



Ion tracking simulations for the WITCH experiment

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Supervisors:

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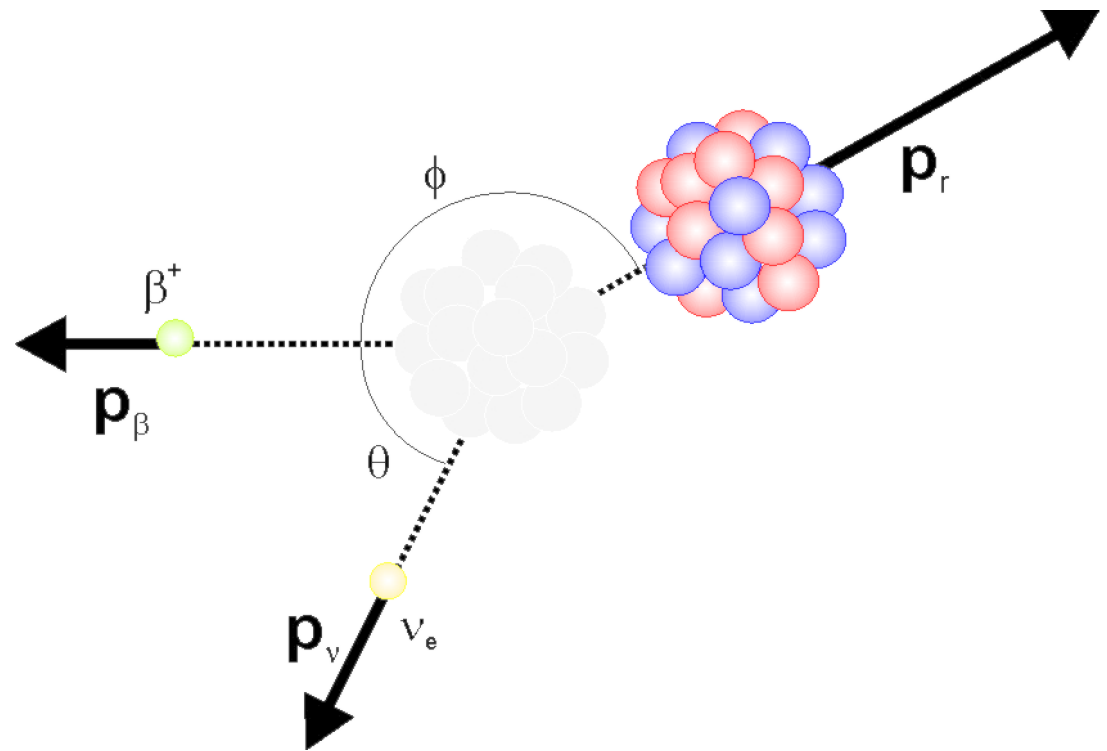
Dr. Martin Breitenfeldt



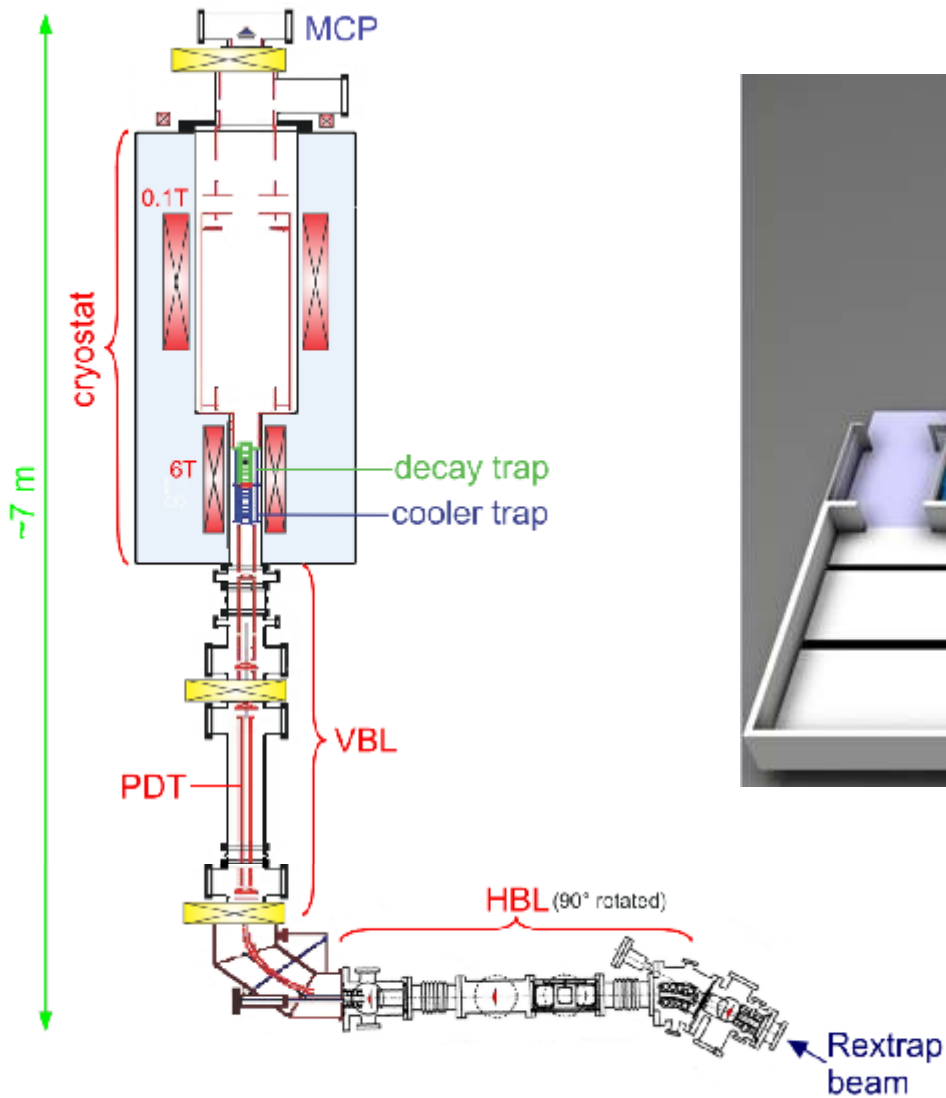
Physical motivations

WITCH - Weak Interaction Trap for **C**harged particles

- Study of β decay
- Determining the **electron-neutrino correlation coefficient**
- Measuring the energy spectrum of the **recoiling nuclei** after β decay



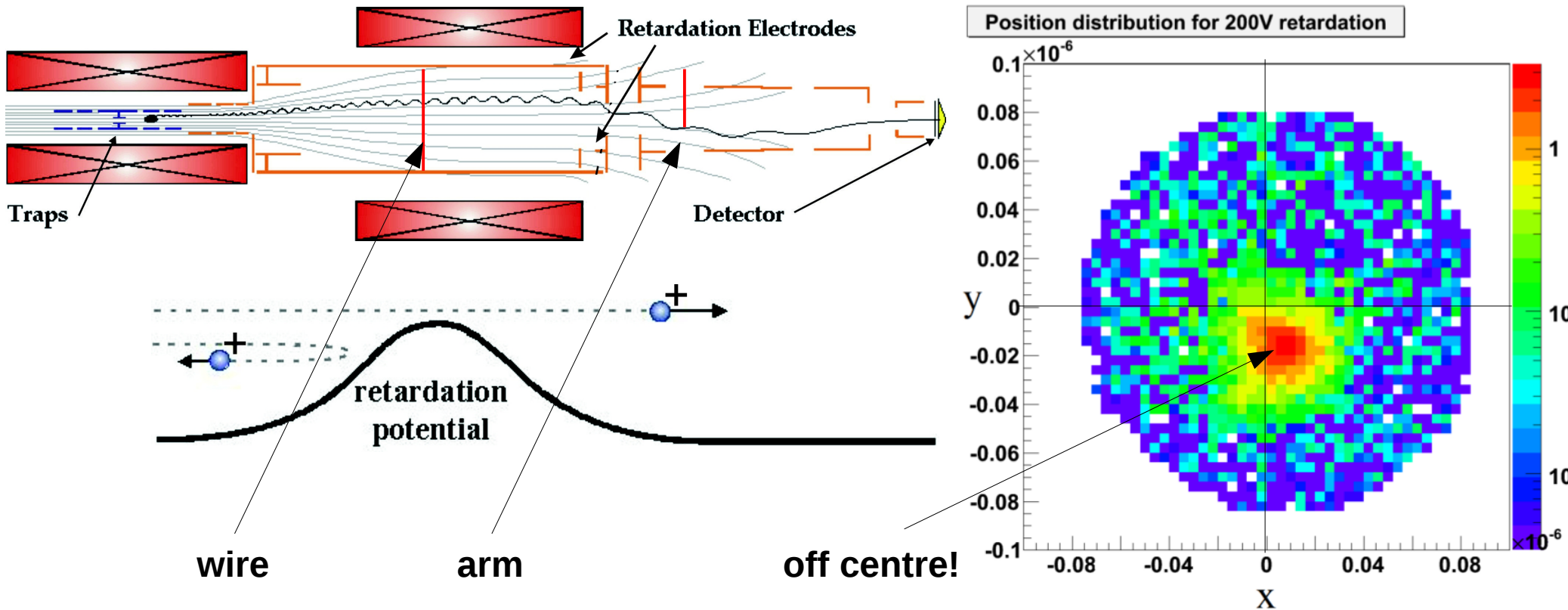
WITCH at ISOLDE



WITCH setup

See also: Dr. Magdalena Kowalska, *Nuclear Physics*,
Summer Student Lecture Programme Course 2013

My project

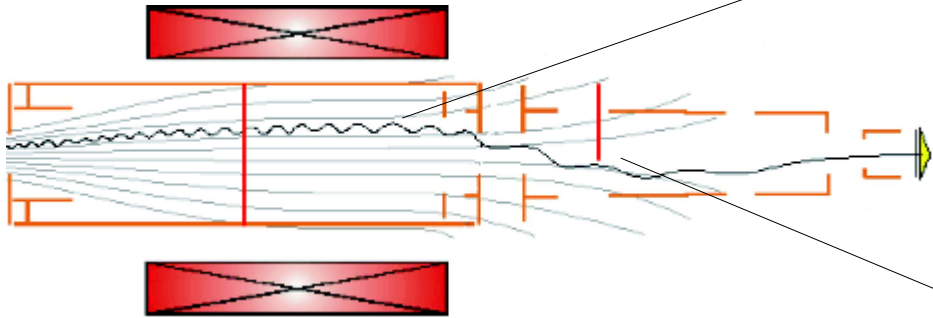


- Two elements are breaking axial symmetry
- My task: changing 2D (r, z) calculations to 3D (r, φ, z)

Electric potential calculations

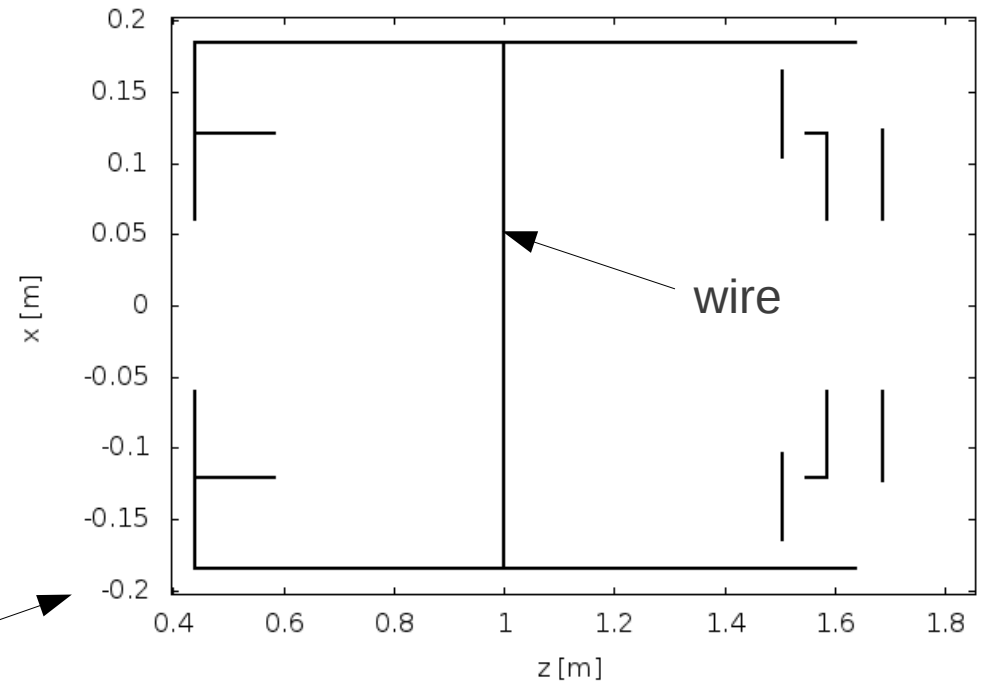
Calculations of electrical potential:

- **2D** – full geometry
– without wire/arm

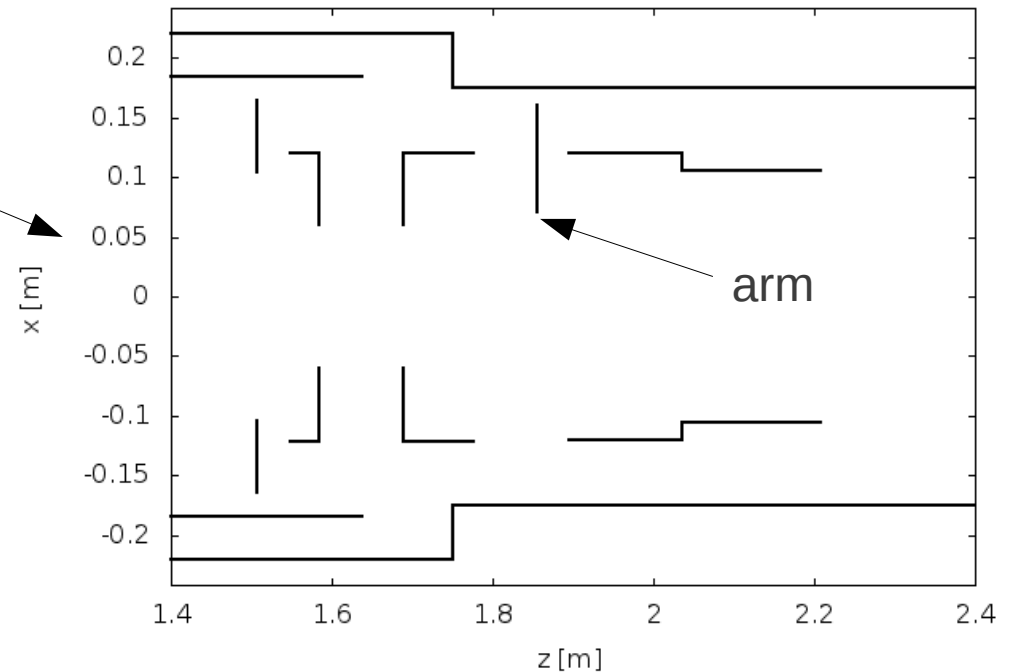


- **3D** – simplified geometry:
 - without wire/arm
 - with wire/arm

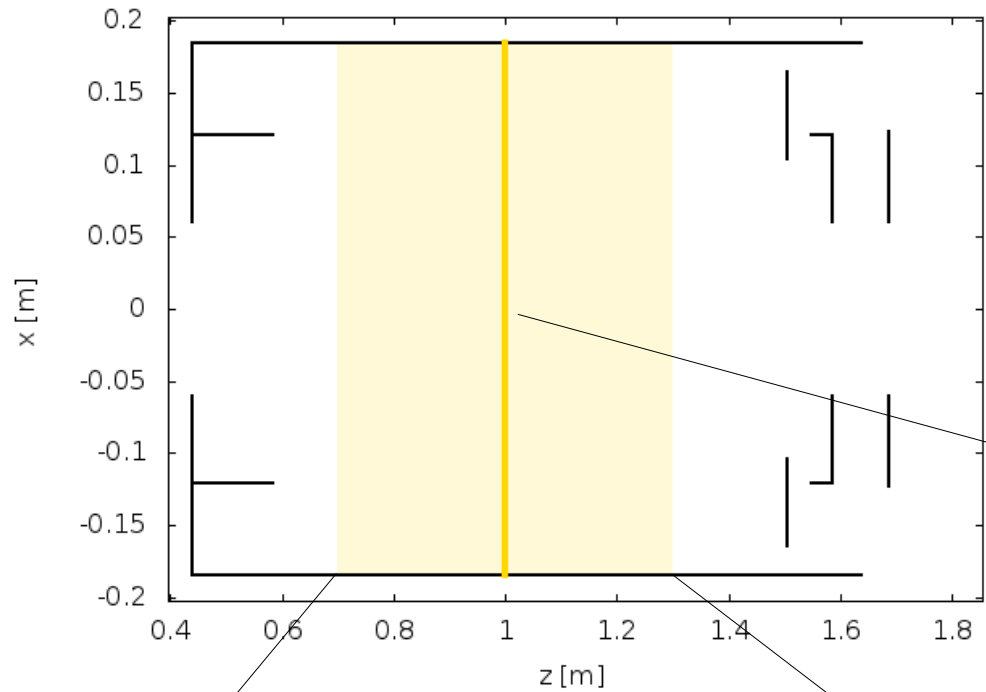
Simplified geometry in wire section



Simplified geometry in arm section

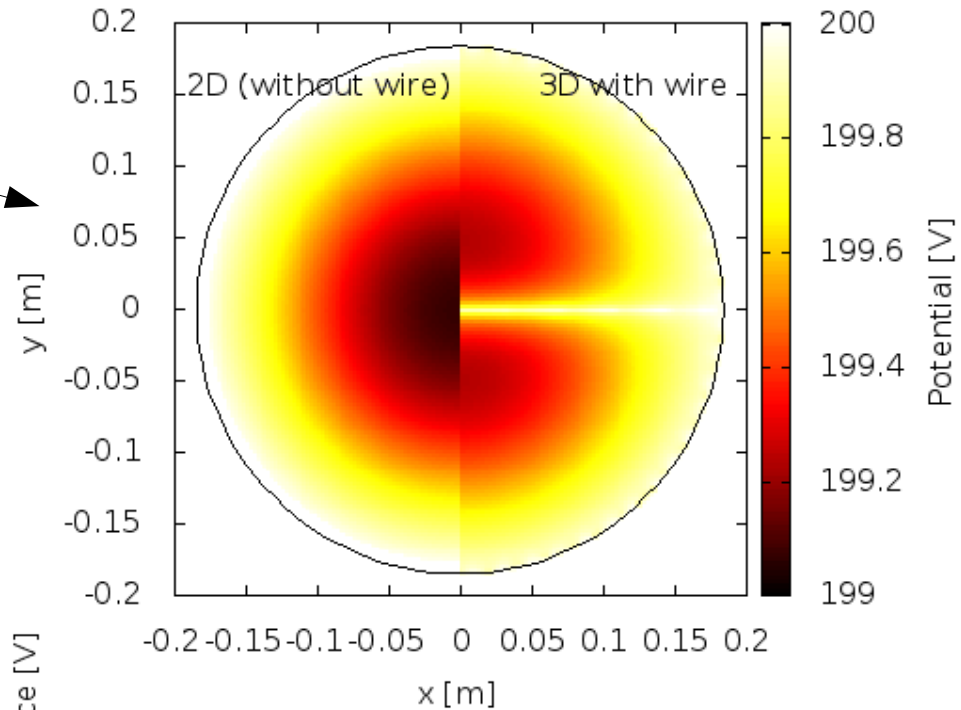


Simplified geometry in wire section

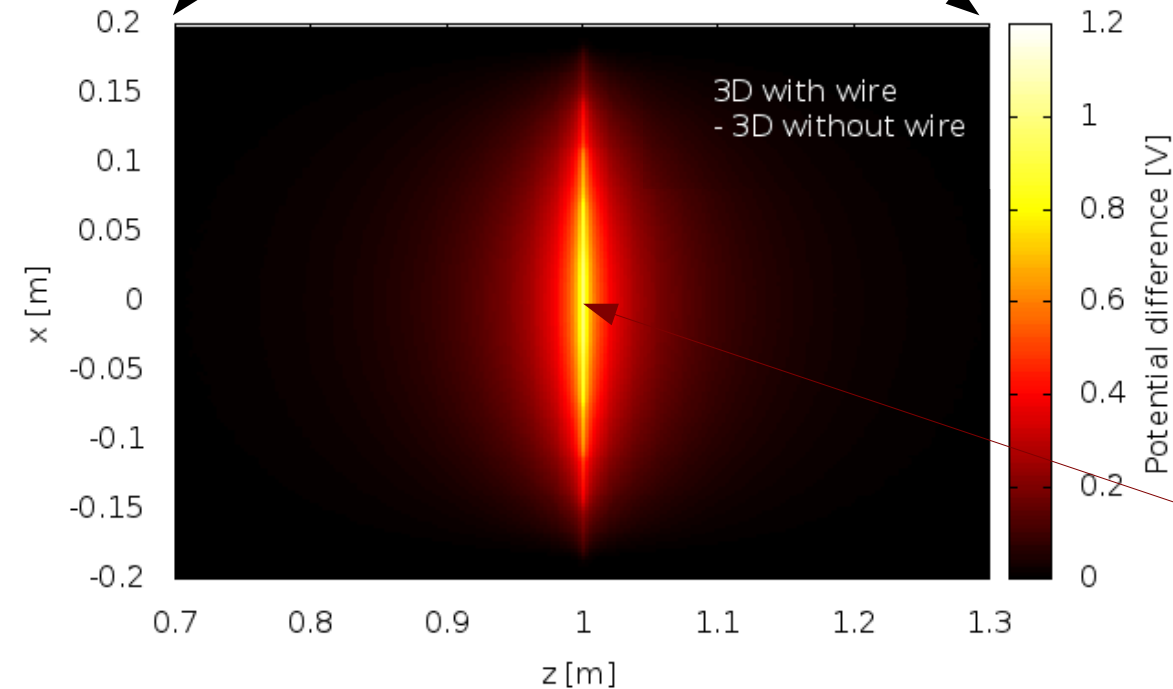


Wire

Potential profile $z = 1.0$ m (wire)

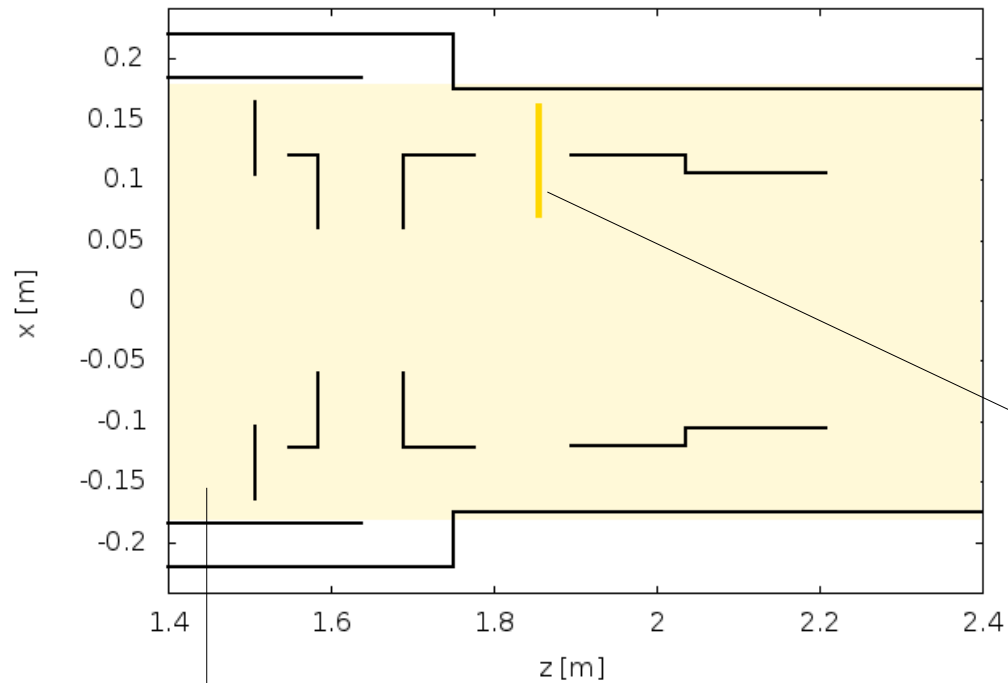


Potential difference profile $y = 0.0$ m

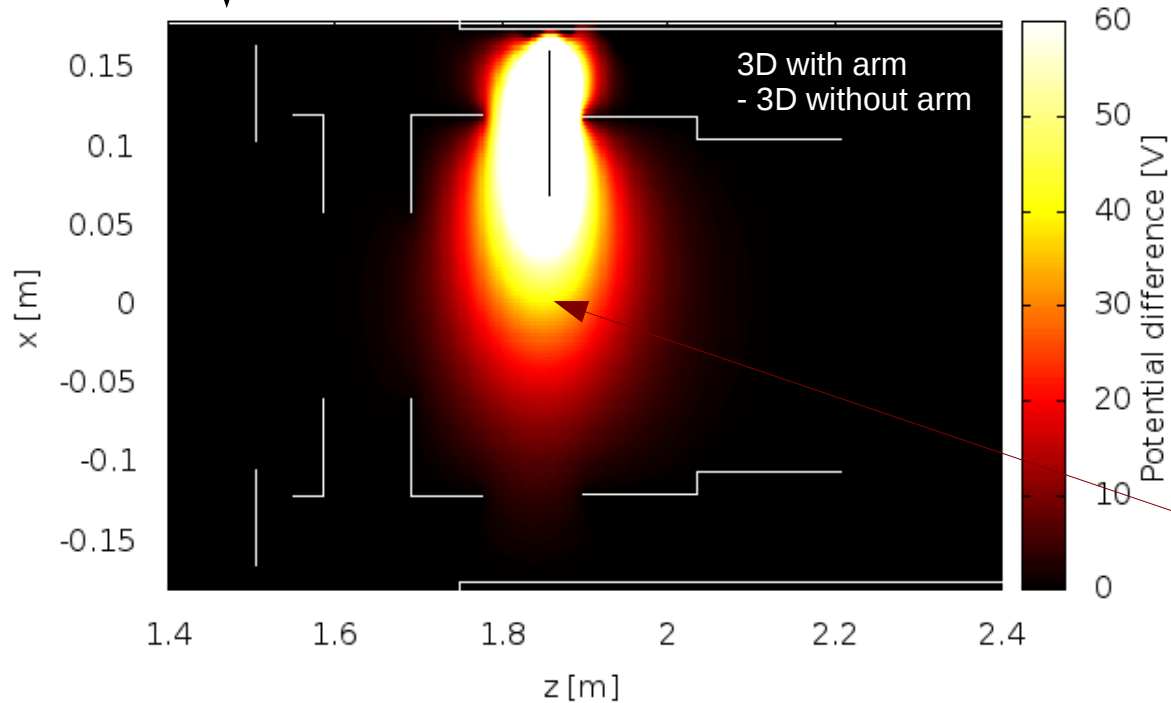


The wire rises the potential in the centre by ~ 1.1 V (0.5%)

Simplified geometry in arm section

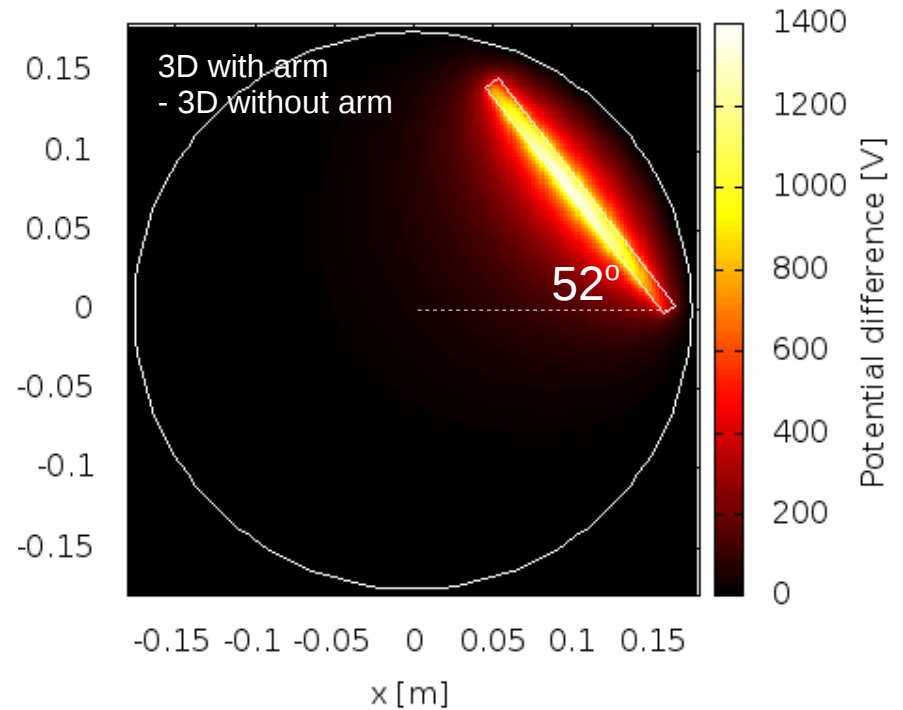


Potential difference profile $y = 0.0$ m



Arm

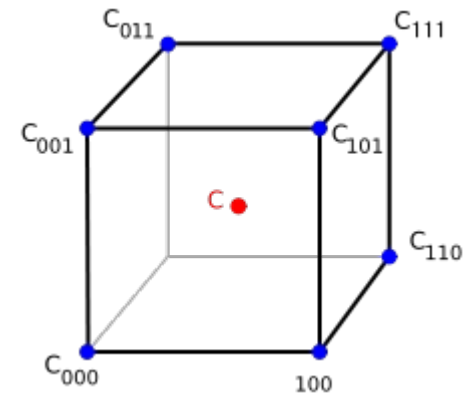
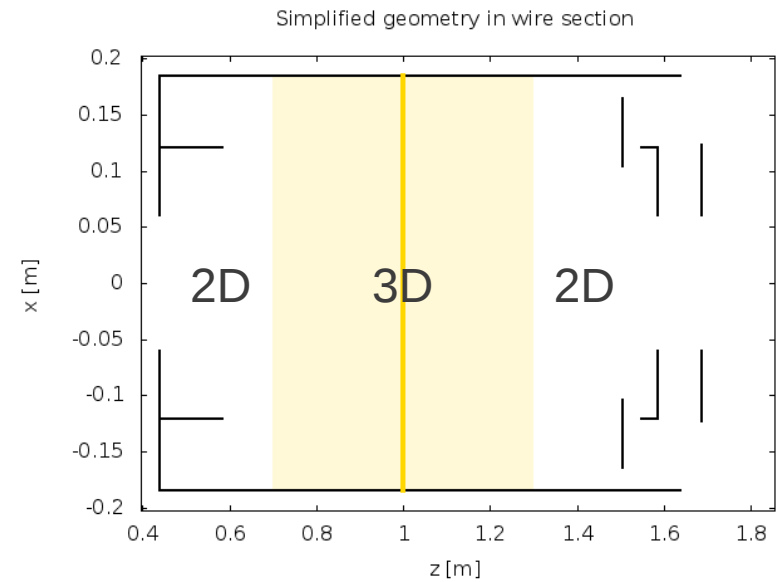
Potential difference profile at $z = 1.856$ m (arm)



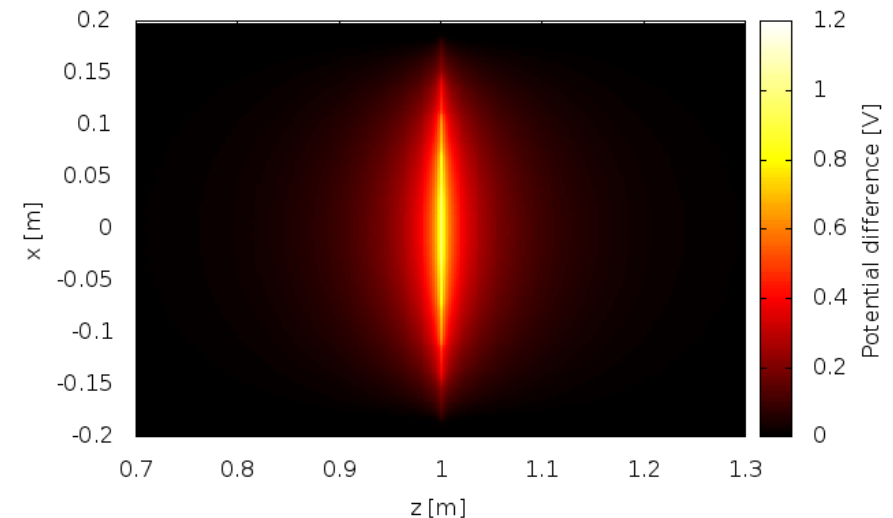
The potential in the centre $(0, 0, 1.855)$ is higher by ~ 38 V (1.3%)

Ions simulations – tracking

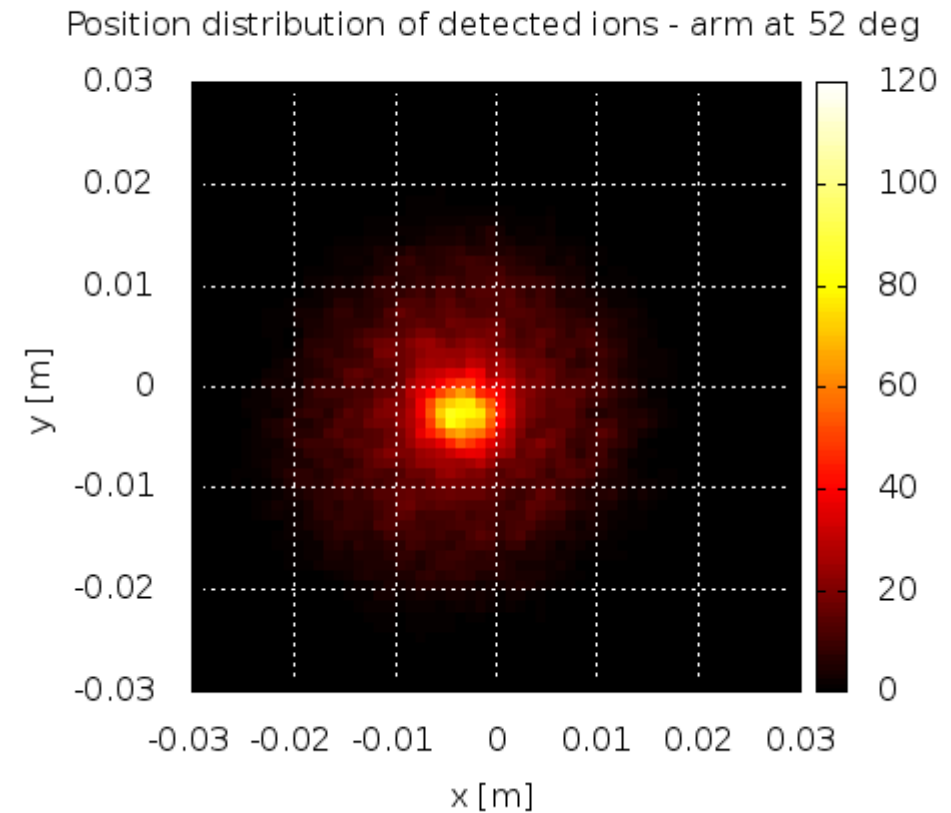
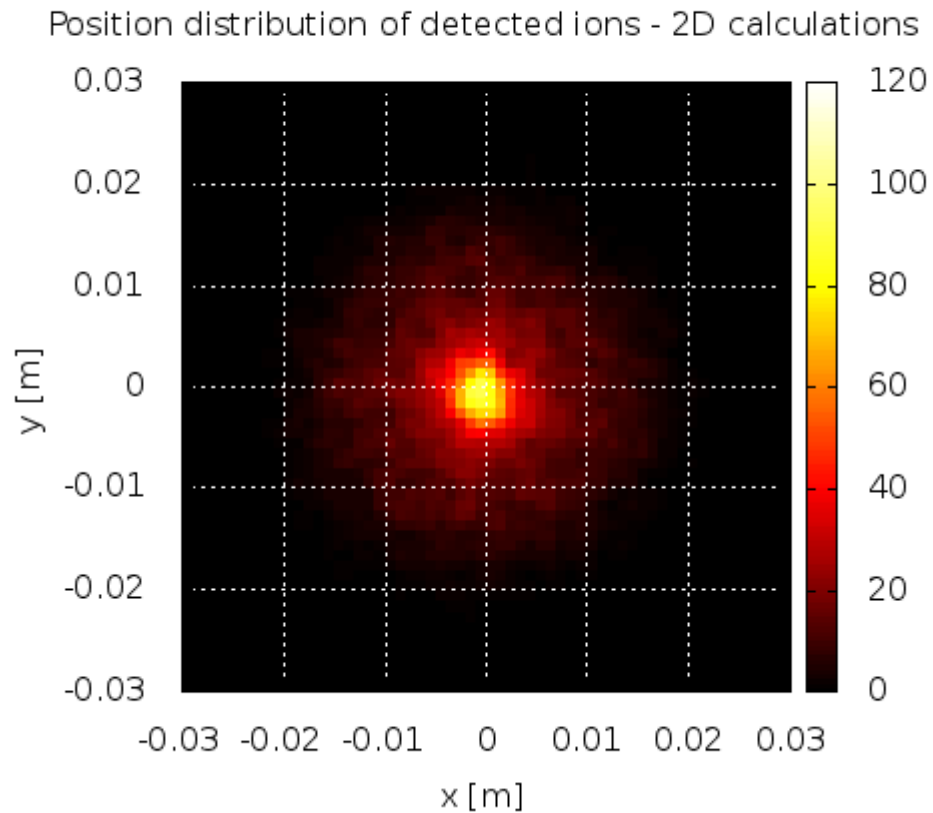
- 3D calculations take 2000× more time than 2D
 - My ideas:
 - switching between 2D and 3D routines
 - 3D interpolation using potential map
 - map of potential difference (with-without element) from 3D calculations
 - adding this difference to 2D calculations
- Simulations only 20% longer



Potential difference profile $y = 0.0$ m



Preliminary results



The arm is deflecting ions!

Outlook

- Still nearly two weeks more
- What more can be done?
 - further investigations of arm's influence
 - adaptive mapping
- Final presentation during the ISOLDE meeting:

Thursday, 22th August, 2 p.m.

ISOLDE Visitors Room 26/1-022

All of you are invited!

- Questions? pb276972@okwf.fuw.edu.pl

If you want to learn more about the WITCH experiment:

- *<http://fys.kuleuven.be/iks/wi/WITCH>*
- M. Beck *et al.* European Physical Journal A **47** (2011)
- M. Beck *et al.* Nuclear Instruments and Methods in Physics Research A **503** (2003) 567-579

Thank you!