A 3D CAD model of a mechanical assembly, possibly a motor or actuator, rendered in a low-poly, faceted style. The assembly is shown in a cutaway view, revealing internal components. The outer housing is a light blue color. Inside, there is a central shaft with a purple-colored component, possibly a rotor or a piston, mounted on it. The background is a dark blue gradient.

Extra Dimensions 3D and time in PDF Documentation

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Introduction

- High energy physics is replete with multi-dimensional information which is often poorly represented by the two dimensions of presentation slides and print media.
- Past efforts to disseminate such information to a wider audience have failed for a number of reasons, including a lack of standards which are easy to implement and have broad support.
- Adobe's Portable Document Format (PDF) has in recent years become the de facto standard for secure, dependable electronic information exchange. It has done so by creating an open format, providing support for multiple platforms and being reliable and extensible.
- By providing support for the ECMA standard Universal 3D (U3D) file format in its free Adobe Reader software, Adobe has made it easy to distribute and interact with 3D content.
- By providing support for scripting and animation, temporal data can also be easily distributed to a wide audience.

U3D

- The Universal 3D (U3D) format is an ECMA standard designed by the 3D Industry Forum (3dif).
- Aims to “*simplify the transformation of complex 3D data into a format that can be streamed, compressed and viewed on affordable, nonproprietary software/hardware platforms while providing a high quality viewing experience*”.
 - [Intel white paper](#)
 - [ECMA Standard](#)

Yet another “killer 3d app?”

- The goal is not new, there have been many proposals in the past, e.g. VRML, and current proposals under development, e.g. X3D.
- However, U3D serves as one of the 3D representations within PDF.
 - de facto standard for document interchange.
 - free reader available on multiple platforms.
- A number of programs becoming available to convert standard CAD and 3D file formats into 3D PDF.
 - Not aware of any good, free, open-source programs.

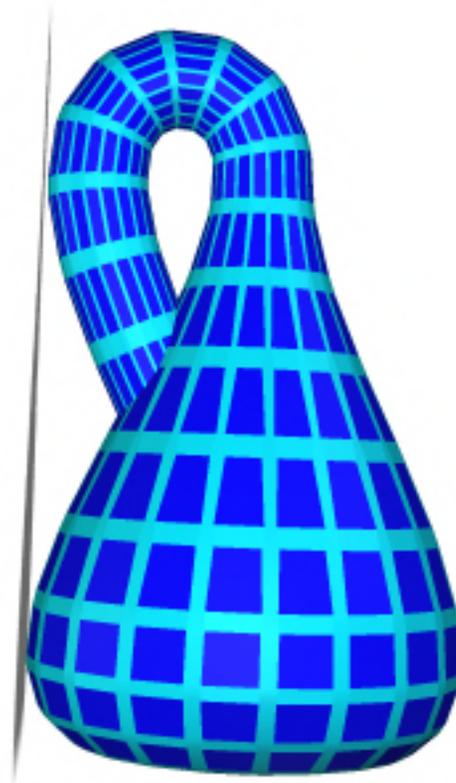
Interactive 3D models

- Acrobat Reader, as of version 7, allows interaction with embedded 3D content.
- e.g. Möbius strip



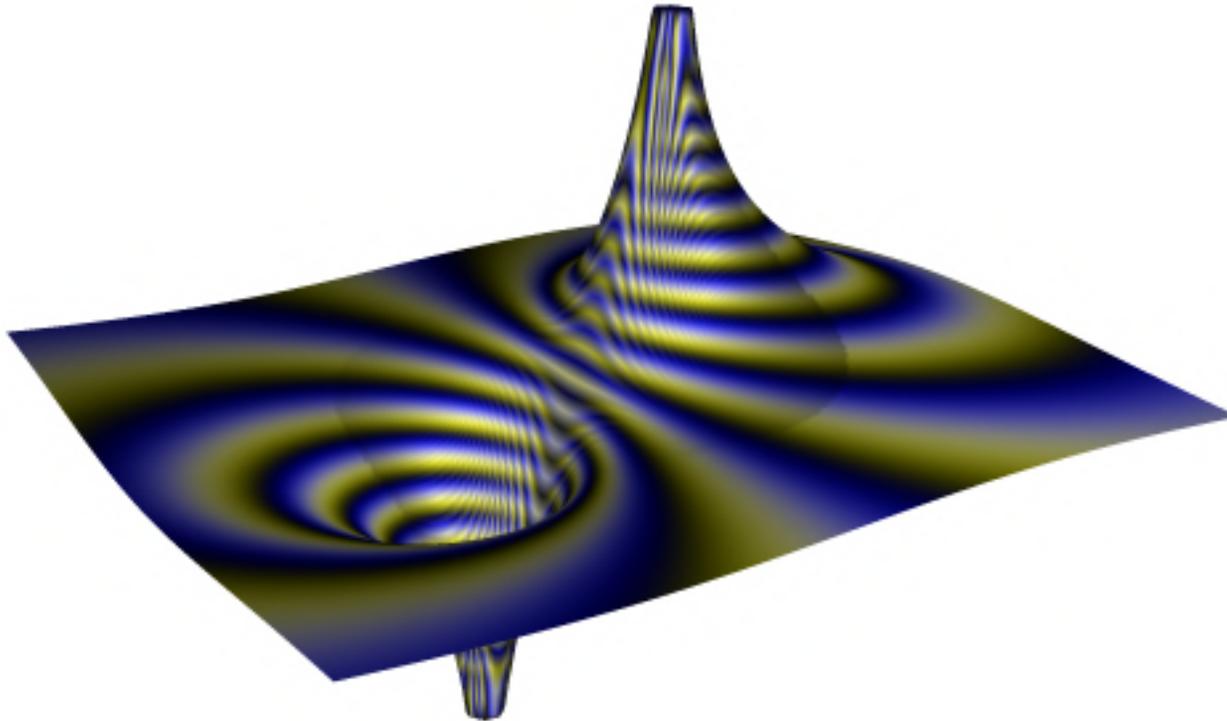
Interactive 3D Models

- Klein Bottle

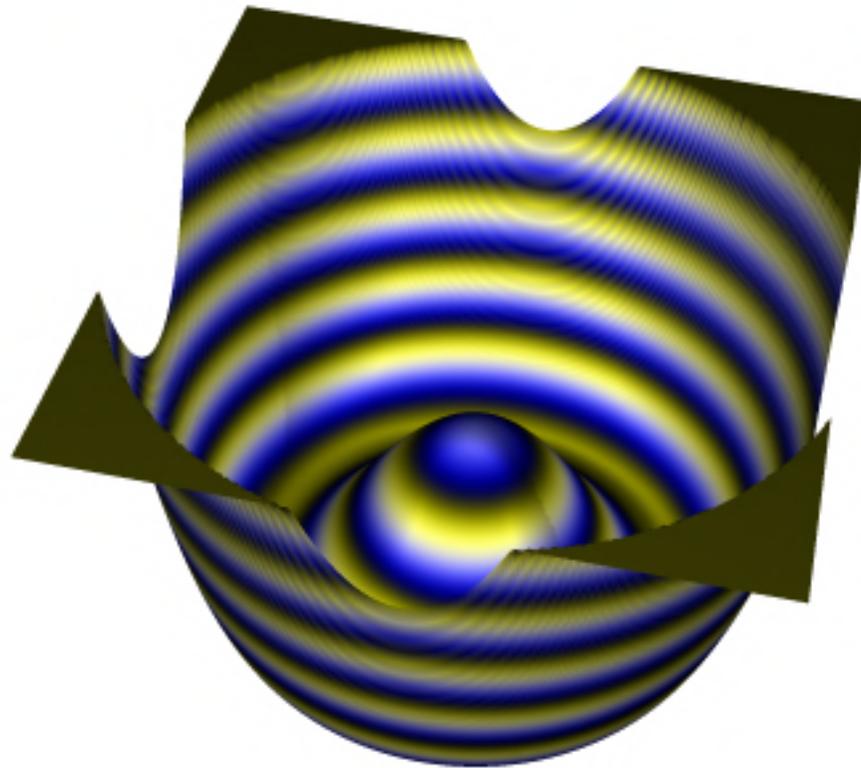


Interactive 3D Models

- Magnetic Dipole Field



Higgs Potential



Javascript: Linking to Views

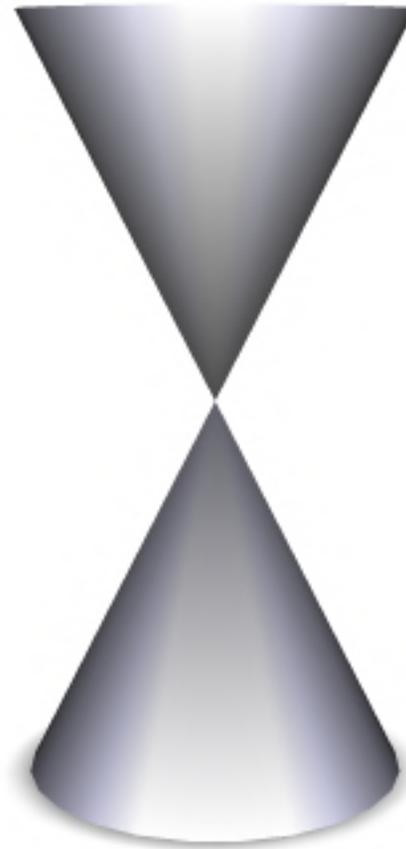
- Can use scripting to control views
 - e.g. conic sections.

Parabola

Hyperbola

Circle

Ellipse



Animation

- Assembly sequence example

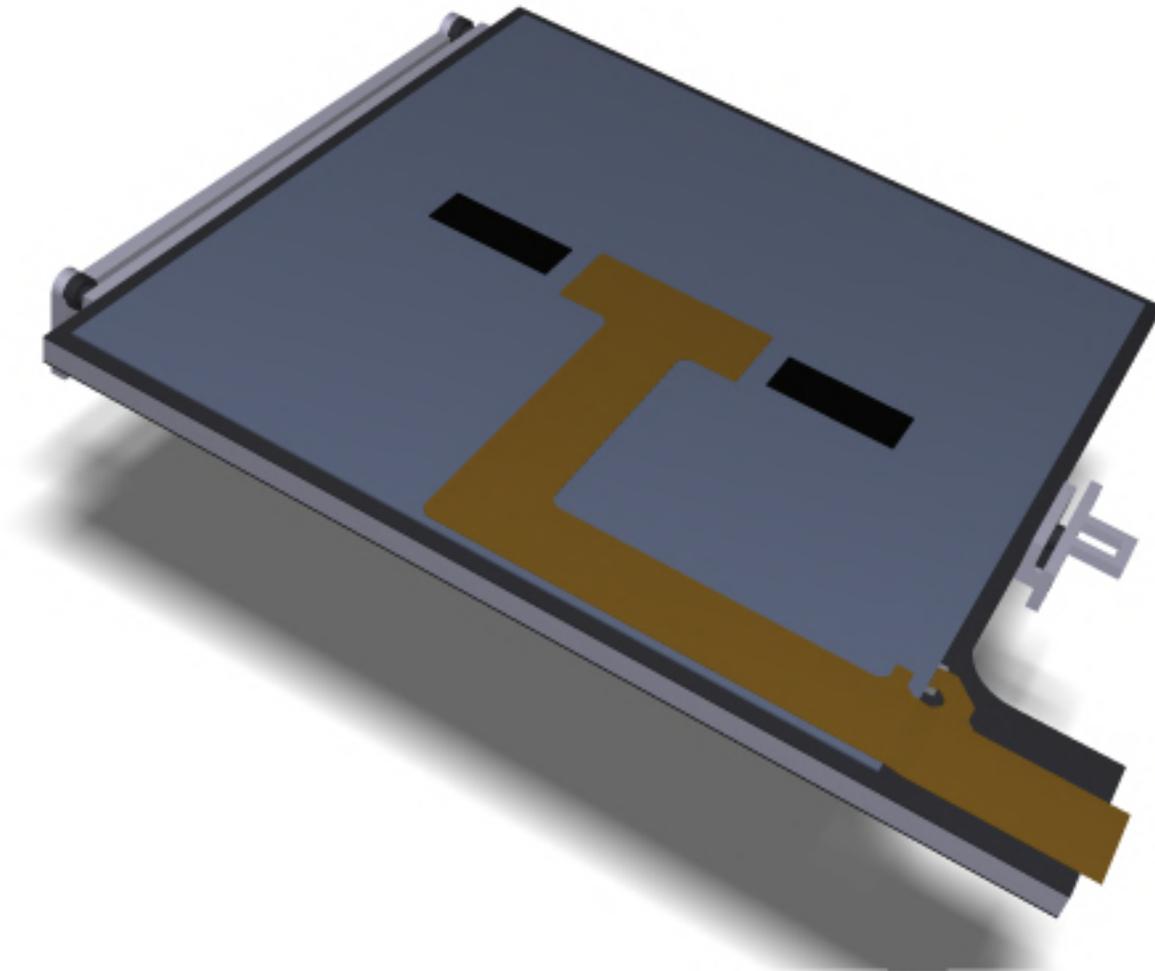
A

B

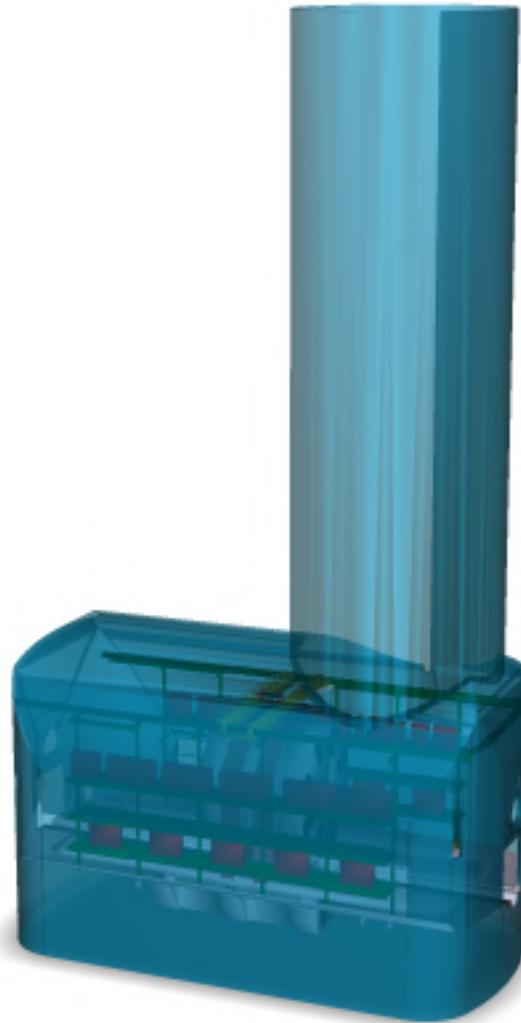
C

D

E



Detector Visualization



Summary

- Ability to embed 3D and enable time evolution of information in standard pdf documents opens up a whole new dimension of information transfer.
- Users have the ability to interact with the scenes, customize the viewing experience, and can exchange commentary via pdf markup.
- Currently only aware of commercial software to create and embed U3D content, but efforts underway to provide a toolkit for some HEP applications.