

# 1 Installation

The application can be either launched directly from source code or using one of the provided executable files. There are three folders with executables and required dependencies for different platforms. All required files are already in each folder except for the data because it is 9GB. Therefore, the data folder needs to be copied into the chosen platform folder. The visualisation will run even without the data files and saved files can be loaded and interacted with, some interesting saved files can be found in the src directory. However, generation of new streamlines requires the data.

- macosx\_10\_9\_x86\_64\blackhole.app\Contents\MacOS\blackhole
- manylinux\_x86\_64\blackhole
- win\_amd64\blackhole.exe

Both the Windows and Linux executables should work on most common distributions of those systems and were tested on multiple different machines. The MacOS executable was not tested and there is no guarantee it works properly. In Windows troubleshooting can be done using the log in User/appdata/local/blackhole.

Running the application from source code can be done by launching the python script main.py. Again the data folder needs to be in the same folder as main.py. Several additional dependencies need to be installed. The following library versions were used.

- Panda3d 1.10.13
- NumPy 1.24.1
- Tkinter 8.6
- Pillow 9.0.1

# 2 Controls

The following list contains input buttons and their effect:

- Left mouse button – Rotation and UI interaction.
- Mouse wheel – Zooming.
- Right mouse button – Panning.
- "S" key – Saves a screenshot of the 3D display region.
- "V" key – Toggles depth buffer debugging.

The following list describes the UI elements and their function:

- Save – Saves a scene to a selected slot.
- Load – Loads a selected save into the visualisation.
- Generate – Generates new streamlines based on the selected dataset.
- Five area tabs – Swap through different areas used for filtering.
- Three radio buttons for area content – Hidden, Magnetic, Electric.
  - Hidden – Hides the selected area.
  - Magnetic – Changes the selected area to visualise magnetic lines.
  - Electric – Changes the selected area to visualise electric lines.
- Hide box – Toggles the visibility of bounding box

- Six bounding box sliders – Each moves one of the six faces of the box.
- Transparent – Toggles transparency
- Two radio buttons for transparency – Flat, Depth.
  - Flat – Flat transparency which can be changed using the alpha slider.
  - Depth – The depth of objects is mapped to transparency.
- Density slider which changes the distribution of streamlines
- Adaptive density button which selectes density based on distance from center.
- Two radio buttons for color – Flat, Magnitude.
  - Flat – Enables selection of flat color using three RGB sliders.
  - Magnitude – Maps the intensity of the vector field to color.

The following elements are global and affect all areas or some other property of the visualisation.

- Halos – Toggle visibility impeding halos.
- Hide null point – Hides the physical representation of the null point.
- Thickness – Slider which changes the thickness of all stream tubes.
- Background – Slider which changes the grayscale background color.