Magic Planet Display

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iVEC

Introduction

- iVEC: Partnership between CSIRO, Murdoch University, Edith Cowan University, Curtin University, and The University of Western Australia.
- Manage supercomputing infrastructure located at Murdoch University and University of Western Australia, and soon at the Pawsey Centre.
- Runs 4 programs
  - eResearch (Jenni Harrison)
  - Industry and Government Uptake (Andrew Beveridge)
  - Education and training (Valerie Maxville)
  - Supercomputing Technology and Applications (George Beckett)
- Also provides visualisation infrastructure and expertise to researchers at the partners. Infrastructure includes
  - novel displays: stereoscopic 3D, immersive, high resolution
  - image and video capture devices: 360 video, stereoscopic 3D
  - visualisation software licenses

Visualisation and displays

- As the name suggests visualisation is largely concerned with the presentation of information to our brains through our sense of vision.
- Makes sense then that we make full use of that sense.

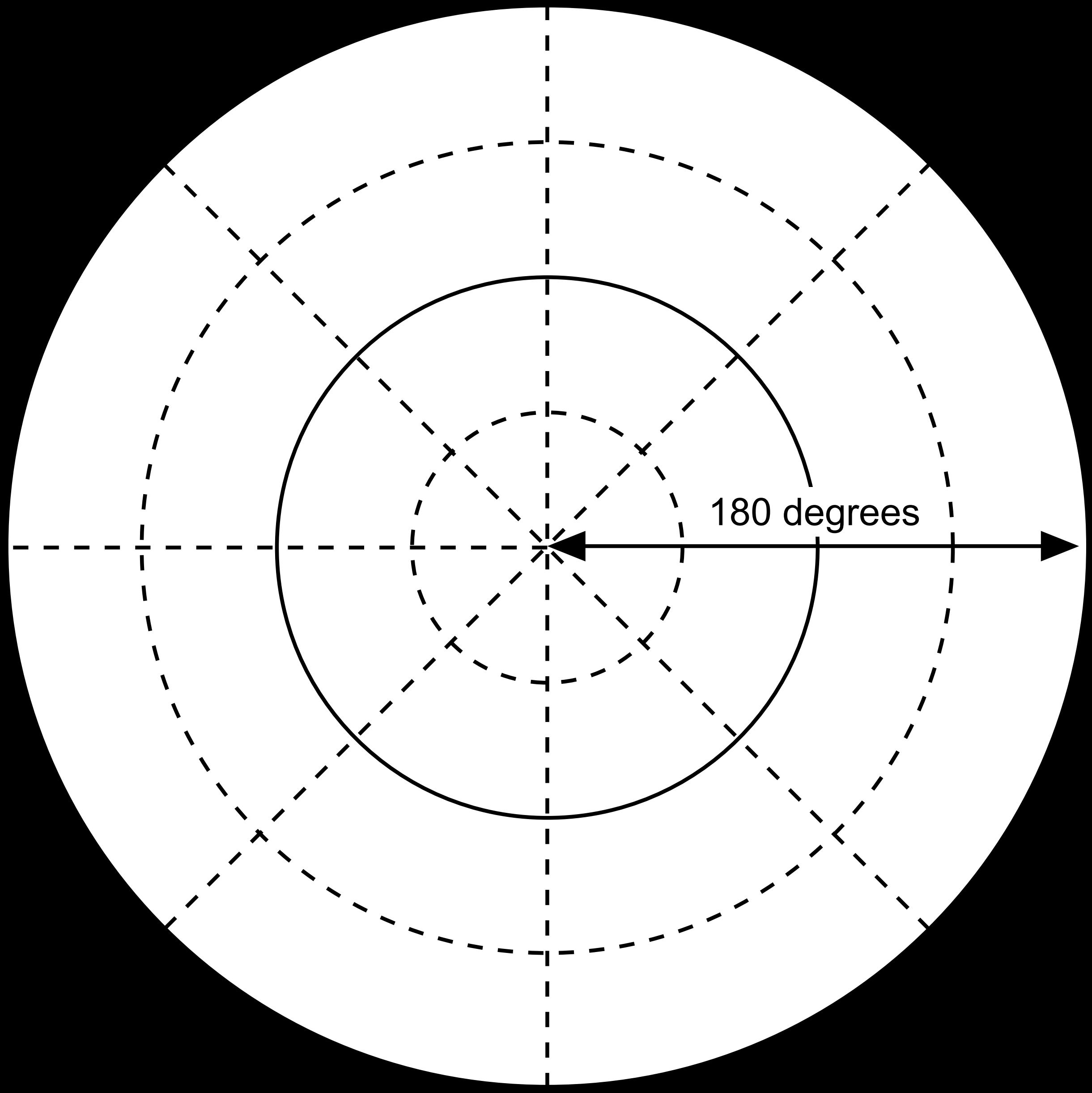
Projections

- My goal was to understand enough about the projection optics so that we could create our own applications independent of the WindowsXP software suite provided.

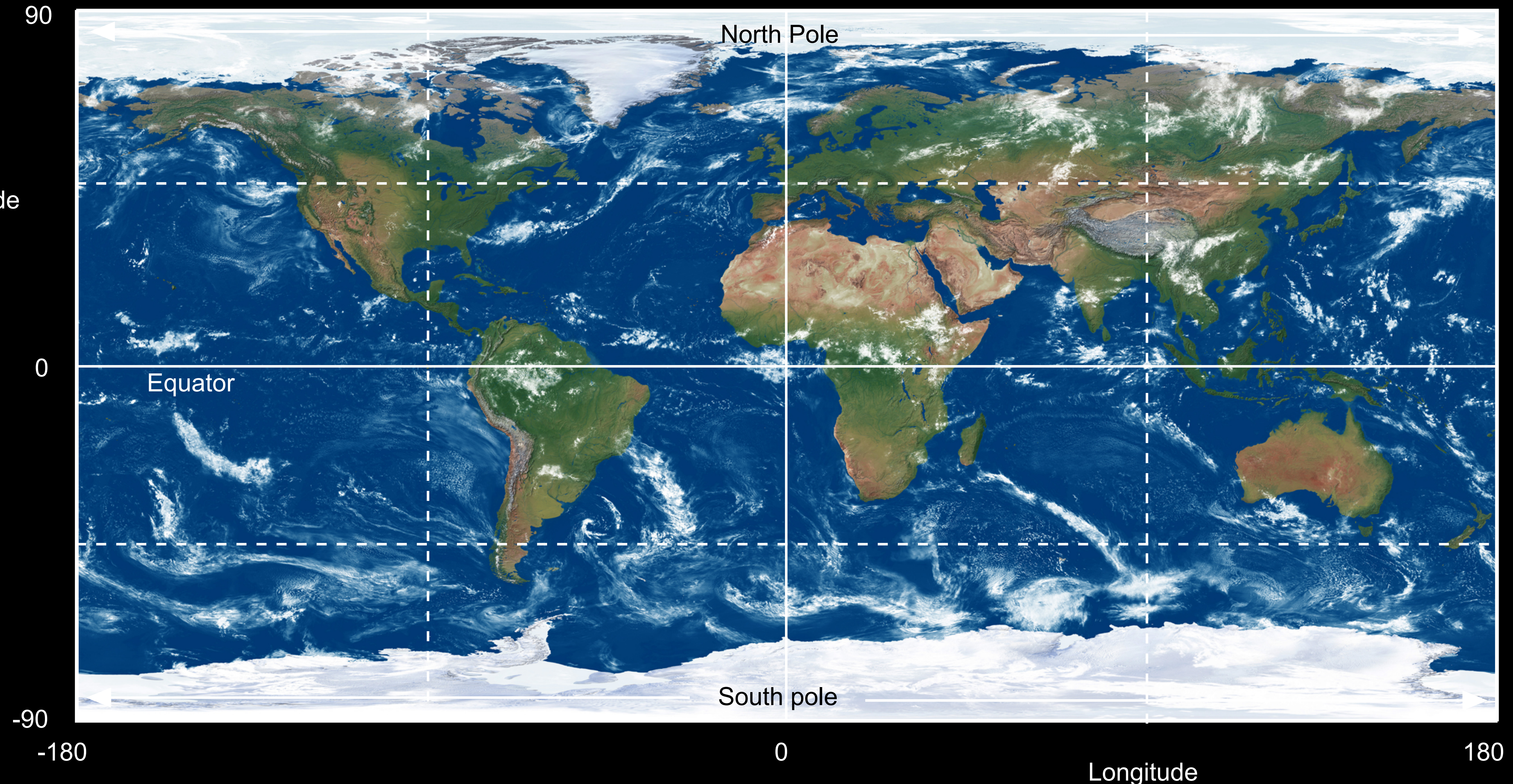
- We are all familiar with orthographic (parallel) and perspective projections.
- These are often inadequate for many displays, particularly those that surround/immerse the viewer.
- The key is usually that one needs to capture a wide field of view.
- Three (at least) options
  - cube maps, also often known as environment maps
  - 360 degree fisheye projection
  - spherical projection, also known as equirectangular projection

Cube maps

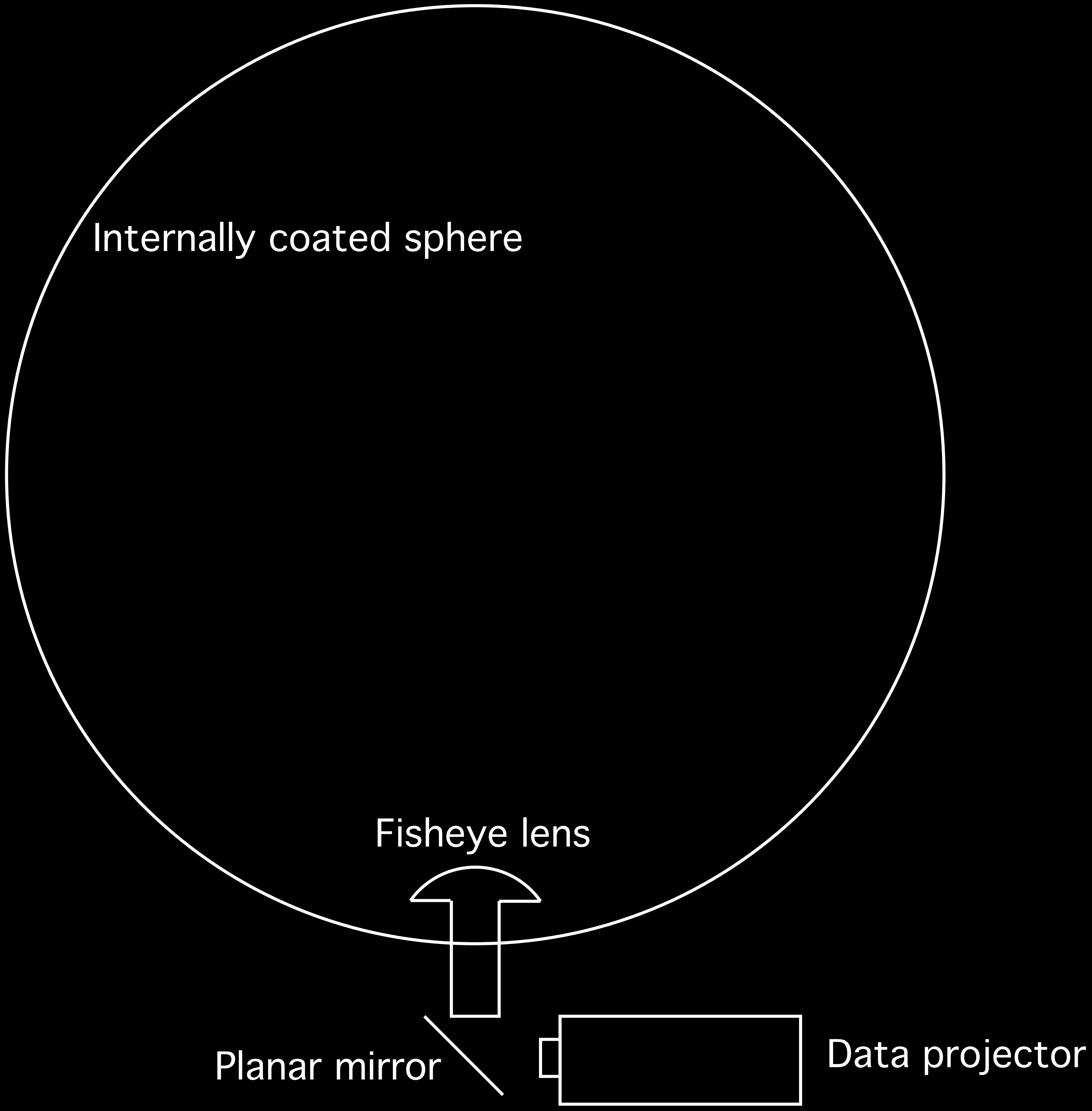
360 degree fisheye



Spherical projection



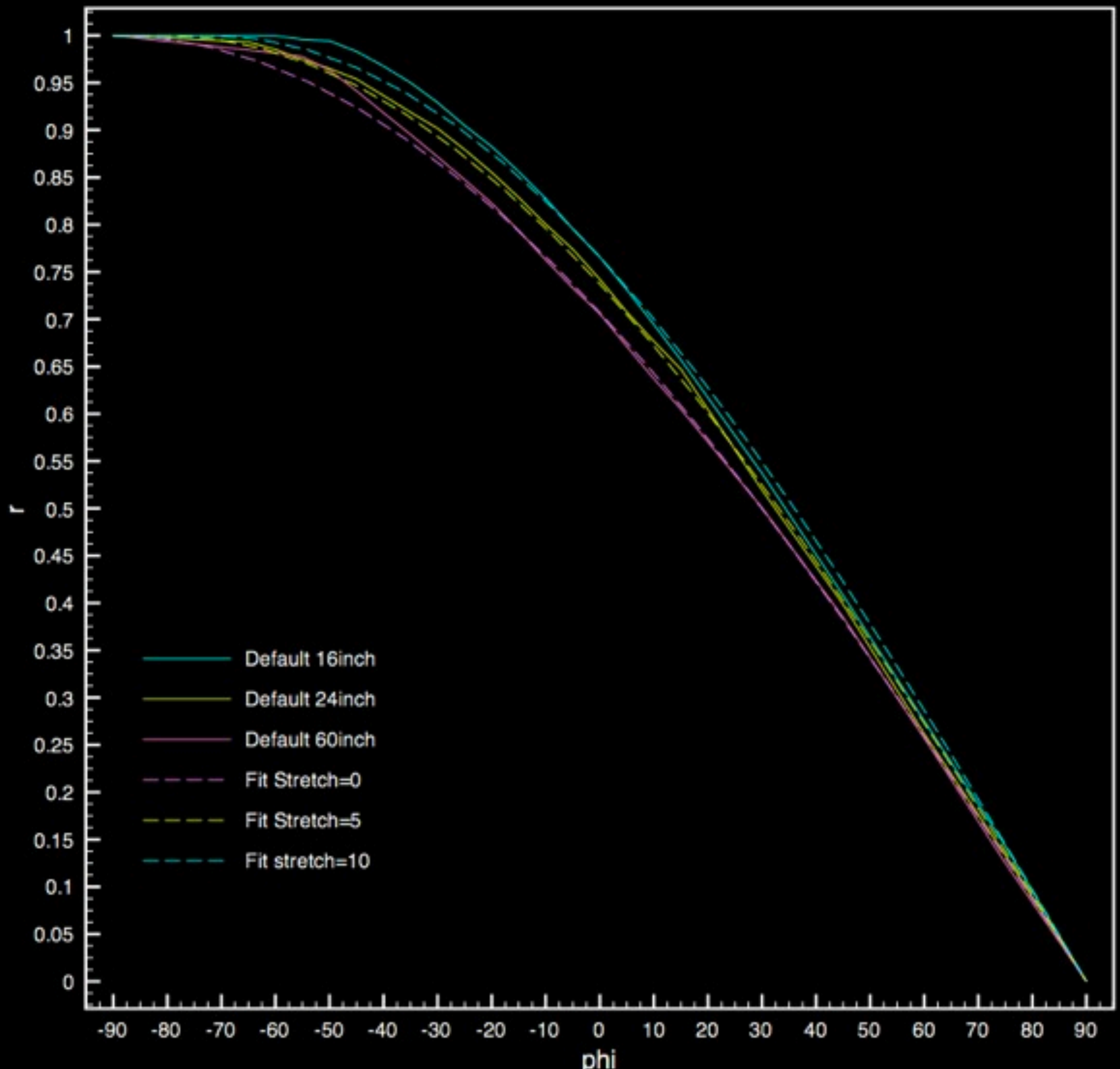
Optics


Internally coated sphere
Fisheye lens
Planar mirror
Data projector

Warping

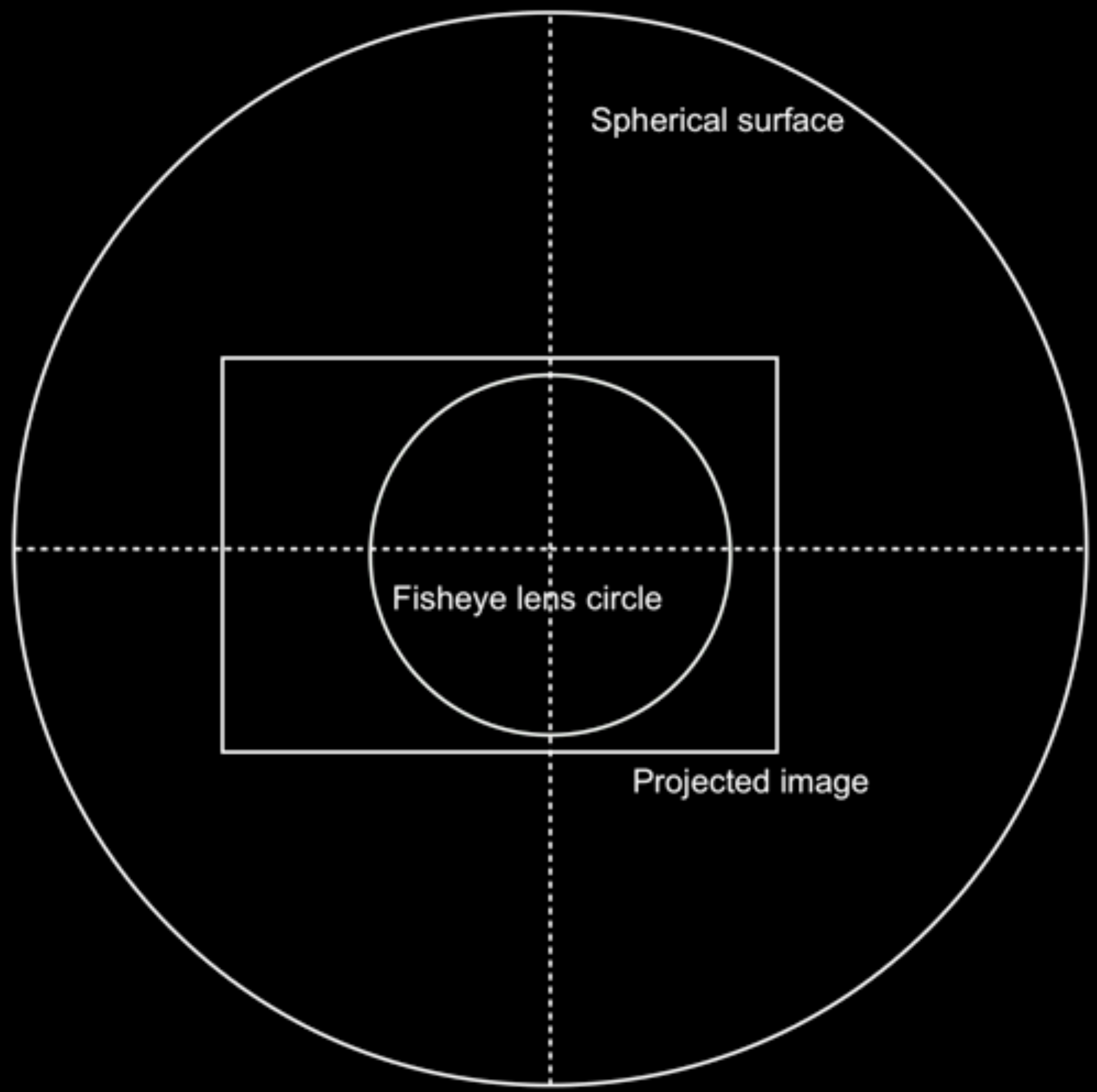
- The Magic planet consists of a data projector and fisheye lens.
- The fisheye lens is located in the base of the sphere rather than at the center of a hemisphere.
- The lens is not a tru-theta lens, that is, the relationship between radius on the fisheye and latitude is not linear.
- Radially symmetric so warping is not a function of longitude.

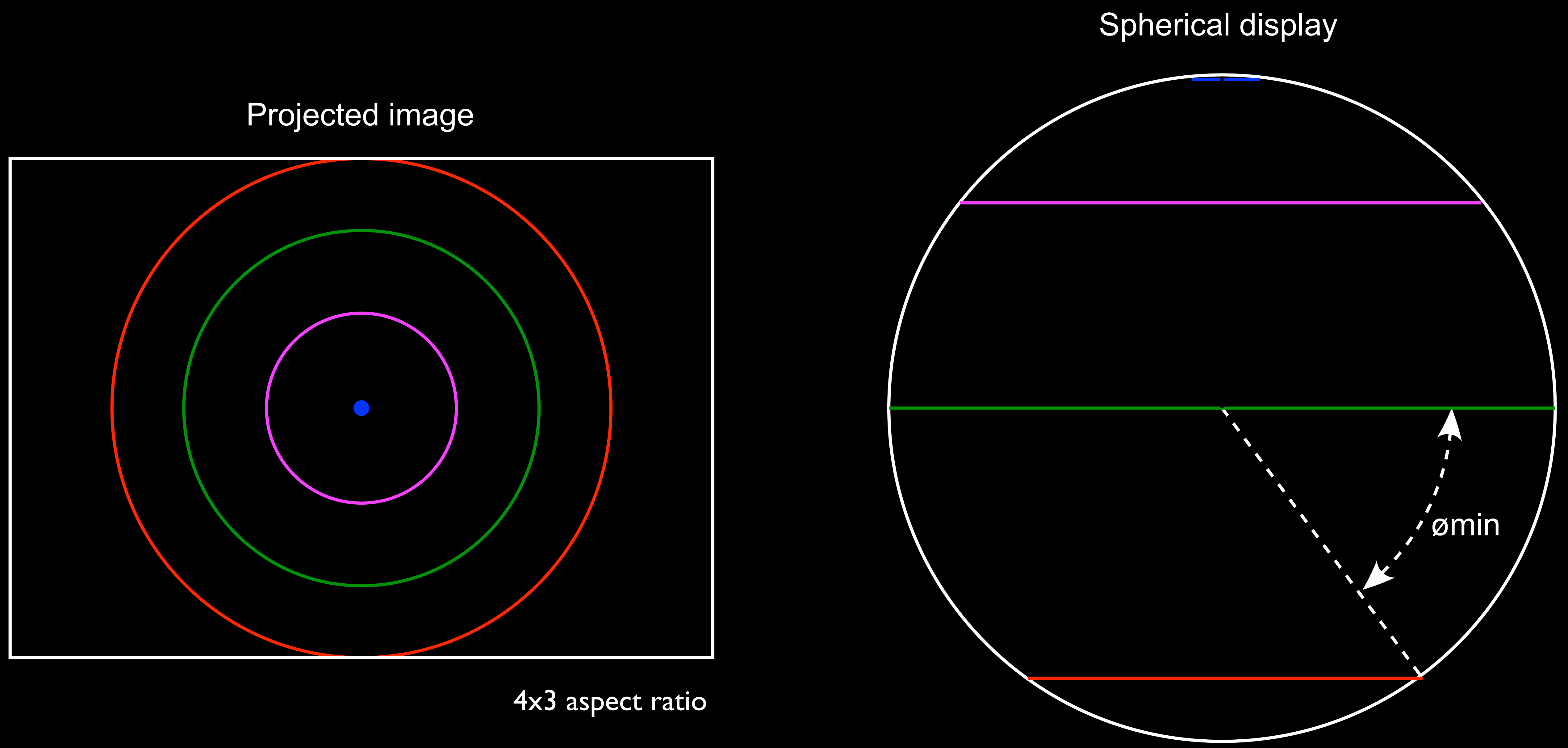
$$r = \cos\left(\frac{1}{2}\left(\phi + \frac{\pi}{2}\right)\right)$$



Lens offset

- Final adjustment required is a horizontal and vertical offset for a non-centered lens.
- Can in theory adjust this mechanically but easier in software.





- More pixels at red ring, but poorer fisheye lens optics.
- Fewer pixels at pink ring than equator but better optics.

Example of the image sent to the projector

Content creation notes

- For image/movie based presentation suggest spherical (equirectangular) projections.
- For realtime applications we now understand the warping.
  Would generally work in polar coordinates.
- For image based presentations 1024x512 is below capable resolution,
  2048x1024 is about right for most of the display surface,
  4096x2048 can look better in some regions.
- Aliasing effects can be a problem with higher resolution.

Demonstration