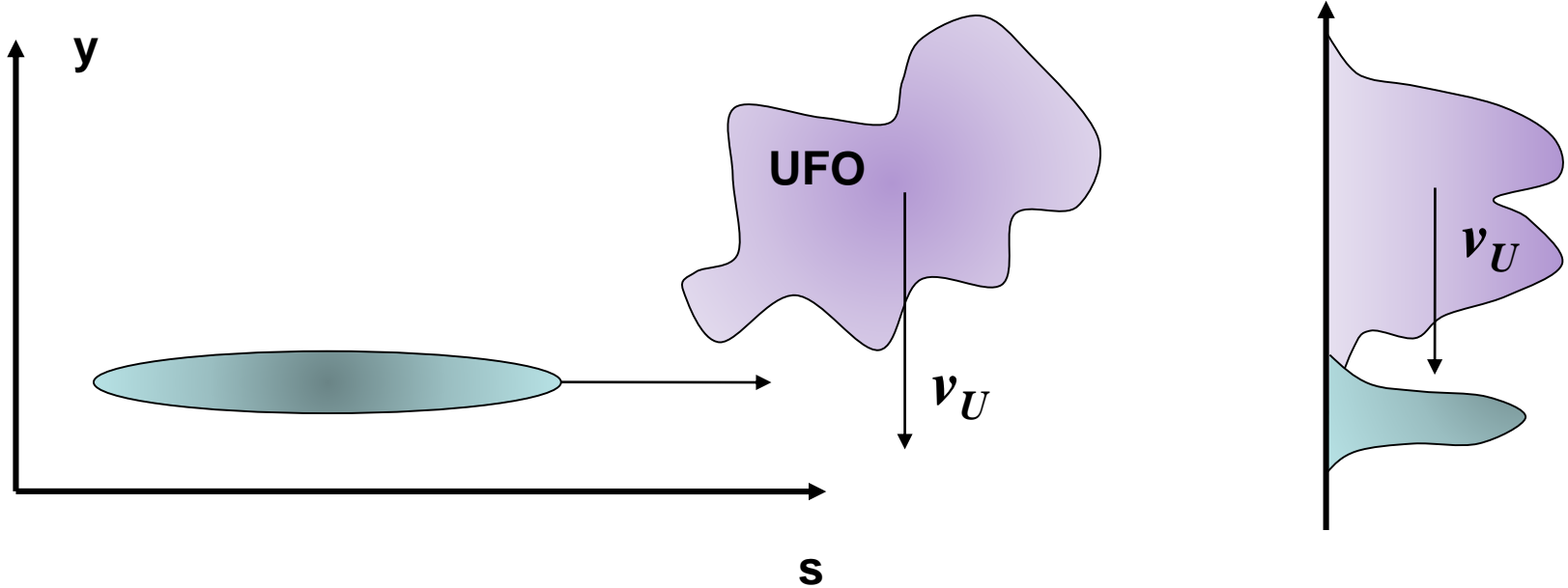


Analysis attempt of dump UFOs

On UFO duration and speed

What follows in based on the assumption that the UFO event is induced by an 'object' falling into the beam



- ❑ The density profile (in 3D !) of the UFO can be complicated, the BLMs allow us to get a glimpse at the overlap of beam and UFO distributions.
- ❑ Extreme cases:
 - If the [UFO << smaller than the beam](#), the UFO is ‘imaging’ the beam and we see essentially the beam profile.
 - If the [beam << smaller than the UFO](#), the beam is ‘imaging’ the UFO.



- When looking at the UFO data (BLM versus time) and after some trial and error, it turns out that a Gaussian shape fits reasonably well (sometimes very well) the time evolution of the signal in ~all cases.
 - >> Generalizes a fit that B. Goddard did on a selected UFO last year.

This is actually quite surprising when one thinks about the possible complicated shape of the UFO.



- Let us assume here that the projection of the UFO density on the y axis is Gaussian. If the UFO moves at a **constant vertical speed** v_U . the loss rate $N(t)$ would be:

$$N(t) \propto e^{-\frac{(y_0 - v_U t)^2}{2(\sigma_b^2 + \sigma_U^2)}}$$

σ_U : vertical UFO size

σ_b : vertical beam size

- A fit to the loss rate using:

$$N(t) \propto e^{-\frac{(t-t_0)^2}{2\sigma_T^2}}$$

σ_T : temporal width

can be used to deduce the average UFO speed :

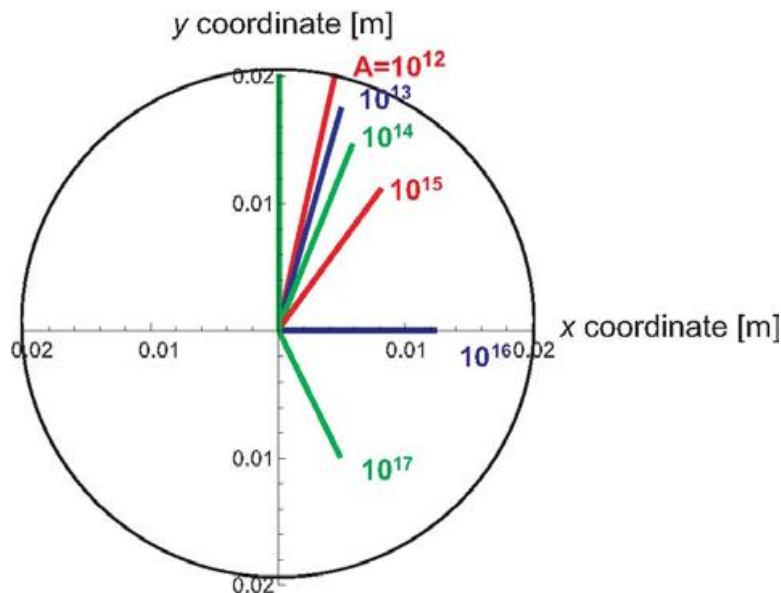
$$v_U = \frac{\sqrt{\sigma_b^2 + \sigma_U^2}}{\sigma_T} > \frac{\sigma_b}{\sigma_T}$$



- If the UFO speed is due to free fall in vacuum, it should be (for a height $h = 0.02$ m) :

$$v_U = v_g = \sqrt{2gh} = 0.63 \text{ (m/s)}$$

- If the UFO is charging up from ionization when it hits the beam, then the speed may change. The UFO may even be expelled out of the beam (vertically and horizontally) – model by F. Zimmermann et al at PAC09 (MOPEC019).



*Round AI UFO trajectories (X-Y) as a function of the no. of atoms (A) of the UFO for $2.3E12$ p.
(F. Zimmermann)*



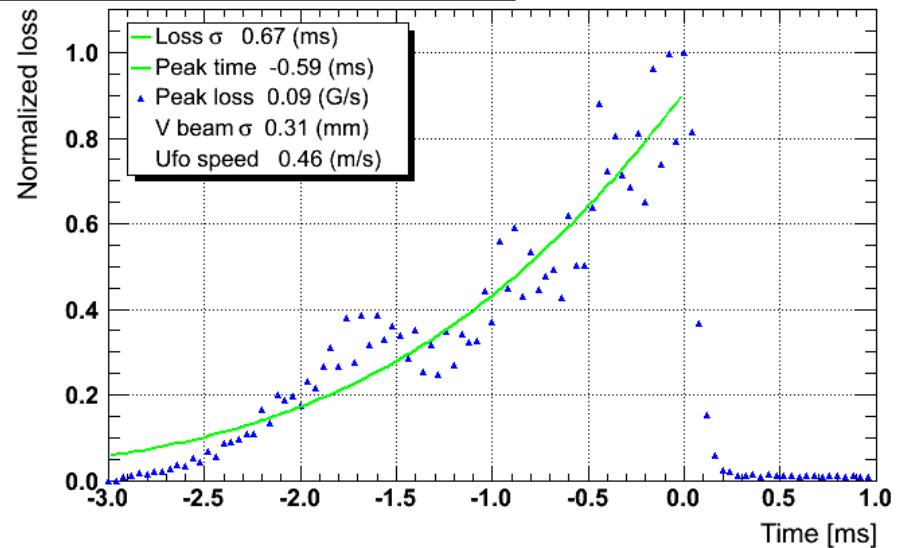
There are 2 types of UFOs that dumped.

Dump triggered while $N(t)$ still increasing

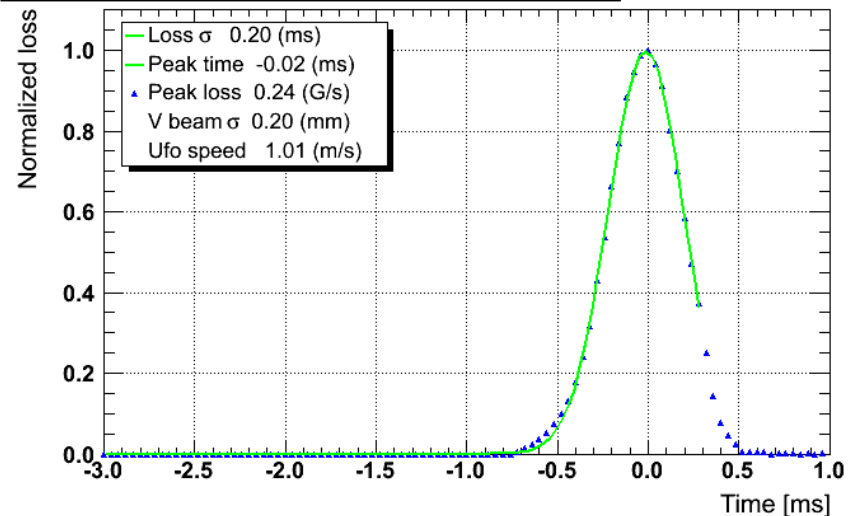
Dump triggered while $N(t)$ was decreasing, i.e. maximum was passed.

Analysis will be concentrated on those events.

UFO No. 1 BLMEI.08L7.B2I30_MBB



UFO No. 10 BLMEI.04L2.B1E10_TCTH.4L2.B1





- The analysis covers the 18 UFOs that dumped the beam and the (last) precursor from the first event.
- The 40 μs data points for (one of) the BLMs with the largest loss are used for the fits.
 - First the highest loss point is determined. This defines $t = 0$. The data points are normalized to the highest loss.
 - The data is then fitted with a Gaussian from -3 ms to xx ms ($xx \geq 0$). The last fit time depends on the event (see next slides).
 - For the precursor the data is fitted from -5 ms to +5 ms.
 - The UFO speed is (under-)estimated as:

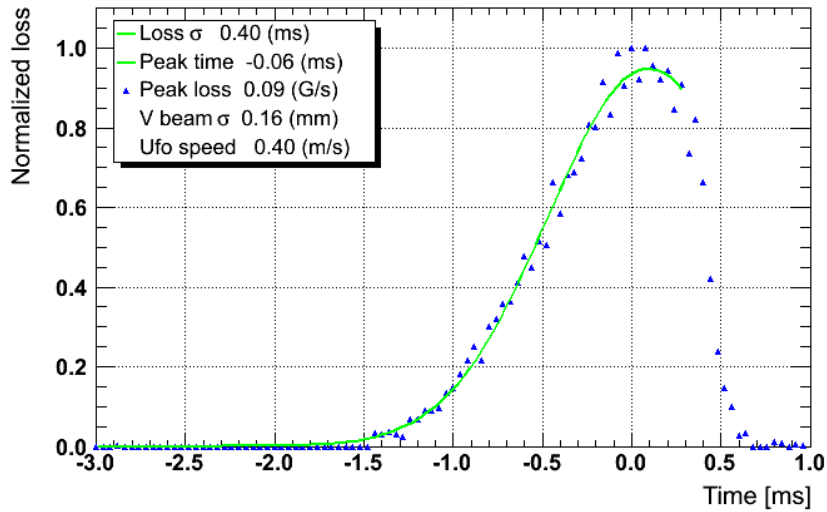
$$v_U = \frac{\sigma_b}{\sigma_T} < \frac{\sqrt{\sigma_b^2 + \sigma_U^2}}{\sigma_T}$$

The beam size is estimated from the magnetic element at the first BLM of the UFO.

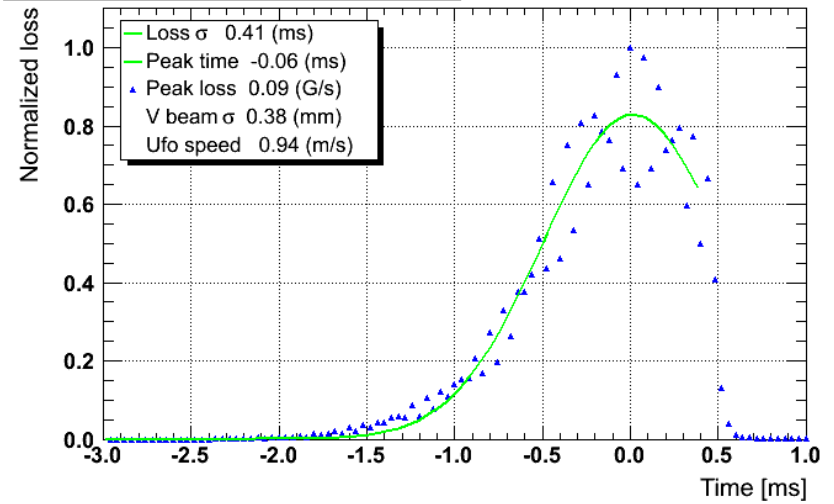
Assumption for emittance: $3.5 \mu\text{m}$.



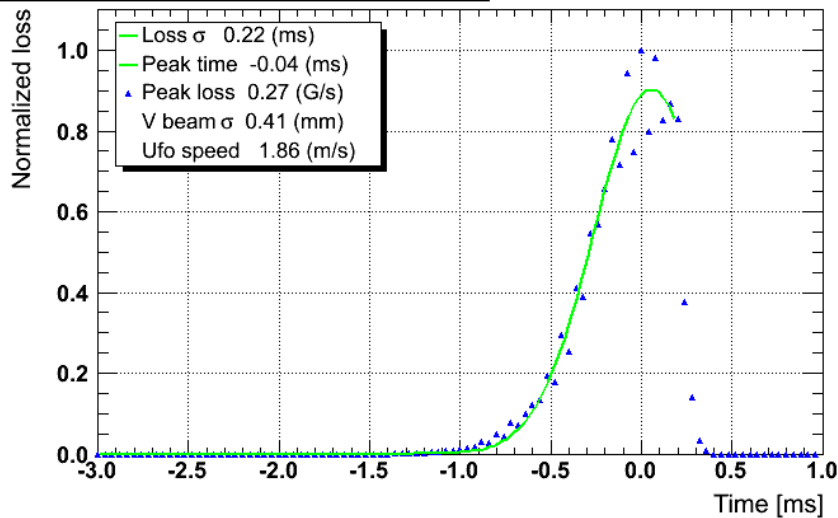
UFO No. 3 BLMQI.11L4.B1110_MQ



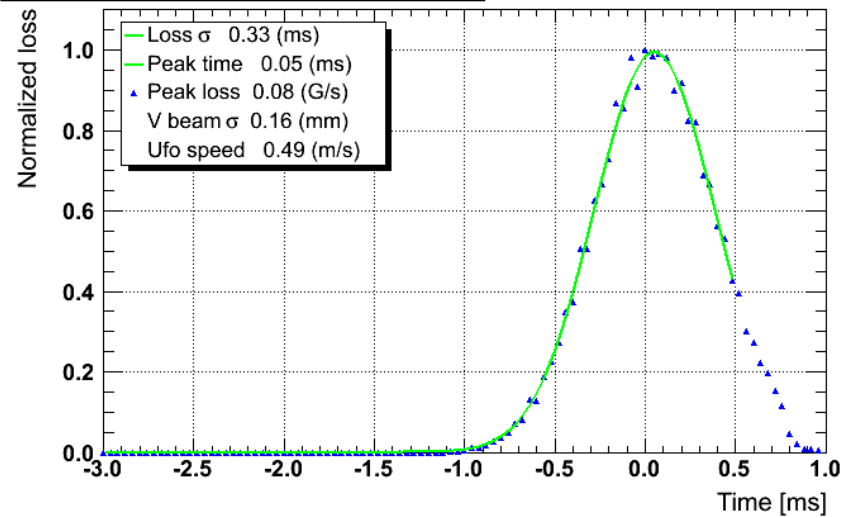
UFO No. 4 BLMQI.15L5.B1110_MQ



UFO No. 5 BLMEI.06R5.B1E10_XRP

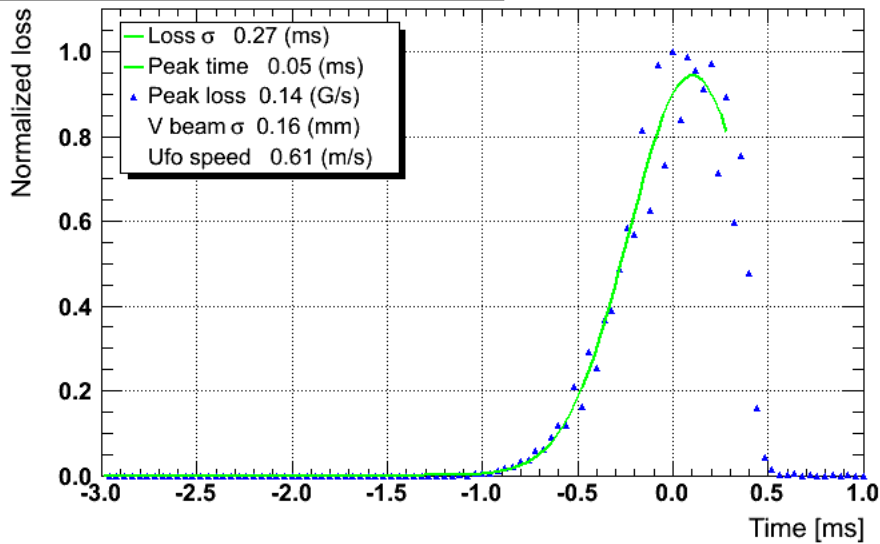


UFO No. 6 BLMQI.22R3.B2E10_MQ

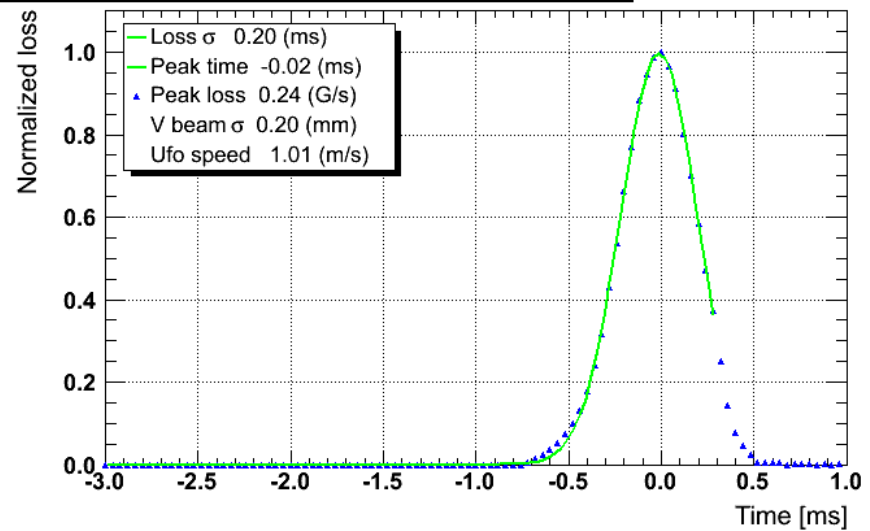




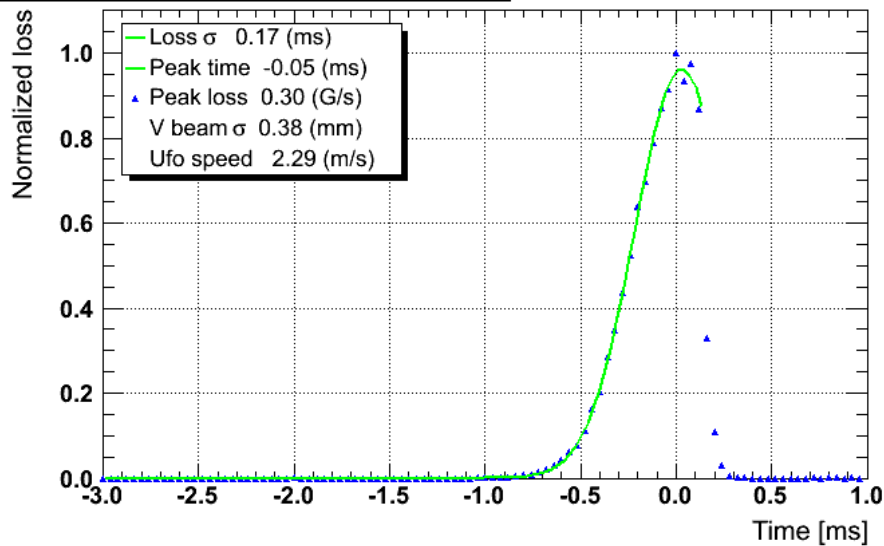
UFO No. 7 BLMQI.25R5.B1E10_MQ



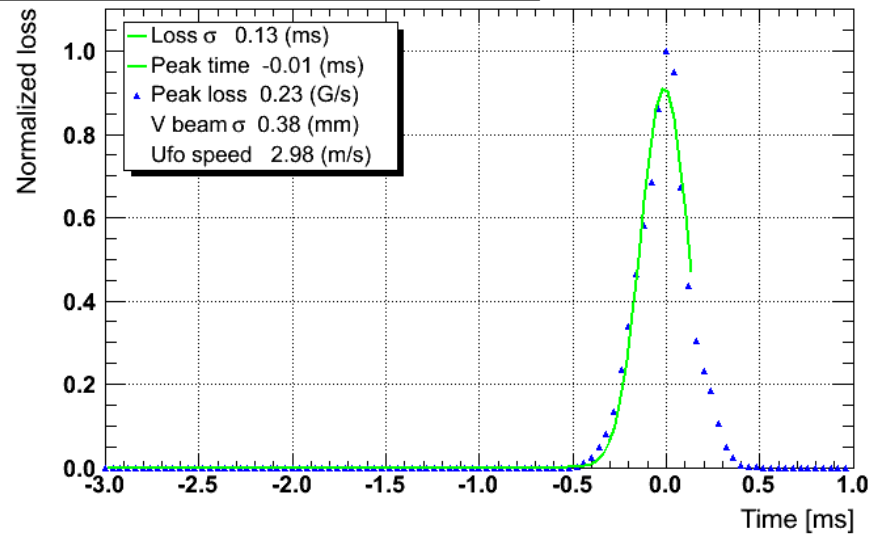
UFO No. 10 BLMEI.04L2.B1E10_TCTH.4L2.B1



UFO No. 11 BLMQI.25R8.B1I10_MQ

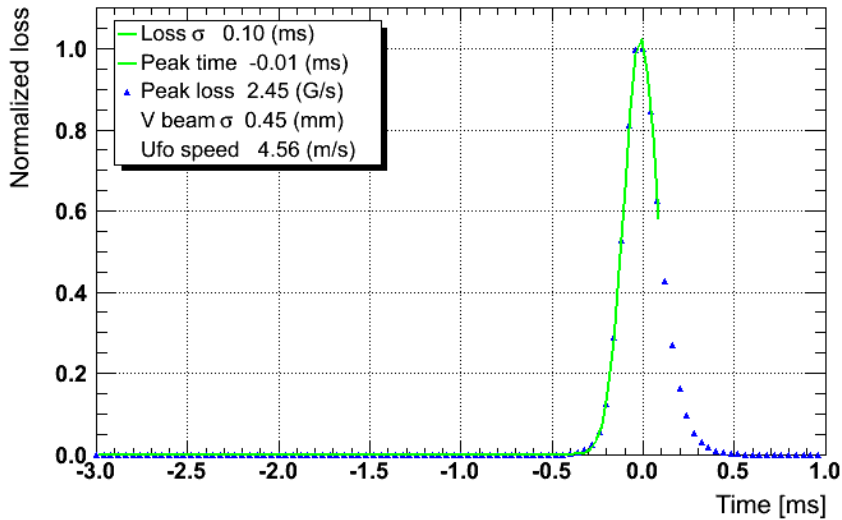


UFO No. 12 BLMQI.05R2.B2E30_MQM

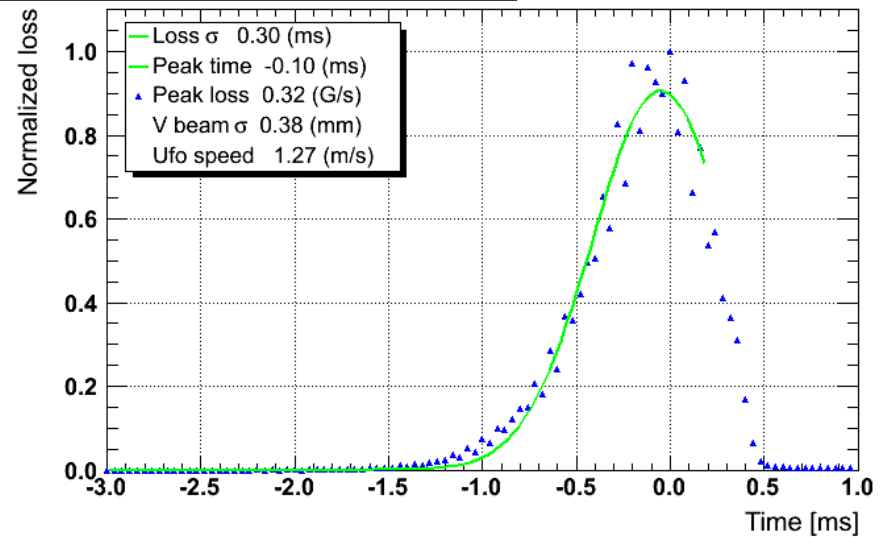




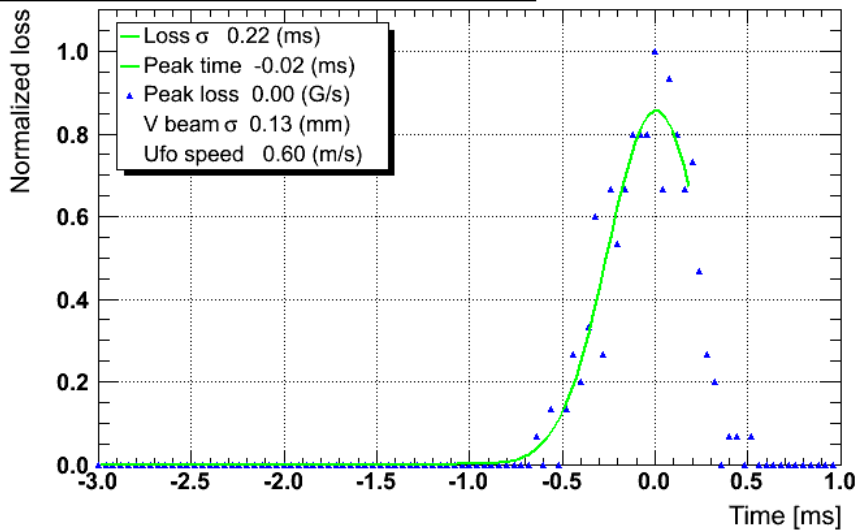
UFO No. 14 BLMEI.05R4.B1I10_BSRTM



UFO No. 15 BLMQI.17L4.B2E10_MQ



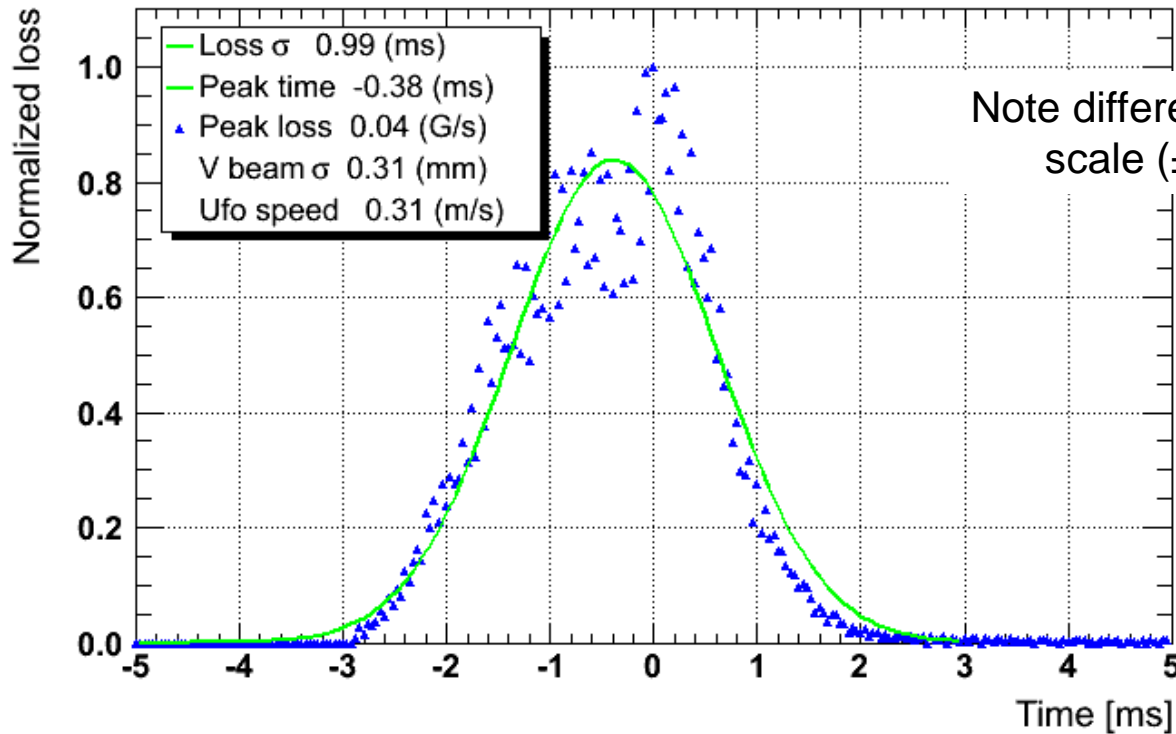
UFO No. 17 BLMQI.03R2.B1I30_MQXA



In many cases the estimated UFO speed is significantly larger than v_g !!
 \Rightarrow 0.4 to 4.5 m/s



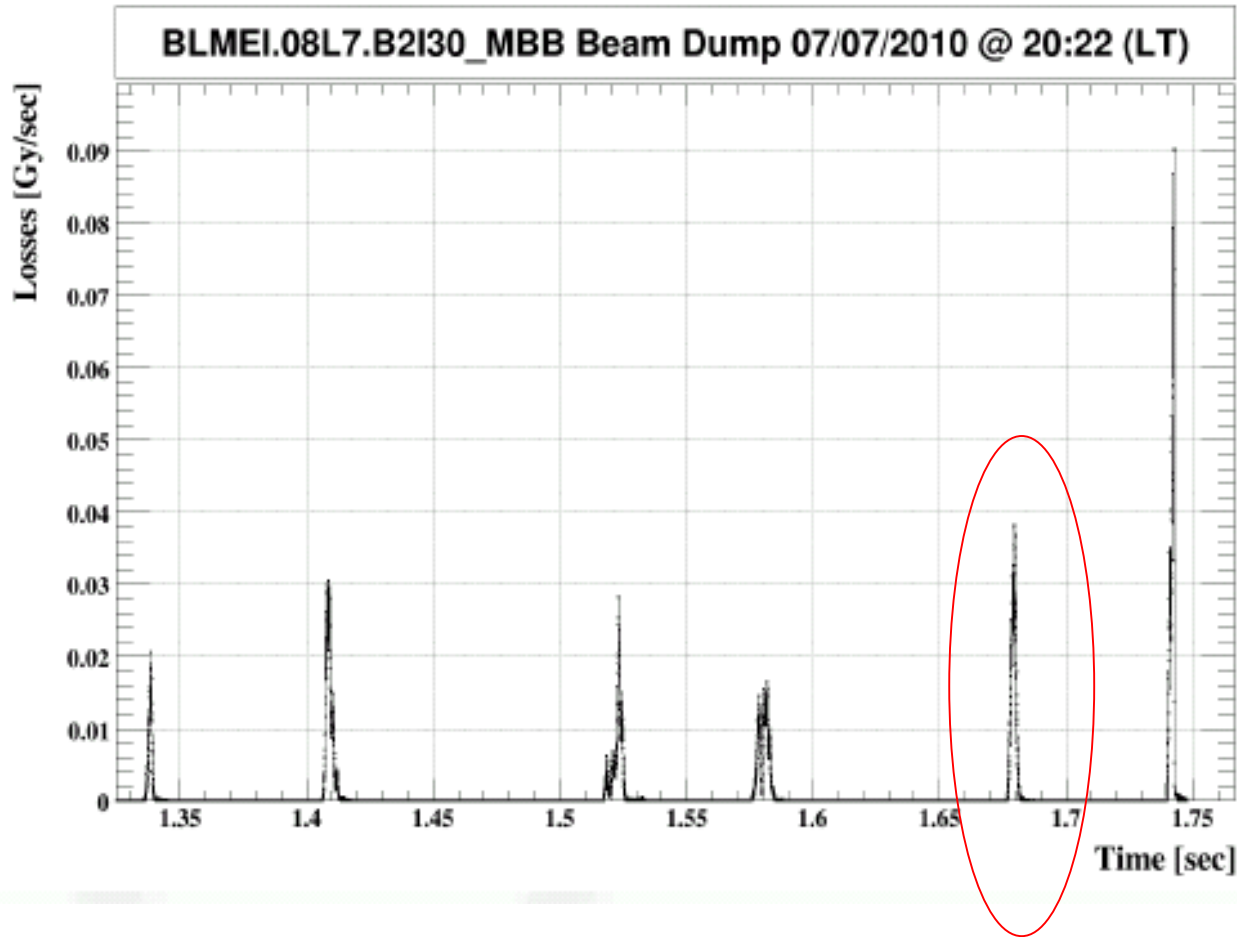
UFO No. 19 BLMEI.08L7.B2I30_MBB



- ❑ Overall shape not ‘too different’ from a Gaussian. Multiple peaks probably due to UFO shape.
- ❑ Average speed of this precursor $0.31 \text{ m/s} < v_g$: could indicate that the UFO was larger than the beam, and that it fell across the beam...



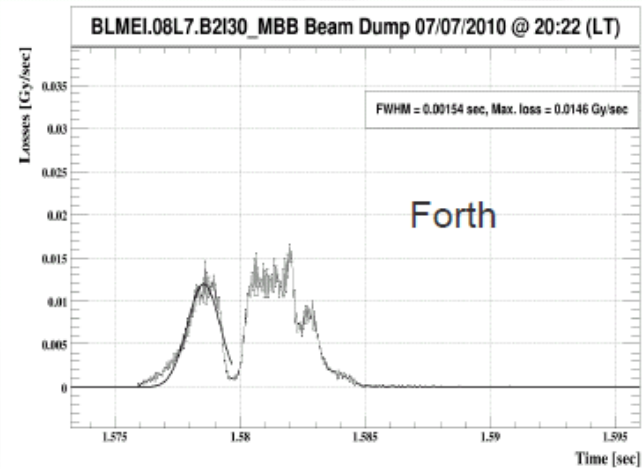
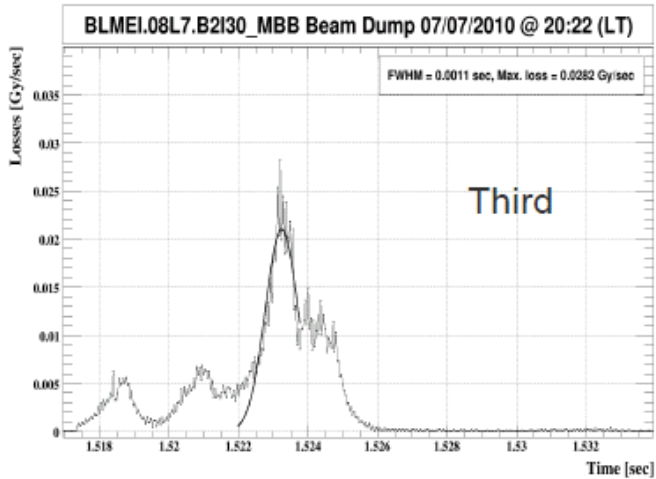
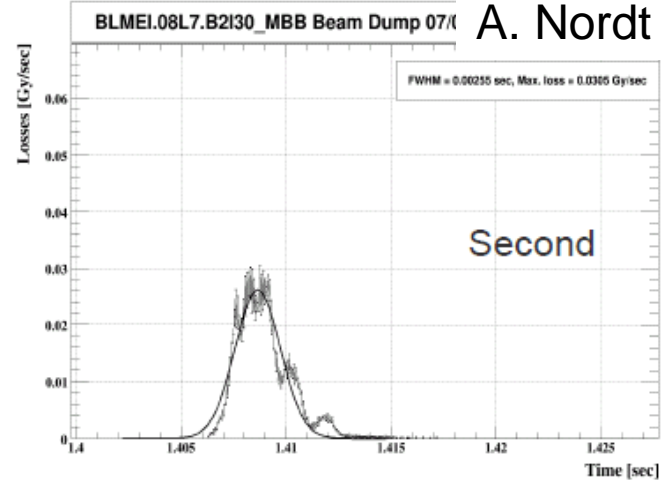
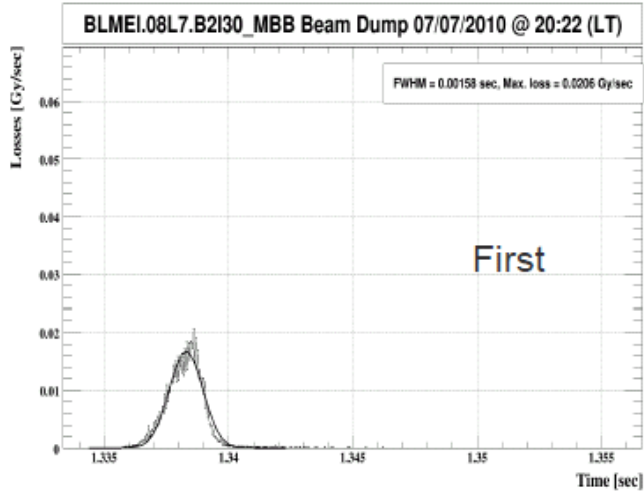
A. Nordt / July 2010



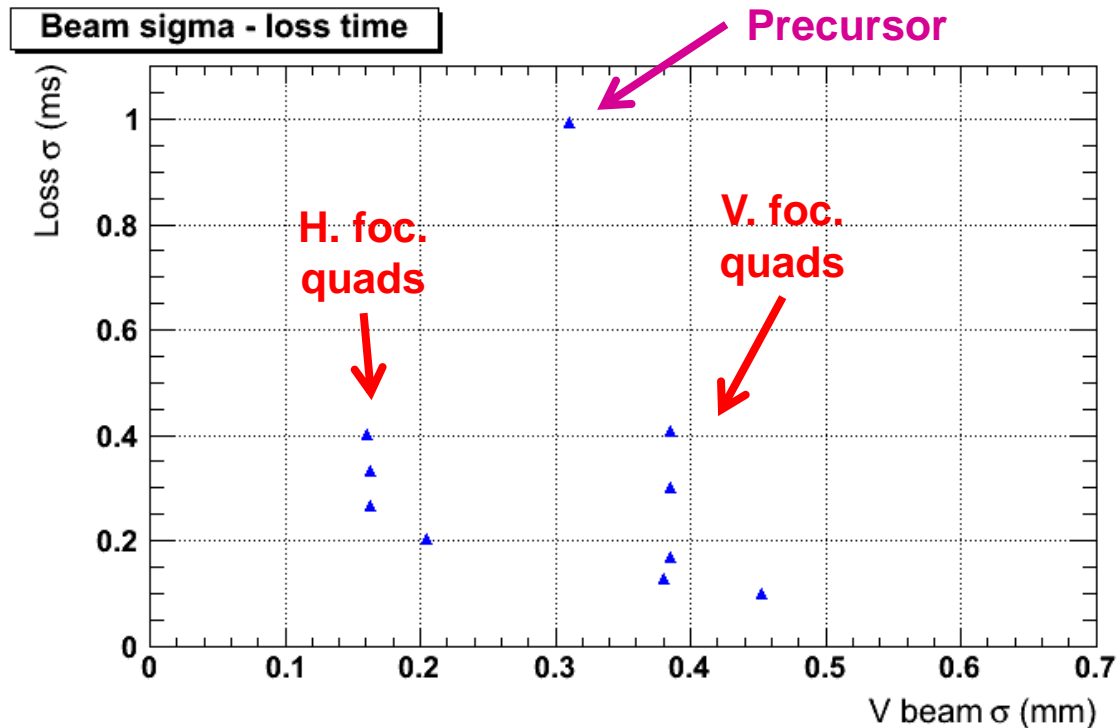
Event 1 – first 4 precursors



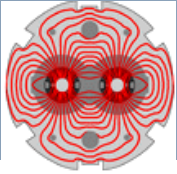
A. Nordt / July 2010



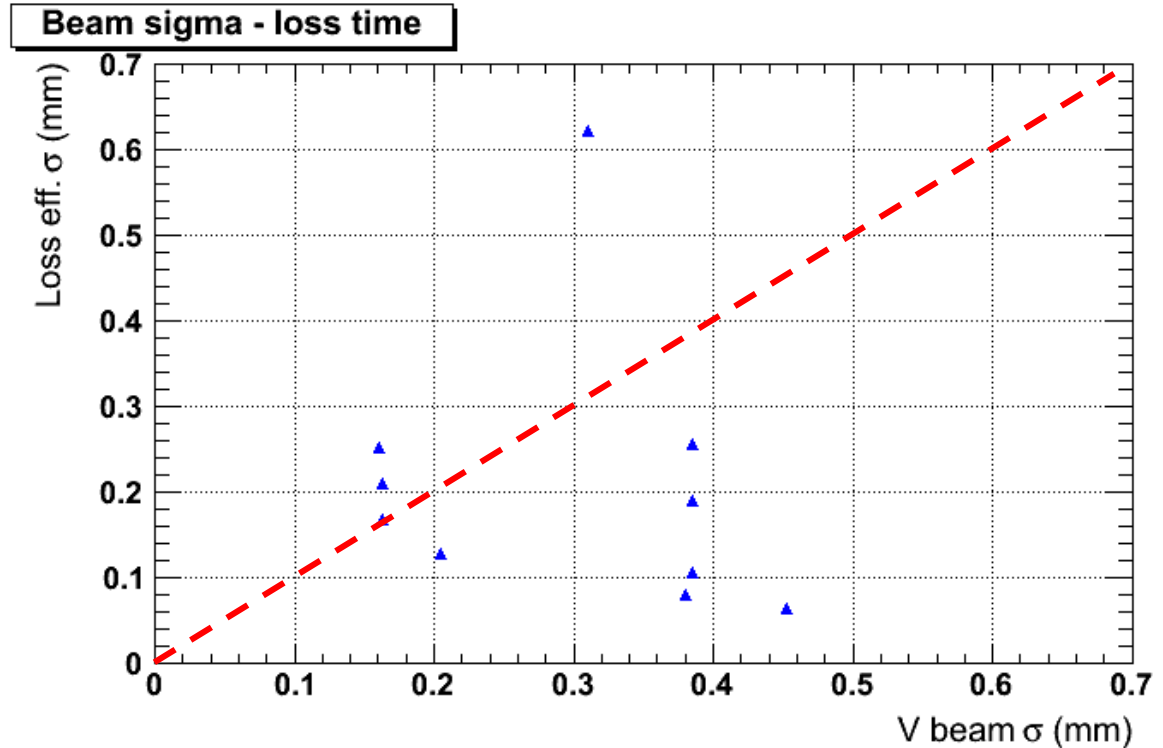
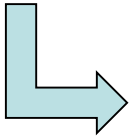
A simple Gaussian approximates 3 of 5 precursors...



- ❑ There is no significant difference between locations of small (H. focusing) and large (V. focusing) beam size.
- ❑ The real sizes could be larger for the H. focusing locations, smaller for the V. focusing locations (UFO source upstream of quadrupole).



$$\sigma_{eff} = \sigma_T v_g$$



- The effective size should be larger than the beam size – not the case of the UFOs where beam size is large.
 - This reflects the fact that the UFO speed estimated from the beam sizes are much too large (wrt gravity). A sign that the UFO is subject to electromagnetic forces, expelled ... ?



- As a next step one could repeat the exercise for the sub-threshold UFOs from Eduardo.
 - From the dcum obtain the betatron function.
 - Correlate again Eduardo's UFO duration estimate with the beam size, respectively estimate a speed.