

Targetry for MICE

- Useful meeting held at RAL last Thursday.
- Representatives of MICE, ISIS & others with Sheffield electronic & mechanical engineers.
- Design requirements discussed.
- Possible implementation considered.
- Some serious problems are evident!

Requirements

- Target out of beam during acceleration.
- At least 25 mm total travel (as beam envelope shrinks).
- Entry 5 mm into beam for last 2 ms of cycle only.
- Operation on demand, up to repetition rate of ISIS (50 Hz).
- Reliability – present design (double resonant pendulum) not sufficiently stable or controllable.

Requirements (2)

- Parking position completely out of beam.
- Minimal change to beam pipe (small slot) – r.f. fields.
- Rapid removal from machine in case of failure or replacement – radiation levels.
- No magnetic disturbance to beam.
- Low levels of vibration.

Suggested design

- Linear motor – same principal as loudspeaker coil.
- T. Bradshaw's design for Sterling refrigerator for Space Station.
- Reliable 40 Hz operation (near resonance).
- Back-to-back operation with servo control is virtually vibrationless.

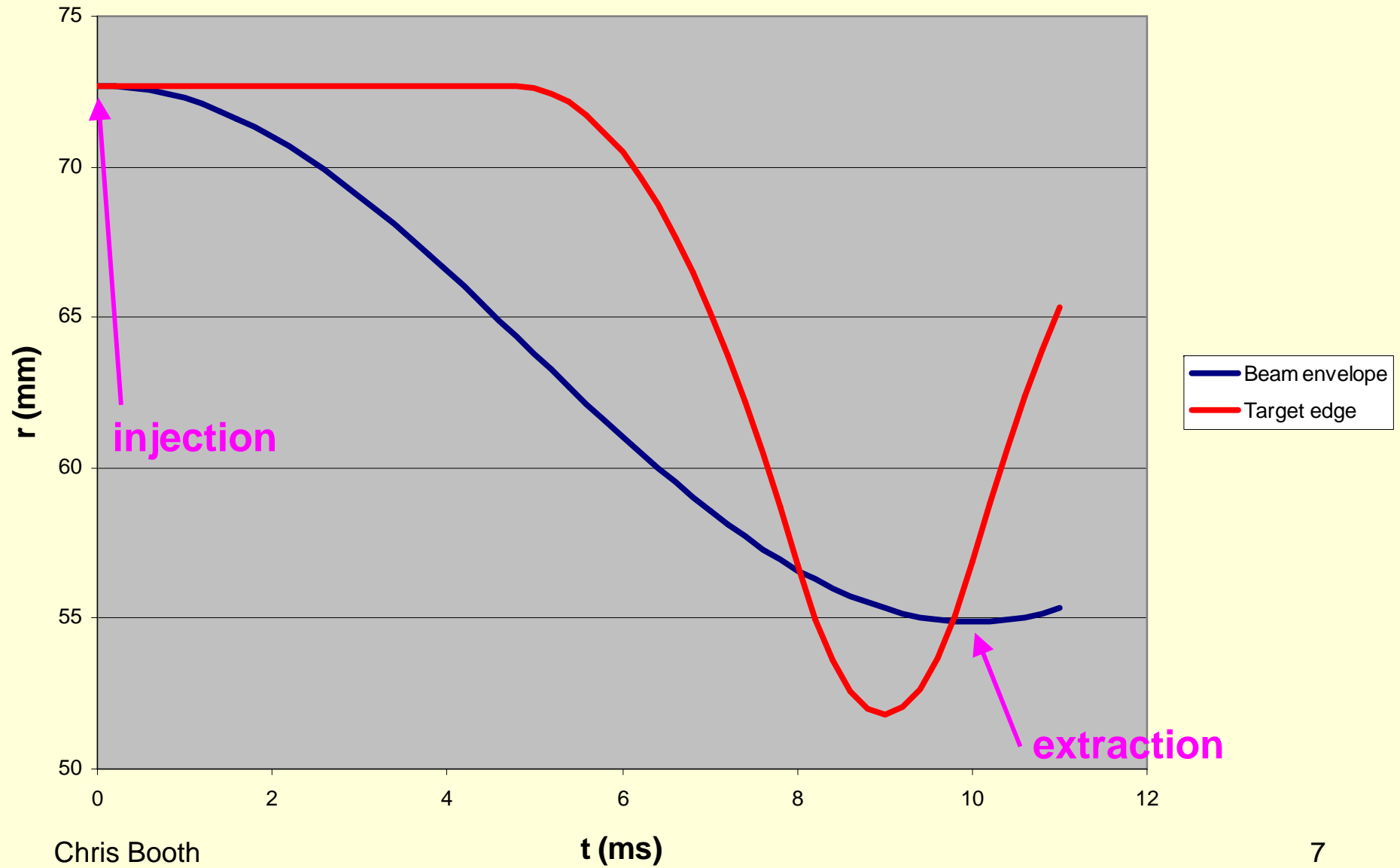
But ...

- Much smaller travel.
- Near resonant, not on demand.
- Motion against restoring gas pressure.
- Very different design constraints.

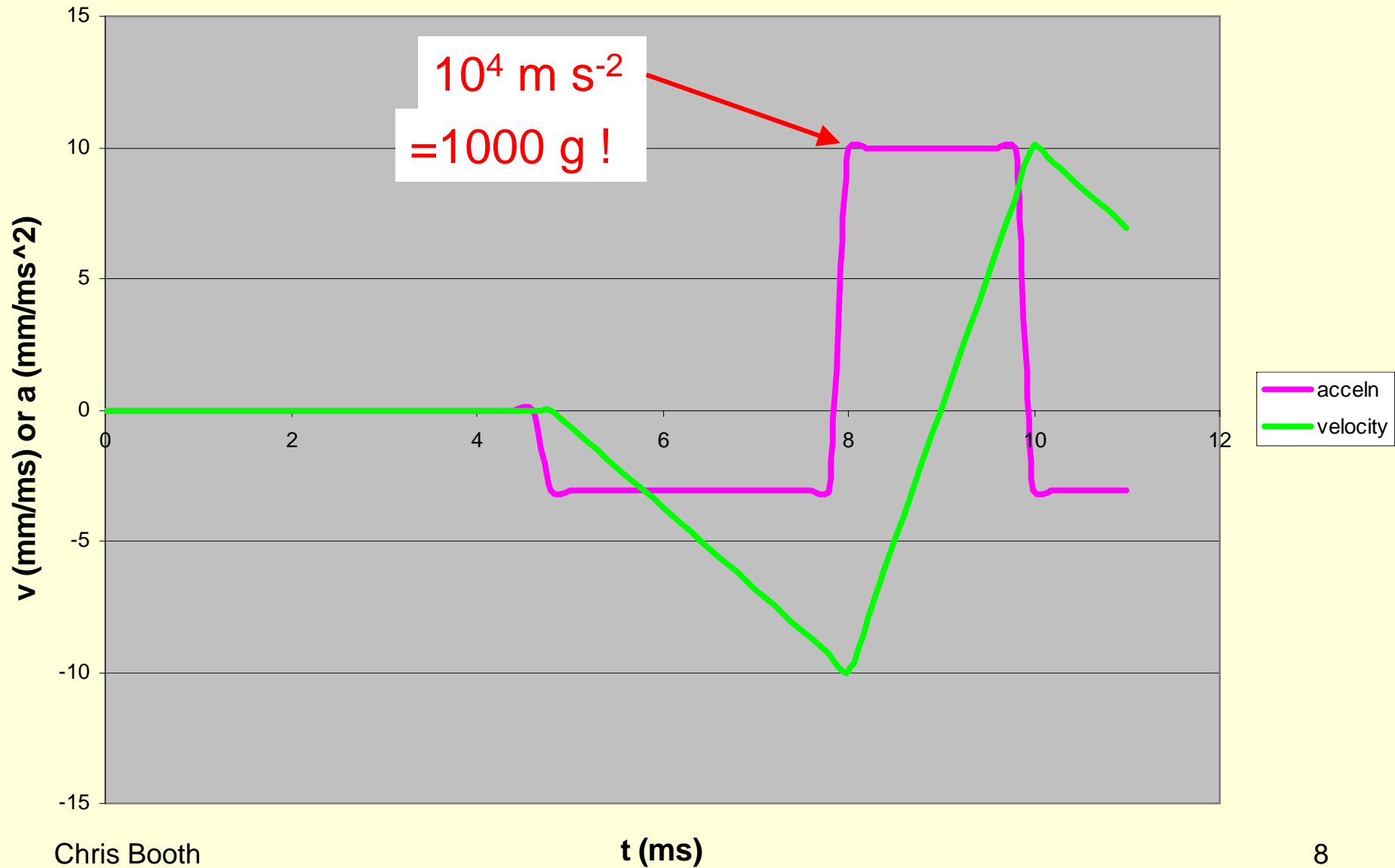
First design calculations

- Optimise motion to minimise peak acceleration, forces, power etc.
- Most efficient not to follow beam profile too closely.

Target Movement



Target velocity & acceleration



Back of the envelope

- Smallest peak acceleration is 10^4 m s^{-2} (i.e. 1000 g!)
- Assume mass of target, support & coil only 250g.
- Peak force 2000 N.
- Coil needs 10^4 Ampere turns.
- $10 \text{ A/mm}^2 \Rightarrow 800 \text{ g copper needed!}$
- Mean power at 50 Hz 160 W.

Problems!!

- Clearly this design is not self consistent!
 - Too much mass
 - Probably too little magnet gap
 - Inadequate cooling?
- Will assembly withstand the stresses?
- ...

Future

- A lot more design studies needed :-
- Is a non-resonant design possible?
- Is a resonant design controllable?
- What can *really* be achieved with the linear motor approach?
- Are there other commercial solutions?
(What does a hard disk mechanism achieve?)

Sheffield plans

- Continue design and feasibility studies.
- Obtain or build and test linear motors.
- Consider intelligent control mechanisms (sensitive to velocity as well as position).
- Investigate disk drive mechanisms and their control circuitry.
- Brainstorm with local Control Engineering department.

But no guarantee present
design is possible!!