Magnetic field mapping in the Meson Hall

New Source meeting

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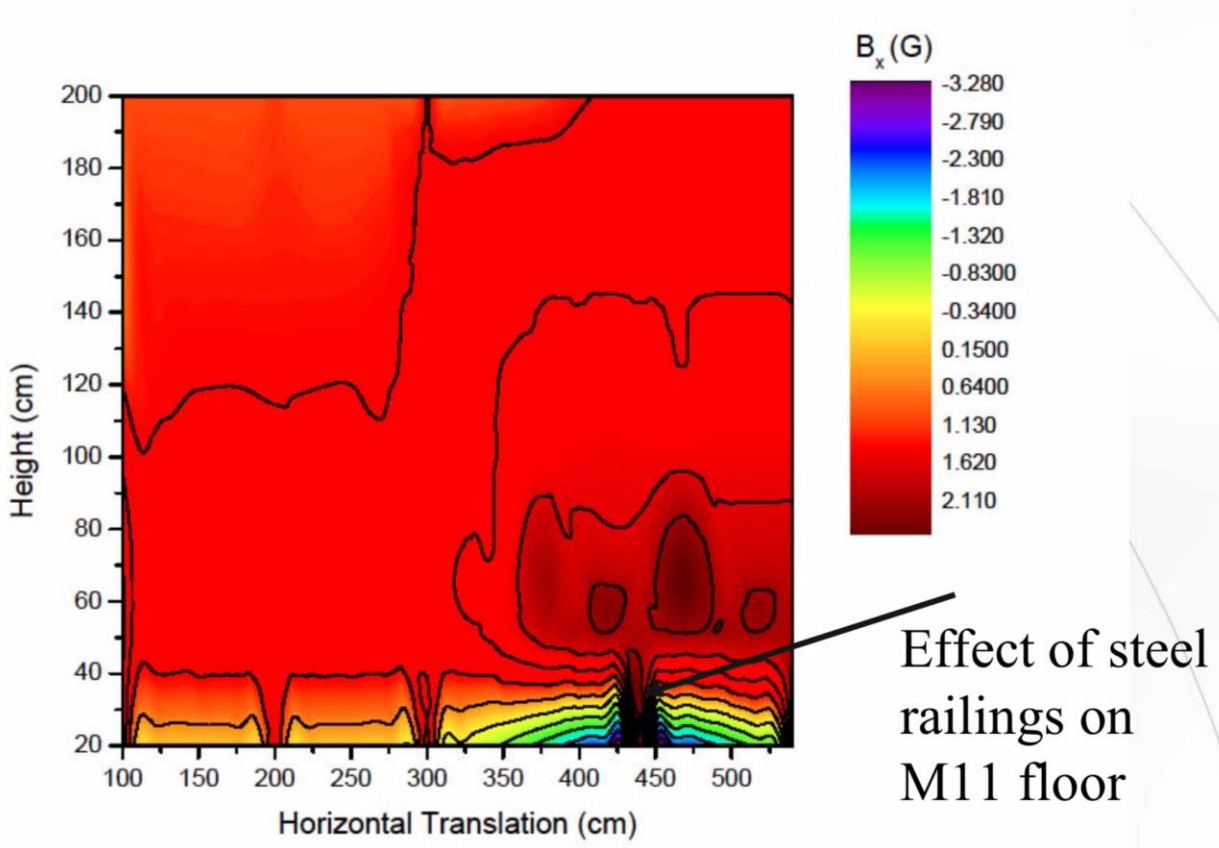
Magnetic field mapping

Over the last weeks, we worked on magnetic field mapping in the TUCAN area (former M13) in the meson hall.

Summary of the measurement by Paul Sarte (2012)

- Field can be up to 350 uT
- Local strong fields near the floor



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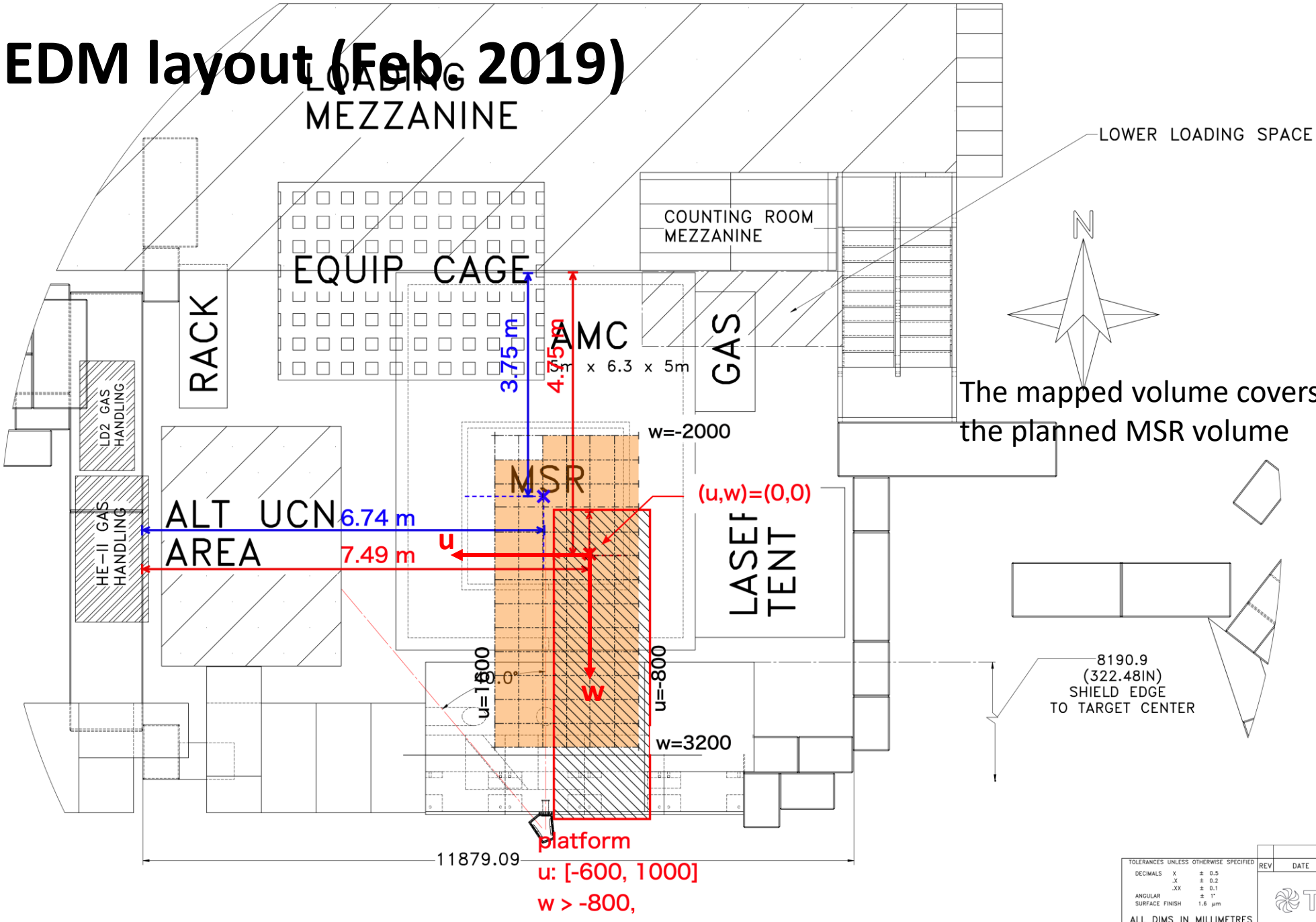
Why repeat?

- Paul's data quality/quantity is low for M13 (he improved the method for M11 and M20 measurements)
- Situation may have changed by newer components
- **Interest in field information for higher position in view of MSR saturation/AMC compensation studies**

Coordinate system

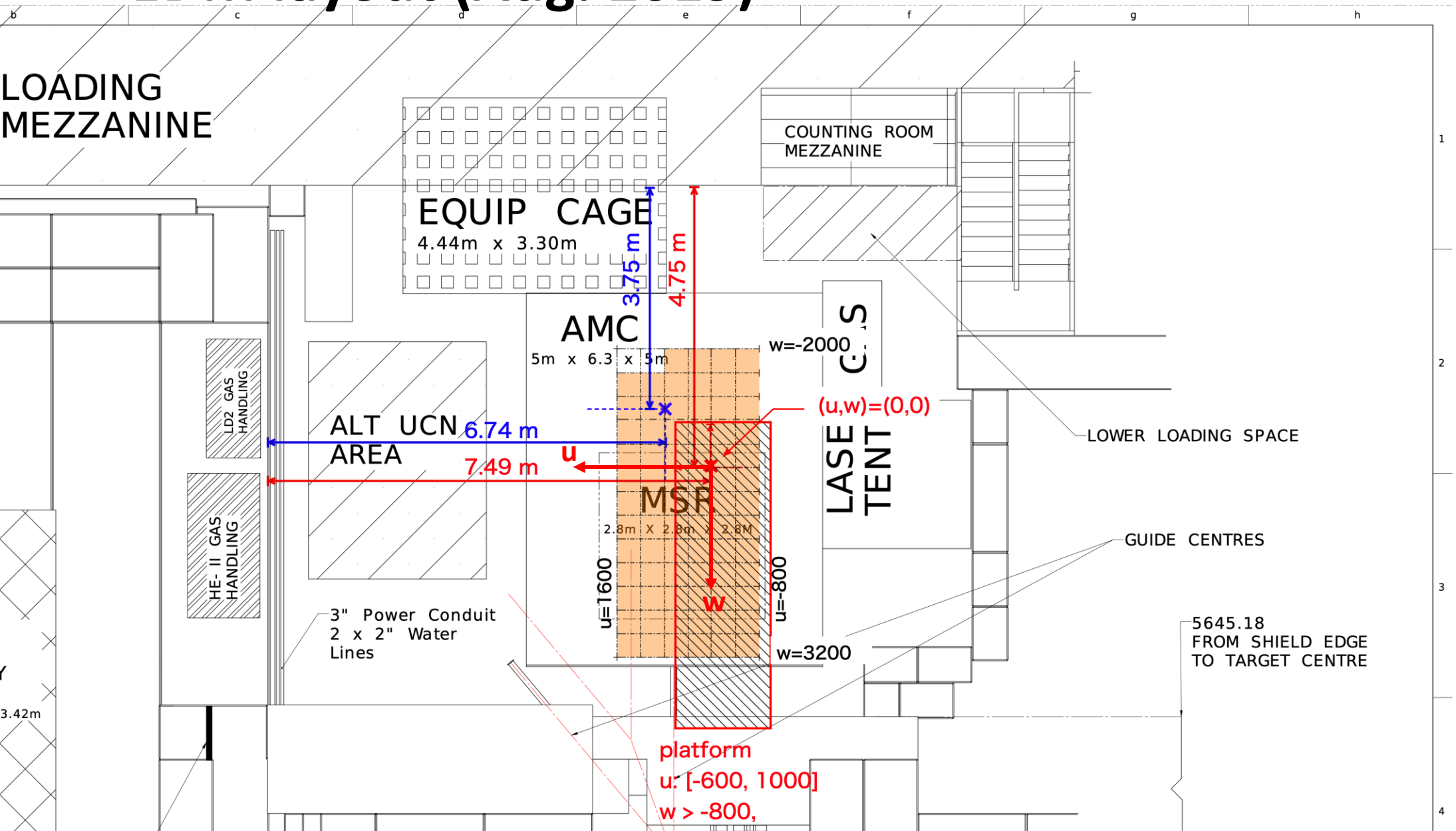
- Marked grids with 40cm intervals, common coordinate system on the floor and on the platform
- The position in the picture on the right: (u,v,w) = (0,0,0)
- v=0 on the platform, the floor level is v=-1.882m

EDM layout (Feb 2019)



The mapped volume covers at least ~1/4 of the planned MSR volume

EDM layout (Aug. 2019)



Measurement (1)

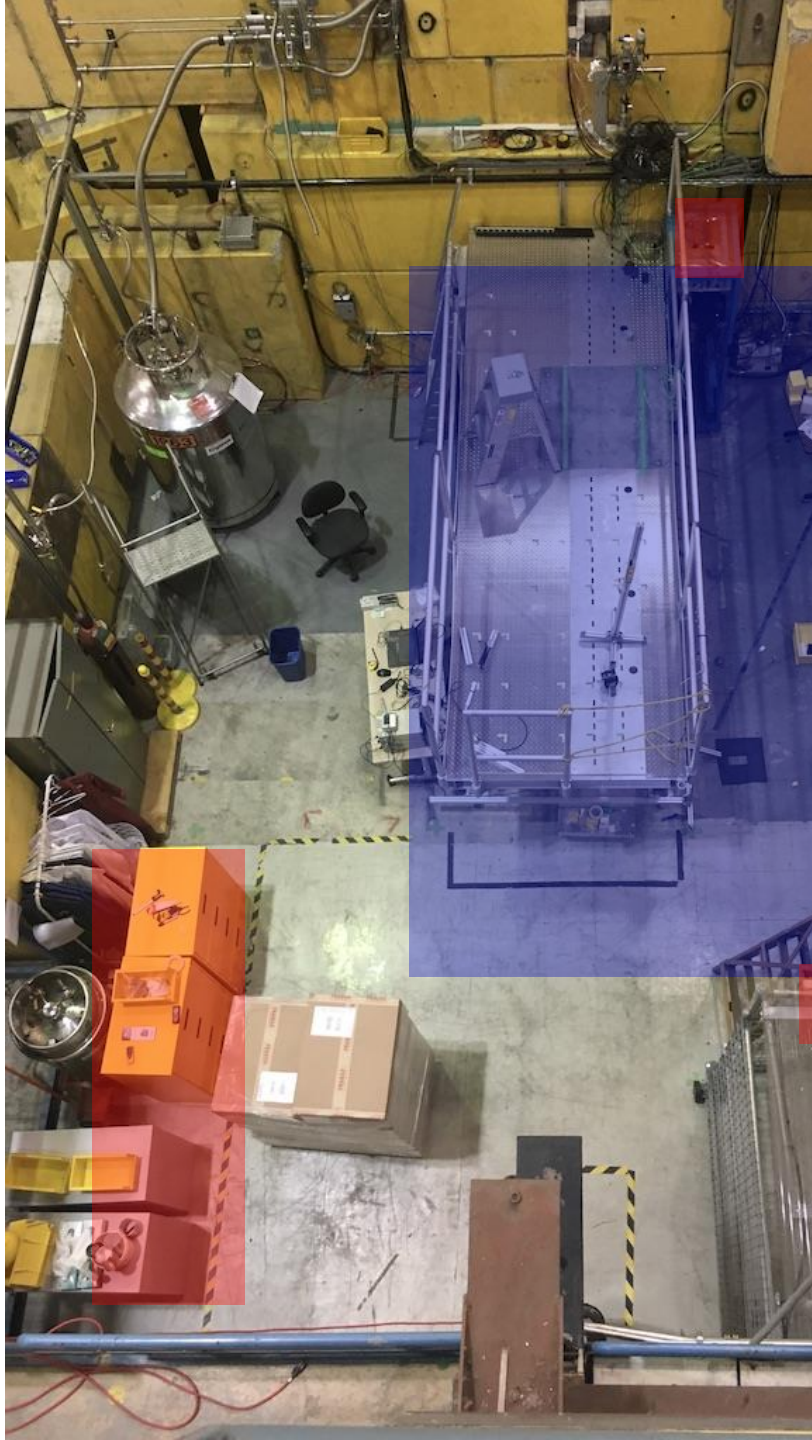
- We relocated magnetic objects (SCM, polarizer, BL magnet, etc.) (thanks to Wolfgang!)
- Took off the rails on the plate beneath SCM (but kept the plate)

- Two poles with different heights (2.1m, 1.6m) prepared. Upgraded for better stability and alignment control (next page)

Planned mapping volume

Magnetic objects

Multimeters and the PC were placed > 1m away from the probe



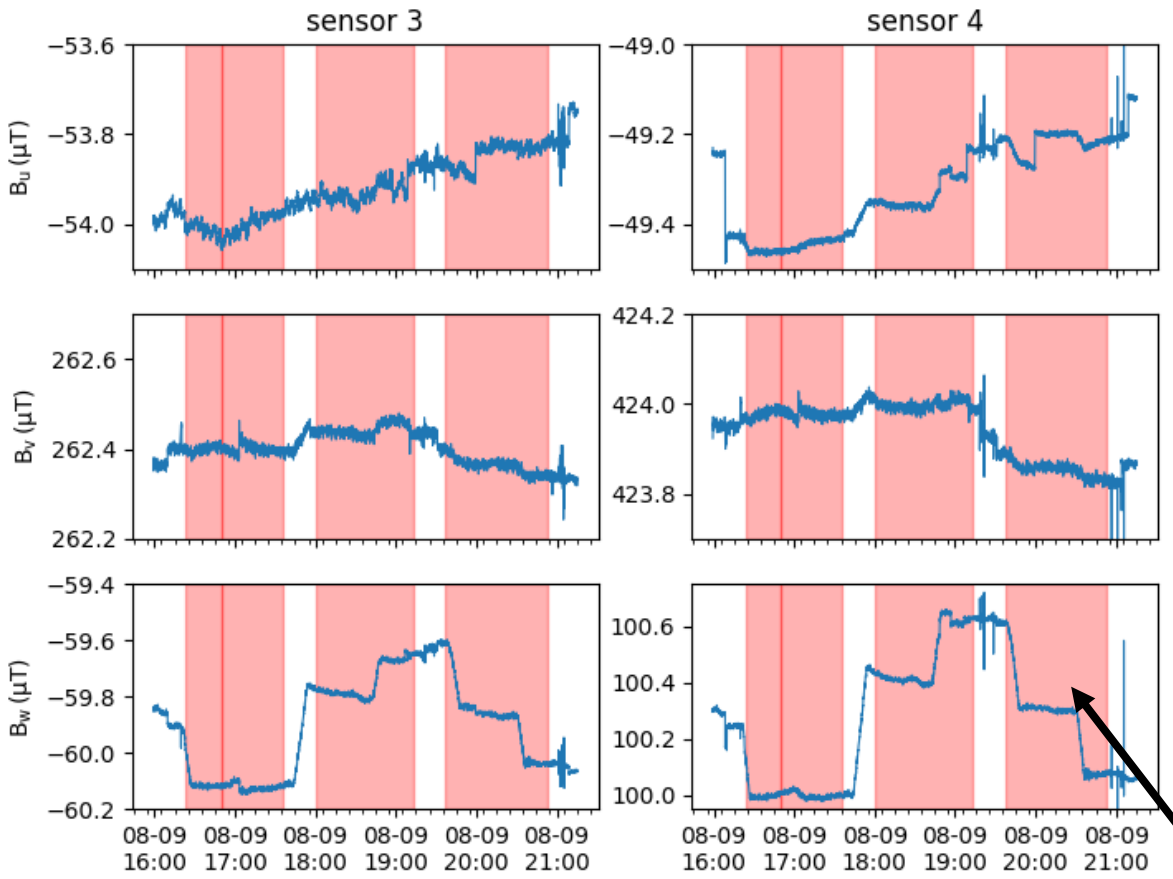
Measurement (2)

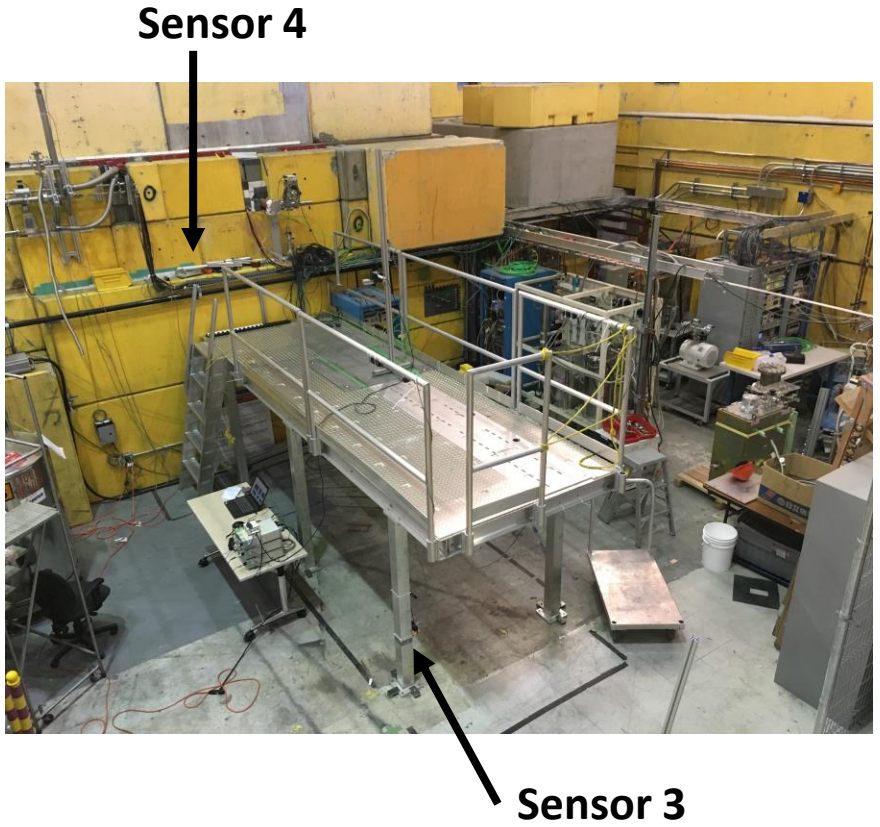
- The triaxial fluxgate magnetometer is fixed with acrylic holder attached to the arm of the pole by screws
- The floor is bumpy, so the 4 screws were used as feet
- Two spirit levels attached on sides of the pole to keep it horizontally aligned
- Mark from a rotary laser used as reference of the absolute height
- Position the pole by the marks, held it at a vertical position by hands
- 5 measurements with 1s interval per each position

Uncertainties/limitations

- Angles:
  - Vertical: the probe leveled by the attached spirit levels to < 0.02°
  - Horizontal: a few degrees?
- The absolute height adjusted with a mark by a rotary laser < 5mm
- Precision of the horizontal grid < 5 cm
- Inevitable small shakes while holding the probe: ?

Monitoring





Steps: M20 changing the longitudinal field

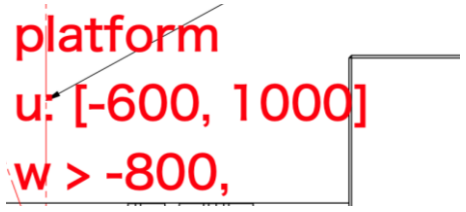
- Consideration (for future measurement)
  We have uT/m order gradients. Cannot expect the field to be stable < 50 nT

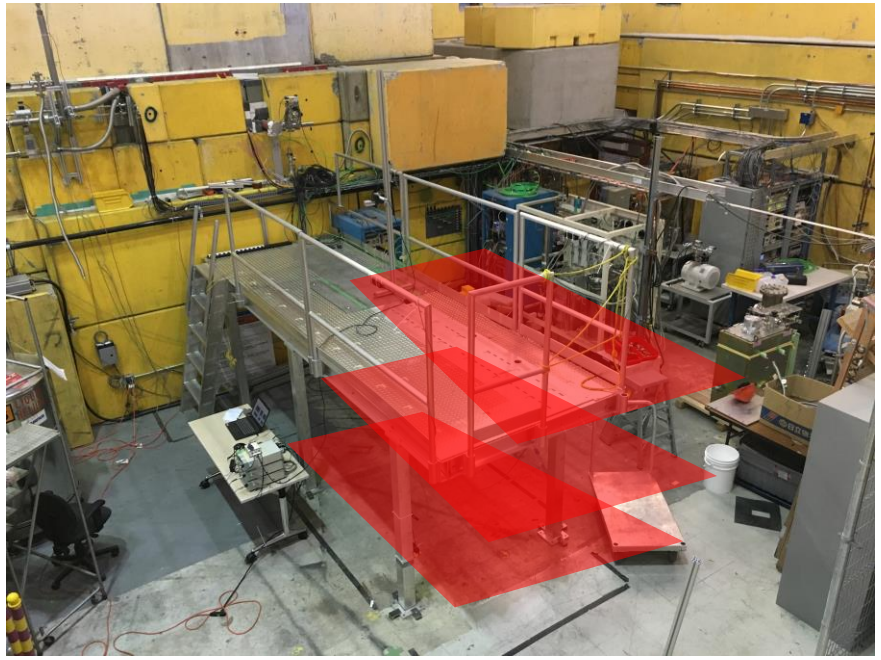
-> Steps on the order of 10 cm is the best we can. This measurement: 40 cm

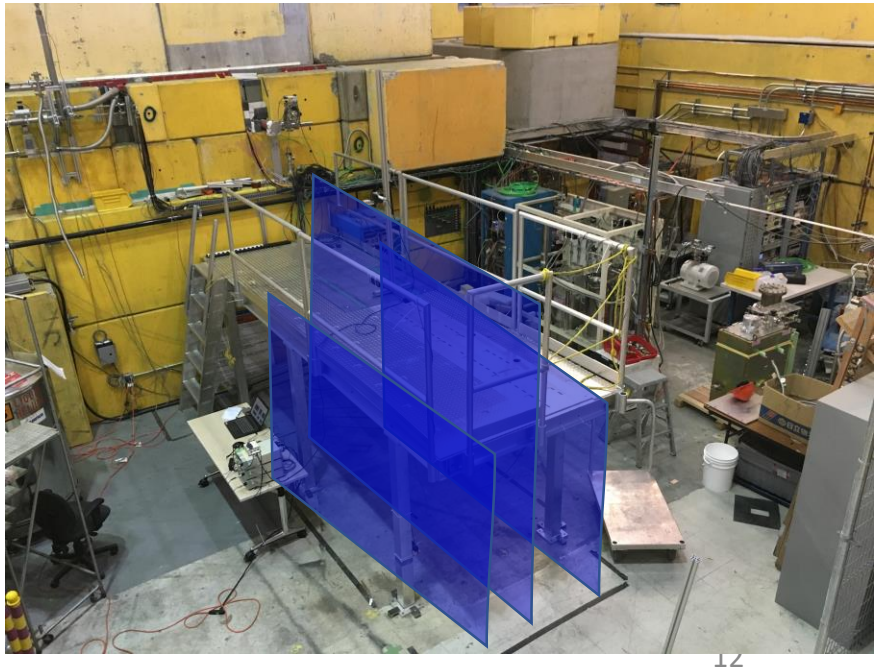
Results

- Results along some cut planes v=const. or u=const.

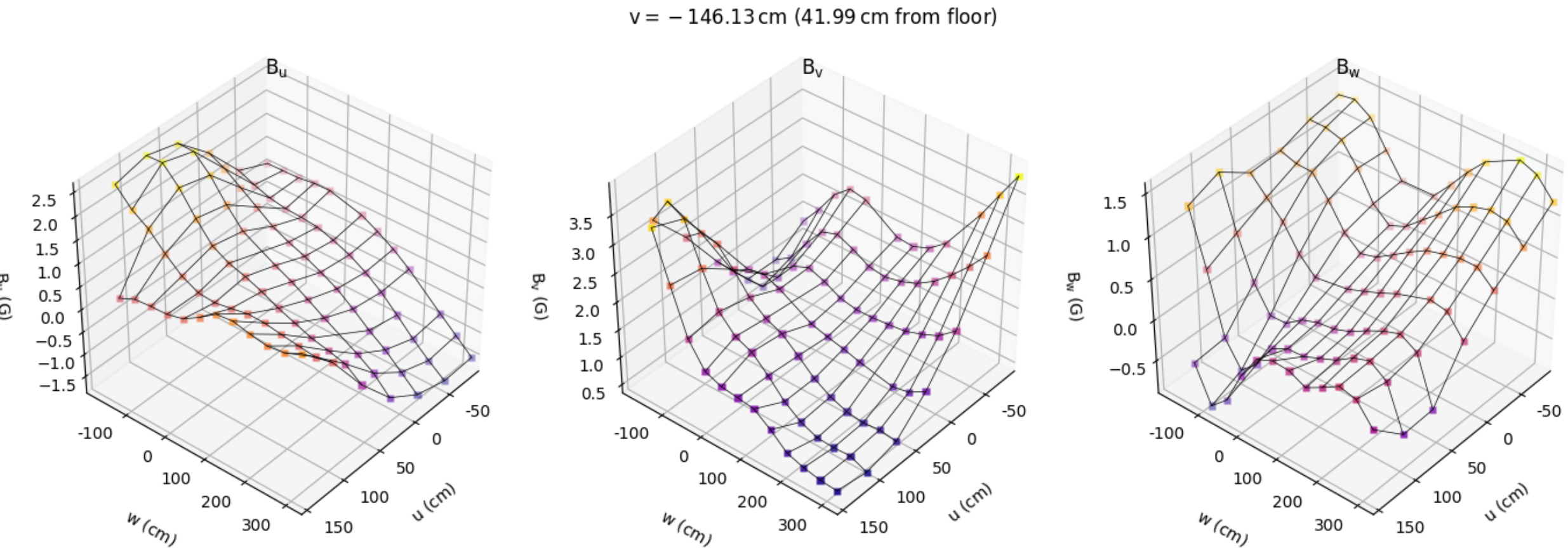
pole positions u=-40, 0, 40, … were scanned on the floor, while pole positions u=-20 cm, 0cm, 20 cm, 60 cm were scanned on the platform due to space limitations



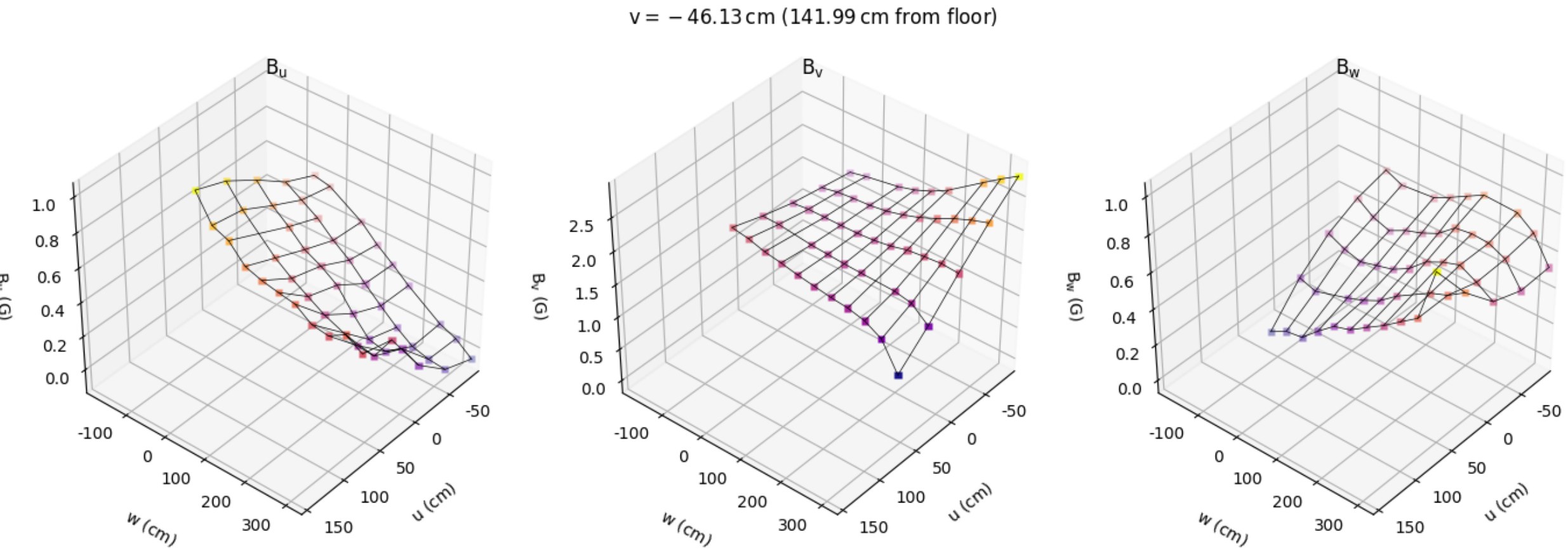




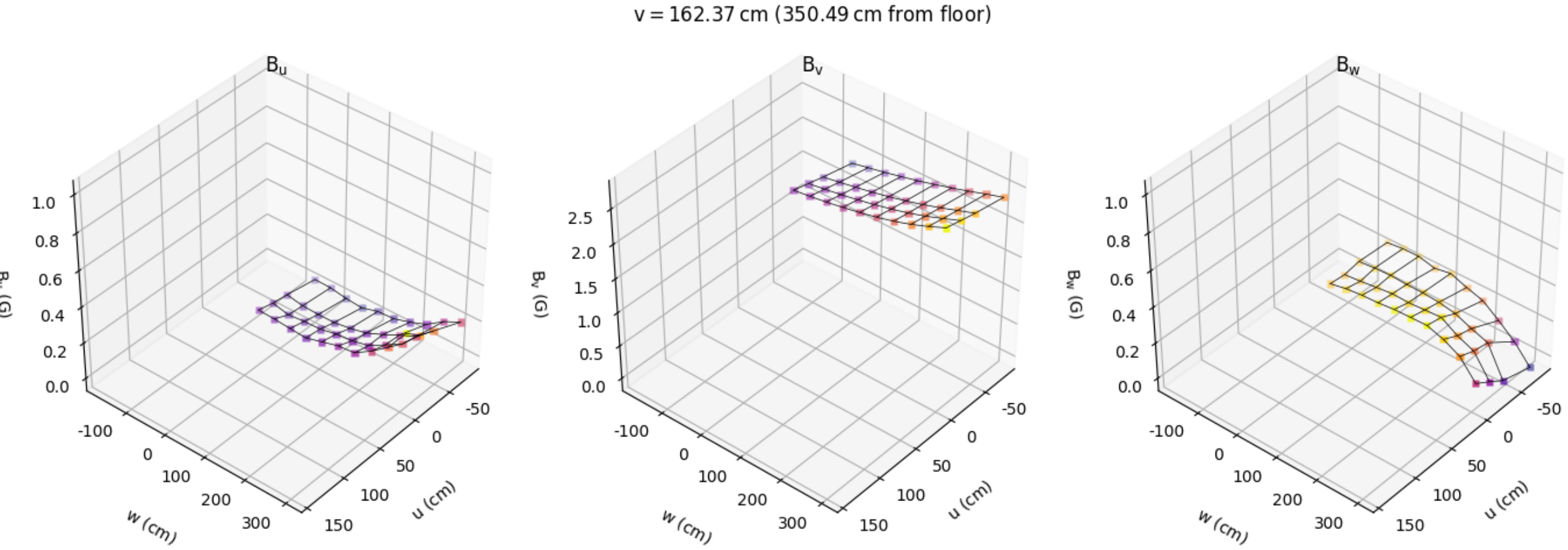
Cut v=-146.13 cm (41.99 cm from floor)



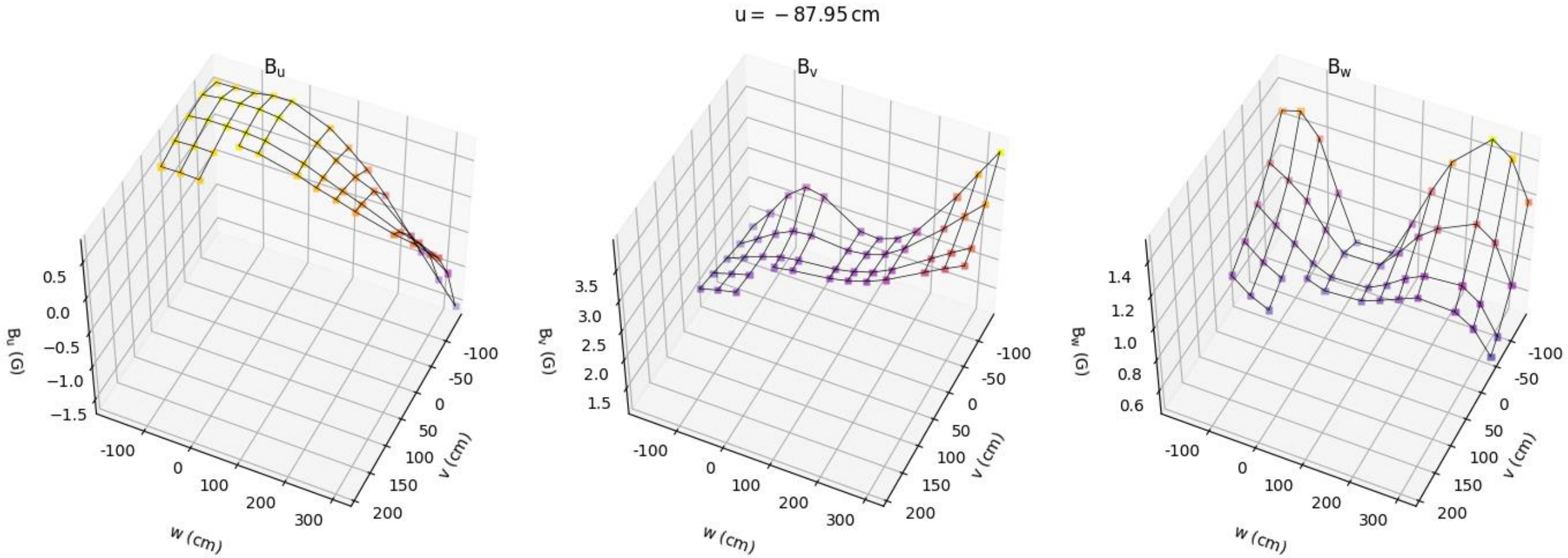
Cut v=-46.13 cm (141.99 cm from floor)



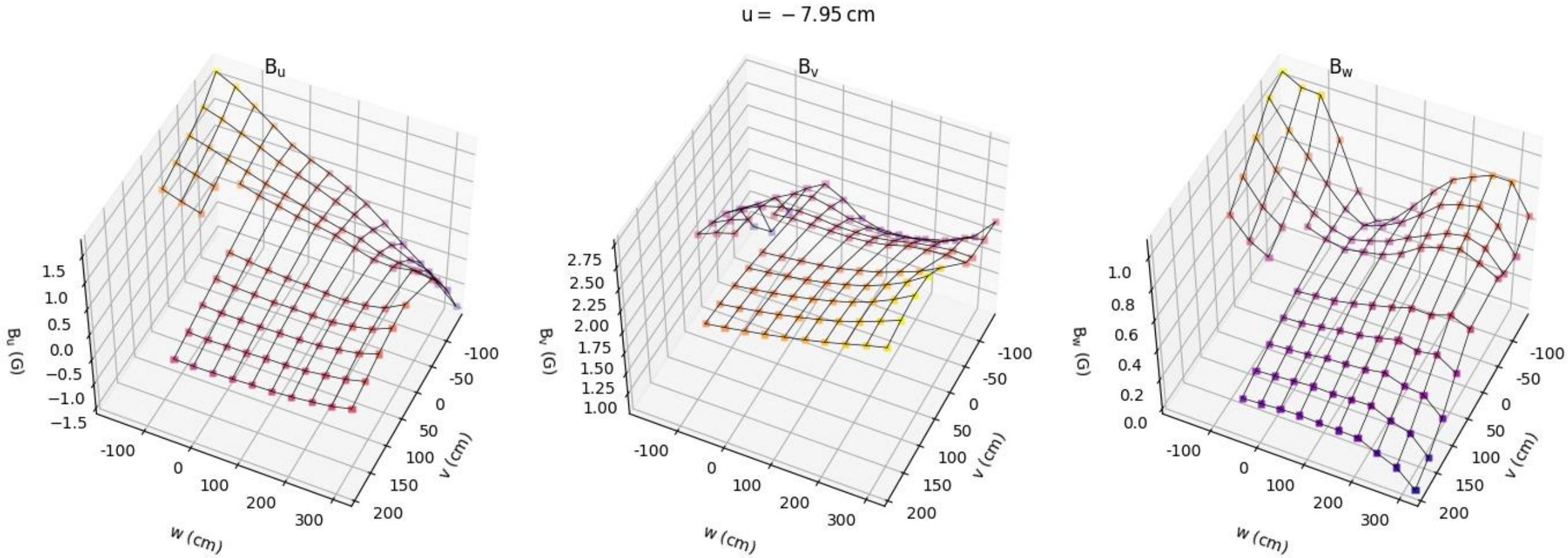
Cut v=162.37 cm (350.49 cm from floor)



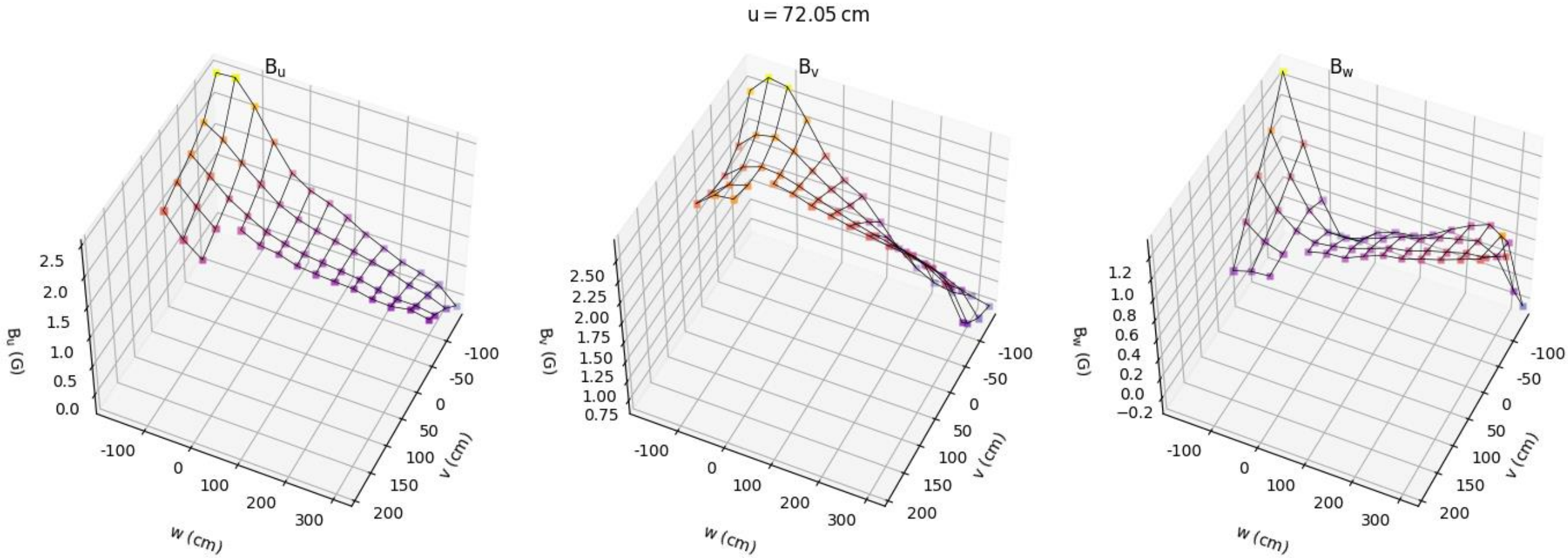
Cut u=-87.95 cm



Cut u=-7.95 cm (contains data on the platform)

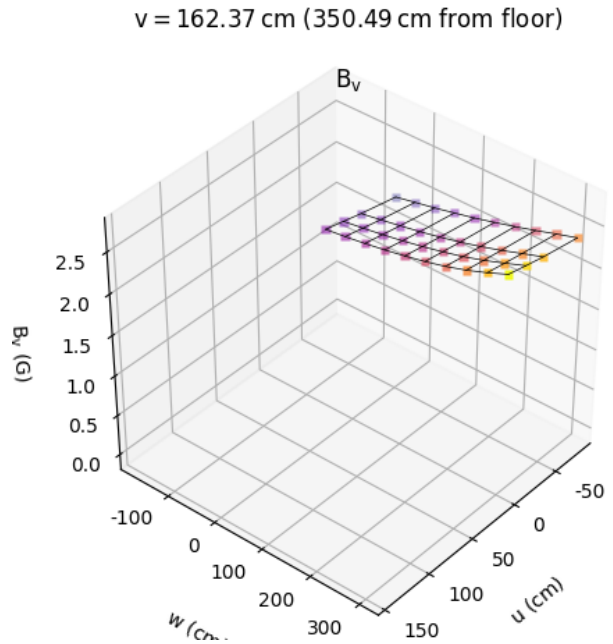


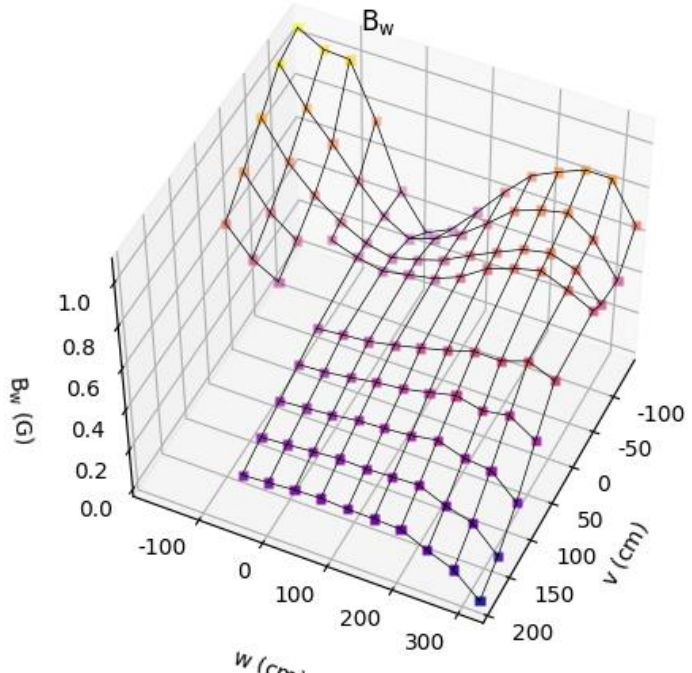
Cut u=72.05 cm

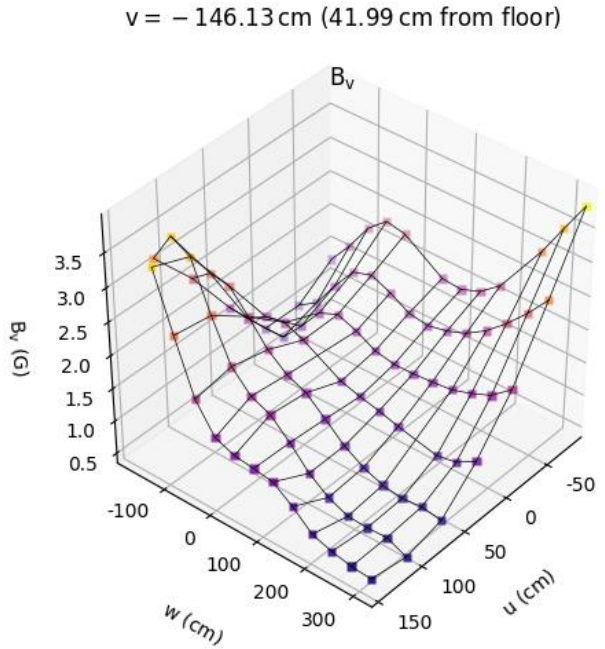


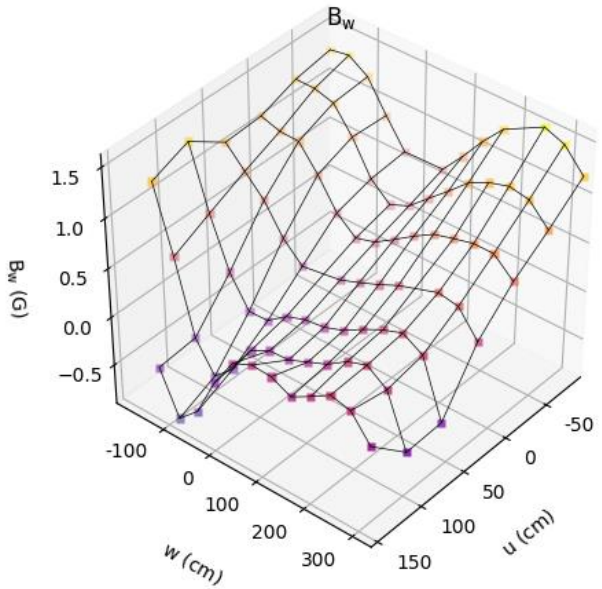
Observations

- Magnetic field is smooth for higher v (v>-50cm).
  In low v region, we see local field stronger distributions
- ‘Valley’ of the B_w along w ~ 0 cm
- At lease three horizontal points where field is concentrated









Next steps

- Interpolate/extrapolate field in order to make denser map
- Check the relations with the local objects and floor structure more closely
- Fitting with Legendre polynomial and input to OPERA (Meadeh & Russ)
  - Better focus of field at higher v
- Design of AMC coils which can well compensate it