



# **It's time we sat down together and had a little talk about...S2PLOT**



SWINBURNE  
UNIVERSITY OF  
TECHNOLOGY

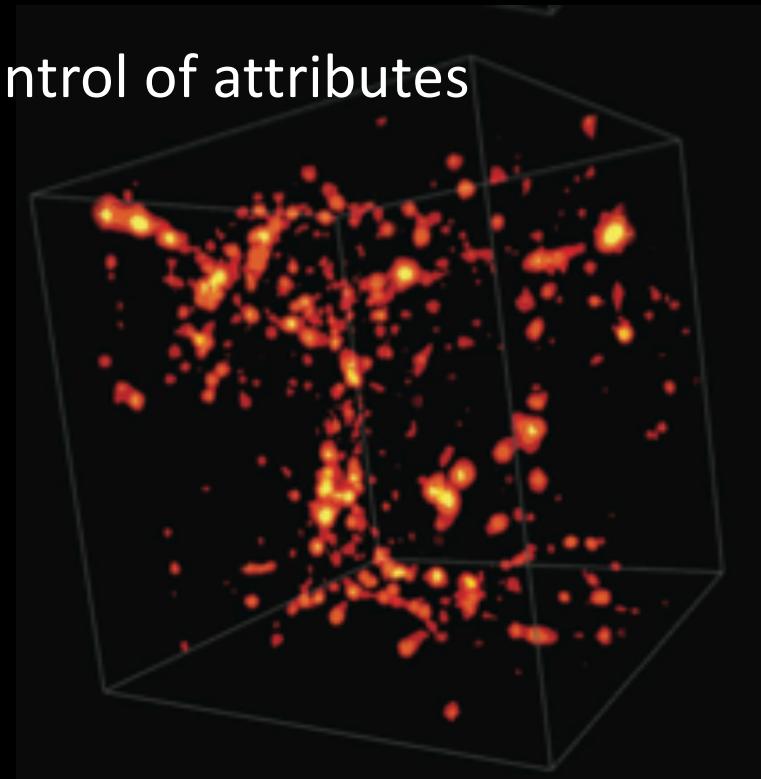
**Christopher Fluke**  
and David Barnes (Monash University)

With contributions from Paul Bourke, Owen Parry, Dany Vohl, et al.

# S2PLOT: Interactive 3D Graphics

A C/C++(/Fortran) **Programming Library** on top of OpenGL

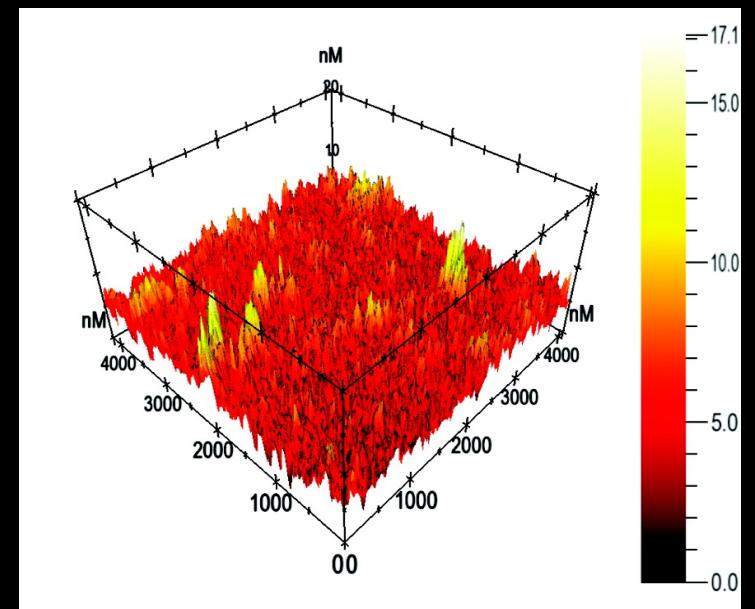
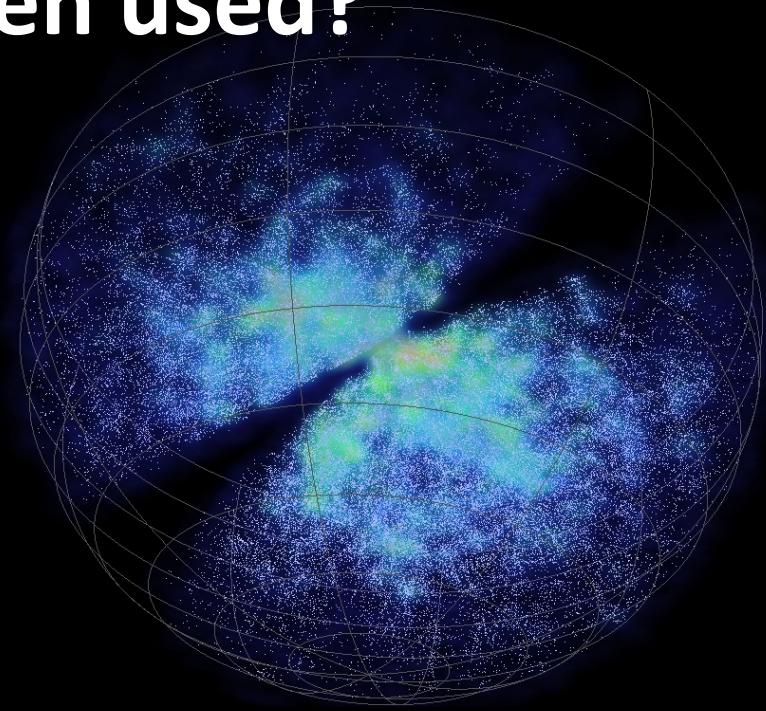
- Incorporating another Library written by Paul Bourke
- **Standard geometrical primitives**
  - Points, lines, spheres, polygons with control of attributes
- **Advanced 3D primitives**
  - Isosurfaces
  - Volume rendering
- **Powerful callback system**
  - Dynamic geometry
  - Texture “Billboards”
  - Response to key-presses



Data: Madhura Killelkar  
Vis: Hassan & Fluke (2011)

# Where has it been used?

- AstroTour
  - Most of the interactive demos but not Solar
- *“Bigger Than Big”*
  - Milky Way and Large-scale Structure sequence
- 6dF Visualisations
  - PASA Homepage (on initial move to CUP)
  - “The Universe in 100 Key Discoveries”  
(Giles Sparrow 2012)
- Outside of Astronomy
  - The skeleton of *Australovenator wintonensis*
  - Roughness of Titanium surfaces for bio-implants



# Origins

- *Future Directions in Astronomy Visualization*  
[Fluke et al. 2006, PASA, 23, 12]
- Why was (is?) it so hard to get CAS astronomers to use the Virtual Reality theatre?
- Why weren't more astronomers using 3D environments?
- Why were so many astronomers using PGPlot?
  - C/Fortran API for 2D graphics (Tim Pearson, c.1983)

# Hello Interactive 3D World

```
#include <stdio.h>
#include <stdlib.h>
#include "s2plot.h"

int main(int argc, char *argv[])
{
    s2open("/?",argc, argv);                      /* Open the display */
    s2win(-1.,1., -1.,1., -1.,1.);                /* Set the window coordinates */

/* Draw the coordinate box: character strings give formatting options */
    s2box("BCDETMN0PQ", 0,0, "BCDETMN0PQ", 0,0, "BDECTMN0PQ", 0,0);

    s2lab("X-axis","Y-axis","Z-axis","Plot");      /* Write some labels */

    s2show(1);                                     /* Open the s2plot window */

    return 1;
}
```

## Example 2

- Plot some randomly coloured points

# Example 3

- Plot some randomly coloured spheres

# Program Structure

Initialise S2PLOT  
environment

s2opend, s2swin, s2svp

Establish static  
geometry

ns2vpoint, ns2sphere, ns2line

Install handles to  
“callbacks”

cs2scb, cs2sdhcb

Enter the S2PLOT  
display loop

s2show

Respond to  
key-presses

Establish dynamic  
geometry

ds2dvr

Render

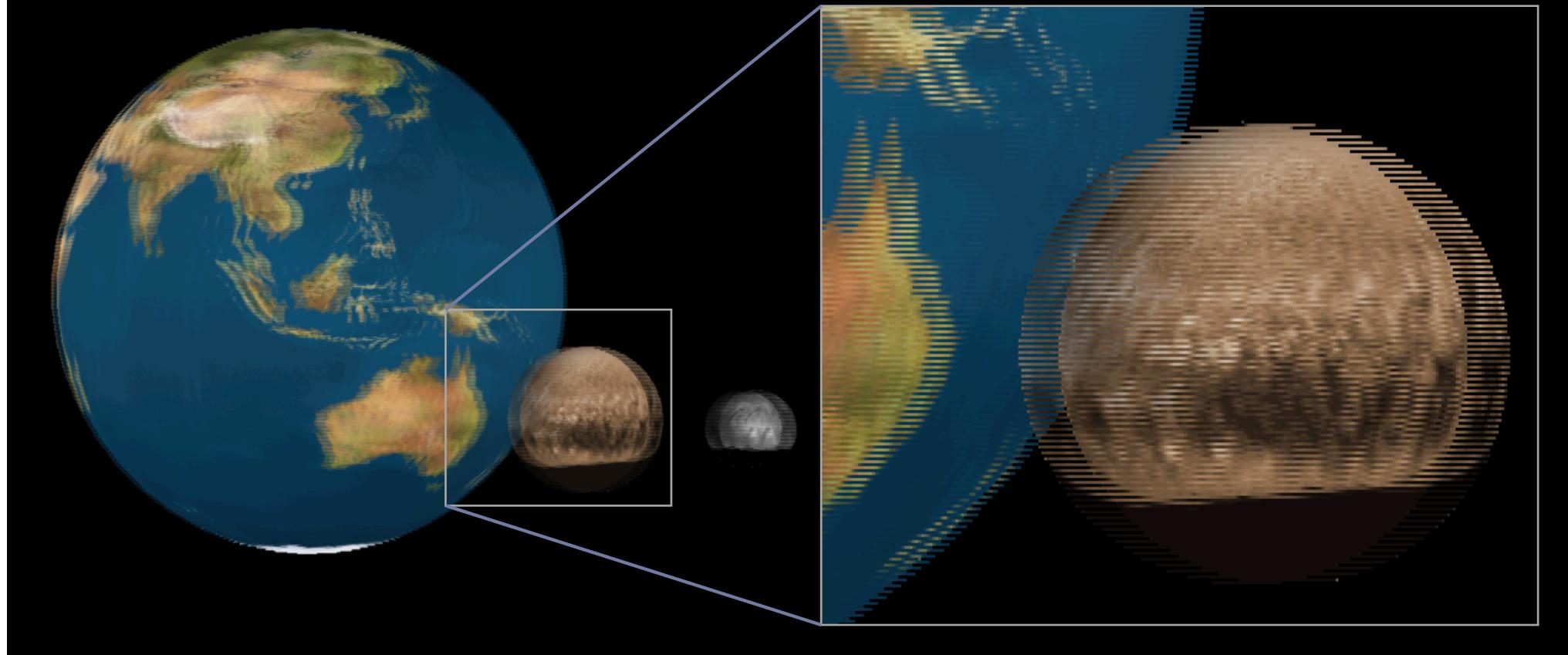
# Example 4

- Callbacks
- Toggle sphere colour using <space> key

# Choose your own Display

**At runtime:**

Mono, Stereo (passive, active, interleaved, anaglyph), Warped (fish-eye)

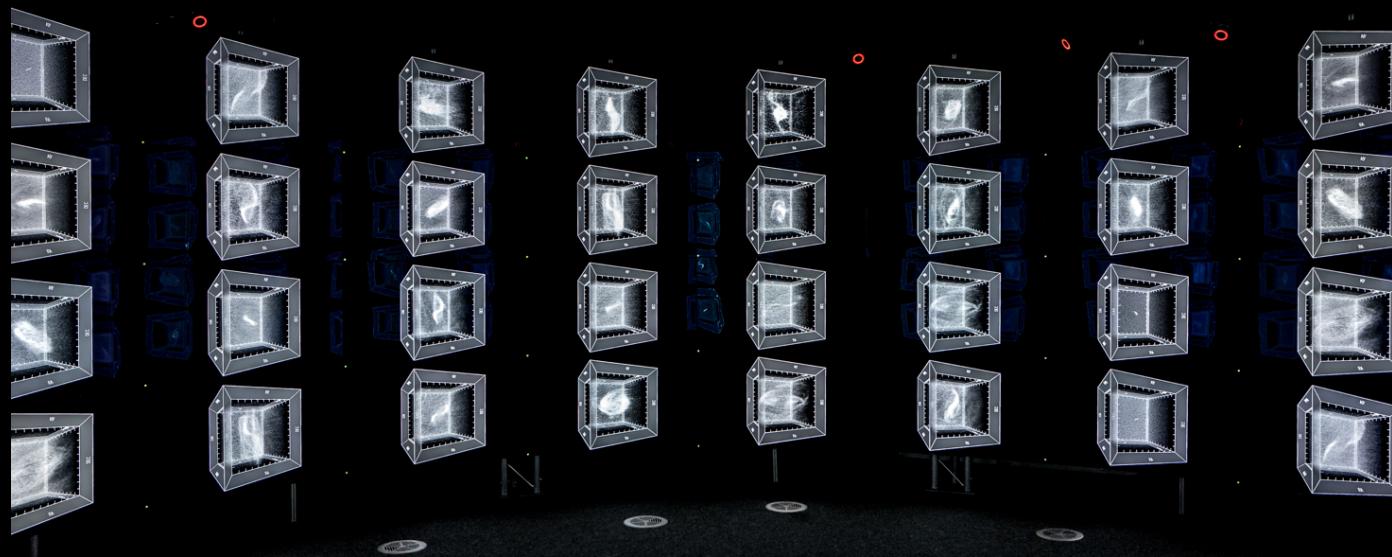


# 3D Publications

- Interactive PDF paper
  - **View:** Adobe Reader Version 8.0 (Windows, macOSX)
  - **Embed:** Adobe Acrobat/Tetra4D plug-in (Windows)
- Open-source pathway
  - Barnes et al., 2013, PloS ONE, 8(9): e69446
  - $\text{\LaTeX}$  + movie-15 package
- <Shift-P> to auto-generate 3D-PDF

# Removing Barriers

- Won't work on my passive/active/... system
  - Yes it can
- Can't publish 3D
  - Yes it can - 3D-PDF extensions
- Can't work in CAVE2
  - Yes it can – encube by Dany Vohl et al. (2016)



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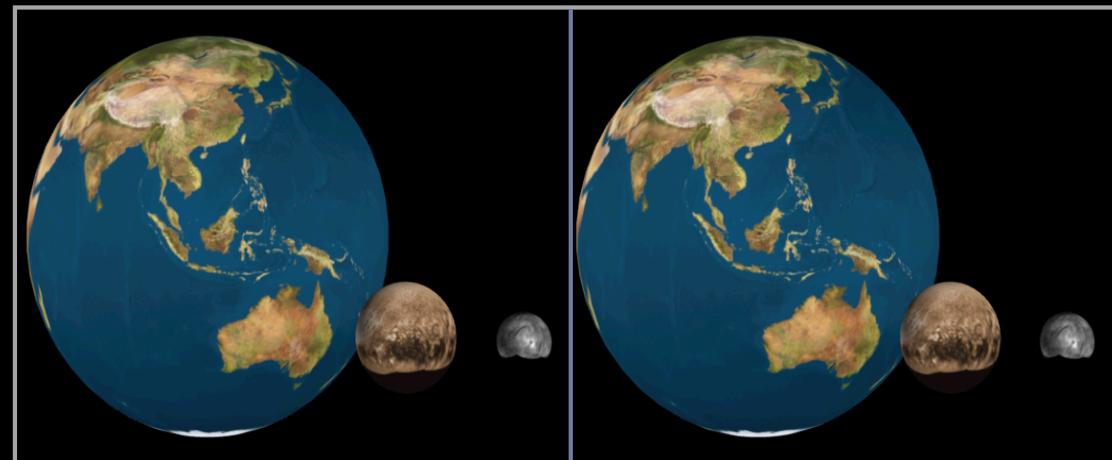
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- Can't work with VR Head-mounted Displays
  - It will soon – Fluke, Barnes, Meade, in prep



Samsung Gear VR



Sony Project Morpheus



Images:

<http://www.samsung.com/au/consumer/mobile-phone/wearables/gear/SM-R321NZWAXSA>

<https://www.playstation.com/en-us/explore/project-morpheus/>

# S2PLOT: Evolution

Work in progress

Head-mounted displays using Mozilla WebVR A-Frame

<https://aframe.io>

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- **Can't work without installing libraries**
  - **Yes it can – Coming very soon S2PLOT-Cloud [thanks to Bernard Meade]**

# But what about Python?

Python wrappers:

<https://github.com/trmrsh/s2plot-python>

(D.Barnes, N.Jones, M.Turk and T.Marsh)

Not part of the S2PLOT core release

Not all functionality is supported

# Awesome. Where can I get it?

- <http://astronomy.swin.edu.au/s2plot>
  - Up to version 3.2.1
  - Installation instructions
  - Function list with sample C Code (>90% of functions)
- <https://github.com/mivp/s2plot>
  - Version 3.4 onwards

*[Let's talk about installation/configuration offline]*

Now let's talk about  
your (3D) data...