



# ALTA: A BRDF analysis library

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# Motivations & Goals



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# The “BRDF Map”

SGD [Bagher et al. 2012]

GGX [Walter et al. 2007]

Ashikmin & Shirley [2000]

He et al. [1991]

Ashikmin et al. [2000]

Lafortune et al. [1997]

Neumann and Neumann [1996]

ABC [Löw et al. 2012]

Ward [1992]

Cook & Torrance [1982]

Hanrahan & Kruger [1993]

Blinn [1977]

Beard-Maxwell [1973]

Oren & Nayar [1994]

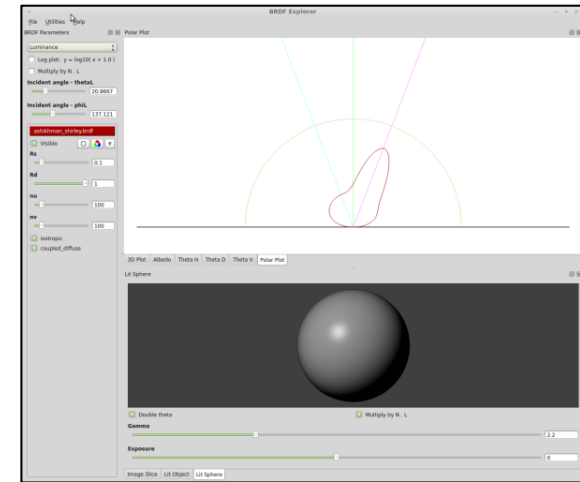
Granier & Heidrich [2003]

Schlick [1994]

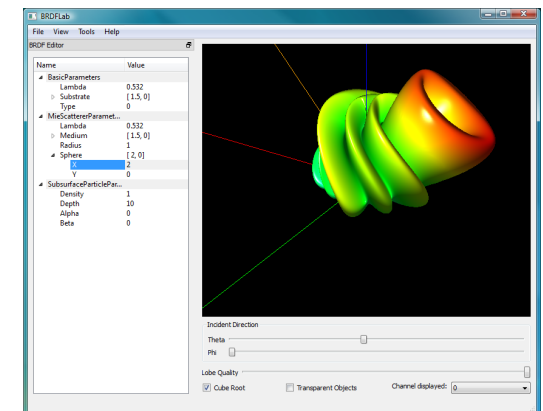
Rational BRDFs [Pacanowski et al. 2012]

# Motivations & Goals

- Understanding BRDF
  - 4D space is complex to visualize
  - Estimating model parameters from data is hard
- Available tools are limited
  - Tools in CG are mostly for preview
  - Tools in other fields are specialized ([Gwyddion](#), [MiePlot](#), ...)



BRDF Explorer



BRDFLab

# Motivations & Goals

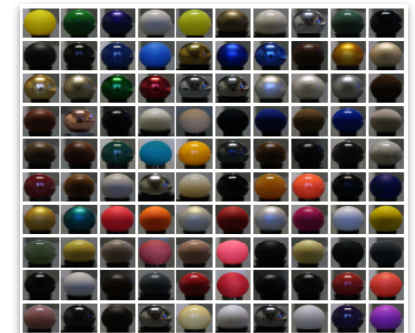
- Heterogeneous measurements
  - plastics and metals mostly
  - different sampling density
  - a few under sampled anisotropic BRDF
- Heterogeneous data formats
  - binary / text
  - various parametrizations
  - incomplete/extrapolated data



Cornell



CURET

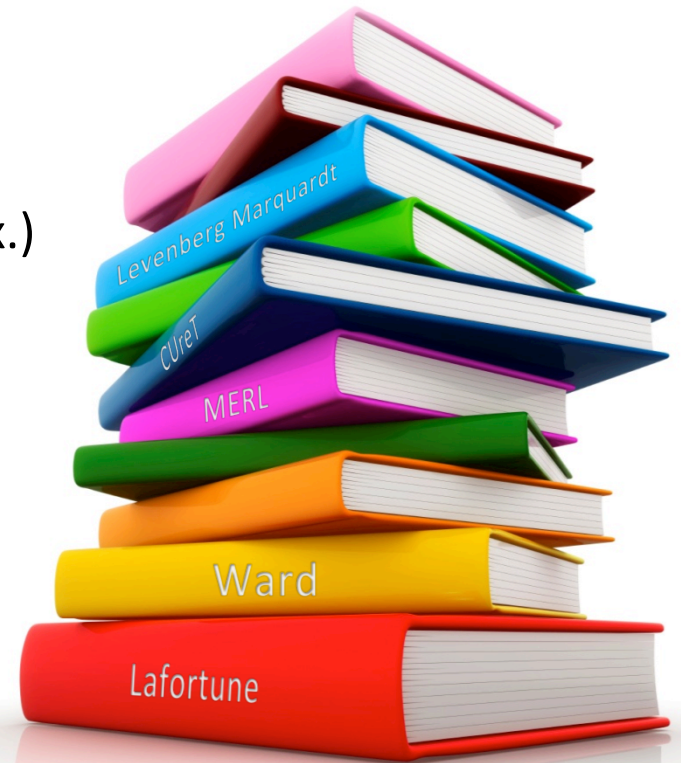


MERL



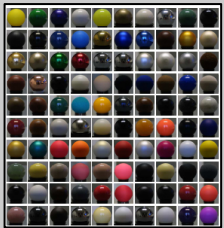
# Introducing ALTA

- Open-source C++ Library
  - Comparison of models (fitting & approx.)
  - Analysis of data
  - Cross platform
- Plugins mechanism
  - Easy to extend
  - Interact with existing (BRDF Explorer)

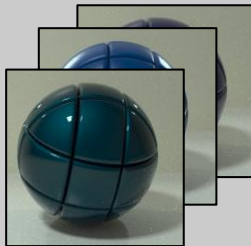


# ALTA overview

## Compatible data



MERL



ASTM

## BRDF Models or Functions

[Low et al. 2012]

[Lafortune et al. 2012]

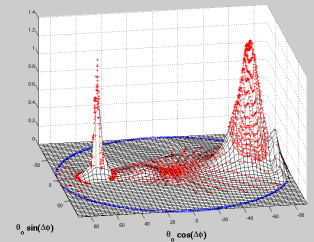
[Beckmann & Spizzichino 1987]

[Pacanowski et al. 2012]

[Blinn 199X]

[Ward 199X]

## Tools

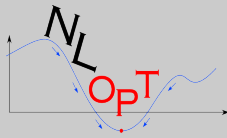


Data interpolation

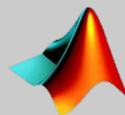
$$\int_X x^k f(x) dx$$

Moment analysis

## Fitters



*nonlinear  
optimization*



Matlab

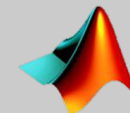
QuadProg++



*quadratic  
programming*

## Compatibility

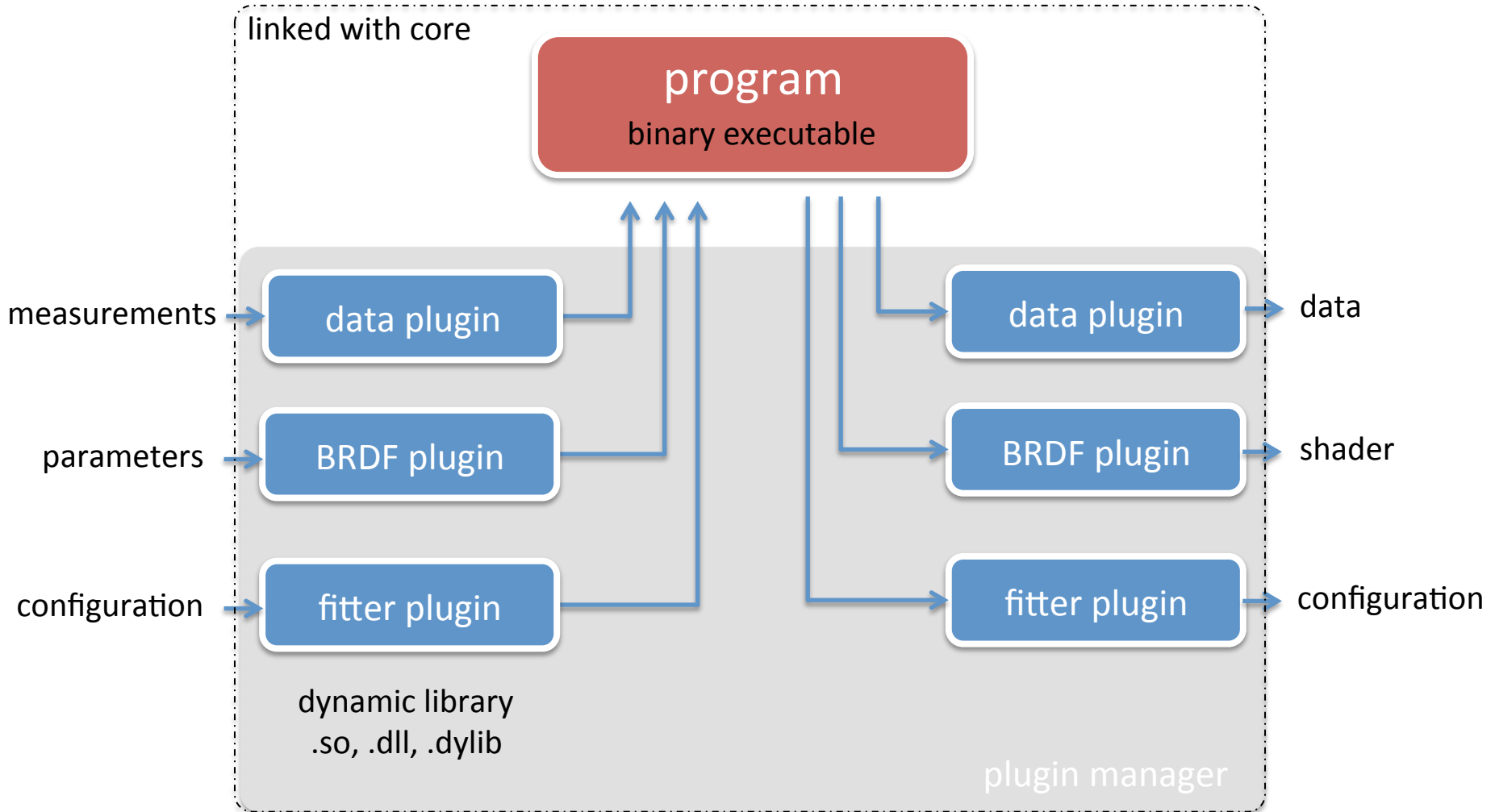
BRDF Explorer



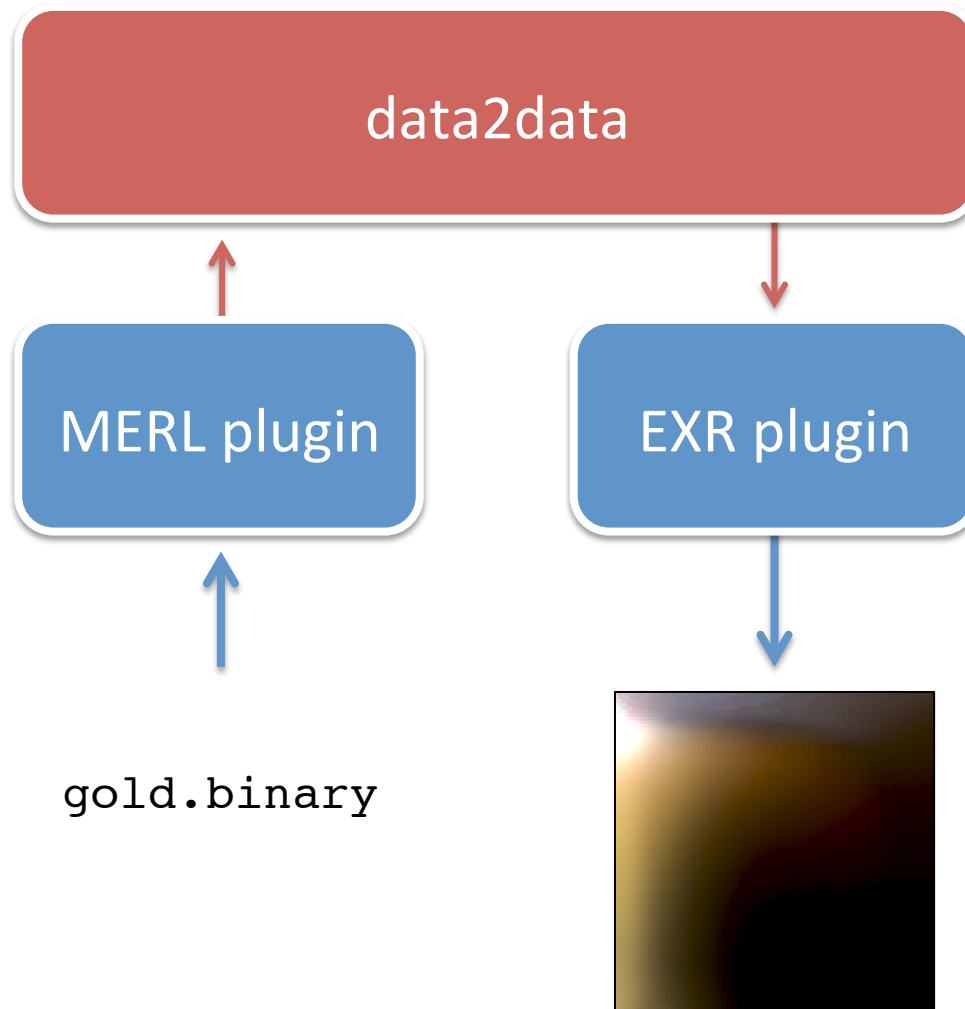
Matlab



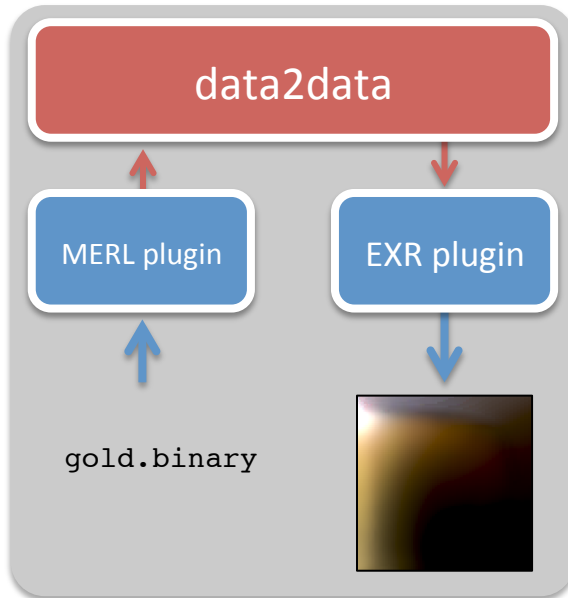
# ALTA Architecture



# Usage example: data conversion



# Usage example: data conversion



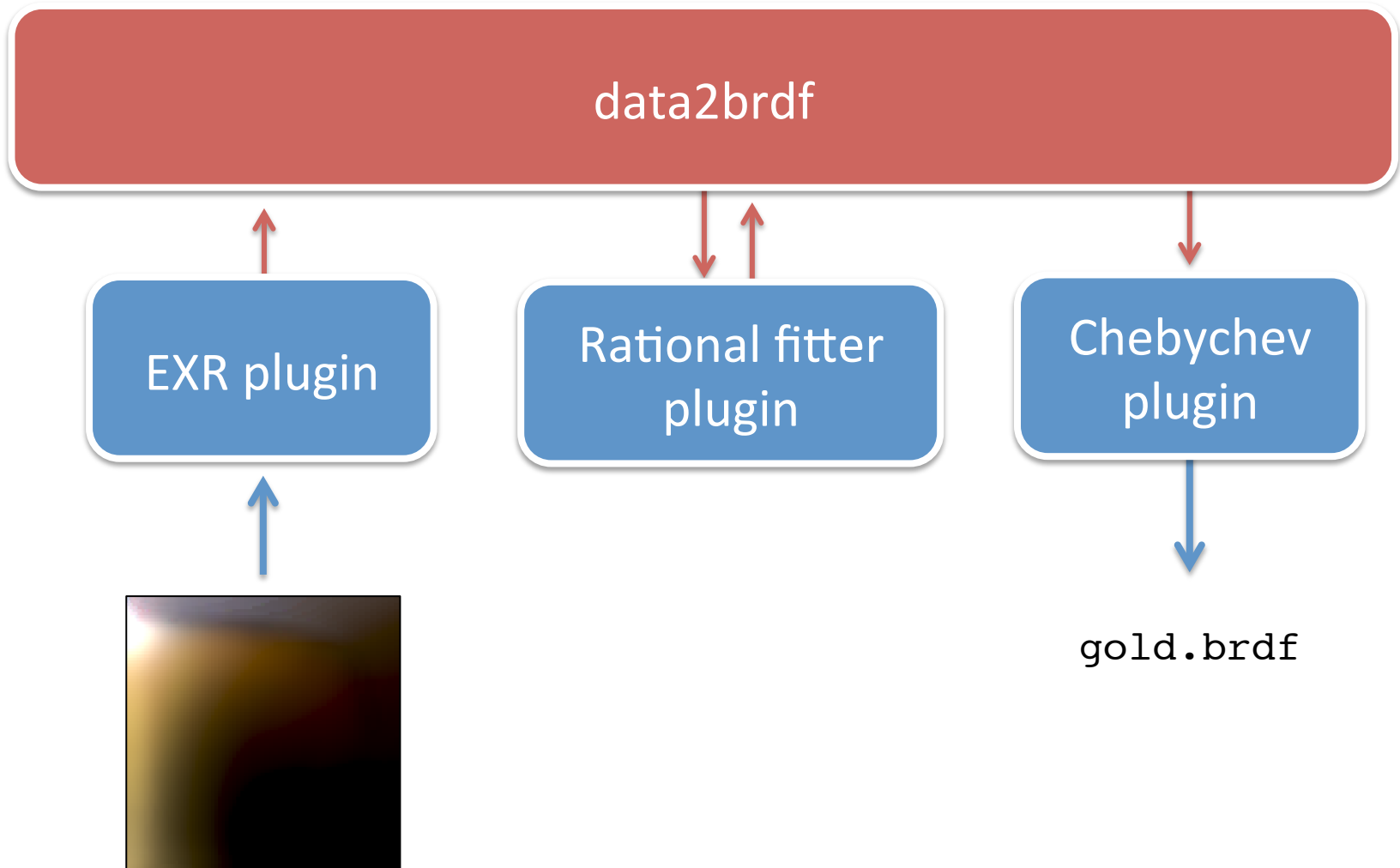
$$\rho(\theta_h, \theta_d, \phi_d)$$

↓

$$\rho(\theta_h, \theta_d), \text{ with } \phi_d = \frac{\pi}{2}$$

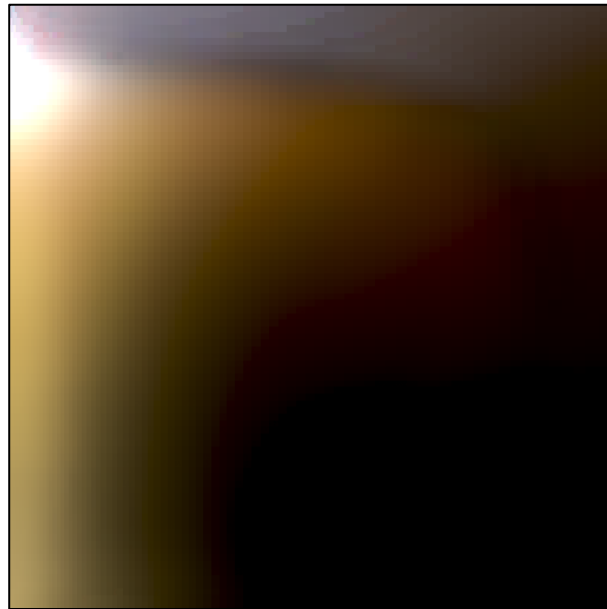
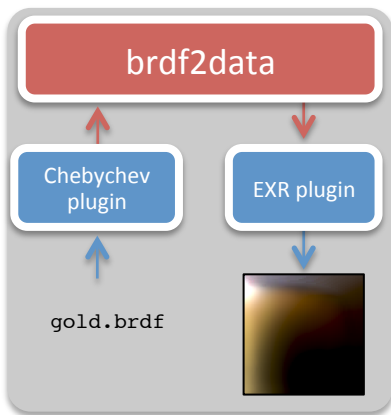
```
laurent$ ./build/data2data --input ~/Research/Data/Merl/gold-metallic-paint.binary --in-data ./build/libdata_merl.dylib --output ../data/2d/merl/gold-met.exr --out-data ./build/libdata_brdf_slice.dylib
```

# Fitting a rational function

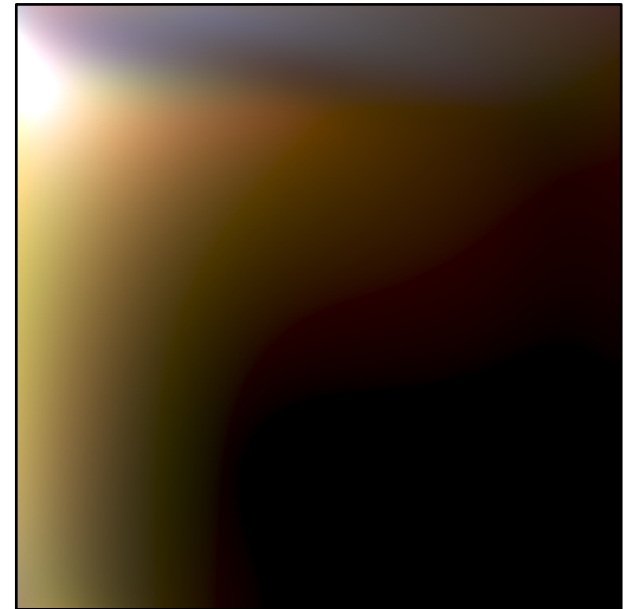




# Comparing data and fitting results



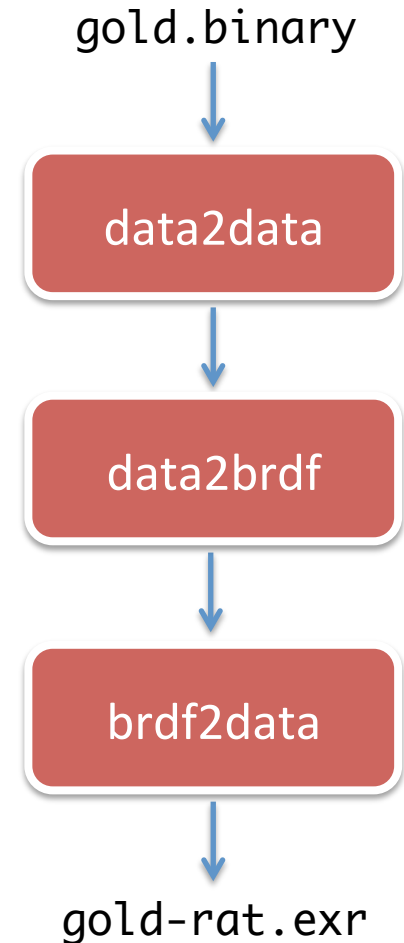
input BRDF slice



conversion from BRDF  
file to data file using `brdf2data`

# XML and scripting capabilities

- Each program has a command line
- Concatenating programs
  - Create complex processes
  - Can be automated using bash scripts
- But ..
  - OS dependent
  - Not ideal for sharing



# XML and scripting capabilities

```
<?xml version="1.0"?>
<alta>
<action name="data2data">
  <!-- Input and output arguments -->
  <input name="gold.binary" />
  <output name="gold-metallic.exr" />
  <!-- Define the data plugin to use -->
  <plugin name="in-data" name="data_merl" />
  <plugin name="out-data" name="data_brdf_slice" />
</action>

<action name="data2brdf">
  <!-- Input and output arguments -->
  <input name="gold-metallic.exr" />
  <output name="gold-metallic.brdf" />
  <!-- Define the function to use -->
  <function name="rational_function_chebychev" />
  <!-- Define the fitting procedure to use -->
  <fitter name="rational_fitter_parallel" />
</action>

<action name="brdf2data">
  <!-- Input and output arguments -->
  <input name="gold-metallic.brdf" />
  <output name="gold-rat.exr" />
  <!-- Define the data plugin to use -->
  <plugin name="data" name="data_brdf_slice" />
</action>
</alta>
```

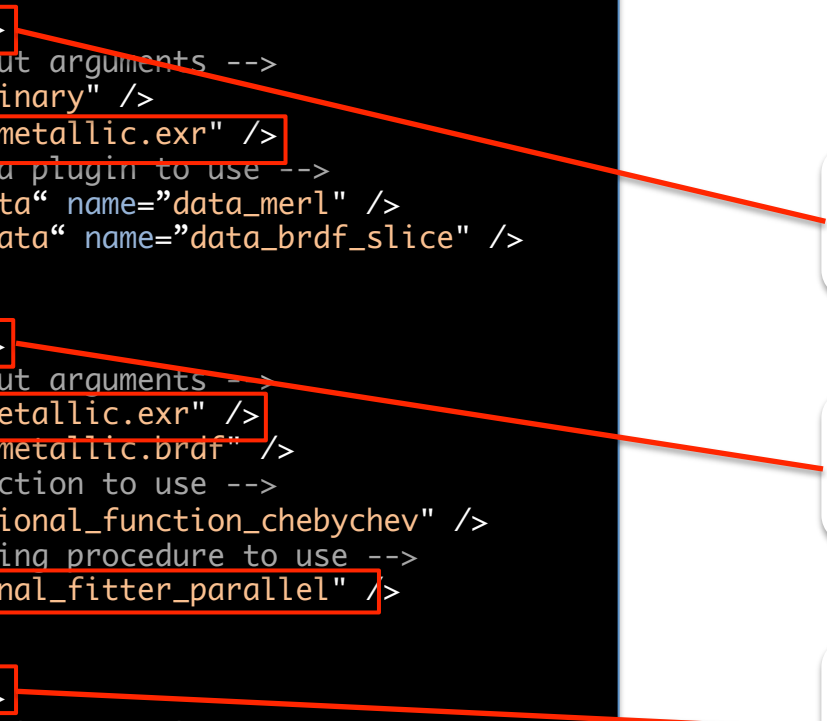
gold.binary

data2data

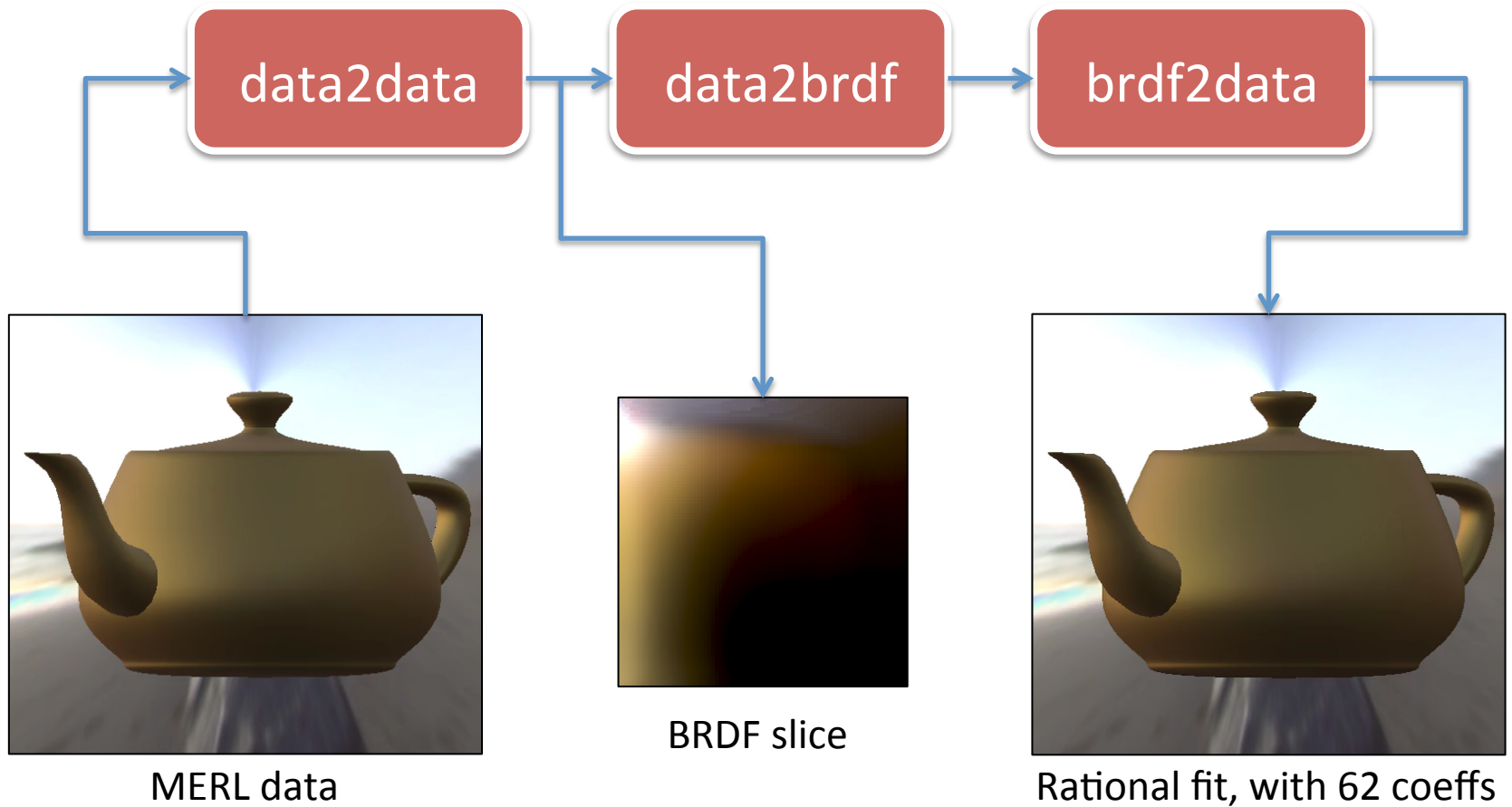
data2brdf

brdf2data

gold-rat.exr



# XML and scripting capabilities



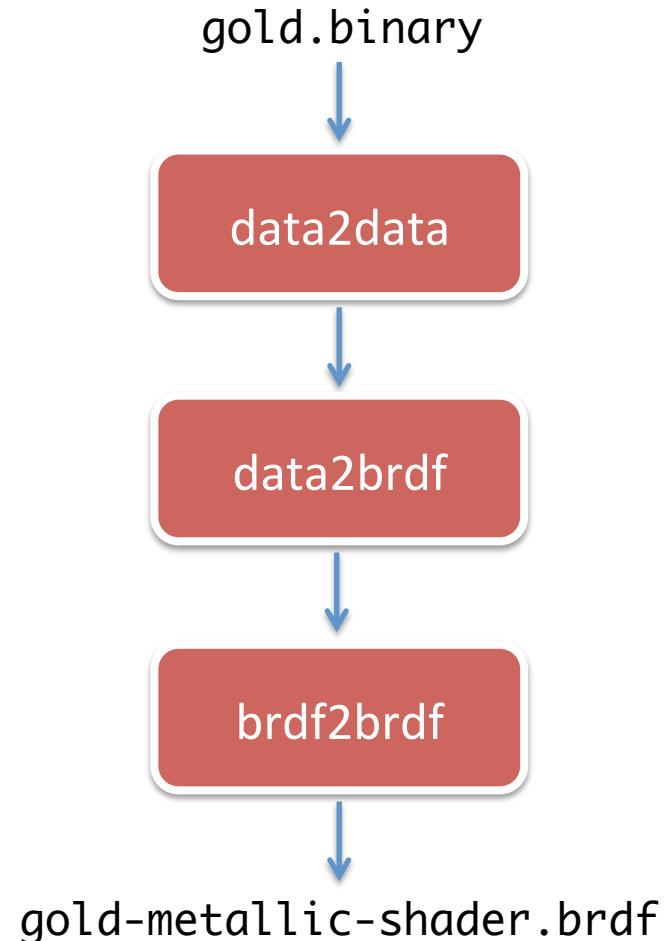


# XML for nonlinear fitting

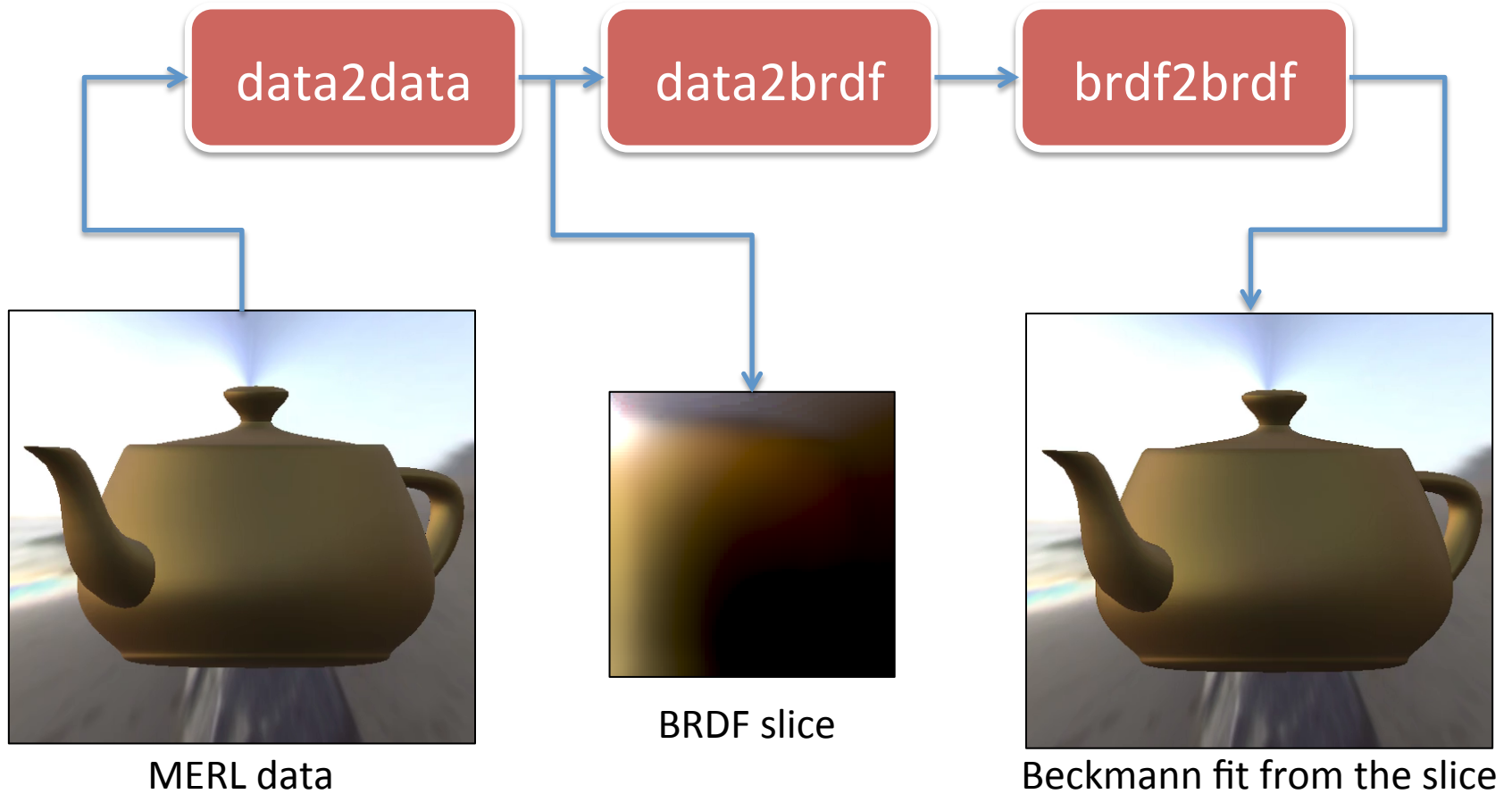
```
<?xml version="1.0"?>
<alta>
<action name="data2data">
  <!-- Input and output arguments -->
  <input name="gold-metallic-paint.binary" />
  <output name="gold-metallic.exr" />
  <!-- Define the data plugin to use -->
  <plugin name="in-data" name="data_merl" />
  <plugin name="out-data" name="data_brdf_slice" />
</action>

<action name="data2brdf">
  <!-- Input and output arguments -->
  <input name="gold-metallic.exr" />
  <output name="gold-metallic.brdf" />
  <!-- Define the function to use -->
  <function name="nonlinear_function_beckmann" />
  <!-- Define the fitting procedure to use -->
  <fitter name="nonlinear_fitter_ceres" />
</action>

<action name="brdf2brdf">
  <!-- Input and output arguments -->
  <input name="gold-metallic.brdf" />
  <output name="gold-metallic-shader.brdf" />
  <!-- Define the data plugin to use -->
  <plugin name="export" name="explorer" />
</action>
</alta>
```



# XML and scripting capabilities





**ALTA NEEDS YOU**

# What can I do ?

- Try it and give us feedback!
- Write XML scripts
- Write plugins
  - Develop your new BRDF model
  - Add your data and analyze it
- Write programs
  - Provide new features for the community



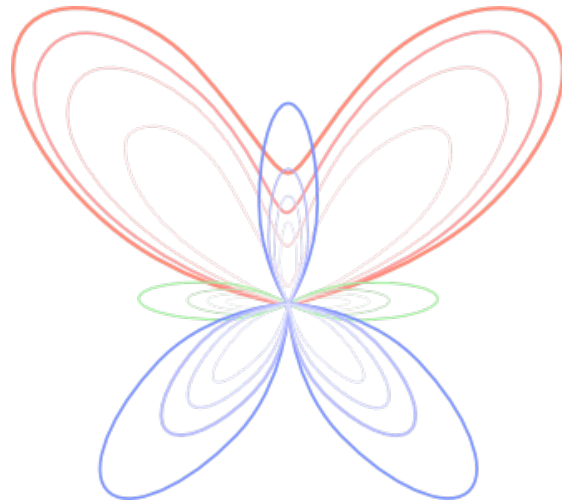
# Future Work

- *Web vitrine* for BRDFs or BxDFs
  - Share your data, functions
  - get automatic comparisons with state of the art techniques
  - Online sharing of the comparisons results / graphics
- Multiple language interface to ALTA
  - Java, C#, Python, R, Matlab, Octave... (possible with SWIG)
- High (> 4D) dimension speed improvements

# Conclusion

- Already available
  - functional for research projects
  - and can be use commercially!
- Support
  - for various OS (MacOS X, Windows, Linux)
  - for various solvers
- Need feedback from companies

# Thank you !



<http://alta.gforge.inria.fr>

SOURCE CODE, TUTORIALS AND  
DOCUMENTATION ARE ALREADY  
AVAILABLE ONLINE