STAND-ALONE MAGLEV SIMULATOR FOR PORTABLE DEVICES

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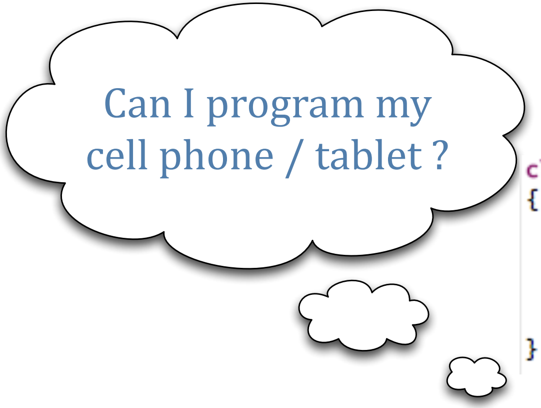
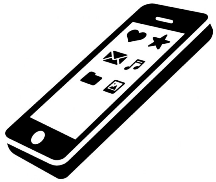
AN OLD DREAM (PERSONAL CHALLENGE)





```
class HelloWorld
{
    public static void main(String[] a)
    {
        System.out.println("Hello world");
    }
}
```

WHOSE REALIZATION MIGHT BE USEFUL

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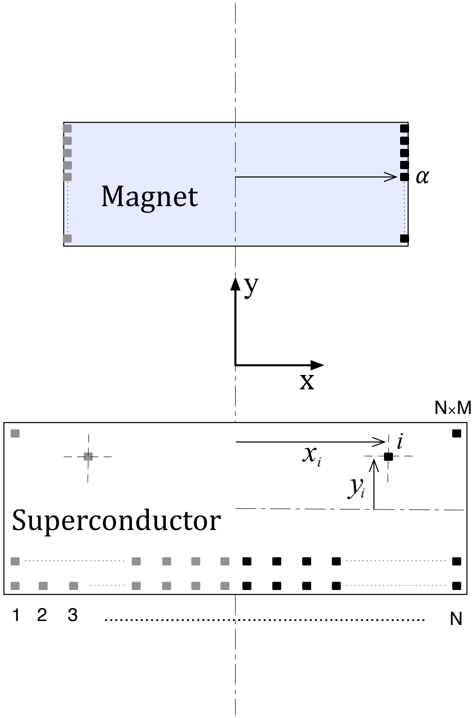
BECAUSE ...

A ***stand-alone*** simulator may be ***useful***: levitation forces with type-II's are highly hysteretic, geometry dependent, path dependent ...

Background physical model: the critical current density

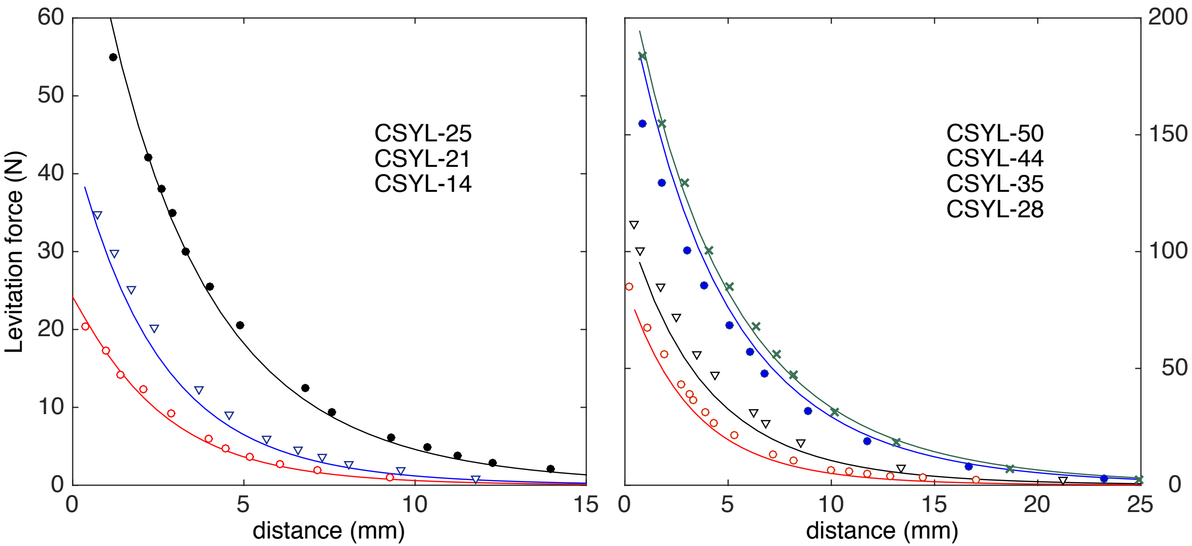


$$|j\rangle \equiv \begin{pmatrix} j_1 \\ j_2 \\ \cdot \\ \cdot \\ j_n \end{pmatrix}$$

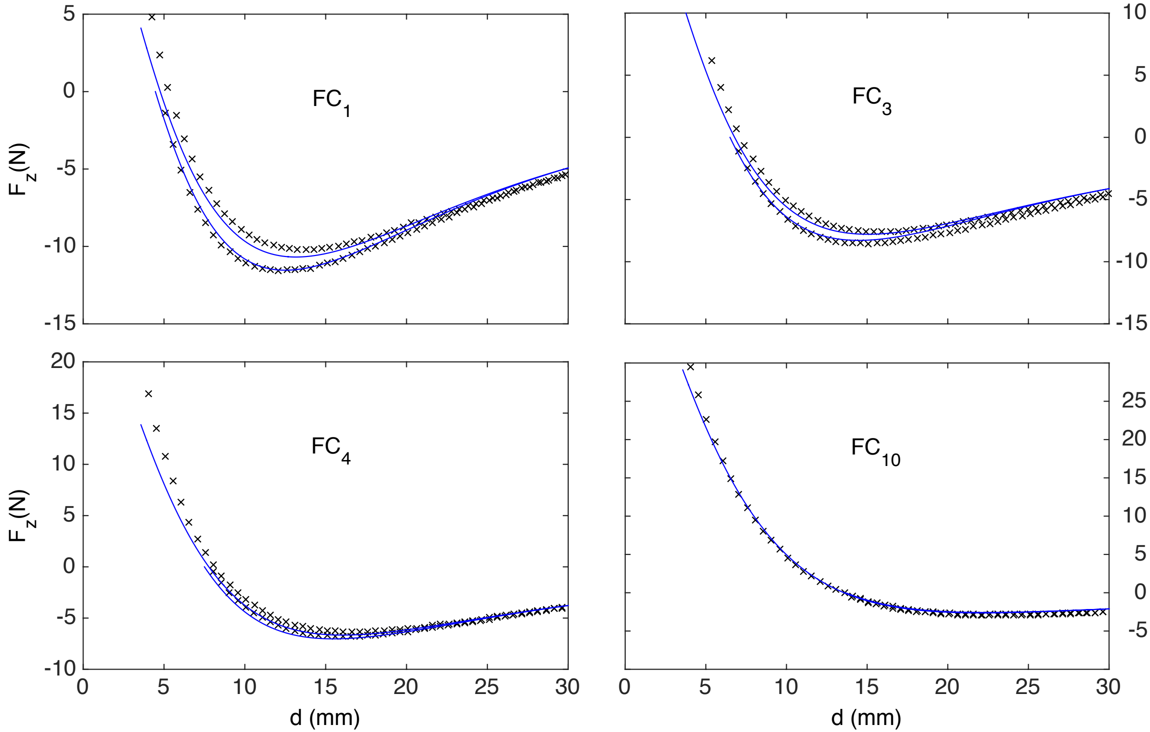
$$j_i \leq j_c \quad \forall\ i$$

$$\mathtt{min}\ \Delta\mathcal{U}[\,|j\rangle\,] = \frac{1}{2}\langle j|\, M\, |j\rangle - \langle \check{j}|\, M\, |j\rangle + \left\langle A_0 - \check{A}_0 \middle| j \right\rangle$$

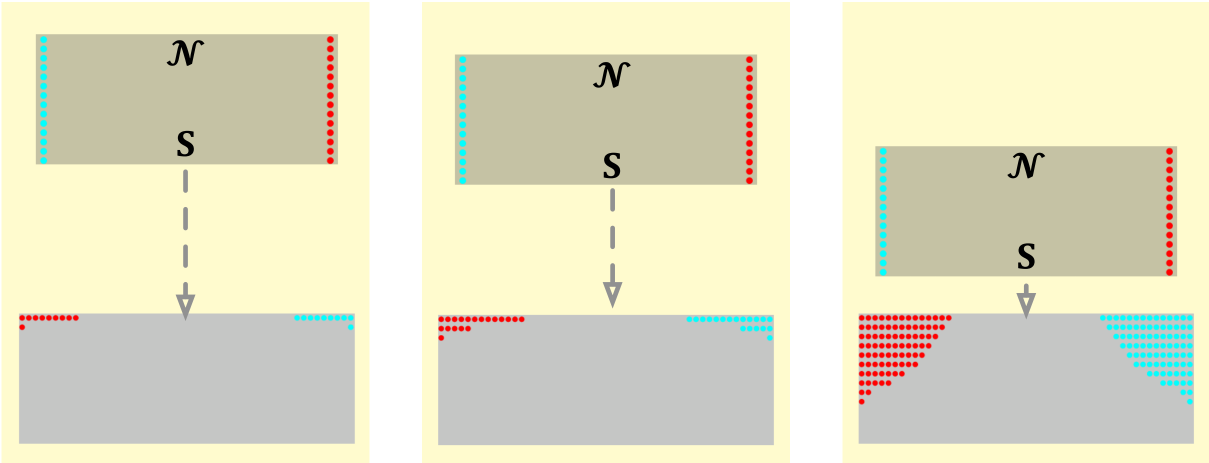
Experimental support:
CAN Superconductors datasheet



Experimental support: hysteresis

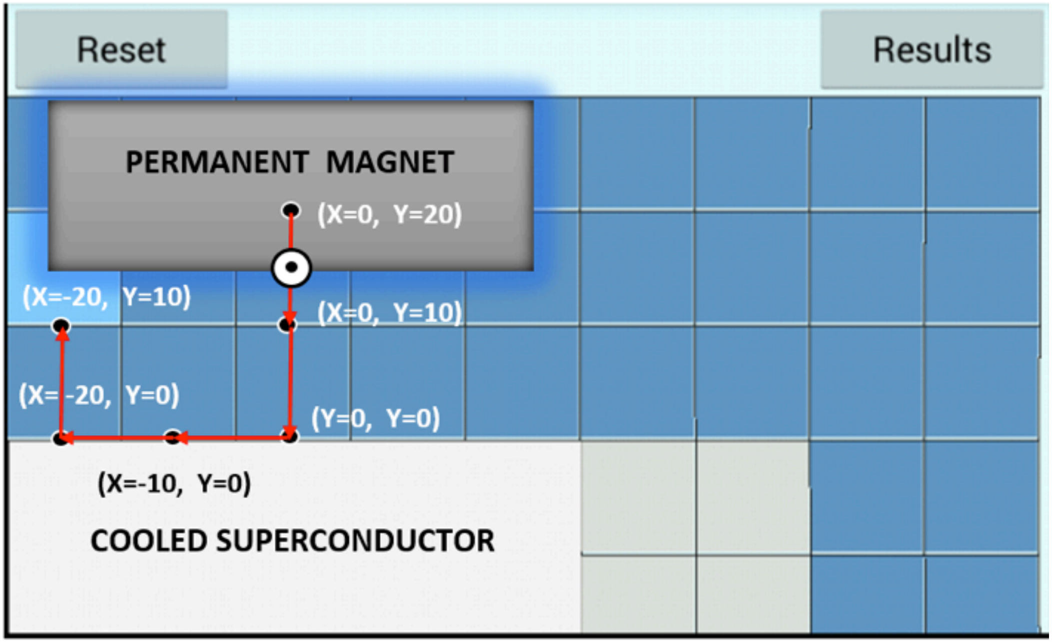


Basics of the simulation



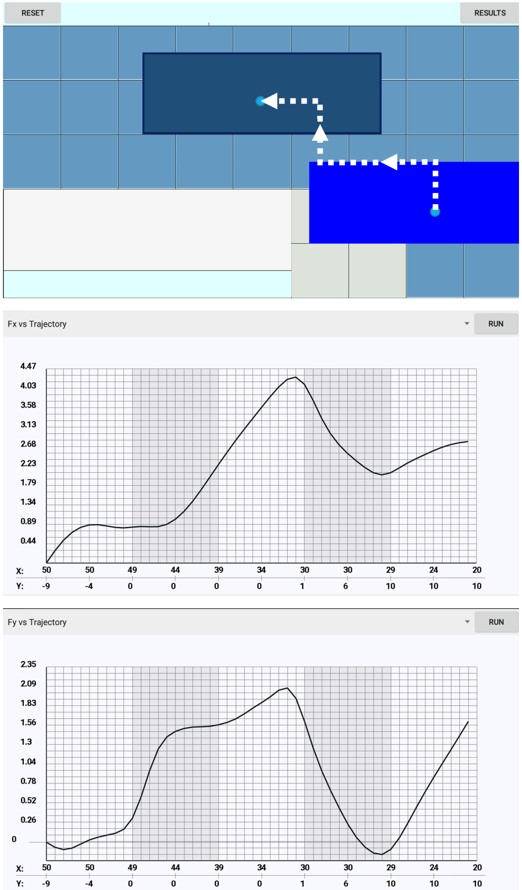
The supercurrent density distribution ($|j\rangle$)
must be found for any trajectory of the magnet !

The main screen on the portable device



Finger gestures on the screen
wag the magnet along the board

Post processing on the device: analysis of force components



$$\mathbf{f} = \mathcal{J}_m \times \mathbf{b}_{\mathrm{sc}}$$

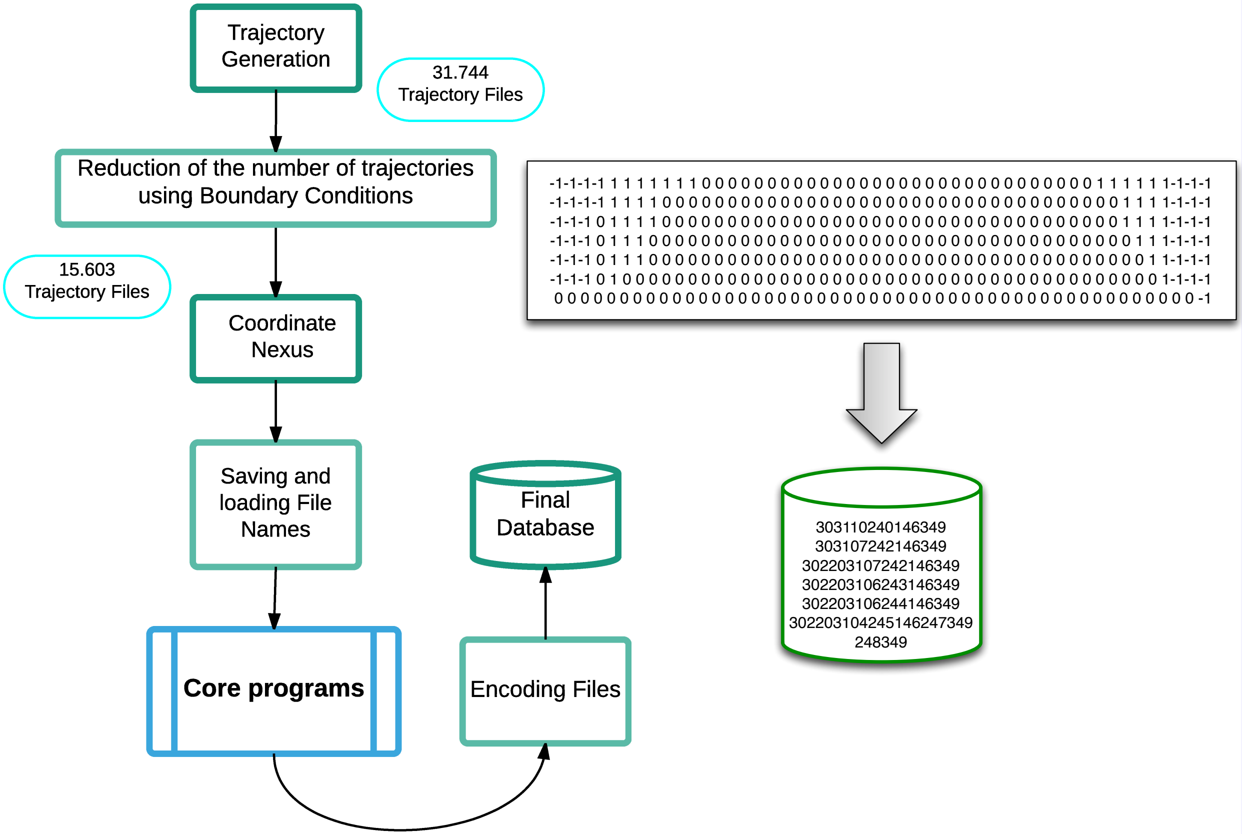
$$\Downarrow$$

$$f_x = -\langle j_{\mathrm{mag}} | b^y_{\mathrm{sc}} \rangle$$

$$f_y = \langle j_{\mathrm{mag}} | b^x_{\mathrm{sc}} \rangle$$

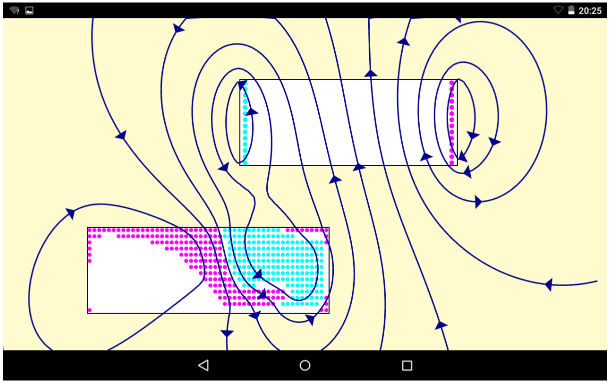
$$| b^{x,y}_{\mathrm{sc}} \rangle = \mathsf{Q}_{x,y} \, | j_{\mathrm{sc}} \rangle$$

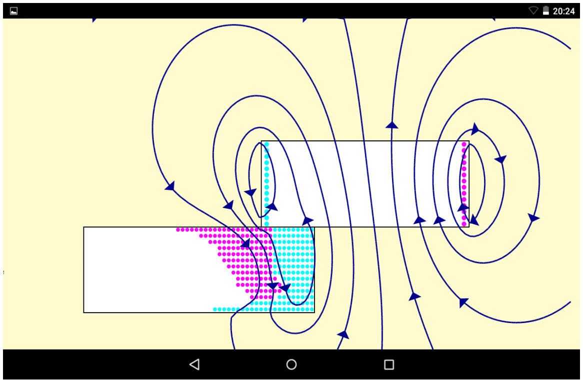
Computations are done via HPC



Background simulations are performed on a cluster and results compressed to a database

Post processing on the device: magnetic field lines





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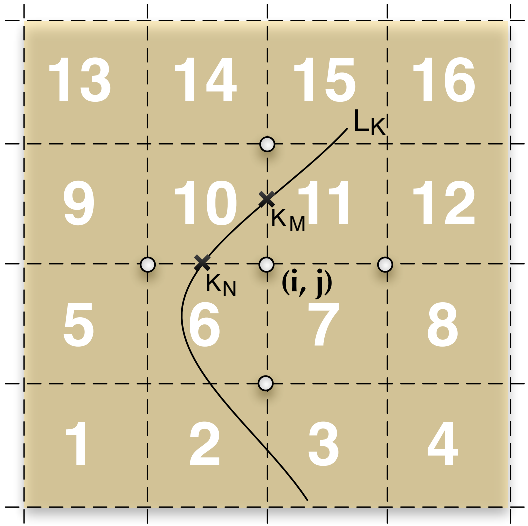
A simple & efficient contour-plotter on your mobile

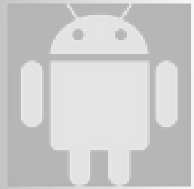


$$|A_z\rangle = \mathtt{M}\,|j\rangle$$

with

$$|j\rangle \equiv |j_{\mathrm{mag}}\rangle \oplus |j_{\mathrm{sc}}\rangle$$

$$A_z(i-1,j) - L_k < 0$$
$$A_z(i,j) - L_k > 0$$
$$A_z(i,j+1) - L_k < 0$$



CONCLUSIONS

- ⋆ We have explored the possibility of realizing electromechanical simulations in standard portable devices: tablets, smartphones . . .

- ⋆ A feasible strategy combines HPC on a linux cluster (construction of database) and eventual post-processing on the portable device ($n_{java} \simeq 8000$)

- ⋆ Levitation forces, current density distributions and magnetic field lines are obtained for a PM/SC system.

- ⋆ Hands-on demonstration . . .

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