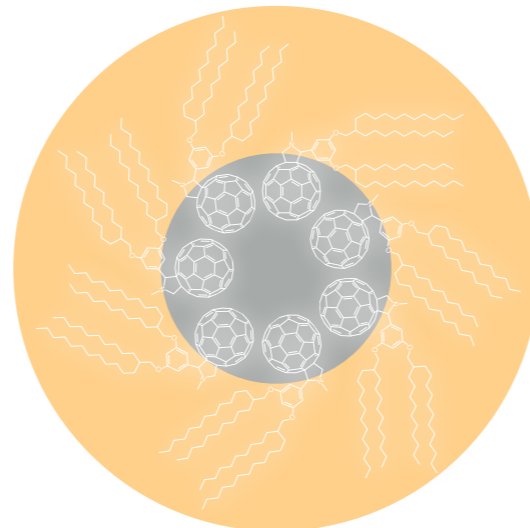
Powders



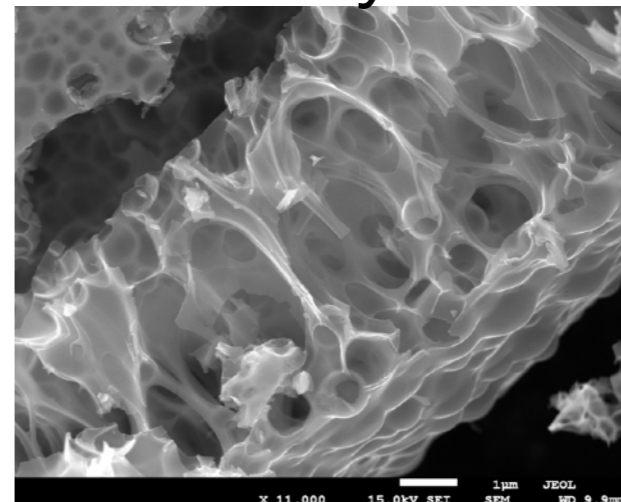
Doughnuts



Micelles



Catalysts



[exit]

Polymer Fibres

Two Dimensional SAXS

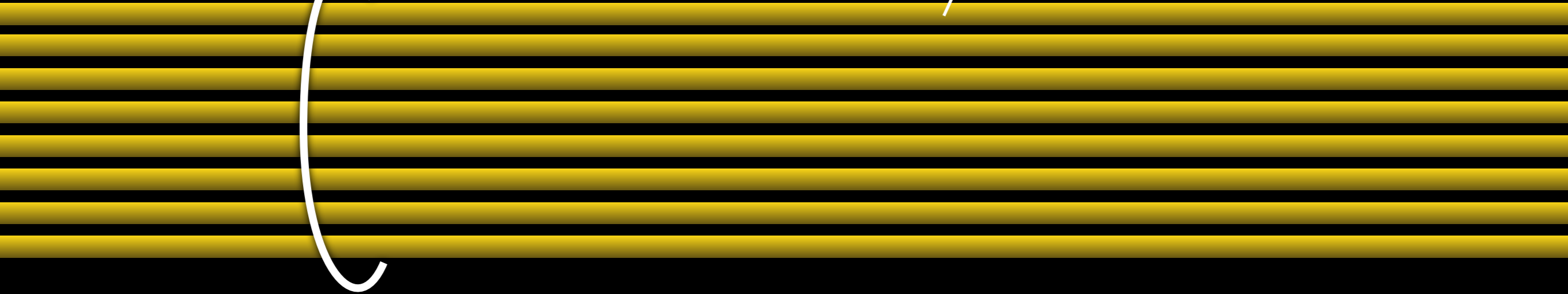


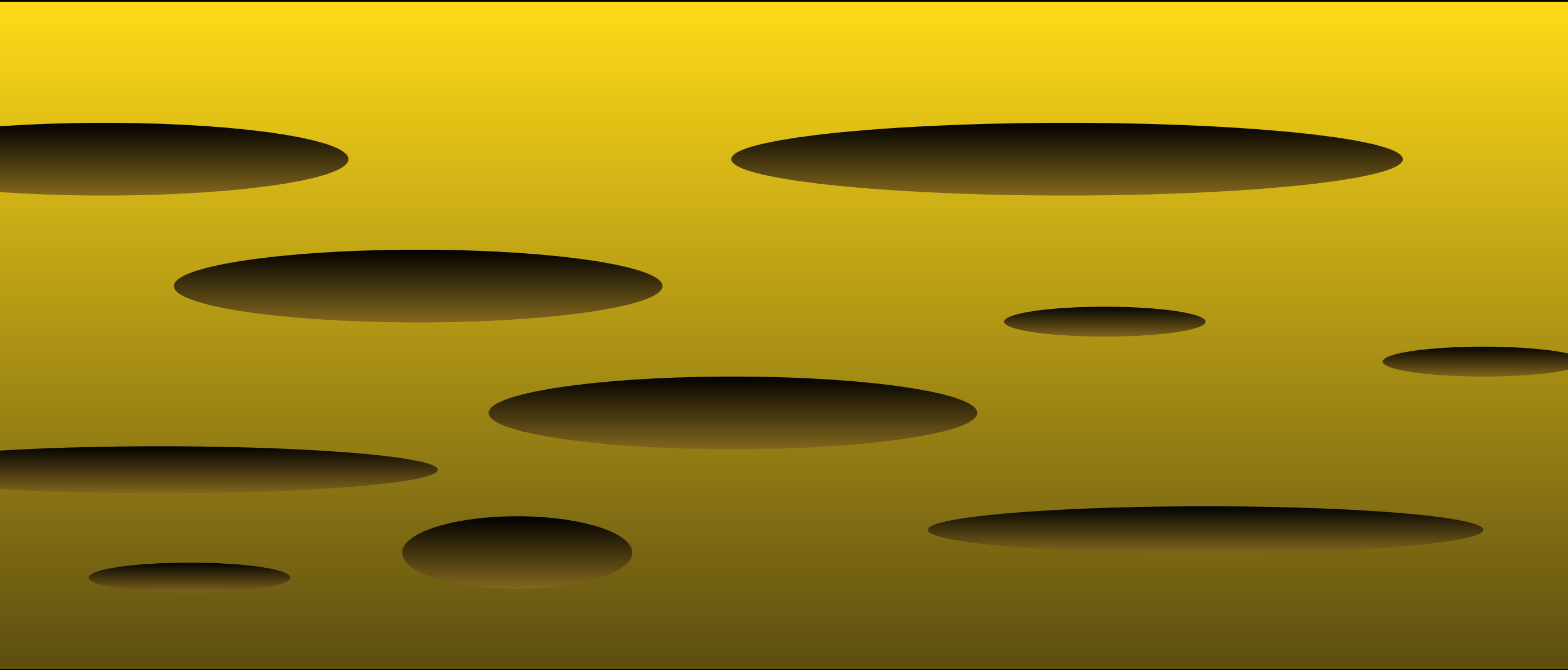
Brian R. Pauw

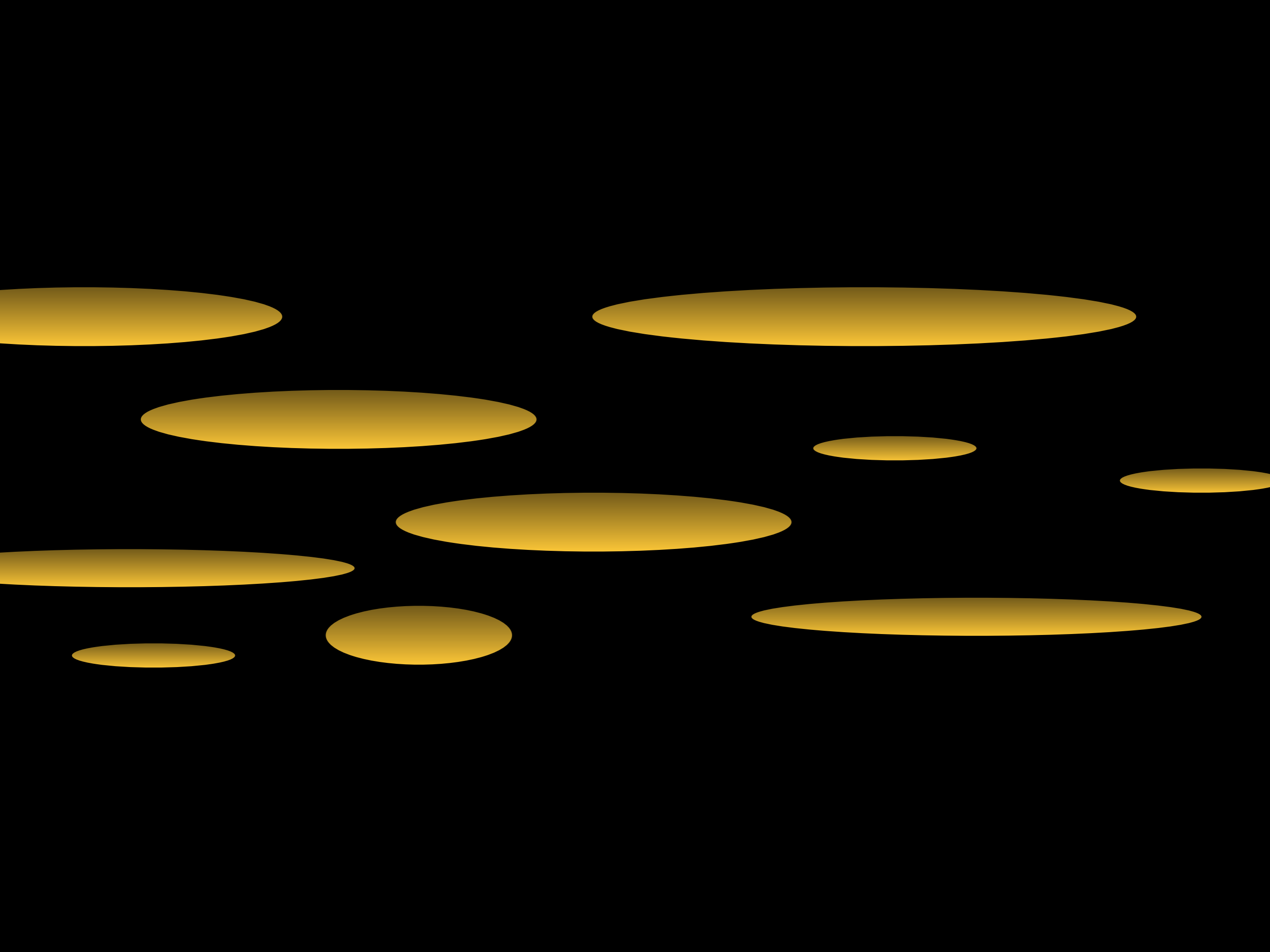


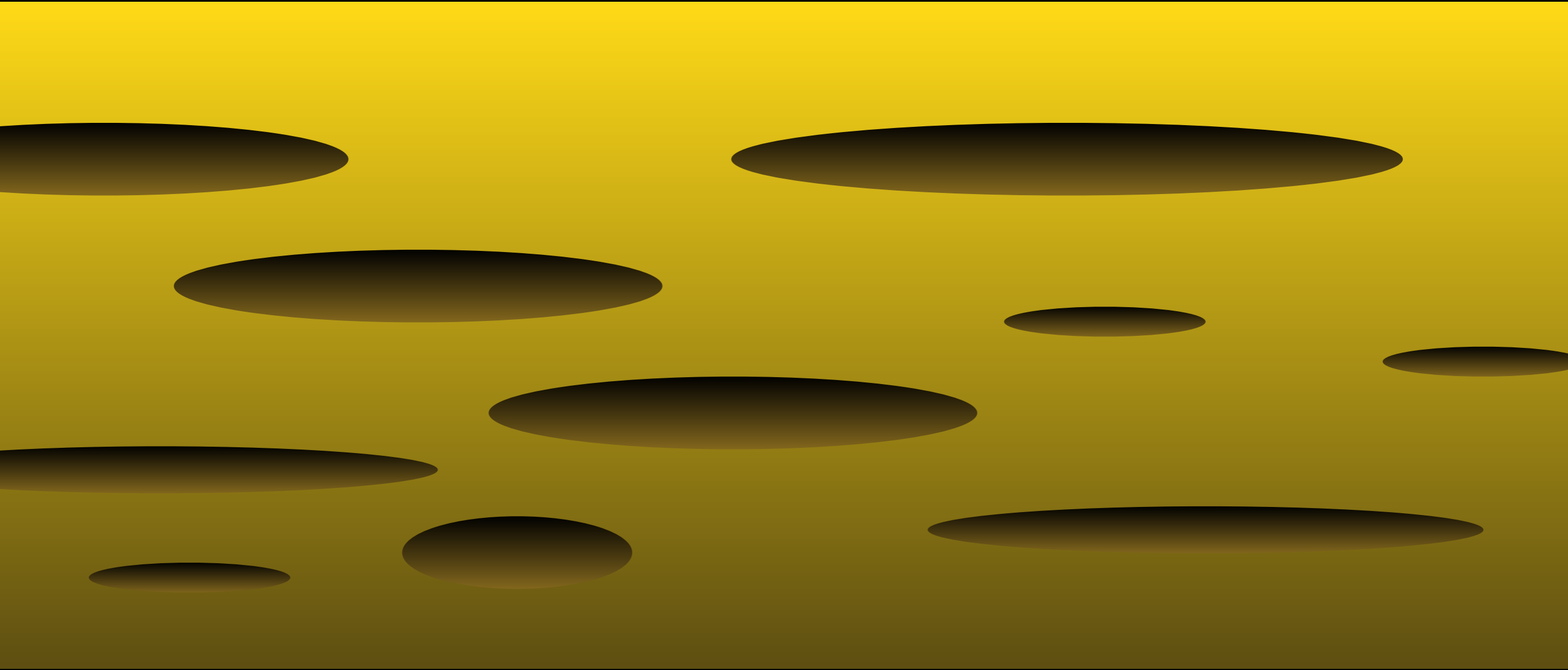
Fibre

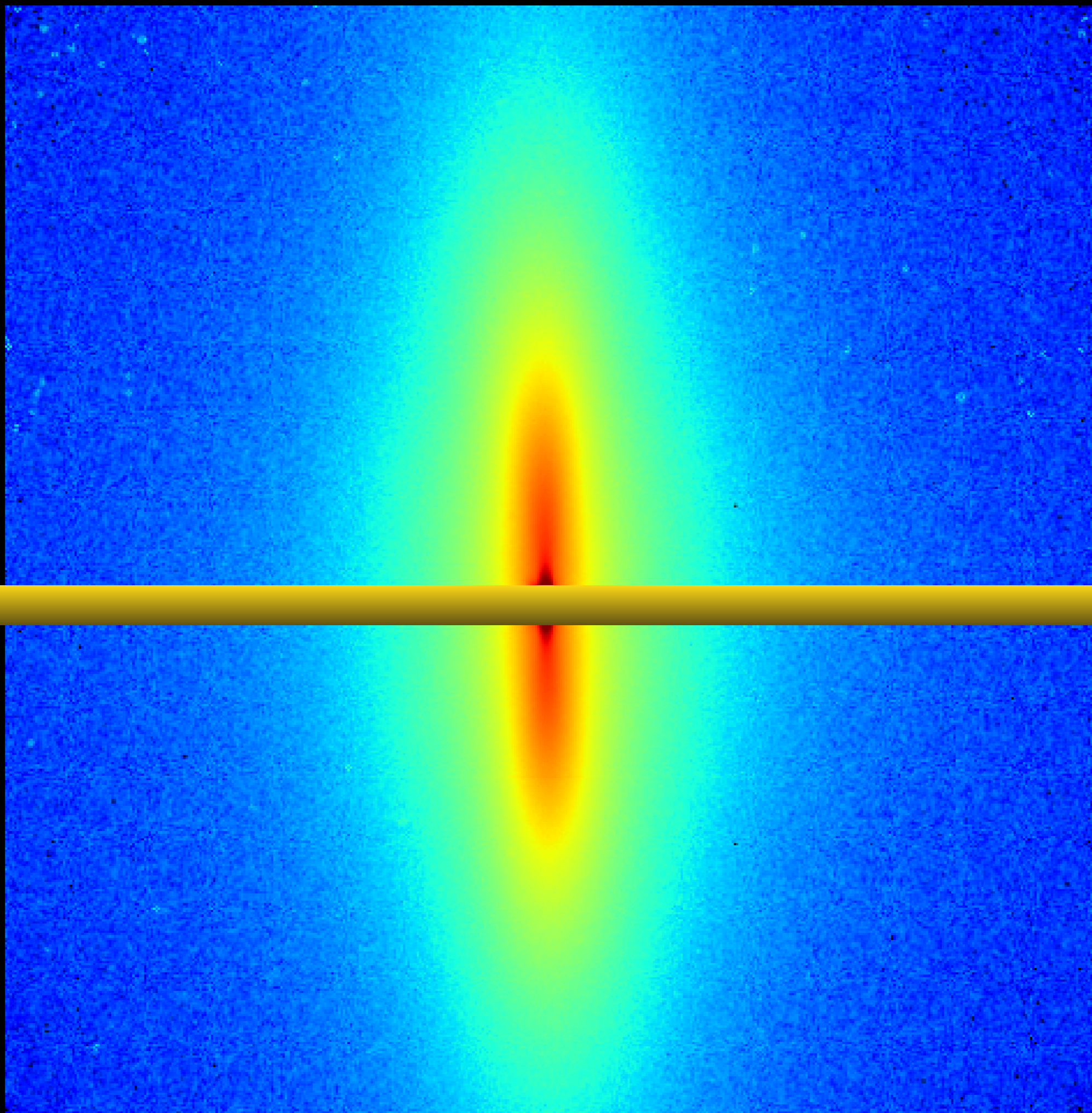
Filament

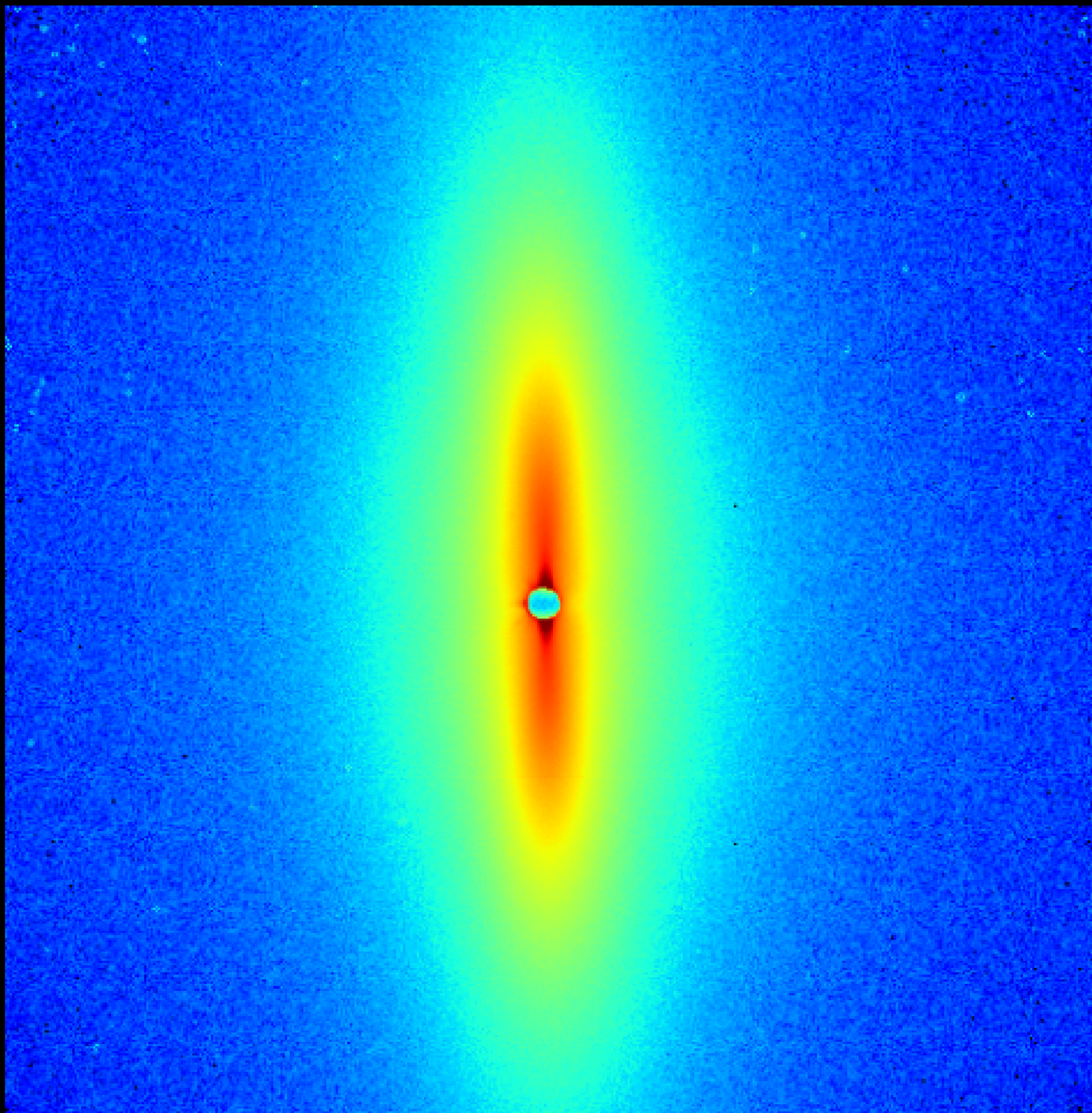


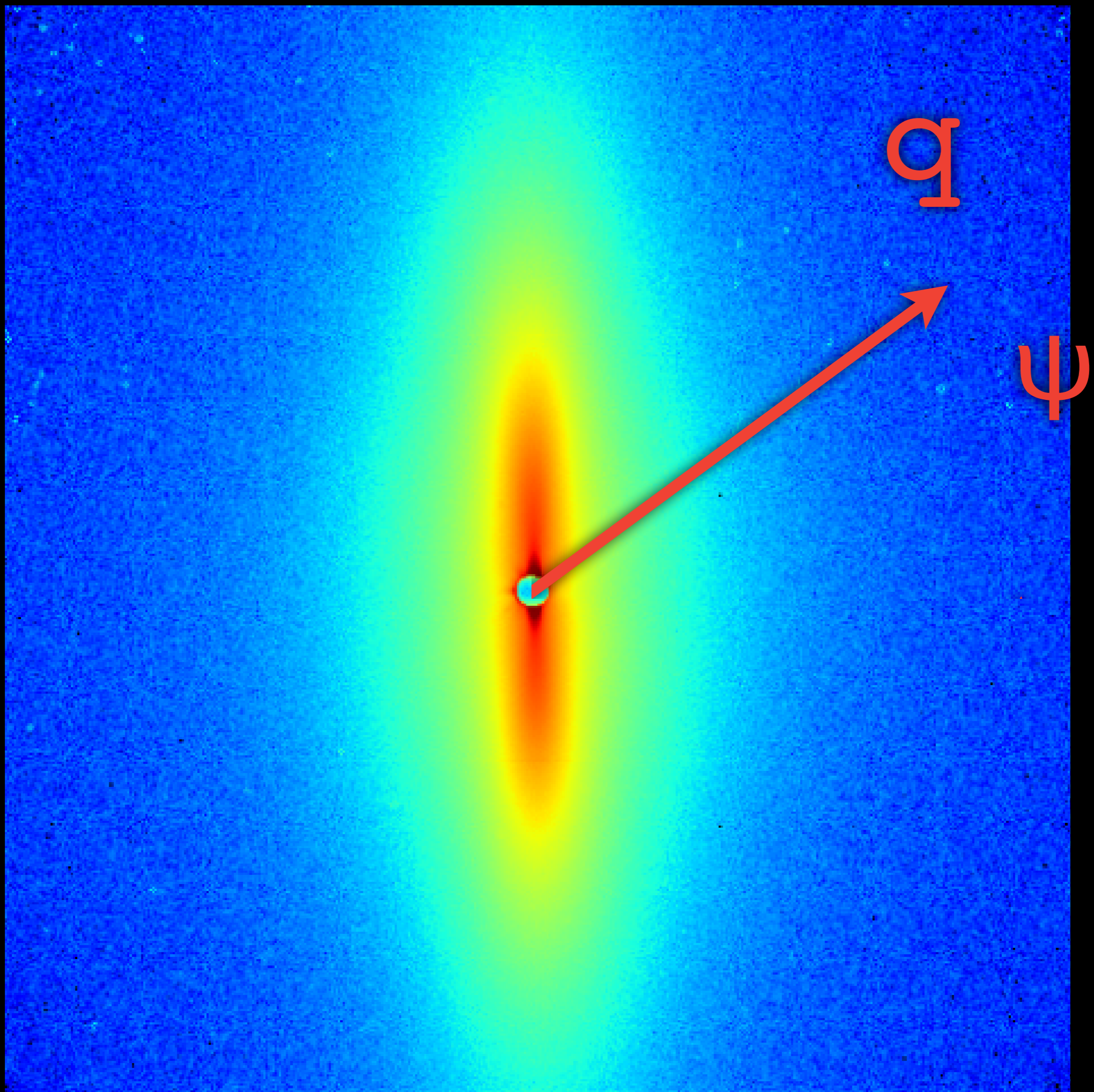


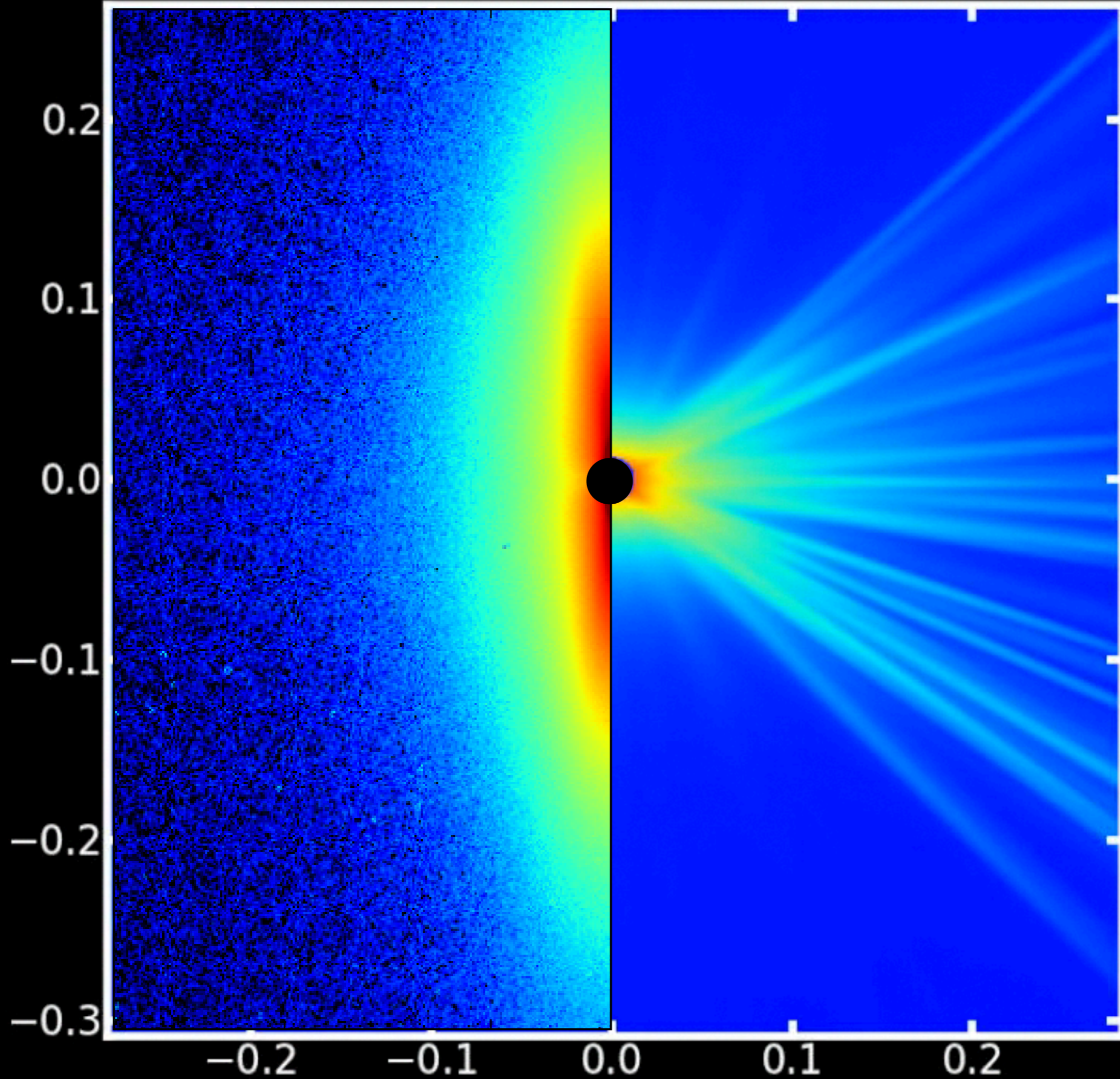




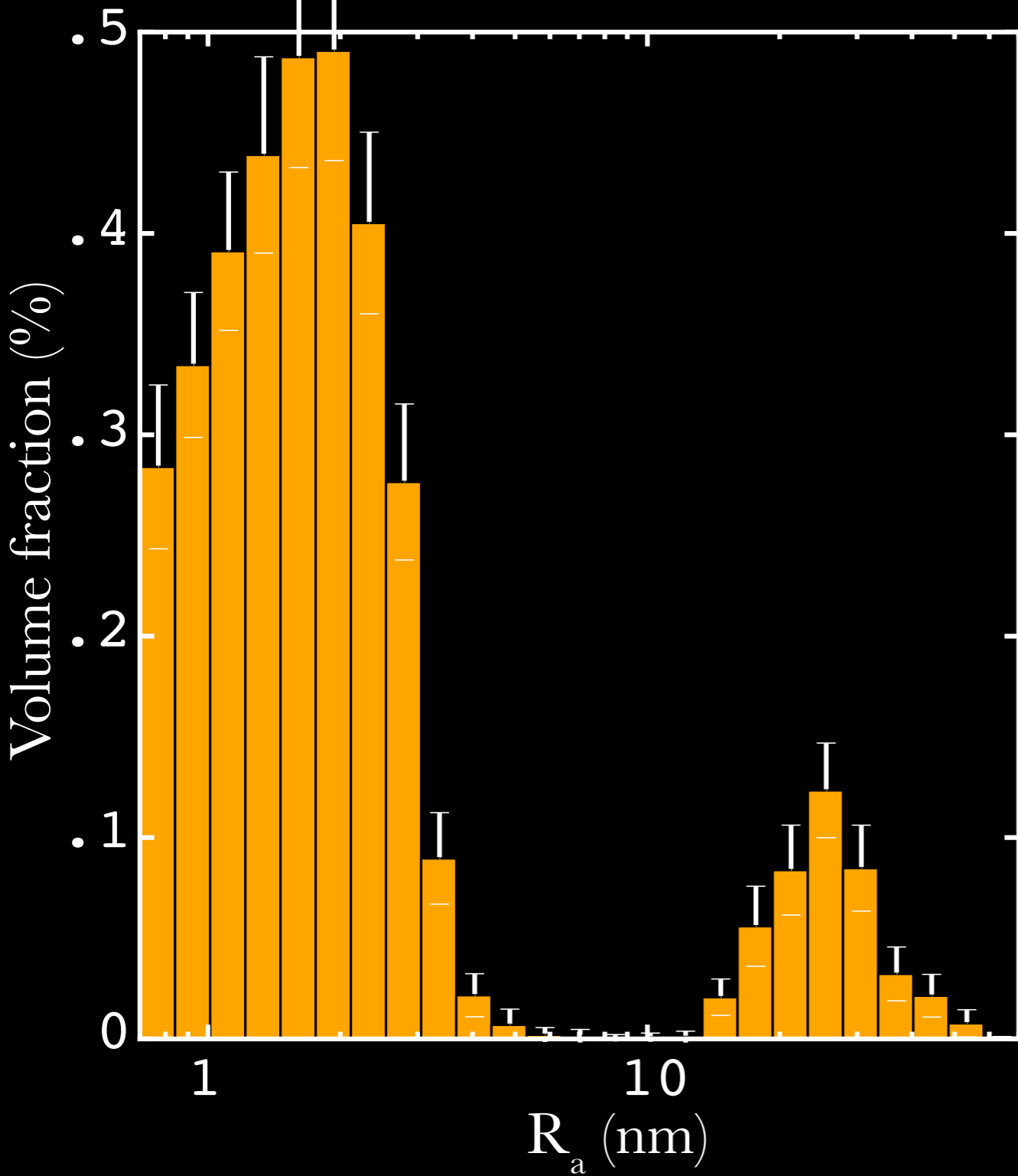




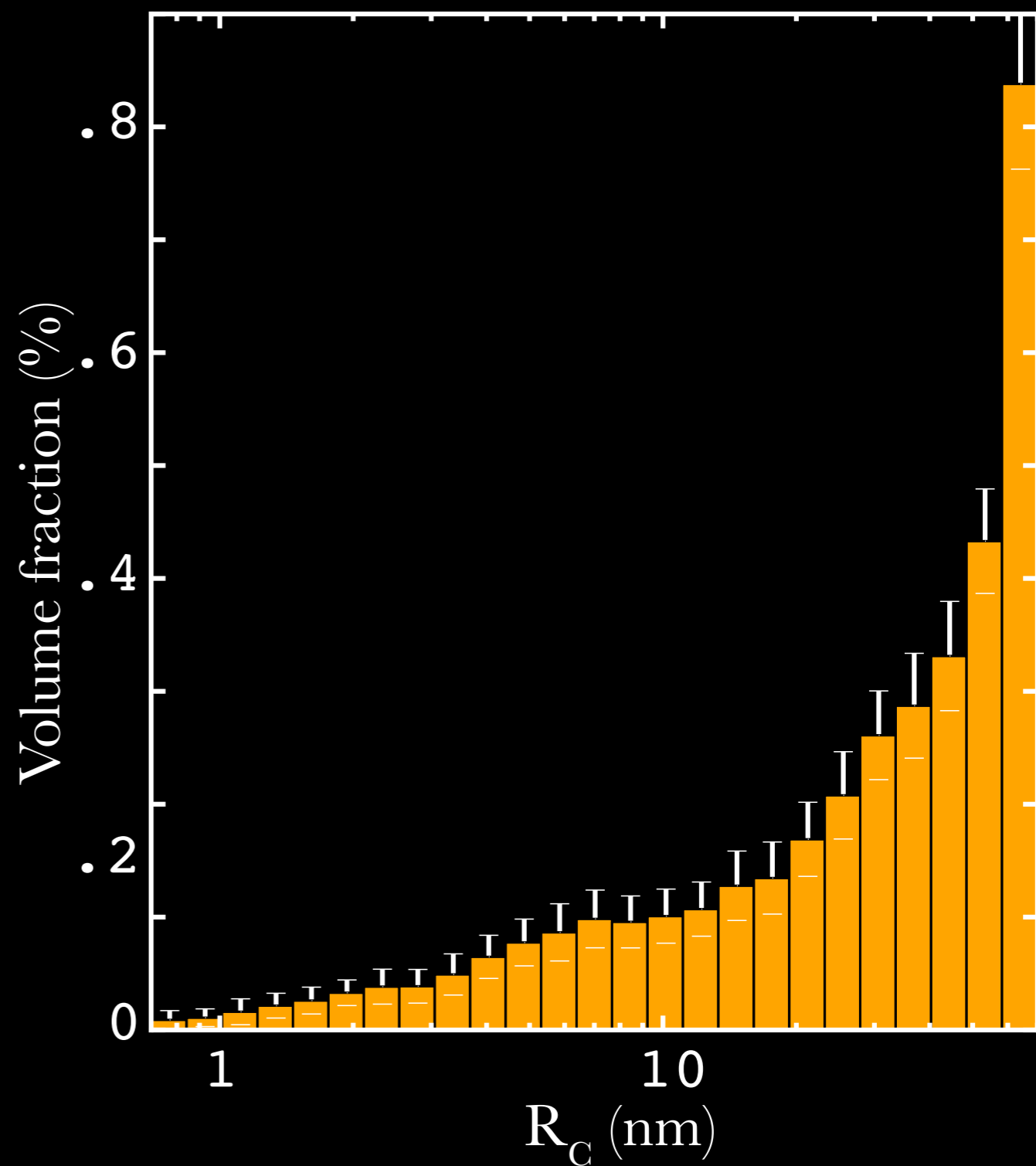




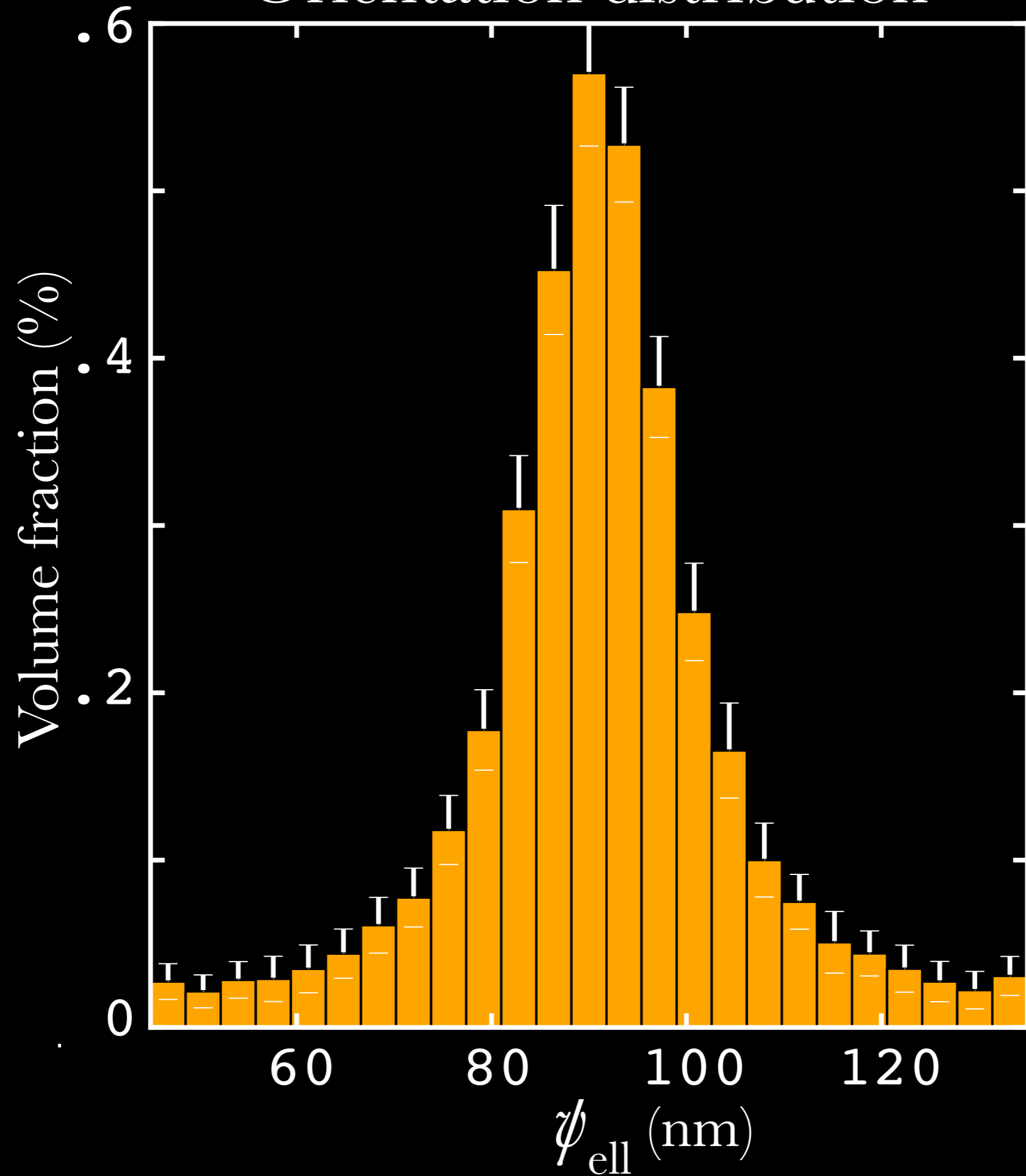
“width”



“length”



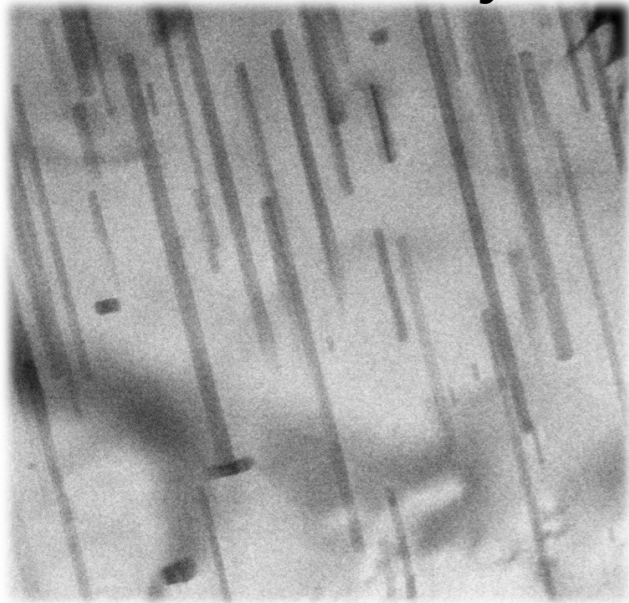
Orientation distribution



Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



Nanoparticles



[Round Robin]

[Ultra-SAXS]

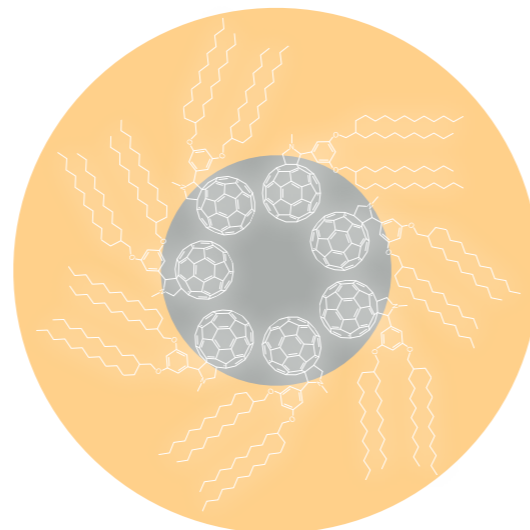
Powders



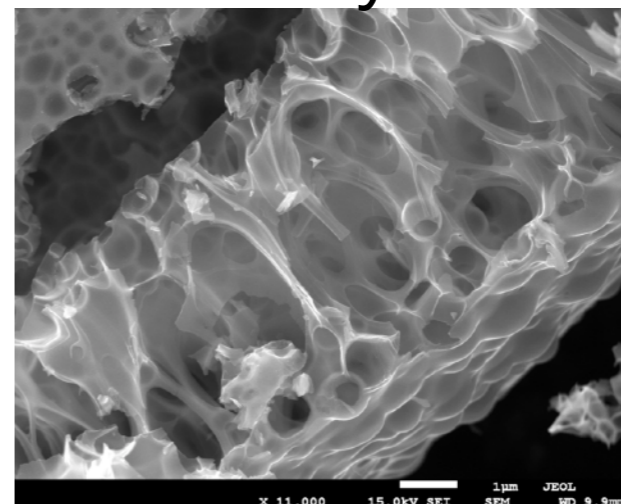
Doughnuts



Micelles



Catalysts



[exit]

Catalysts

Everything & SAXS

Zoe Schnepp,
Yuanjian Zhang,
Masahiko Tanaka,
Yoshitaka Matsushita

Brian R. Pauw,
Martin Hollamby

Pigs
+
Salt
+
Oven
(gas mark 6)

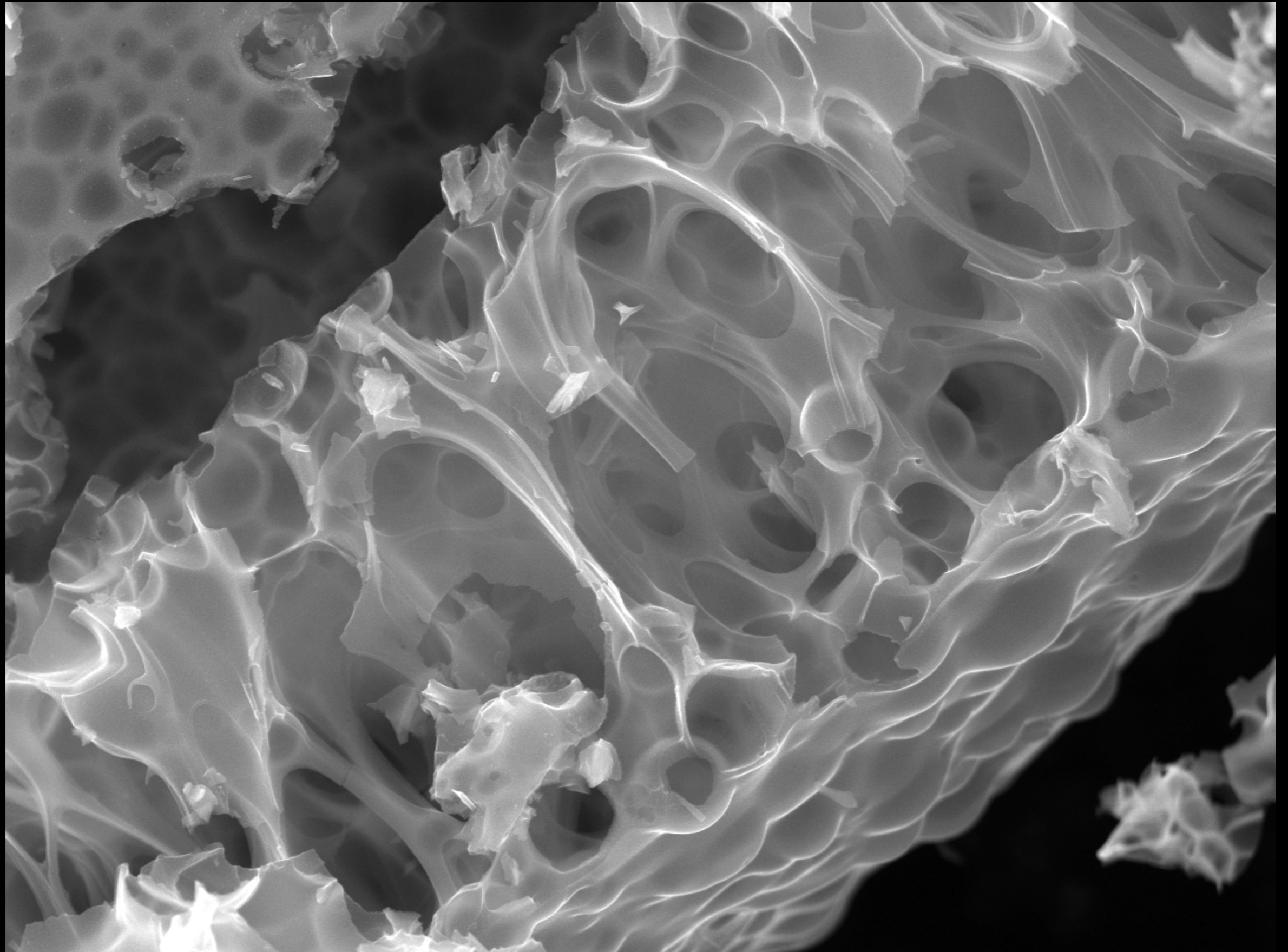
Gelatin
+
Salt
+
Oven
(gas mark 48)

Bacon!

Foam structure



Foam structure

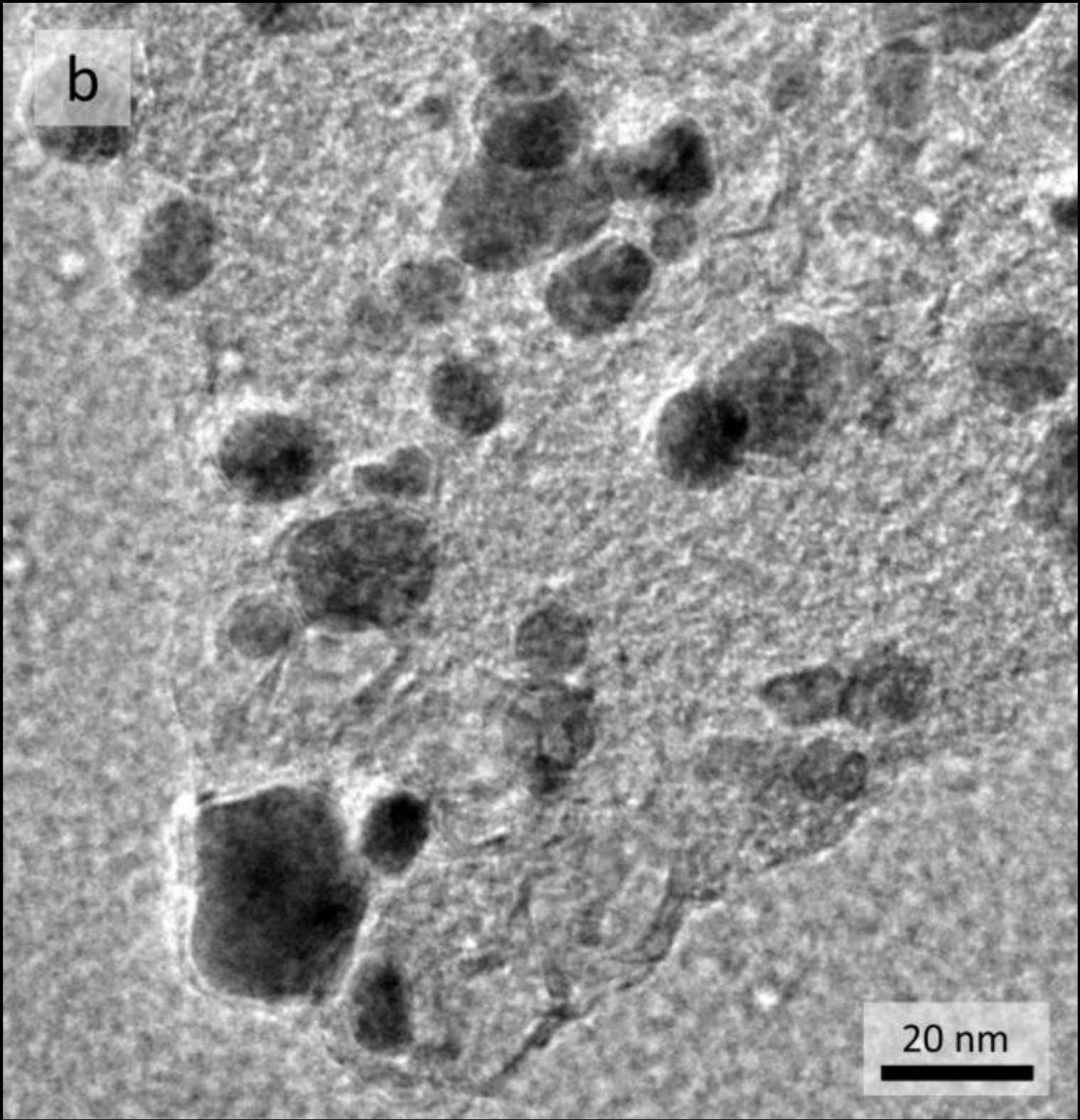


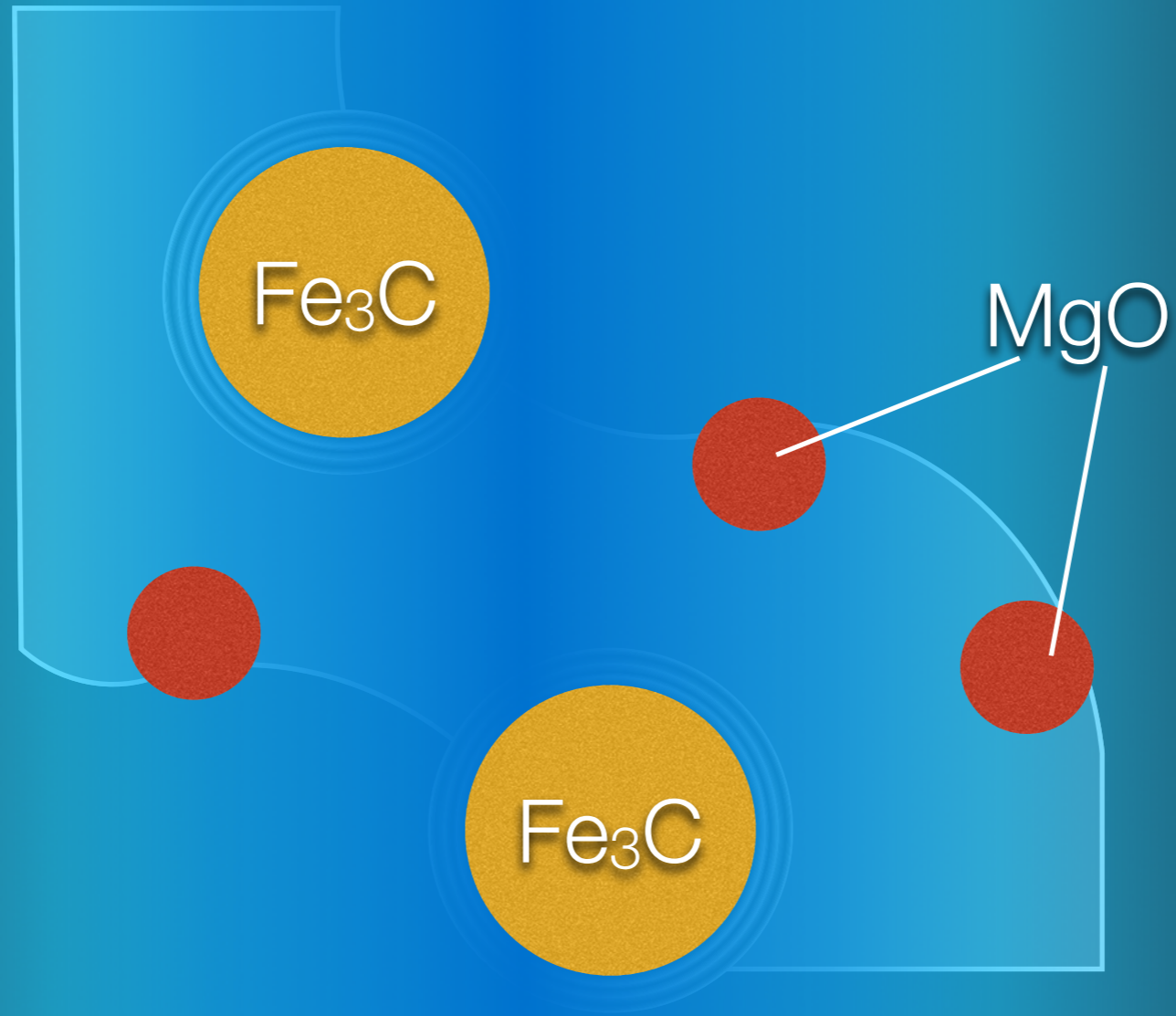
X 11,000

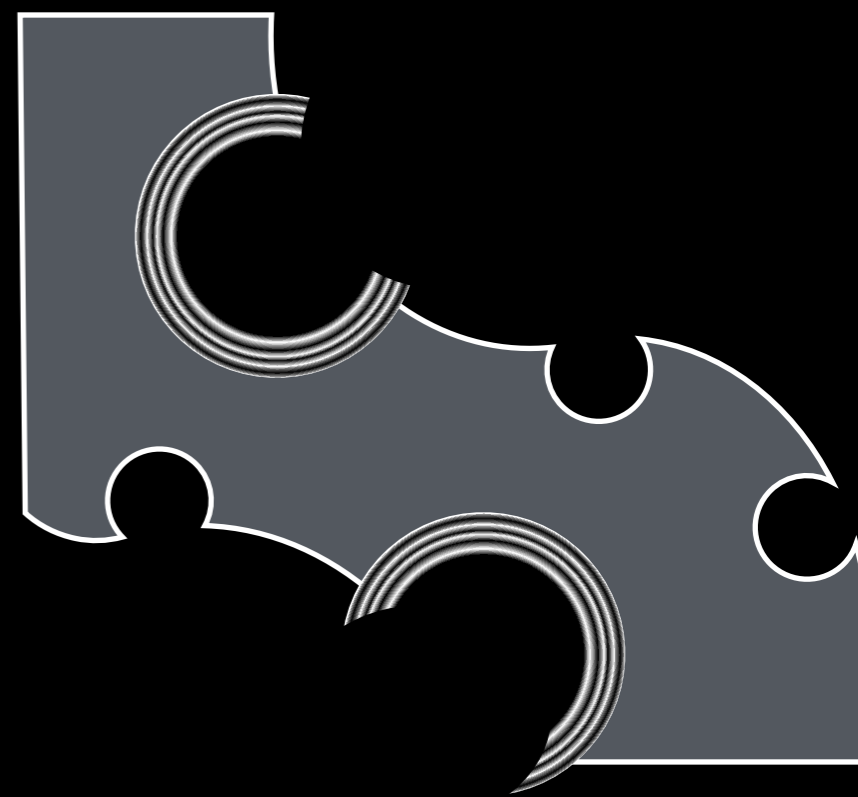
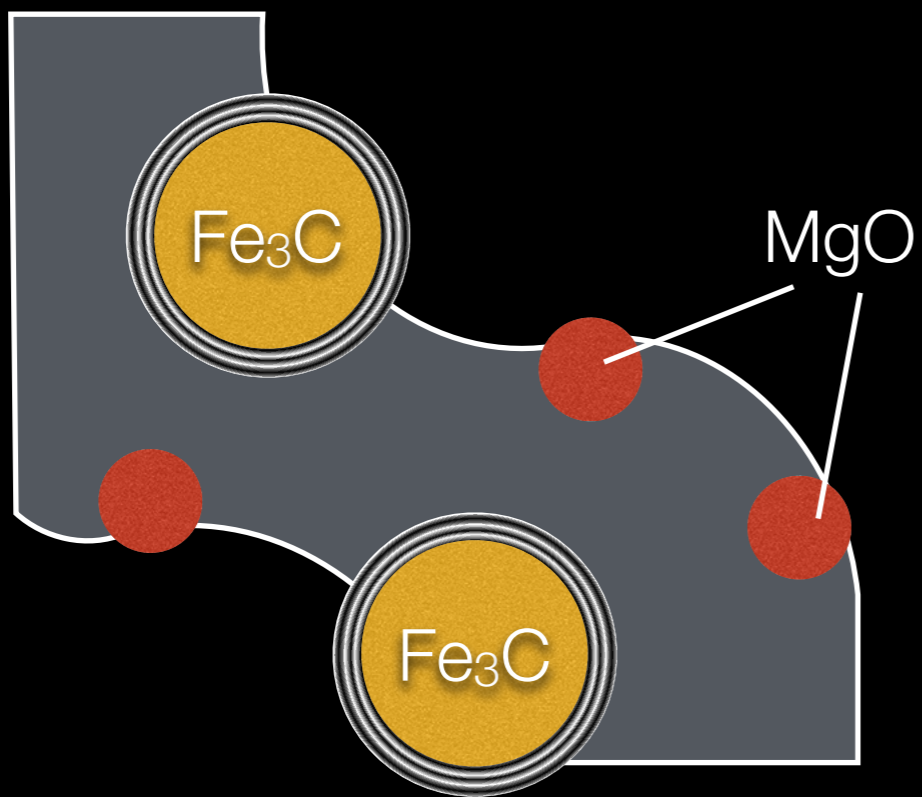
15.0kV SEI

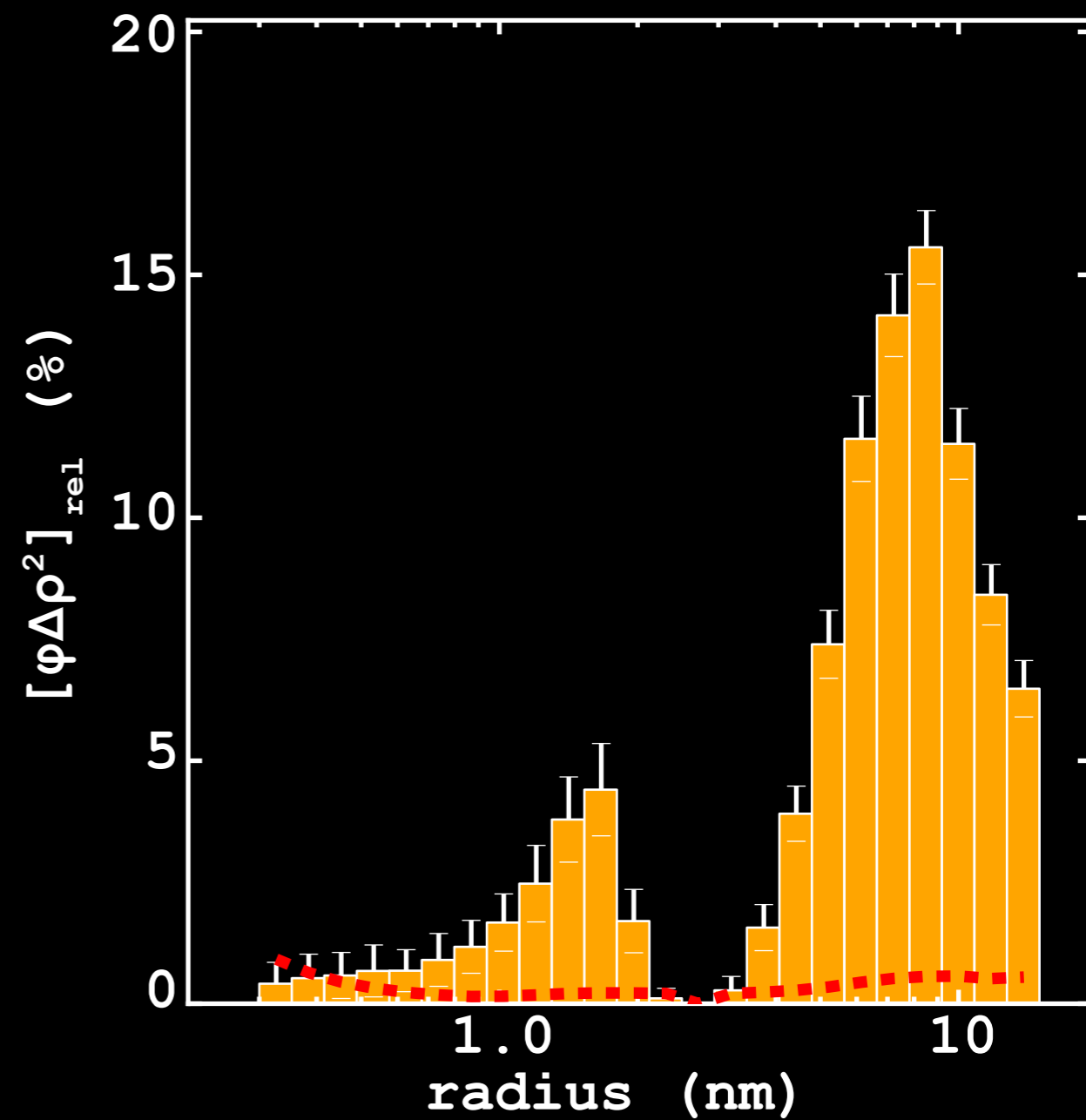
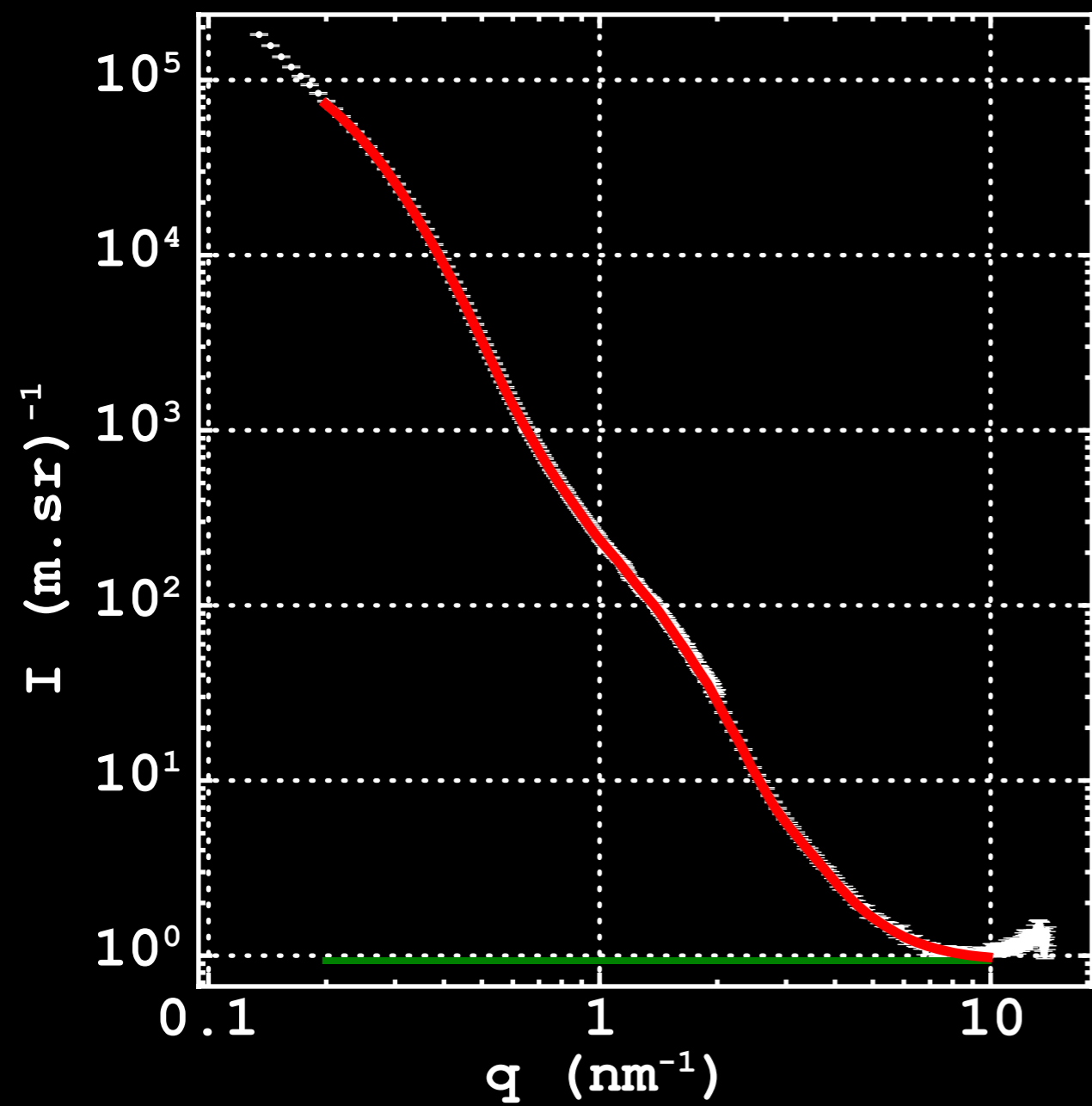
1 μ m
SEM

JEOL
WD 9.9mm

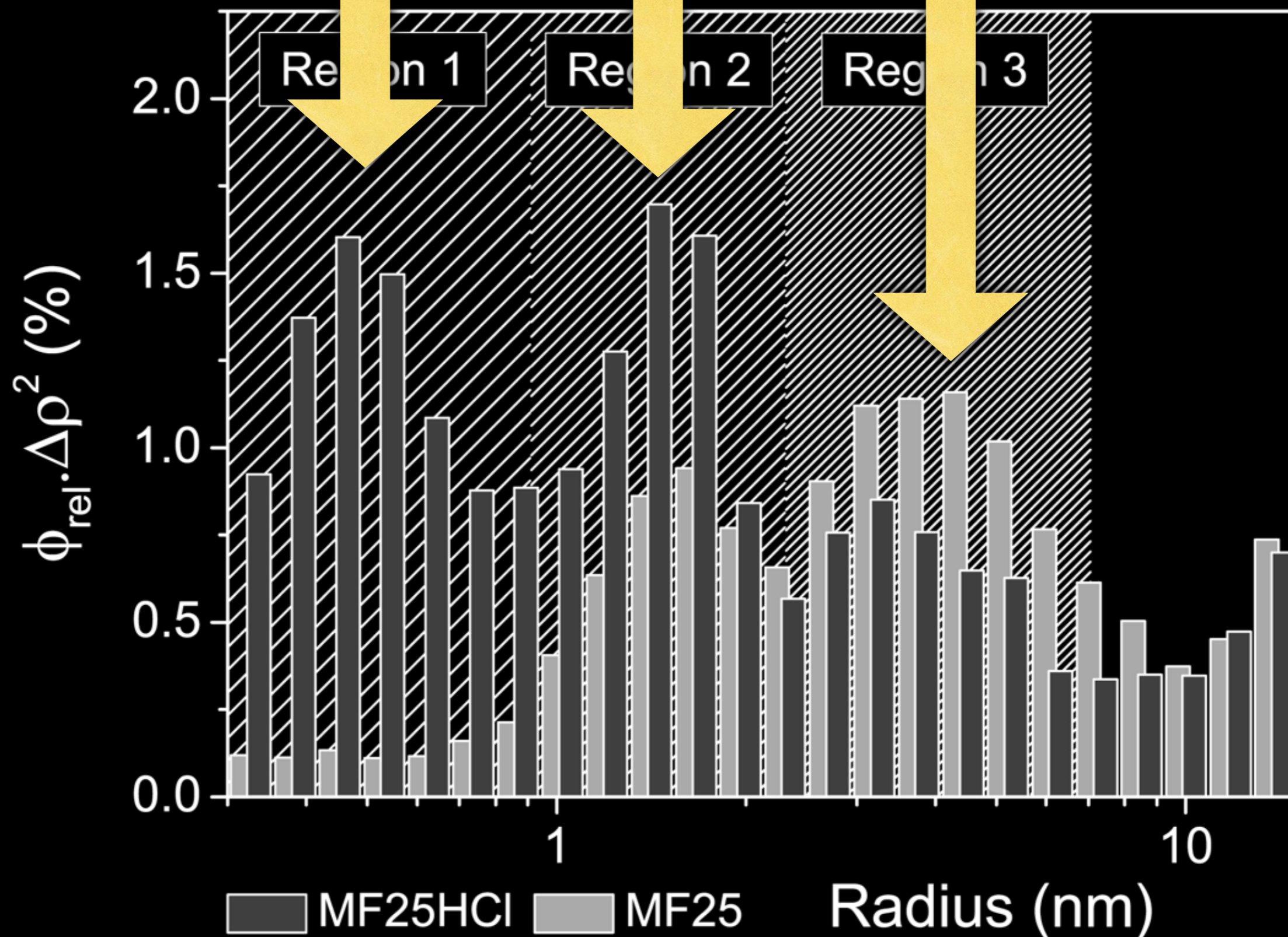








Rough Surface MgO Fe₃C



Jello-
chea
Serves as

by Ai

GANGTOK, FRIDAY 18 OCTOBER 2013

Jelly-making protein could help make cheap fuel cells

New research shows that a catalyst made from gelatin, the same protein used to make jelly desserts, helps fuel cells be more efficient. This may offer a cheap alternative to the expensive metal-based fuel cells.

In a fuel cell, energy released from a chemical reaction (most commonly hydrogen and oxygen combining to form water) is converted into electricity. Many carmakers like Toyota are racing to find a commercially viable fuel cell. If they are able to, cars of the future will spit out only water, instead of the carbon dioxide, water and other pollutants that today's fossil fuel powered cars do. Researchers from the UK, Japan and China, led by Zoe Schnepf at the University of Birmingham, reported their new catalyst in the *Journal of Materials Chemistry A*. To make the catalyst, they mixed salts of magnesium and iron to create a porous foam

much larger particles of iron carbide. This meant that the ratio of magnesium to iron can be used to tune the pore size. During heating iron carbide converts the carbon around it to a thin sheet, which happens to be good for a fuel cell reaction. Nitrogen atoms in the gelatin become

catalyst is also as durable as the platinum ones. Platinum is too expensive to be used for commercial fuel cells. In recent years, there have been many efforts to find a cheaper and better alternative. Schnepf's catalyst needs cheap gelatin and plentiful metal nitrate salts, making it one of the best alternatives yet. By exploiting the properties of biological polymers, Schnepf and colleagues found simple



SCIENCE

Meteorite pulled from Russian lake

HIMALAYAN MIRROR 7

The object plunged into Lake Chebarkul in central Russia on 15 February, leaving a 6m-wide hole in the ice. Scientists say that it is the largest fragment of meteorite yet found. More than 1,000 people were injured when a 17m, 10,000-tonne space rock burned up over Central Russia, breaking windows and rocking buildings.

Live footage showed a team pull out a 1.5-metre-long (five-foot-long) rock from the lake after first wrapping it in a special covering and placing it on a metal sheet while it was still underwater. The fragment was then pulled ashore and placed on top of a scale for weighing, an operation that quickly went wrong. The rock broke up into at least three large pieces as it was lifted from the ground with the help of levers and ropes.

Then the scale itself broke, the moment it hit the 570kg (1,255lb) mark. Dr Caroline Smith, curator of meteorites at London's Natural History

Museum, confirmed that the object was a meteorite from characteristic features known as fusion crust and regmaglypts, which are obvious in images. "Fusion crust forms as the meteoroid is travelling through the atmosphere as a fireball. The outer surface gets so hot it melts the rock to form a dark, glassy surface crust which we term fusion



Regmaglypts are the indentations, that look a bit like thumbprints, also seen on the surface of the meteorite." Sergey Zamozdra, an associate professor at Chelyabinsk State University, told the Interfax news agency: "The preliminary examination... shows that this is really a fraction of the Chelyabinsk meteorite. This chunk is most probably one of the top 10 biggest meteorite fragments ever found." The divers' mission had been hampered by a number of factors. The rock fragment lay at 13m depth, not 6m or 8m as was originally thought. The Vesti 24 rolling news channel reported that divers had already recovered more than 12 pieces from Lake Chebarkul since the incident on 15 February. The station said that only four or five of the had turned out to be meteorites.

18-Foot Oarfish Found on Catalina Amazes Scientists, Campers

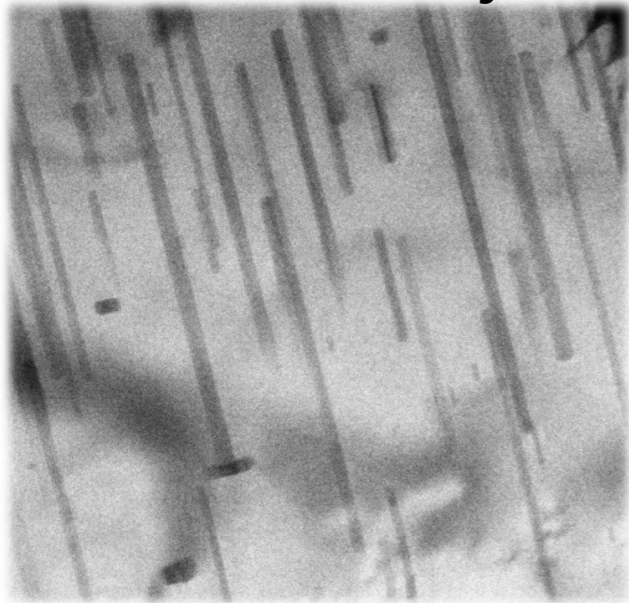
DO YOU KNOW

1) How does scratching cure itching sensation? Very sensitive, rapidly adapting, mechanoreceptive free nerve endings that elicit only the tickle sensation are found almost exclusively in the superficial layers of the skin. This sensation is transmitted by very small type - C nerve fibres. These are unmyelinated fibers with a diameter of 0.5 microns. These fibres transmit impulses at velocities as great as 120 m/sec. Unlike the type - A fibres, impulses at velocities as great as 120 m/sec. The process of scratching can relieve the itch and tickle sensation in some animals including man. The scratch reflex is the important spinal function. (1) a position sense to find the exact point of irritation. (2) a and from

Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



Nanoparticles



[Round Robin]

[Ultra-SAXS]

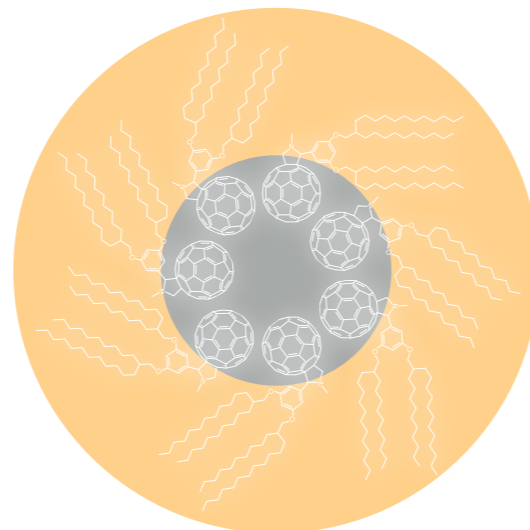
Powders



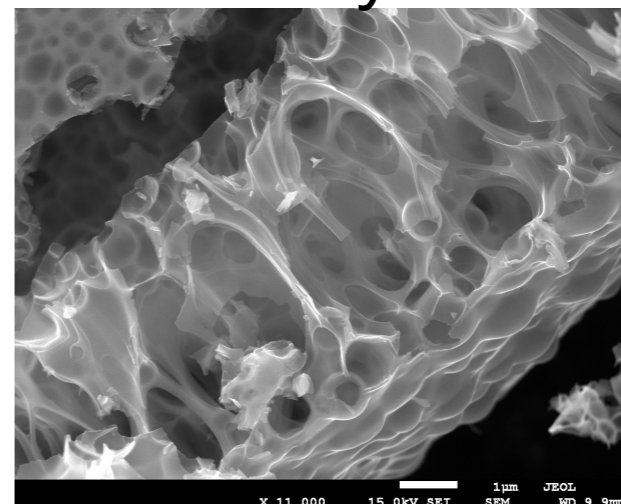
Doughnuts



Micelles



Catalysts



[exit]

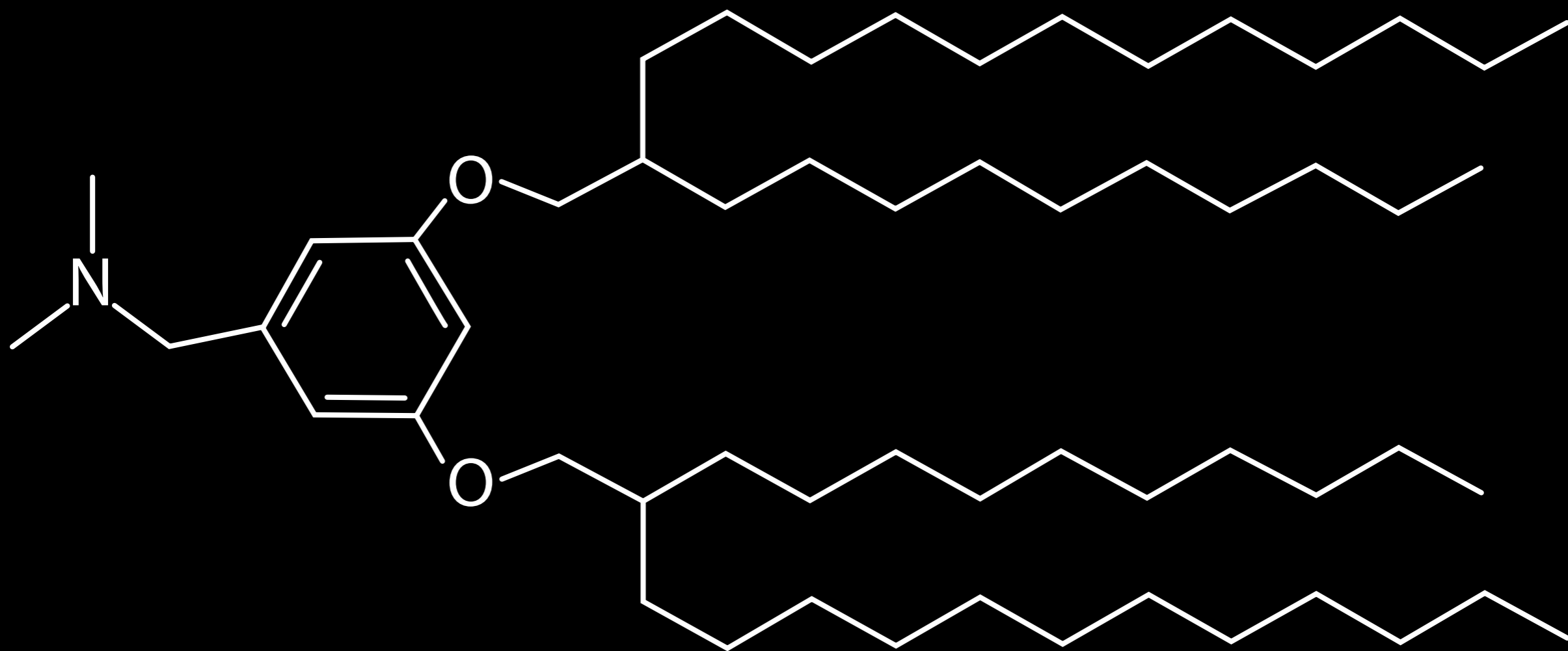
Liquid structures I

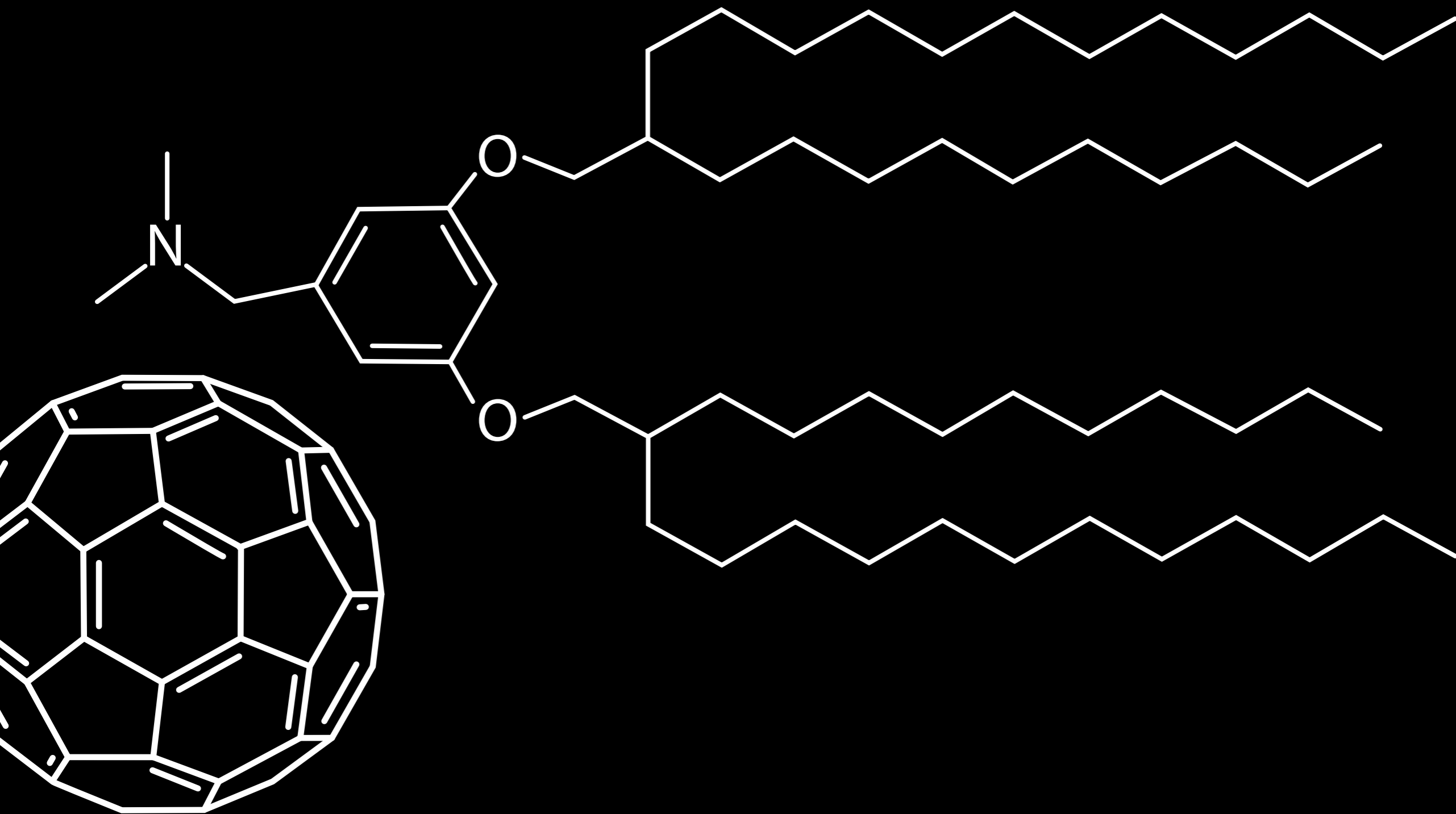
Everything & SAS

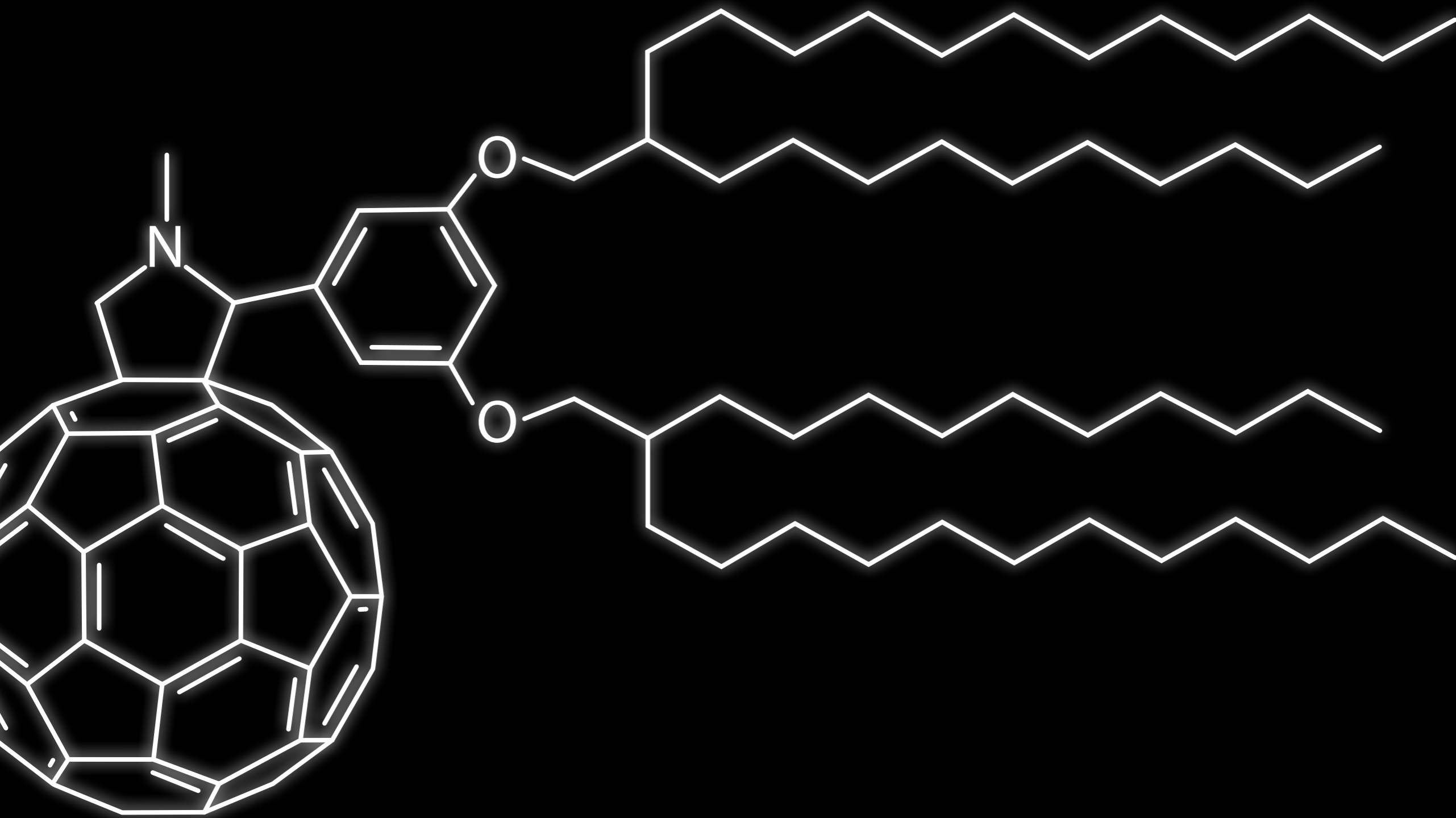
Martin J. Hollamby
M. Karny, P.H.H. Bomans,
N.A.J.M. Sommerdijk,
A. Saeki, S. Seki,
H. Minamikawa, I. Grillo,
P. Brown, J. Eastoe,
H. Möhwald, T. Nakanishi

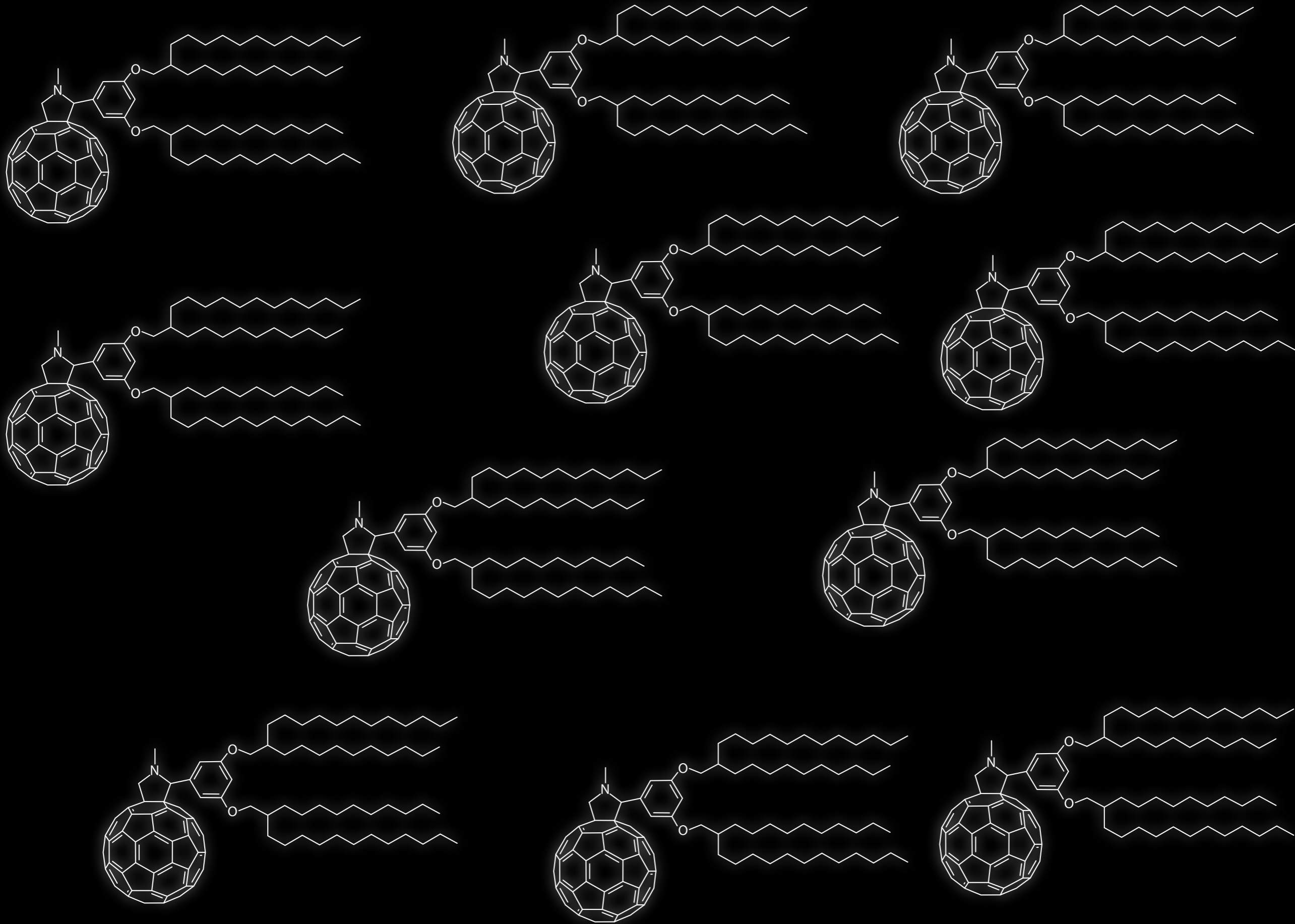
Martin J. Hollamby
Brian R. Pauw

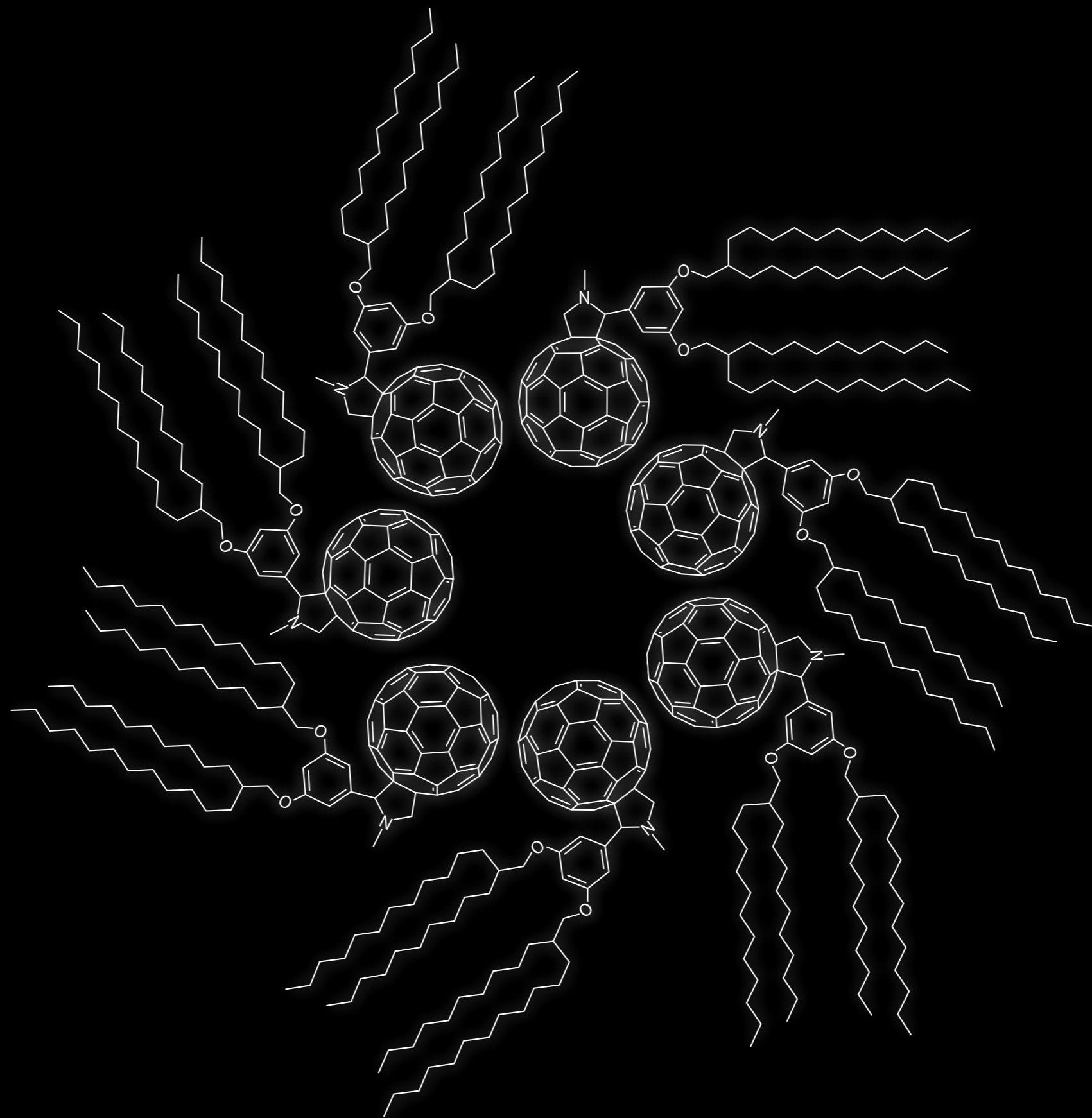


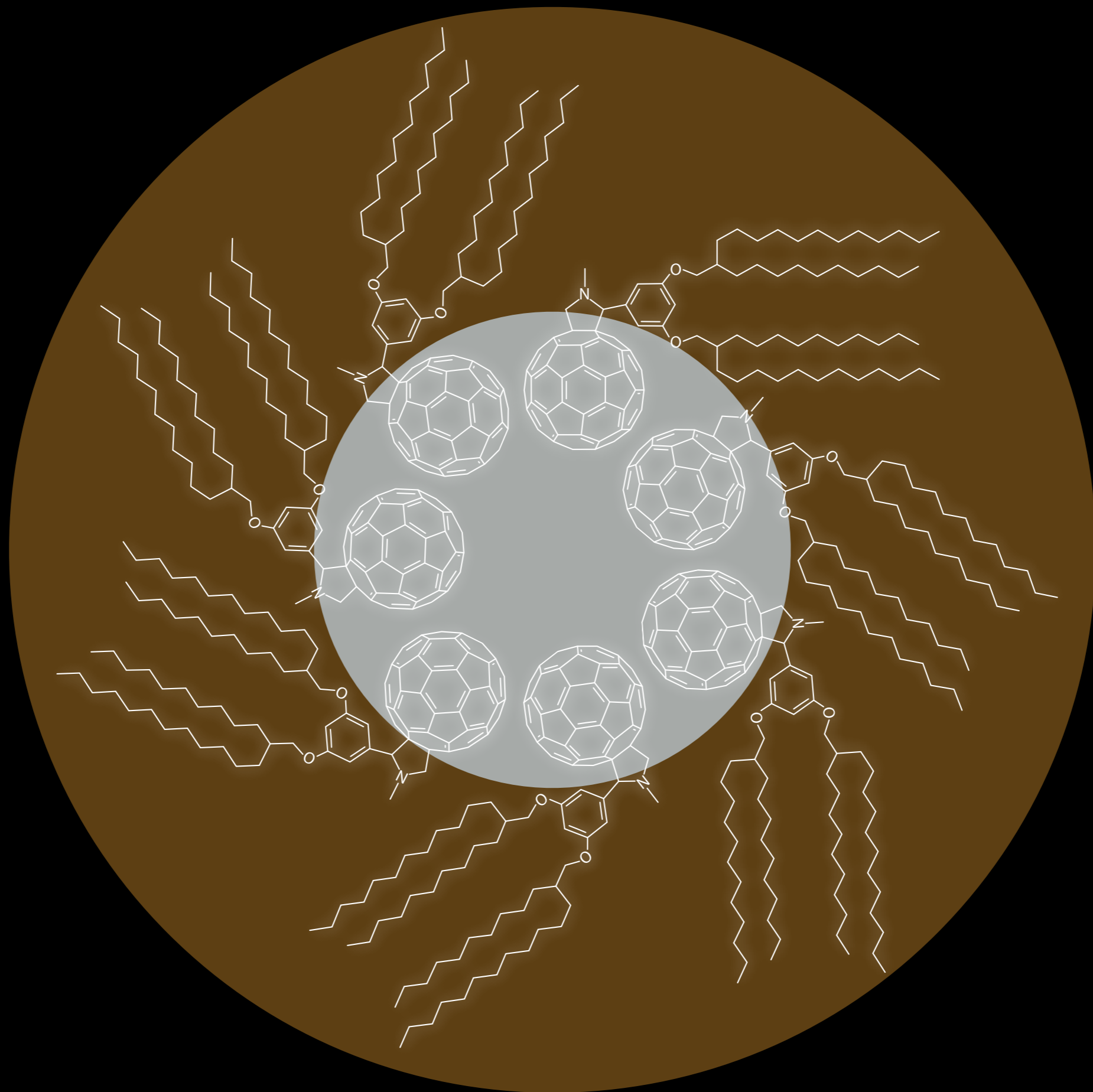


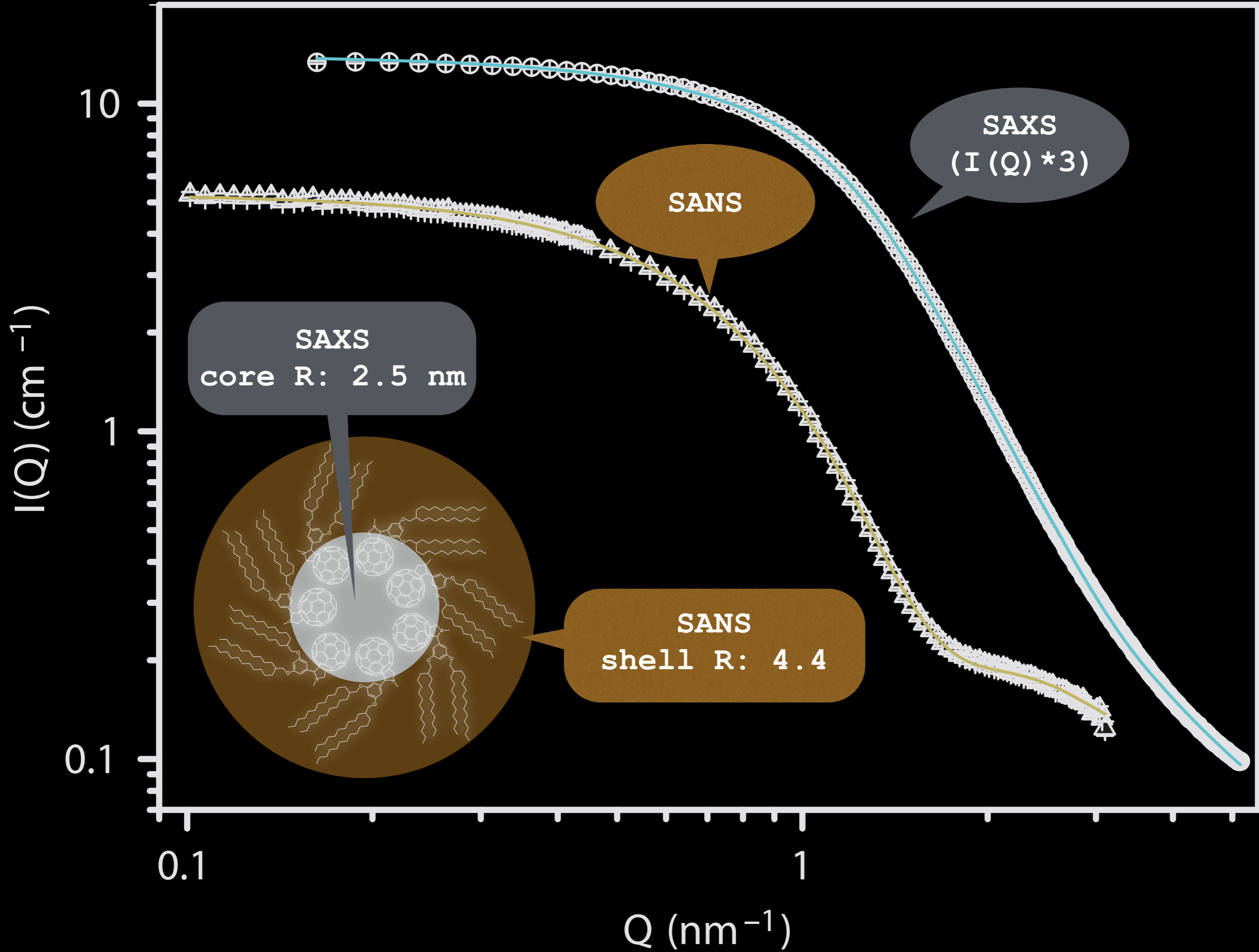


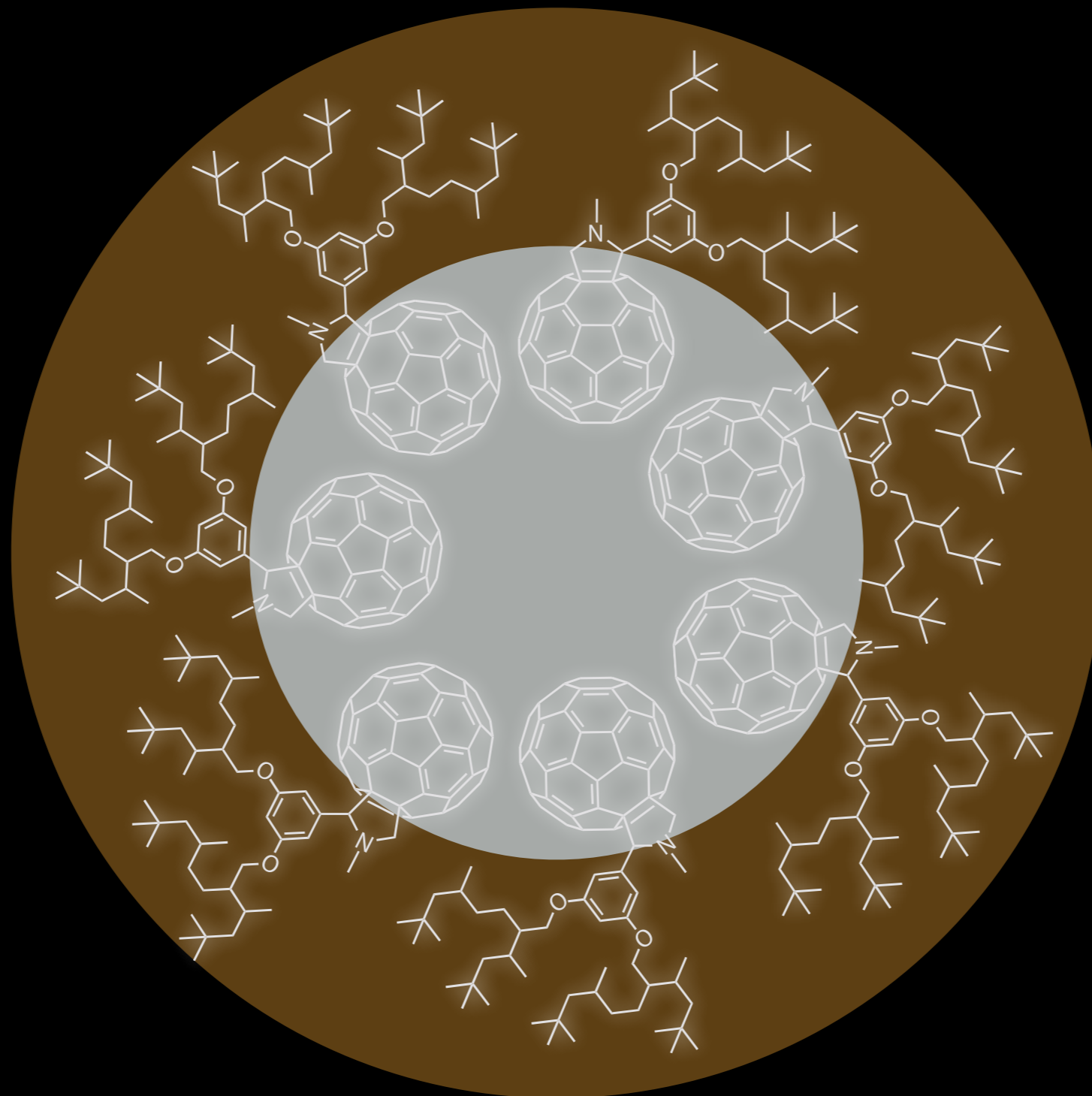


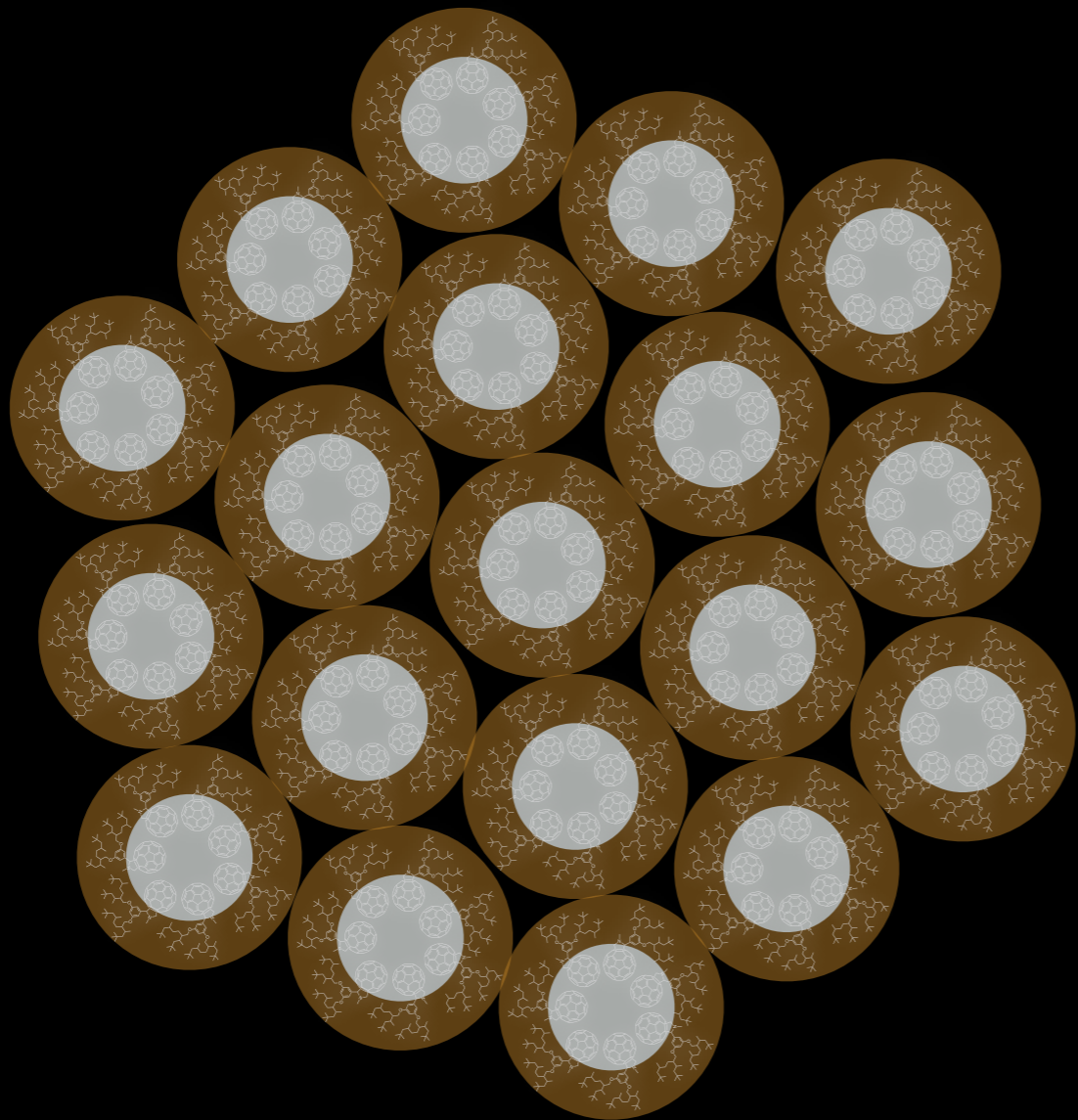


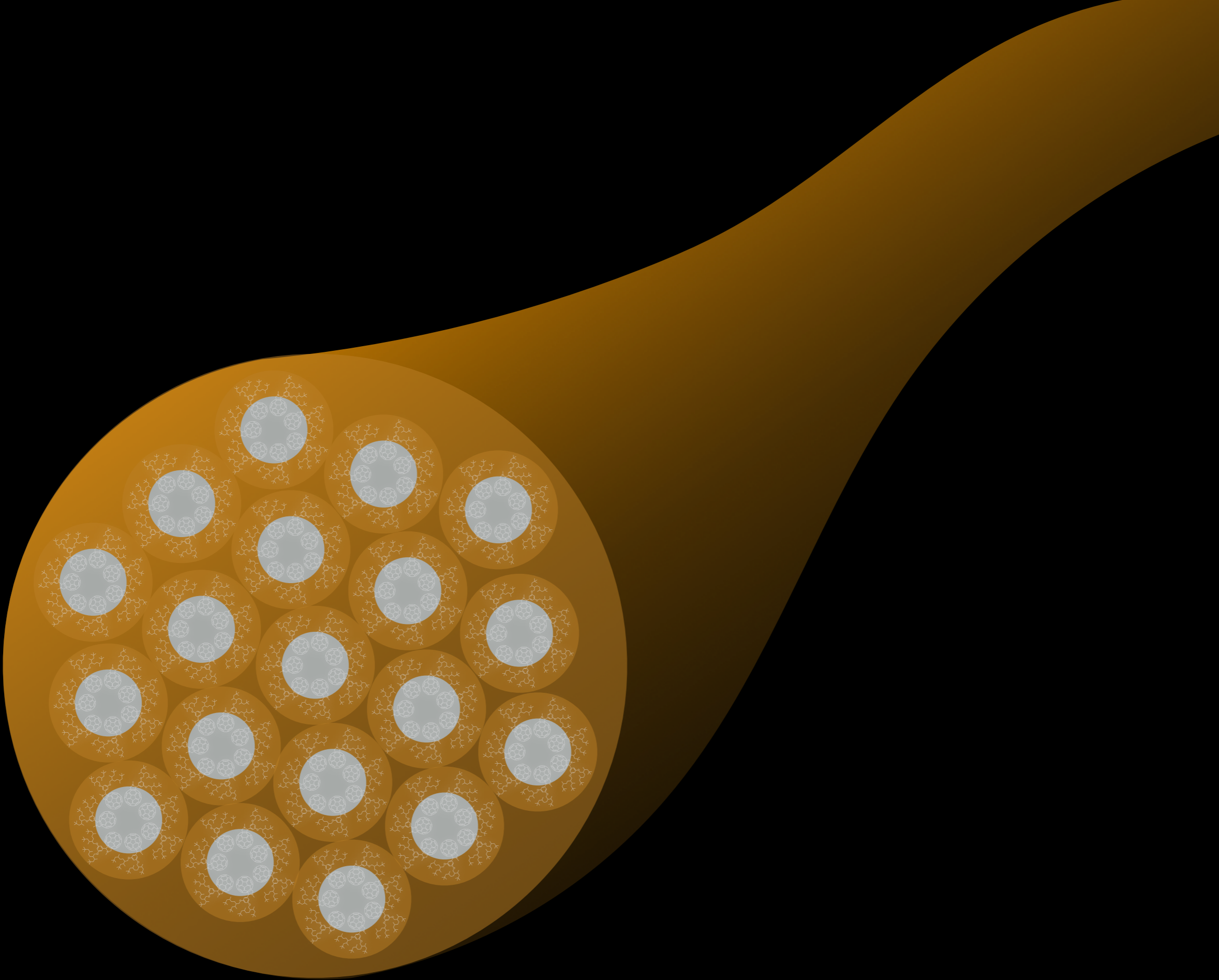












Directed assembly of optoelectronically active alkyl- π -conjugated molecules by adding *n*-alkanes or π -conjugated species

Martin J. Hollamby^{1,2*}, Maciej Karny³, Paul H. H. Bomans⁴, Nico A. J. M. Sommerdijk⁴, Akinori Saeki⁵, Shu Seki⁵, Hiroyuki Minamikawa⁶, Isabelle Grillo⁷, Brian R. Pauw¹, Paul Brown⁸, Julian Eastoe⁸, Helmuth Möhwald⁹ and Takashi Nakanishi^{1,3*}

Supramolecular assembly can yield ordered structures by taking advantage of the cumulative effect of multiple non-covalent interactions between adjacent molecules. The thermodynamic origin of many self-assembled structures in water is the balance between the hydrophilic and hydrophobic segments of the molecule. Here, we show that this approach can be generalized to use solvophobic and solvophilic segments of fully hydrophobic alkylated fullerene molecules. Addition of *n*-alkanes results in their assembly—due to the antipathy of C₆₀ towards *n*-alkanes—into micelles and hexagonally packed gel-fibres containing insulated C₆₀ nanowires. The addition of pristine C₆₀ instead directs the assembly into lamellar mesophases by increasing the proportion of π -conjugated material in the mixture. The assembled structures contain a large fraction of optoelectronically active material and exhibit comparably high photoconductivities. This method is shown to be applicable to several alkyl- π -conjugated molecules, and can be used to construct organized functional materials with π -conjugated sections.

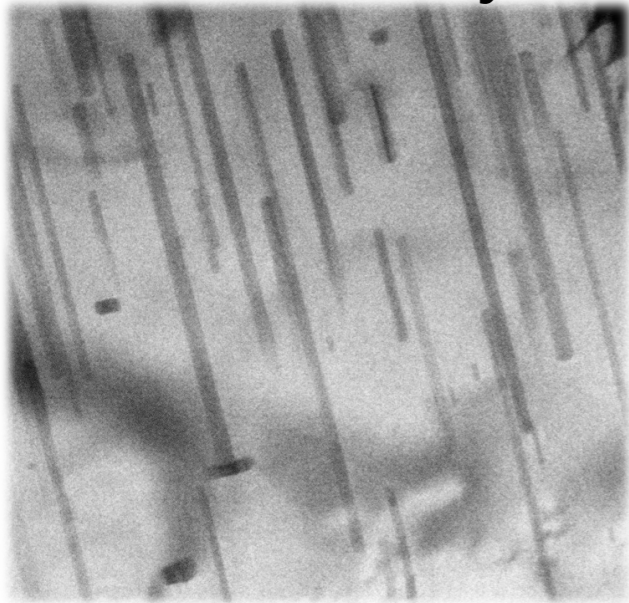
Supramolecular chemistry generates complex structures over a range of length scales. Structures such as DNA origami^{1,2}, supramolecular polymers^{3,4} and supra-amphiphiles⁵ are formed via multiple non-covalent interactions between adjacent molecules that are programmed by their chemical structure. Similarly, in solution, amphiphiles with hydrophilic and hydrophobic sections assemble through multiple non-covalent interactions. However, assembly is also governed by solution parameters such as concentration and solvent type, as well as the balance of hydrophilic and hydrophobic content within the amphiphile⁶. This permits a single amphiphile to be directed to assemble into one of a range of structures simply

mutually immiscible alkyl (long, branched) and π -conjugated (C₆₀, C₇₀ or azobenzene) parts. The asymmetric hydrophobic amphiphiles are formed by attaching alkyl chains to just one side of a π -conjugated moiety^{13–16}. Alkyl chains are routinely attached to π -conjugated molecules to improve solubility and to tune self-assembly^{11,12,17–19}. Similarly to the directed assembly of conventional hydrophobic–hydrophilic amphiphiles, the introduction of additives or solvents with a selective affinity towards either part of the hydrophobic amphiphile was expected to provoke the formation of various complex ordered fluids including micelles, gels and two-component liquid crystals⁶. By changing the solution parameters,

Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



Nanoparticles



[Round Robin]

[Ultra-SAXS]

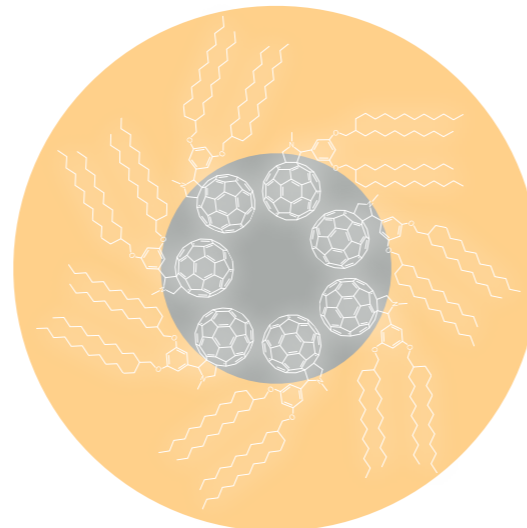
Powders



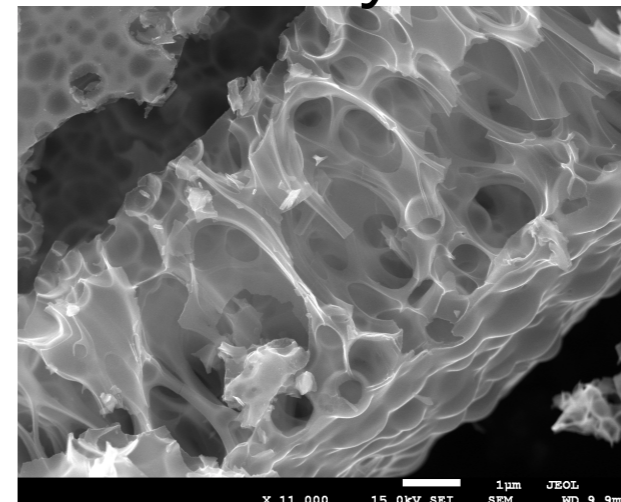
Doughnuts



Micelles



Catalysts



[exit]

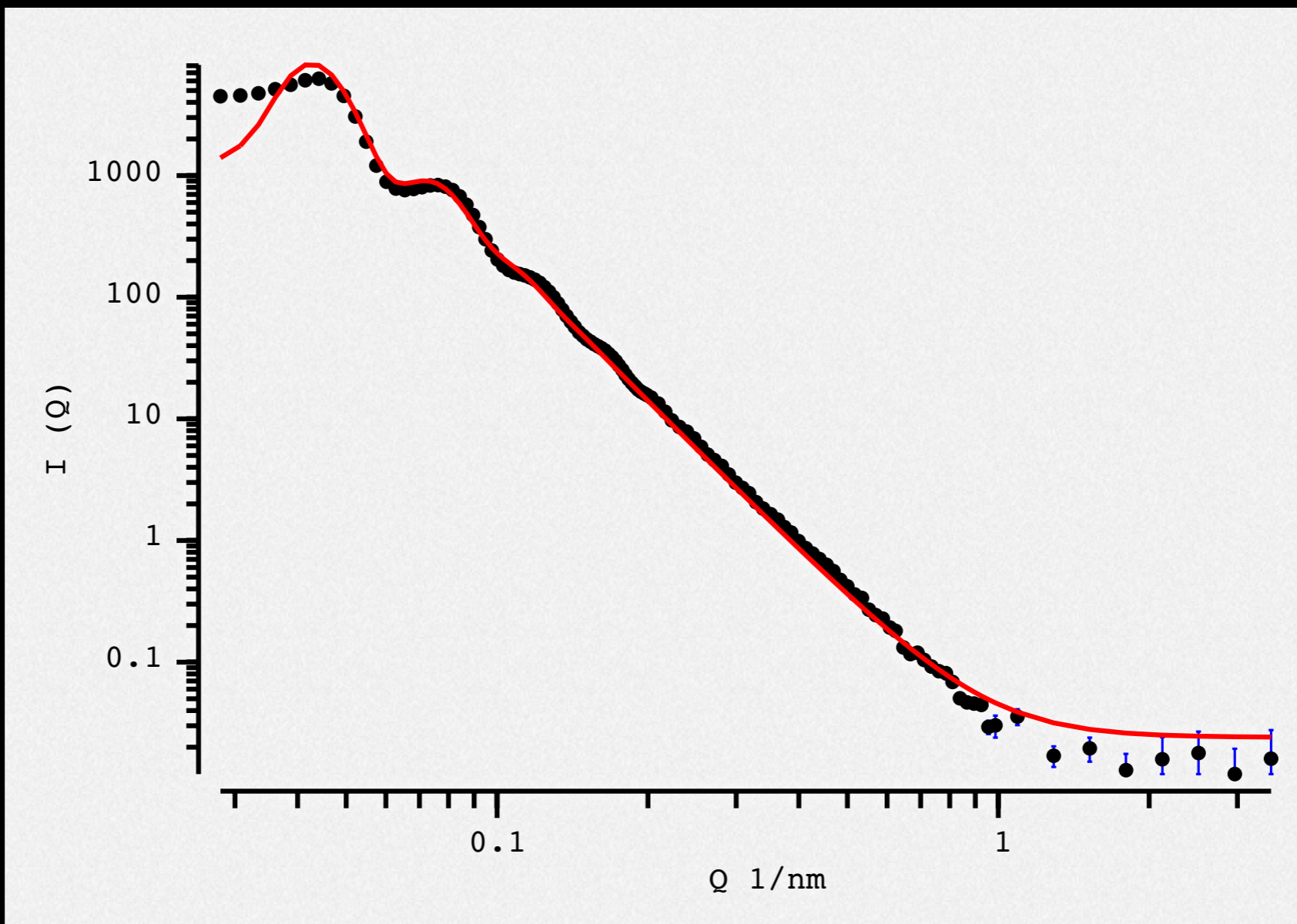
Packed nanoscale powders

SAXS

A yellow callout box with rounded corners and a pointer pointing upwards towards the word 'SAXS'.

Brian R. Pauw





Fitting of data: Hoghoj_newrebin_2014-12-03_15-59-42

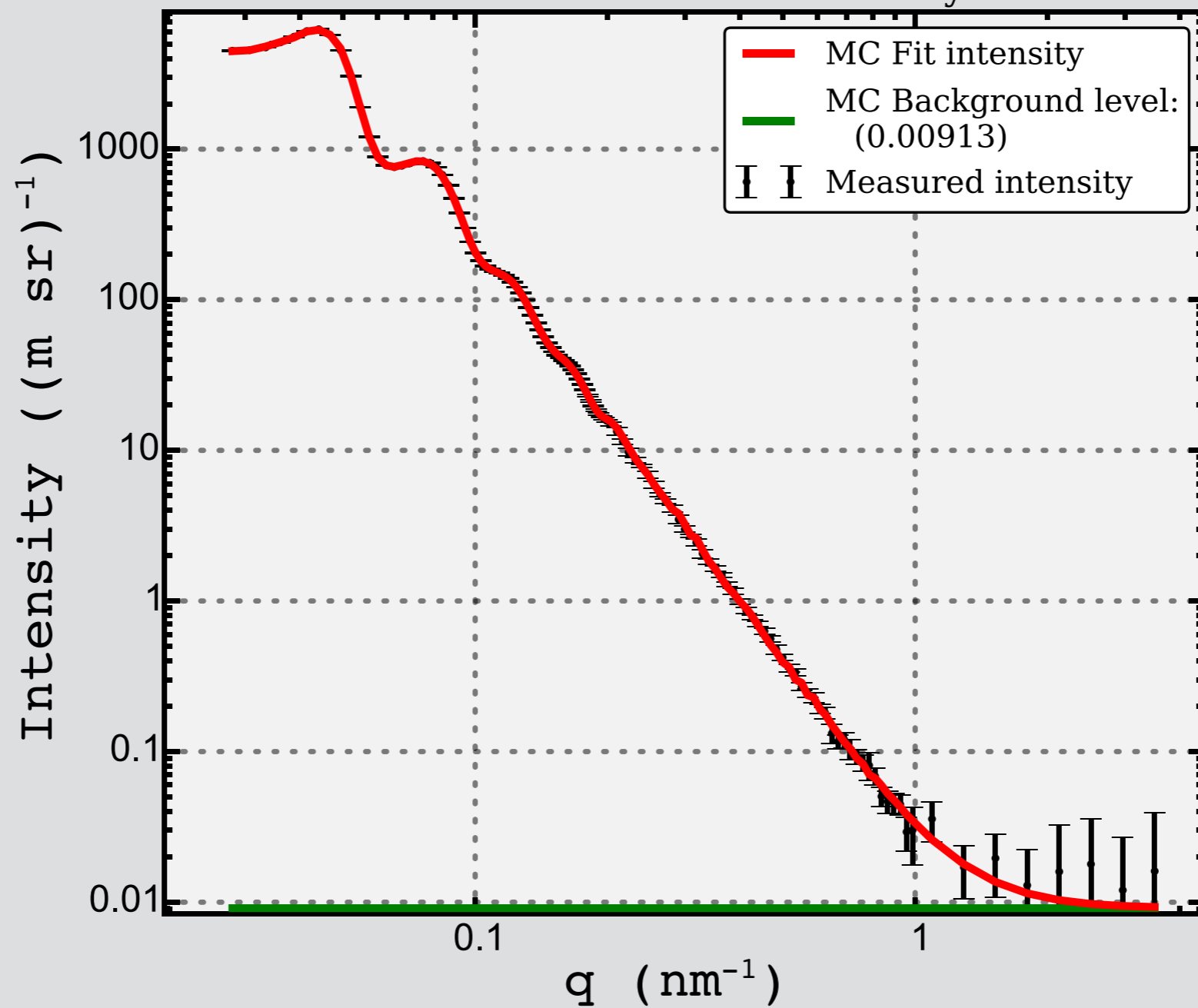
Q-range: 2.81×10^7 to 3.5×10^9

Active parameters: 1, ranges: 1

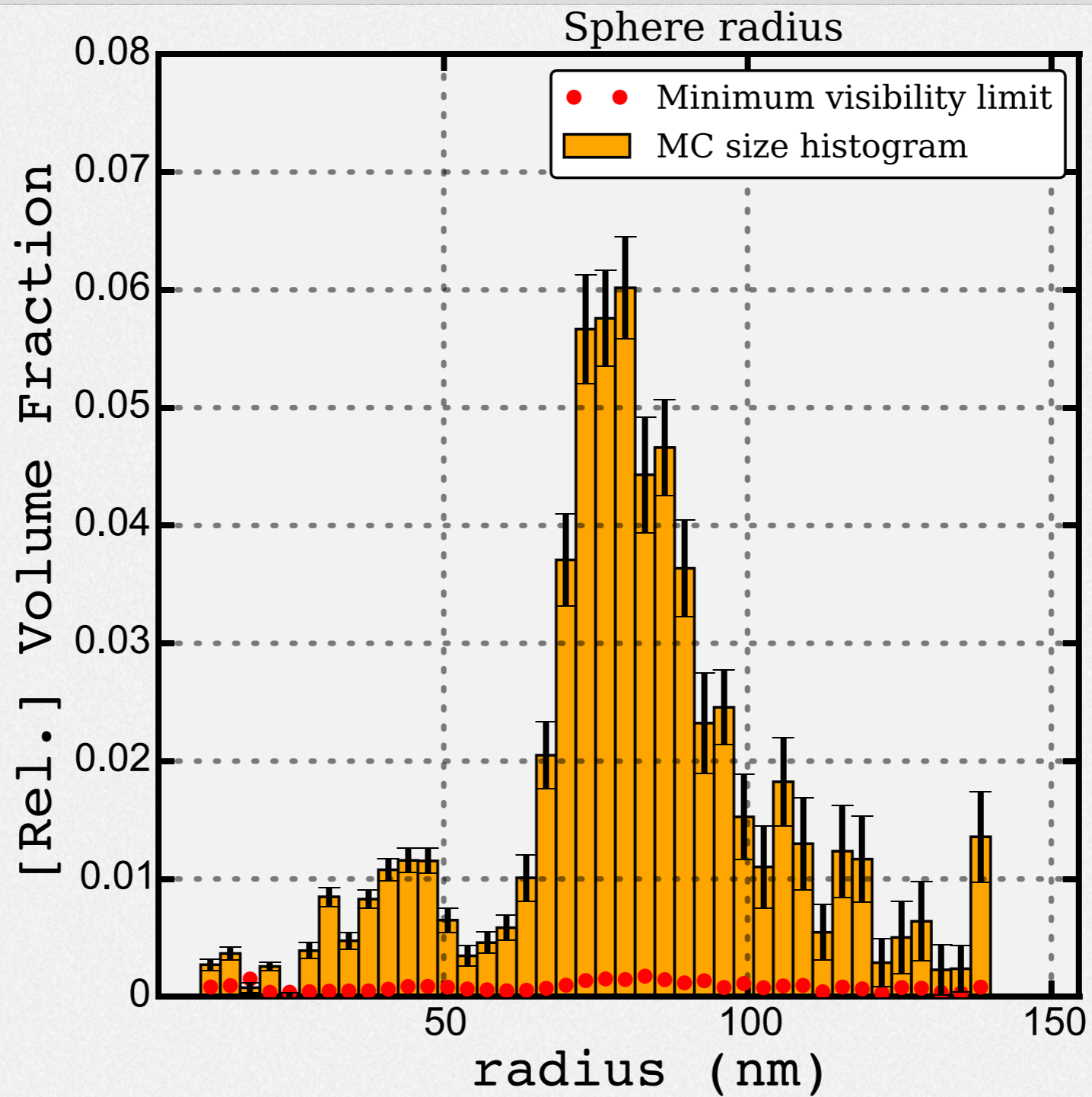
Background level: 0.00913 ± 0.000569

Timing: 100 repetitions of 3.96 ± 1.25 seconds

Measured vs. Fitted intensity



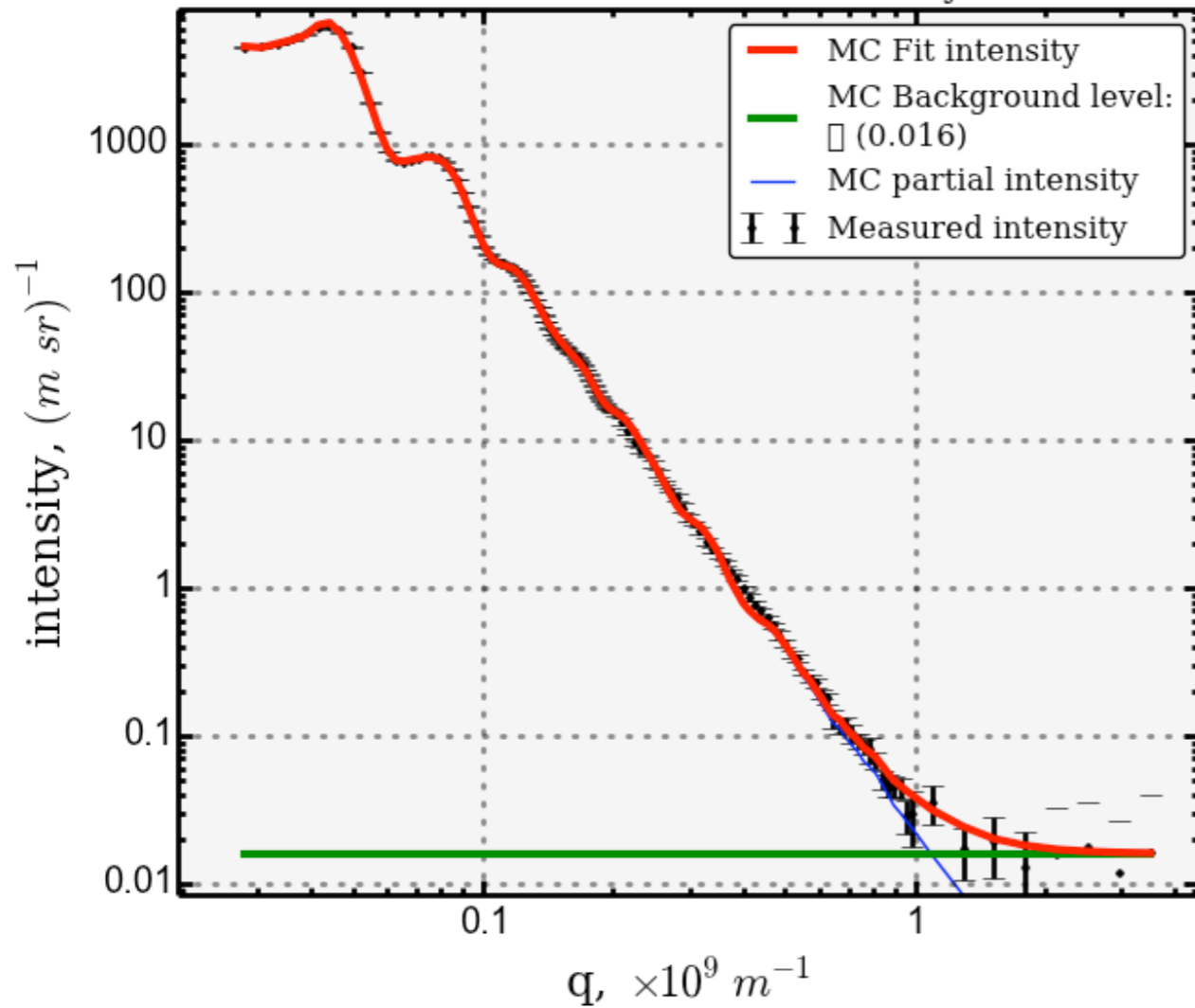
Range 1e-08 to 1.4e-07, vol-weighted
totalValue: 6.264e-01 ± 1.765e-03
mean: 8.120e-08 ± 3.104e-10
variance: 5.502e-16 ± 1.500e-17
skew: -1.410e-01 ± 4.766e-02
kurtosis: 3.735e+00 ± 4.800e-02



Vol. frac. 0.5 (instead of 0.62)

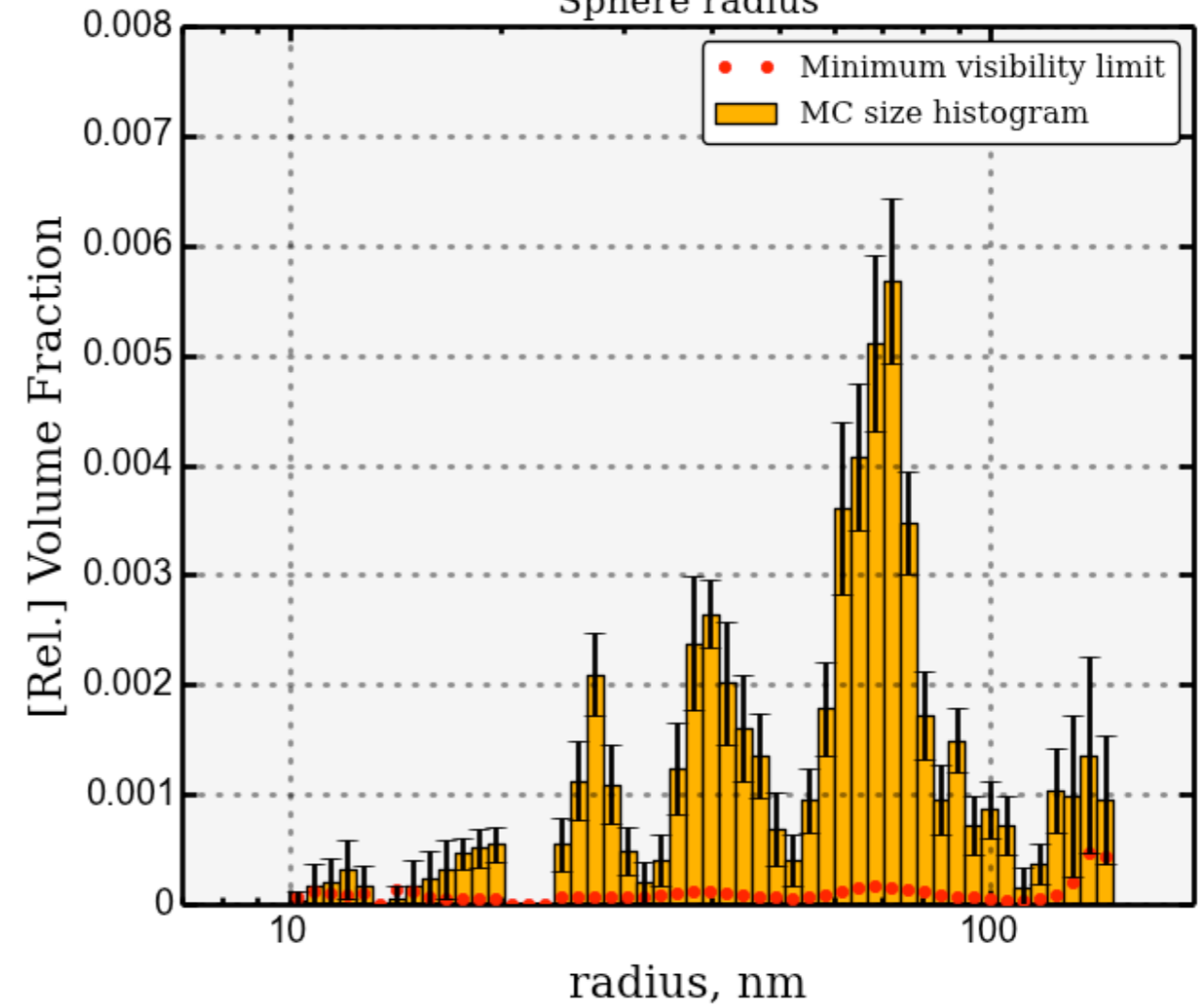
Fitting of data: Hoghoj_rebin_2014-06-26_16-44-45
Q-range: 2.806410e-02 to 3.502027e+00
Active parameters: 1, ranges: 1
Background level: 1.595011e-02 ± 9.483175e-04

Measured vs. Fitted intensity



Range 0.0 to inf, vol-weighted		Range 0.0 to inf, num-weighted	
totalValue:	5.744e-02 ± 8.146e-04	totalValue:	1.000e+00 ± 7.602e-16
mean:	6.303e+01 ± 1.609e+00	mean:	2.313e+01 ± 6.879e-01
variance:	8.840e+02 ± 1.186e+02	variance:	2.408e+02 ± 4.832e+00
skew:	7.481e-01 ± 1.192e-01	skew:	2.172e+00 ± 8.888e-02
kurtosis:	3.517e+00 ± 1.923e-01	kurtosis:	9.220e+00 ± 7.581e-01

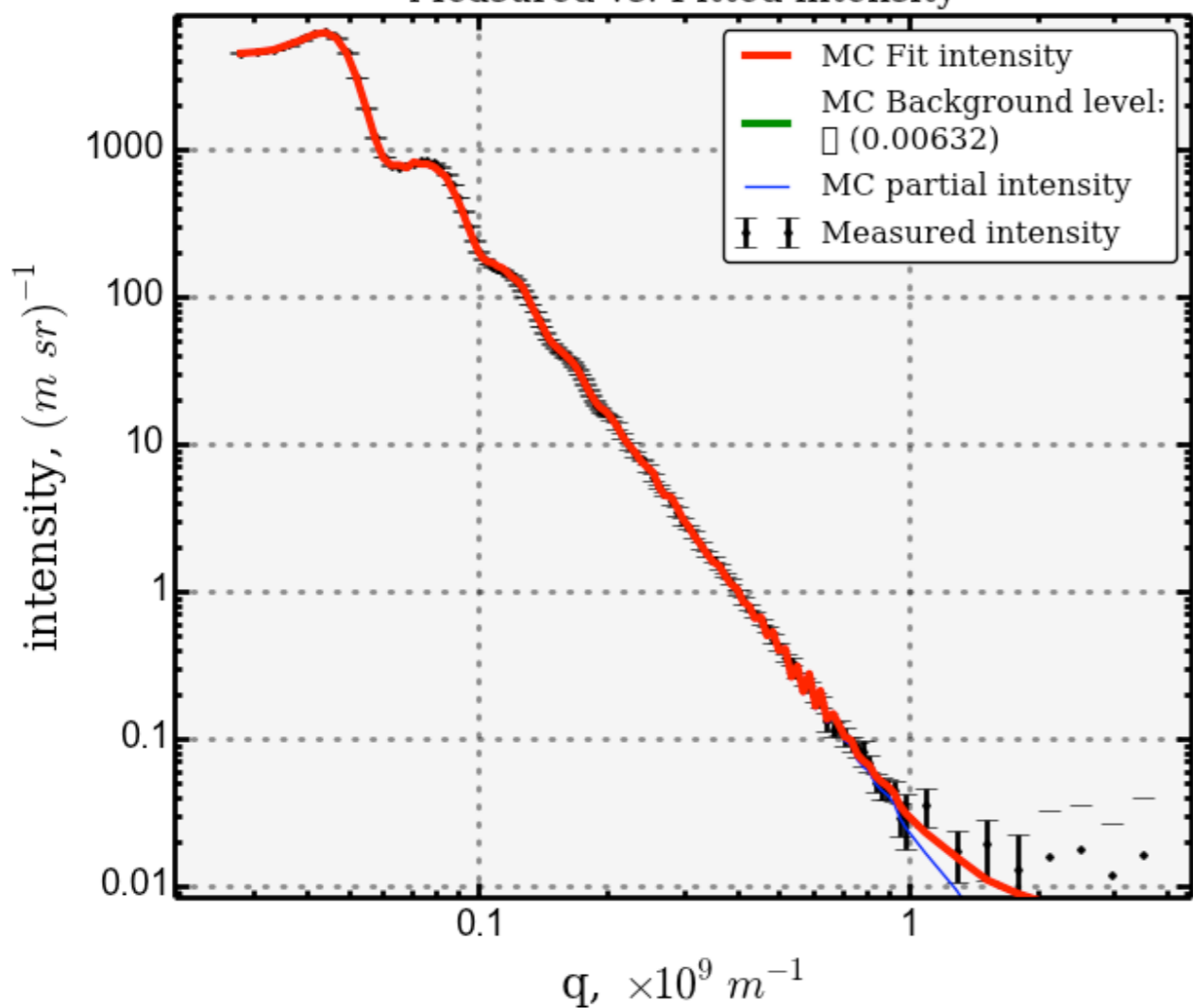
Sphere radius



Vol. frac. 0.72 (instead of 0.62)

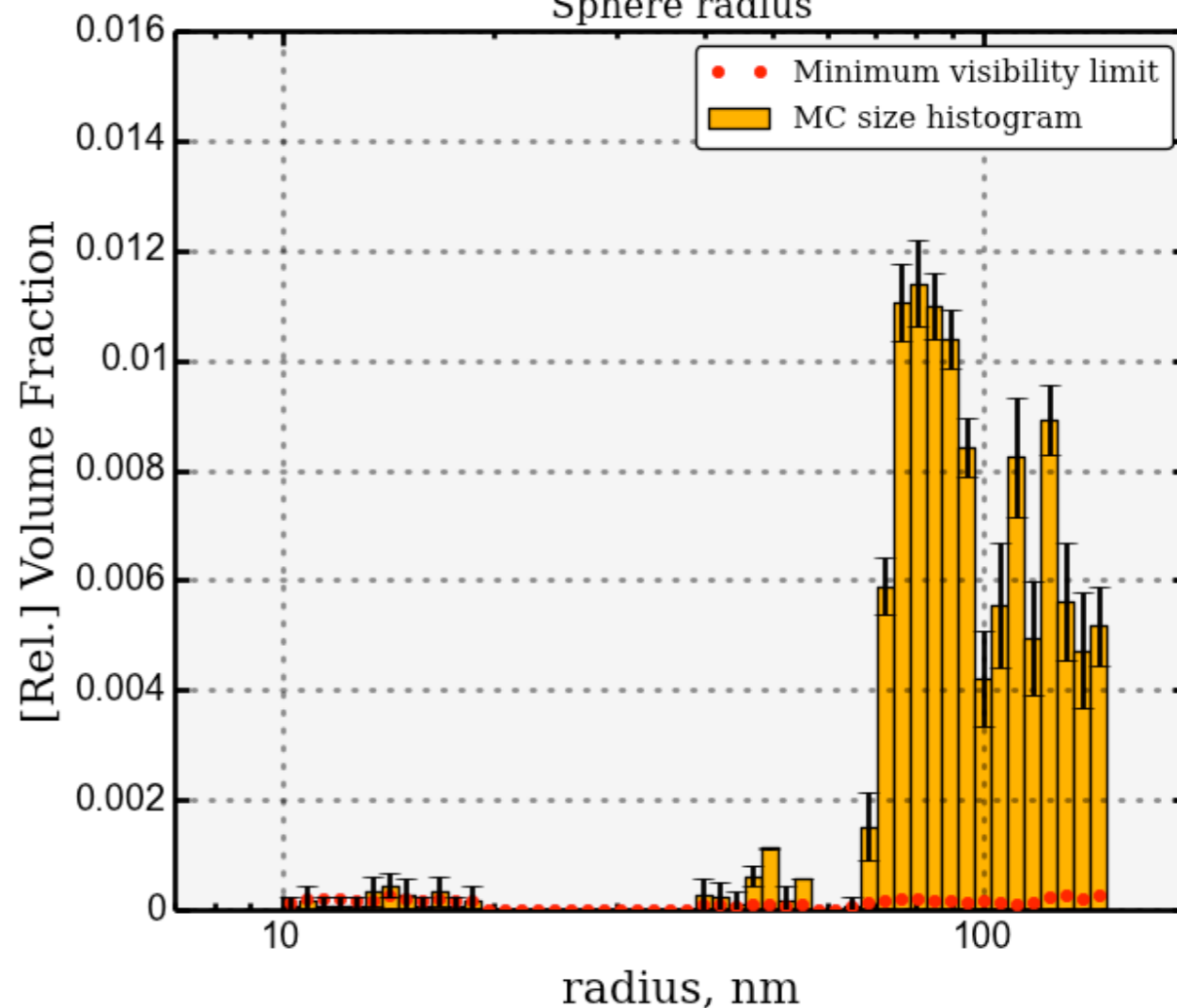
Fitting of data: Hoghoj_rebin_2014-06-26_17-02-14
Q-range: 2.806410e-02 to 3.502027e+00
Active parameters: 1, ranges: 1
Background level: 6.320637e-03 ± 2.013909e-03

Measured vs. Fitted intensity



Range 0.0 to inf, vol-weighted		Range 0.0 to inf, num-weighted	
totalValue:	1.123e-01 ± 6.434e-04	totalValue:	1.000e+00 ± 6.723e-16
mean:	9.725e+01 ± 6.359e-01	mean:	2.658e+01 ± 4.159e+00
variance:	6.659e+02 ± 3.157e+01	variance:	7.795e+02 ± 1.327e+02
skew:	-2.173e-01 ± 6.023e-02	skew:	2.082e+00 ± 3.933e-01
kurtosis:	3.638e+00 ± 2.185e-01	kurtosis:	6.305e+00 ± 1.683e+00

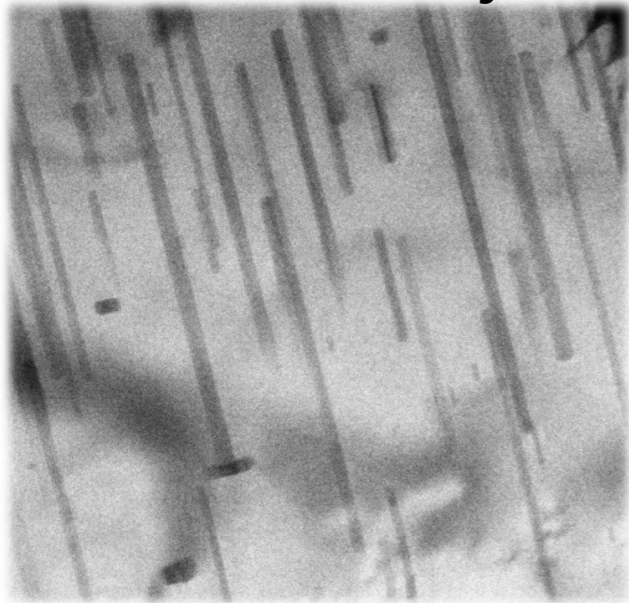
Sphere radius



Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



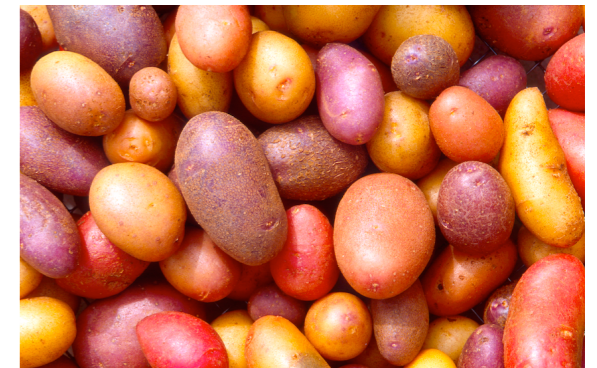
Nanoparticles



[Round Robin]

[Ultra-SAXS]

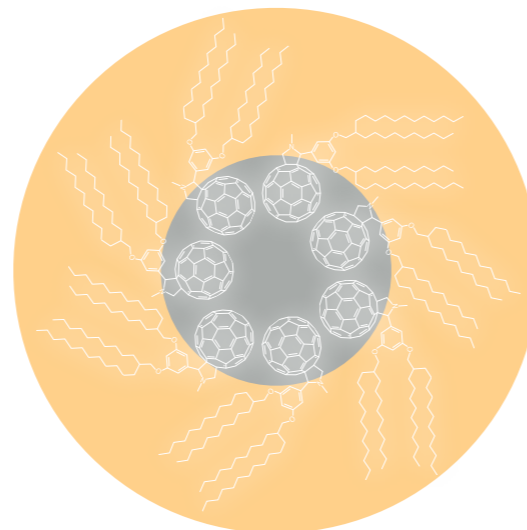
Powders



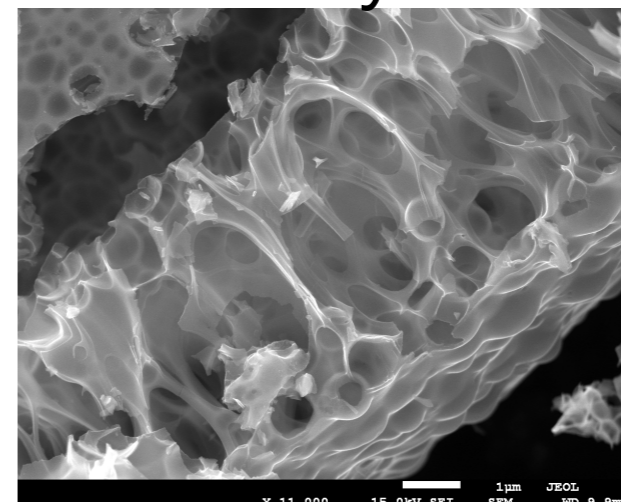
Doughnuts



Micelles



Catalysts



[exit]

Quantum Dots

SAXS, XRD, *et al.*

Benjamin Abécassis

Cécile Bouet

Cyril Garnero

Dora Constantin

Nicolas Lequeux

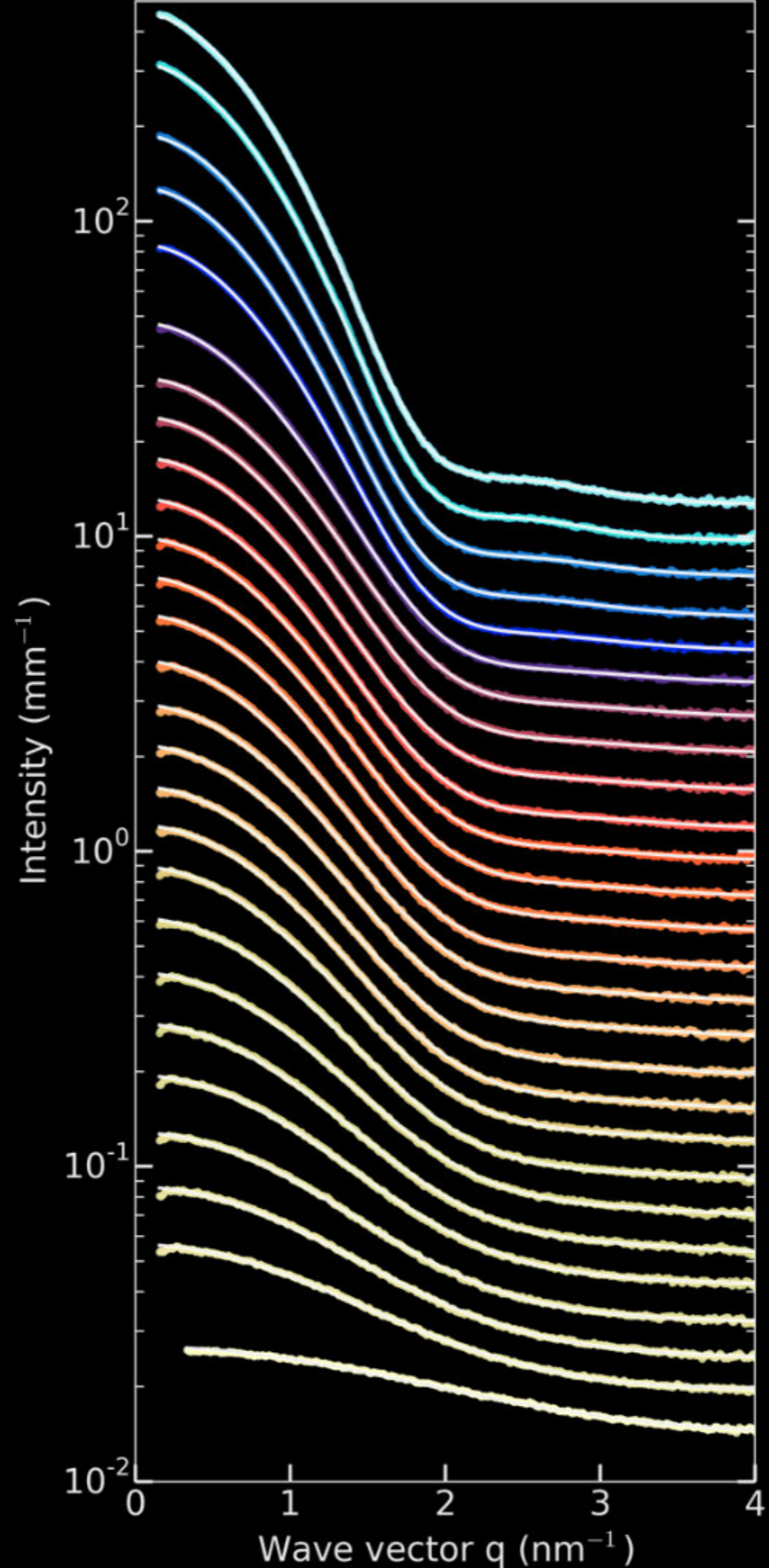
Sandrine Ithurria

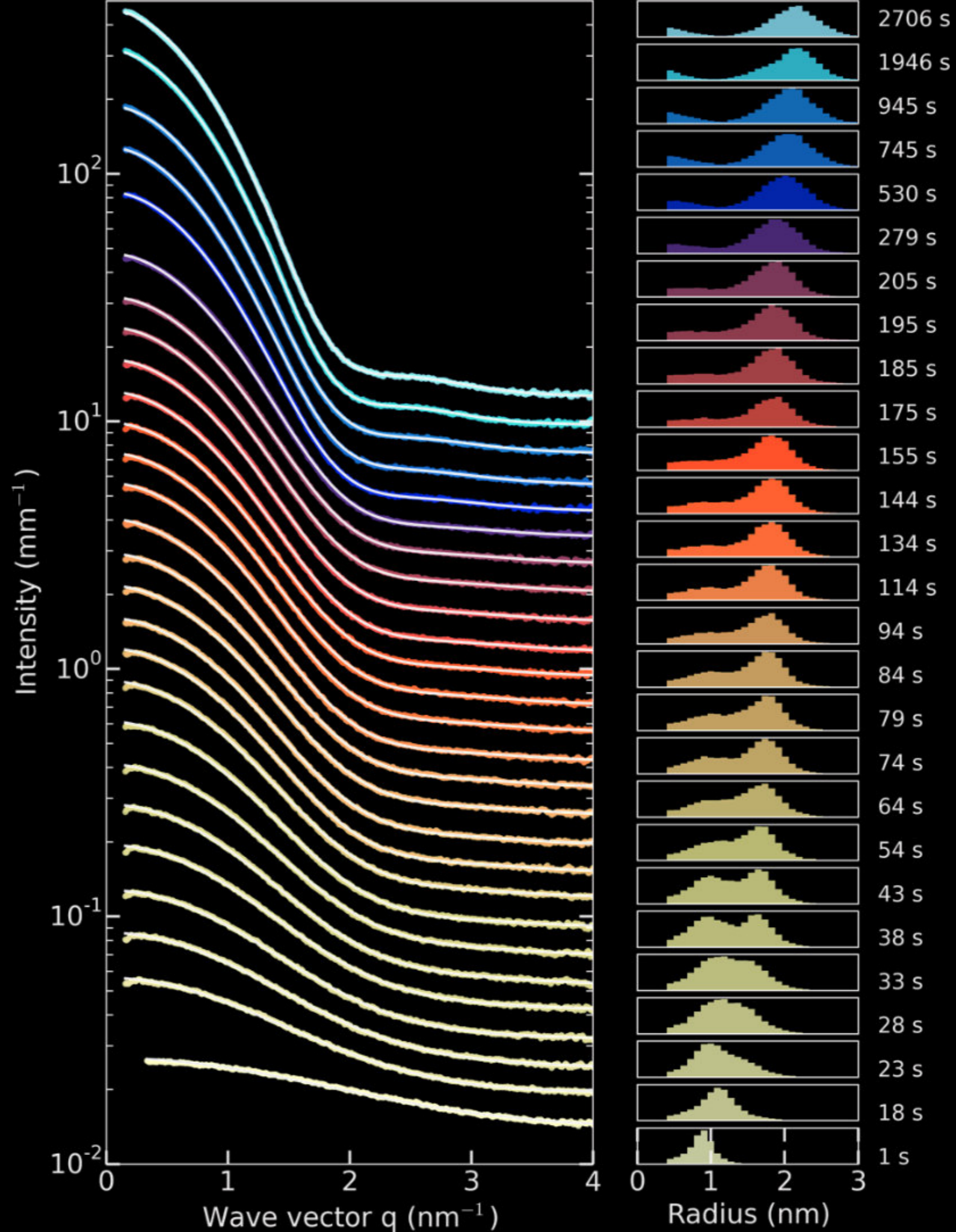
Benoit Dubertret

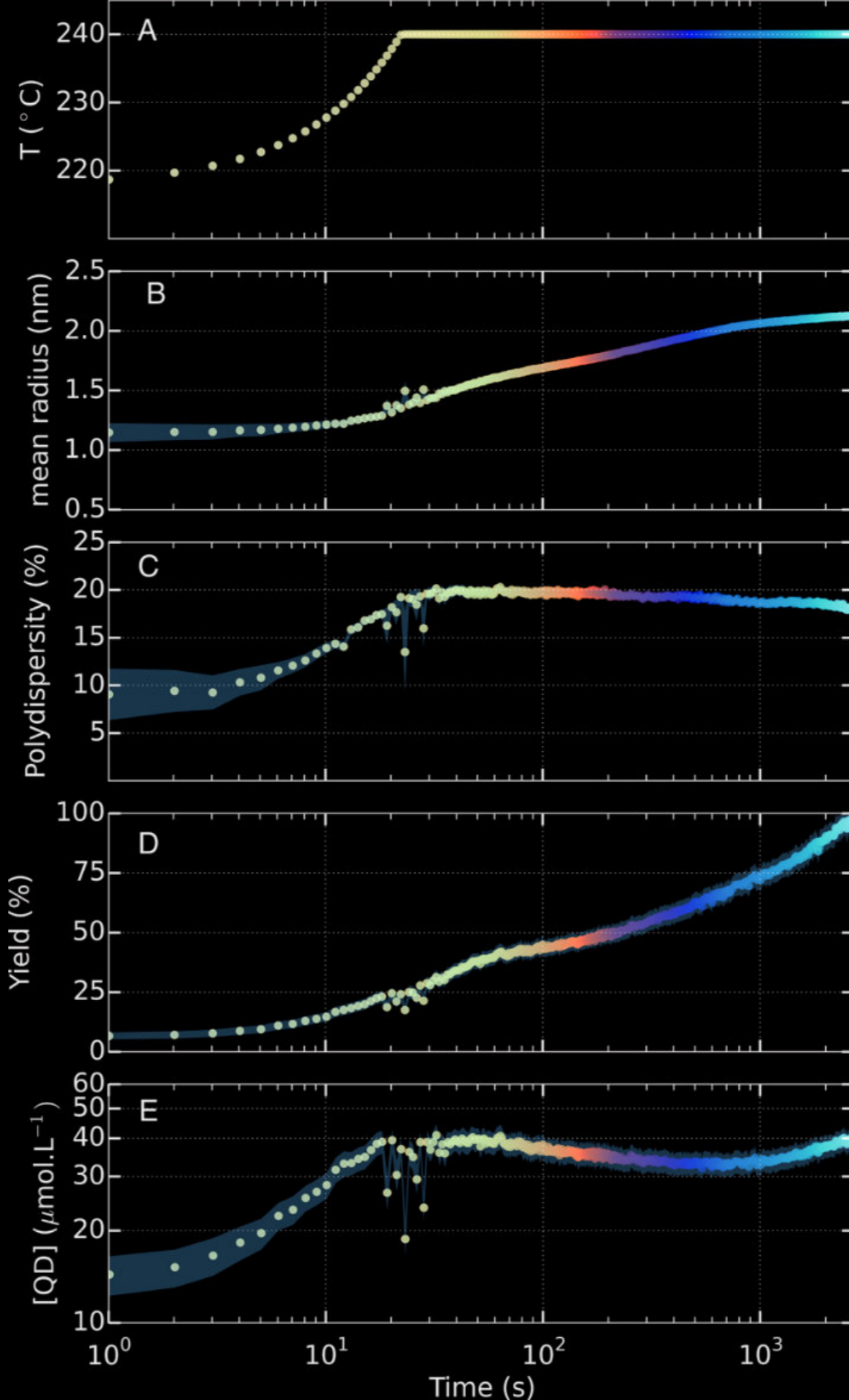
Brian R. Pauw

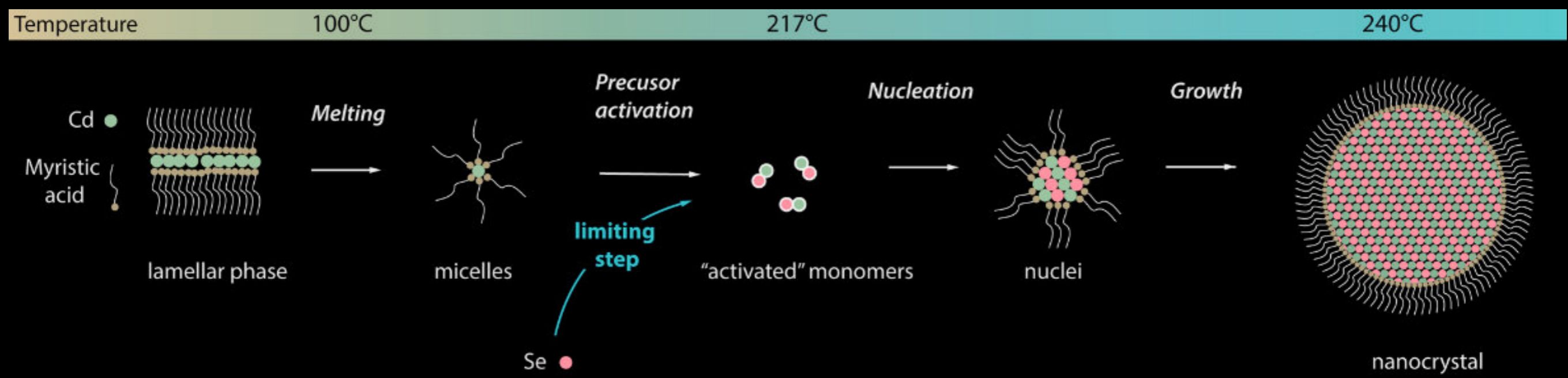
Diego Pontoni

By what mechanism
do they grow?





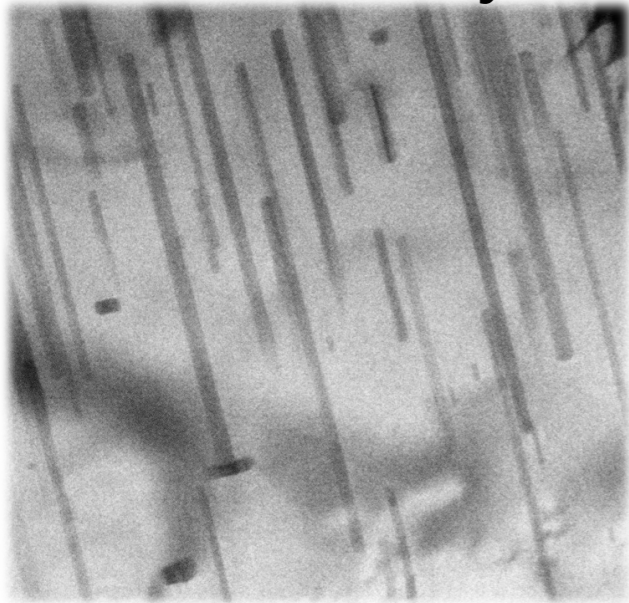




Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



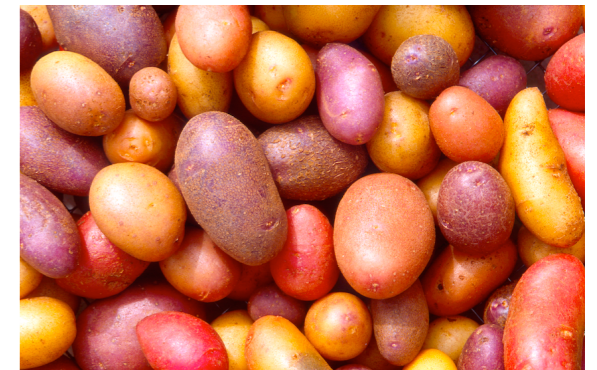
Nanoparticles



[Round Robin]

[Ultra-SAXS]

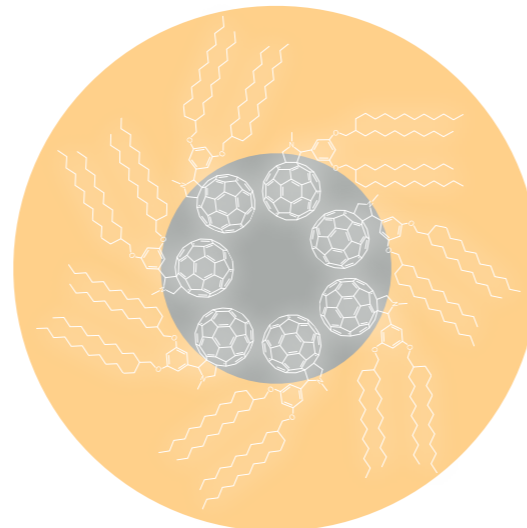
Powders



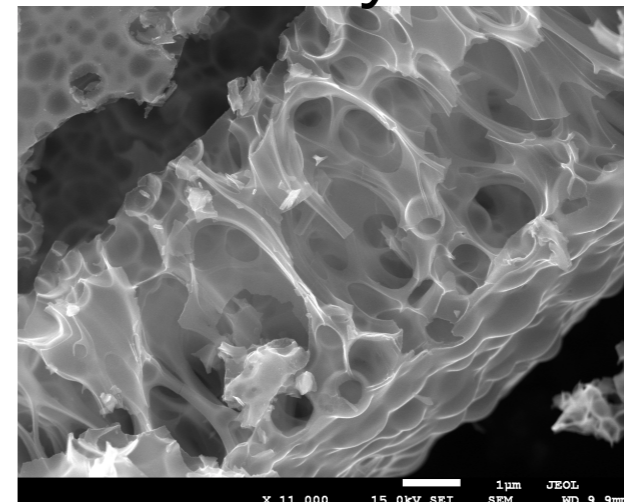
Doughnuts



Micelles



Catalysts



[exit]

Liquid structures II

SAXS & SANS

Martin J. Hollamby

Keisuke Aratsu

Brian R. Pauw

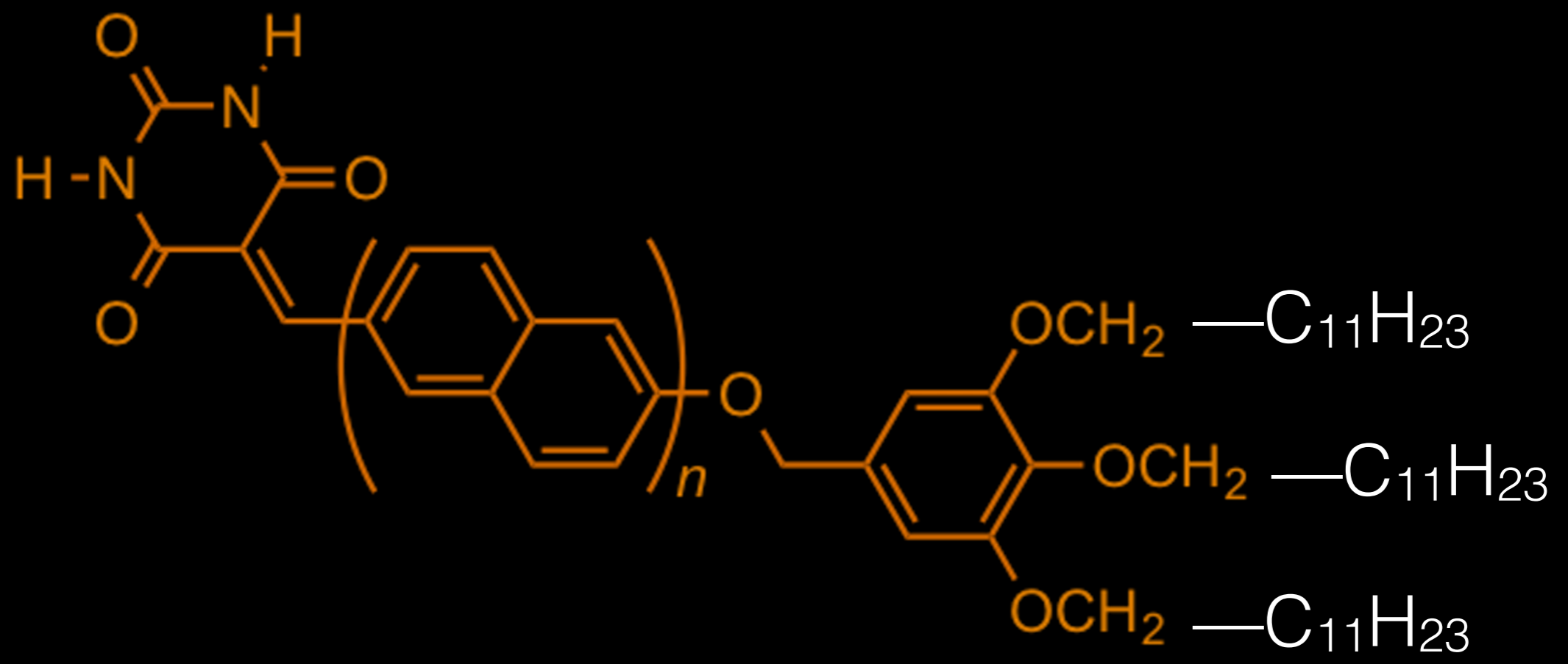
Sarah E. Rogers

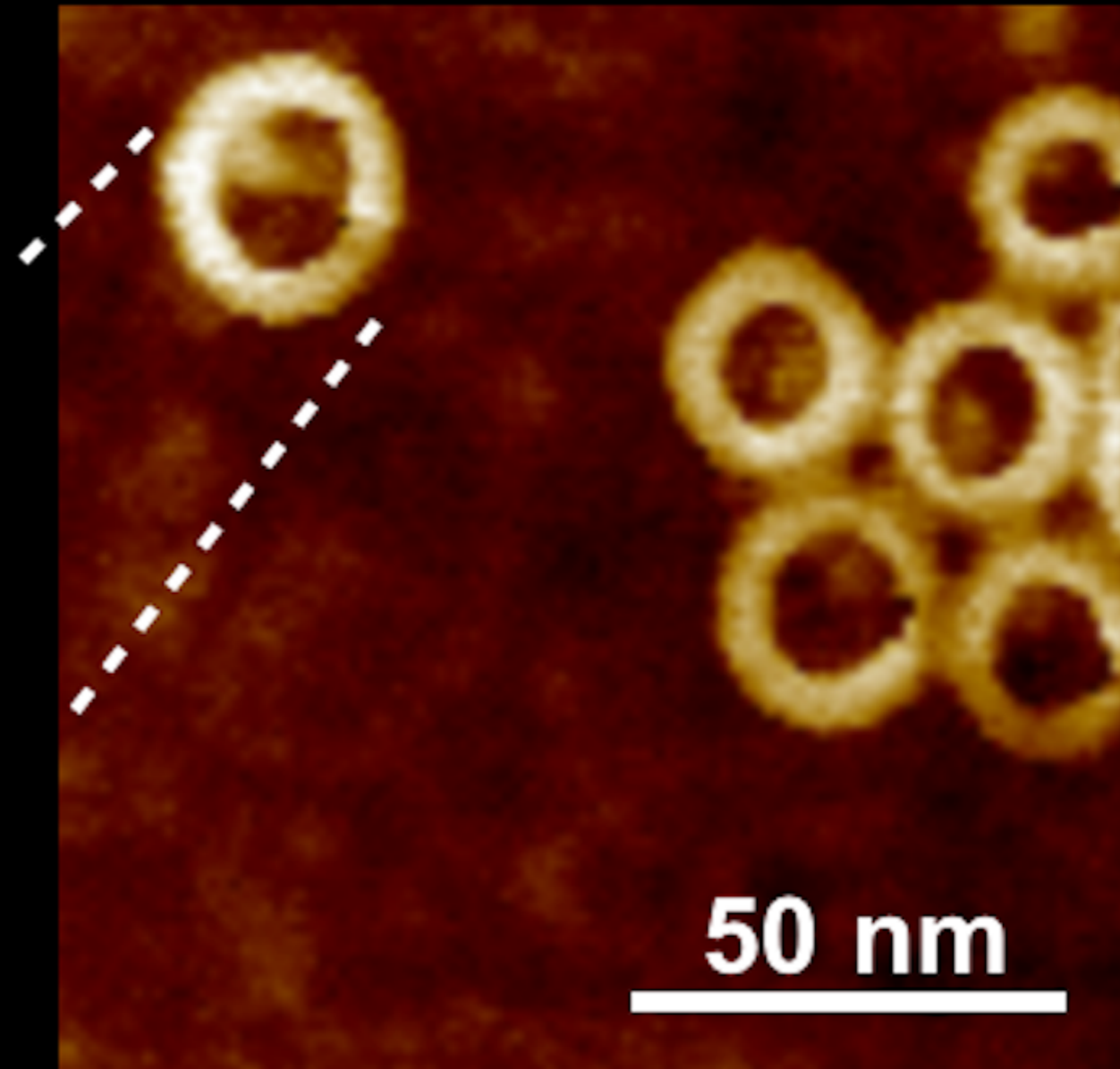
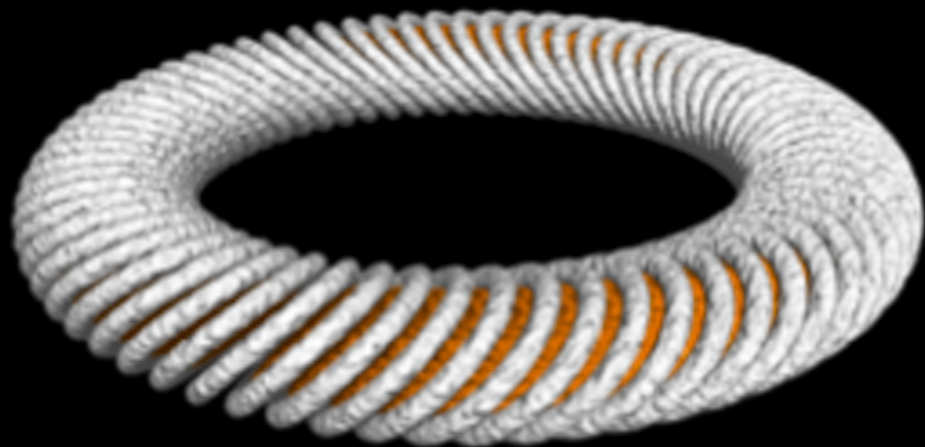
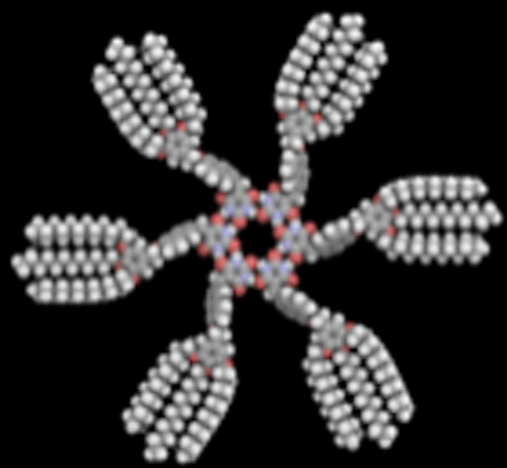
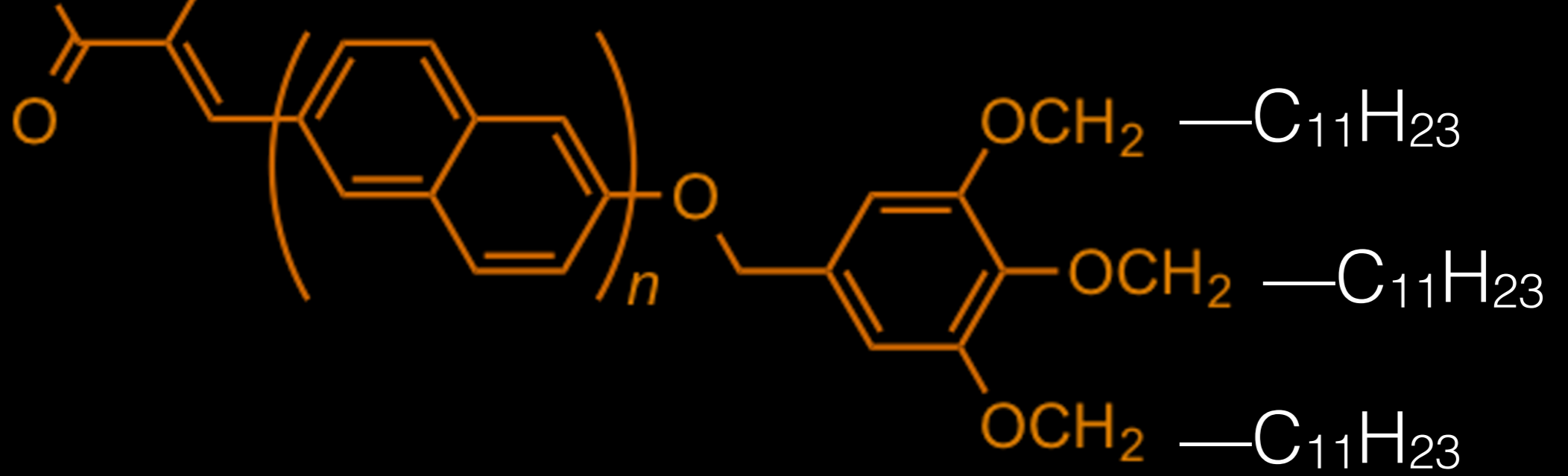
Andrew J. Smith

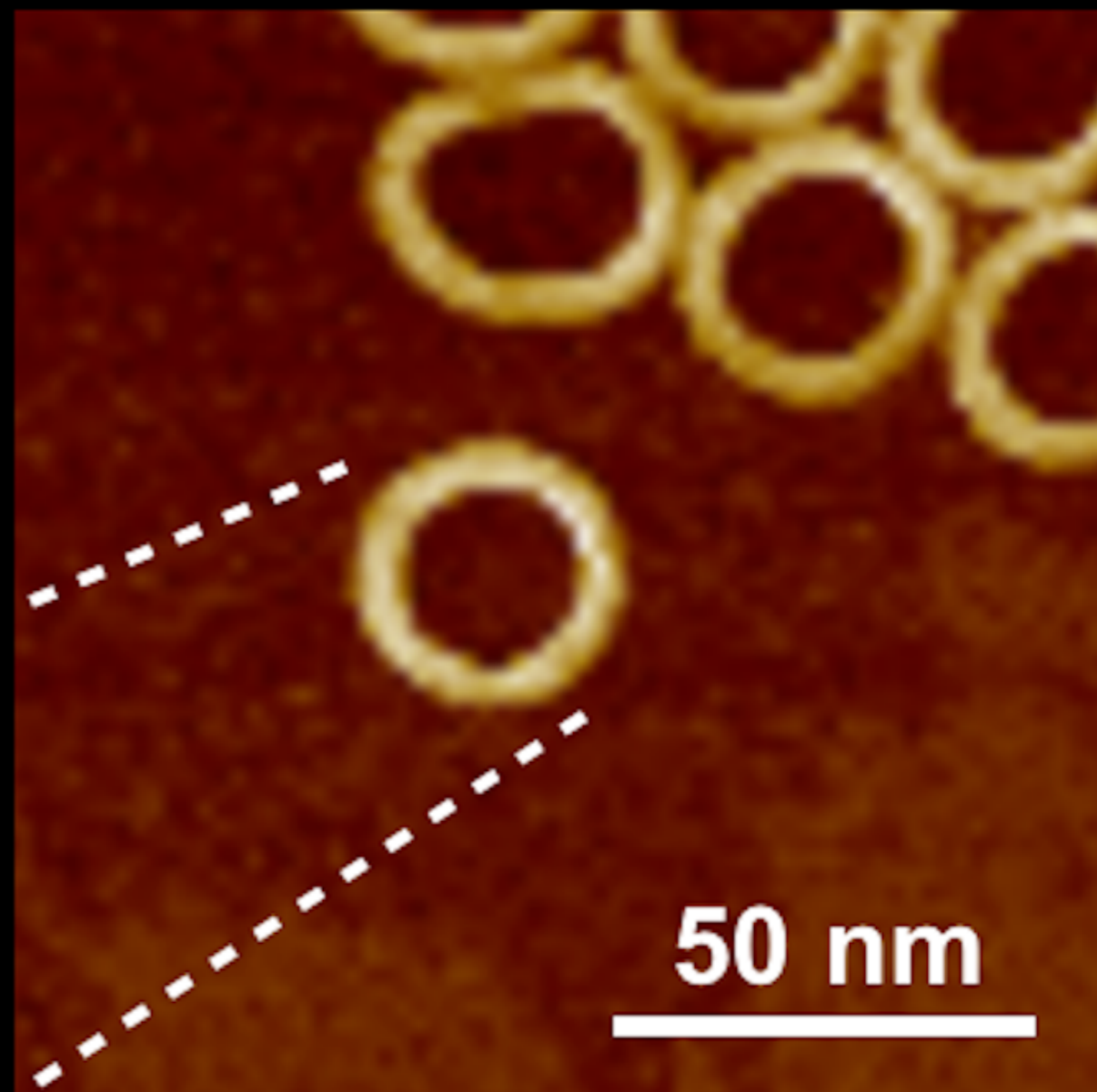
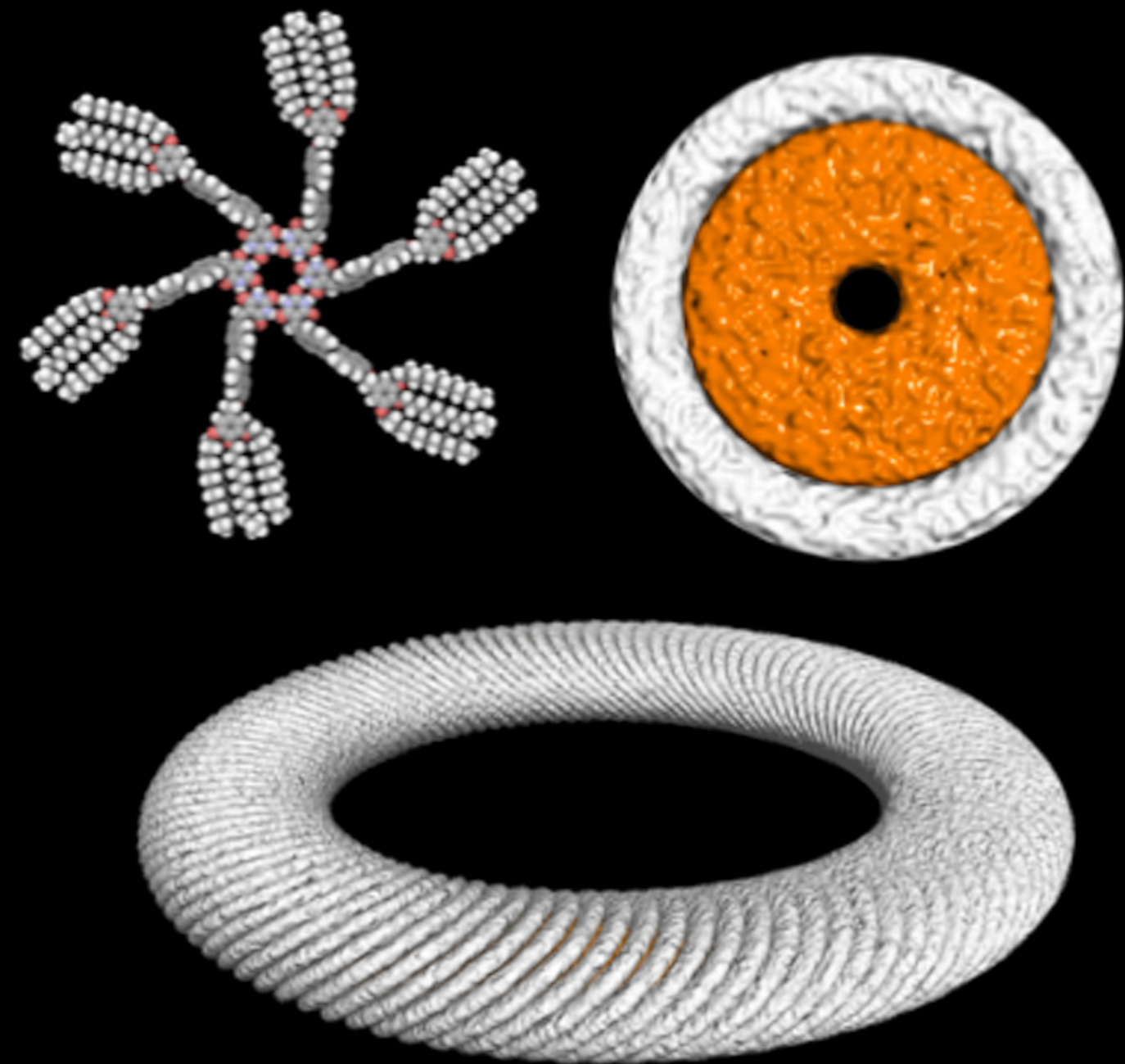
Mitsuaki Yamauchi

Xu Lin

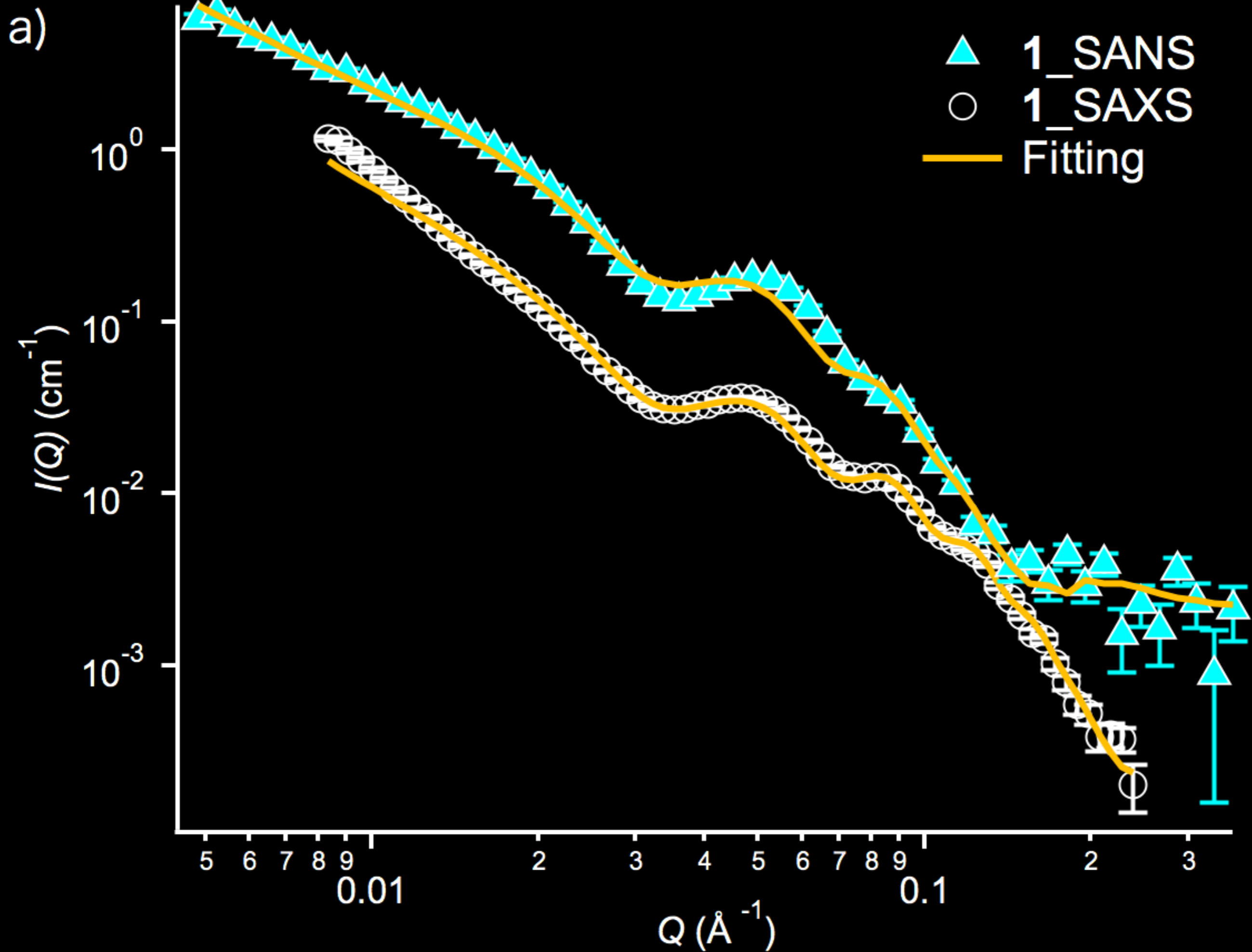
Shiki Yagai

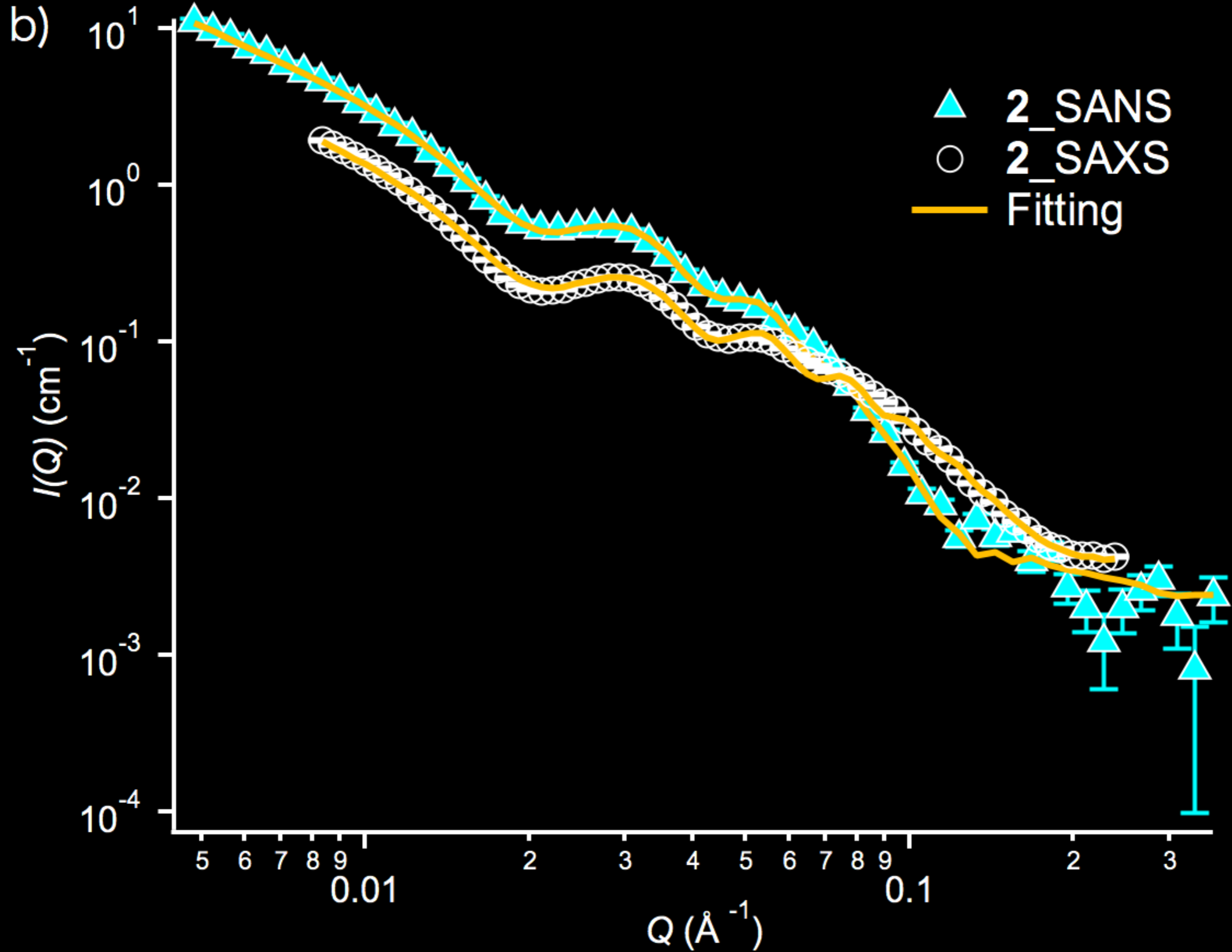


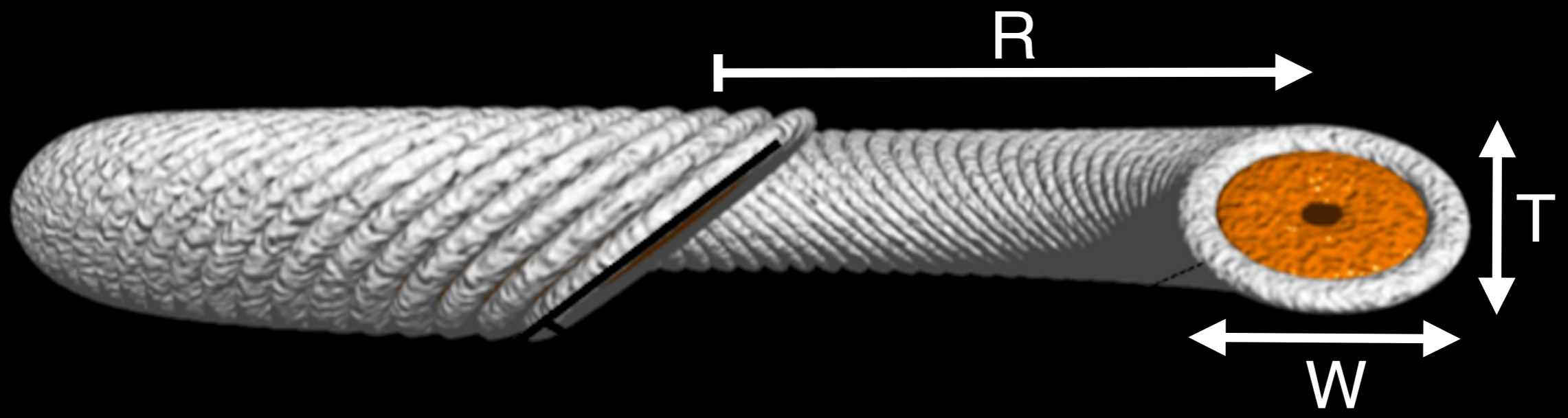


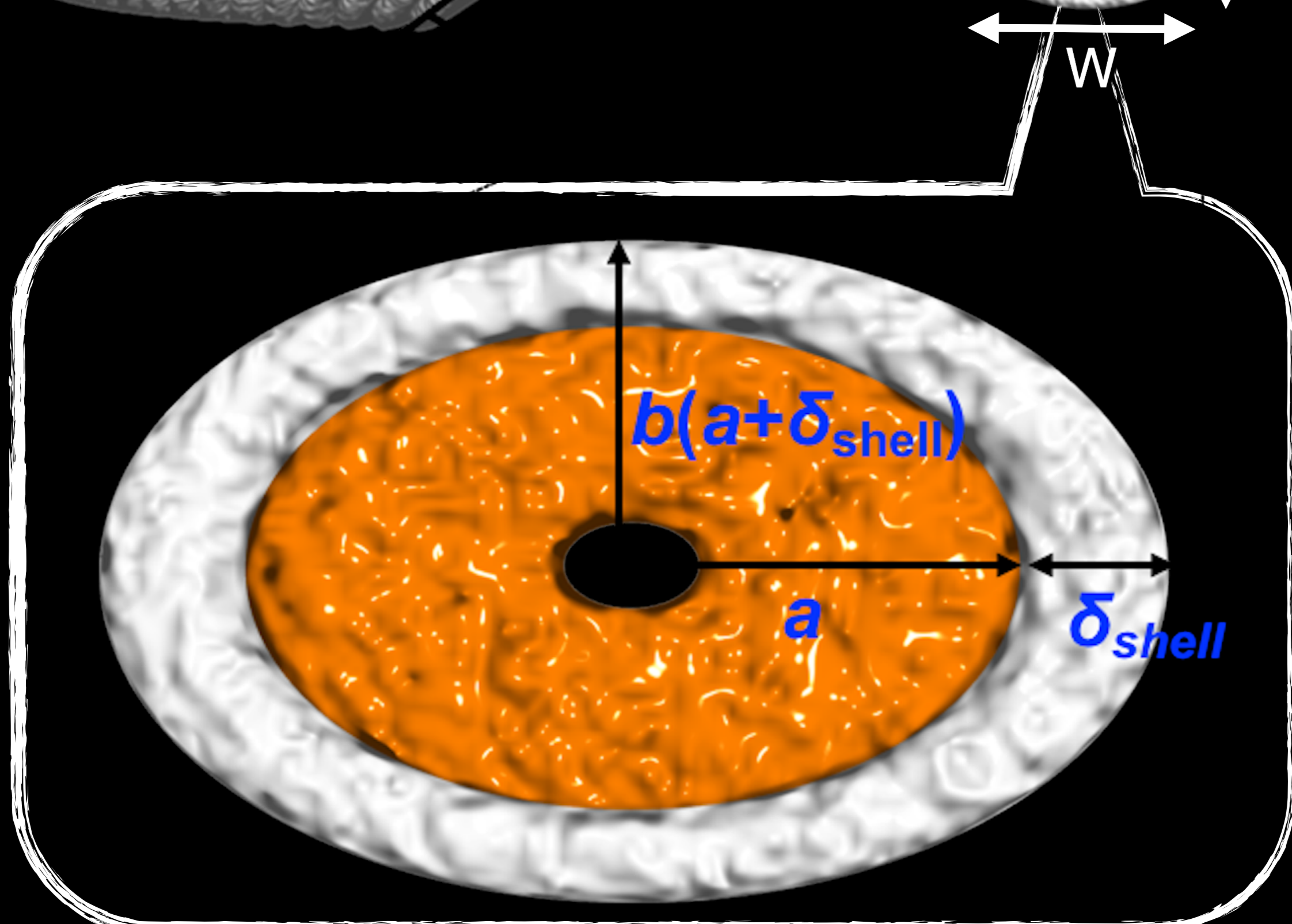
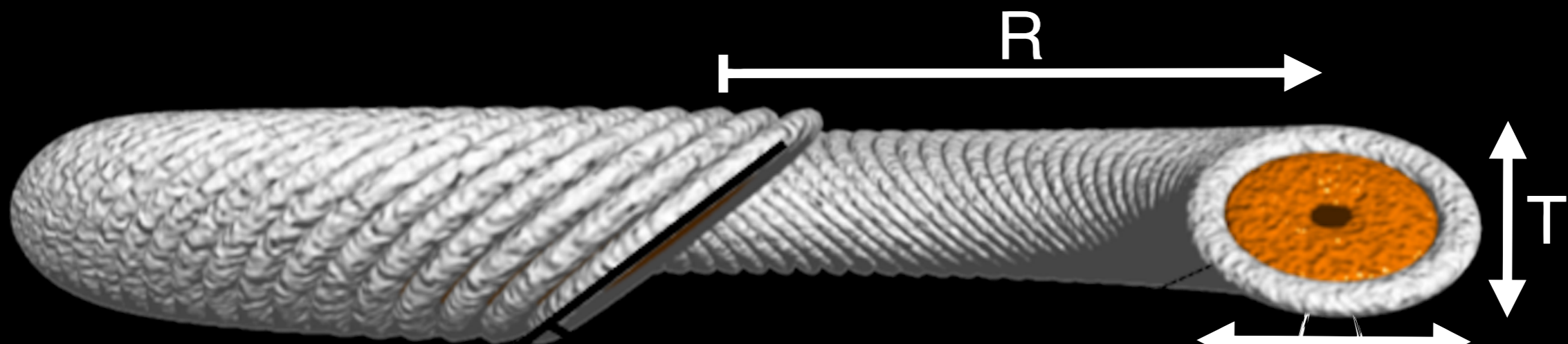


Do they exist in the solvent?





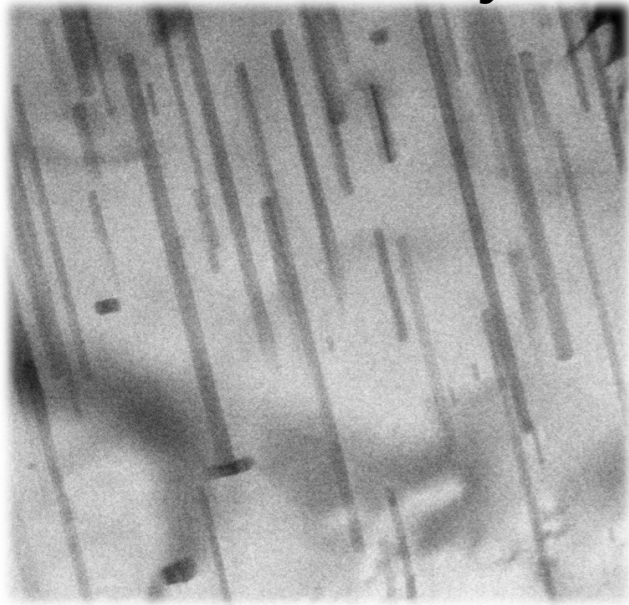




Choose your own adventure

(at your own risk)

Metal alloys



Polymers



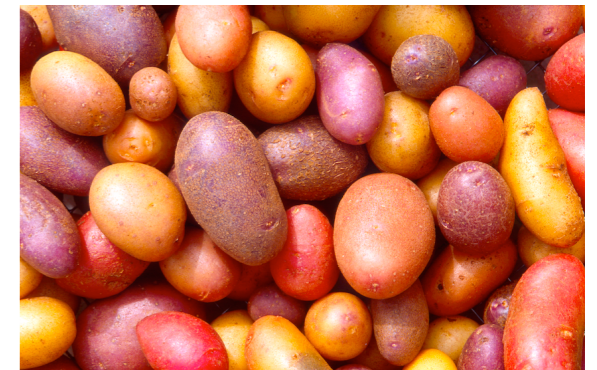
Nanoparticles



[Round Robin]

[Ultra-SAXS]

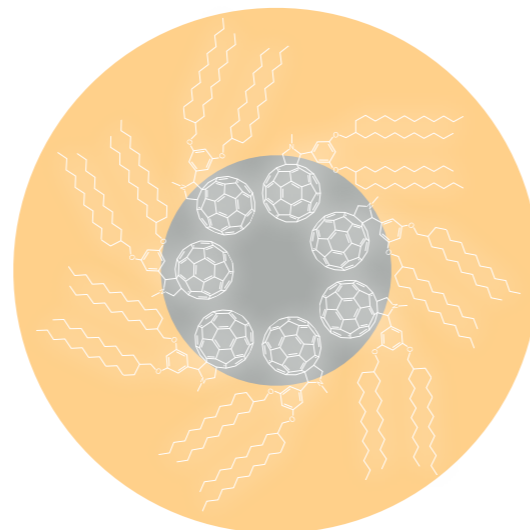
Powders



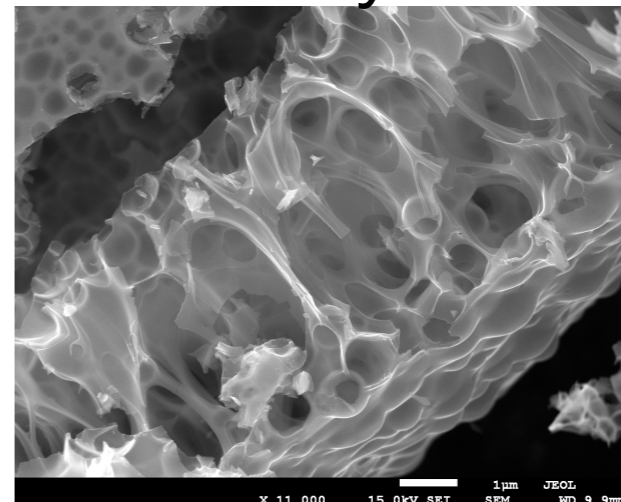
Doughnuts



Micelles

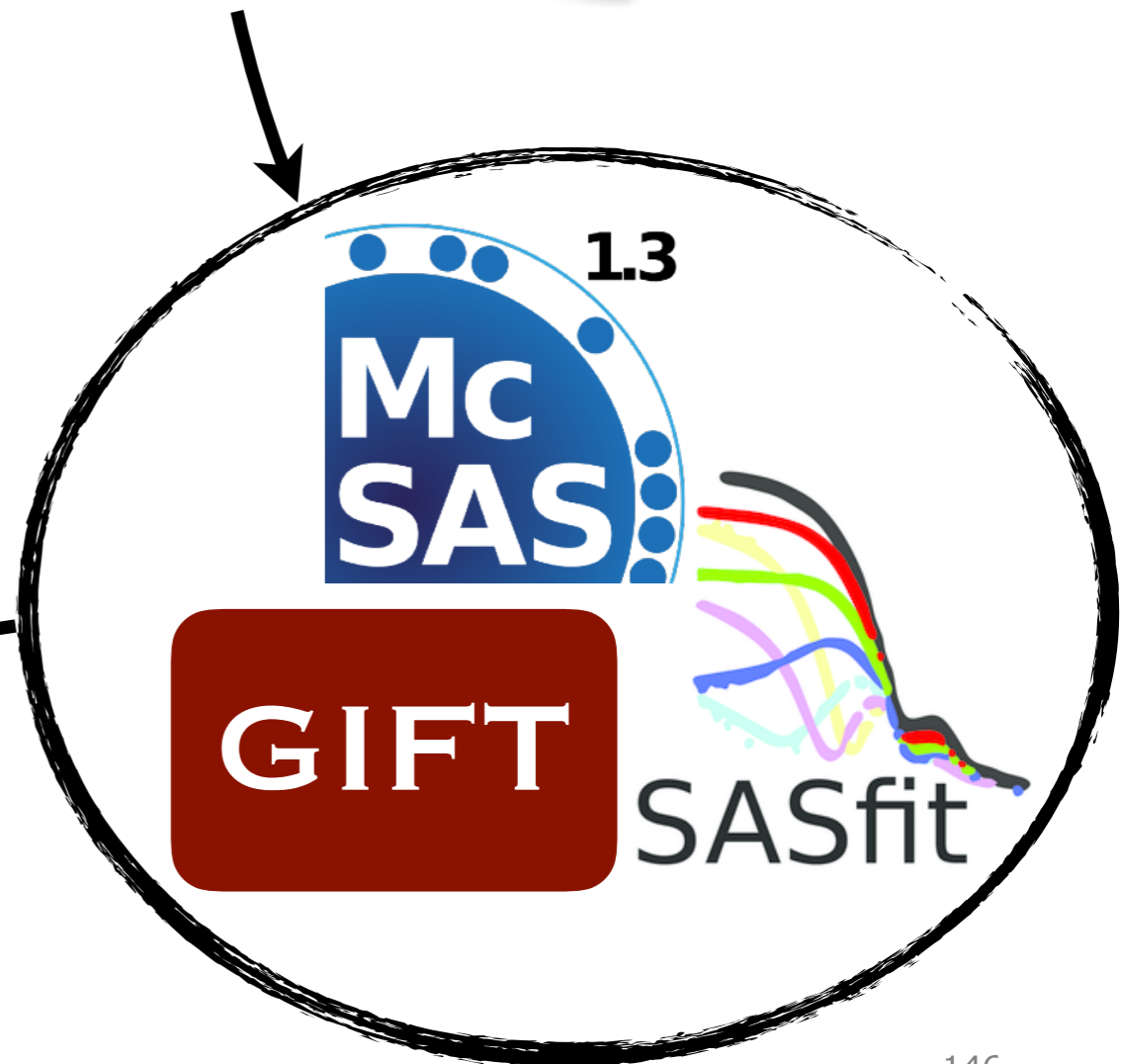
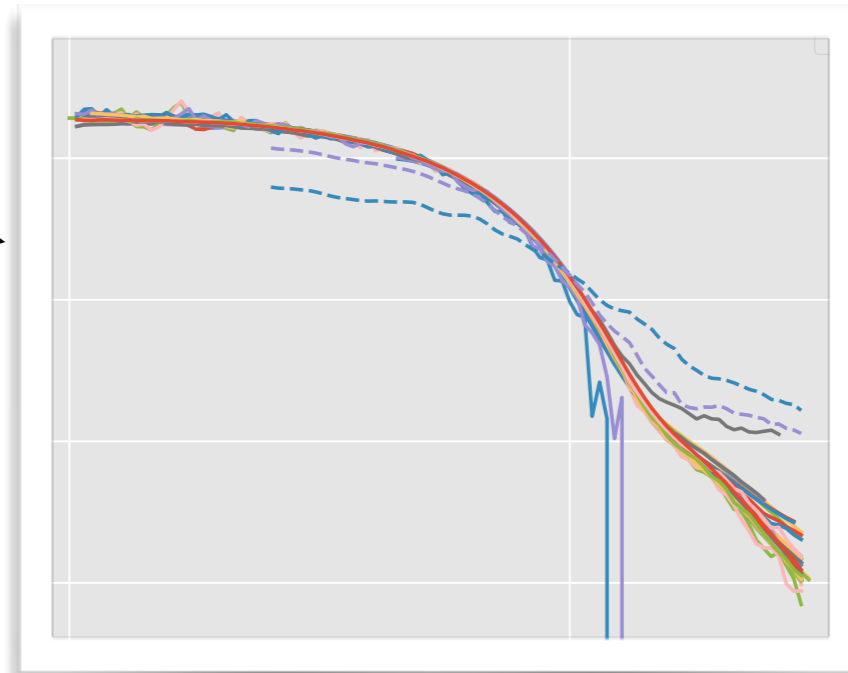


Catalysts



[exit]

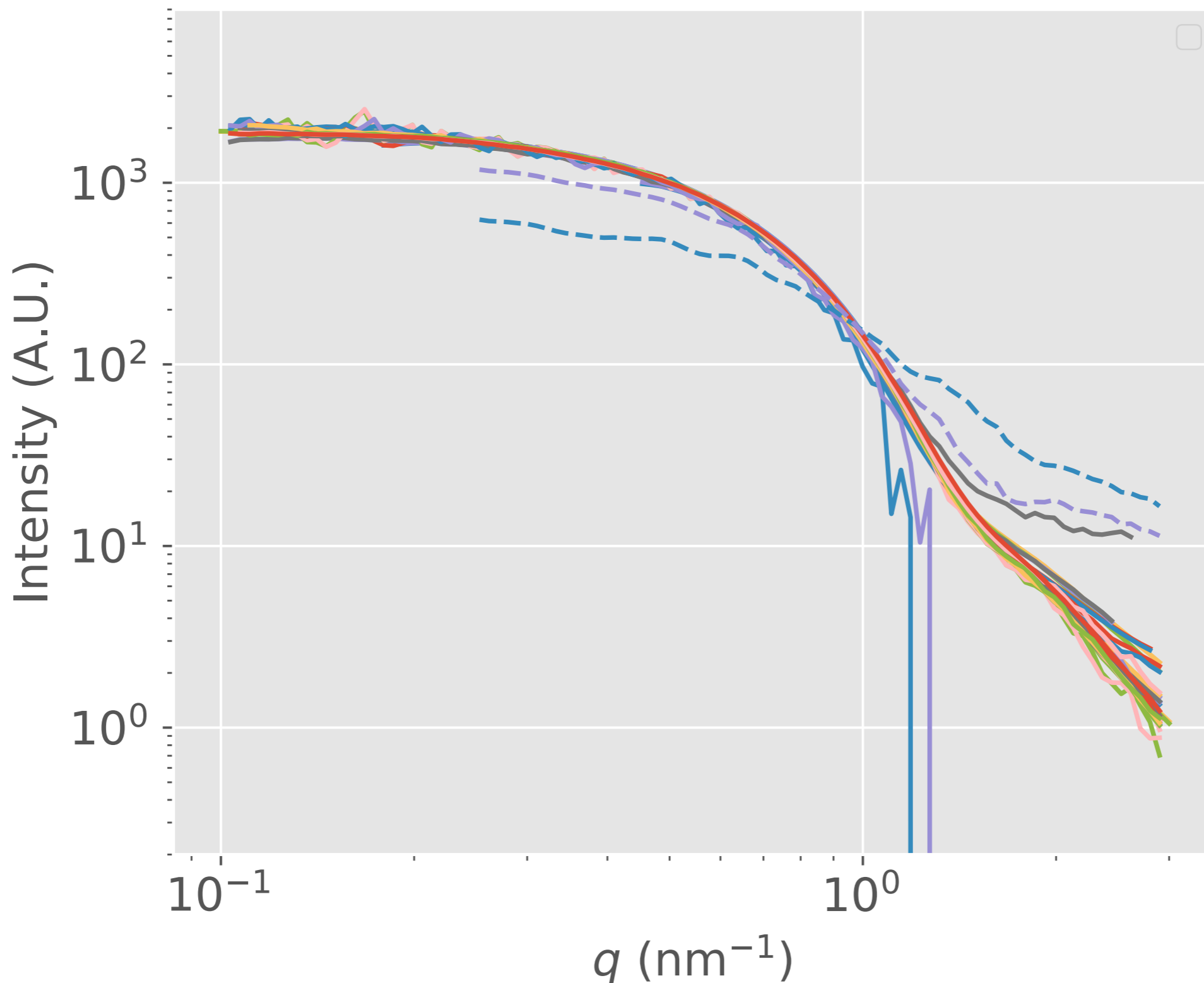
Round Robin

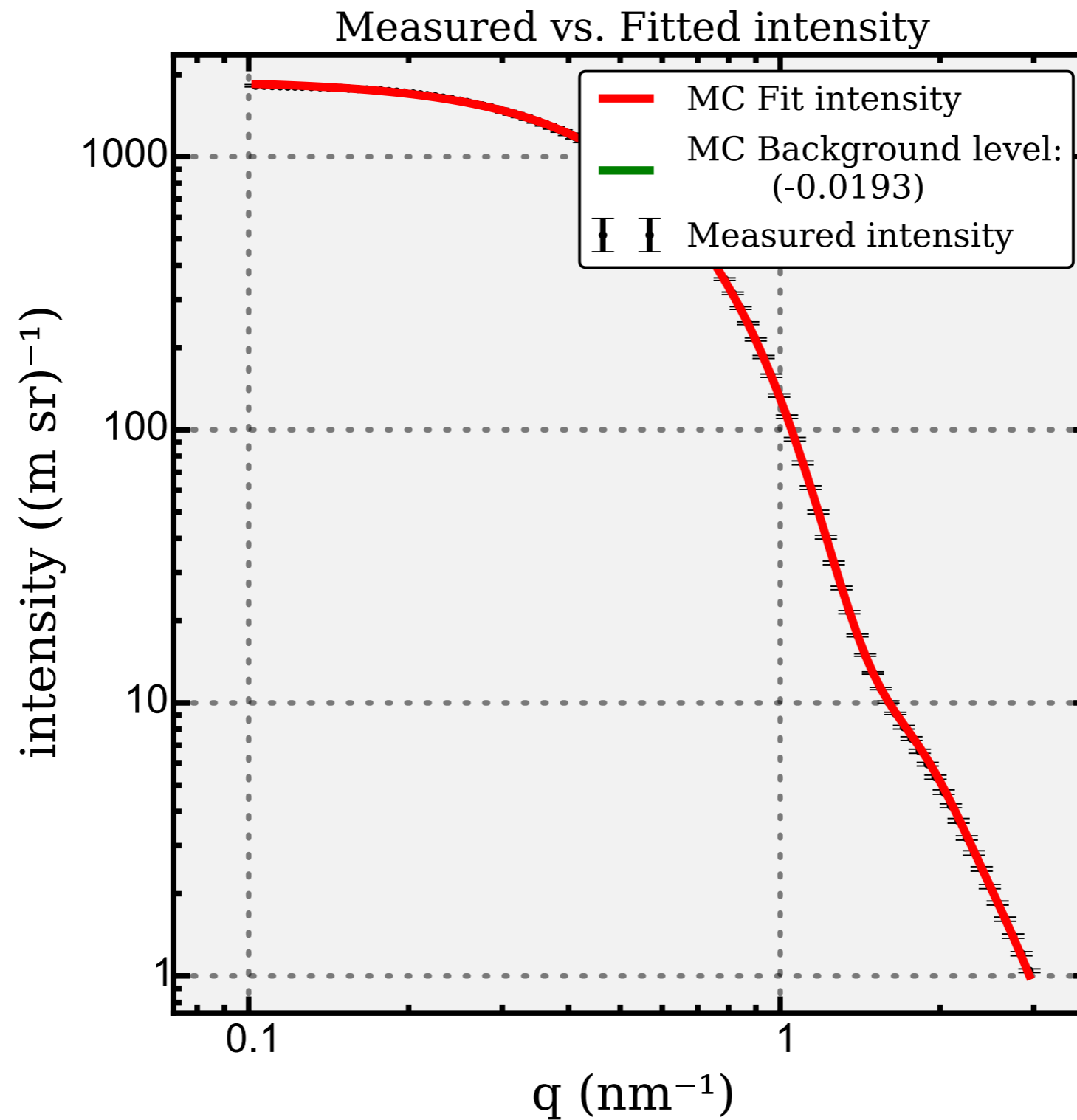


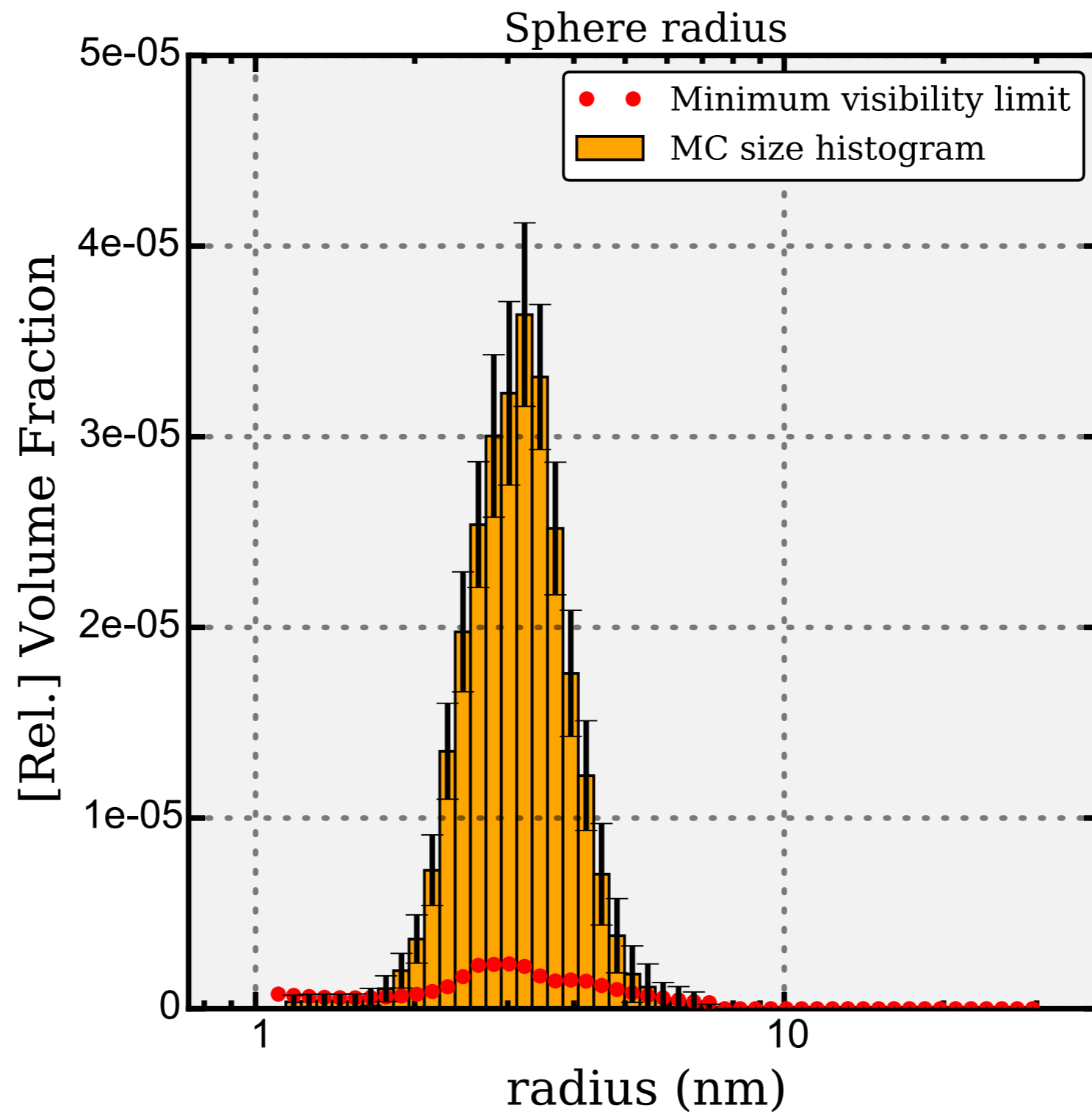
"Moreover, there is an opinion [...] that many national labs do useless research. This type of papers only reiterates such allegations"

Reviewer #3

All 45 anonymized datasets, scaled to best match

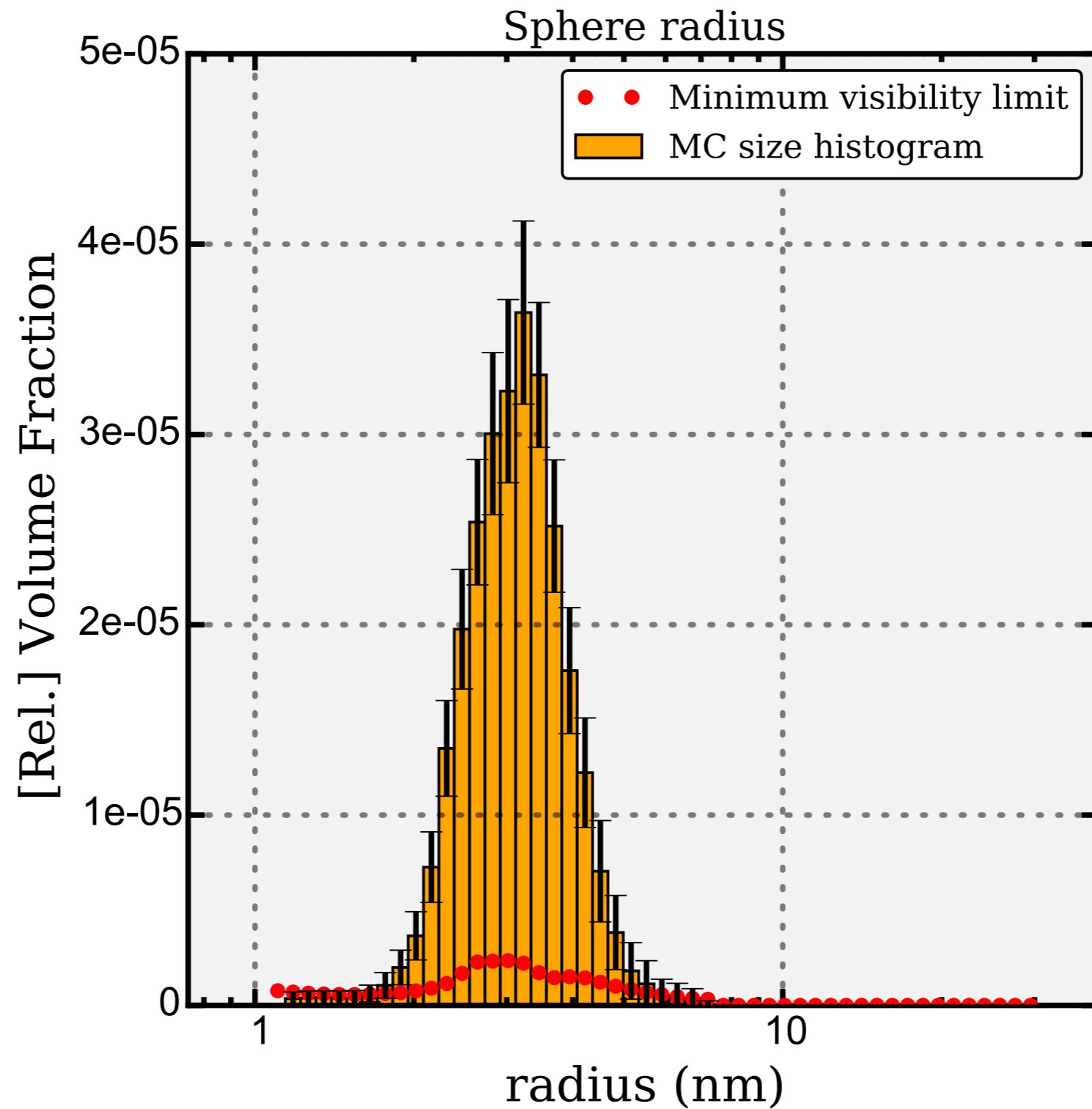


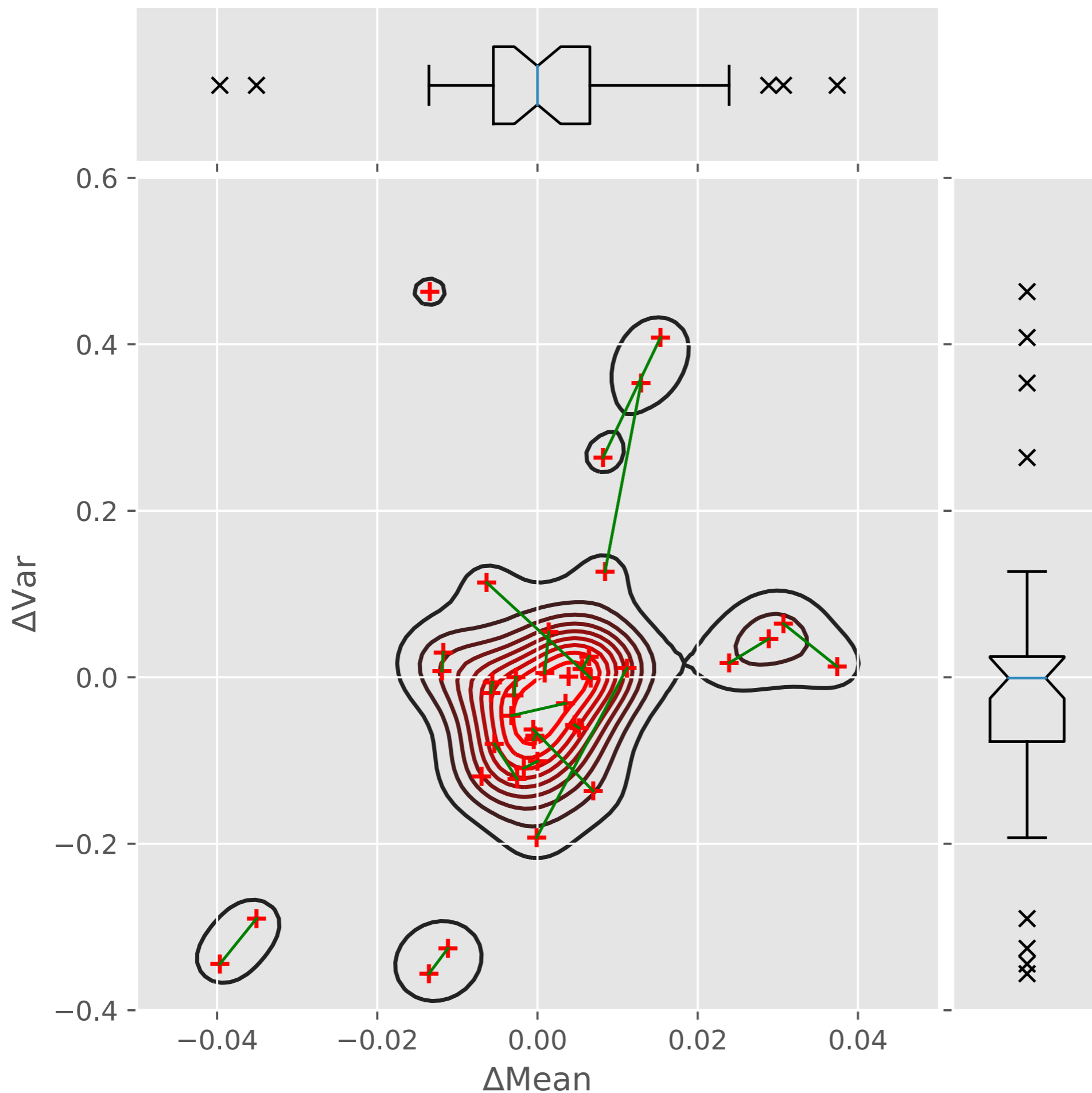


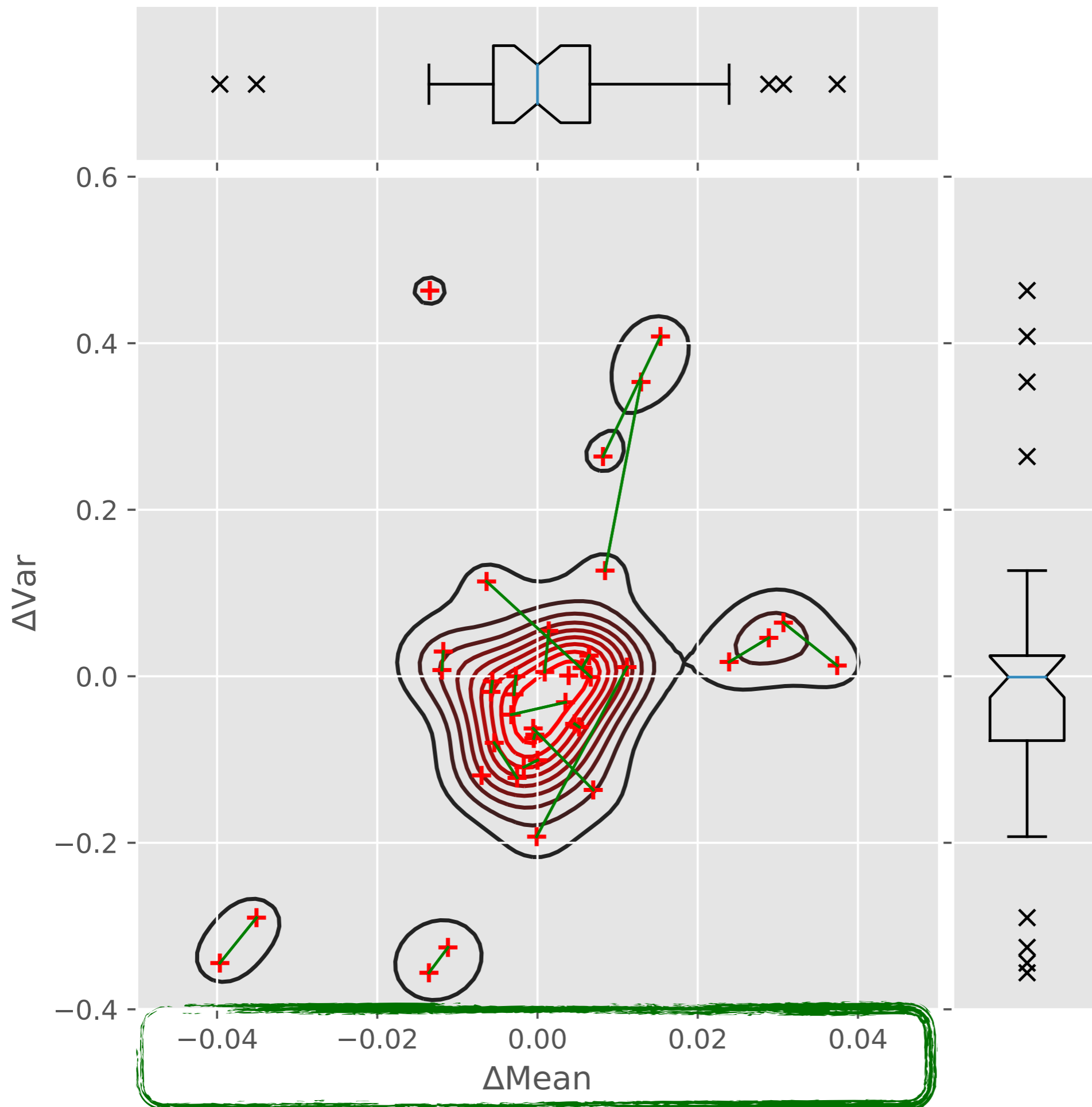


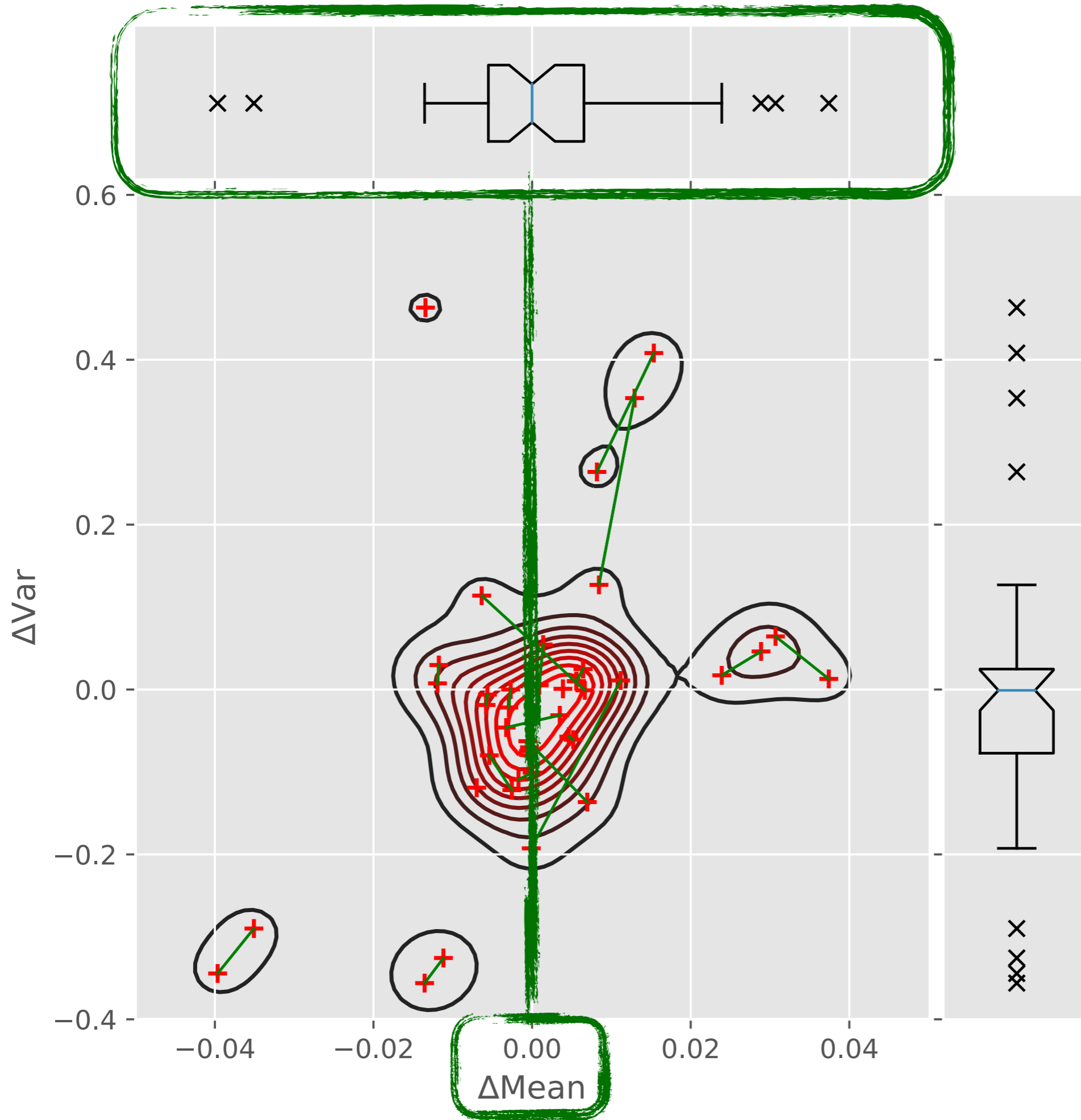
Range $1.06718e-09$ to $3.04757e-08$, vol-weighted

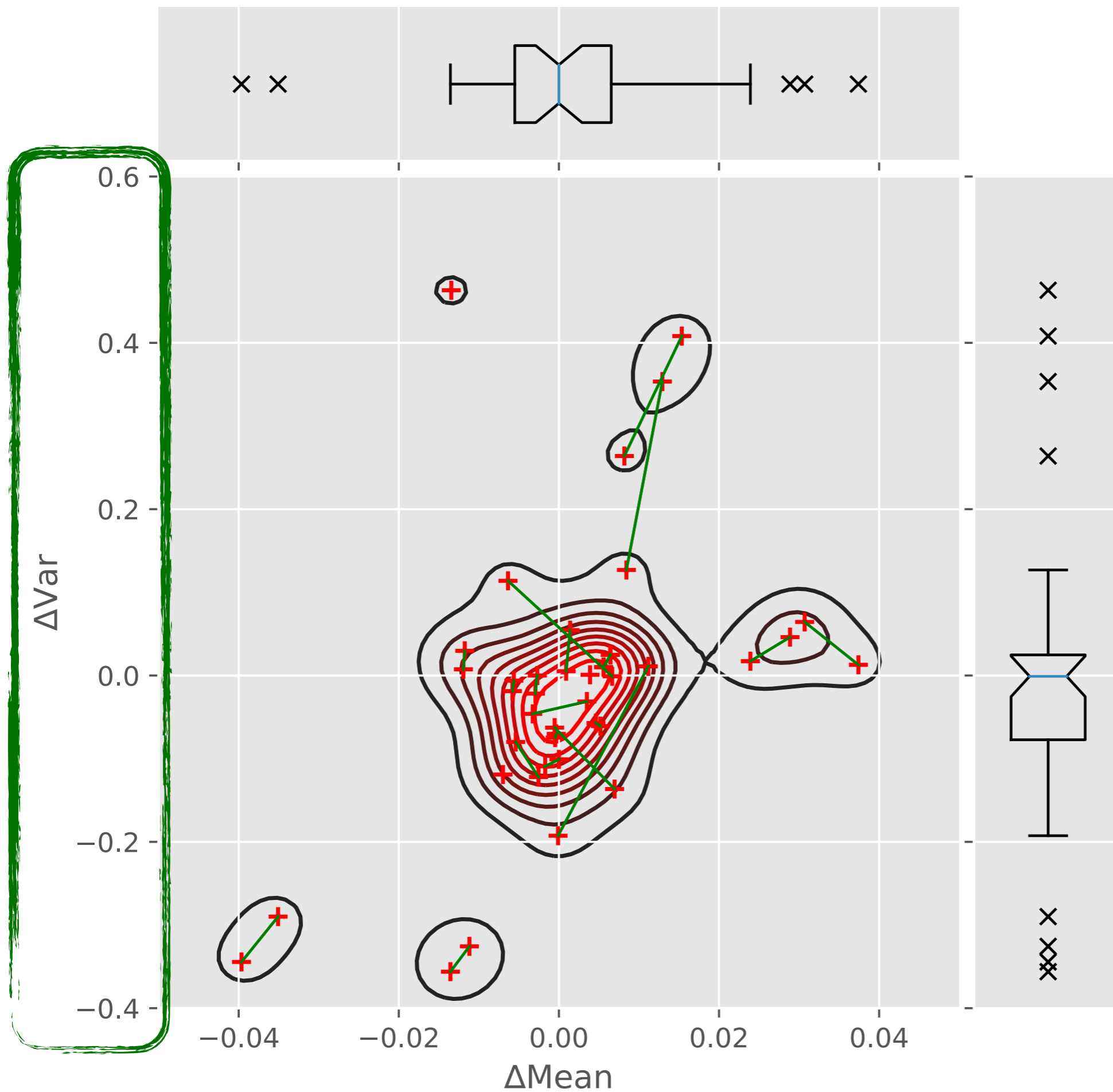
totalValue:	$2.774e-04$	$\pm 6.669e-07$
mean:	$3.173e-09$	$\pm 4.660e-12$
variance:	$4.990e-19$	$\pm 1.619e-20$
skew:	$6.442e-01$	$\pm 2.454e-01$
kurtosis:	$4.488e+00$	$\pm 1.246e+00$

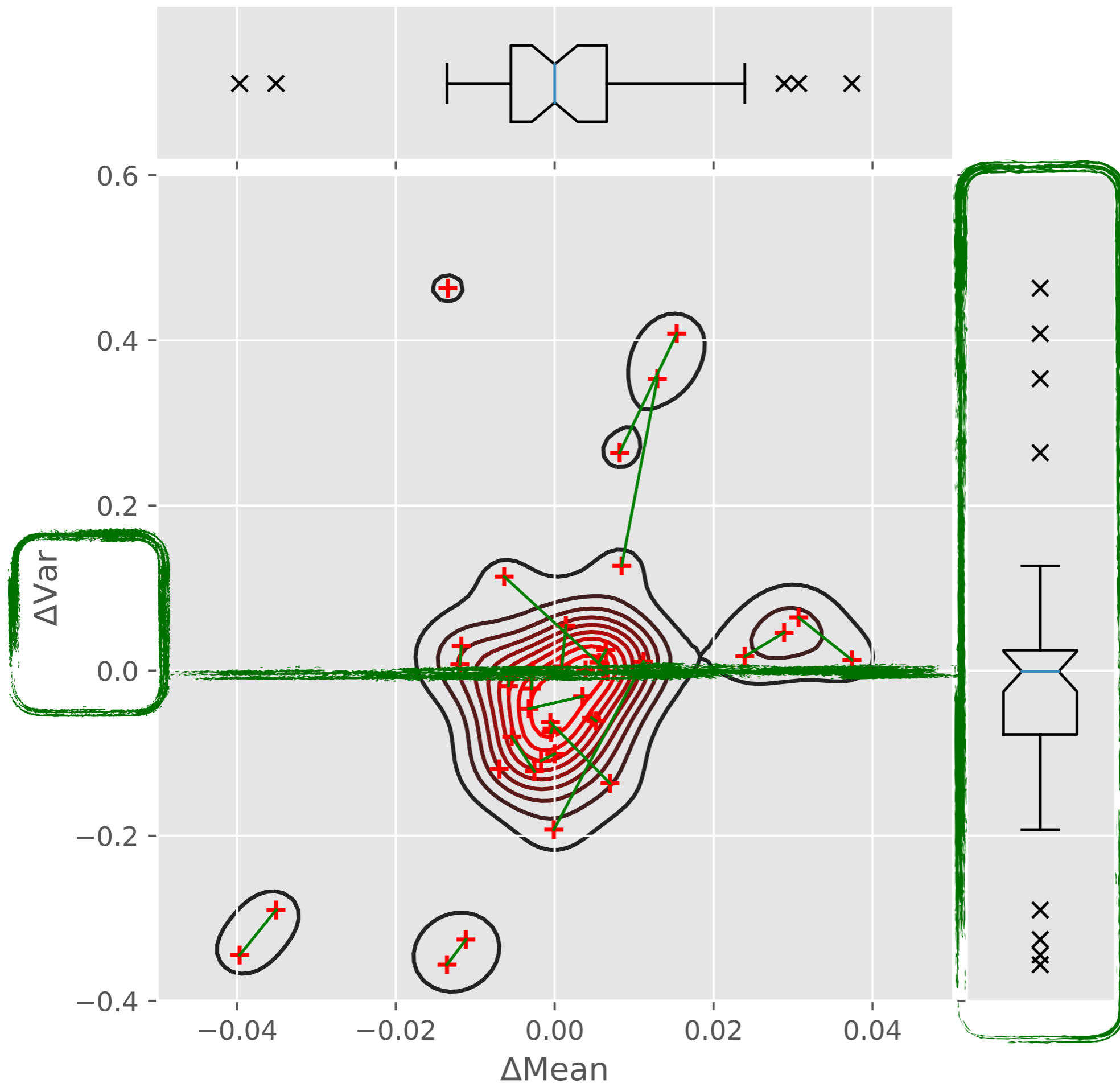


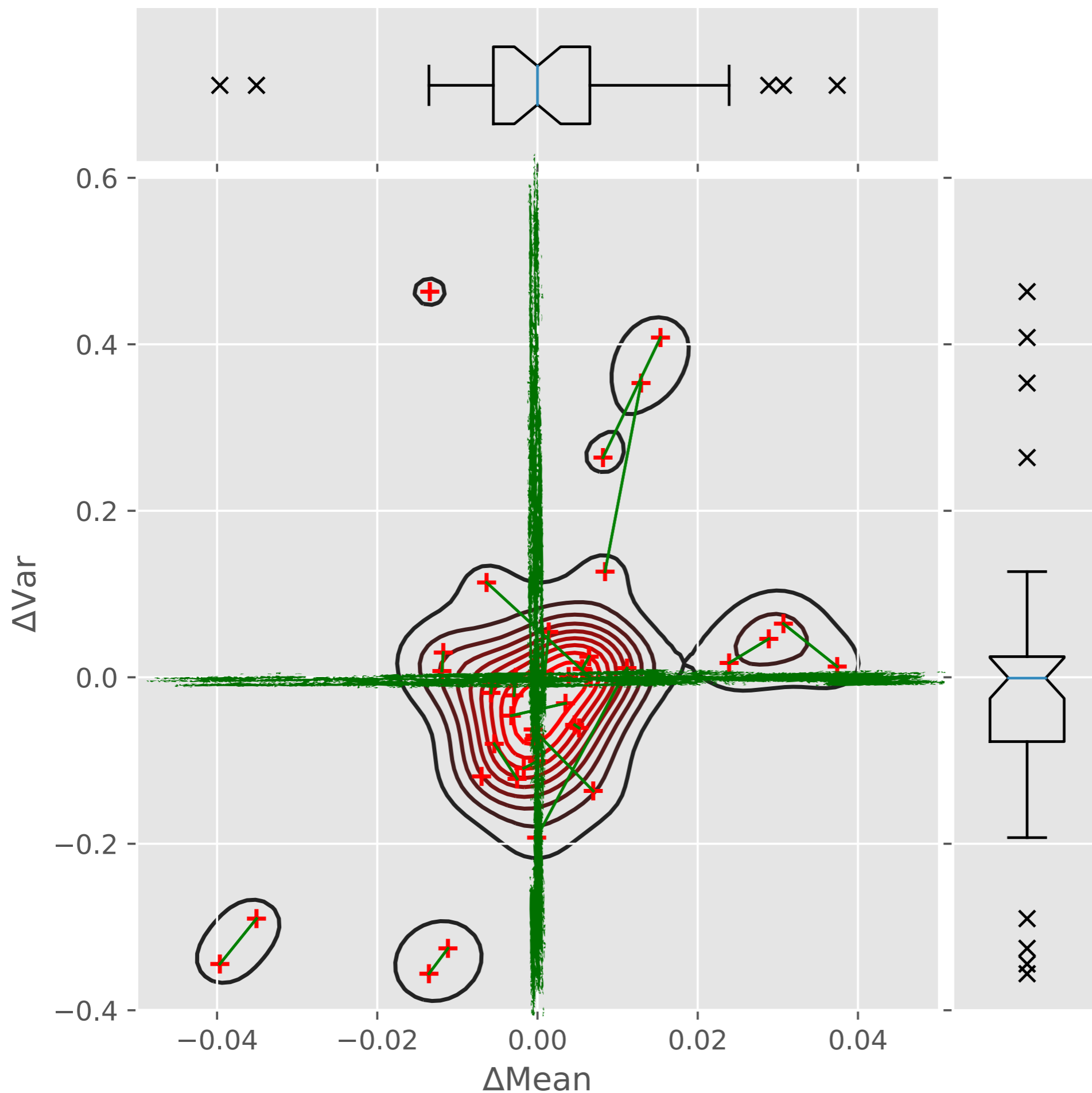


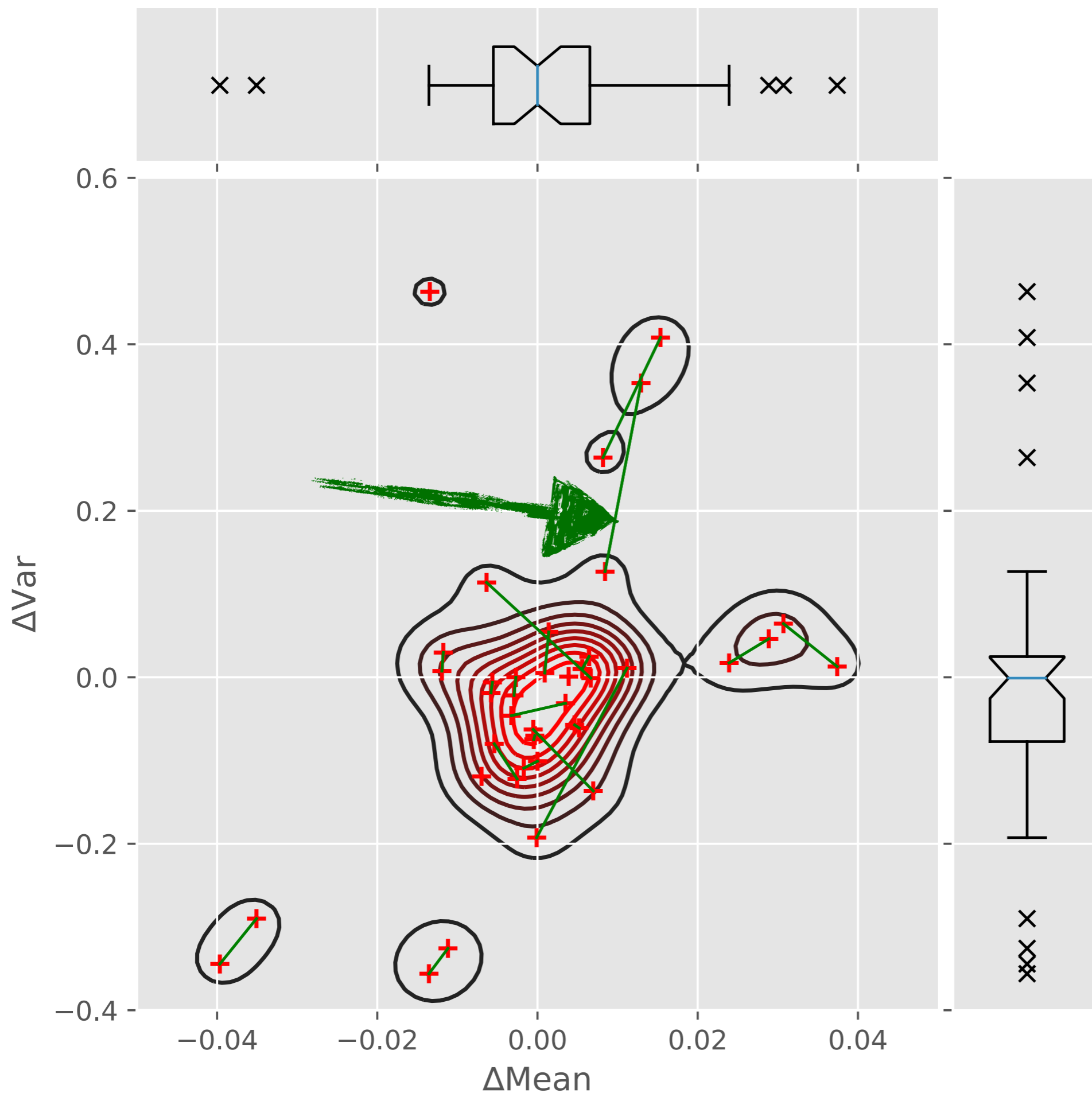


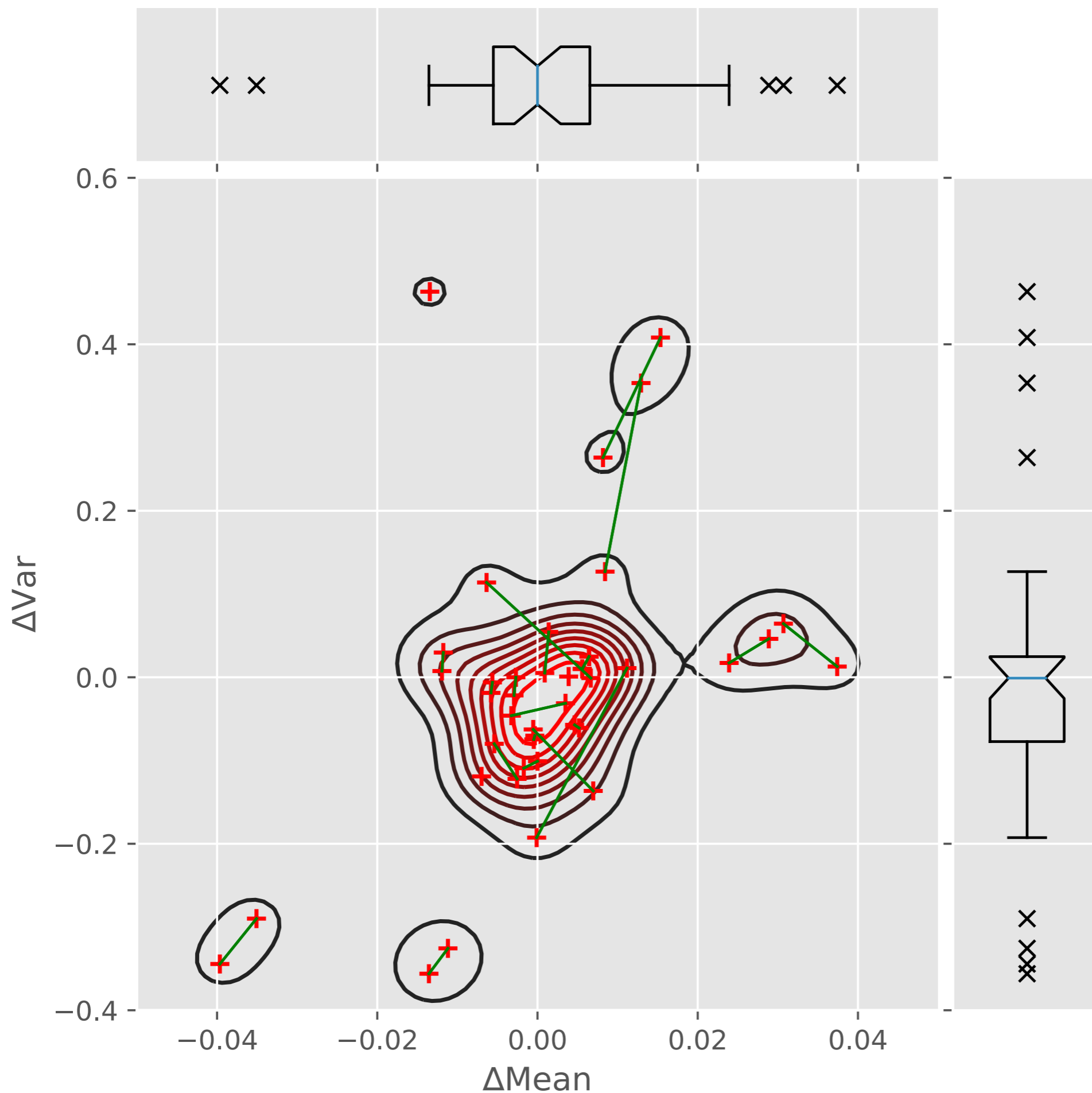


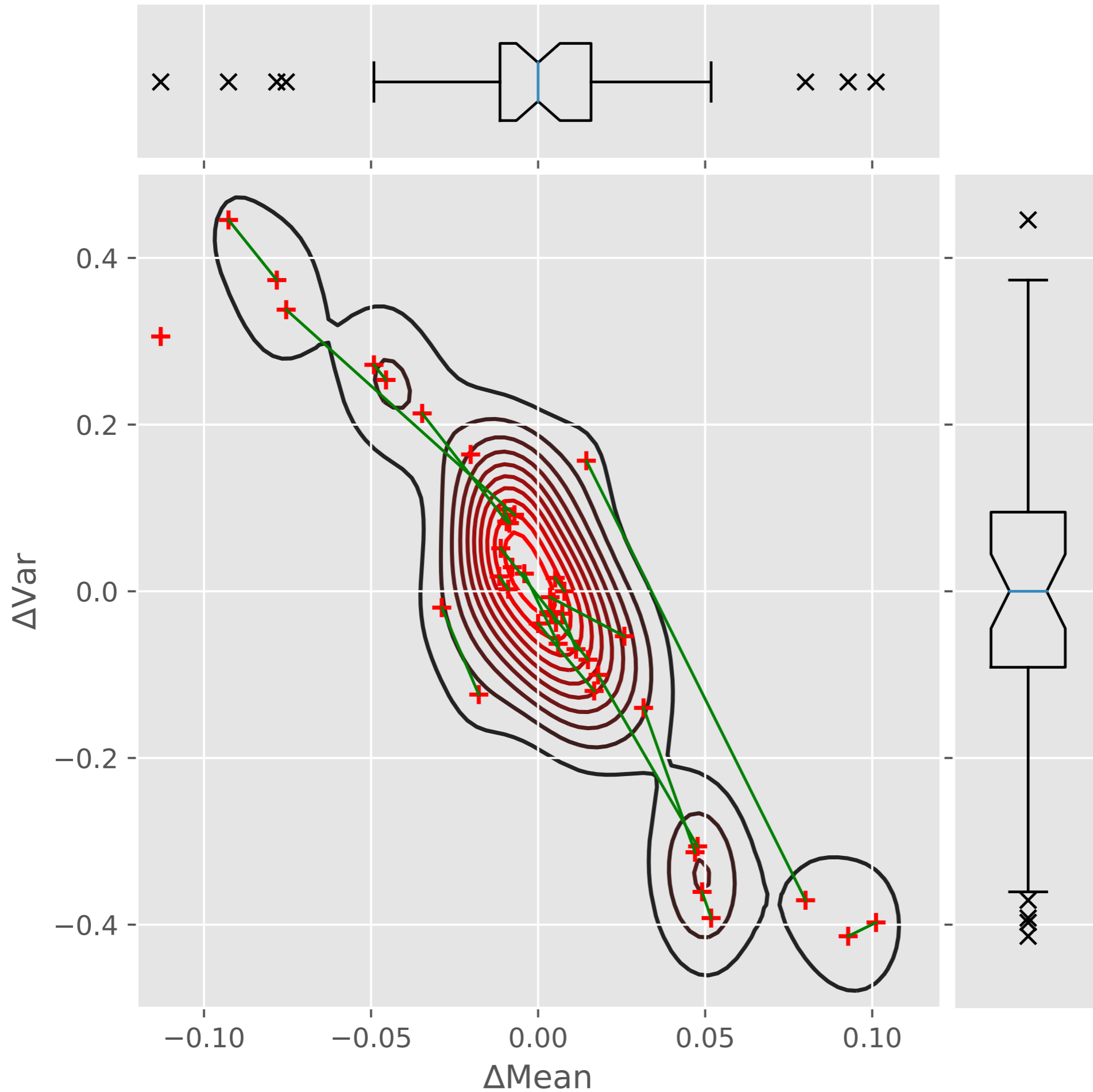




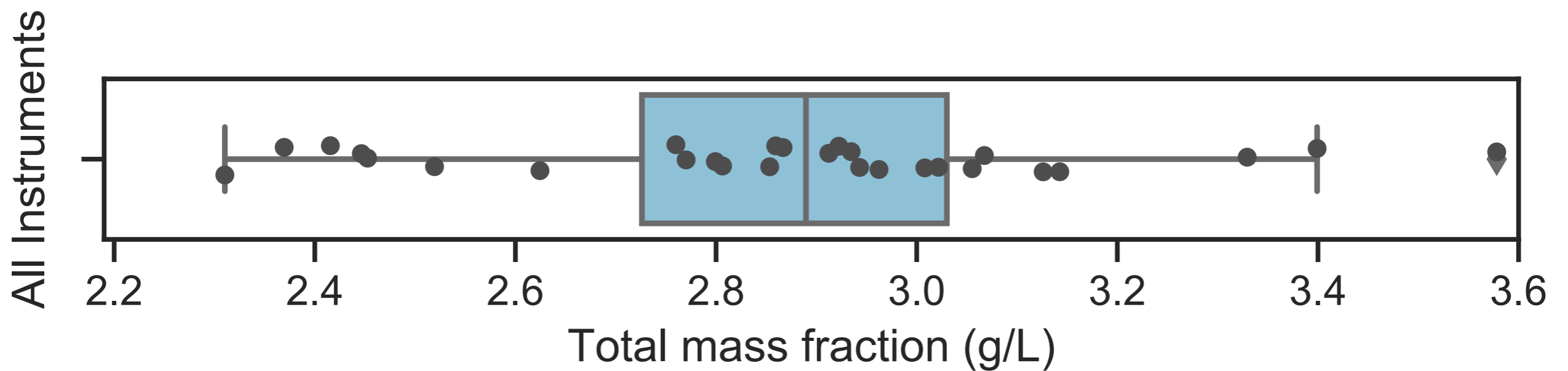








Volume fractions



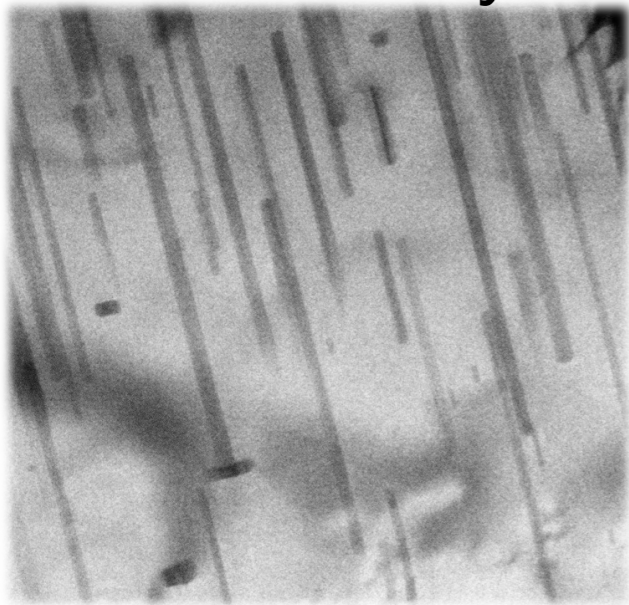
But what did we learn?

- Easy sample
 - Good result
 - Software effects minimal
 - Time to look at q calibration and uncertainties
 - Intensity uncertainties need to be defined
 - Round Robins make sense...
 - (but double-check, send samples back!)
-

Choose your own adventure

(at your own risk)

—
Metal alloys



Polymers



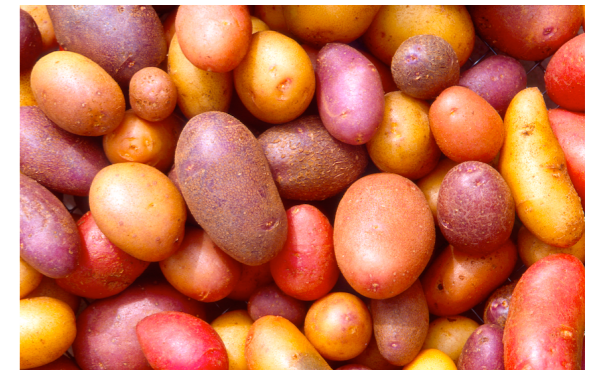
Nanoparticles



[Round Robin]

[Ultra-SAXS]

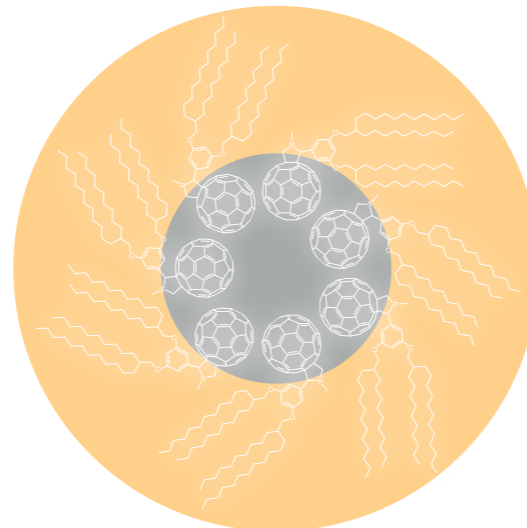
Powders



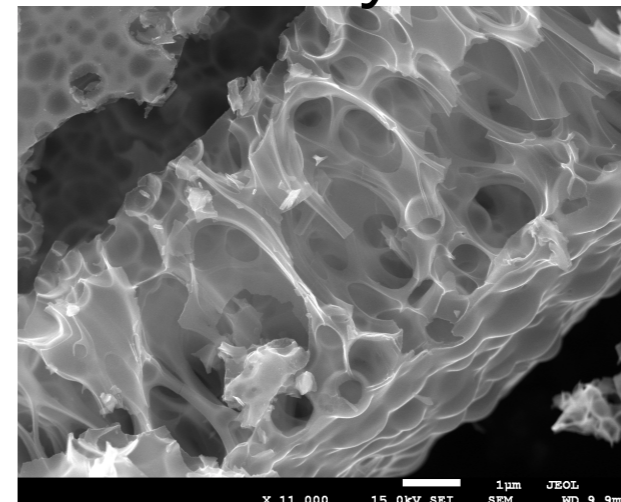
Doughnuts



Micelles



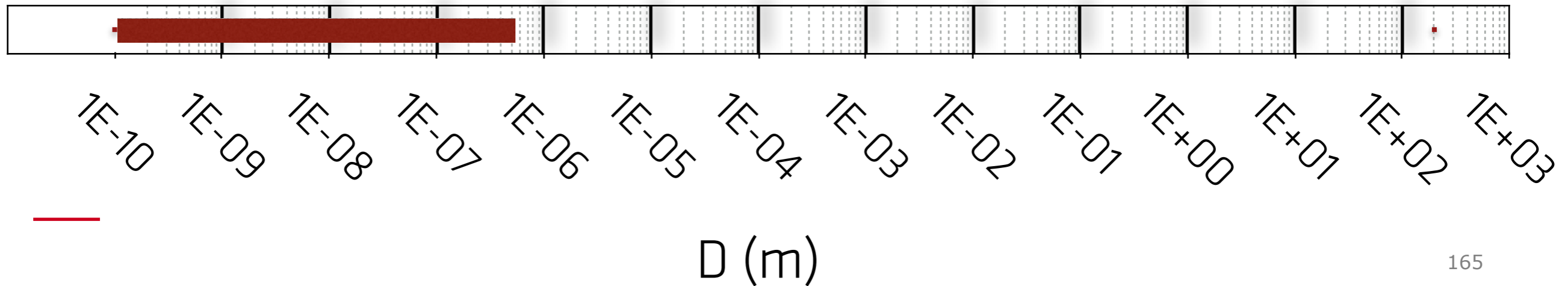
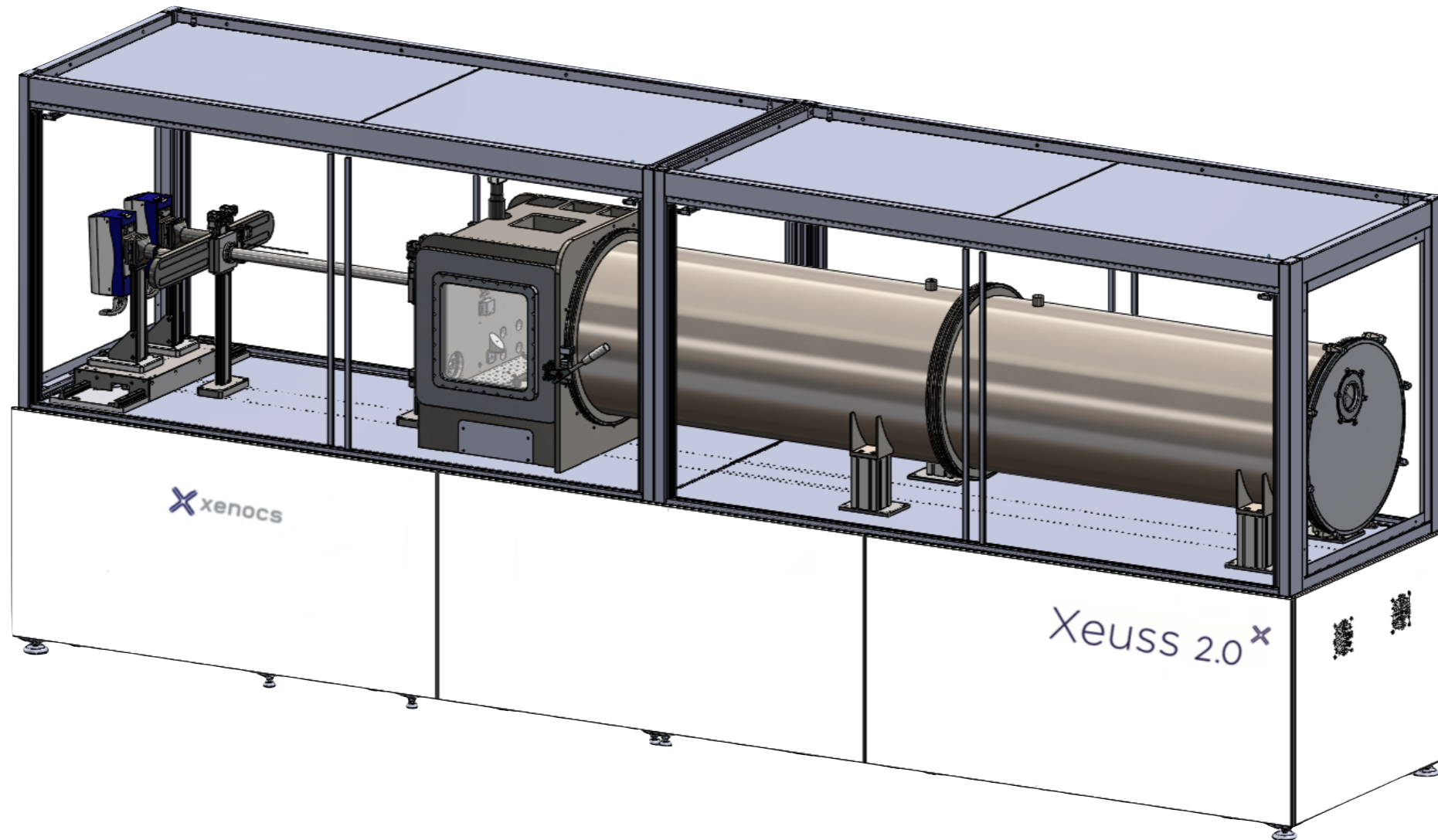
Catalysts

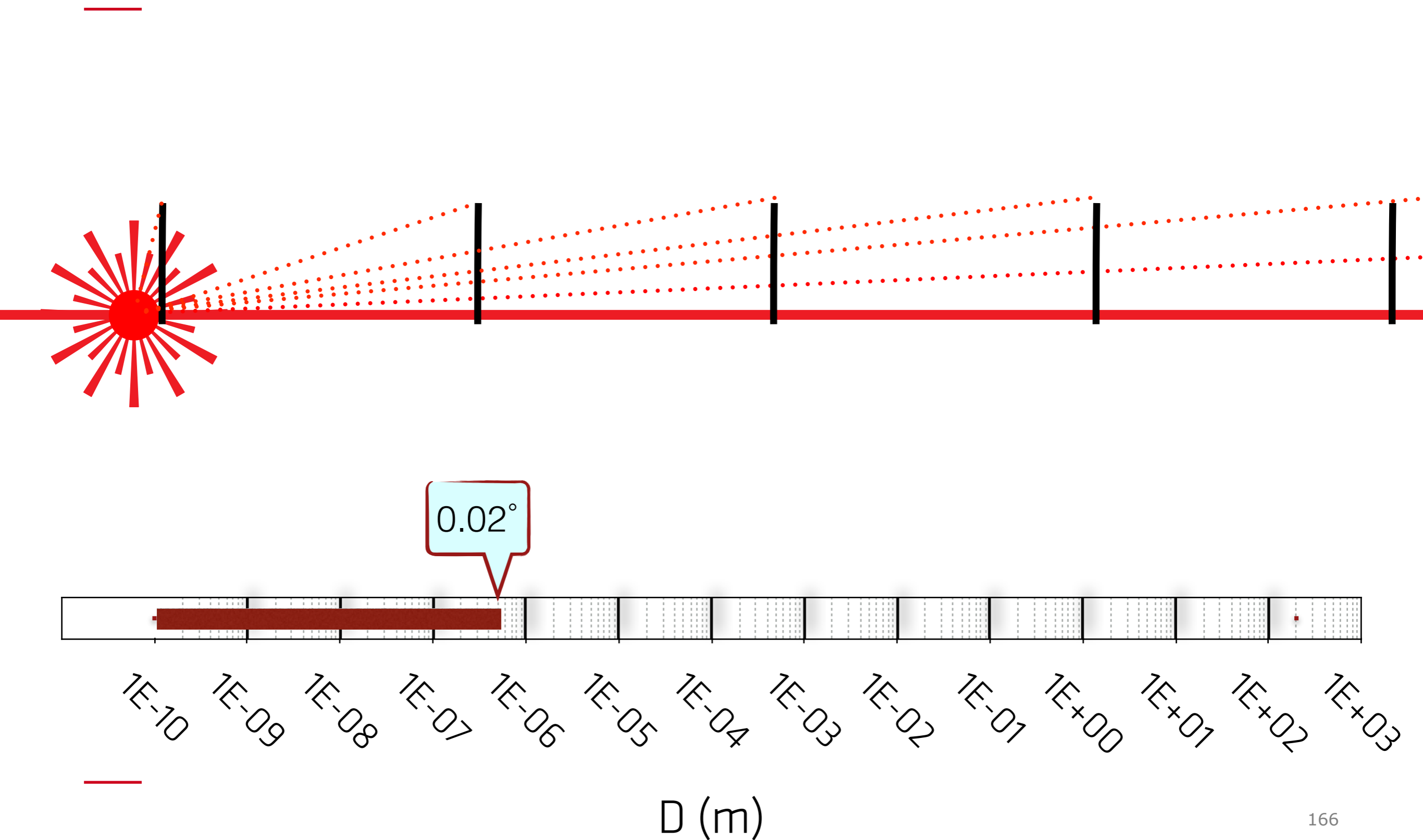


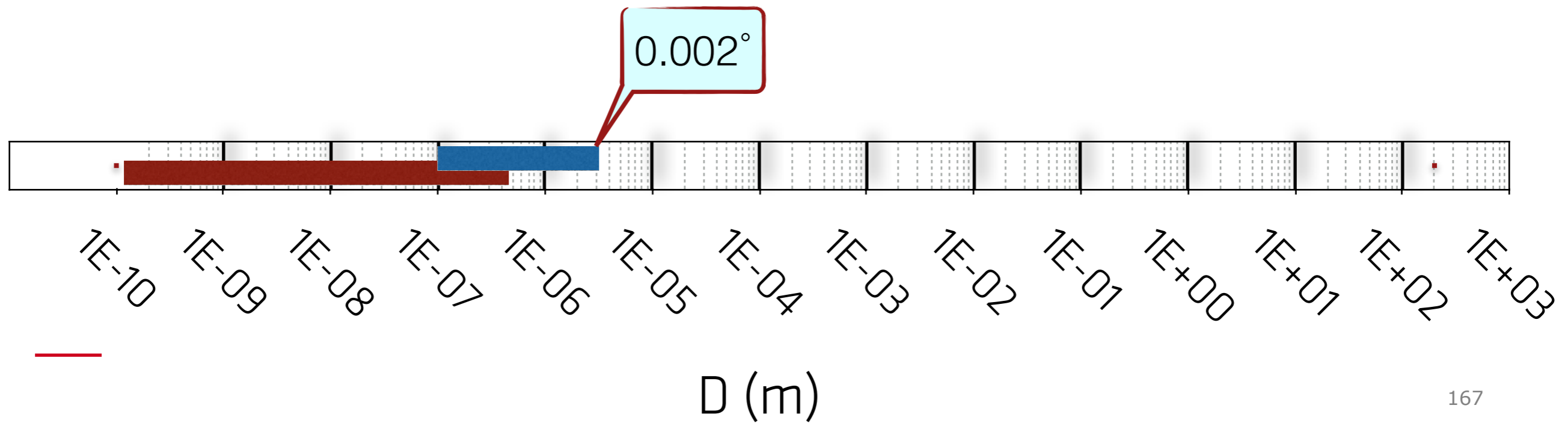
[exit]

(US/S/W)AXS

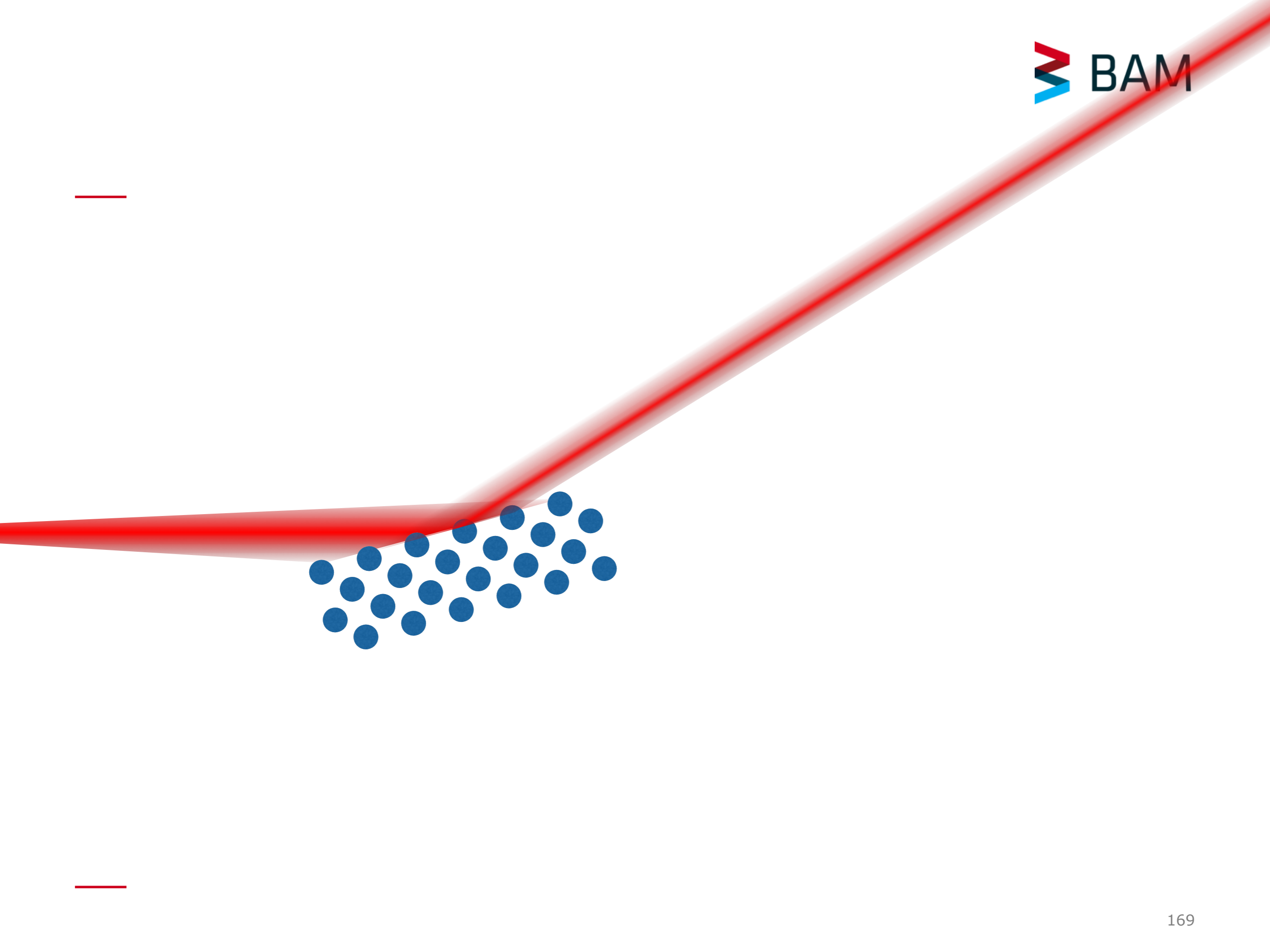
The MAUS

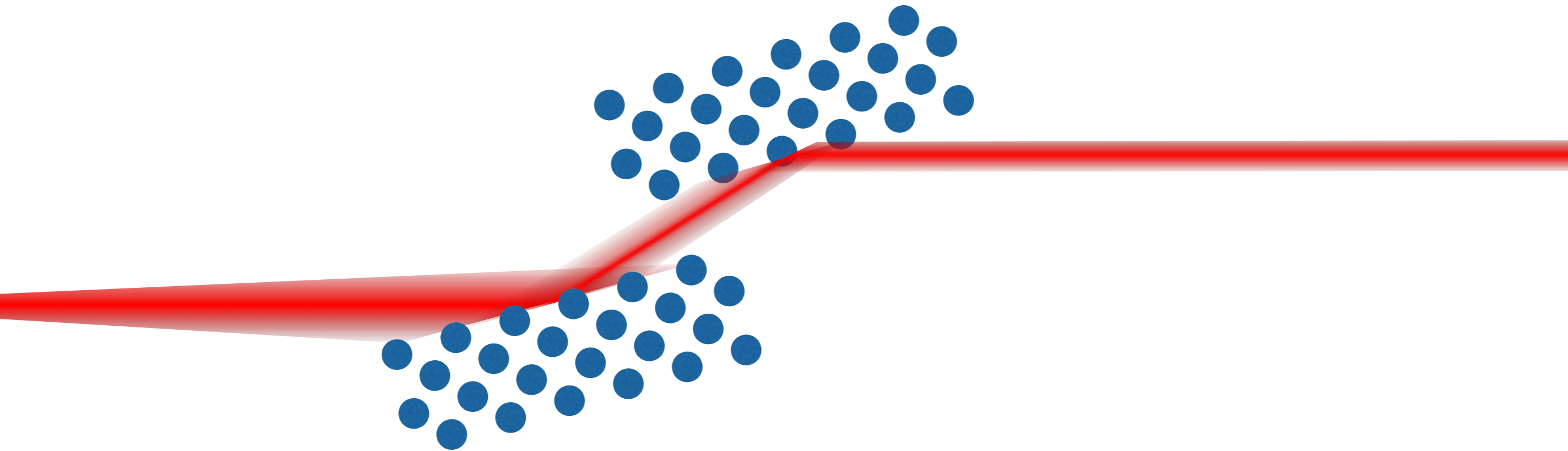


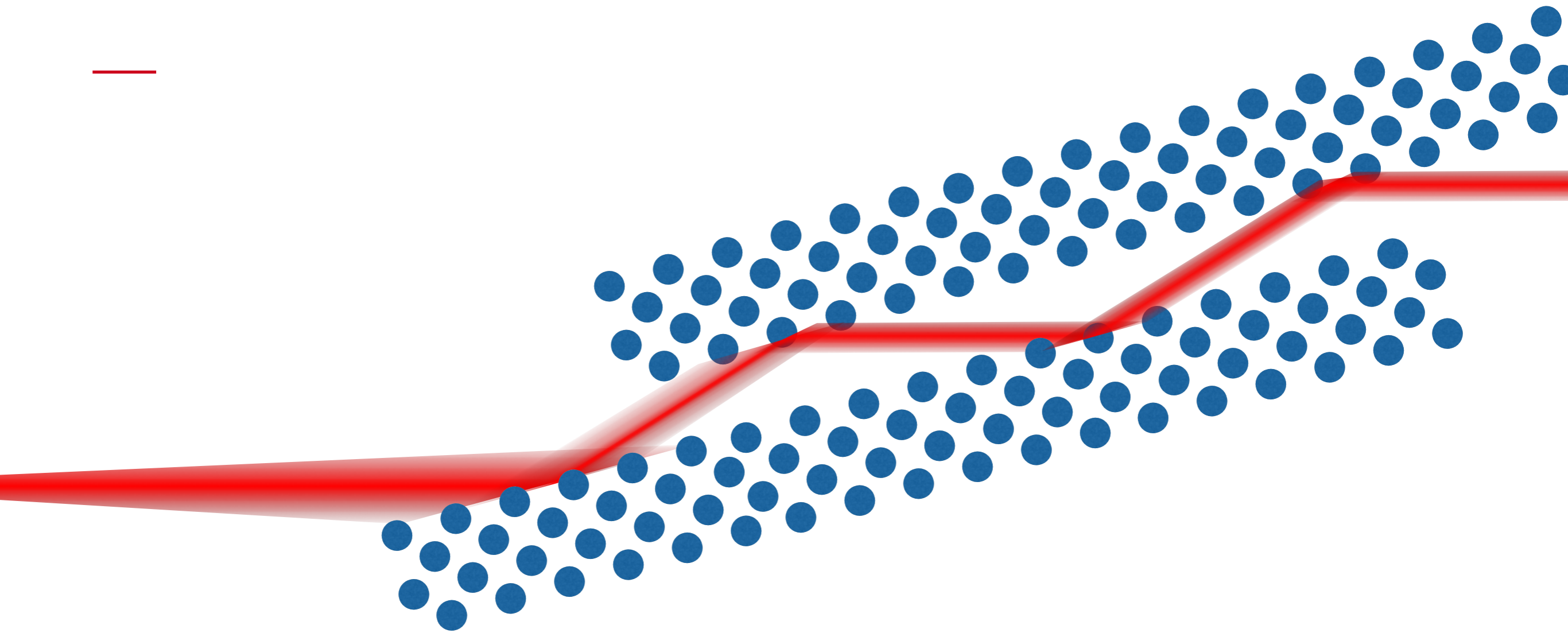




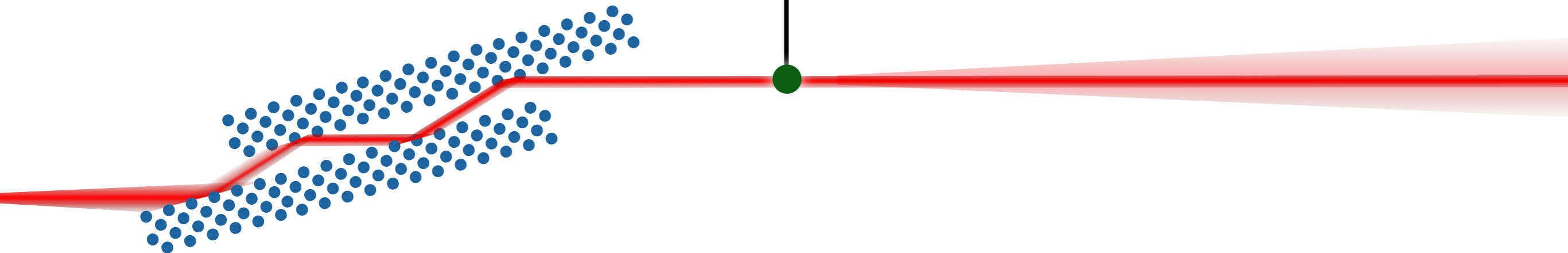


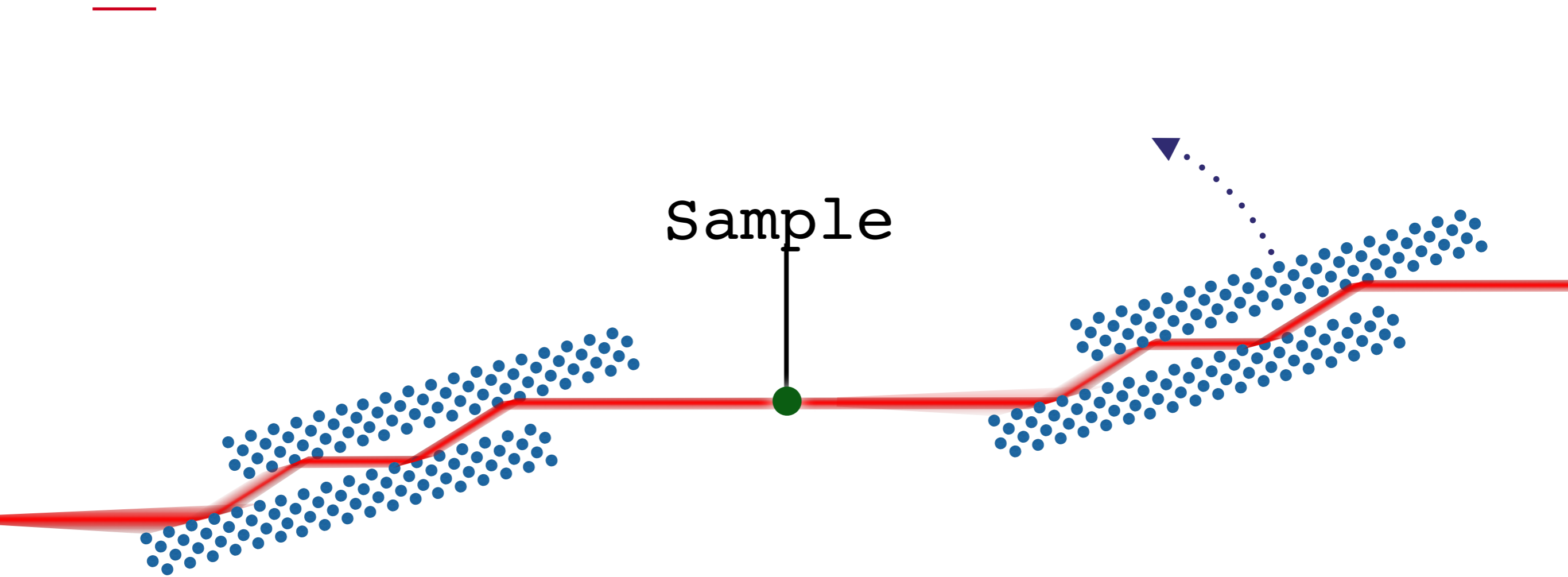


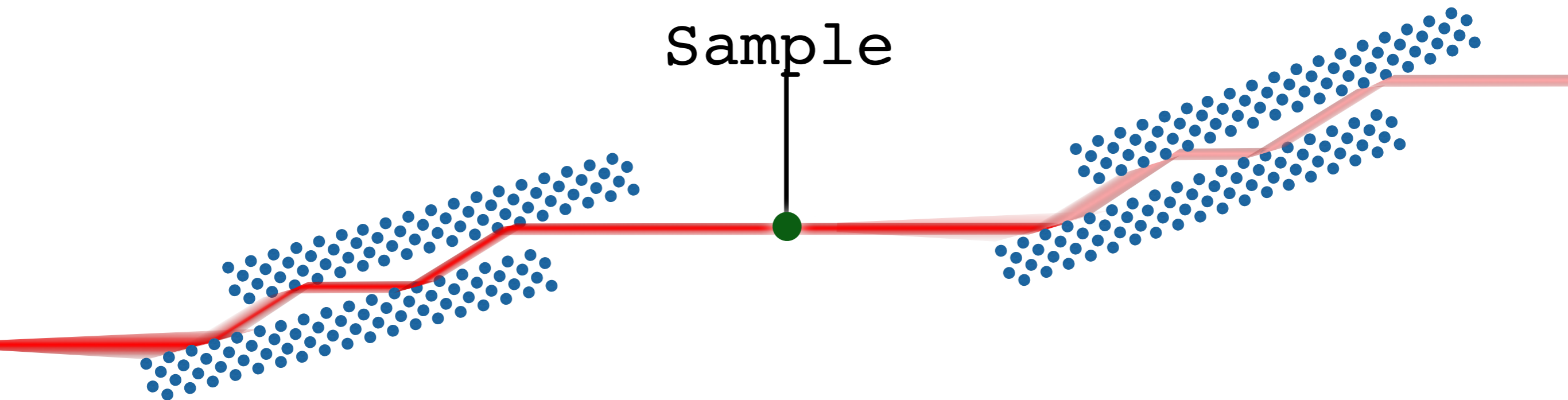




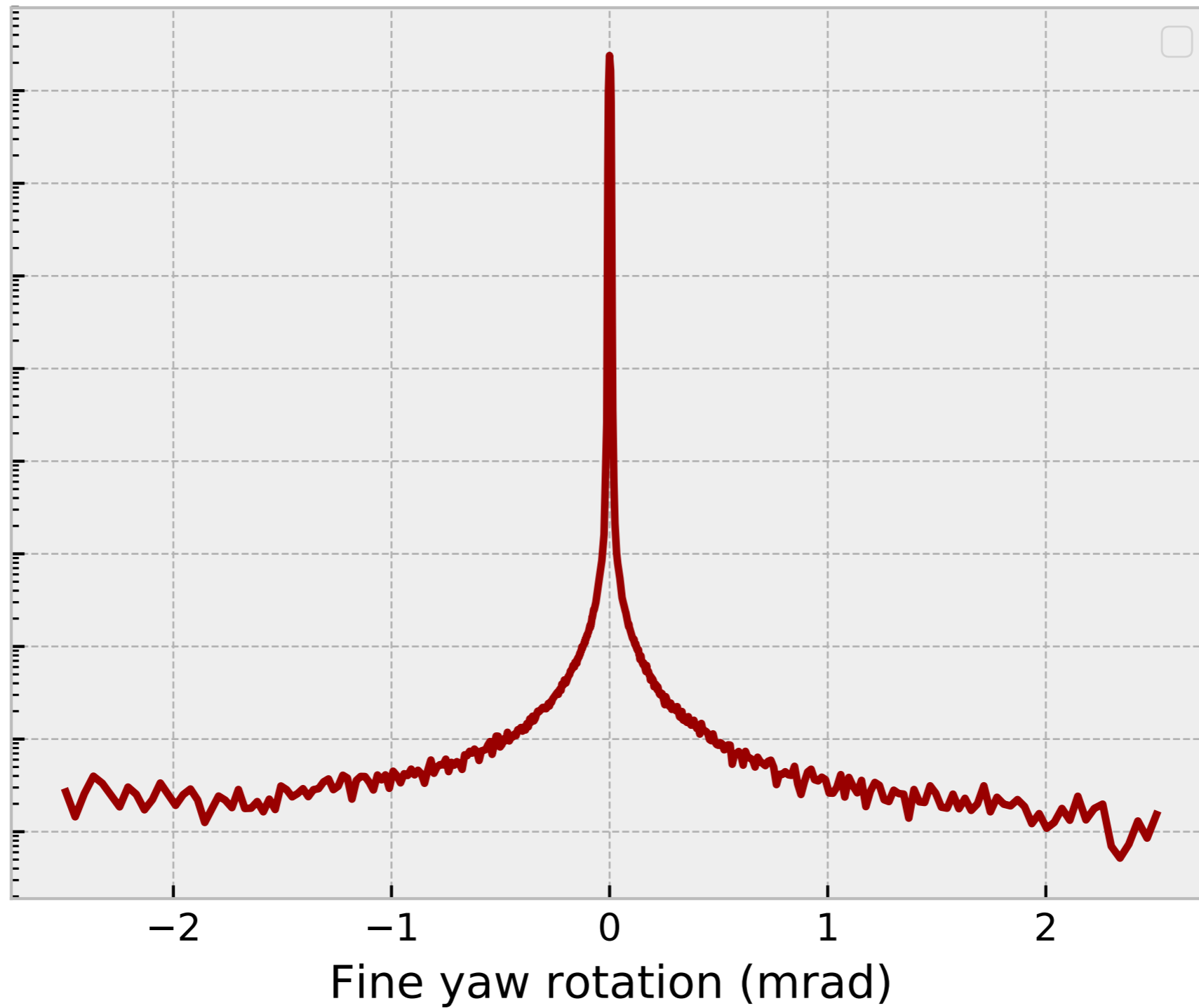
Sample







The USAXS addition





Caution:



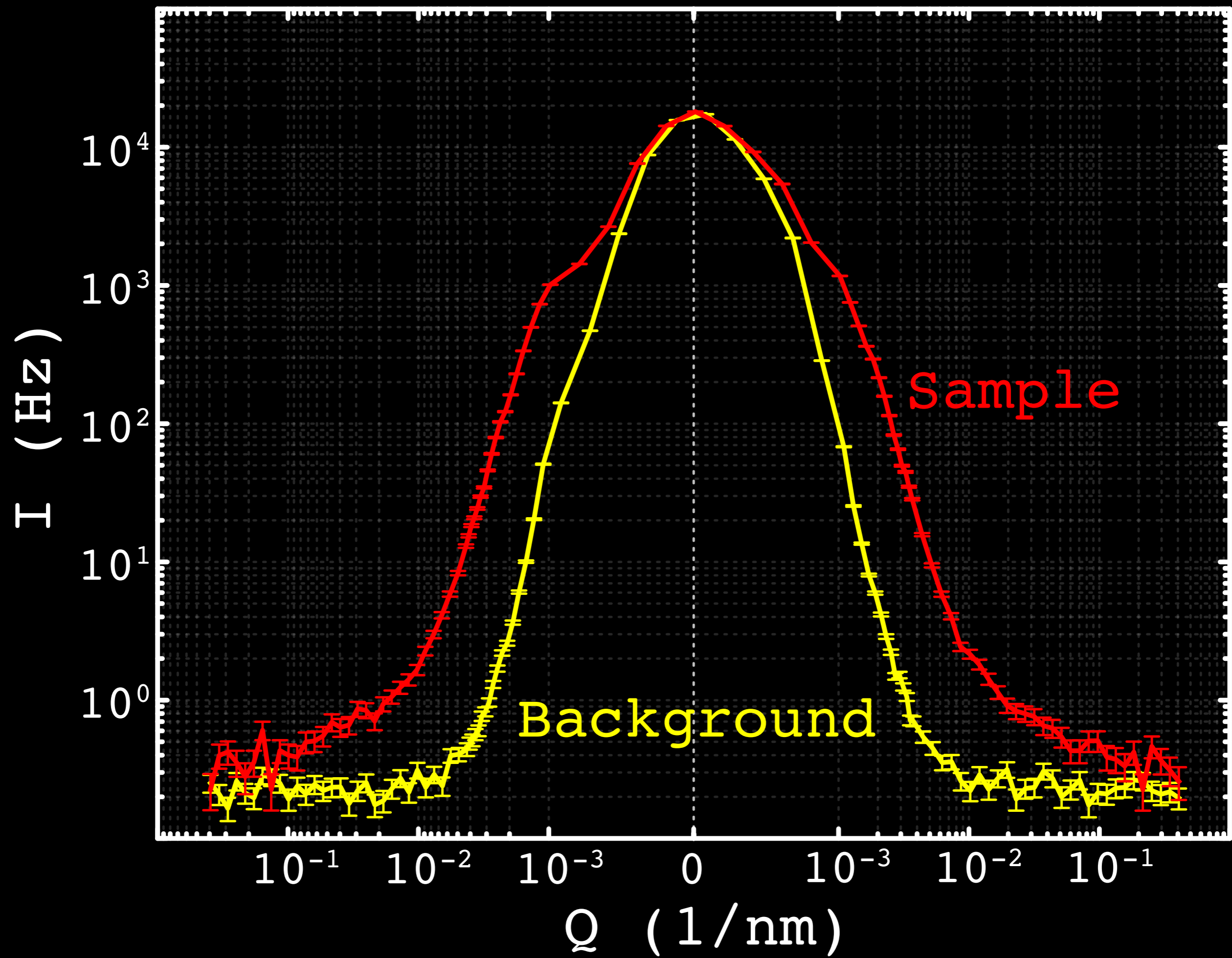
X-ray device
in possible use
inside enclosure

Caution:



X-ray device
in possible use
inside enclosure

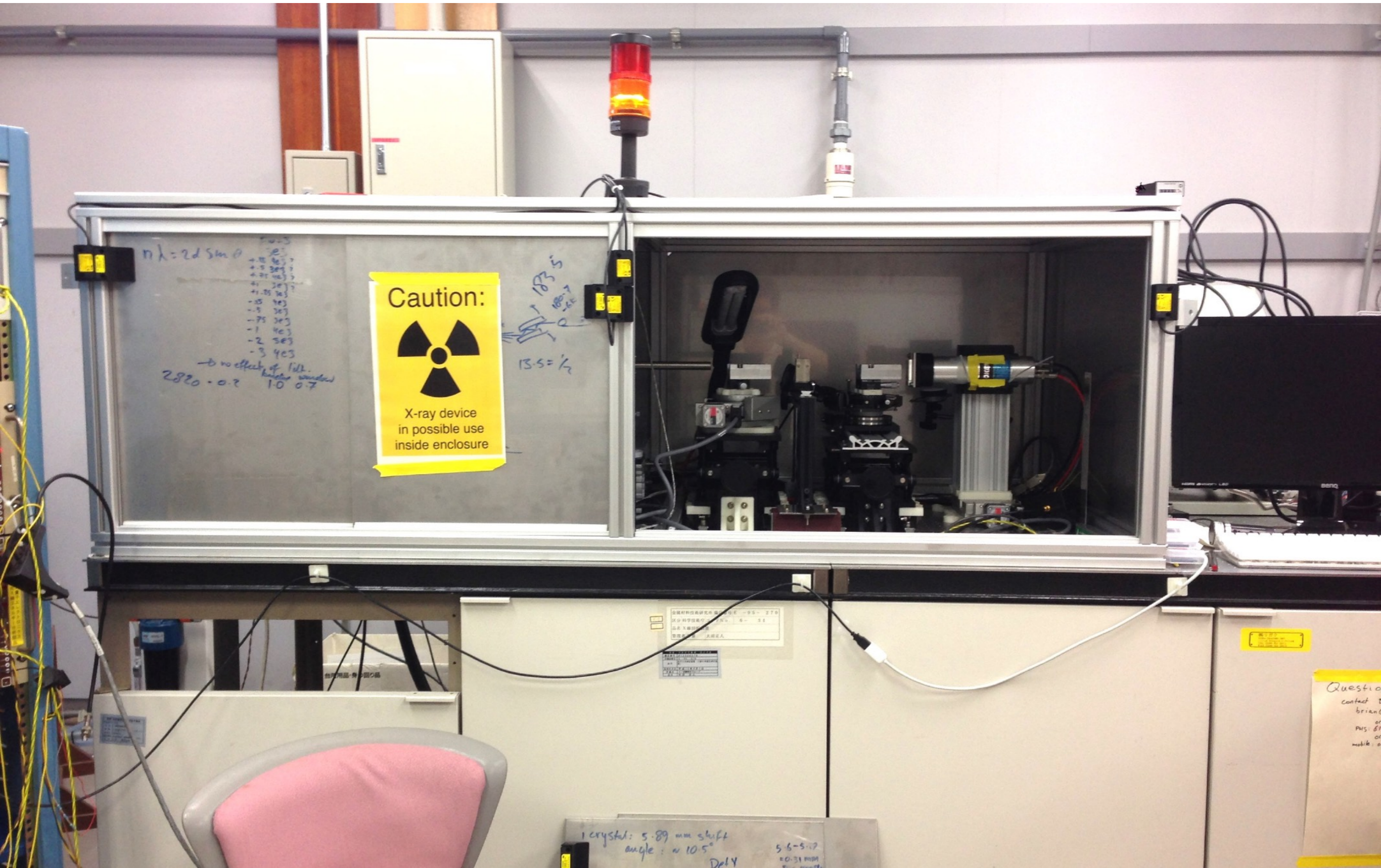
510-215-7
Contact: Bruno P. Brun
brun@black.nl
Aug. 2006
Mobile: +31-6-2000-0000

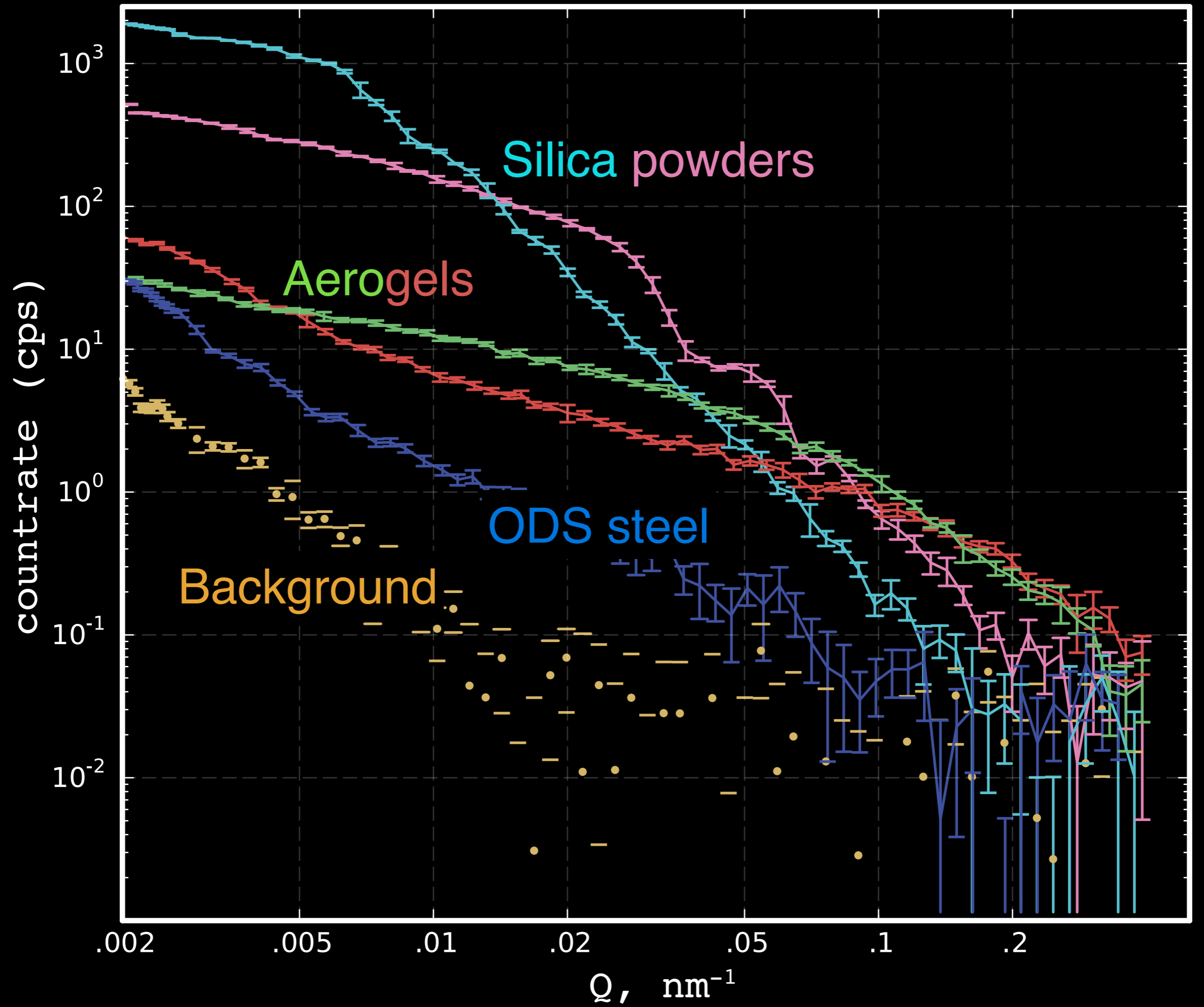


Version I: from scrap



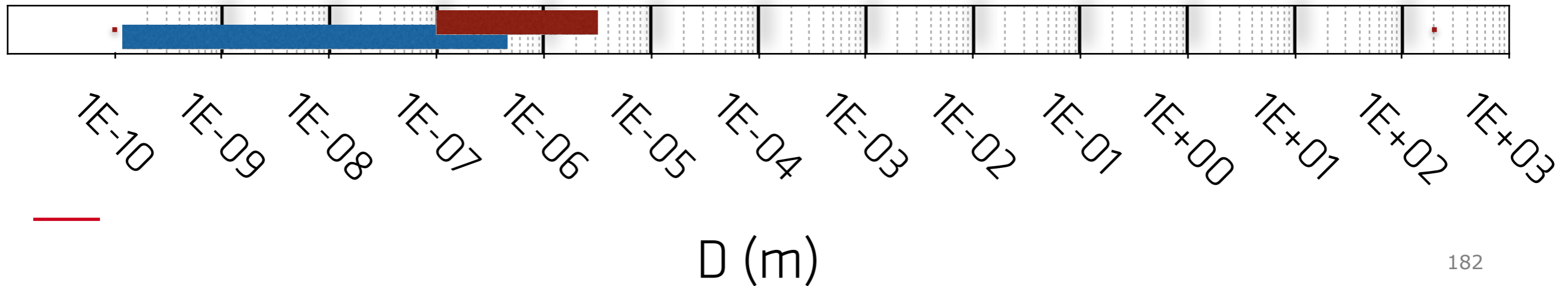
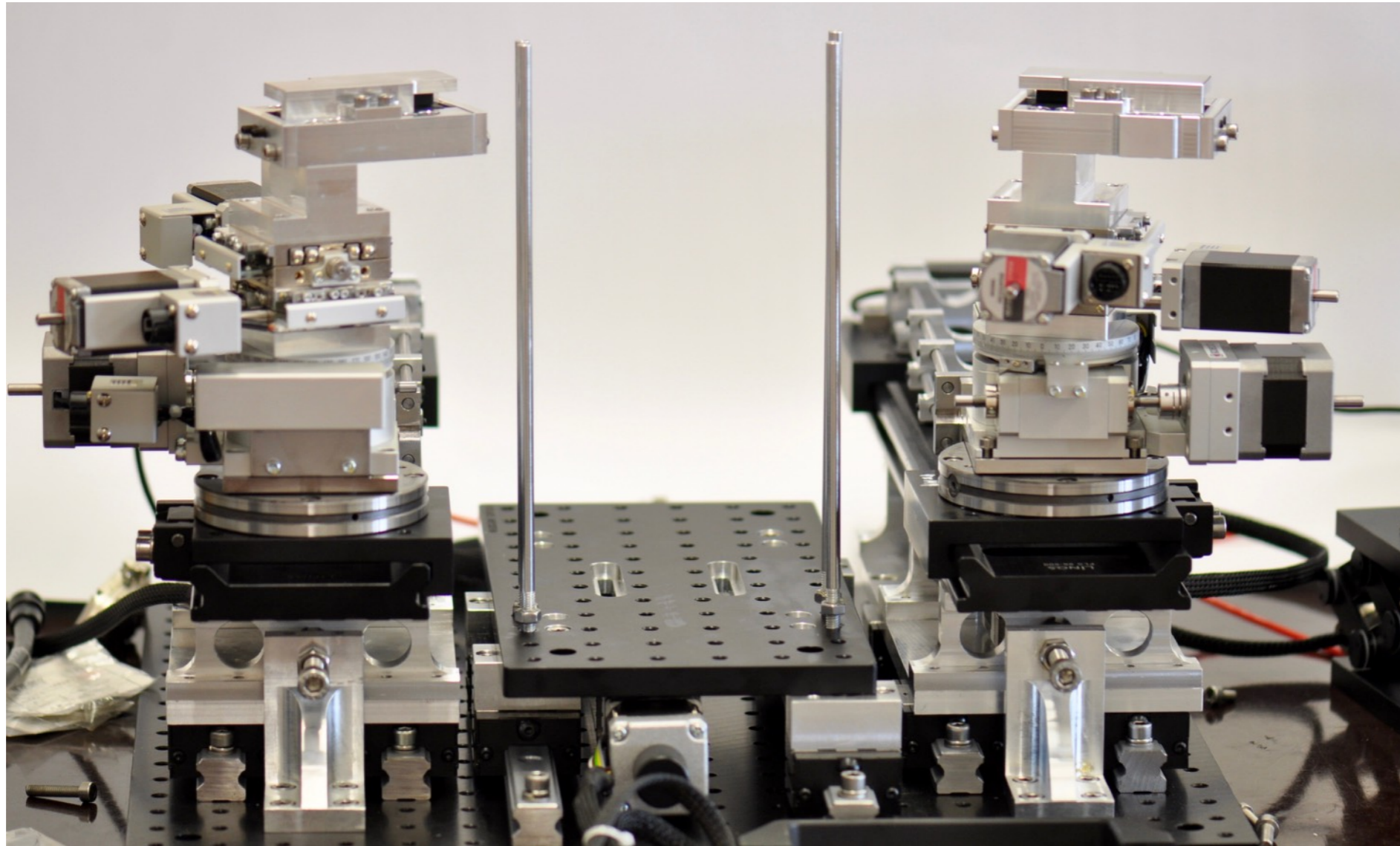
Version II: A little more elegance





Version III: For integration

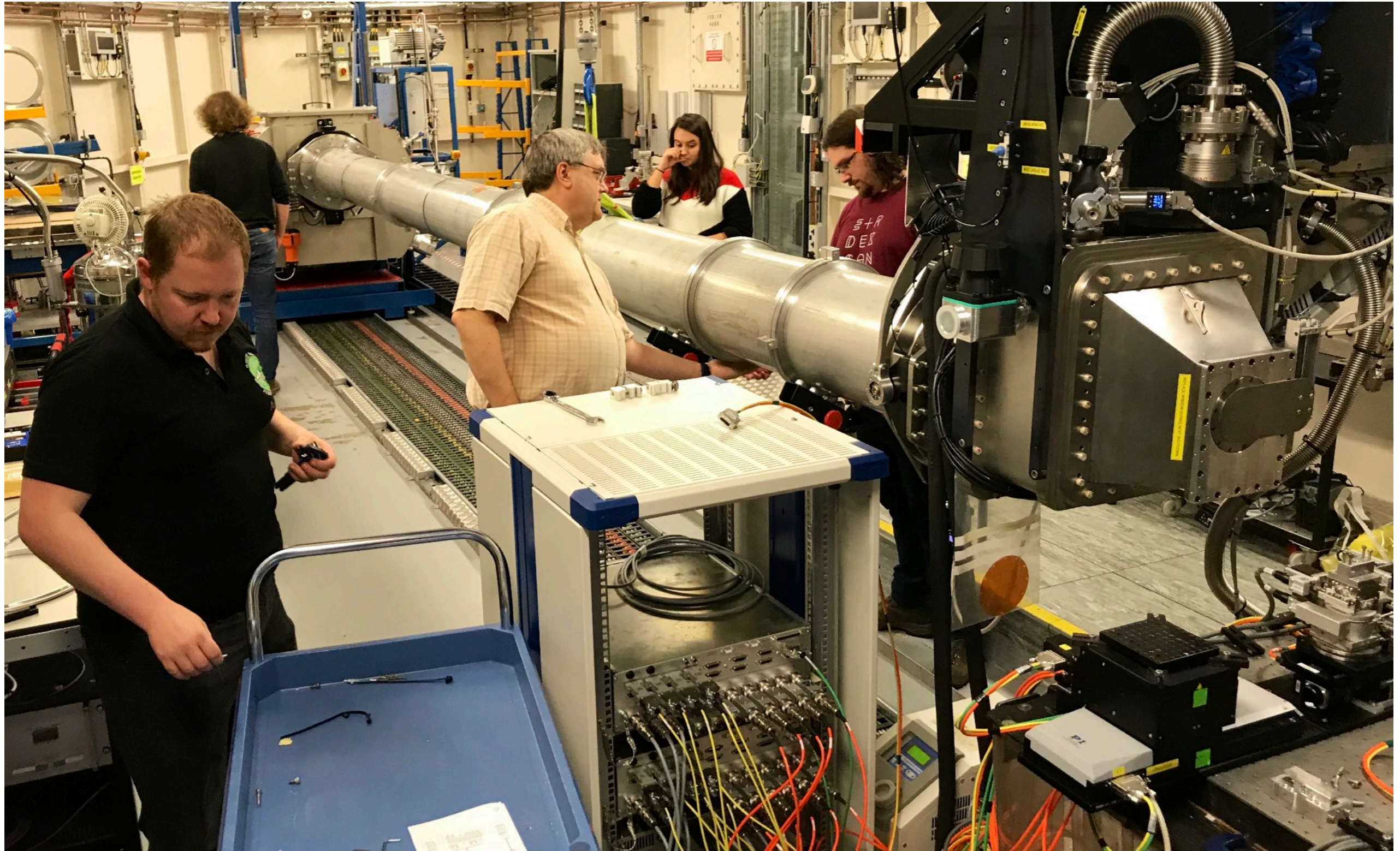
Version III: For integration

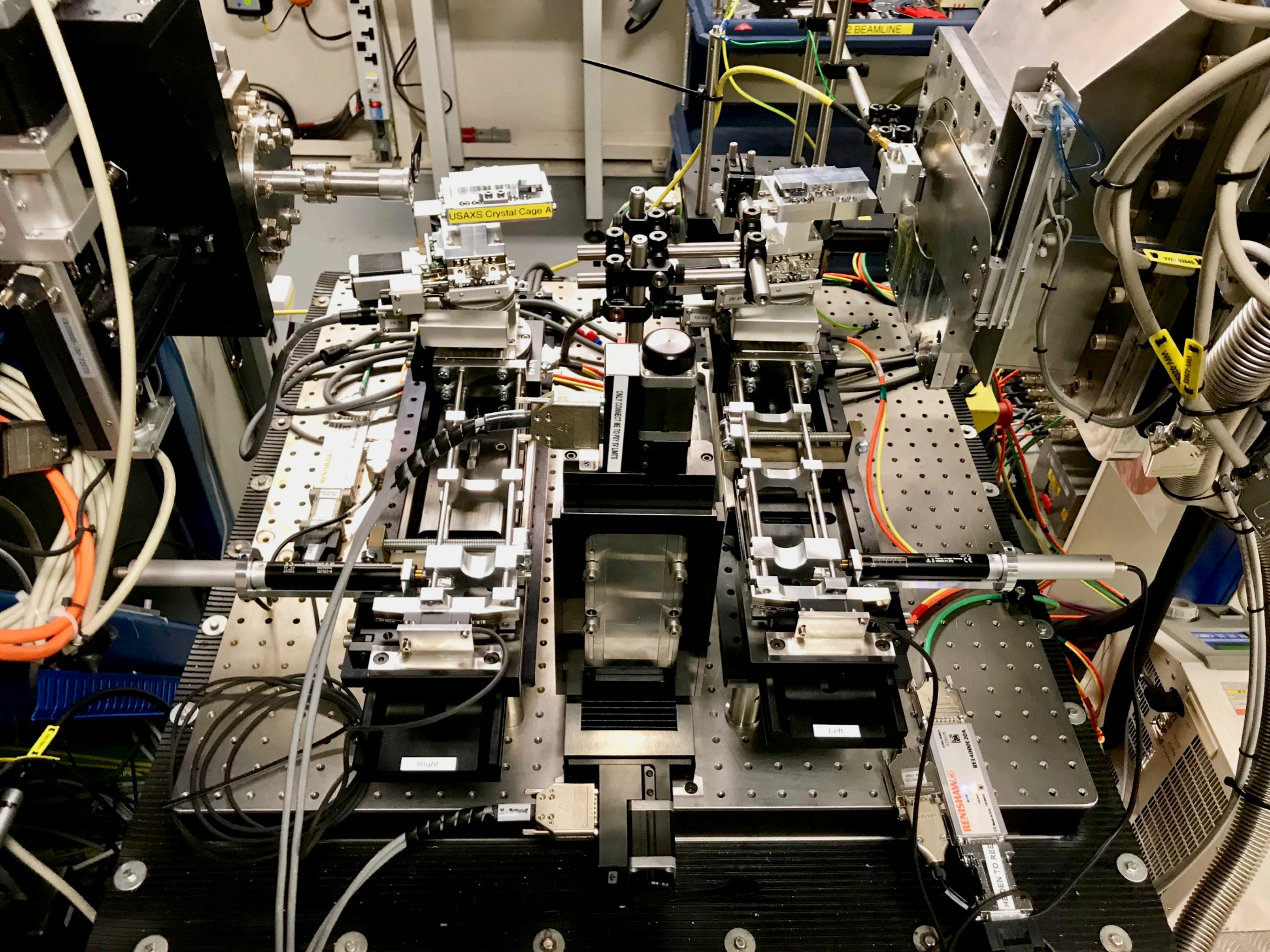


Version III: For integration



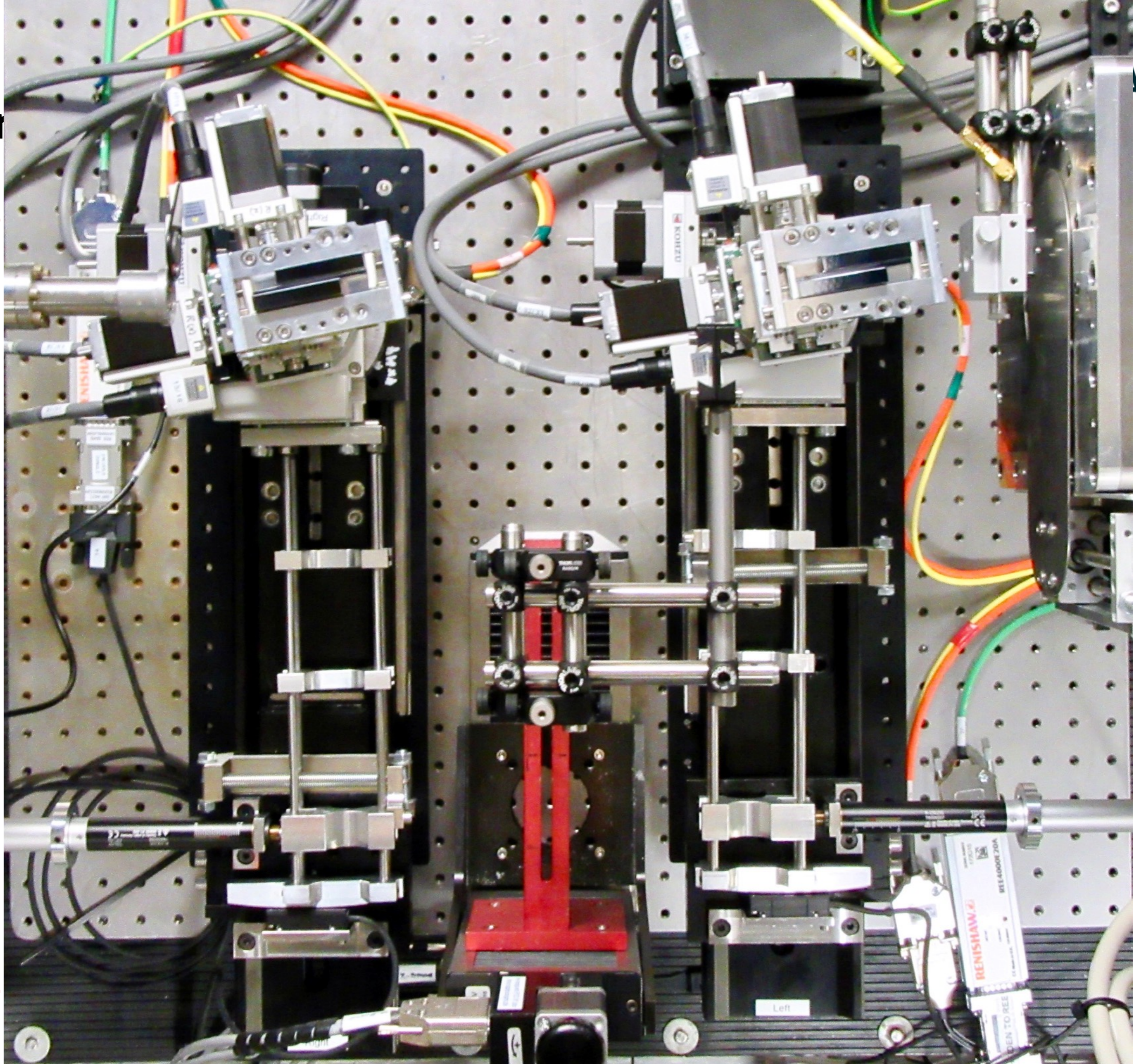
Version III: For integration



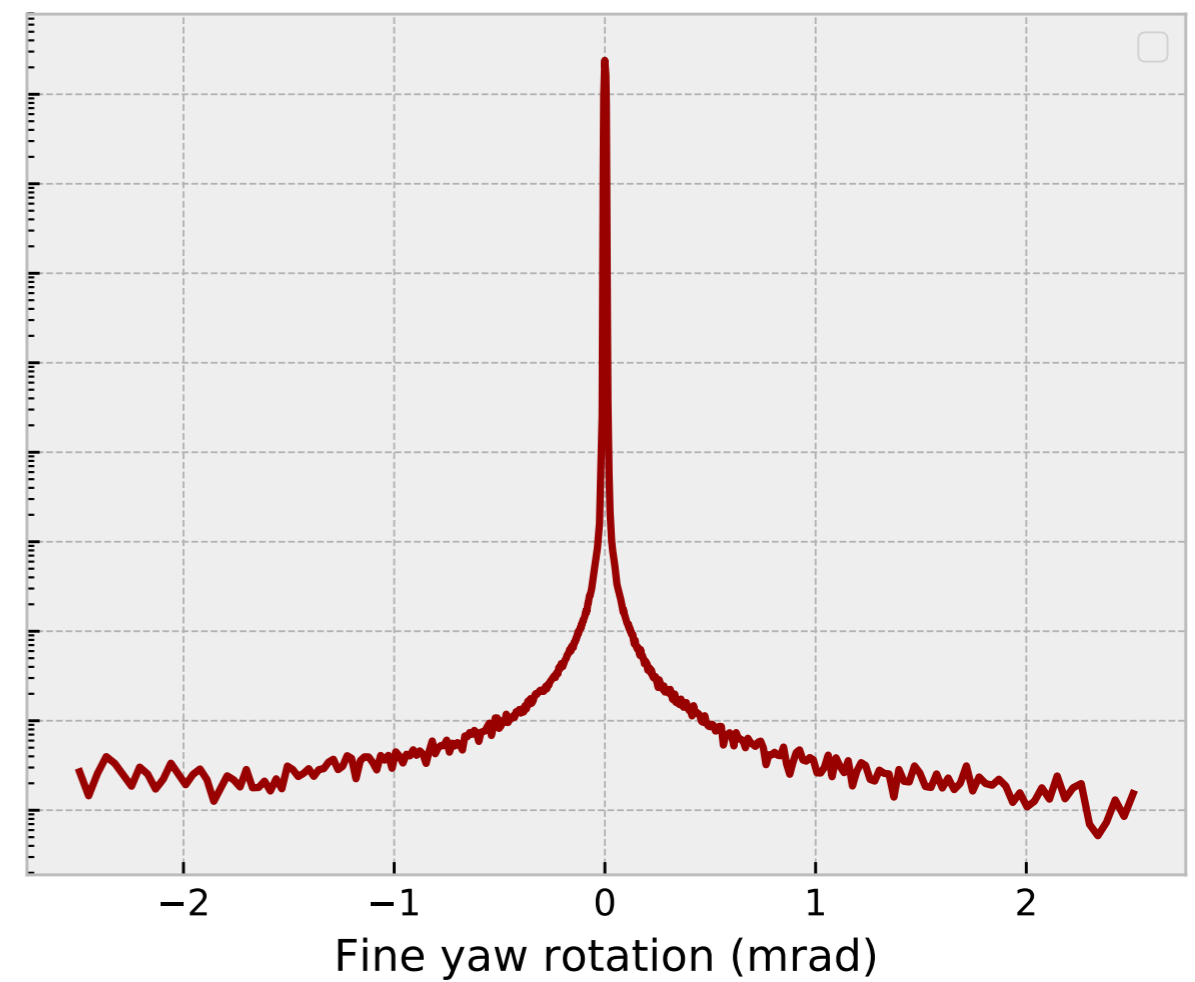
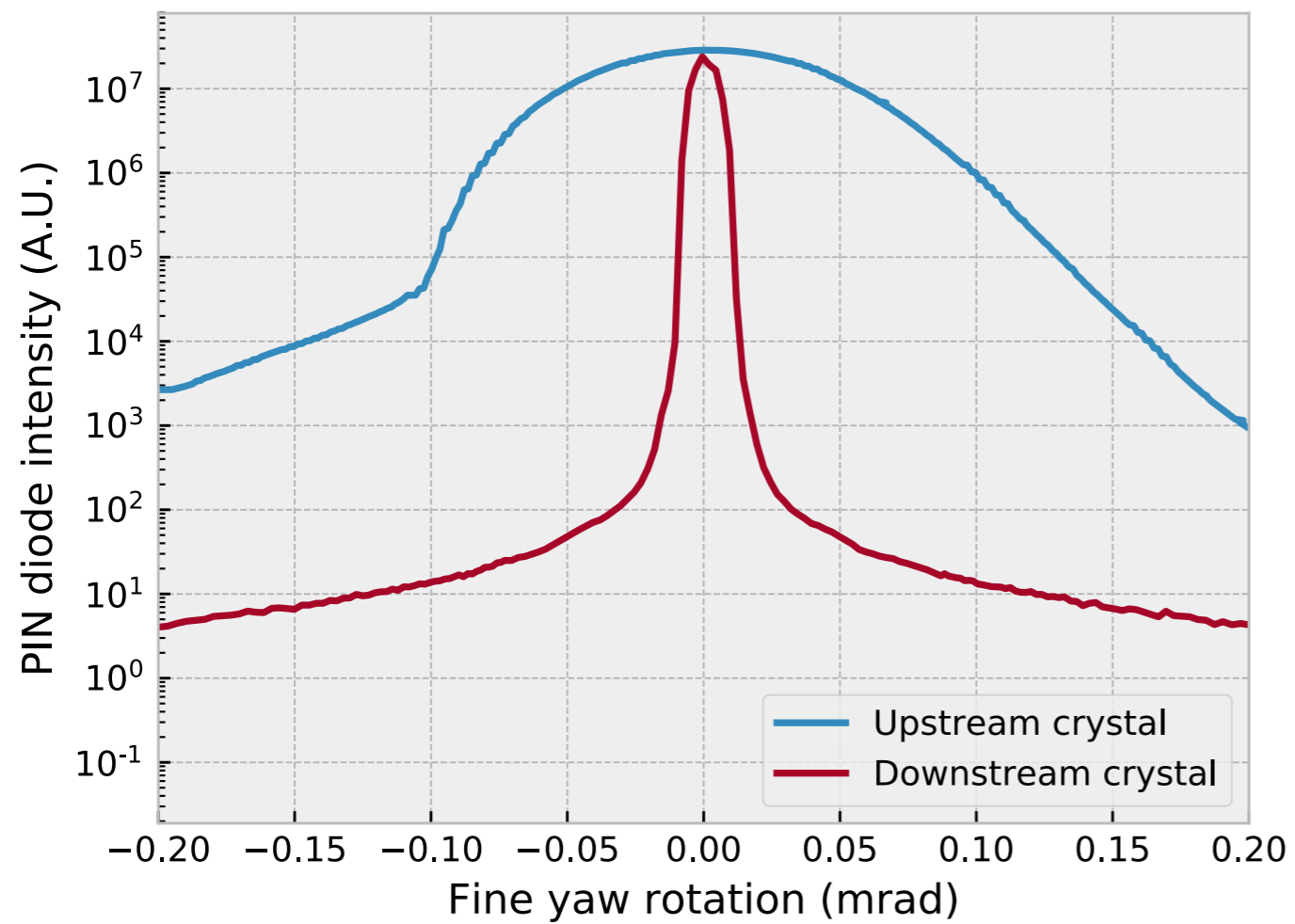


Ver

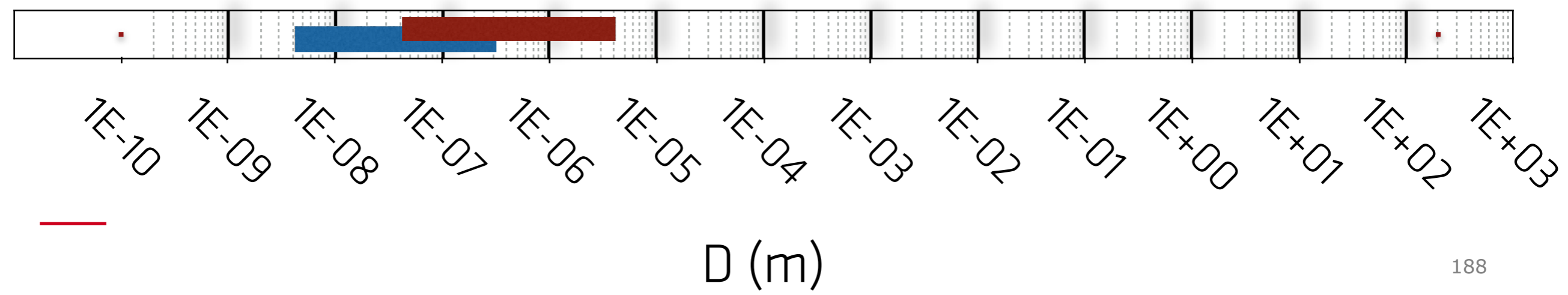
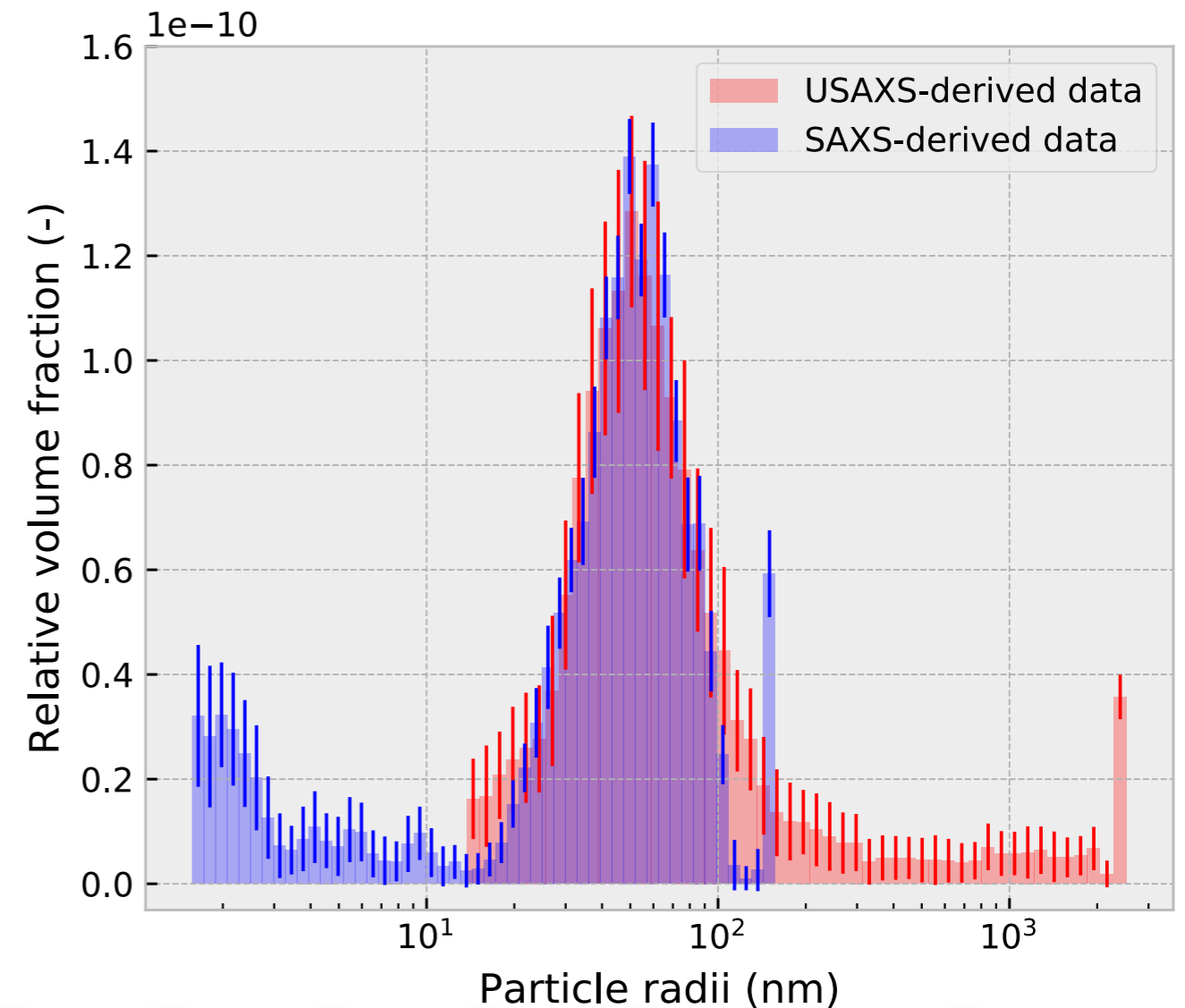
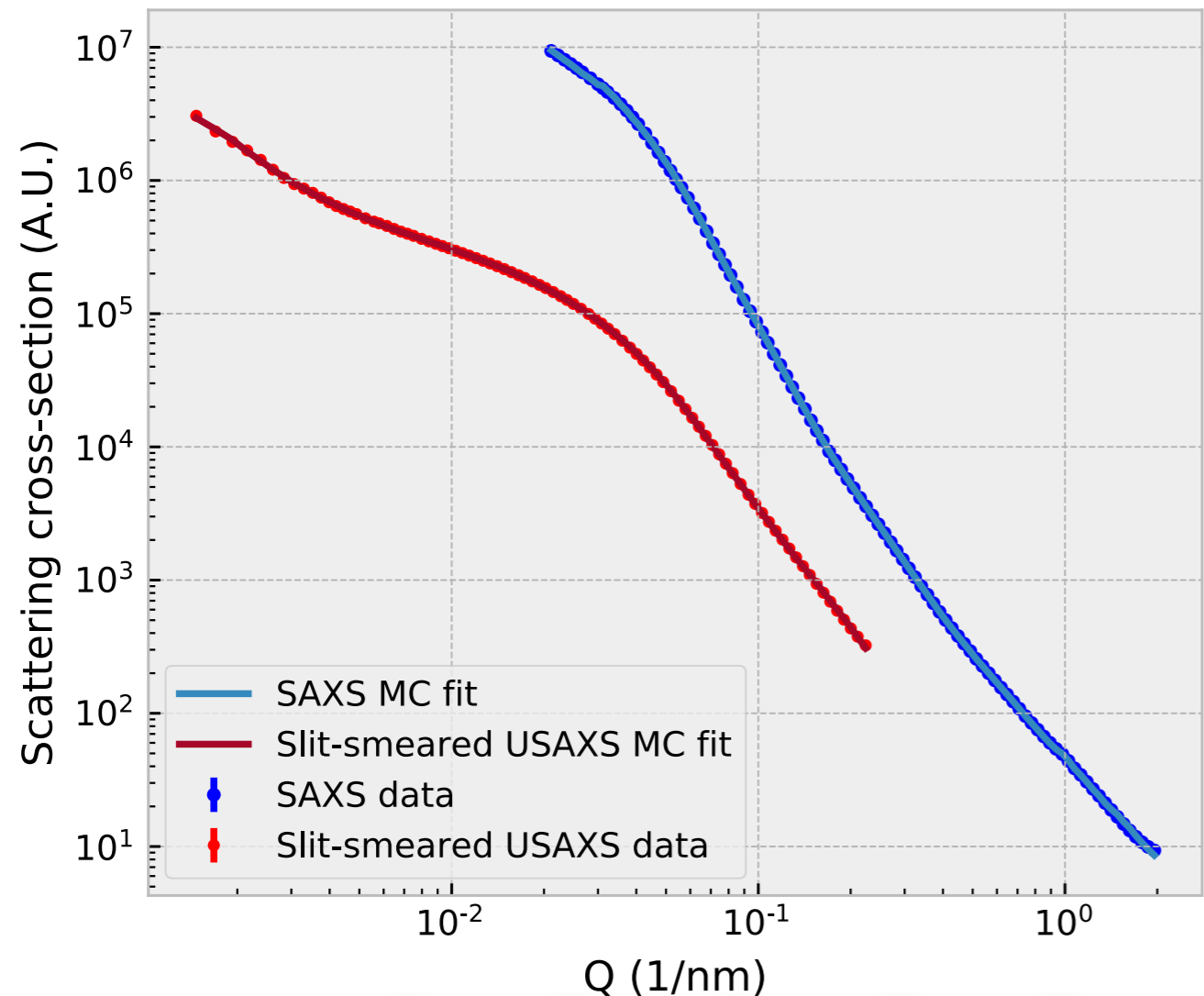
AM



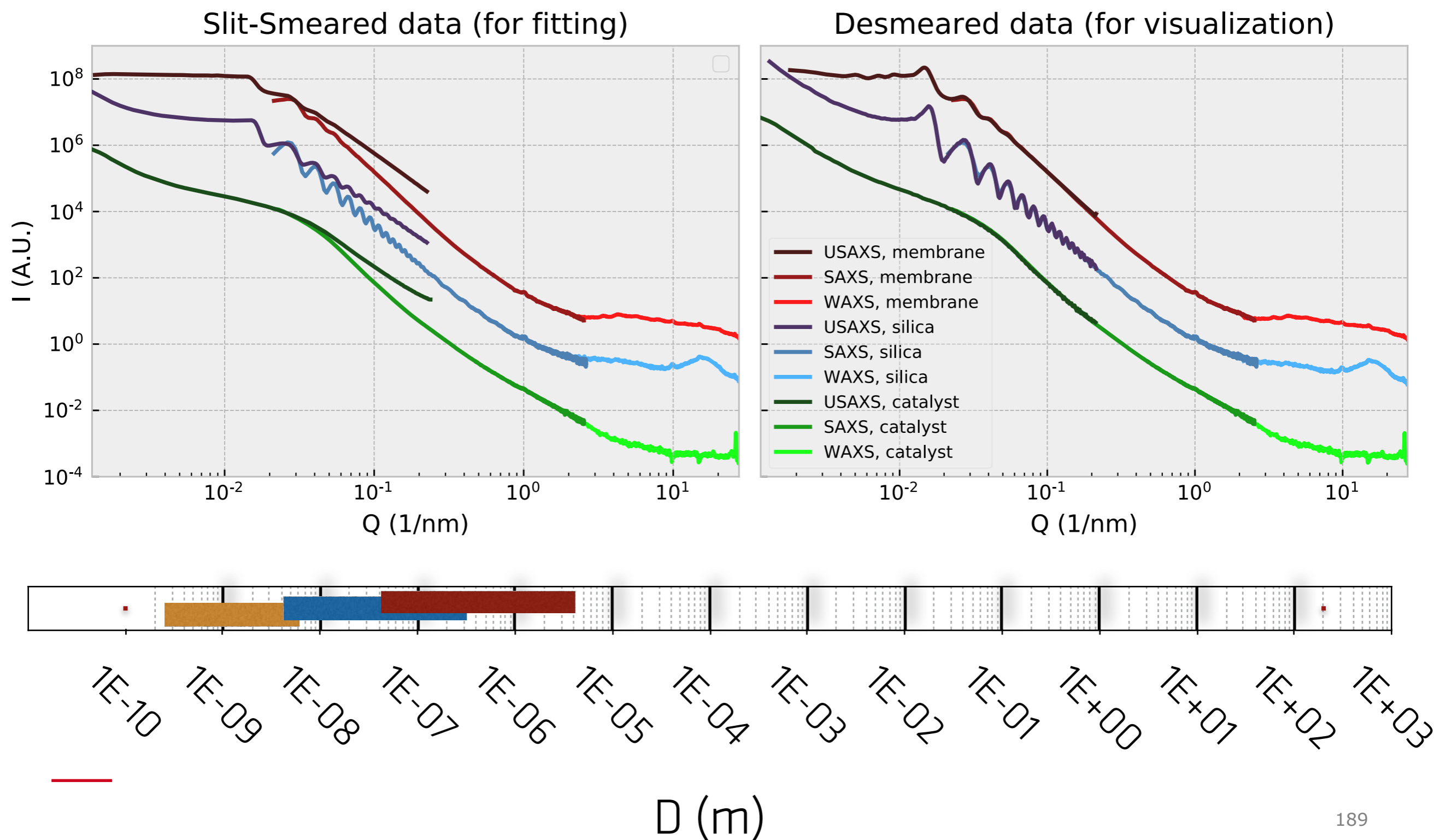
The USAXS addition



The USAXS addition



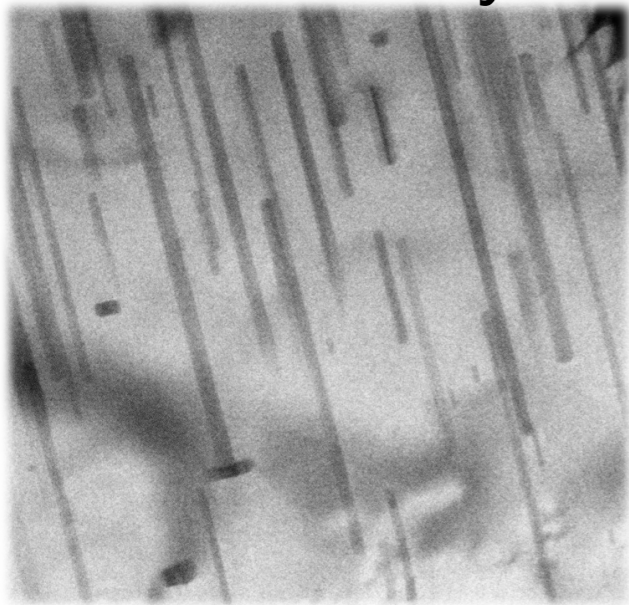
The USAXS addition



Choose your own adventure

(at your own risk)

Metal alloys



Polymers



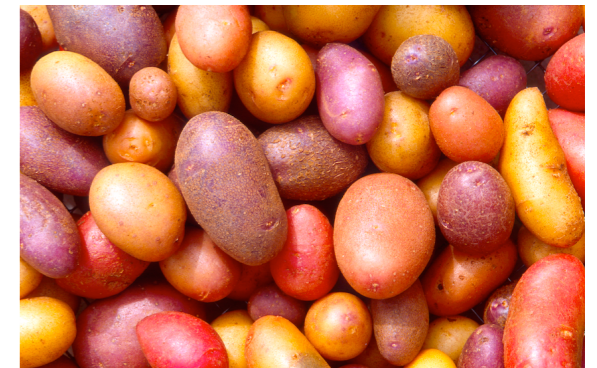
Nanoparticles



[Round Robin]

[Ultra-SAXS]

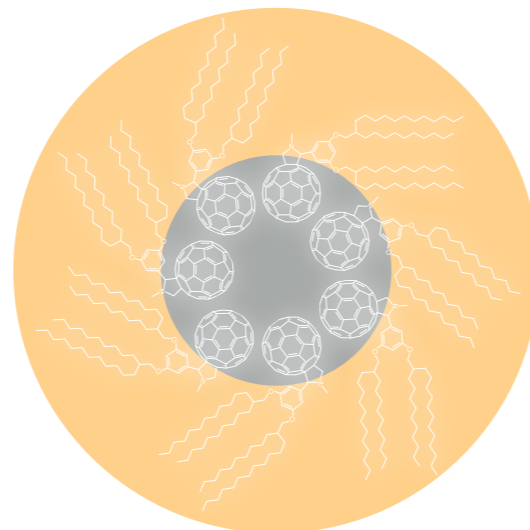
Powders



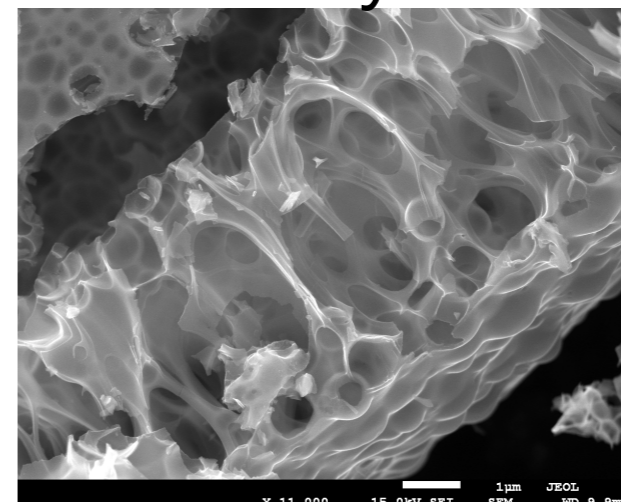
Doughnuts



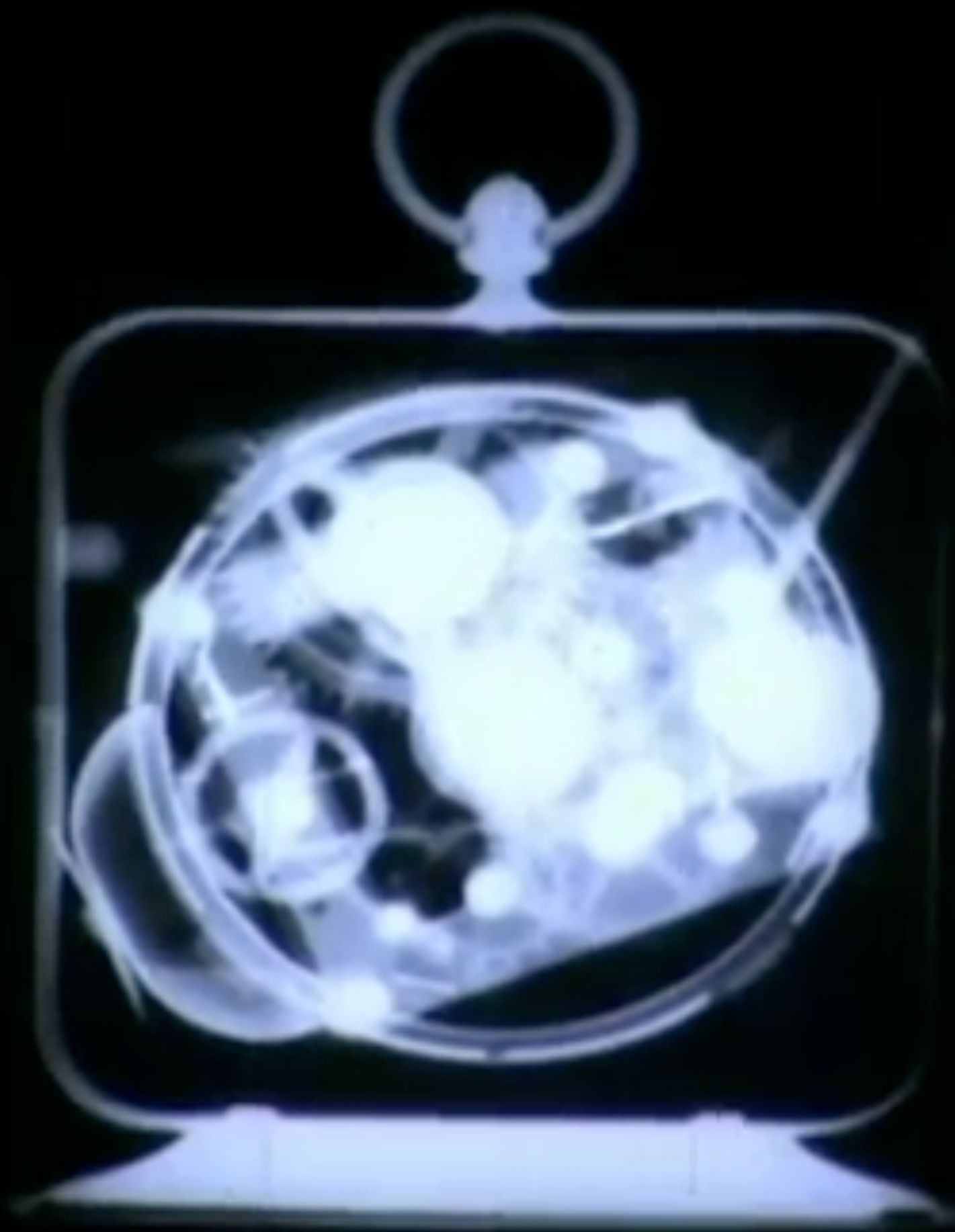
Micelles



Catalysts



[exit]



Q?

Thanks to:

B. Abécassis
J. W. Andreasen
L. Benning
I. Bressler
P. Butler
F. Emmerling
D. Fujita
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