

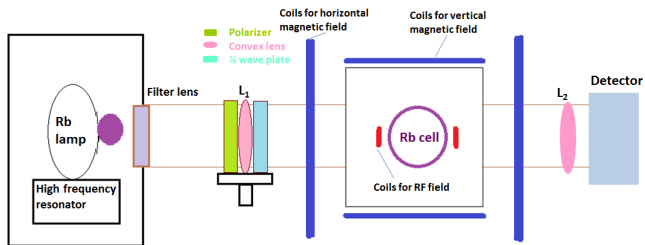
On the Shape of Optical Pumping Signal

Ce Shen¹ 12307110225

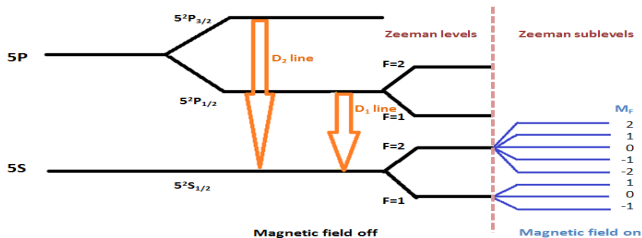
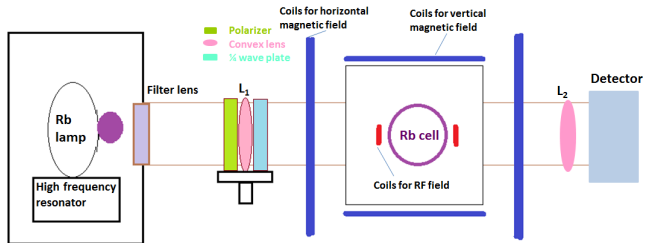
June 23, 2015

¹Department of Physics, Fudan University

Review



Review



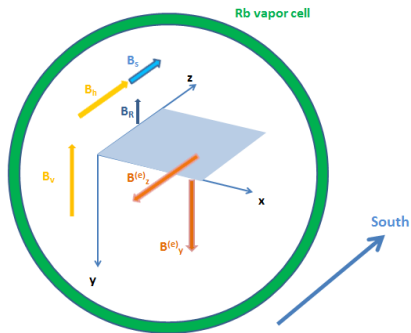
Optical Pumping

In this experiment,

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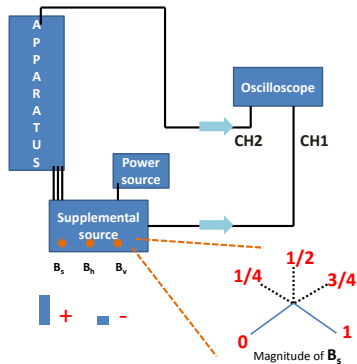
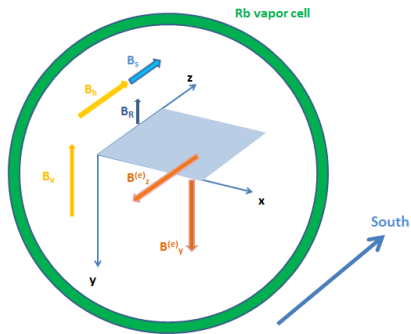
- the magnetic field configuration is like



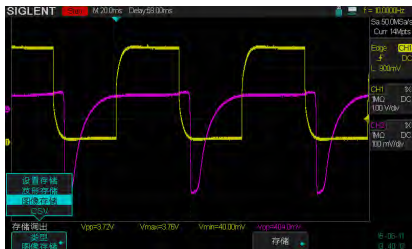
Optical Pumping

In this experiment,

- the magnetic field configuration is like
- and the schematic of circuit is like



The fig:0



Obtained: (+++)

$$B_h = 0.068A,$$

$$B_s = 3/4,$$

$$B_v = 0.067A.$$

The shape changes continuously
with $|B_h - 0.068|$, thus

$$B_y^{(e)} = 0.067A$$

We call it **fig:0** from now on for convenience.

Other figures

With increasing B_h :

fig:0

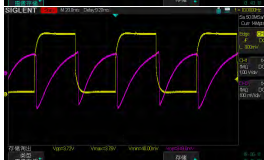


fig:1

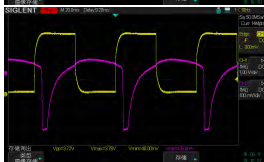


fig:2

Other figures

With increasing B_h :



fig:0

fig:1

fig:2

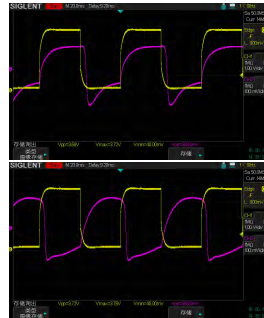


fig:0.5

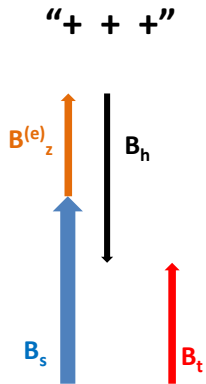
(pseudo)-

fig:1.5

Experiment Data

Fig:0, fig:0.5, fig:1.5 and fig:2 are ultra-sensitive to the change of B_h , so we **trace** the four figures to obtain conditions for each one to occur:

$B_h \backslash B_s$	$1/4$	$1/2$	$3/4$	1
fig				
0		0.076	0.066	0.056
0.5	0.085	0.089	0.086	0.078
1.5	0.158	0.258	0.357	0.419
2		0.273	0.378	0.447



Analysis

A previous **wrong** thought:



fig:0

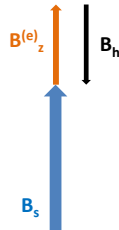
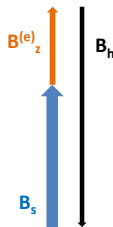
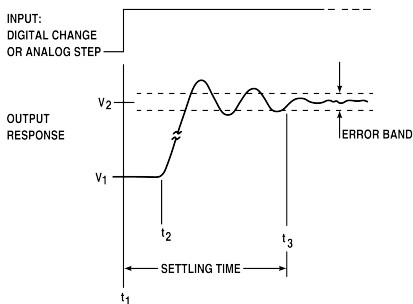


fig:2



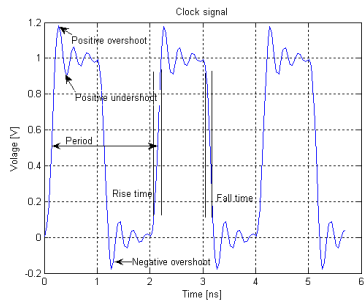
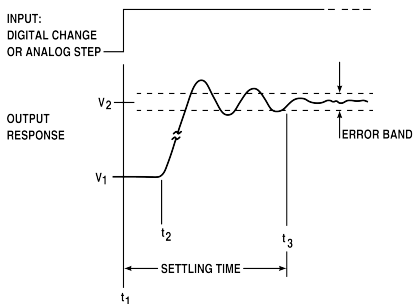
Overshoot

In signal processing, control theory, electronics, and mathematics, overshoot is the occurrence of a signal or function **exceeding its target**. It arises especially in the step response of bandlimited systems such as low-pass filters. (Cited from en.wikipedia.org)



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The Correct Process

“+ + +” , $B_v = 0.067A$, $B_s = 3/4$, increase B_h from 0 to max.

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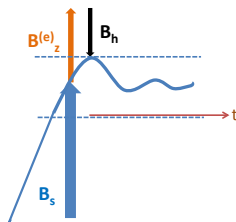


fig:0

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“+ + +”, $B_v = 0.067A$, $B_s = 3/4$, increase B_h from 0 to max.

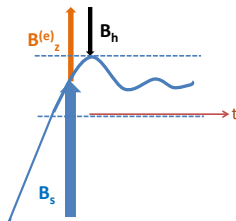
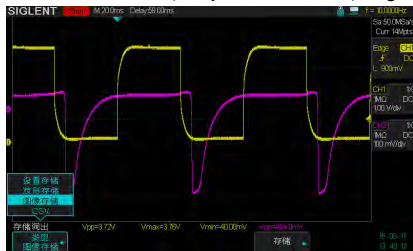
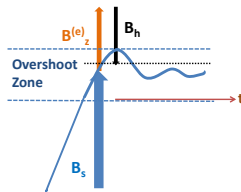


fig:0



pre-fig:0.5

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“+ + +” , $B_v = 0.067A$, $B_s = 3/4$, increase B_h from 0 to max.

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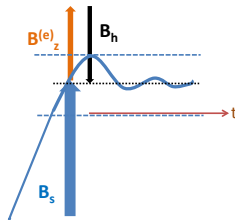
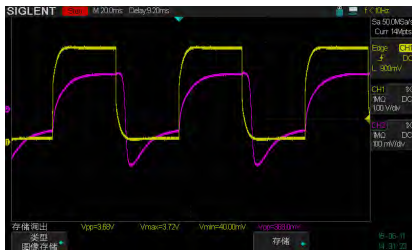


fig:0.5

The Correct Process

“+ + +” , $B_v = 0.067A$, $B_s = 3/4$, increase B_h from 0 to max.

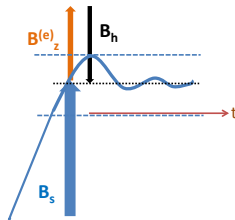
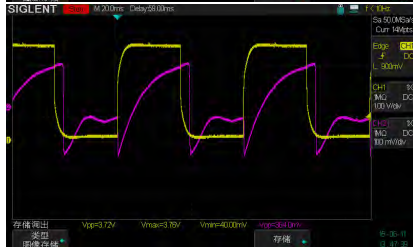
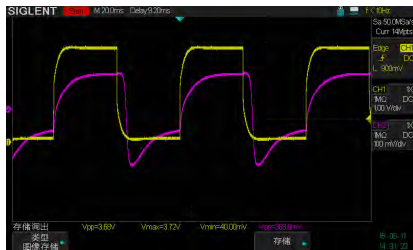
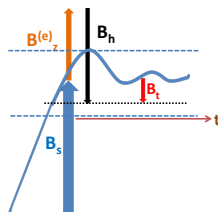


fig:0.5



post-fig:0.5

The Correct Process

See the animation below on the change of total magnetic field B_t

Click here to start:

The Correct Process

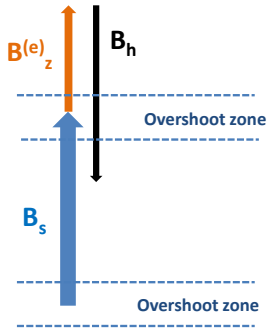
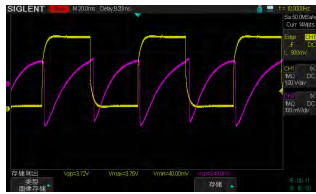


fig:1

The Correct Process

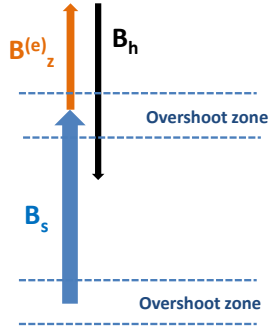


fig:1

The Correct Process

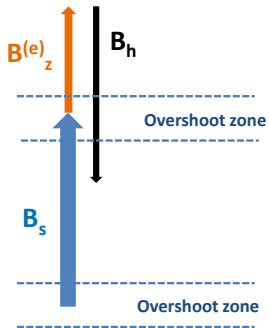
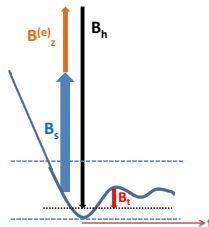
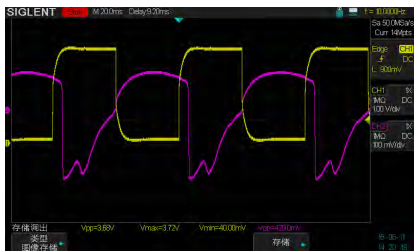


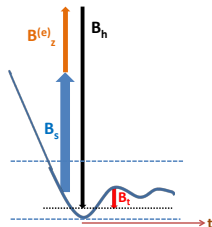
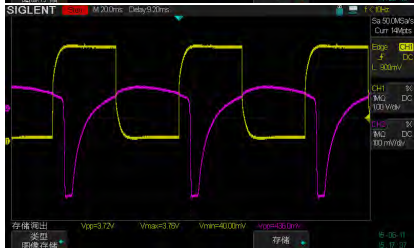
fig:1

The Correct Process



post-fig:1.5

The Correct Process



post-fig:1.5

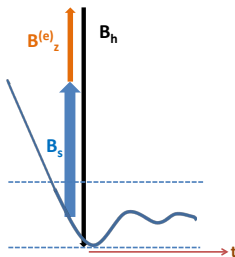
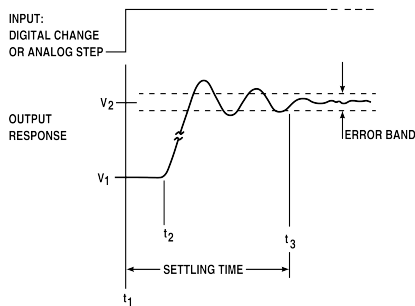


fig:2

Comparison

Notice that overshoot only occurs when the scanning field B_s is a **rectangular wave**. If a triangular wave is used instead, no overshoot-related phenomena will be observed.



Bibliography

Bibliography:

- ① Modern Physics Experiment, L. S. Dai and D. X. Dai, Higher Education Press
- ② [https://en.wikipedia.org/wiki/Overshoot\(signal\)](https://en.wikipedia.org/wiki/Overshoot(signal))

Acknowledgements

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- Prof. Yanhong Xiao

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Thanks!