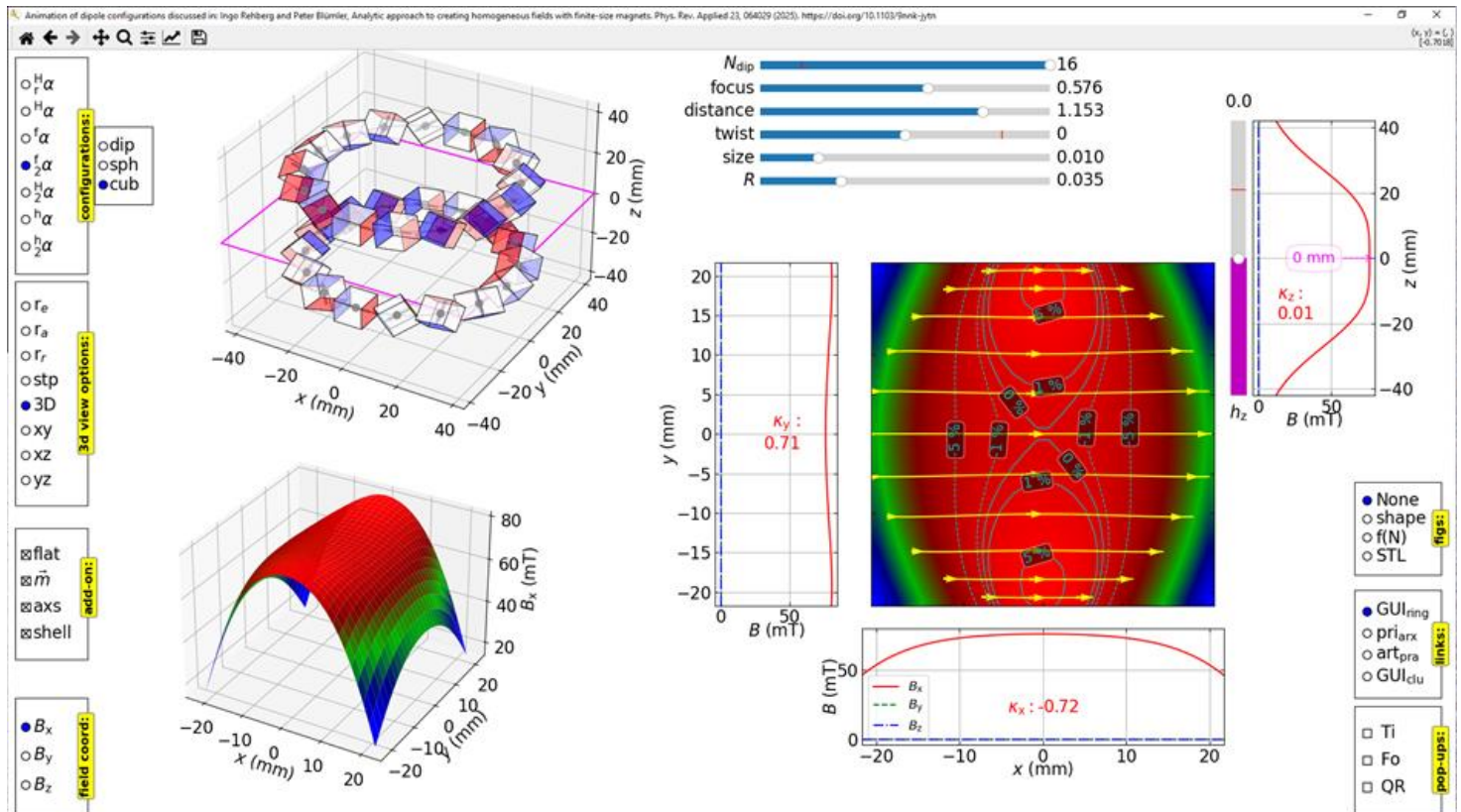


# User Guide: Aligning Magnets for Homogenous Fields (V 2.0.0)



Screenshot of the GUI based on an open source Python script, [10.5281/zenodo.1500667](https://zenodo.org/record/1500667)

## 1. Configurations

Use this RadioButton to choose between seven different types of dipole rings.

The naming is adapted from:

- arXiv:2502.18262 (<https://arxiv.org/abs/2502.18262>)

- PRApplied: <https://doi.org/10.1103/9nnk-jytn>, <https://aps.altmetric.com/details/174641821/news>

- Choosing the magnet shape with the second RadioButton:
  - **dip**: a point dipole. All lengths are then given in units of the ring radius  $R$ .
  - **sph**: A sphere of finite size (as determined by the sliders, in meter).
  - **cub**: a cube of finite size (as determined by the sliders, in meter).
- Configuration Sliders:
  - **$N_{dip}$** : Number of magnets in a ring
  - **focus**: the focal length (in units of  $R$ )
  - **distance**: The distance (in units of  $R$ ) between ring in stacked configurations
  - **twist**: twist angle in degree (for stacked configurations)
  - **size**: the diameter (in meters) for a sphere, and the edge length for a cube
  - **$R$** : the radius of the magnet centers (in meters).

## 2. 3D View Options

Set specific viewing angles for the upper-left 3D plot.

- To rotate the rings, use the top three rotation buttons.
- To stop the rotation, press the "stp" button.

## 3. Add-On Checks

Enable additional plot elements via the checkboxes:

- **flat**: Displays the magnetic field within planes. If checked, the "hz" slider adjusts the height of that plane.
- **m**: indicates the direction of the moment with an arrow.
- **axs**: shows the axes.
- **shell**: indicates the shape (rod, sphere, or cube)

## 4. Field Component

Choose which magnetic field component to display:

- x, y, or z

## 5. Pop-Ups

Optional overlays are:

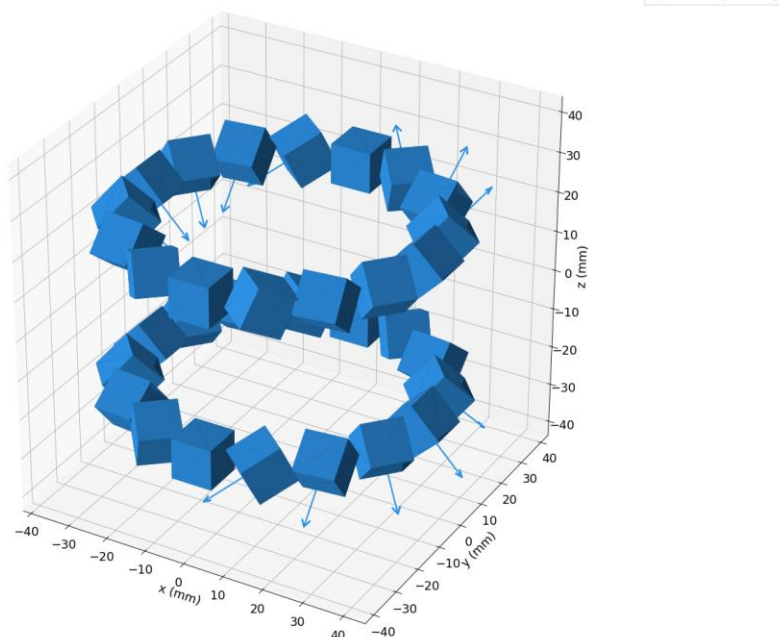
- Ti: The title (useful for a presentation, editable within the script).
- Fo: Display the formula showing the field's power-law deviation from the center value.
- QR: A QR code for quick access to this software.

## 6. External Links

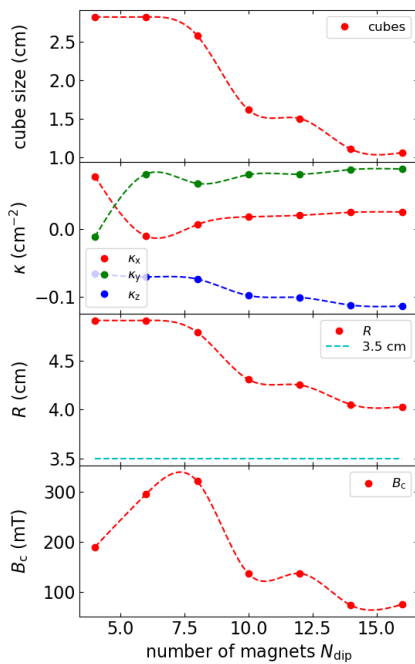
- **GUI<sub>ring</sub>**: The source code of this GUI.
- **art<sub>pra</sub>**: The article explaining theoretical and experimental background.
- **pri<sub>arx</sub>**: The preprint for that article.
- **GUI<sub>clu</sub>**: A related interactive tool for exploring general dipole clusters.

## 7. Additional Figures

- **shape**:  
Show the cluster as a 3d magpylib-plot.

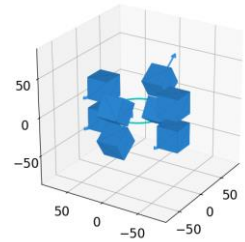
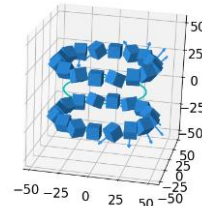


- f(N):**

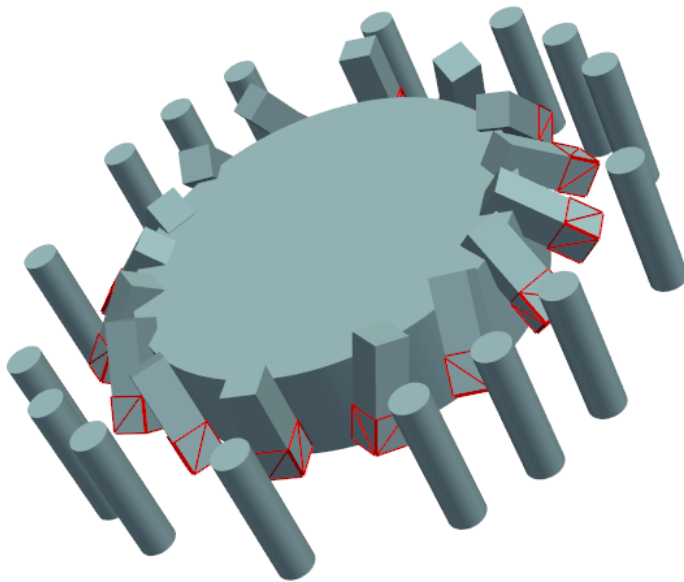


The field strength and the curvature as a function of the number of magnets (a focused sandwich configuration is chosen for this example). The inner diameter (cyan) is chosen by the **R-slider** (which is the radius of the magnet centers in the plot described above). For a given magnet number, the size is then chosen as large as possible, with a spacing of at least 1 mm between the cubes.

The plots on the right hand side illustrate the first (4 per ring) and the last (16 per ring) number of cubes considered here.



- STL:**



Generates an STL-file as a help for 3d-printing of the corresponding magnet holder. You see the negative part of the magnet support here. The red lines indicate the position of the cubes.