

High magnetic field generation with single turn coils

Roald Frederickx Kasper Meerts

December 15, 2010

Titularis: Prof. Christian Van Haesendonck
Begeleider: Prof. Johan Vanacken

1 Inleiding

2 Onze aanpassingen

3 Resultaten

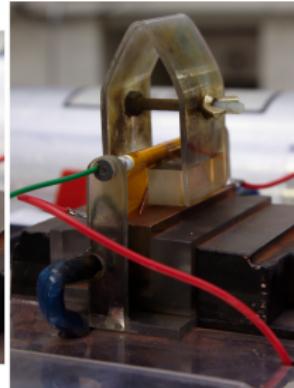
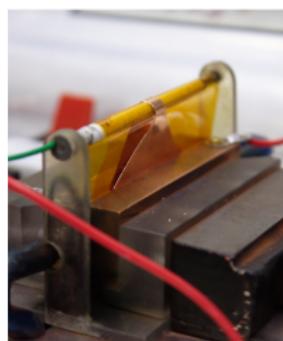
4 Conclusie

5 Dankwoord

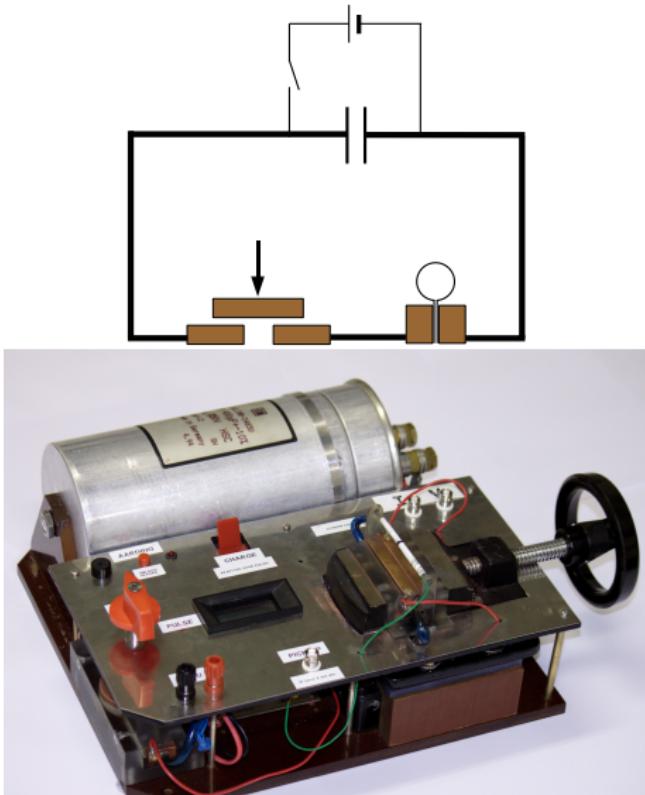
- Vaste-stoffysica
- Materiaaleigenschappen
- Methodes

Methode	Veld (T)
Permanente magneet	1.3
Gewone electromagneet	36
Hybride electromagneet	45
Gepulst (niet-destructief)	89
Single Turn Coil	400
Explosief	2800

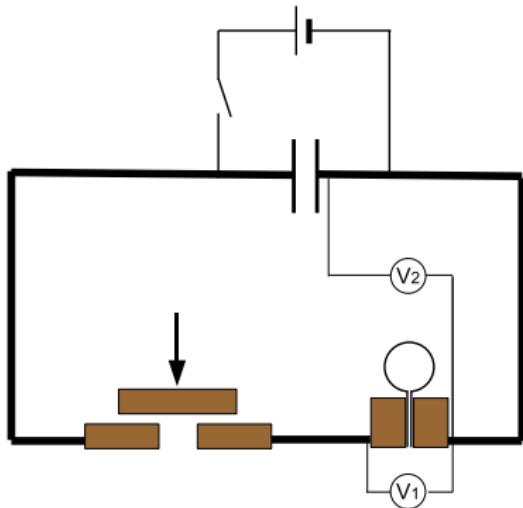
- Destructief gepulst
- Geen vernieling in de sample space



- Mobiel apparaat
- Kleine schaal
- Proof of concept
- ~ 2 tesla
- $400 \mu\text{F}$
- 850 V
- 150 J



- Oorspronkelijk
 - dB/dt pickup-spoel
 - Nieuw: 136 mm^2
- Onze toevoegingen
 - Spanning over spoel
 - Stroom (door shunt)

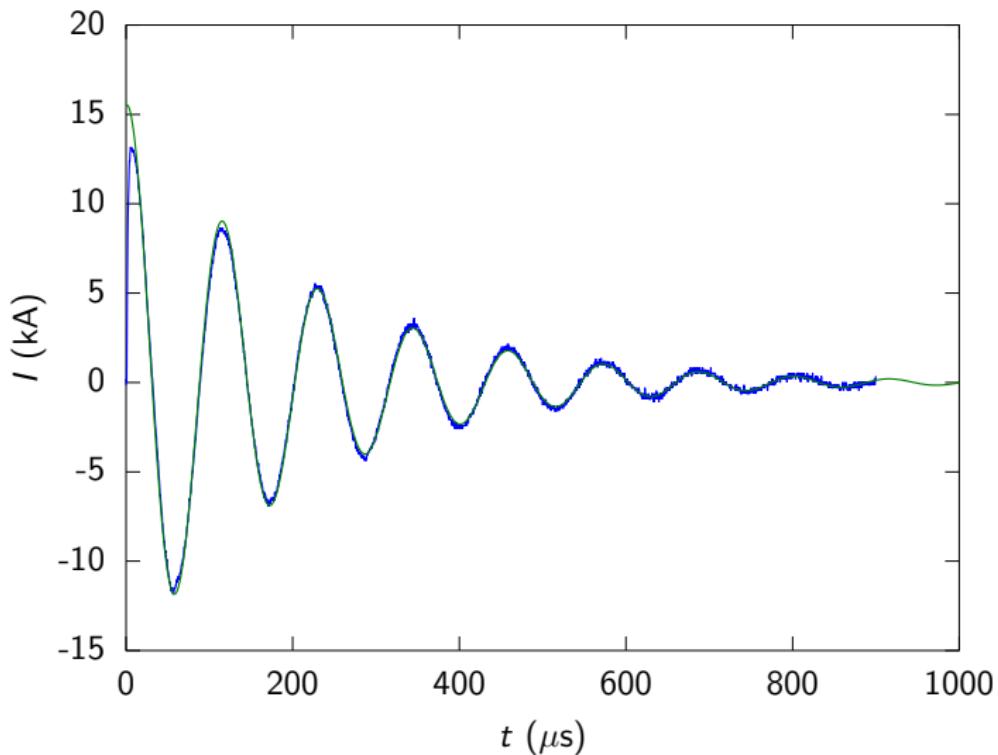


Spanning over shunt → Stroom

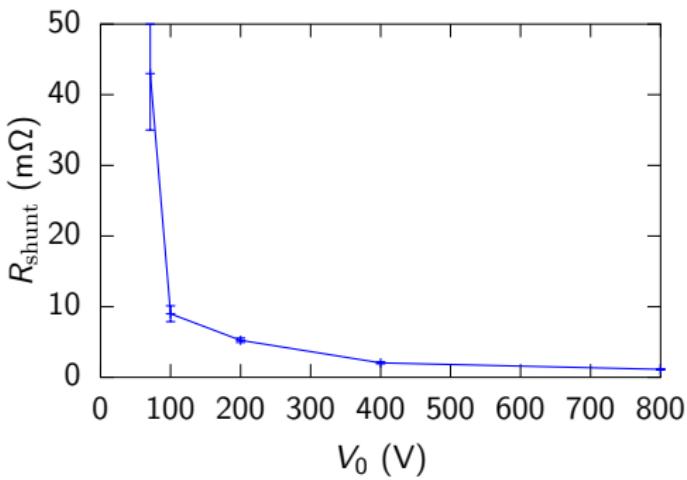
- Meting zonder spoel
- RLC circuit
- $L = \text{parasitaire inductantie}$
- C gekend

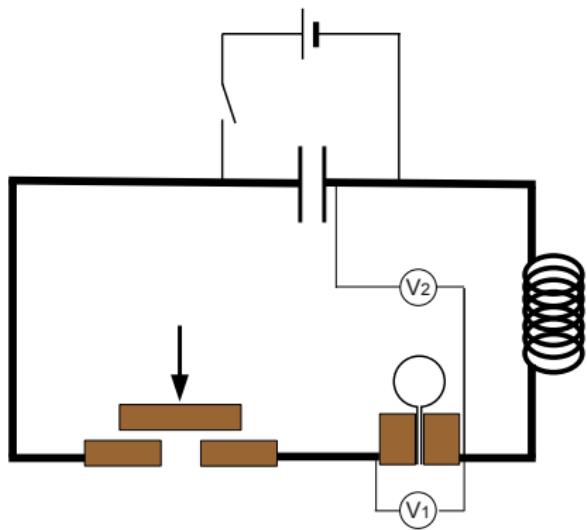
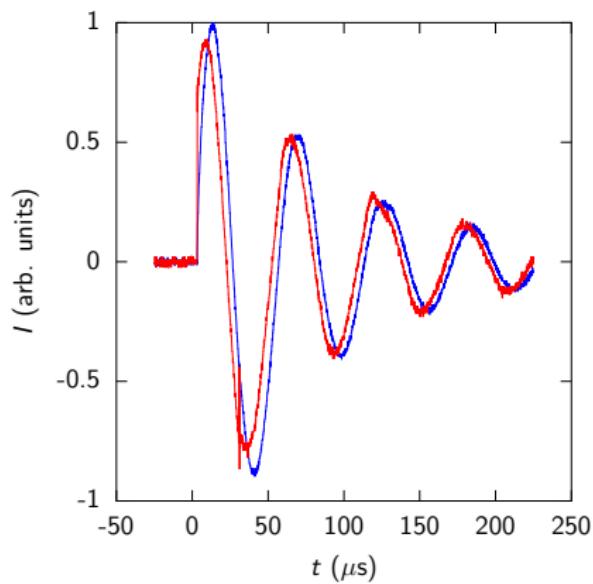
$$I(t) = -V_0 C \frac{\omega}{\sqrt{1 - \zeta^2}} e^{-\zeta \omega t} \sin \omega_d t$$

$$\omega^2 = \frac{1}{LC} \quad \zeta = \frac{R}{2L\omega} \quad \omega_d = \omega \sqrt{1 - \zeta^2}$$

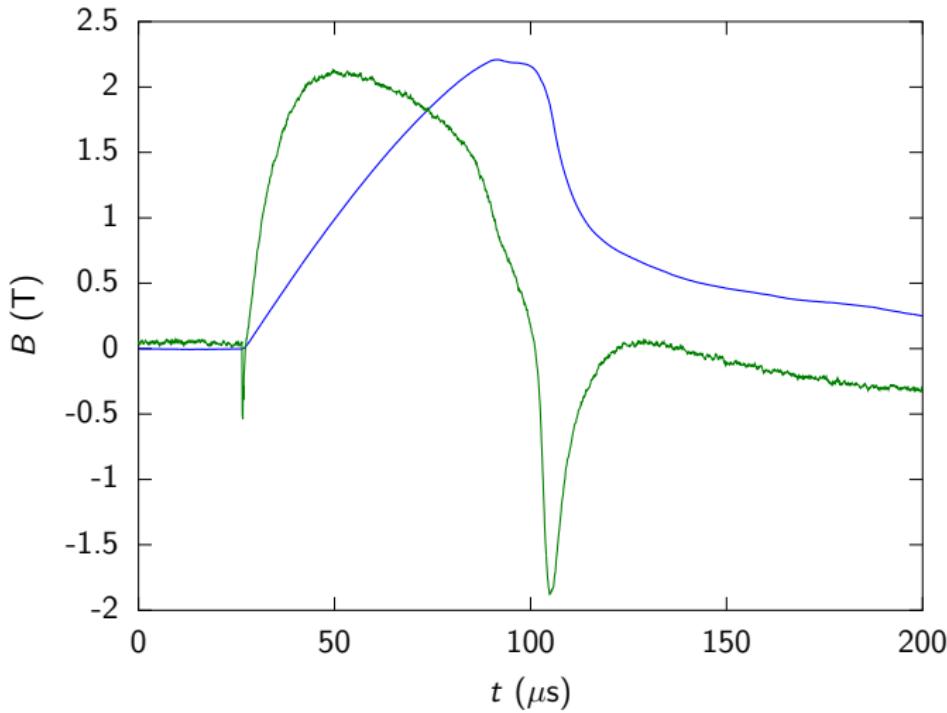


V_0 (V)	L (μ H)	R (m Ω)	R_{shunt} (m Ω)
71	0.83 ± 0.06	12 ± 3	43 ± 8
100	0.84 ± 0.03	9 ± 1	9 ± 1
200	0.82 ± 0.01	8.3 ± 0.6	5.3 ± 0.3
400	0.82 ± 0.01	7.1 ± 0.6	2.0 ± 0.1
800	0.82 ± 0.01	7.7 ± 0.7	1.12 ± 0.09





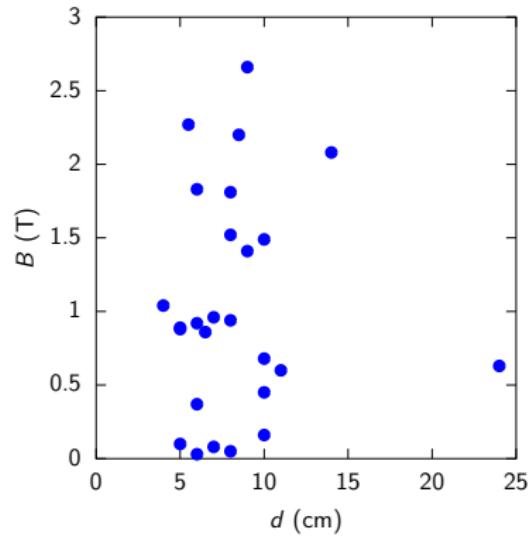
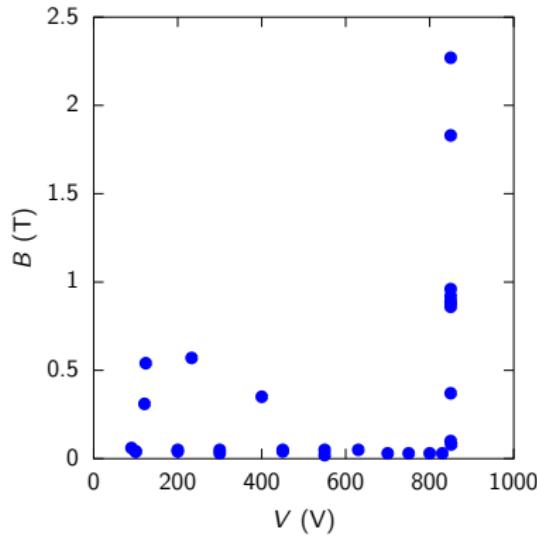
- 127 metingen
- 28 metingen bij maximale energie
- 10 piekvelden boven 1 T
- Maximaal 2.7 T
- Herinner: proof of concept

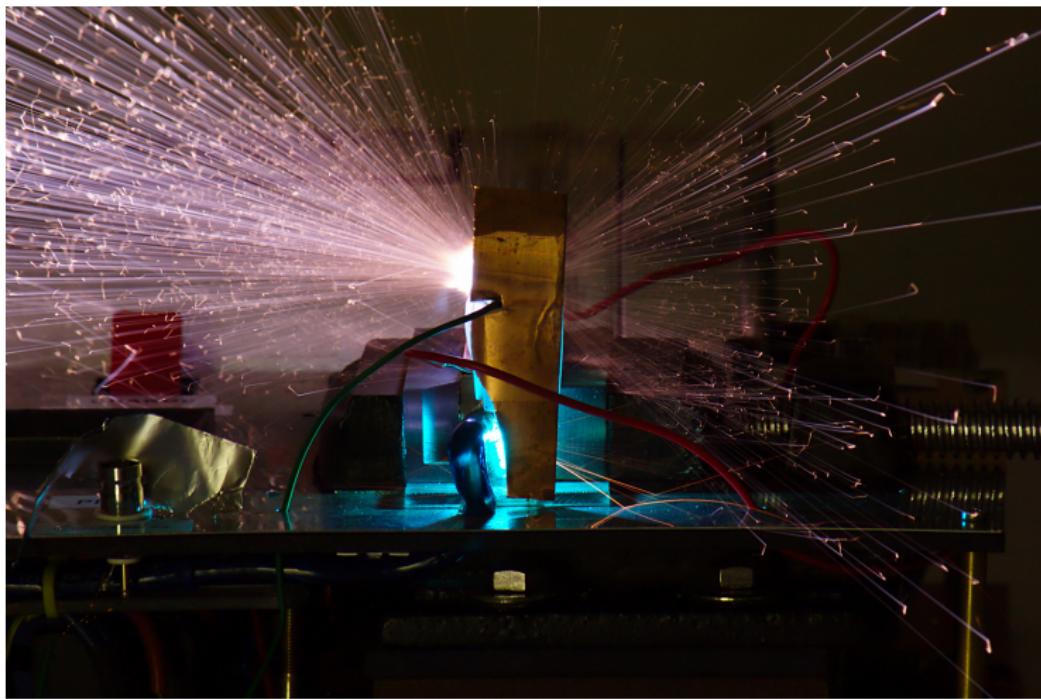


Hoger veld

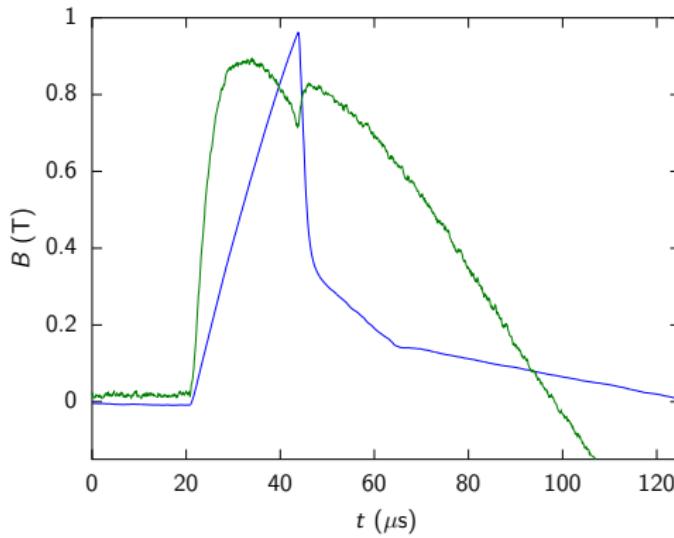
- Parasitaire L kleiner want energie gedeeld \rightarrow geometrie
- Grottere $\omega \rightarrow B$ piek vóór desintegratie $\rightarrow L, C \downarrow$
- Maar meer energie in condensatoren $\rightarrow V \uparrow$

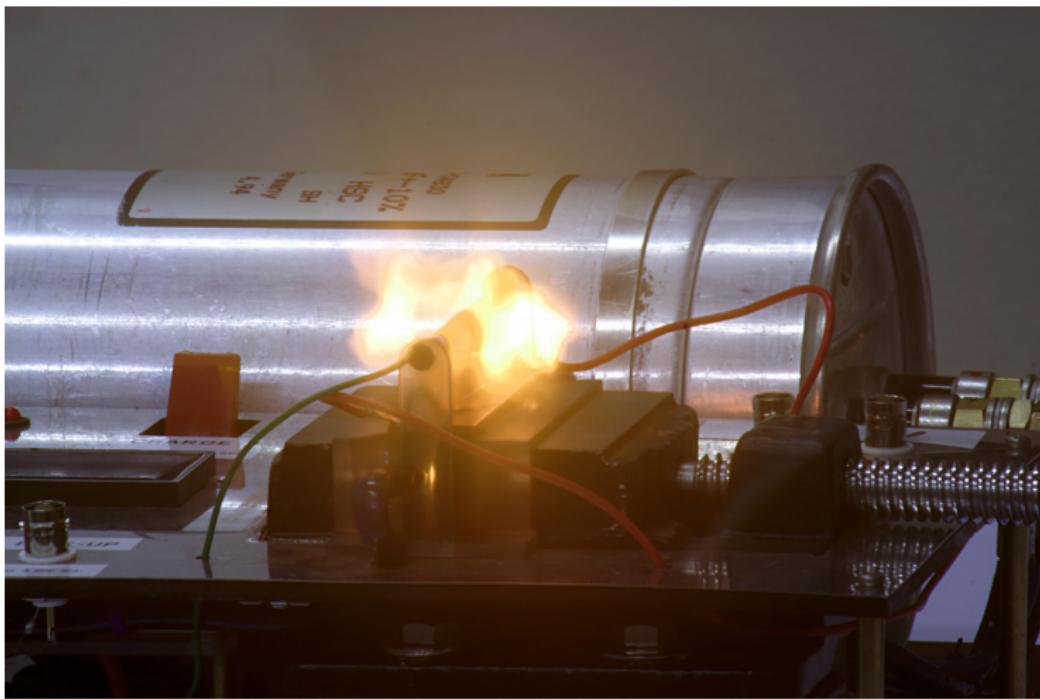
Geen invloed van spanning condensator of dikte van spoel meetbaar



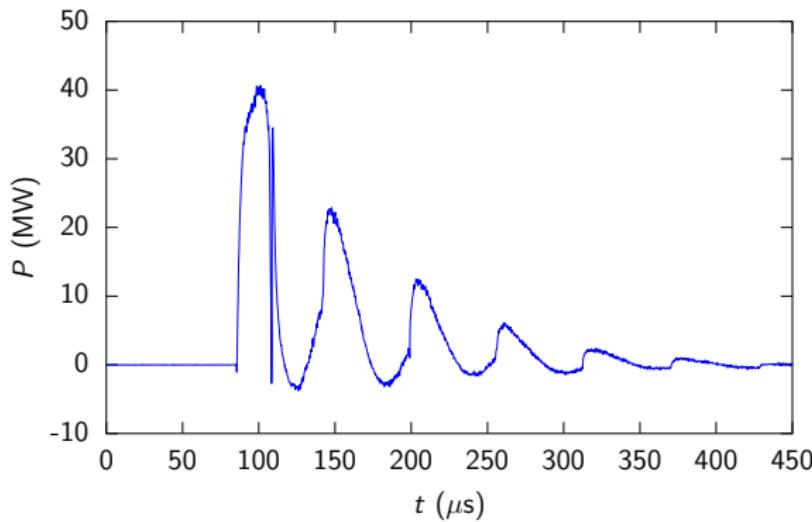


- Plasmageleiding
- Karakteristieke knik
- Dunne materialen zoals aluminium





- $P = VI$
- Enkel kwalitatief!



Conclusie

- Velden tot 2.7 T
- Geen correlatie gevonden met spanning of spoelafmetingen
Wel verwacht (meer metingen)
- Hoogfrequente signalen meten niet evident
- Nieuwe fenomenen bestudeerd door extra meetmogelijkheden
 - Vermogendissipatie in spoel en plasma
 - Plasmageleiding
 - Spoelvervorming

Met dank aan Prof. Johan Vanacken



