

Glycoinformatics Consortium
(GLIC) seminar series

- Glycan Arrays -



CarbArrayART for glycan microarray data storage, presentation and reporting

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Glycosciences Laboratory: glycan probe library

Mammalian-type sequences

N-Glycans

- high mannose
- paucimannose
- complex
- hybrid

O-Glycans

- mucin type
- O-Fucosyl
- O-Mannosyl

Glycolipids

- neutral
- sialylated (e.g. gangliosides)
- sulfated

Glycosaminoglycan oligosaccharides

- hyaluronic acid
- chondroitin sulfates A & C
- dermatan sulfate
- heparin & heparan sulfate

Other oligosaccharides

- A, B & H blood group-related
- Lewis antigens a, b, x, y
- other neutral
- sialylated and/or sulfated
- other acidic

Exogenous sequences from fungal, bacterial and plant polysaccharides

Oligosaccharides derived from fungal, bacterial and plant polysaccharides

- glucan
- chitin and chitosan
- polysialic acids
- mannan, xylan and arabinan

Over 900 Lipid-linked glycan probes derived from natural sources or chemically synthesized

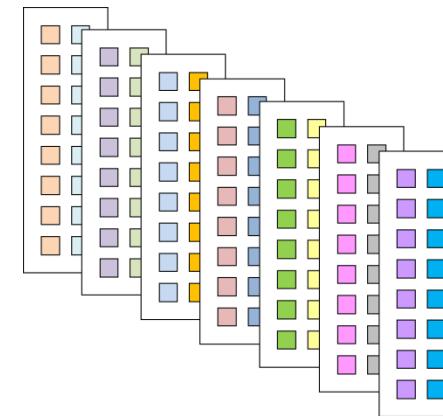
<https://glycosciences.med.ic.ac.uk/glycanLibraryIndex.html>

- Tang PW, Gooi HC, Hardy M, Lee YC, Feizi T. *Biochem Biophys Res Commun* 1985, 132: 474-480.
- Fukui S, Feizi T, Galustian C, Lawson AM, Chai W. *Nat Biotechnol* 2002, 20: 1011-1017.

- Feizi T, Chai W. *Nat Rev Mol Cell Biol* 2004, 5: 582-588.
- Liu Y, Palma AS, Feizi T. *Biol Chem* 2009, 390: 647-656.

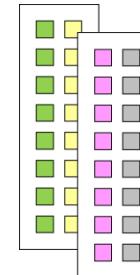
Glycan microarray slides generated in the Glycosciences Laboratory

Comprehensive screening oligosaccharide microarrays

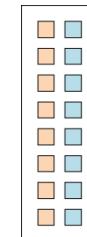


Each coloured box contains
< 64 glycan probes arrayed

Focused arrays for specific projects



Glucan oligosaccharides
glucan-binding receptors
antibodies
carbohydrate binding modules (CBMs)



Sialyl oligosaccharides
influenza viruses and other sialic acid-binding proteins



Ganglioside-related polyomaviruses
Glycosaminoglycan chains
GAG-binding proteins and viruses
N-glycans
broadly neutralizing anti-HIV antibodies

Mucins
Human microbiota

From their earliest stages glycan microarrays signalled
the need for a processing software



BEILSTEIN INSTITUT

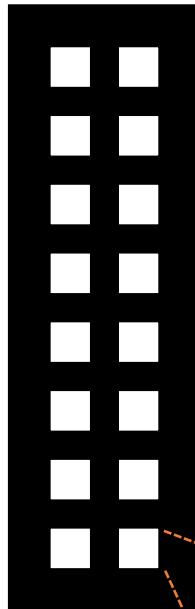
Software Tools for Storing, Processing and Displaying Carbohydrate Microarray Data

Mark Stoll and Ten Feizi

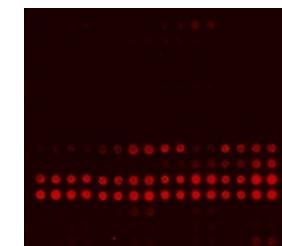
[Proceeding of the Beilstein Symposium on Glyco-Bioinformatics, 123-140 \(2009\)](#)

Glycan microarray data

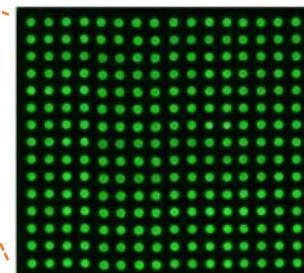
16-pad nitrocellulose-coated glass slide



Overlaying with glycan binding samples (proteins, viruses, serum samples, etc)



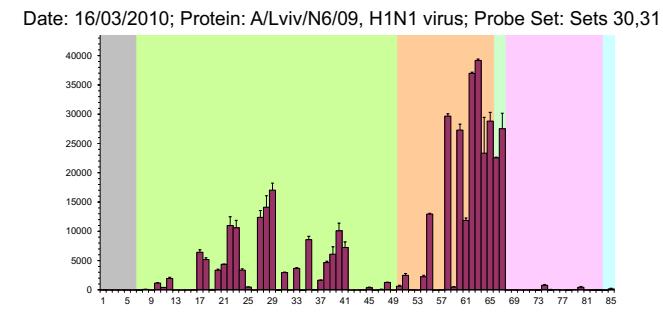
Detection of binding Alexa Fluor 647-labelled streptavidin



Cy3 marker for array quality control and spot location

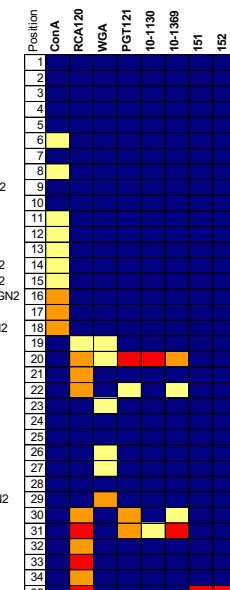
64 glyco-probes per subarray
2 levels of concentration per
glyco-probe in duplicate

Data processing, storage and presentation



Chart

Tabulation



Heat map

Software tools are based on Microsoft Office and Visual Basic

Limited extensibility

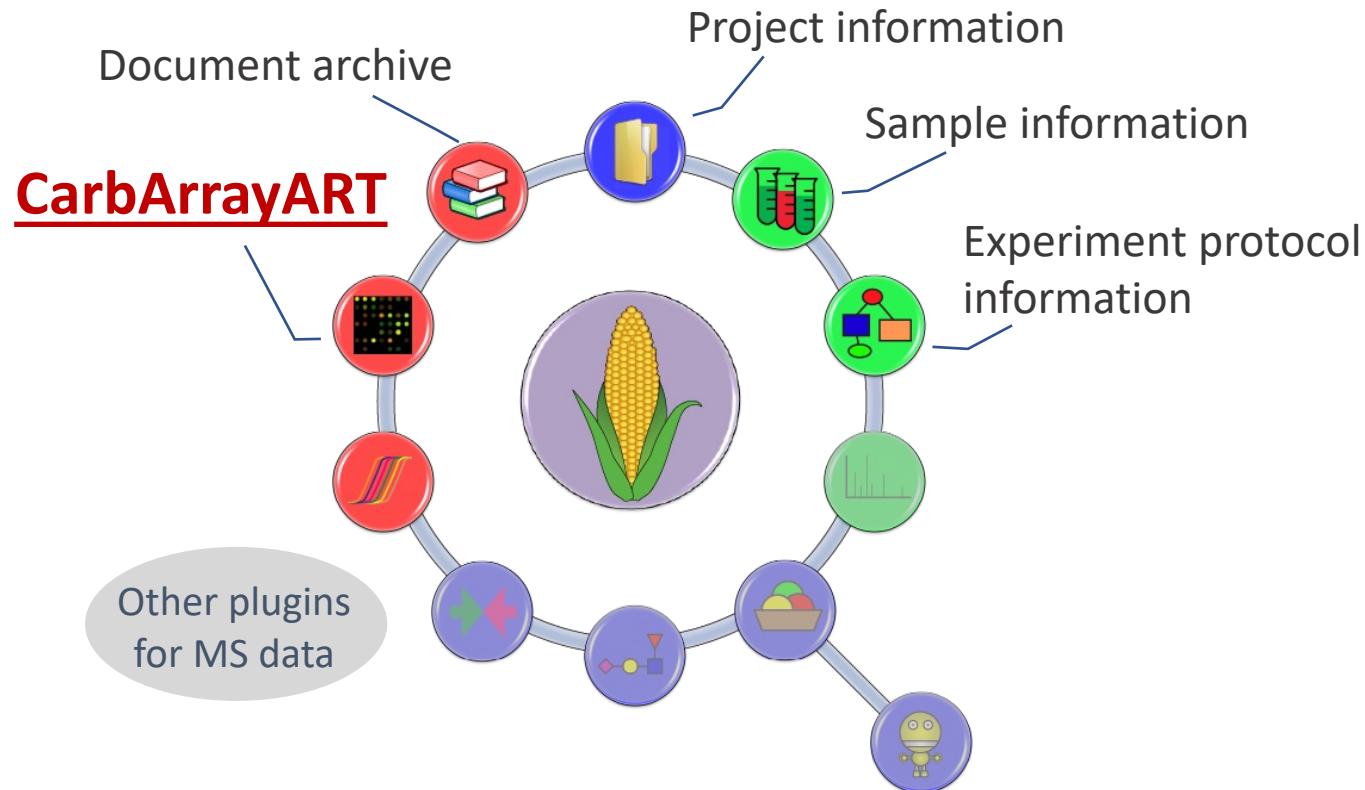
Hence, the need to develop a **robust** and **distributable** glycan array software,

Carbohydrate micro-Array Analysis and Reporting Tool



Plugin of GRITS Toolbox

Collaboration with René Ranzinger and Sena Arpinar at Complex Carbohydrate Research Center
Stand-alone Java application / Available in multiple platforms / Plugins and modules



CarbArrayART webpage

<http://carbarrayart.org>



Welcome to CarbArrayART

Carbohydrate microArray Analysis and Reporting Tool (CarbArrayART) is a software tool for glycan microarray experimental design, data storage, processing, presentation and reporting. CarbArrayART capitalizes on [GRITS Toolbox](#) which was originally developed for processing, interpreting and archiving glycomic mass spectrometry data. CarbArrayART utilizes the functionalities provided by [GRITS Toolbox](#) for storing glycan microarray realated information including glycan structures and metadata such as project information, sample description and experimental details.

The main features of CarbArrayART are:

1. Storage of carbohydrate microarray related data including glycan probe lists, array geometry, information on glycan-binding samples and experimental protocols and scan data.
2. Presentation of data as tables, charts and matrices (heatmaps) with filtering and sorting of glycans as needed.
3. Reporting of microarray data in Word, PDF and Excel formats, together with metadata that are compliant with [MIRAGE \(Minimum Information Required for a Glycomics Experiment\)](#).

You will be referred to [Manual and Support](#) page for the installation and step-by-step operation.

About 

Highlights  Firefox

Manual and Support 

Download 

Minimum information to have in hand

Glycan probe

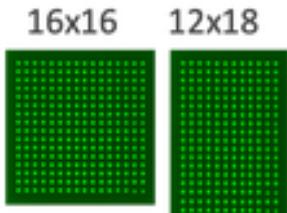
Glycan library (the list of glyco-probes) included in the array

Glycan sequence information would be required in order to use the sequence-based filtering and sorting functions in Tabulation View. [GlycoCT{condensed}](#), [2D TEXT](#), [CFG-IUPAC](#), [Glyco Workbench Sequence \(GWS\)](#) and [WURCS formats](#) can be used for entering glycan sequences.

Subarray layout

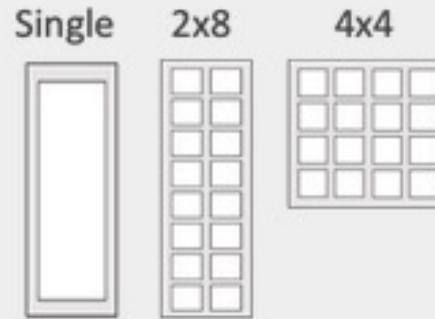
Layout of printed spots associated with glyco-probe IDs and concentrations (or doses) and the number of replicates in each Subarray (block or pad).

Examples illustrated are of 16x16 spots/subarray of 64 glyco-probes at 2 doses (2 and 5 fmol) printed in duplicate or 12x18 spots/subarray of 36 probes printed at a single dose or concentration and 6 replicates.



Slide layout

Examples illustrated are of the layout of array(s) on a microarray slide: single array/slide or 2x8 subarrays/slide or 4x4 subarray/slide)



Project

User-defined name for the project

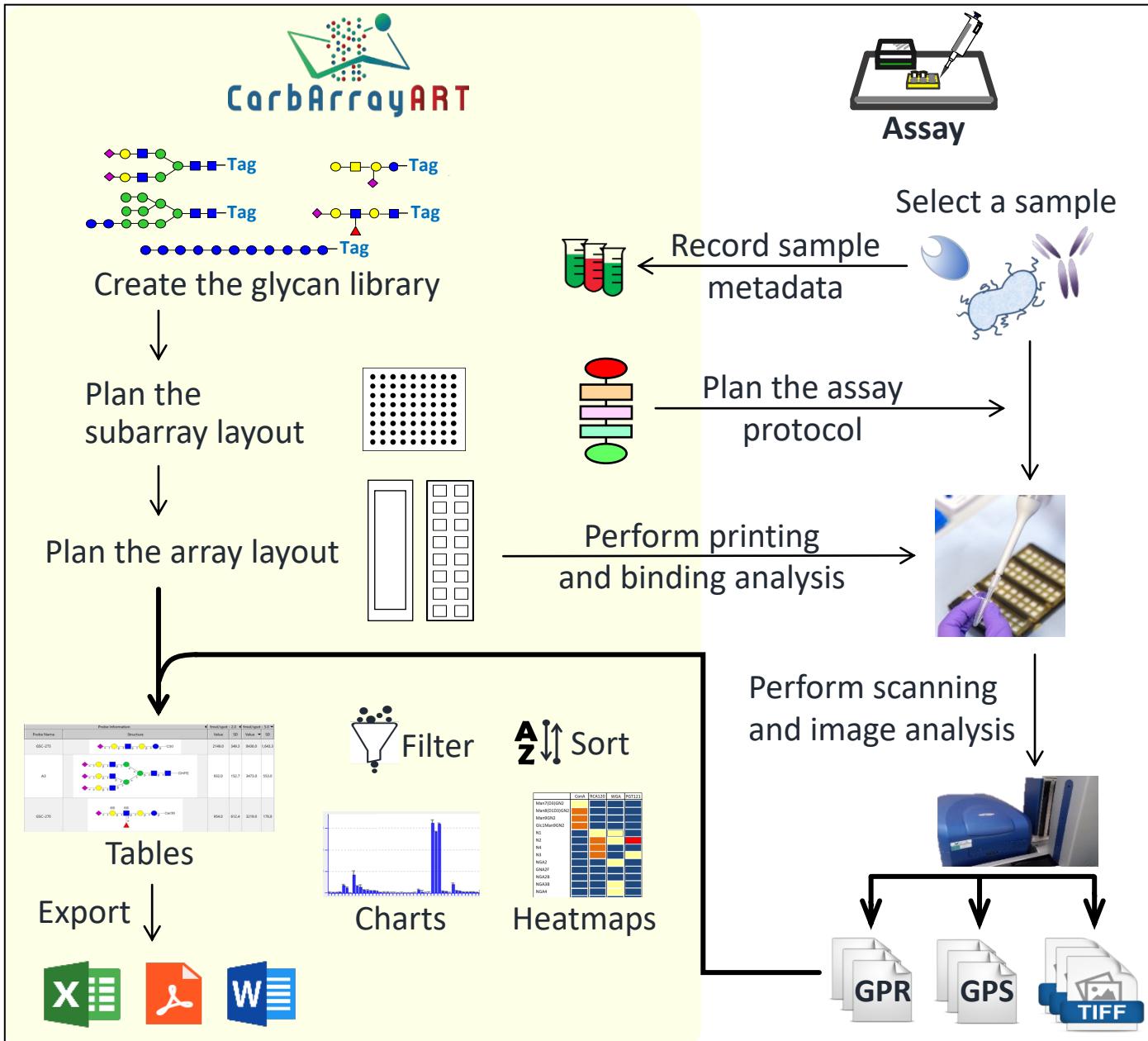
Analyte

Name of the carbohydrate-binding sample

Glycan array data

Quantified array data in the form of a gpr file (GenePix scanner) or an Excel file (Proscan)

The data management workflow of a microarray analysis



The data management workflow in CarbArrayART (left, yellow background)

The experiment workflow (right)

Highlights are:

- MIRAGE* compliant with respect to data input and output
- Data storage and management
- Data presentation
- Data sharing and publication



* Liu, Yan, et al. Glycobiology 27.4 (2017): 280-284.

Tools in CarbArrayART

1. Glycan probe entry tool

2. Subarray layout entry tool

3. Slide layout entry tool

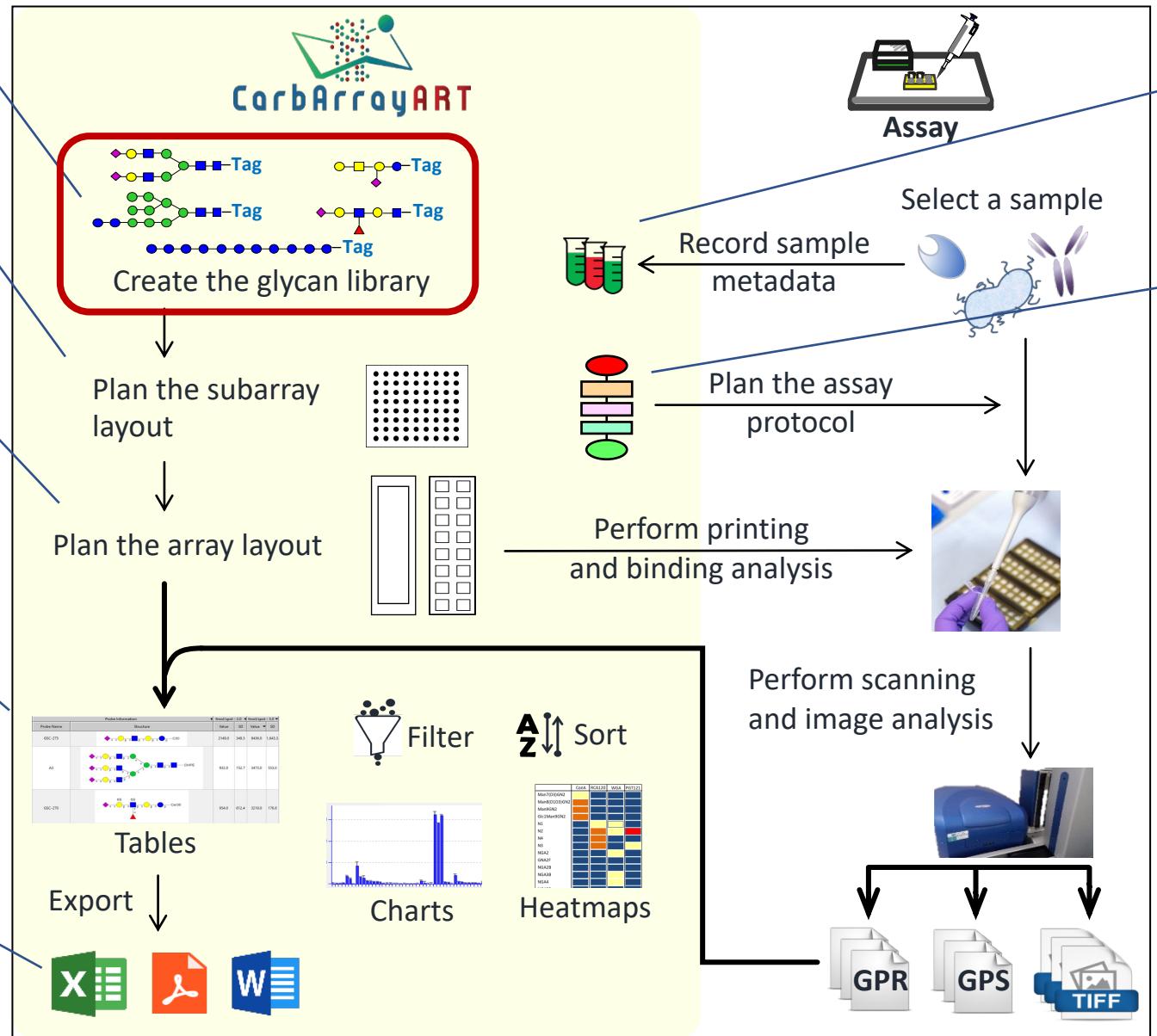
6. Data presentation

7. Data sharing

4. Sample metadata entry tool

5. Experiment design tool

User's manual:
<http://carbarrayart.org>



Left, yellow background:
The data management
workflow in CarbArrayART

Right: The experiment
workflow

1. Glycan Glyco-probe entry tool

Glycan probe section

- Name (mandatory)
- Comments
- Backbone type

Texts highlighted in blue:
MIRAGE compliant

Glyco-probe

Select from library Search

Glyco-probe ID

Glyco-probe Name*

Comment on purity

Other comment

Backbone type

Backbone type

Group A: Gal, Glc, Lac, LacNAc
Group B: LNnT, LNT
Group C: Polylactosamine (linear,branched)
Group D: N-glycan
Group E: Ganglioside related
Group F: O-glycan
Group G: Polysialyl
Group H: GAG
Group I: Other homo-oligomers
Group J: Miscellaneous
Blood group and Lewis type
Sialylated and sulphated milk-related and Lewis type



Tag section

- Name
- Sequence (text)
- Nature (natural, synthesized or unknown)

Tag Name

Structure if known

Tag Nature

Comment

1. Glycan Glyco-probe entry tool

Glycan section

- Name
- Sequence

Sequence formats:

- GlyTouCan ID
- GlycoCT{condensed}
- 2D TEXT
- CFG-IUPAC
- Glyco Workbench Sequence (GWS)
- WURCS

Glycan moiety

- Please fill below if glycan moiety information are required -

Enter another glycan moiety information

Select from library

Or enter new glycan

Glycan name

Sequence

Get sequence from GlyTouCan ID

Or upload file



Create glycan probe library

Tools in CarbArrayART

1. Glycan probe entry tool

2. Subarray layout entry tool

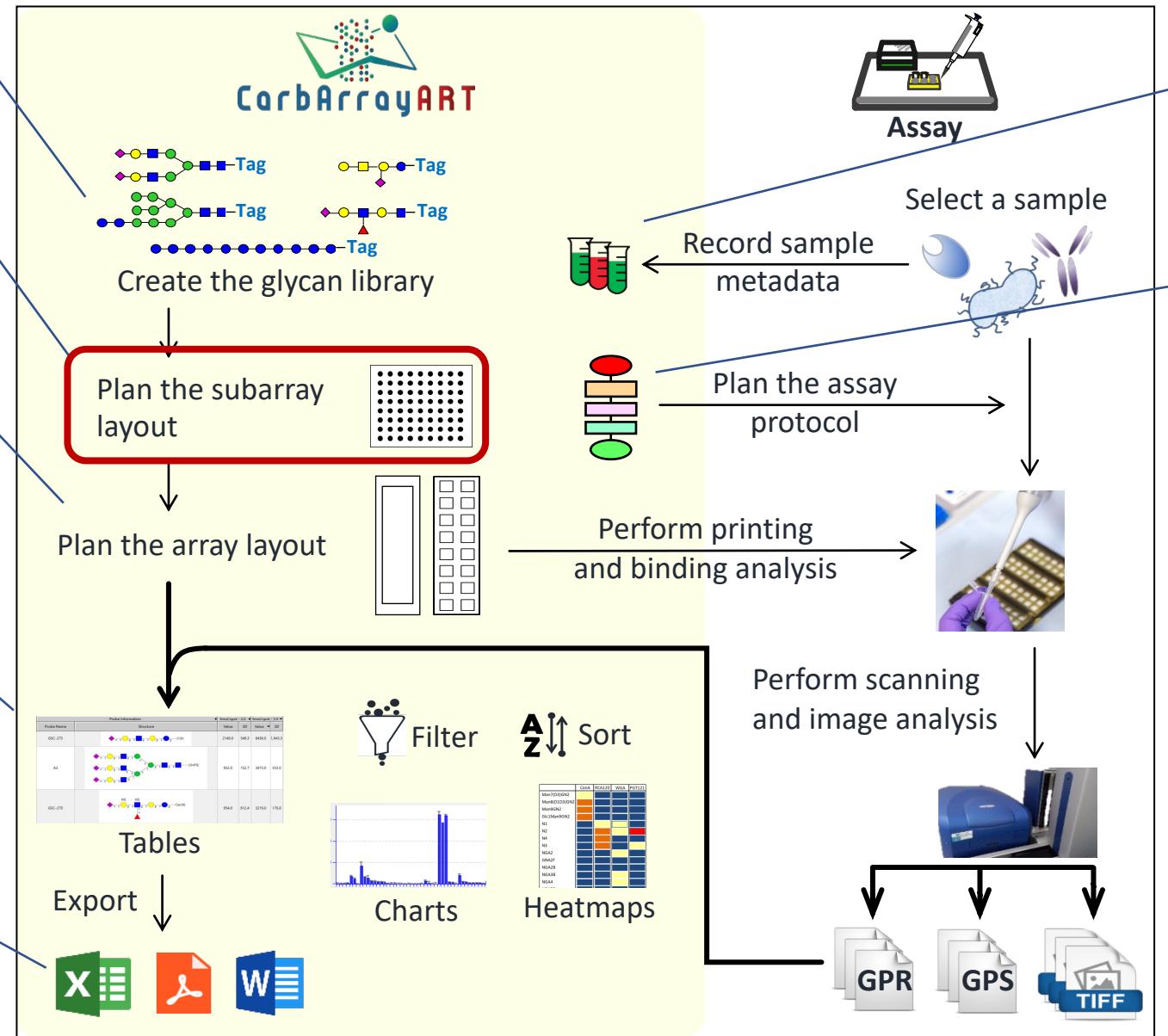
3. Slide layout entry tool

6. Data presentation

7. Data sharing

4. Sample metadata entry tool

5. Experiment design tool



Left, yellow background:
The data management workflow in CarbArrayART

Right: The experiment workflow

2. Block layout entry tool: example layout

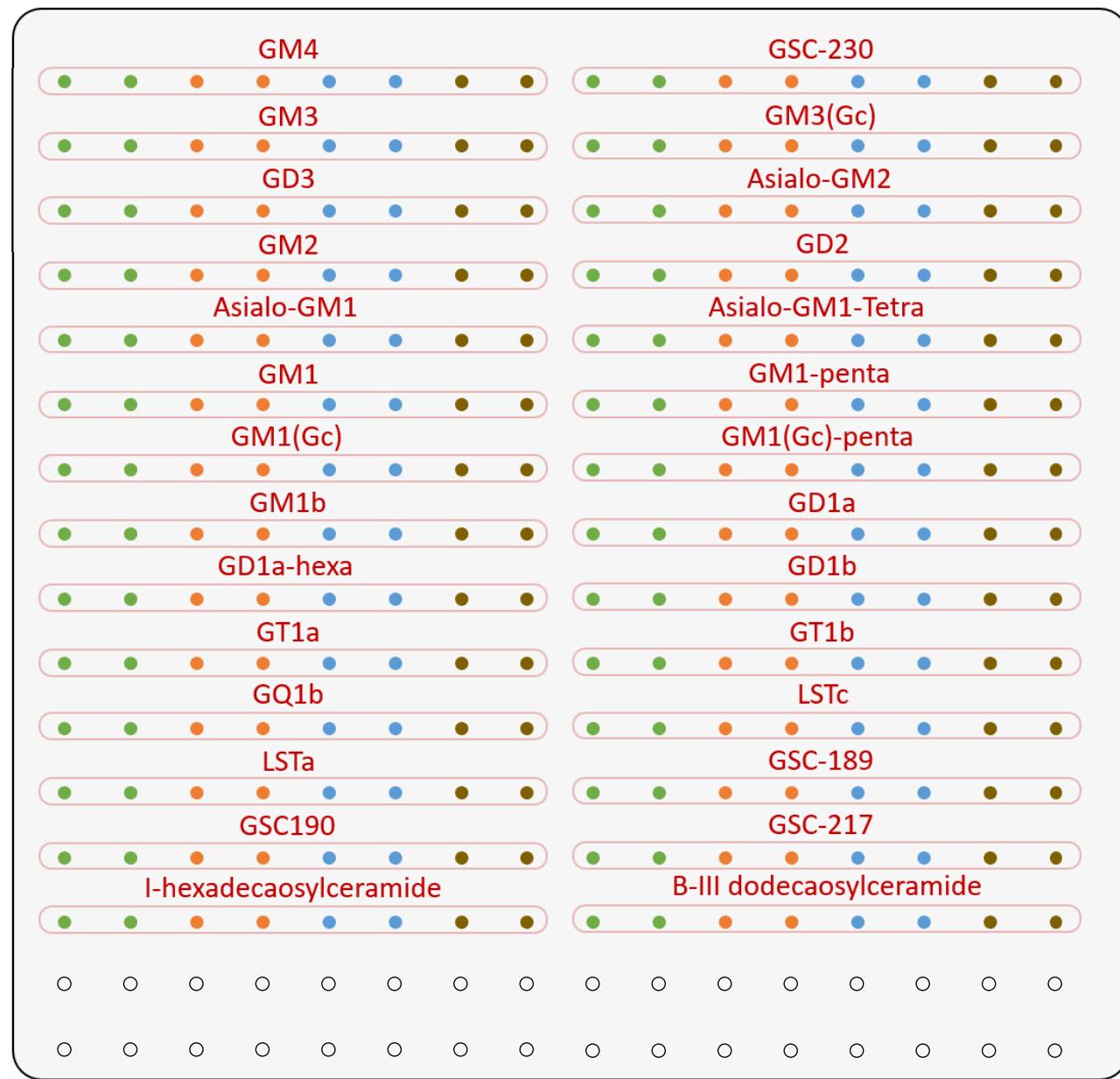
Ganglioside dose response set

The set has 28 glycan probes with:

- 4 levels (0.3, 0.8, 1.7 and 5 fmol)
- Duplicate spots

- 0.3 fmol/spot
- 0.8 fmol/spot
- 1.7 fmol/spot
- 5 fmol/spot
- Empty

- Number of Spot Columns = 16
- Number of Spot Row = 16



2. Block layout entry tool: entry page 1

Ganglioside dose response set

The set has **28** glycan probes with:

- **4** levels (0.3, 0.8, 1.7 and 5 fmol)
- **Duplicate spots**

- 0.3 fmol/spot
- 0.8 fmol/spot
- 1.7 fmol/spot
- 5 fmol/spot
- Empty

- Number of Spot Columns = **16**
- Number of Spot Row = **16**

Subarray Layout Tool

Enter information about a glycan microarray subarray layout

Subarray Layout ID

Name*

Comment

Number of replicates (option)

Number of levels (arrayed glyco-probe)*

Number of glyco-probes*

Subarray geometry (the number of spots)*

Column

Row

< Back

2. Block layout entry tool: entry page 2

Arrayed glyco-probe levels

	Value	Unit
1	0.0	fmol/spot
2	0.0	fmol/spot
3	0.0	fmol/spot
4	0.0	fmol/spot

Glyco-probe list

Search by: Name ID Search

Subarray/Block layout

ID	Glyco-probe
1	GM4-Cer
2	GSC-230-Cer36
3	GM3-Cer
4	GM3(Gc)-Cer
5	GD3-Cer
6	Asialo-GM2-Cer
7	GM2-Cer
8	GD2-Cer

Row	Col...n	Glyco-probe	Level	Ident...array
1	1		1	1
1	2		1	1
1	3		2	1
1	4		2	1
1	5		3	1
1	6		3	1
1	7		4	1
1	8		4	1

< Back Next > Finish Cancel

2. Block layout entry tool: entry page 2

To define the concentration or dose of glycan probes arrayed

Select the unit of the level(s)

- Units of levels:
- (a) fmol/spot
 - (b) ul/spot
 - (c) mM
 - (d) uM
 - (e) mg/ml
 - (f) pmol/ul

	Value	Unit
1	0.0	fmol/spot
2	0.0	fmol/spot
3	0.0	fmol/spot
4	0.0	fmol/spot

Glyco-probe list

Search by: Name ID

ID	Glyco-probe
1	GM4-Cer
2	GSC-230-Cer36
3	GM3-Cer
4	GM3(Gc)-Cer
5	GD3-Cer
6	Asialo-GM2-Cer
7	GM2-Cer
8	GD2-Cer

Subarray/Block layout

Row	Col...n	Glyco-probe
1	1	
1	2	
1	3	
1	4	
1	5	
1	6	
1	7	
1	8	

< Back 18

2. Block layout entry tool: entry page 2

Library of pre-saved glycan probes
using Glycan Probe Entry Tool

	Value	Unit
1	0.0	fmol/spot
2	0.0	fmol/spot
3	0.0	fmol/spot
4	0.0	fmol/spot

Glyco-probe list

Search by: Name ID

ID	Glyco-probe
1	GM4-Cer
2	GSC-230-Cer36
3	GM3-Cer
4	GM3(Gc)-Cer
5	GD3-Cer
6	Asialo-GM2-Cer
7	GM2-Cer
8	GD2-Cer

Subarray/Block layout

Row	Col...n	Glyco-probe
1	1	
1	2	
1	3	
1	4	
1	5	
1	6	
1	7	
1	8	

< Back Next >

2. Block layout entry tool: entry page 2

	Value	Unit
1	0.0	fmol/spot
2	0.0	fmol/spot
3	0.0	fmol/spot
4	0.0	fmol/spot

Glyco-probe list

Search by: Name ID

ID	Glyco-probe
1	GM4-Cer
2	GSC-230-Cer36
3	GM3-Cer
4	GM3(Gc)-Cer
5	GD3-Cer
6	Asialo-GM2-Cer
7	GM2-Cer
8	GD2-Cer

Subarray/Block layout

Row	Col...n	Glyco-probe	Level	Ident...array
1	1		1	1
1	2		1	1
1	3		2	1
1	4		2	1
1	5		3	1
1	6		3	1
1	7		4	1
1	8		4	1

2. Block layout entry tool: entry page 2

	Value	Unit
1	0.0	fmol/spot
2	0.0	fmol/spot
3	0.0	fmol/spot
4	0.0	fmol/spot

Block layout table:

- To define the printing location of each glyco-probe
- The number of rows and columns of spots (counting from the top-left corner)
- Glyco-probe arrayed
- Levels of glyco-probe arrayed
- Identification number of glyco-probes in this subarray:
The number indicates a group of glyco-probes.

Subarray/Block layout

Row	Col...n	Glyco-probe	Level	Ident...array
1	1		1	1
1	2		1	1
1	3		2	1
1	4		2	1
1	5		3	1
1	6		3	1
1	7		4	1
1	8		4	1

< Back Next > Finish Cancel

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2. Block layout entry tool: entry page 2

Subarray Layout Tool

Fill the tables for subarray layout.

Arrayed glyco-probe levels

	Value	Unit
1	0.3	fmol/spot
2	0.8	fmol/spot
3	1.7	fmol/spot
4	5.0	fmol/spot

Glyco-probe list

Search by: Name ID

Block layout

Drag and drop

Row	Column	Glyco-probe	Level	Identification number in this subarray
1	1		1	1
1	2		1	1
1	3		2	1
1	4		2	1
1	5		3	1
1	6		3	1
1	7		4	1
1	8		4	1
1	9		1	2
1	10		1	2
1	11		2	2
1	12		2	2
1	13		3	2

Processed data (average intensity values) are calculated if the glycan probes in one block are ...

- (1) The same probe ID
and
- (2) The same group number (identification number)
and
- (3) the same level

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Tools in CarbArrayART

1. Glycan probe entry tool

2. Subarray layout entry tool

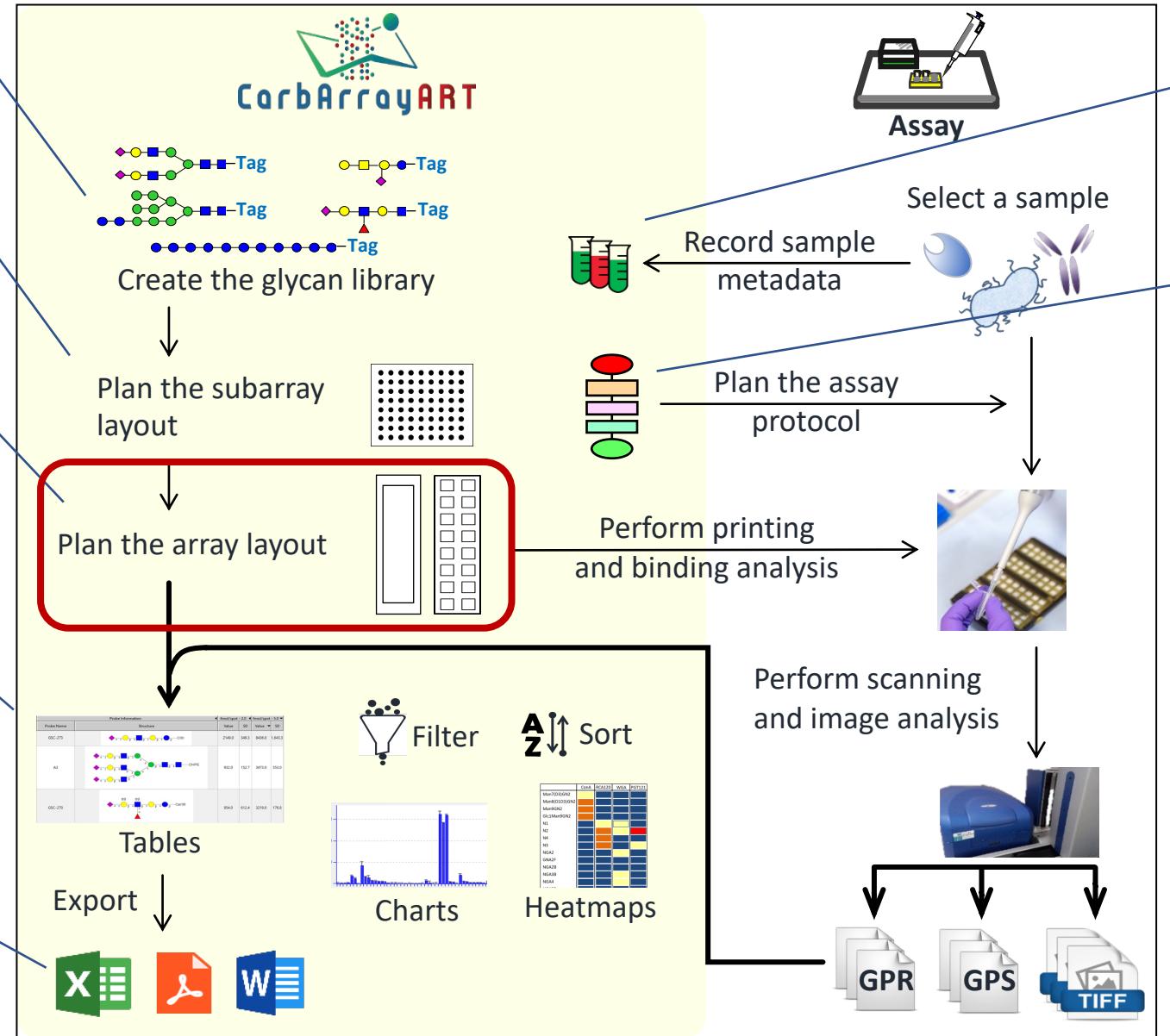
3. Slide layout entry tool

6. Data presentation

7. Data sharing

4. Sample metadata entry tool

5. Experiment design tool



Left, yellow background:
The data management
workflow in CarbArrayART

Right: The experiment
workflow

3. Slide layout entry tool: entry page 1

Array Layout Tool

Enter information about the microarray layout

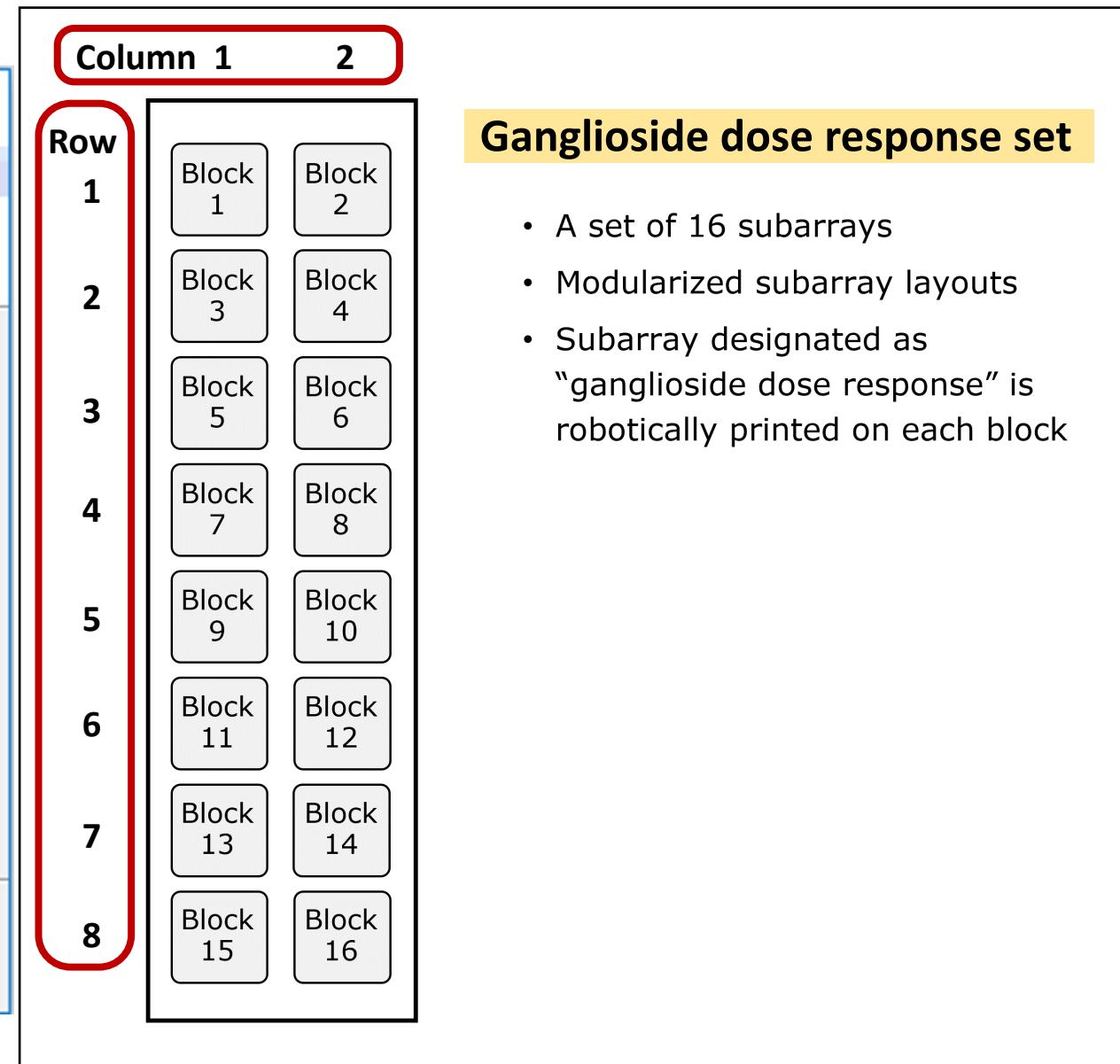
Name* |Ganglioside dose response set

Comments

Array geometry (the number of subarrays/blocks)

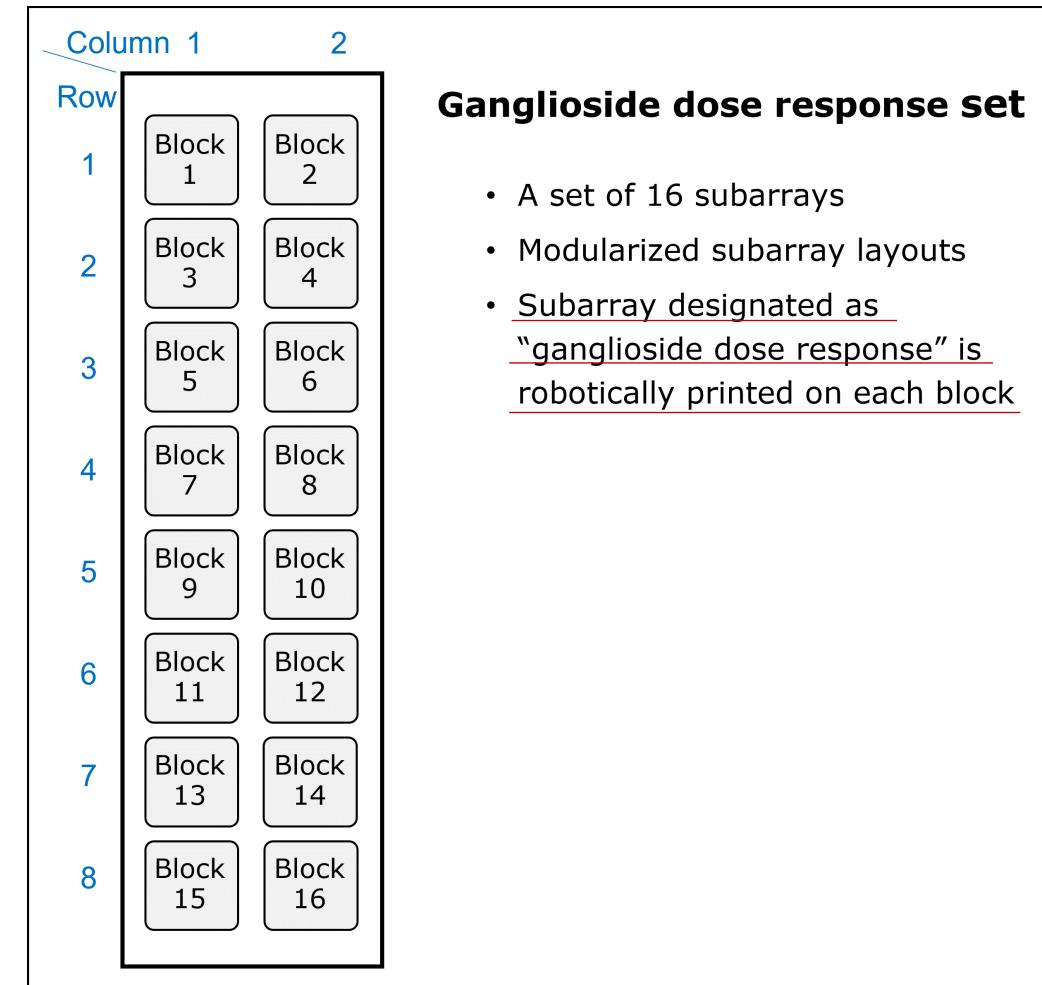
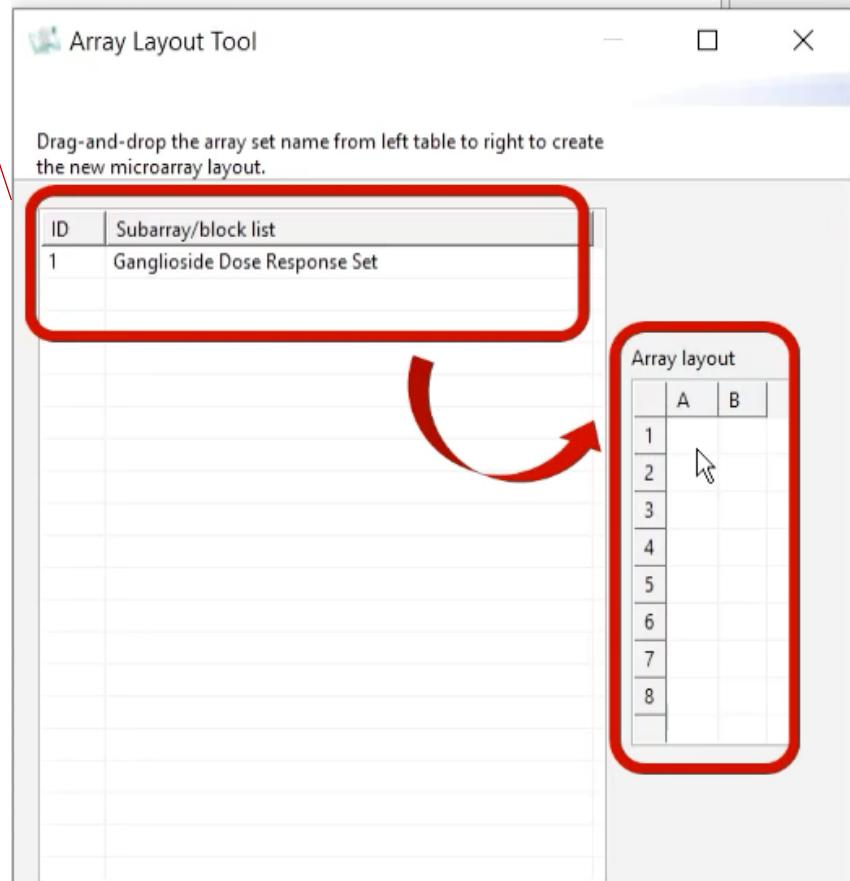
column* 2
row* 8

< Back Next > Finish Cancel



3. Slide layout entry tool: entry page 2

Library of pre-saved subarray layouts



- A set of 16 subarrays
- Modularized subarray layouts
- Subarray designated as
"ganglioside dose response" is
robotically printed on each block

Data Entry - Slide layout entry from an Excel file

GenePix Array List (GAL) like file

An Excel file contains:

- Block numbers in a slide
- Spot numbers (row and columns) in a block
- Glycan probe information arrayed in the spot

	Block	Spot column number in Block	Spot row number in Block	Glycan probe ID if the glycan is recorded in CarbArrayART (Numbers)	Printed glycan probe name (*if the spot is not empty)	Glycan probe printing concentration or dose value (Numbers) (*if the spot is not empty)	Glycan probe concentration or dose unit (Selection) (*if the spot is not empty)	Comments on purity of printed glycan probe	Other comments on printed glycan probe
1									
2	1	1	1	1	GM2	0.3	fmol/spot		
3	1	2	1	1	GM2	0.3	fmol/spot		
4	1	3	1	1	GM2	0.8	fmol/spot		
5	1	4	1	1	GM2	0.8	fmol/spot		
6	1	5	1	1	GM2	1.7	fmol/spot		
7	1	6	1	1	GM2	1.7	fmol/spot		
8	1	7	1	1	GM2	5	fmol/spot		

Tools in CarbArrayART

1. Glycan probe entry tool

2. Subarray layout entry tool

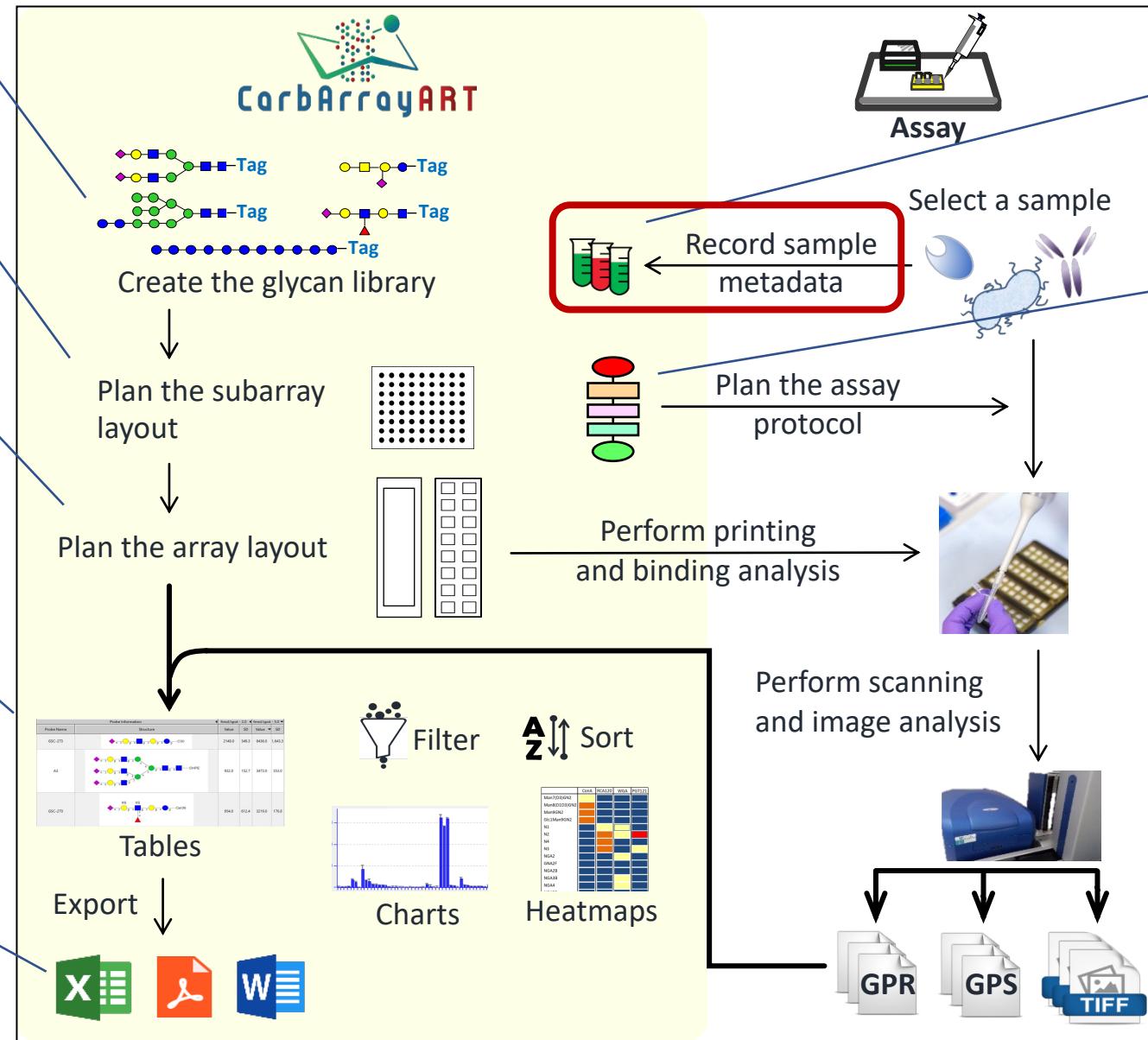
3. Slide layout entry tool

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7. Data sharing

4. Sample metadata entry tool

5. Experiment design tool



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The data management
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Right: The experiment
workflow

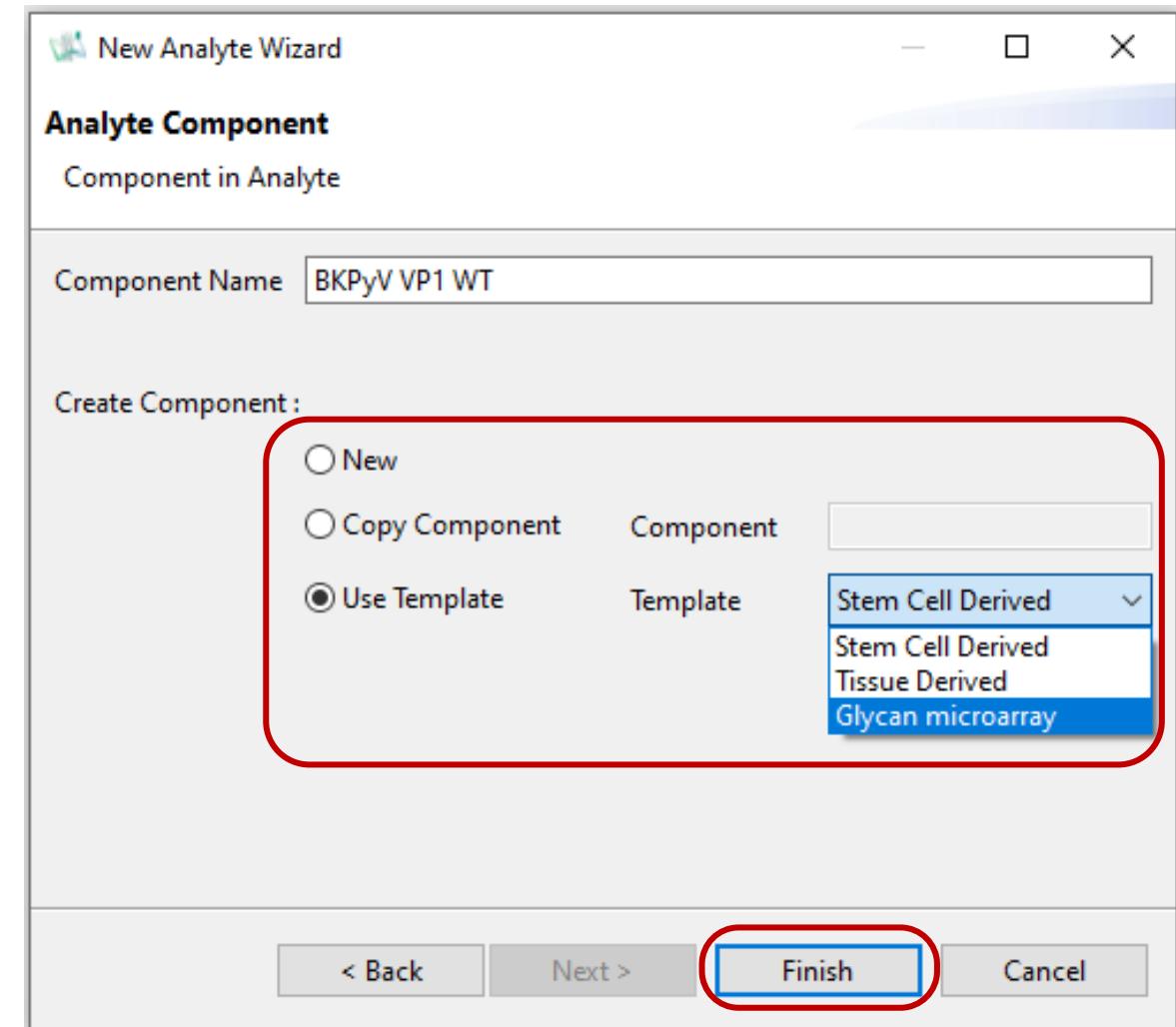
4. Glycan binding sample metadata entry

New: Create a new sample metadata from scratch

Copy component: Copy from the saved sample metadata (parameter values are also copied)

Use Template: Create a new sample metadata using the template (parameter values are empty)

Users can create a new entry using the pre-stored template from pull-down menu.



4. Glycan binding sample metadata entry

Component Info				Tracking			
Descriptor Group / Descriptor	Value	Unit	Guidelines	Descriptor Group / Descriptor	Value	Unit	Guidelines
Sample type			MIRAGE Glycan Microarray	Source			
Species				► Commercial			
Subtype				► Collaborator			
Strain				Delivery Date			
► Database Entry			MIRAGE Glycan Microarray	Dispatch date			
Molecular weight							
► Antibody							
► Tag			MIRAGE Glycan Microarray				
► Label			MIRAGE Glycan Microarray				
Hazardous							
► Infectious							
► Toxic							
► Treated non-hazardous							
► Preservative							
► Storage condition							
Reference for the sample preparation							
► Recombinant							
► Natural							
► Synthetic							
Amount				Purity Q.C.			
Descriptor Group / Descriptor	Value	Unit	Guidelines	Descriptor Group / Descriptor	Value	Unit	Guidelines
Sample form				► Purity, Quantitative			MIRAGE Glycan Microarray
► Solid				► Qualitative			MIRAGE Glycan Microarray
► Solution							
► Aliquot							

* Liu, Yan, et al. "The minimum information required for a glycomics experiment (MIRAGE) project: improving the standards for reporting glycan microarray-based data." Glycobiology 27.4 (2017): 280-284.

4. Glycan binding sample metadata entry

The screenshot shows the CarbArrayART software interface with four main sections:

- Component Info:** A table with columns for Descriptor Group / Descriptor, Value, Unit, and Guidelines. It includes a sidebar with expandable categories like Database Entry, Antibody, Tag, Label, Hazardous, Infectious, Toxic, Treated non-hazardous, Preservative, Storage condition, Recombinant, Natural, and Synthetic.
- Tracking:** A table with columns for Descriptor Group / Descriptor, Value, Unit, and Guidelines. It includes a sidebar with Source, Commercial, Collaborator, and Delivery Date.
- Amount:** A table with columns for Descriptor Group / Descriptor, Value, Unit, and Guidelines. It includes a sidebar with Sample form, Solid, Solution, and Aliquot.
- Purity/Quality control:** A table with columns for Descriptor Group / Descriptor, Value, Unit, and Guidelines. It includes a sidebar with Purity, Quantitative, and Qualitative.

A red box highlights the 'Component Info' section, and a bulleted list describes its features:

- A default template exists in CarbArrayART designed based on MIRAGE Glycan Microarray Guidelines
- Four sections: (1) Component information, (2) Tracking, (3) Amount and (4) Purity and Quality control information
- The parameters compliant with MIRAGE guidelines are labelled in the 'Guidelines' column
- The item highlighted in red is a unique parameter which can be entered once

* Liu, Yan, et al. "The minimum information required for a glycomics experiment (MIRAGE) project: improving the standards for reporting glycan microarray-based data." Glycobiology 27.4 (2017): 280-284.

4. Glycan binding sample metadata entry: example entry

Descriptor Group / Descriptor	Value	Unit	Guideli...
Sample type	Recombinant		MIRAGE ...
Species	Homo sapiens		
▼ Database Entry			MIRAGE...
Database name	Protein Data Bank		MIRAGE ...
Database URI	https://www.rcsb.org		
ID	4MJ1		MIRAGE ...
ID URI	https://www.rcsb.org/structure/4...		
Molecular weight	151.94	kDa	
▼ Tag			MIRAGE...
Name	His-tag (polyhistidine or His6)		MIRAGE ...
Position	N-terminal		

Tools in CarbArrayART

1. Glycan probe entry tool

2. Subarray layout entry tool

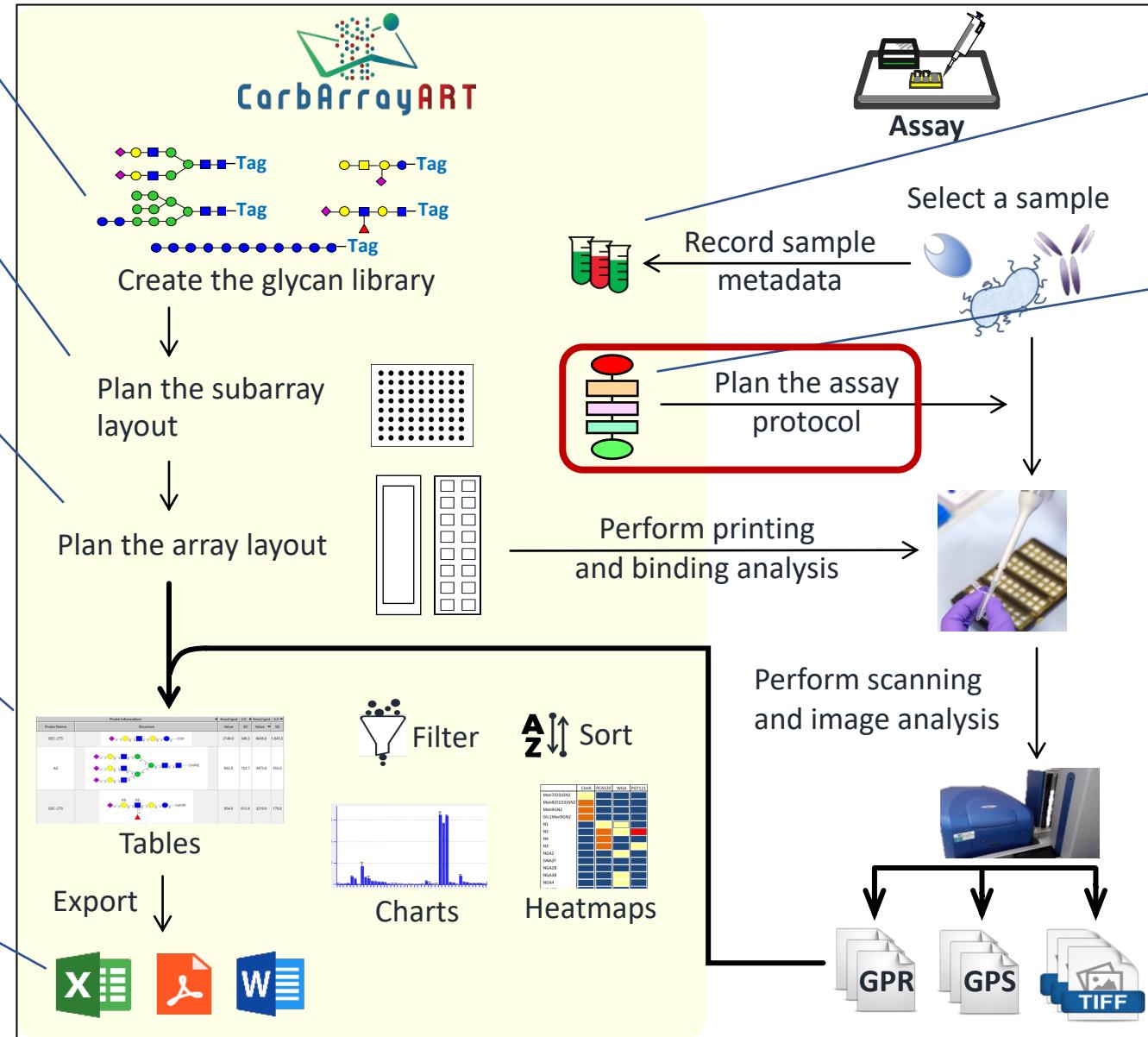
3. Slide layout entry tool

6. Data presentation

7. Data sharing

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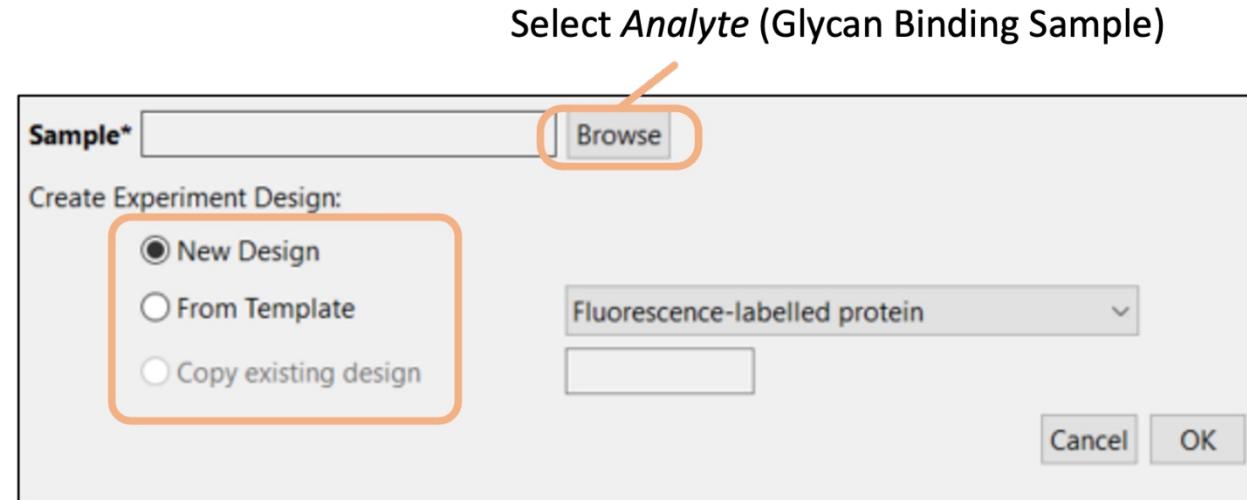
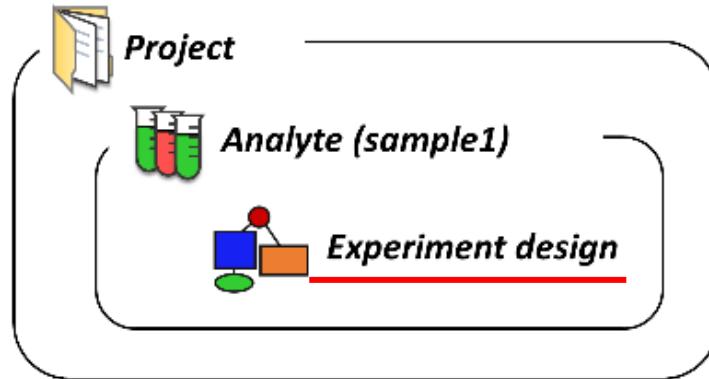
5. Experiment design tool



Left, yellow background:
The data management
workflow in CarbArrayART

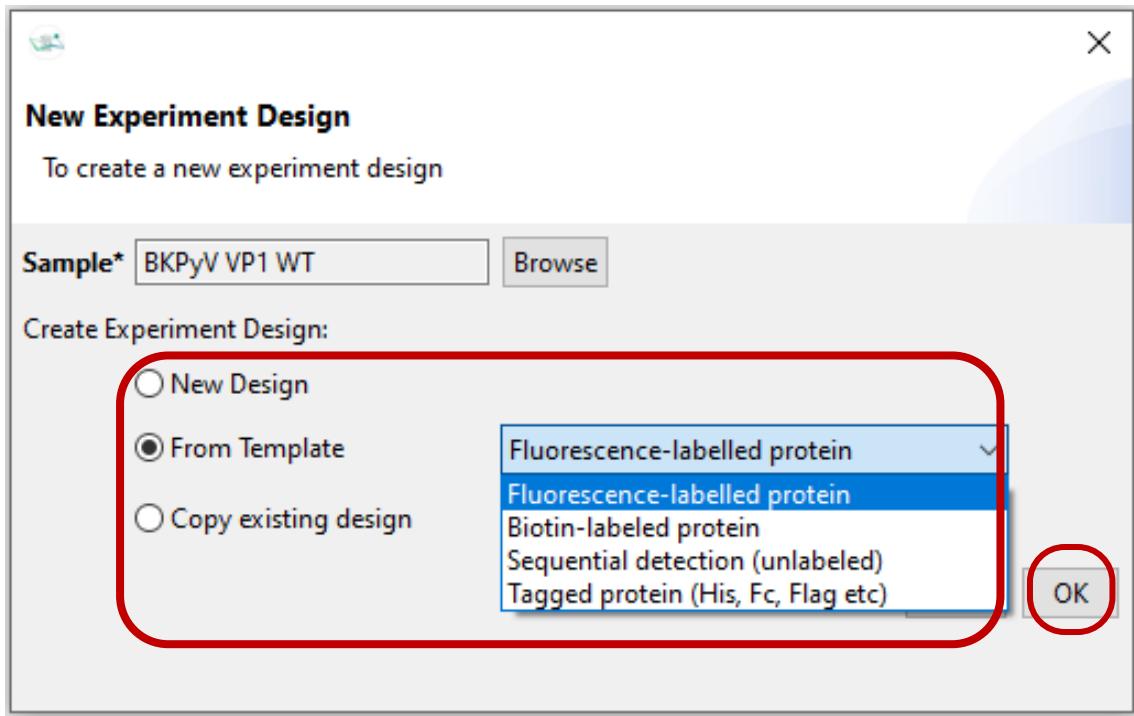
Right: The experiment
workflow

5. Experimental protocol designing tool



Protocol and metadata used for a glycan microarray experiment is linked to the *Analyte* (glycan binding sample) information.

5. Experimental protocol designing tool

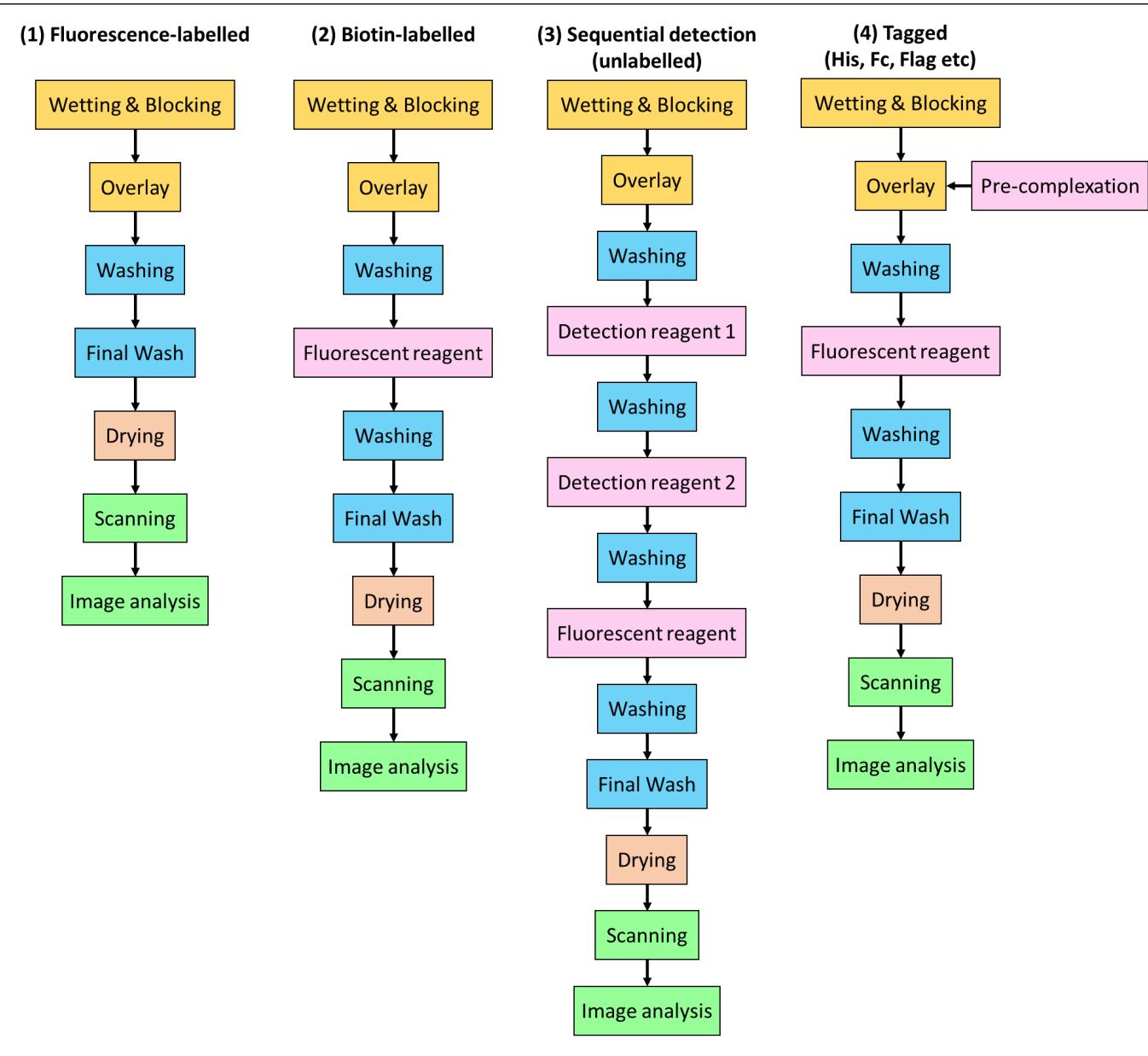


Users can create a new protocol using the template.

There are four pre-stored templates in CarbArrayART as default:

- Fluorescence-labelled sample
- Biotin-labelled sample
- Sequential detection (unlabelled)
- Tagged sample (His, Fc, Flag etc)

5. Experimental protocol designing tool

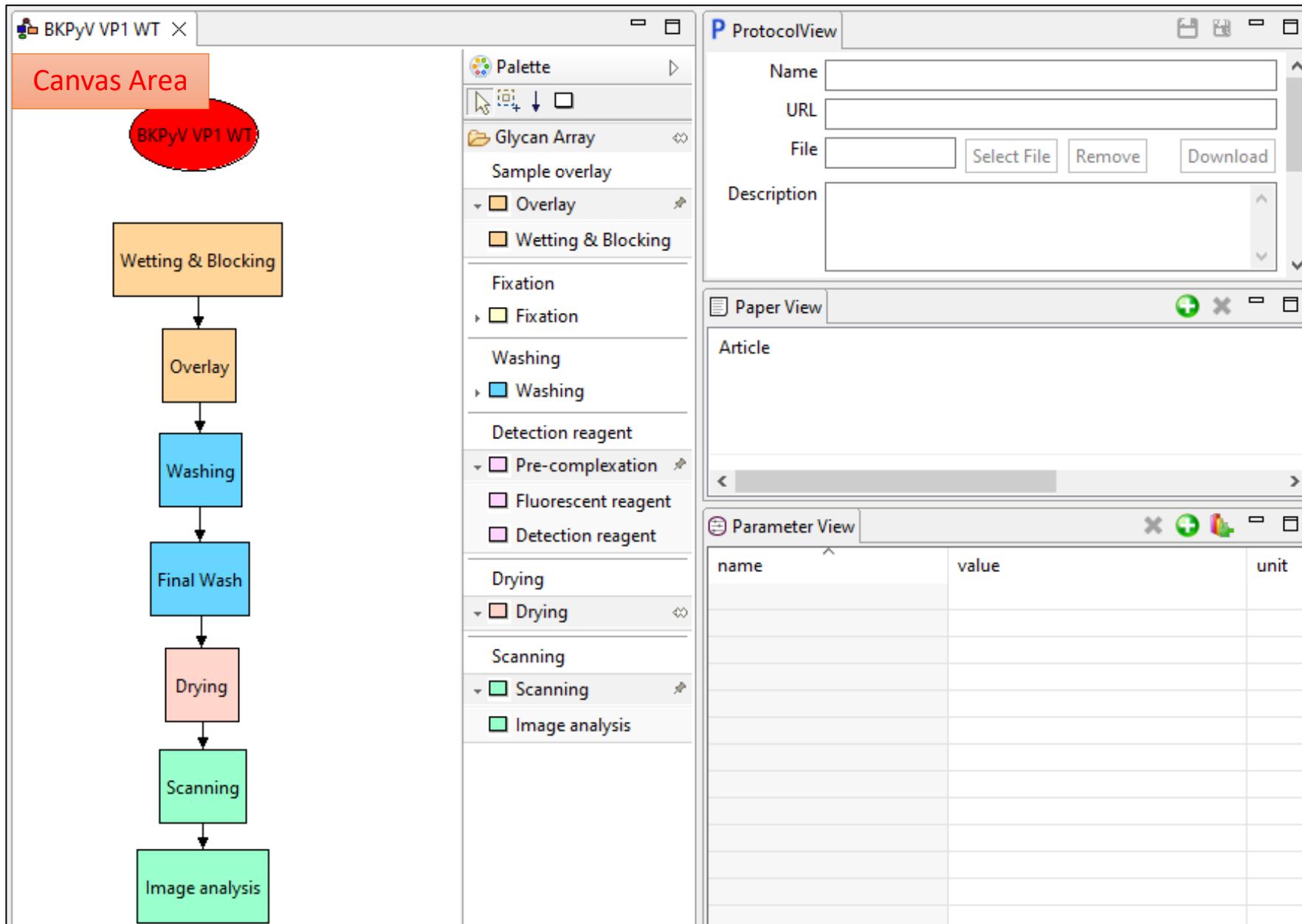


Users can create a new protocol using the template.

There are four pre-stored templates in CarbArrayART as default:

- Fluorescence-labelled sample
- Biotin-labelled sample
- Sequential detection (unlabelled)
- Tagged sample (His, Fc, Flag etc)

5. Experimental protocol designing tool



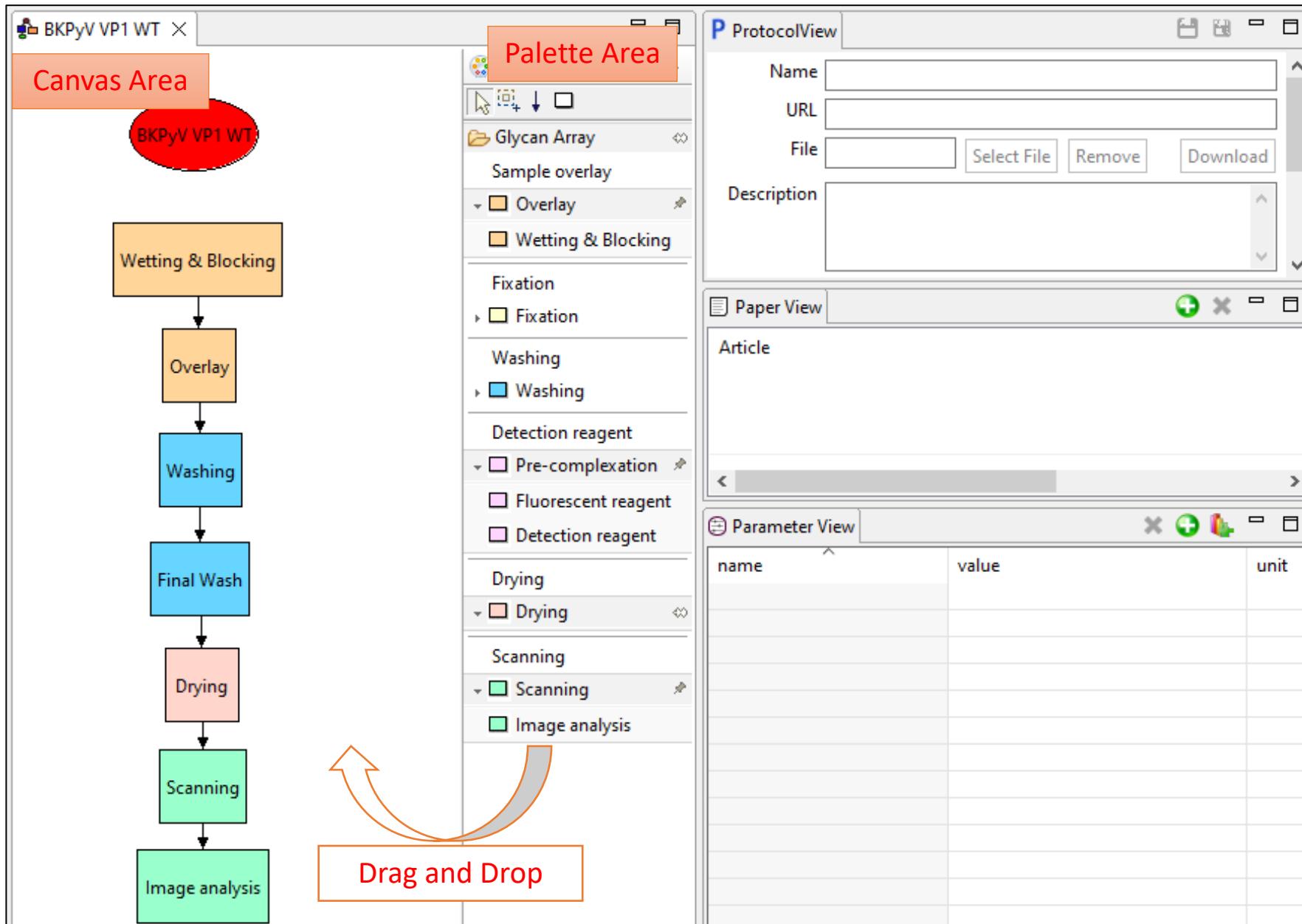
<Canvas>

Design an experiment workflow by locating boxes and arrows.

A box in the canvas indicates each step (protocol) such as 'Overlay' and 'Washing'.

An arrow indicates the flow of the steps.

5. Experimental protocol designing tool



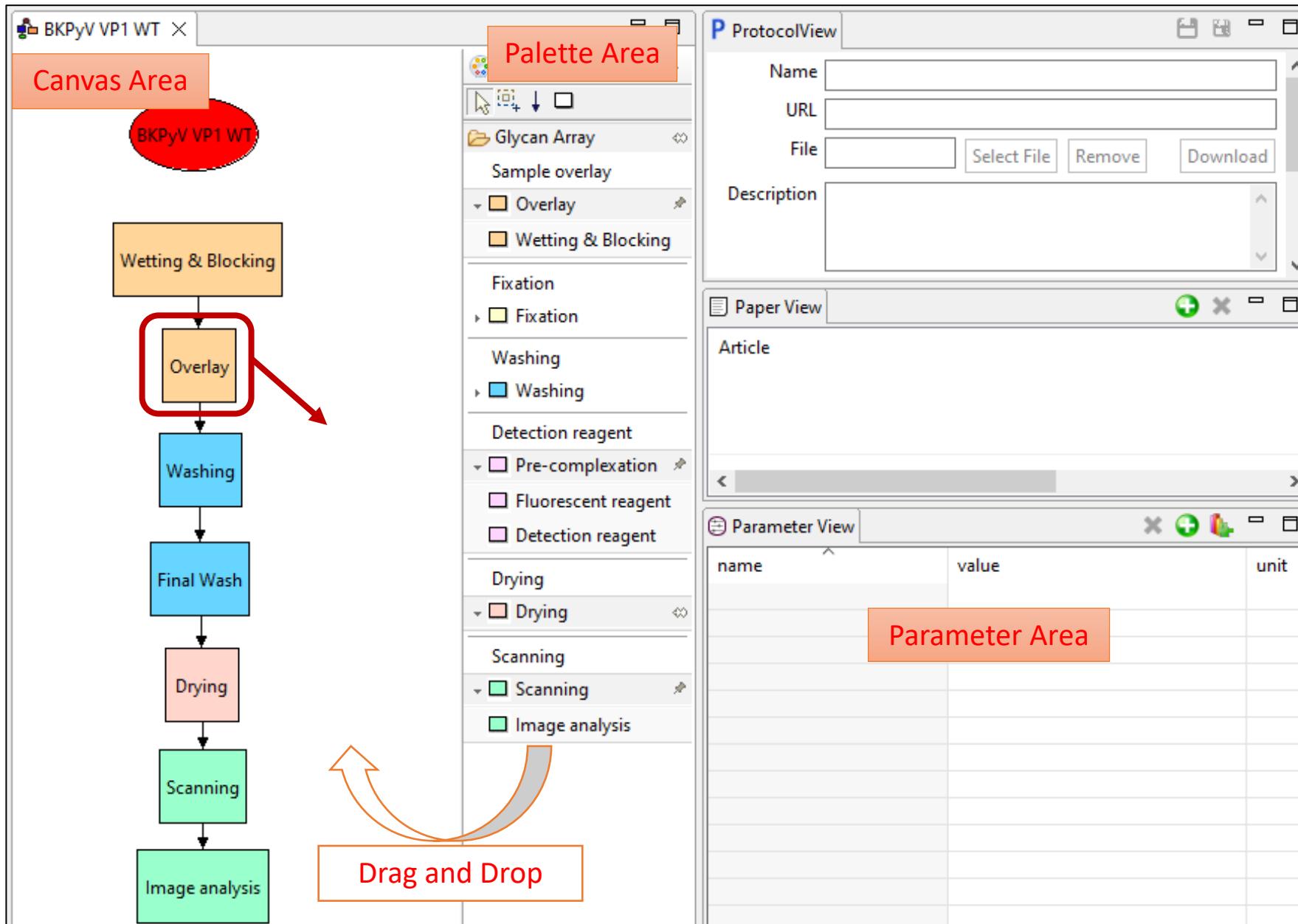
<Palette area>

Each box indicates the pre-stored protocols:

- (1) Sample overlay
- (2) Fixation
- (3) Washing
- (4) Detection reagent
- (5) Drying
- (6) Scanning

Users can create a new protocol from scratch by drag-and-drop boxes from the Palette Area and connect them with arrows.

5. Experimental protocol designing tool



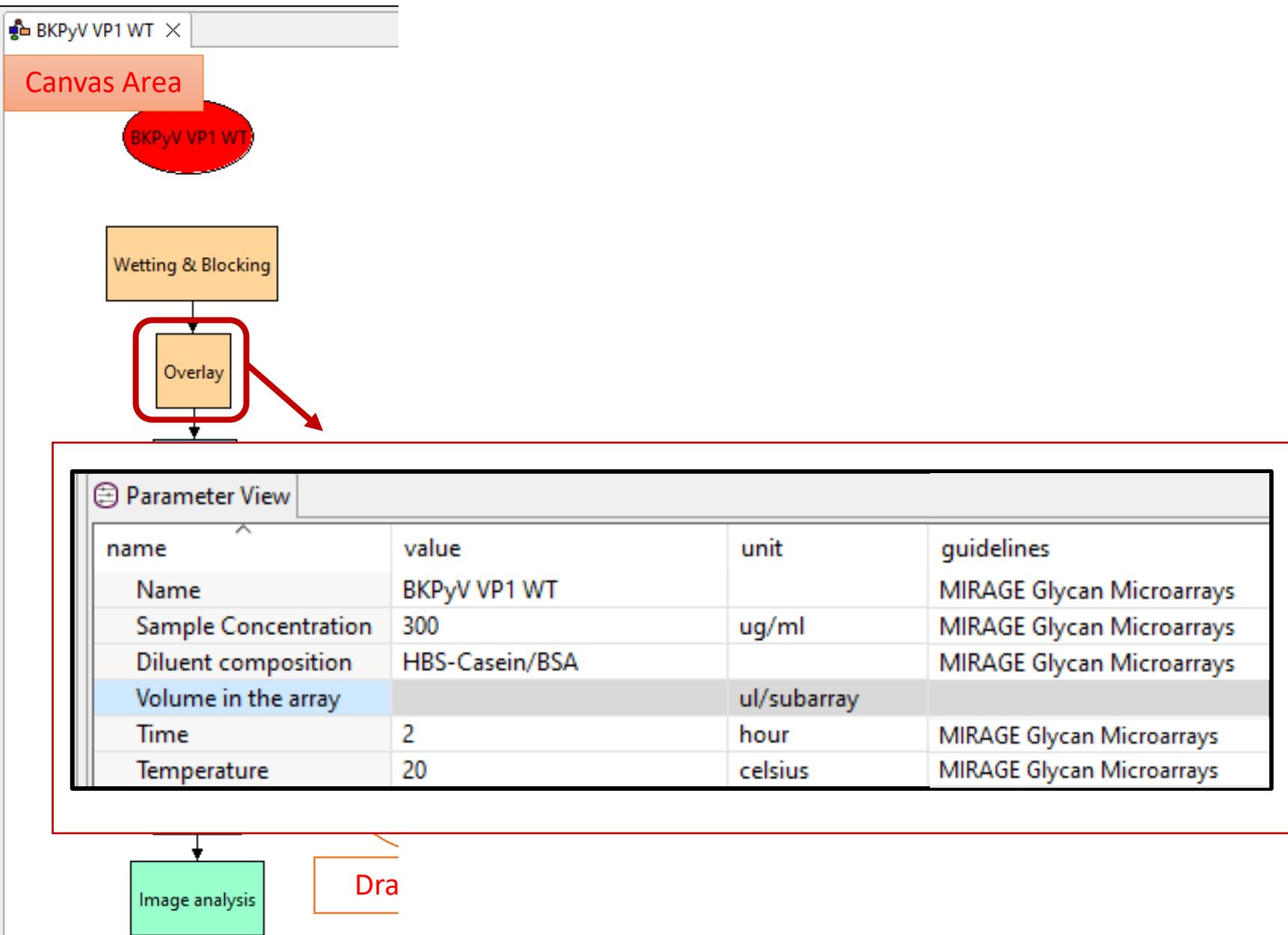
<Parameter area>

The metadata corresponding to the protocol are stored in this section.

Each protocol has a pre-stored metadata list in CarbArrayART based on the MIRAGE Glycan Microarray Guidelines.

The parameters compliant with MIRAGE guidelines are labelled in the 'Guidelines' column.

5. Experimental protocol designing tool



<Parameter area>

The metadata corresponding to the protocol are stored in this section.

Each protocol has a pre-stored metadata list in CarbArrayART based on the MIRAGE Glycan Microarray Guidelines.

The parameters compliant with MIRAGE guidelines are labelled in the 'Guidelines' column.

Tools in CarbArrayART

1. Glycan probe entry tool

2. Subarray layout entry tool

3. Slide layout entry tool

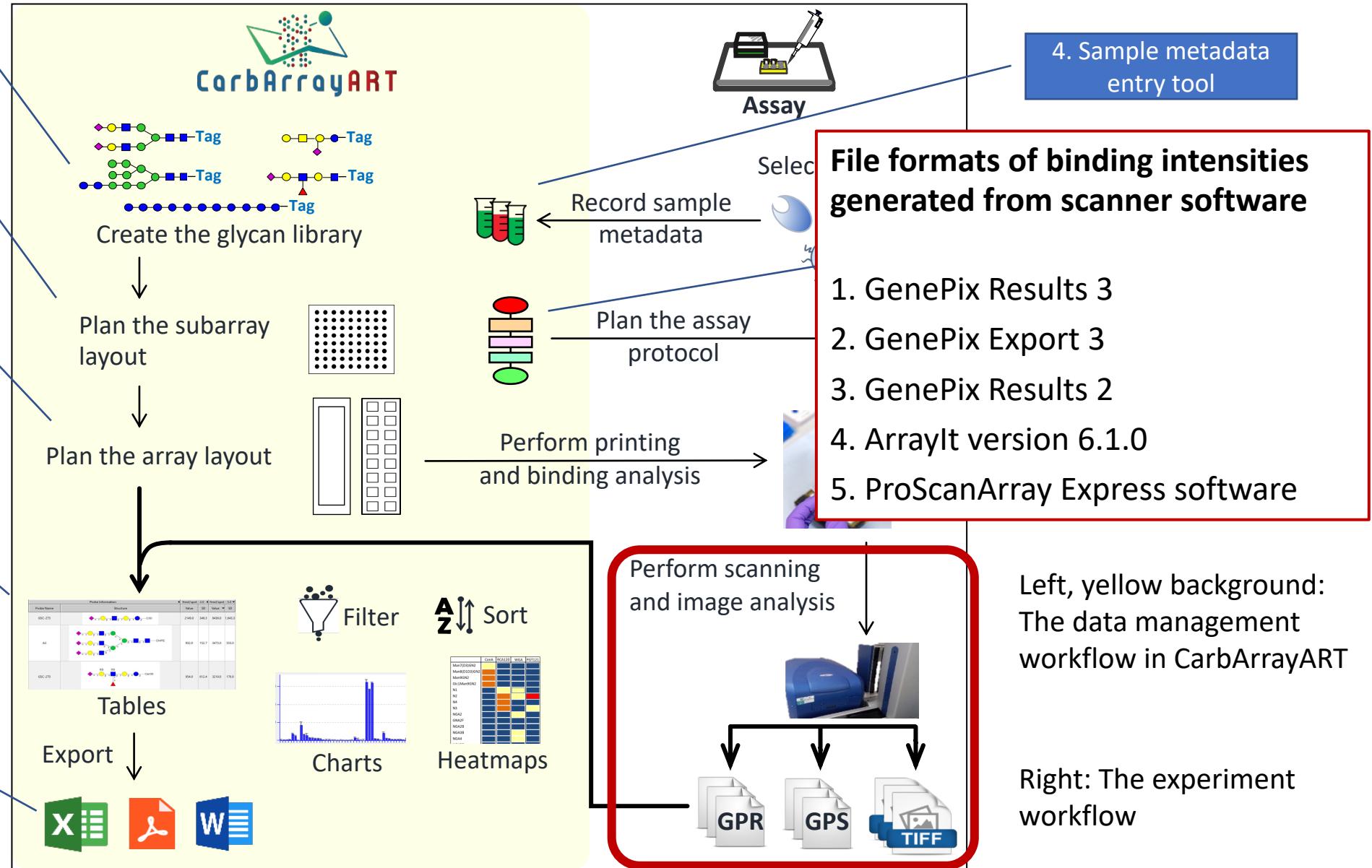
6. Data presentation

7. Data sharing

4. Sample metadata entry tool

File formats of binding intensities generated from scanner software

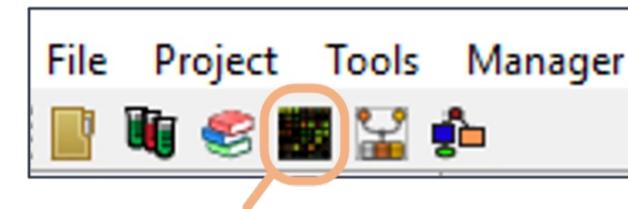
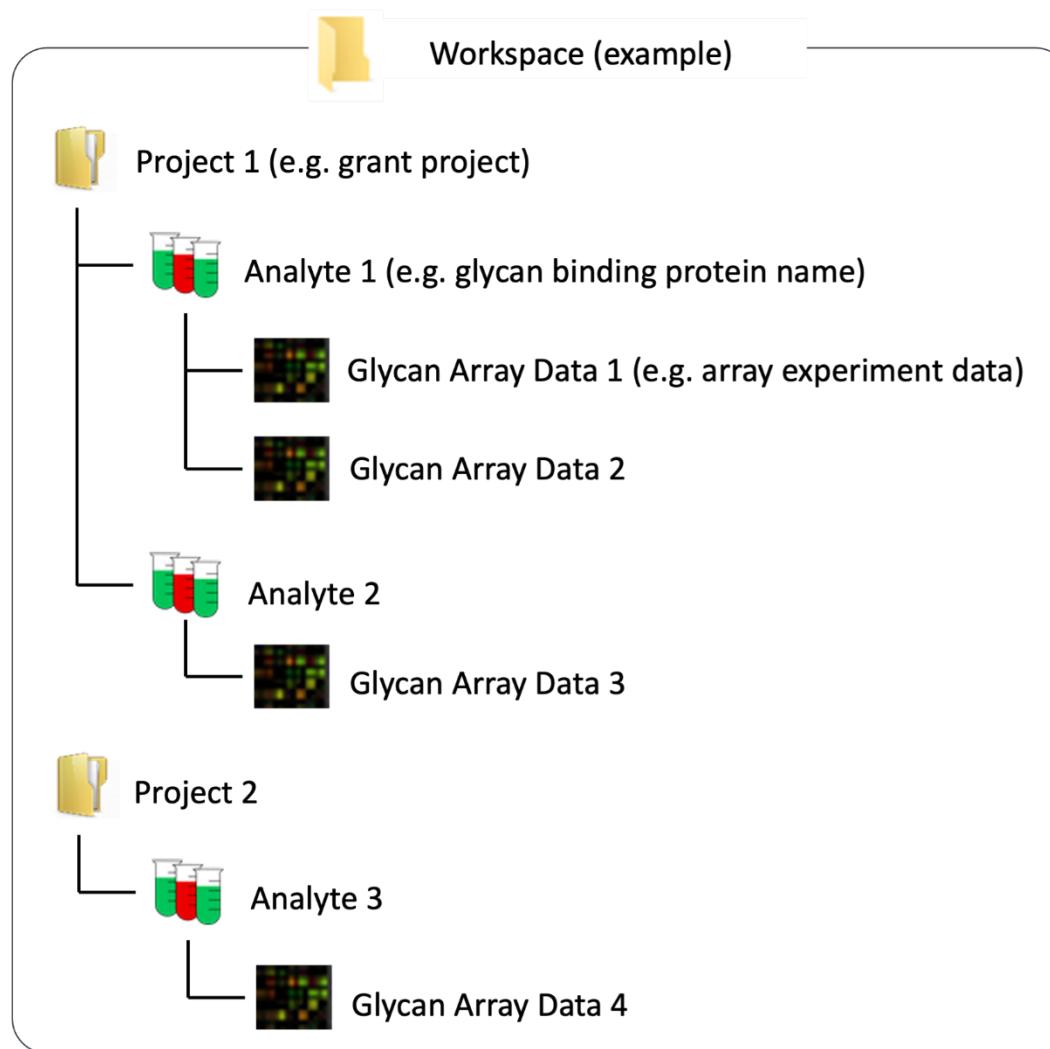
1. GenePix Results 3
2. GenePix Export 3
3. GenePix Results 2
4. ArrayIt version 6.1.0
5. ProScanArray Express software



Left, yellow background:
The data management workflow in CarbArrayART

Right: The experiment workflow

6. Data presentation: Create a new *Project, Analyte and Glycan Array Data*



Create a new Glycan Array Data

6. Data presentation: Glycan Array Data – parameter entry

The screenshot displays a software window with five input fields, each labeled with a number from 1 to 5:

- 1** Name:
- 2** File Type:
- 3** Number of Slides:
- 4** Statistical Method:
- 5** Signal to Use:

- 1. Name** – A name of scan data
- 2. File Type** – GenePix (gpr) or ProScan (Excel)
- 3. Number of Slides** – The number of slides used per experiment (in many cases 1 slide per experiment)
- 4. Statistical Method** – Select one from: Average or Elimination
 - * Elimination method calculates an average value after removing the maximum and the minimum values per glyco-probe
- 5. Signal to Use** – Select one from: Median-B, Mean-B, Median or Mean (*'B' stands for Background)

6. Data presentation: Glycan Array Data – scan file upload

After selecting the pre-saved array layout and glycan binding sample tested, users can upload the scan file(s).

Select the fluorophore used if it is recorded in the scanned file

Slide	File Name	File Type	Scan Power(s)	Fluorophore (select one)
▼ Slide 1	Alexa slide 1 set...	GenePix	85.0	Alexa 647
	Alexa slide 1 set...	GenePix	90.0	Alexa 647
	Alexa slide 1 set...	GenePix	100.0	Alexa 647
	Cy3 slide 1 sets ...	GenePix	100.0	Cyanine 3

Upload Files

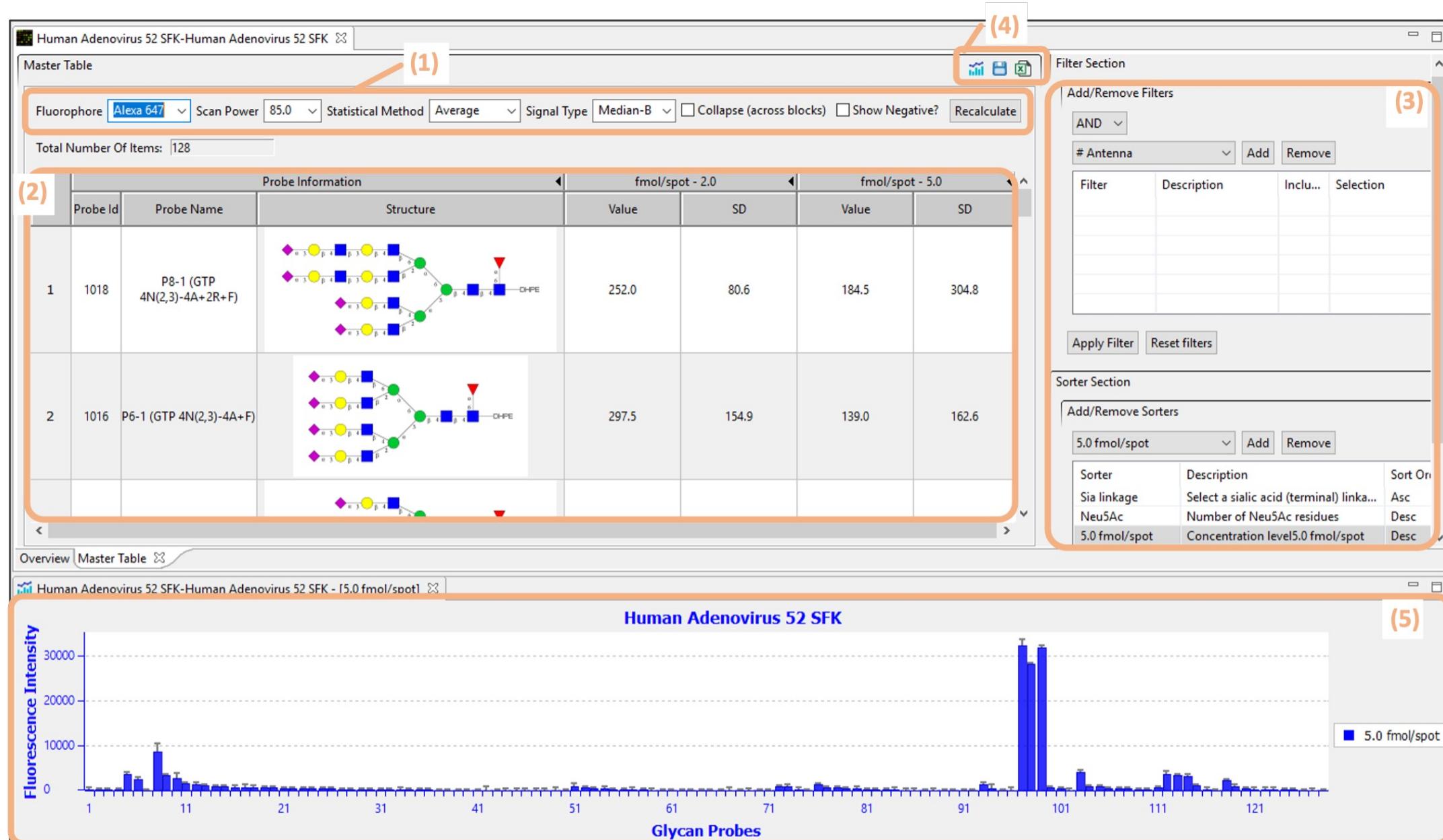
Alexa 647

Cyanine 3

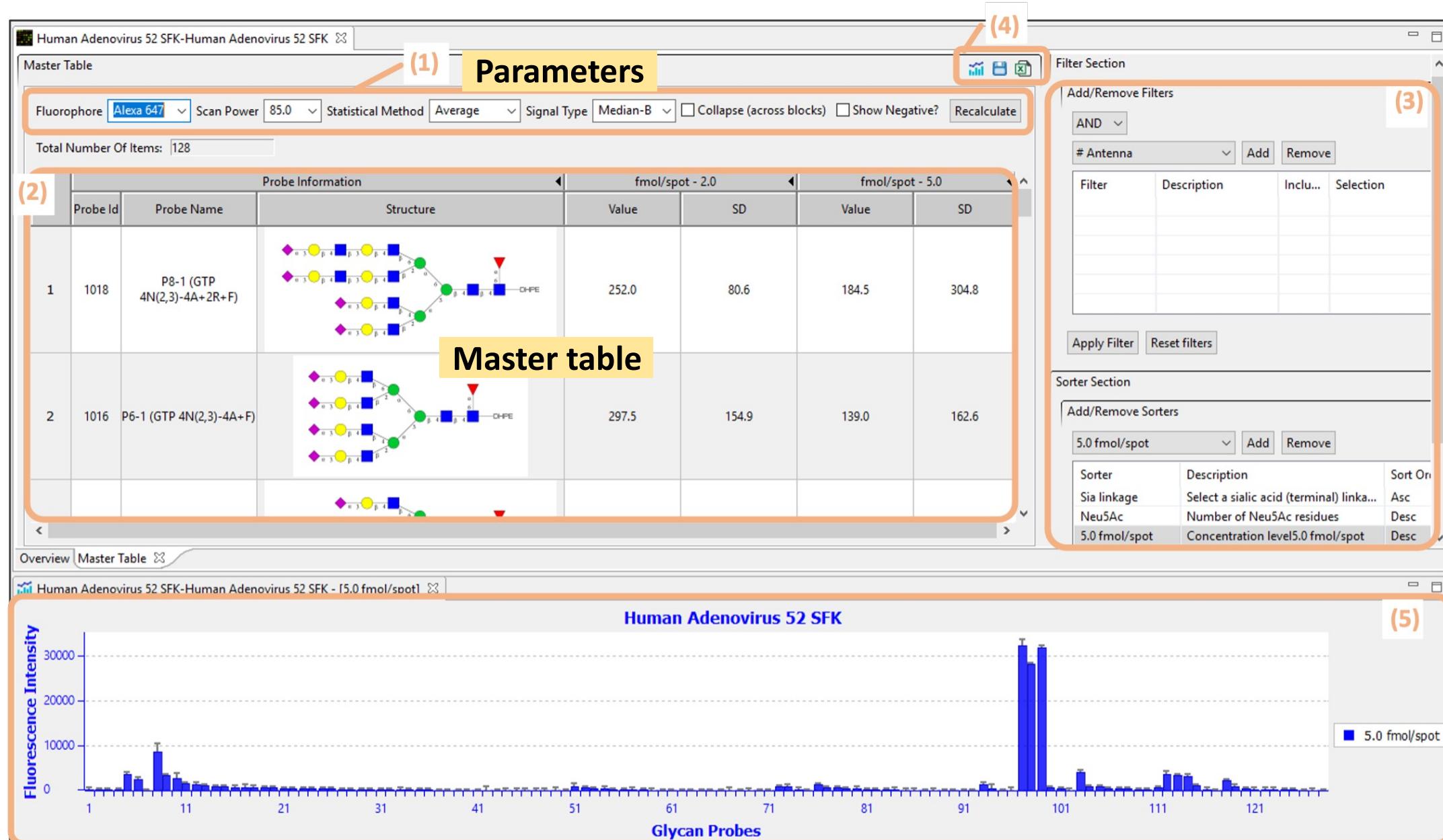
Cyanine 5

< Back Next > **Finish** Cancel

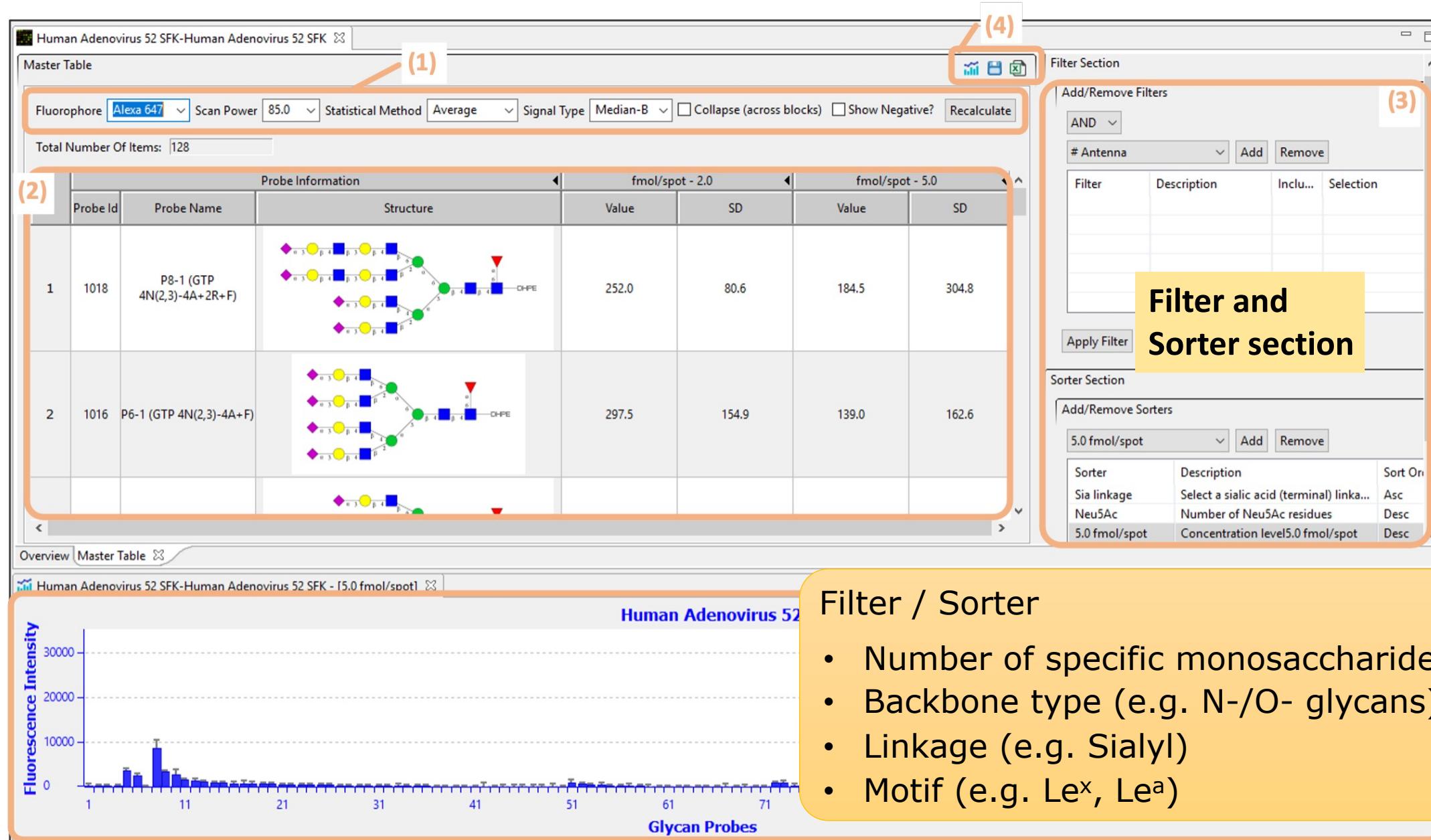
6. Data presentation: Tabulation view



6. Data presentation: Tabulation view



6. Data presentation: Tabulation view



6. Data presentation: Tabulation view

Tool buttons (4)

Filter Section (3)

Histogram view (5)

Master Table

Fluorophore: Alexa 647 | Scan Power: 85.0 | Statistical Method: Average | Signal Type: Median-B | Collapse (across blocks) | Show Negative? | Recalculate

Total Number Of Items: 128

Probe Information

Probe Id	Probe Name	Structure	fmol/spot - 2.0		fmol/spot - 5.0	
			Value	SD	Value	SD
1	P8-1 (GTP 4N(2,3)-4A+2R+F)		252.0	80.6	184.5	304.8
2	P6-1 (GTP 4N(2,3)-4A+F)		297.5	154.9	139.0	162.6

Overview | **Master Table**

Human Adenovirus 52 SFK - [5.0 fmol/spot]

Fluorescence Intensity

Human Adenovirus 52 SFK

Glycan Probes

5.0 fmol/spot

47

Monosaccharides and Motifs for filtering and sorting

- 78 types of monosaccharides
- 72 motifs
- Acidic
- Number of branch
- Number of monosaccharides
- Terminal linkage (e.g. Neu5Ac α2,3 terminal)

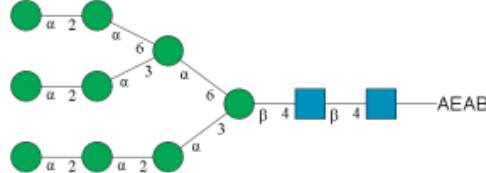
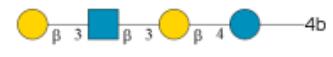
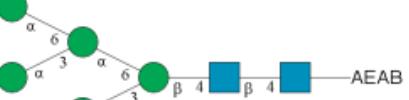
Name	Acidic
Fuc (Fucose)	▲
Gal (Galactose)	●
GalNAc (N-acetyl-galactosamine)	■
Glc (Glucose)	●
GlcA (Glucuronic acid)	◇ ✓
GlcNAc (N-acetyl-glucosamine)	■
IdoA (Iduronic acid)	◆ ✓
Kdo (3-deoxy-manno-octulosonic acid)	○ ✓
Man (Mannose)	●
Neu5Ac (N-acetylneurameric acid)	◆ ✓
Neu5Gc (N-glycolylneurameric acid)	◇ ✓
Kdn (3-deoxy-glycerol-galacto-nonulosonic acid)	◆ ✓
Ara (Arabinose)	★
Rha (Rhamnose)	▲
Xyl (Xylose)	★
Phosphate	✓
Sulphate	✓

6. Data presentation: Create heatmaps using the comparing tool

Data Compare Example X

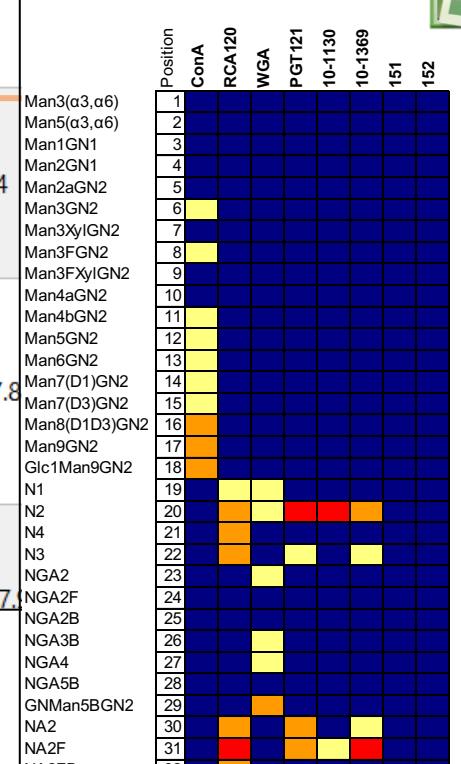
Master Table

Total Number Of Items: 66

Probe Id	Probe Name	Probe Information		GlyTouCan ID	AAL:100.0 uM		WGA:100.0 uM	
		Structure	Glycan ID		Value	SD	Value	SD
1	Man9-GN2-AEAB (NG015)		G56202TA	271.5	98.0	11734.0	1,816.2	
2	LNT-4b		G45827GY	19.25	34.6	7.5	4.4	
3	Man5-GN2-AEAB (NG016)		G03652TR	99.5	149.1	205.25	327.8	
4	Lex-Tri		G01187XC	11.75	14.2	4218.25	2,817.1	

An Excel file for creating heatmaps is included in the CarbArrayART software package.





Legend for heatmap colors:

- <10% (Light Yellow)
- 10-30% (Yellow)
- 30-70% (Orange)
- 70-100% (Red)

Tools in CarbArrayART

1. Glycan probe entry tool

2. Subarray layout entry tool

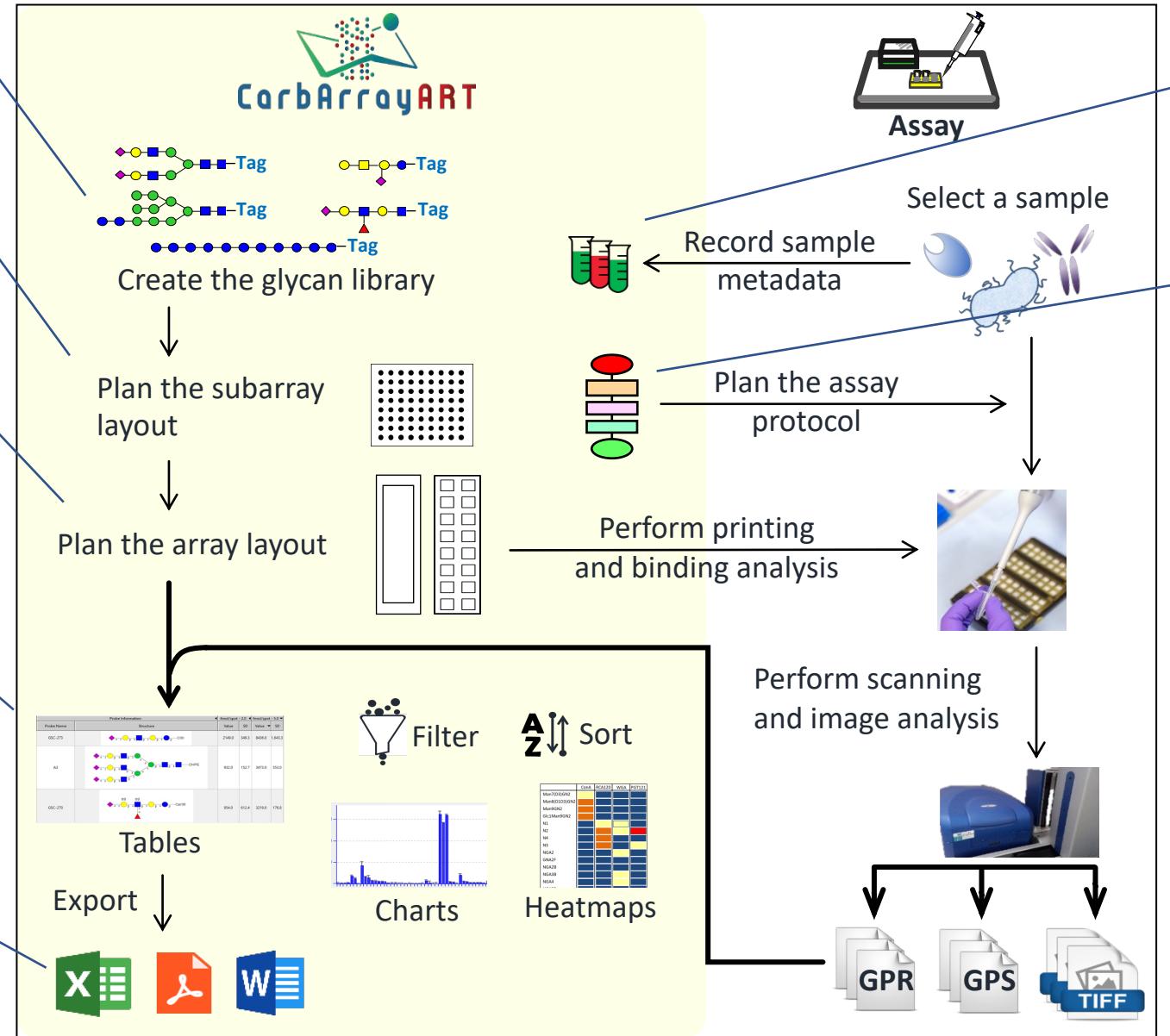
3. Slide layout entry tool

6. Data presentation

7. Data sharing

4. Sample metadata entry tool

5. Experiment design tool

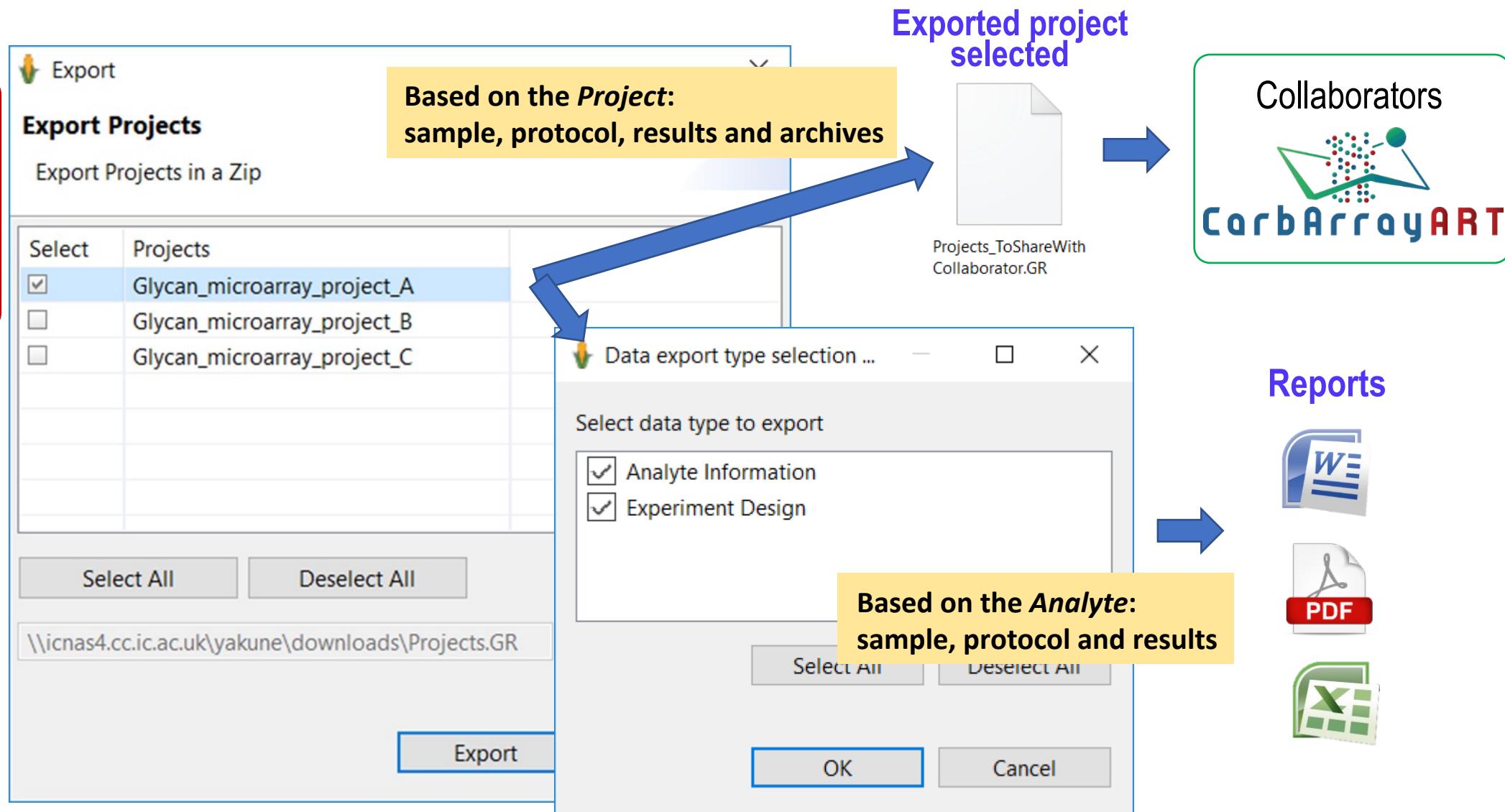
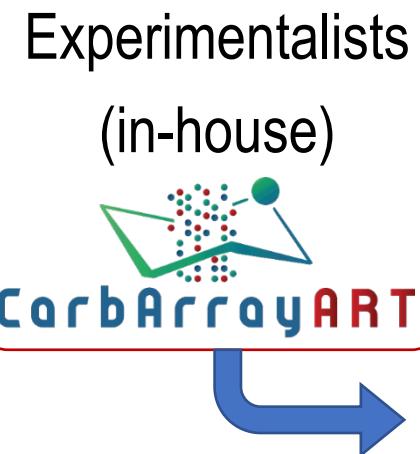


Left, yellow background:
The data management
workflow in CarbArrayART

Right: The experiment
workflow

Data sharing / publication

Data sharing with collaborators: Data export as Project(s) and Reports



Data export: Word file

User's manual and video tutorials

<http://carbarrayart.org>

Manual and Support

 Home



Manual

- Manual for sections
 - 1. [Introduction](#)
 - 2. [Software architecture](#)
 - 3. [How to download and open the software](#)
 - 1. CarbArrayART download
 - 2. [Installation and starting CarbArrayART](#)
 - [Windows](#)
 - [Mac](#)
 - 3. [Select workspace](#)
 - 4. [Glosarray of terms used in the software](#)
 - [Key terminologies](#)
 - 5. [Minimum information required for glycan microarray data presentation](#)
 - 6. [CarbArrayART: Front page](#)

Video tutorials

- [How to start CarbArrayART \(Windows\)](#)
- [Glycan probe entry tool](#)
- [Subarray layout entry tool](#)
- [Array \(slide\) layout entry tool](#)
- [How to record Sample \(Analyte\) metadata](#)
- [Filtering function using glycan probe levels](#)

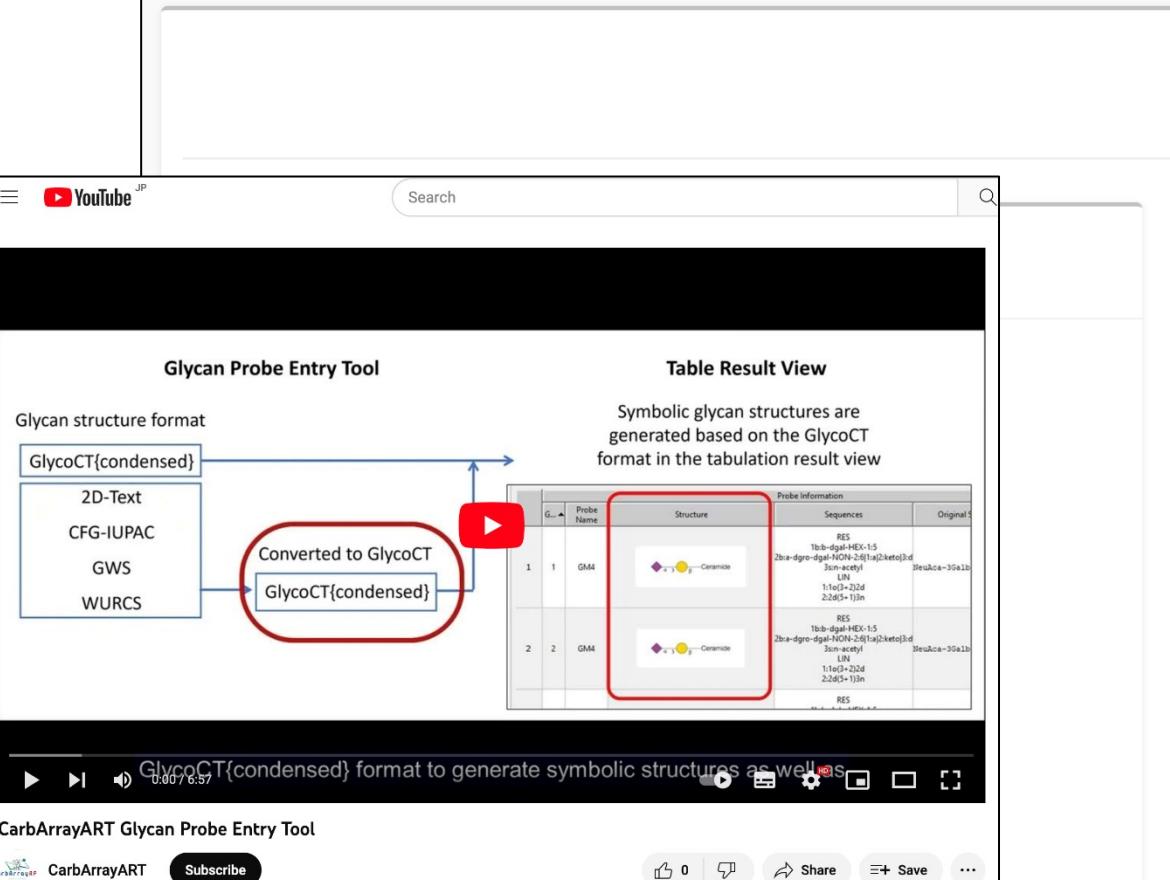
More videos coming soon...

User's manual and video tutorials

<http://carbarryart.org>

Manual and Support

[Home](#)



Glycan Probe Entry Tool

Glycan structure format

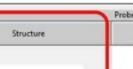
- GlycoCT{condensed}
- 2D-Text
- CFG-IUPAC
- GWS
- WURCS

Converted to GlycoCT

GlycoCT{condensed}

Table Result View

Symbolic glycan structures are generated based on the GlycoCT format in the tabulation result view

Probe Name	Structure	Probe Information
1 1 GM4	 Ceramide	Sequences RES 1b:b-dgal-HEX-1:5 2ba-dgro-dgal-NON-2:6[1a]2[keto]3:d 3[acetyl]LIN 1:1[glc-2:2d 2:2[glc-1]3n
2 2 GM4	 Ceramide	Sequences RES 1b:b-dgal-HEX-1:5 2ba-dgro-dgal-NON-2:6[1a]2[keto]3:d 3[acetyl]LIN 1:1[glc-2:2d 2:2[glc-1]3n
		RES

GlycoCT{condensed} format to generate symbolic structures as well as

CarbArrayART Glycan Probe Entry Tool

CarbArrayART [Subscribe](#)

0 0 Share Save ...

data presentation

6. CarbArrayART: Front page



Video tutorials

- How to start CarbArrayART (Windows)
- Glycan probe entry tool
- Subarray layout entry tool
- Array (slide) layout entry tool
- How to record Sample (Analyte) metadata
- Filtering function using glycan probe levels

More videos coming soon...

Future direction: CarbArrayART as a vehicle for transfer of the data to and from the repository



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- Lisete M. Silva (University of Aveiro / ICL)



Thank you very much!

<http://carbarrayart.org>

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The next talk will be...

27th February 2023 10AM (EST)



Dr. Akul Y Mehta

National Center for Functional Glycomics

Title: Using GLAD for exploratory glycan microarray
data analysis and visualization