



# Update on preparation for upcoming UFO MD

Mika Väänänen  
CERN

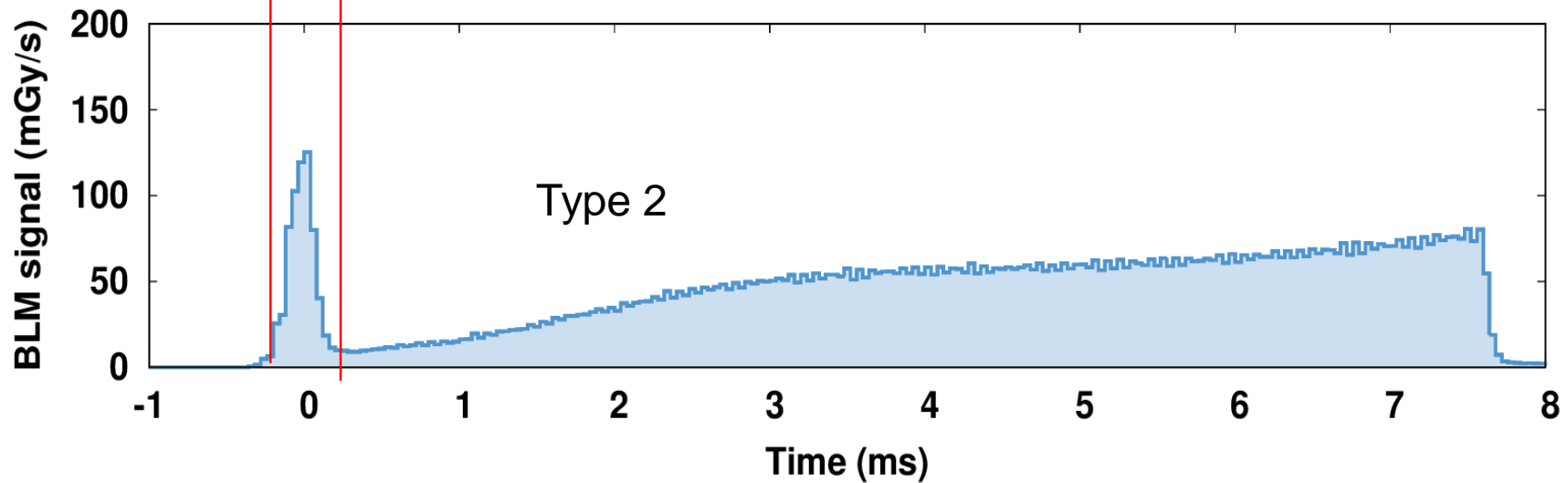
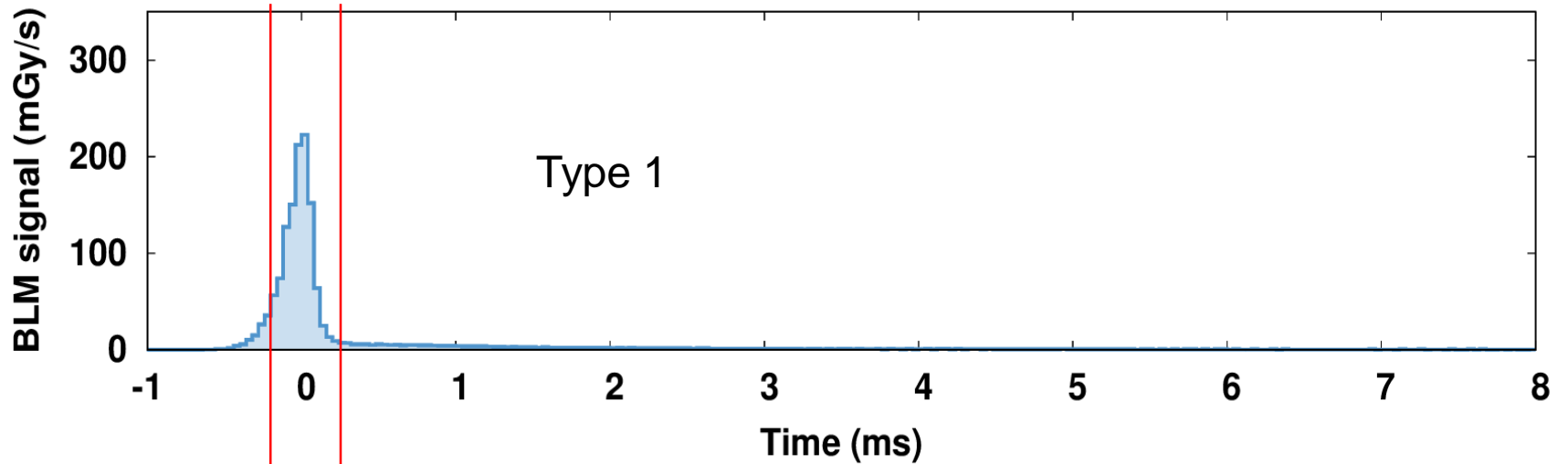


TE-MPE-PE Section meeting – 5 September 2018

# UFOs

- Dust particles in the beam pipe
- Cause beam losses
  - Localized and at collimators
- May lead to beam instabilities and/or quenches
- Two types
  - Type 1: all around the ring ( $\sim 1$  ms)
  - Type 2: localized at 16L2 ( $\sim$ tens of ms)
- Type 2 dynamics studied last year

# UFOs



# dBLM UFO studies

- Aims
  - Acquire knowledge of UFO dynamics
  - Validate and improve current models
- Use fast dBLMs for bunch-by-bunch losses
- Previous readout system (ROSY) wasn't good enough
  - Poor resolution, not flexible enough, proprietary system

# VFC Readout system

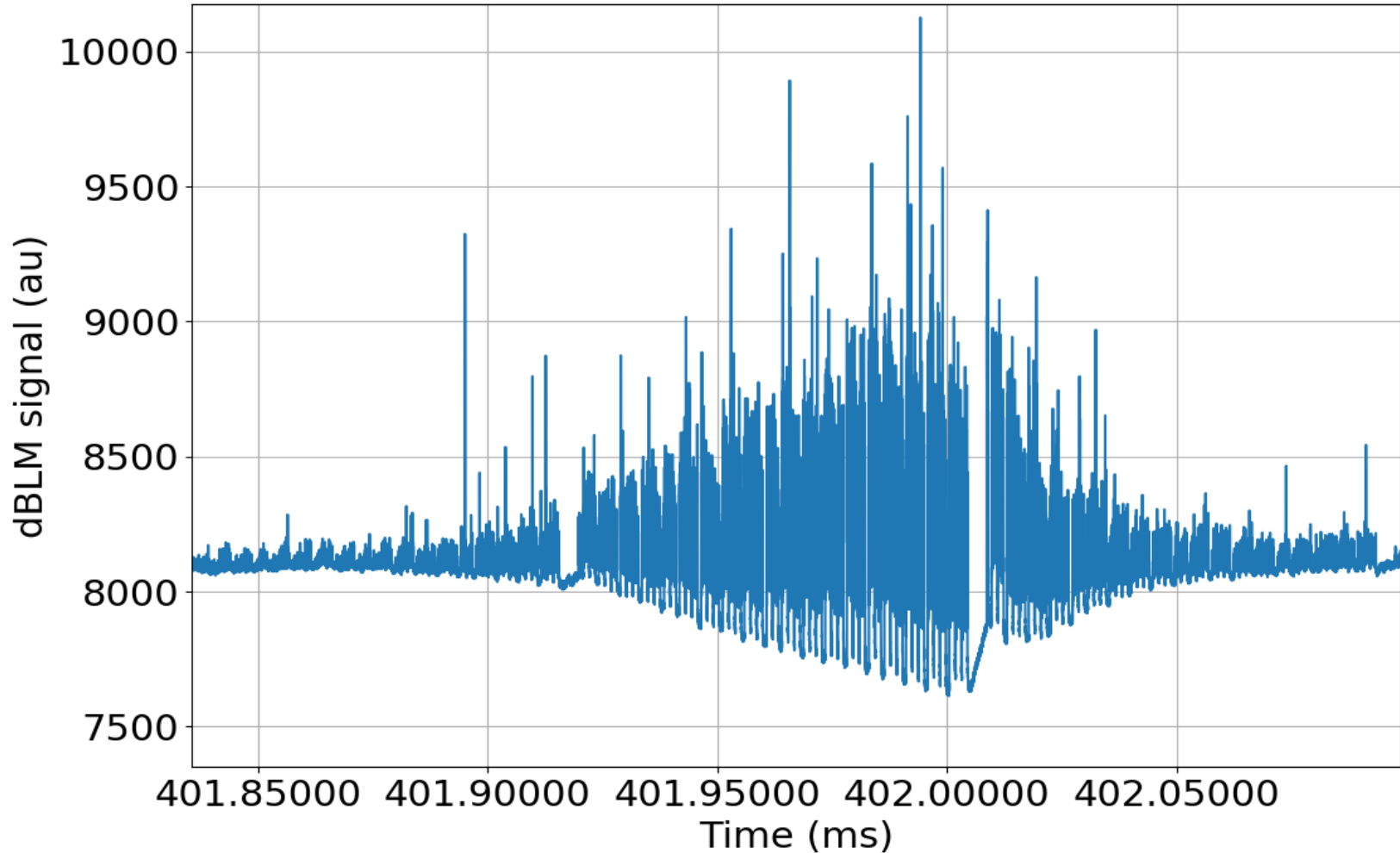
- FPGA readout
- 1.538 ns time resolution
- Currently in the betatron collimator region (IR7)
- Will also be installed in 16L2
- Better ADC (more bits)
- Allows for sophisticated trigger conditions (ROSY allowed only simple threshold)

# VFC Readout system

- Two channels per beam
  - Channel 0: vertical, horizontal and skew losses
  - Channel 1: vertical losses
  - Channels trigger together, beams independently
- Data dumps triggered by
  - UFO detection algorithm
  - Beam dump, collimator movement

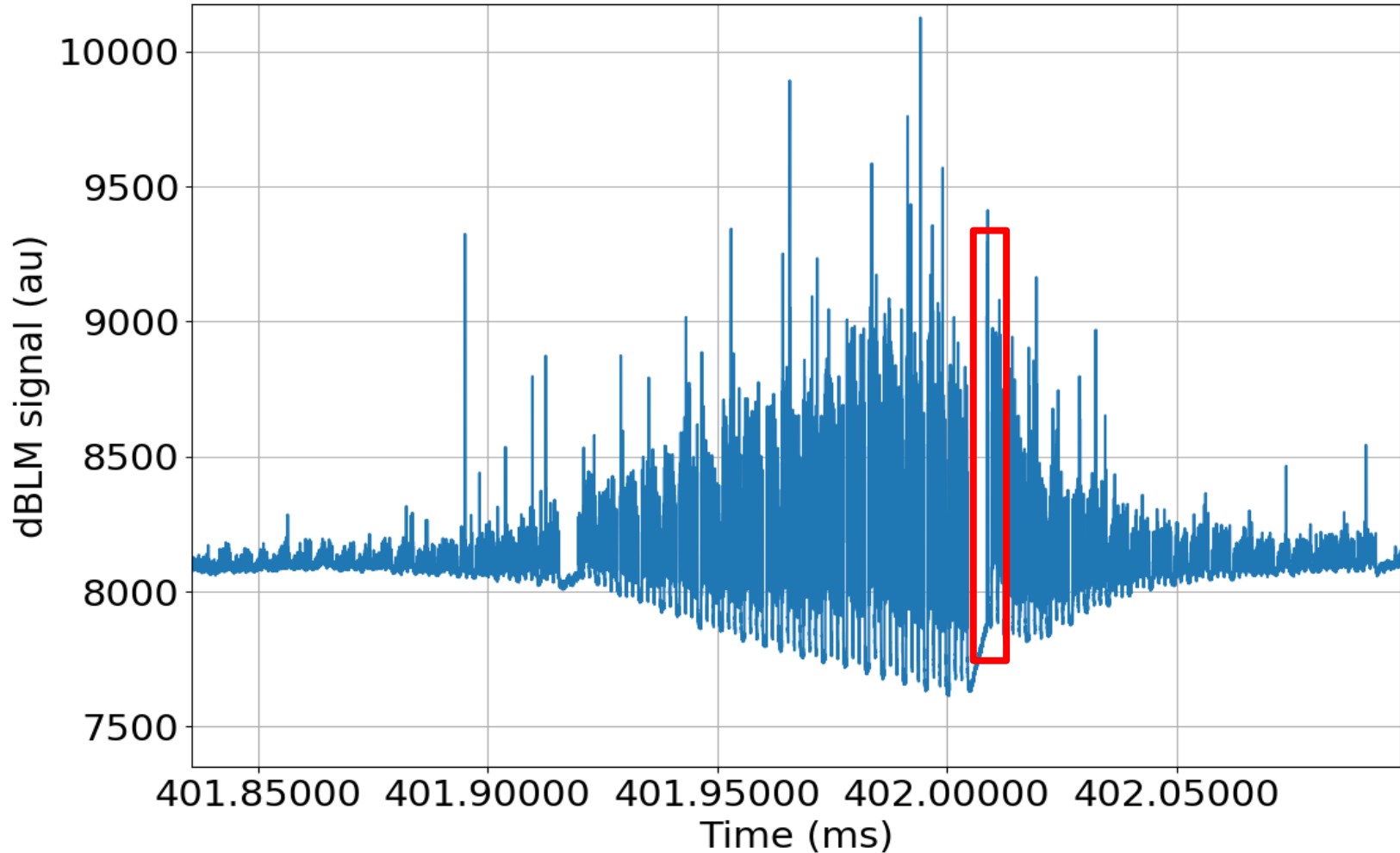
# Typical UFO signal

b1, ch0, 20180806, 220338



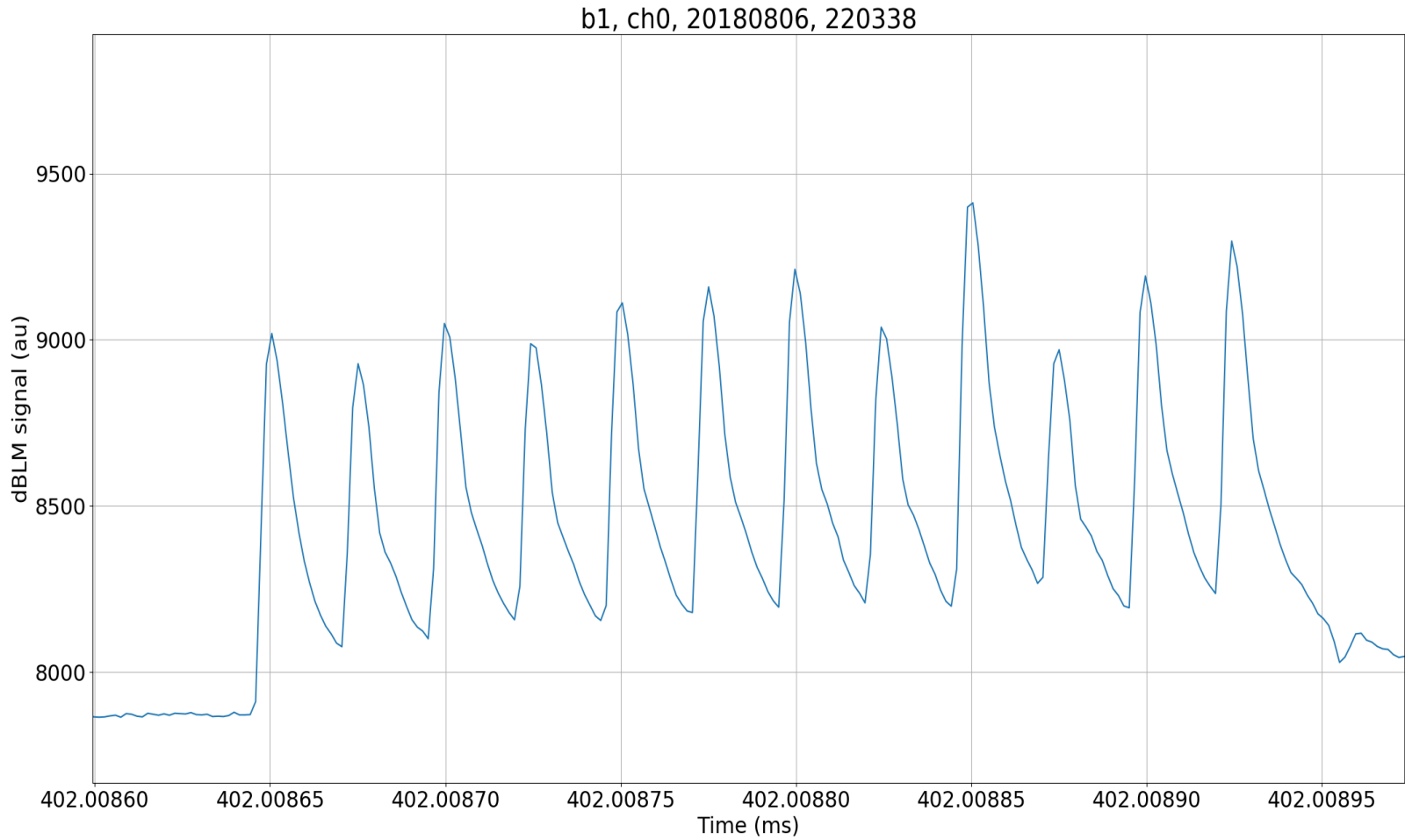
# Typical UFO signal

b1, ch0, 20180806, 220338



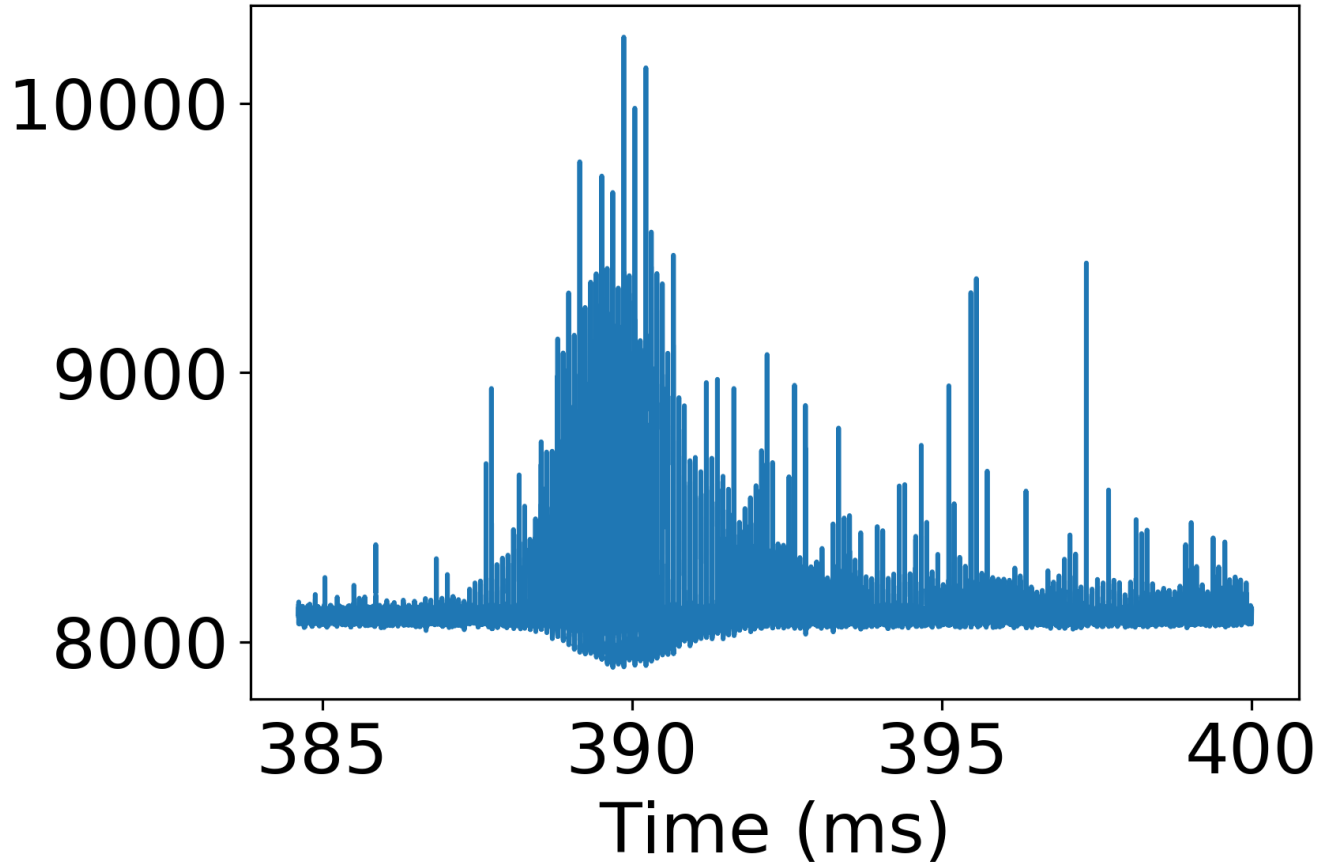


# Typical UFO signal



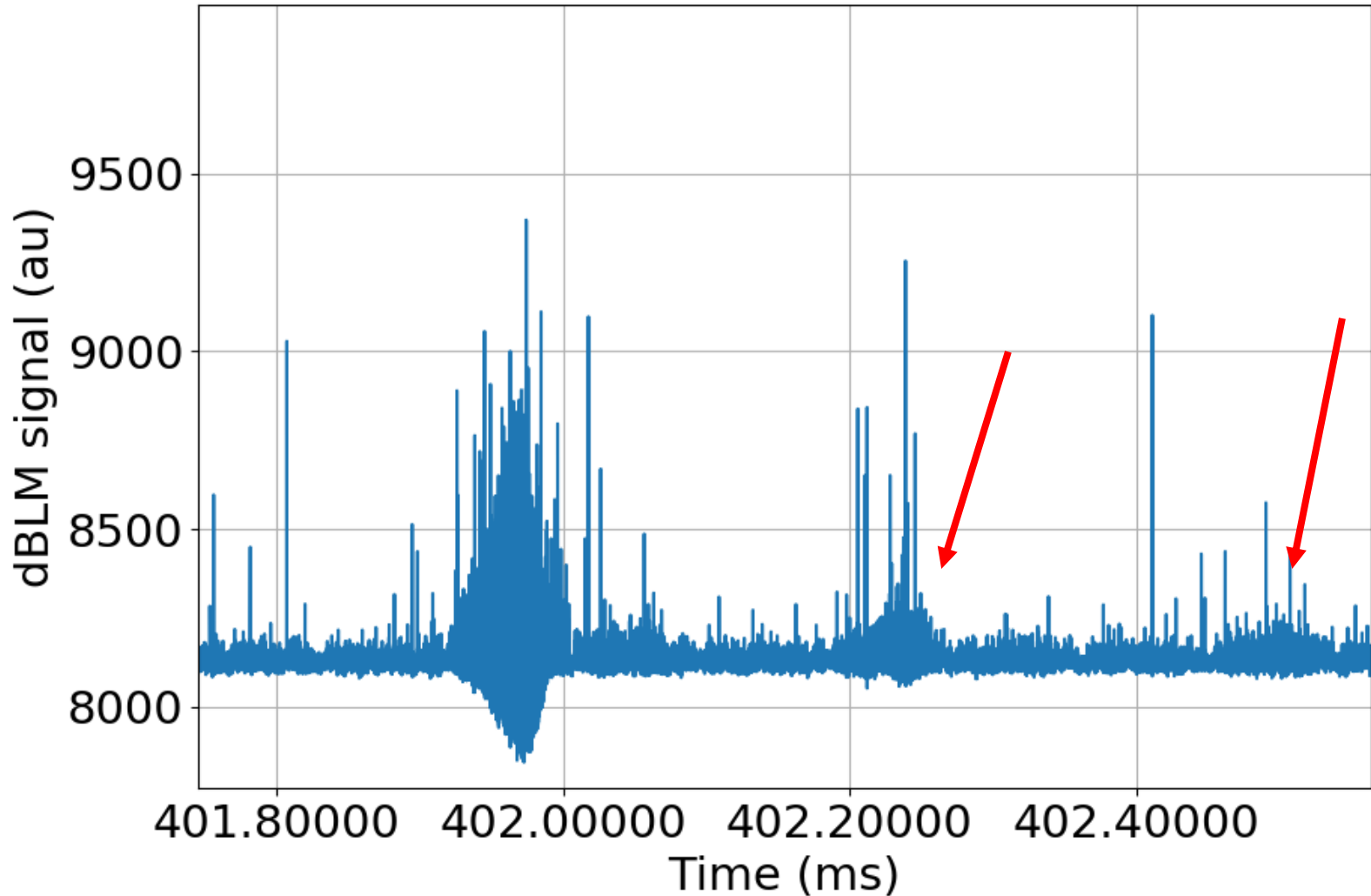
# Wire scans also detectable

b1, ch0, 20180803, 075710



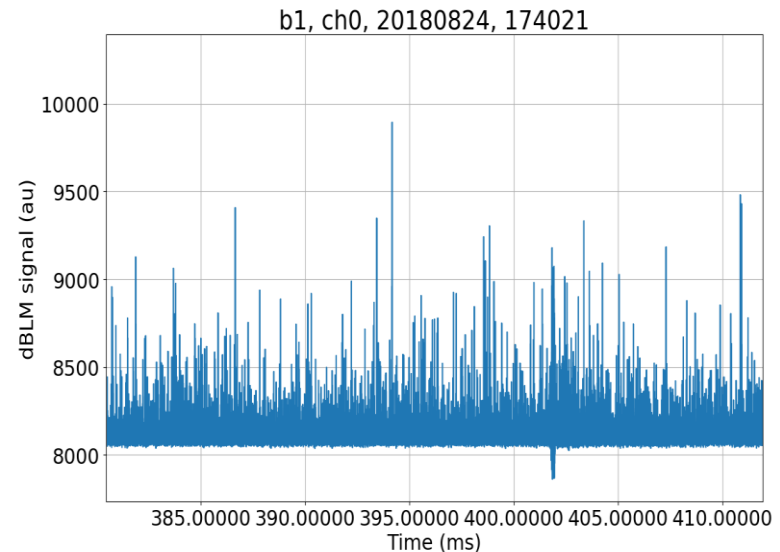
# New observations

b2, ch0, 20180823, 150941

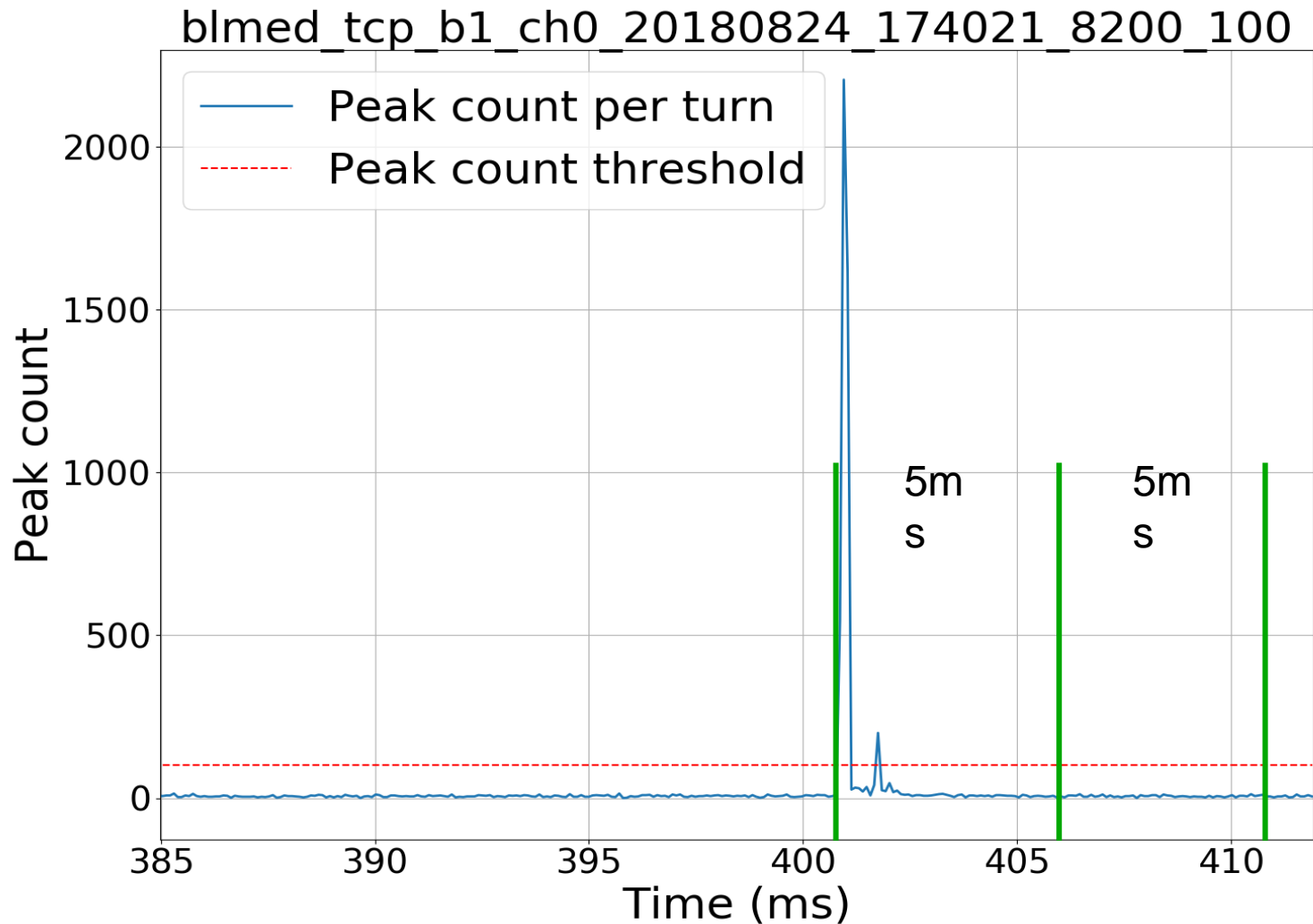


# UFO detection algorithm

- 10 ms window:
  - 0-5 ms: 100 bunches per turn over a certain loss threshold
  - 5-10 ms: less than 100 bunches per turn over a certain threshold



# UFO detection algorithm



# UFO detection algorithm

- Developed in iterations
  - 1. 3ms + 3ms, 9000 units, 10 peaks
    - 9000 too high a threshold
  - 2. 5ms + 5ms, 8500 units, 5 peaks
    - ~200 triggers/day (~80GB of data); too sensitive
  - 3. 5ms + 5ms, 8200 units, 100 peaks
    - ~10 triggers/day; noticeably better efficiency
- Still some tuning to do

# Detected UFOs

- From 12.7.-3.9., 15 UFOs in total detected
  - 9 were detected by UFO Buster
  - 6 produced clear UFO like signals, but not detected by UFO Buster
  - Discrepancy due to UFO Buster triggering conditions
    - UFO Buster uses RS9 -> very small UFOs don't create enough integrated losses
    - Veto condition on collimator icBLMs
- 8 UFOs between 12.7.-21.8. (3/beam week)
- 7 UFOs between 22.8.-3.9. (7/beam week)

# What next ?

- Pre-fill MD
  - increase emittance in two bunches (1 vertically, 1 horizontally)
  - UFO will interact with blown up bunches before hitting the beam core
  - Gives information about plane of motion and dynamics
  - Compare measurements and simulations (energy deposition, # of nuclear interactions...), identify size and material



# What next ?

- This week: first tests with blown up bunches
  - See if any negative effects to normal physics
  - Try different emittances to see how high we can go
- If successful, implement automatic procedure to all proton physics fills

**Thank you!**