

# Spectrometer Characterization

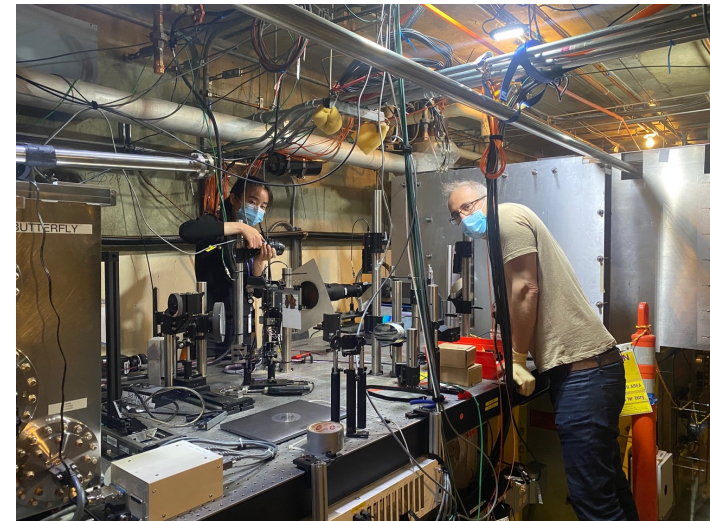
Gevy Jiawei Cao

University of Oslo

Oct 5, 2022

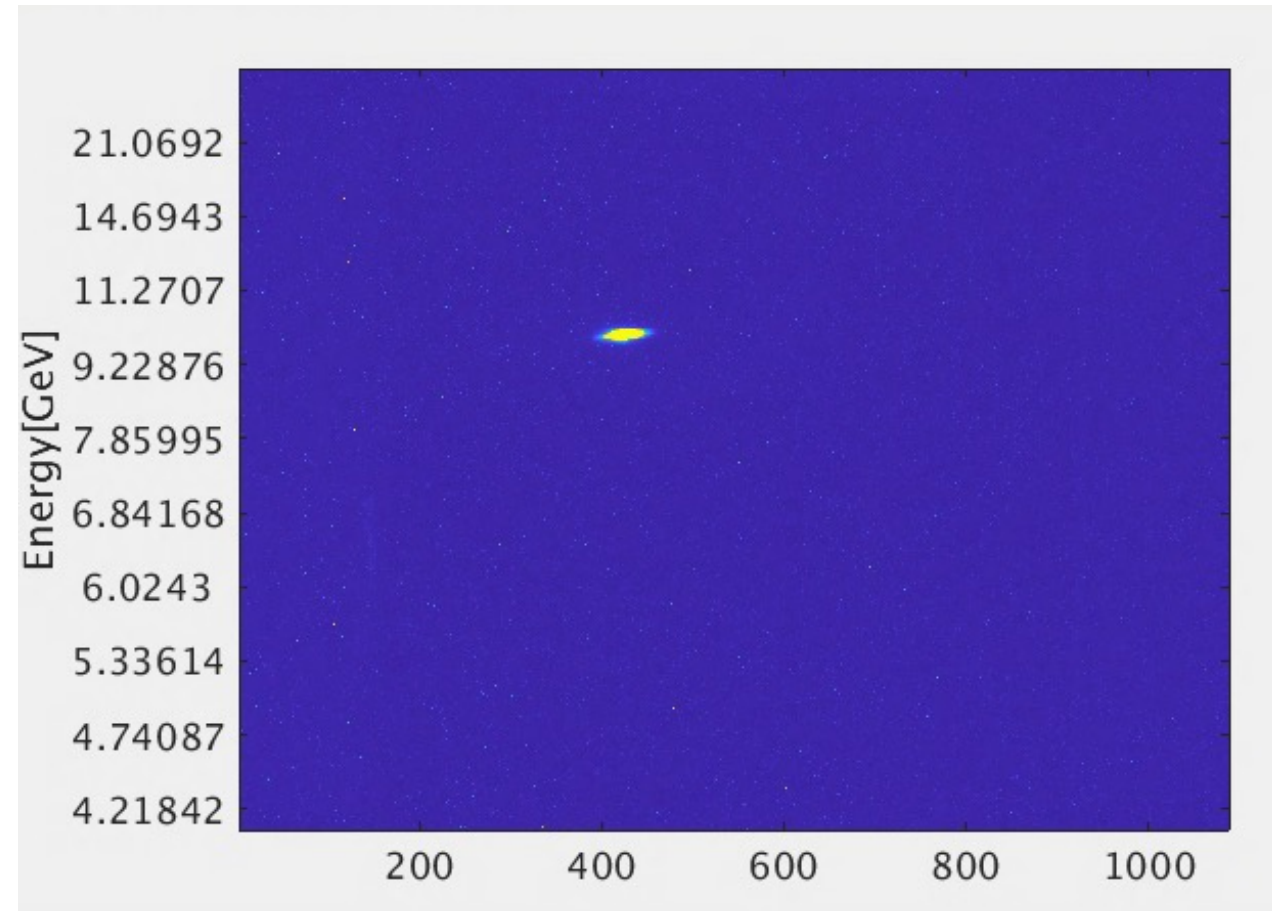
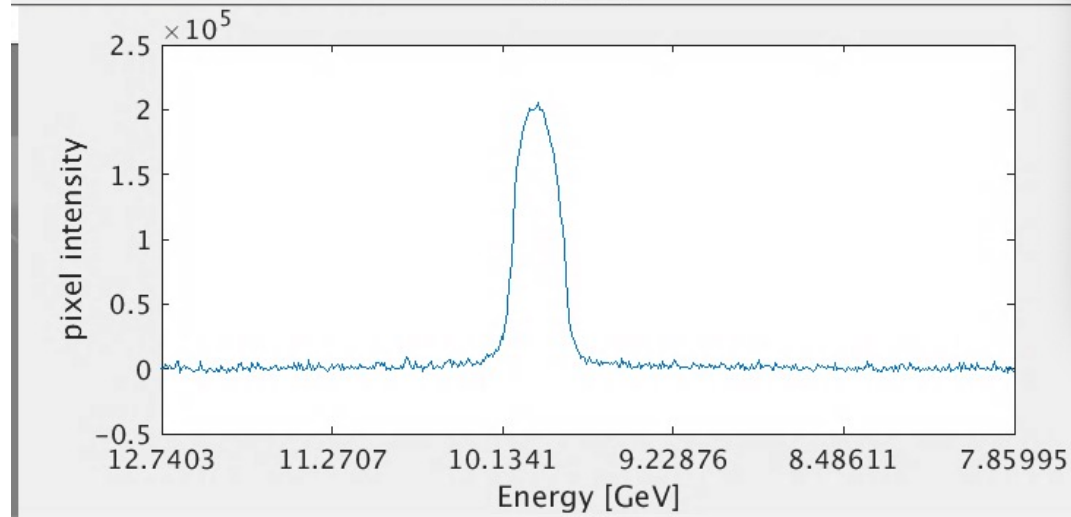
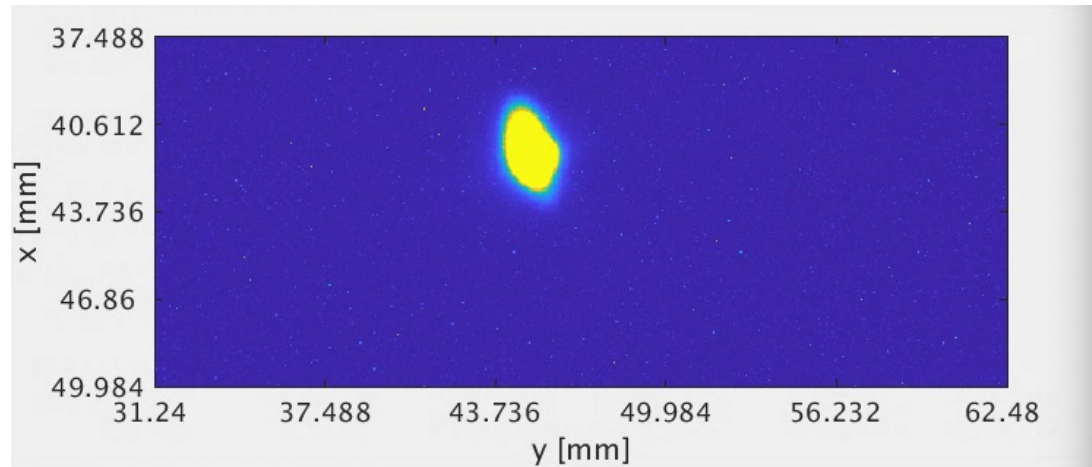
# Summary SLAC FACET-II work Year 2022-2023

- Kristine Bonnevie Travel Stipend from UiO for 6 months.
  - 4.5 months March-August 2022 done
  - 1-2 months spring 2023
- Experimental participation at FACET-II E300:
  - Dump Table camera installation, maintenance and preparation for data-taking.
  - Shifts involving spectrometer commissioning
  - Analysis on spectrometer energy calibration, spectrum comparison and quad steering offsets..
- Simulation studies on beam-beam effects, 15TeV linear colliders and positrons in collaboration with Spencer, Glen and Tim at SLAC and Sébastien at LOA.



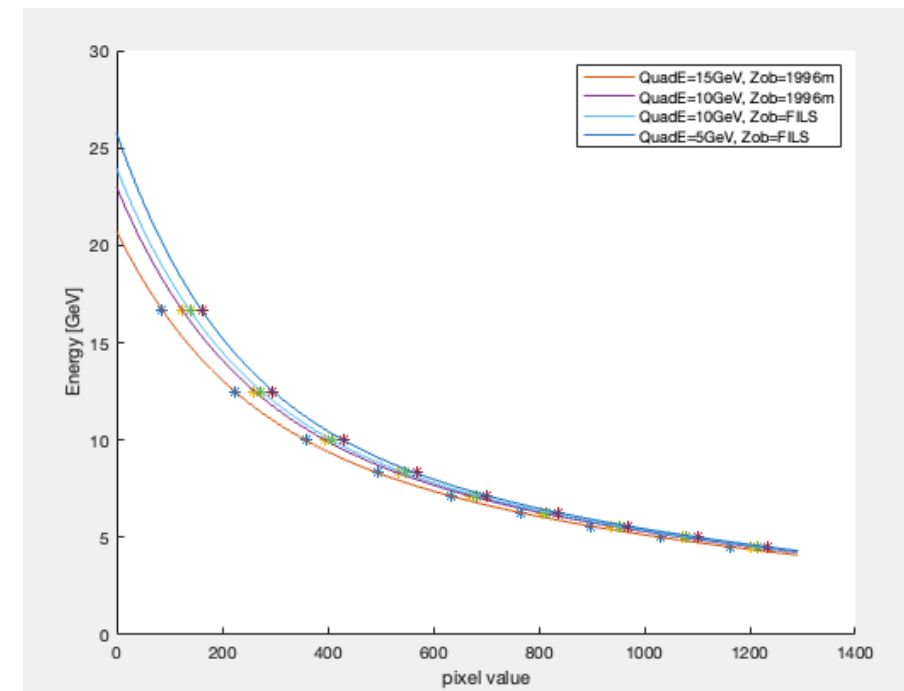
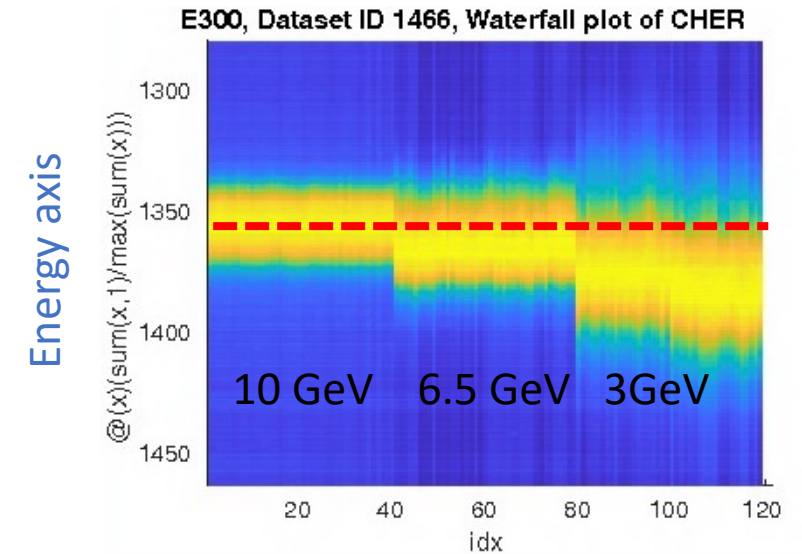
# Spectrometer energy calibration

- $y(B_{dip}) = f(E_{nom}, B_{dip}) = f(E)$

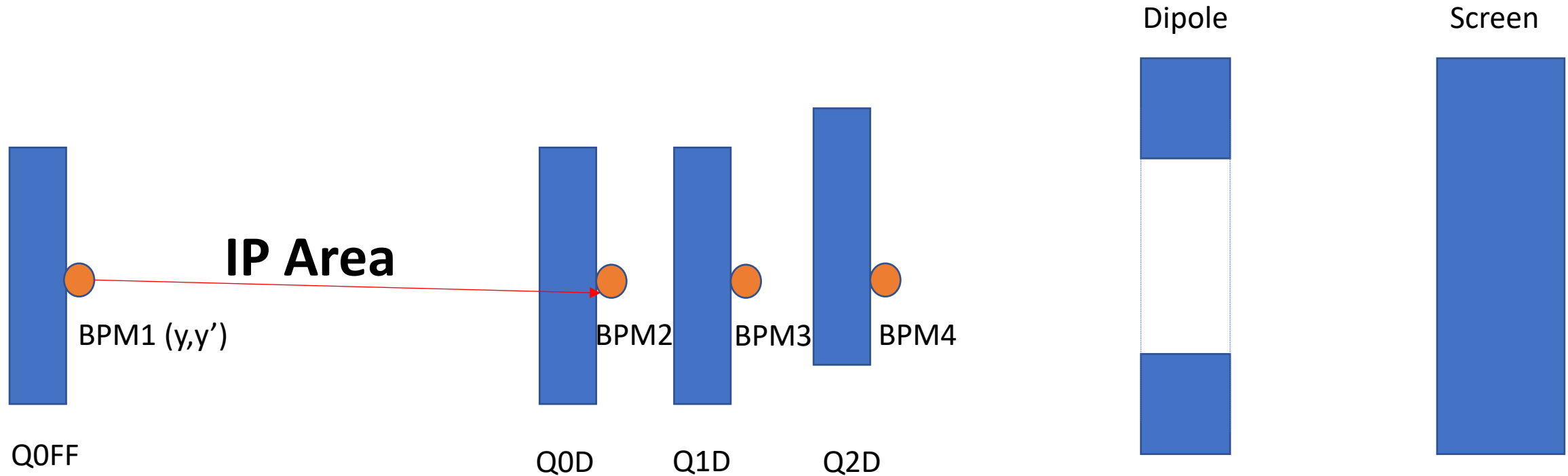


# Spectrometer characterization – Quad Steering

- Particles with the same energy should always hit the same pixel on a given camera, but not the case in the datasets..
- Many factors could deflect the particles on the camera:
  - FF/Spec Quad offsets
  - Jitter in dipole settings
  - Incoming beam vector
- How do we take this into account when calibrating the energy axis?



# Quad steering model

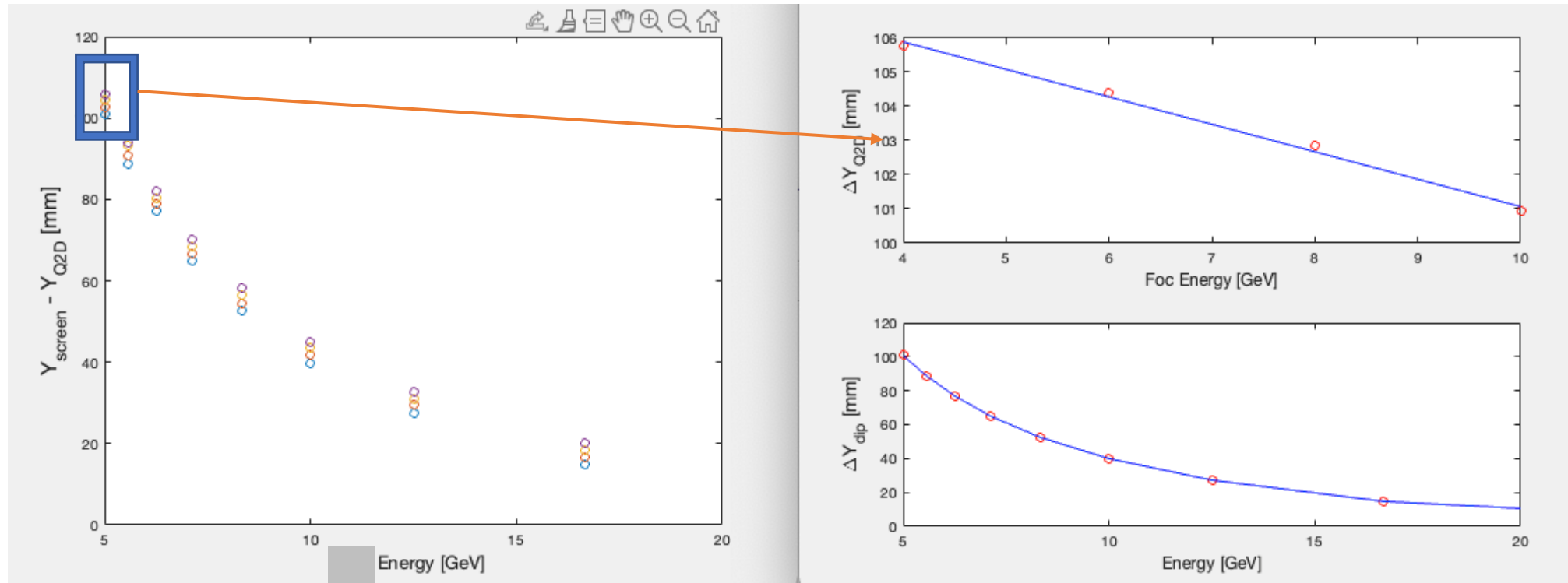


Relatively constant deflection angles  $\alpha_1$  &  $\alpha_2$  that characterize, to some extent, offsets due to Q0D and Q1D

Assume differences between BPM4 and the pixels on the screen are due to dipole deflection + Quads offset

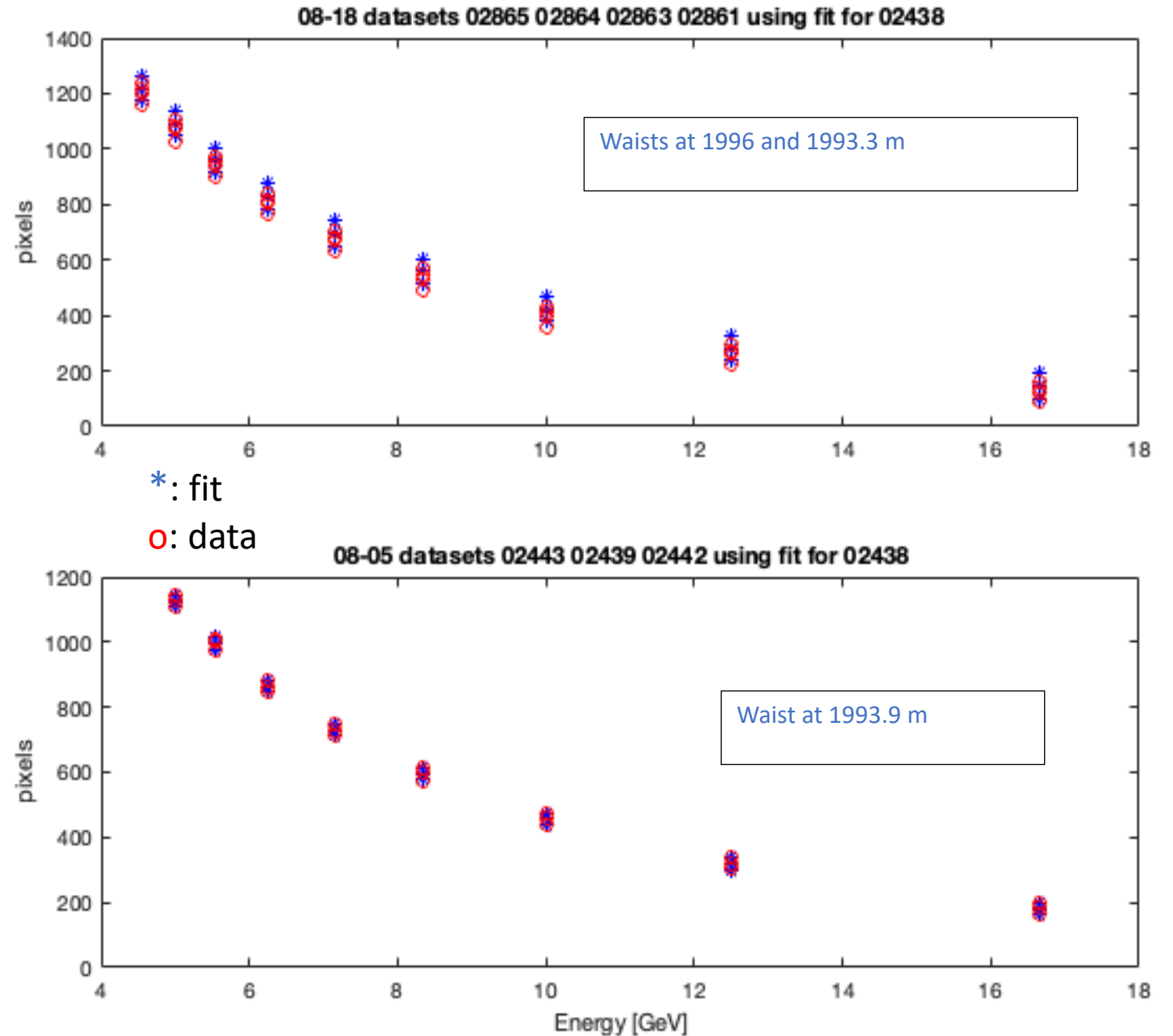
# Quad steering model

- $$Y_{screen}(E_{nom}) = y_0 + \alpha_1 \Delta z_{10} + \alpha_2 \Delta z_{21} + \underbrace{f(B_{dip})}_{\Delta y_{dip}(E_{nom}^2/B_{dip})} + \underbrace{f(B_{foc})}_{\Delta y_{Q2D}(B_{foc}/E_{nom})}$$

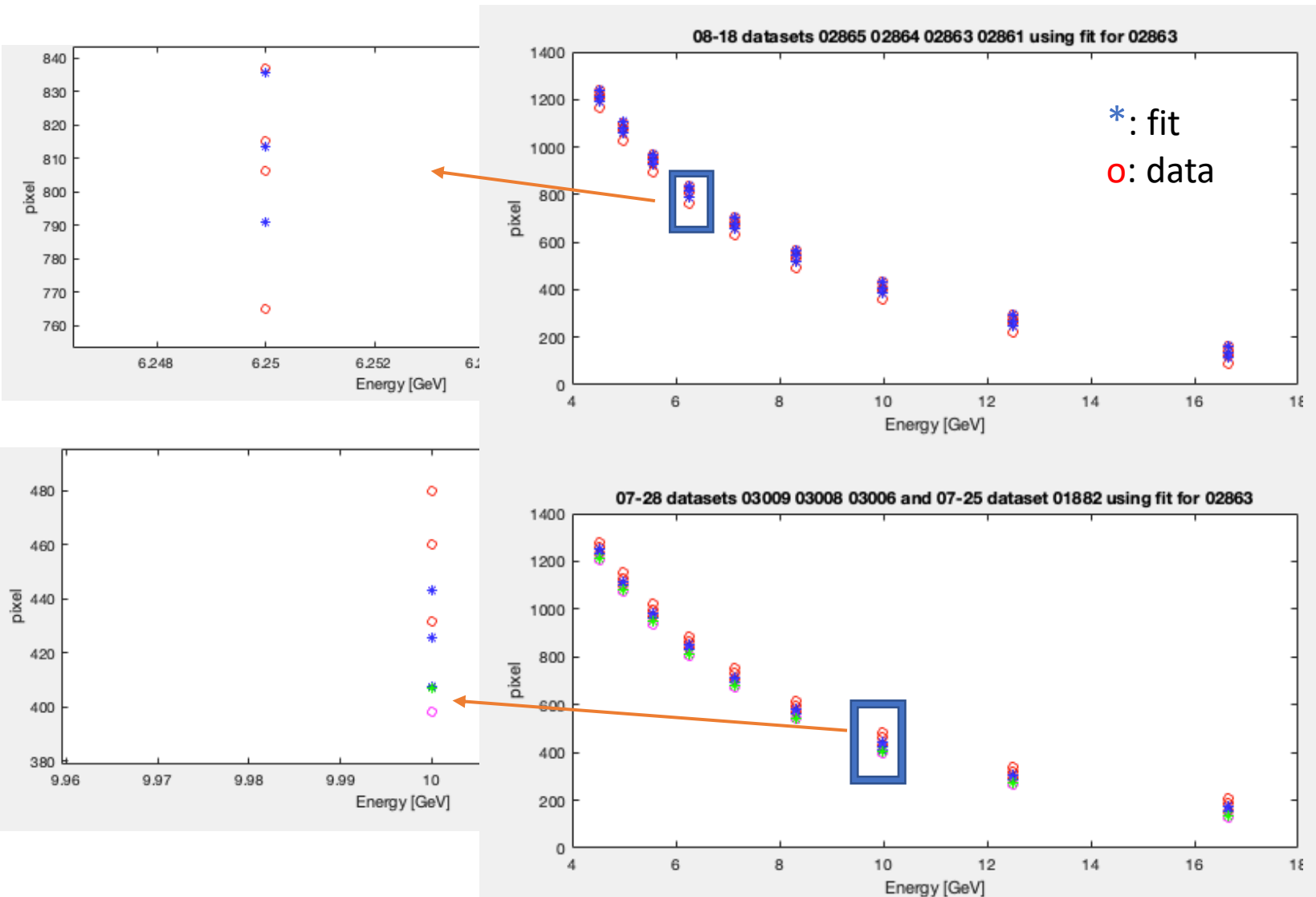


# Quad Steering

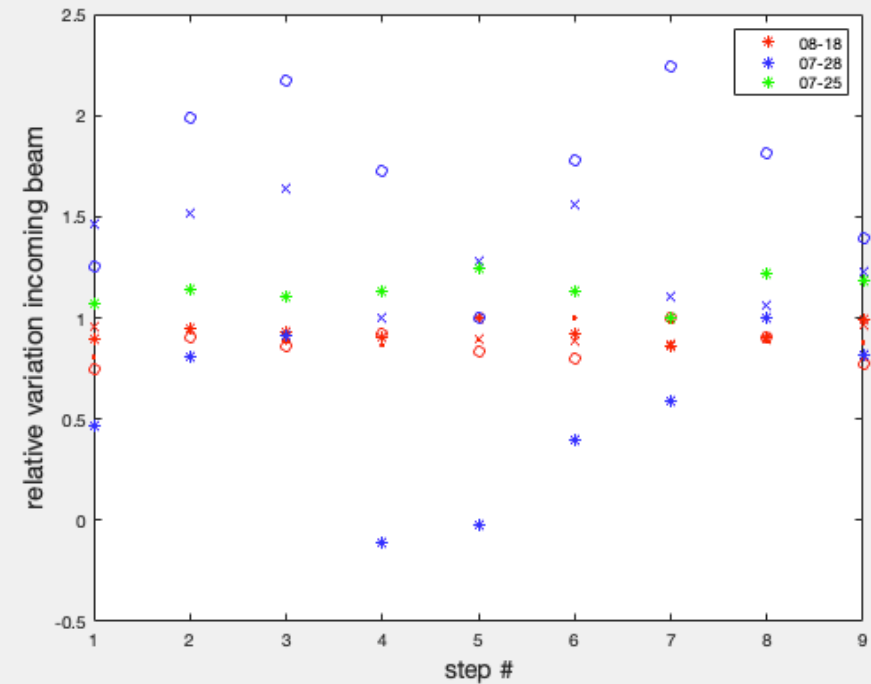
- Same fit for different days & different waist locations.
- Waist at 1996m: ~30-35 pixels off, 1993.3m: ~15-20 pixels off.
  - Constant shift due to FF quad settings?
  - Dependence on incoming beam vector of the day?



# Quad steering



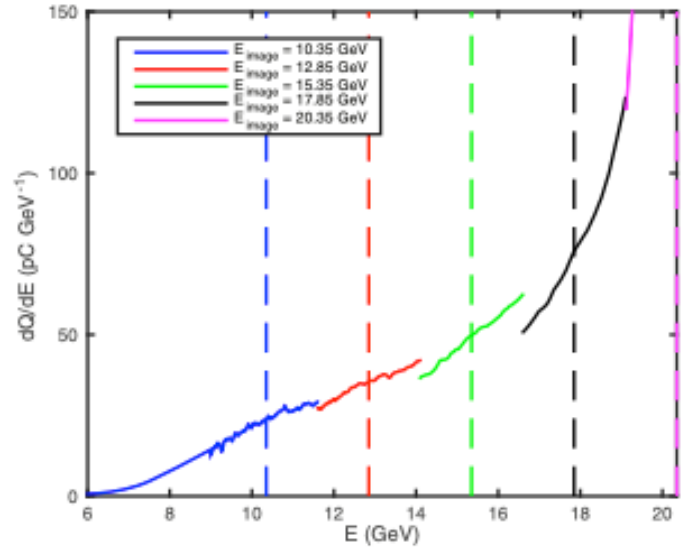
- Fit quality depends on the incoming beam vector variation of the day..



# Energy Spectrum Measurements

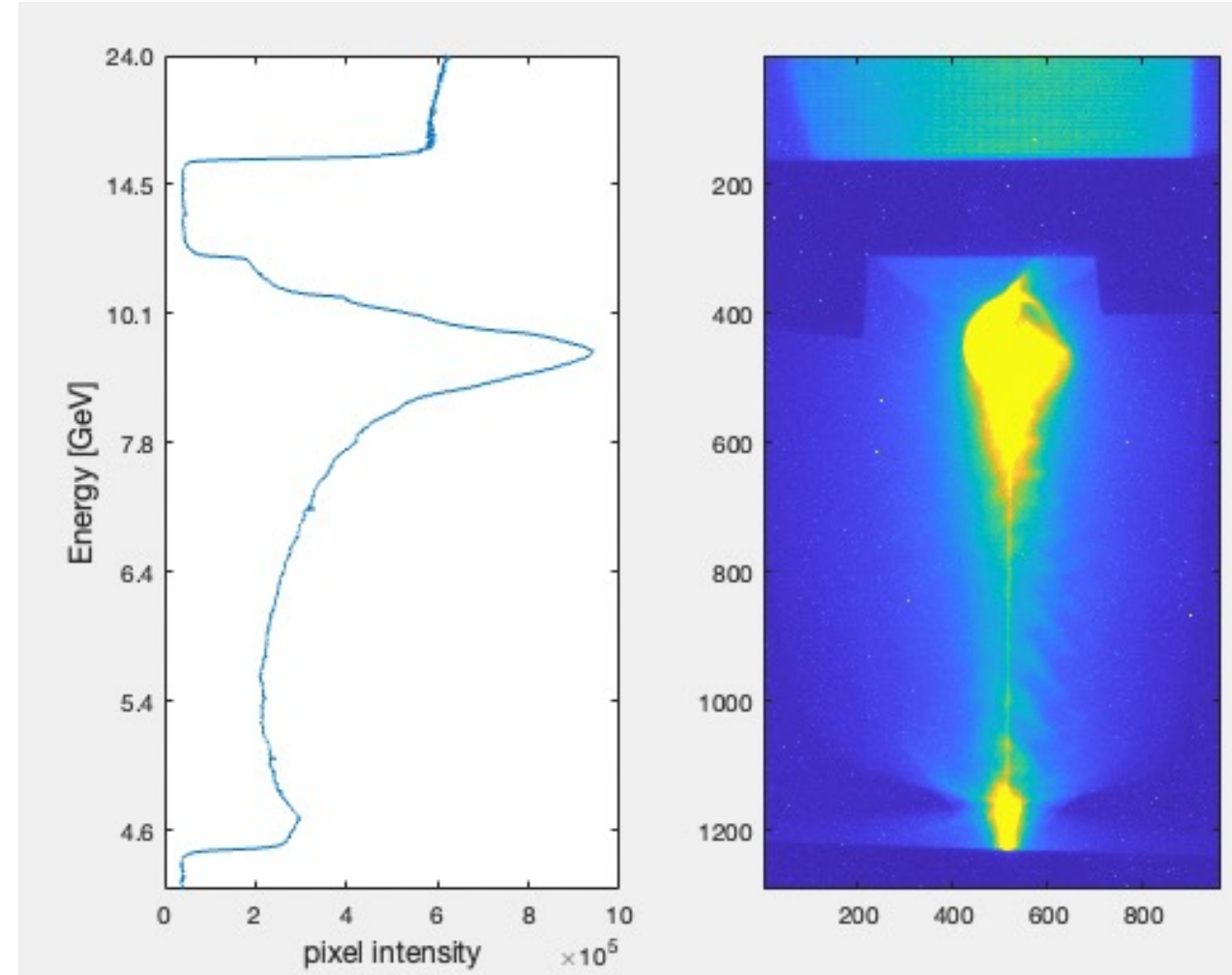
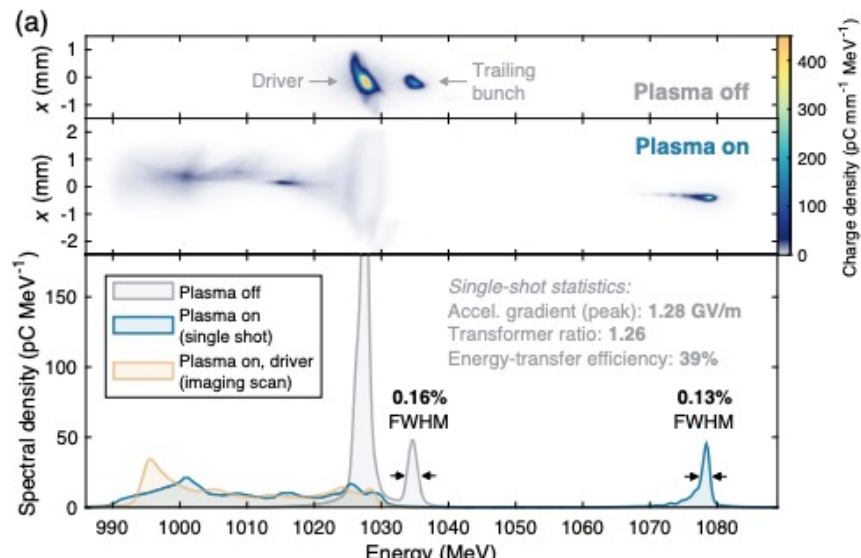
S.Corde et al. 2016

Energy depletion

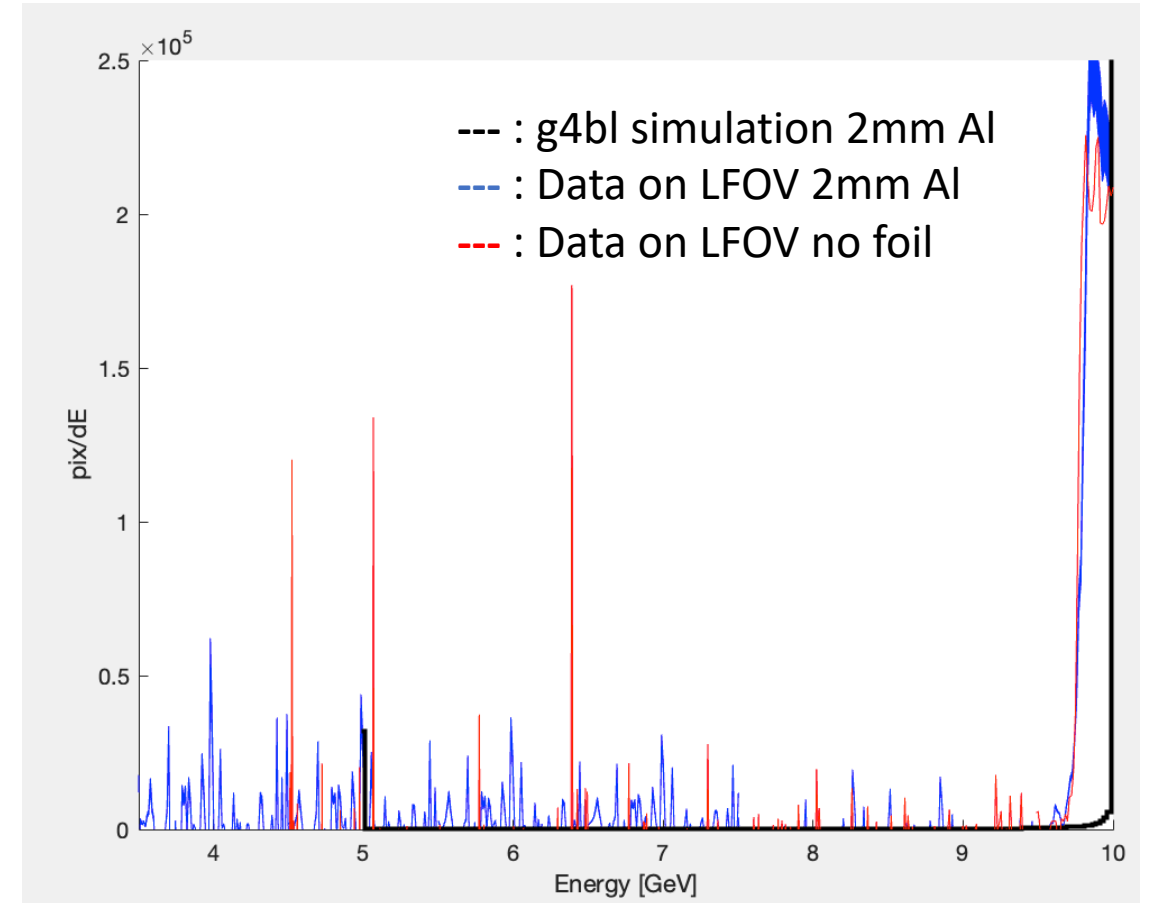
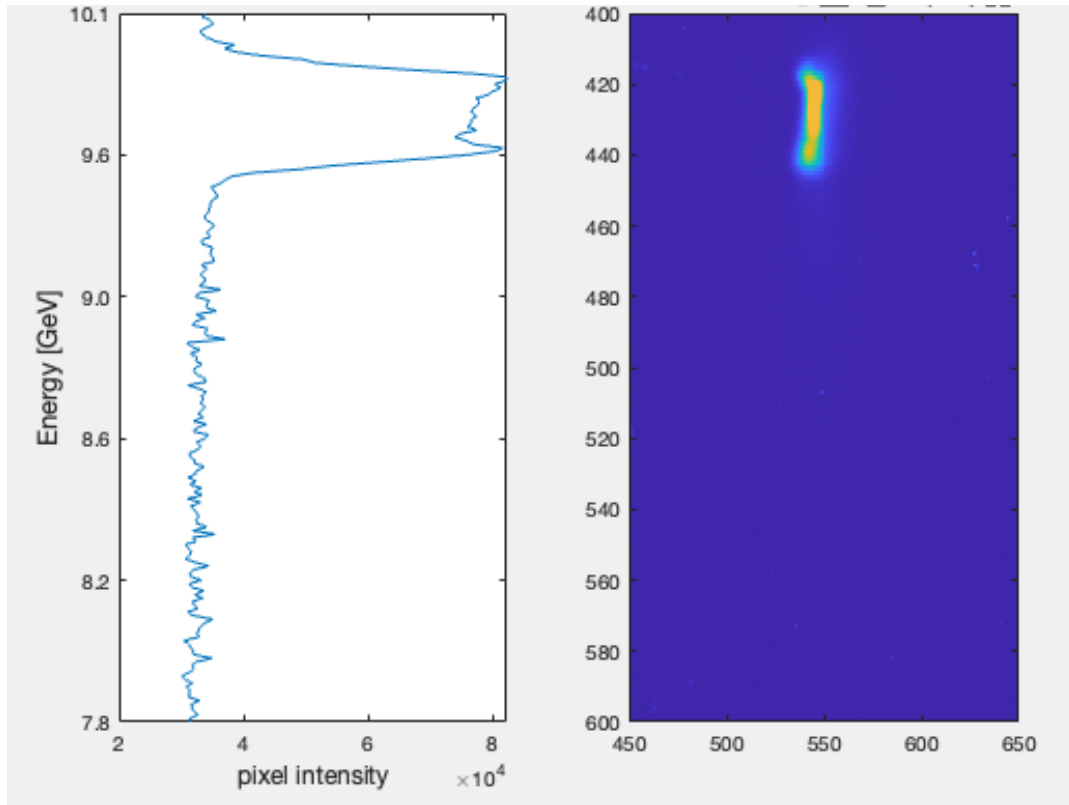


C.A.Lindstrom et al 2020

Charge acceleration/ deceleration



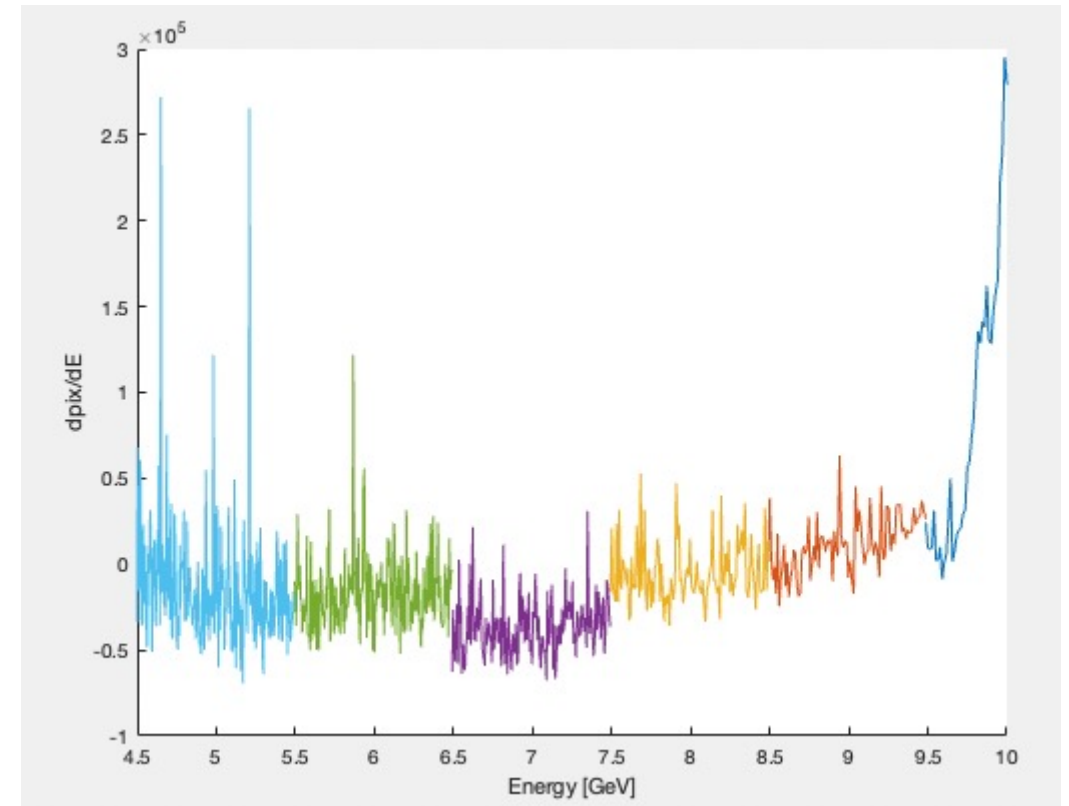
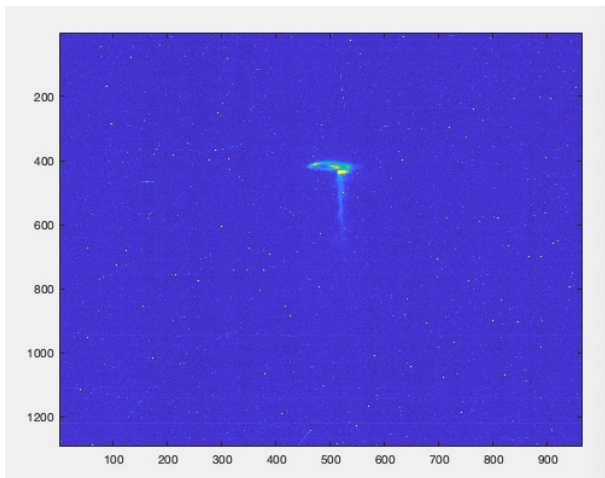
# Energy Spectrum Measurements with Al



- Not the best datasets to do this study...
- Extremely difficult to resolve – need steps of 10 MeV...

# Energy Spectrum Measurements with plasma (SUPER PRELIMINARY)

- Haven't yet constructed a meaningful spectrum
- Factors to take into account:
  - Quad steering
  - $dQ/dI_{pix}$
  - Charge lost in plasma



# Future work

- Add BPMS:LI20:3340 to DAQ next time
- Investigate effects of the waist location/FF quads and incoming beam vector on the energy axis
- Test quad steering model(s) on more data and on older CHER data
- Incorporate charge calibration on the screens and quad steering into the energy spectrum
- Energy spectrum measurements using plasma directly, need to either find or take better data