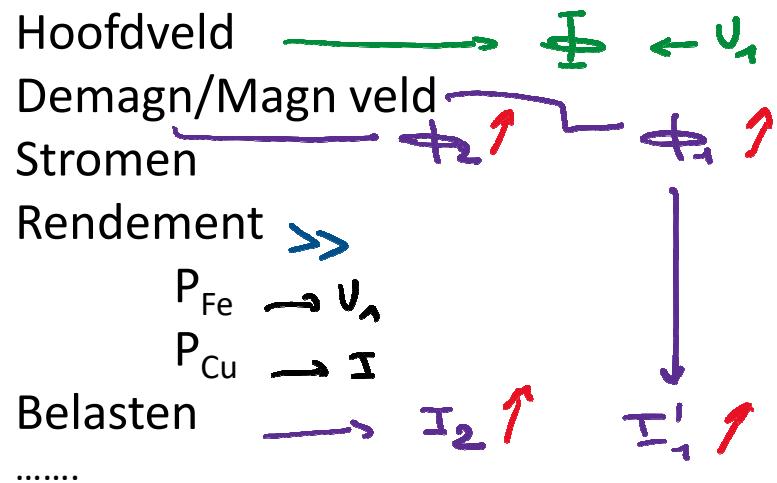


Transformatoren

Driefasige Transformatoren

Inzichten :



Asynchrone machines

L. Butaye

$\equiv 3T$ transfo
sec kantsl.

Hoofdstuk 1

Inleiding tot elektrische machines

L. Butaye

1.1 Classificatie



De naam '**elektrische machine**' geldt voor elke **machine**,

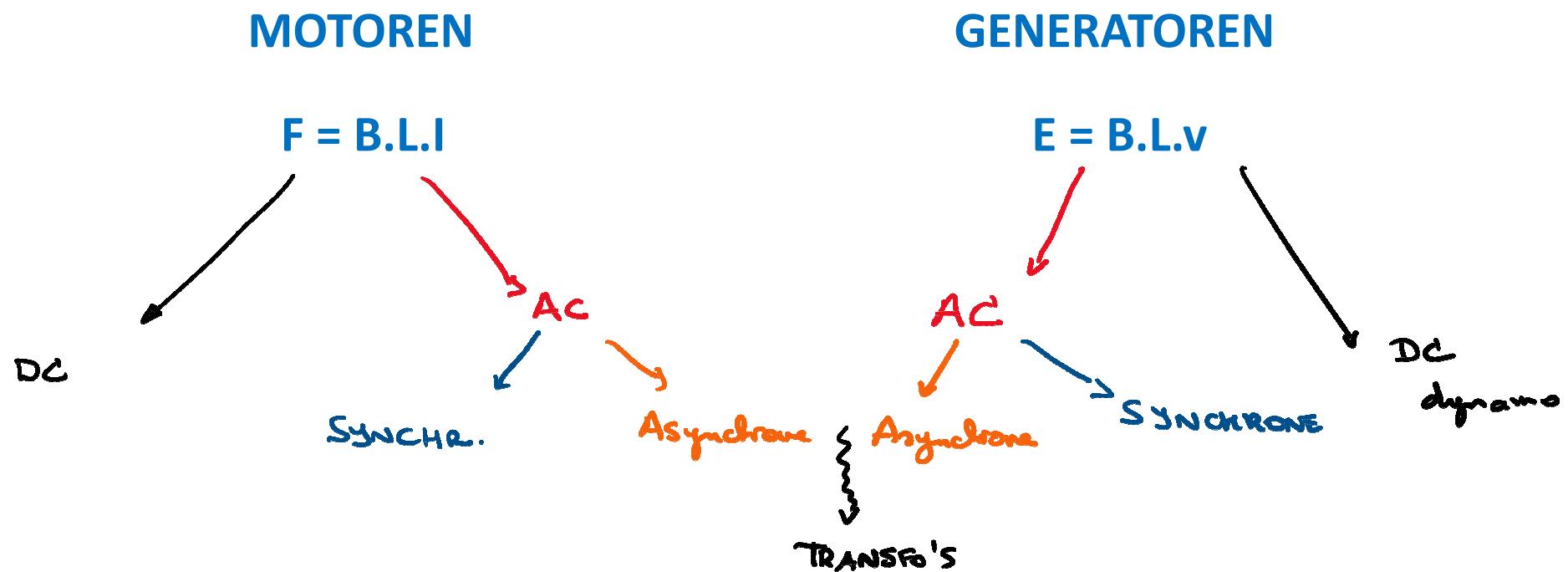
waarin een **elektrisch geleidend circuit** in beweging is ten opzichte van een **magnetisch of elektromagnetisch veld** of **omgekeerd**

en waarbij telkens **elektrische energie** omgezet wordt in **mechanische energie** of **omgekeerd**.

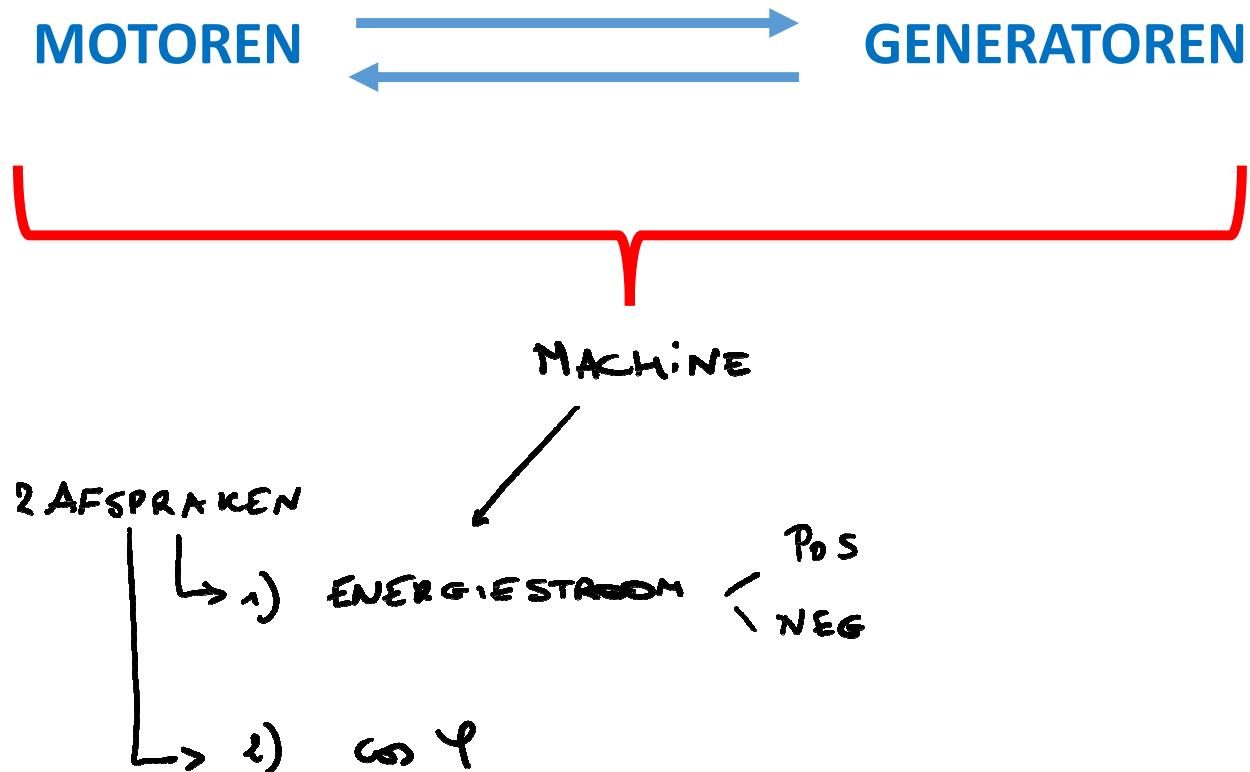
Faraday's experiment (1821)

Elektromotor 1832 - 1837 (600 tpm) – 1873 (Gramme)

1.1 Classificatie



1.2 Conventies



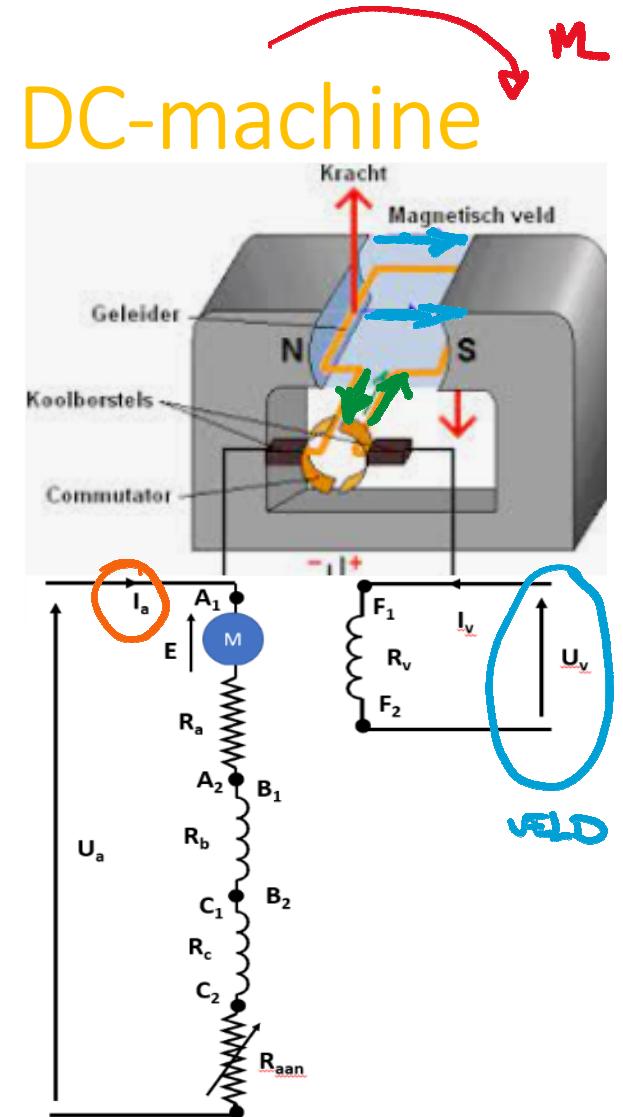
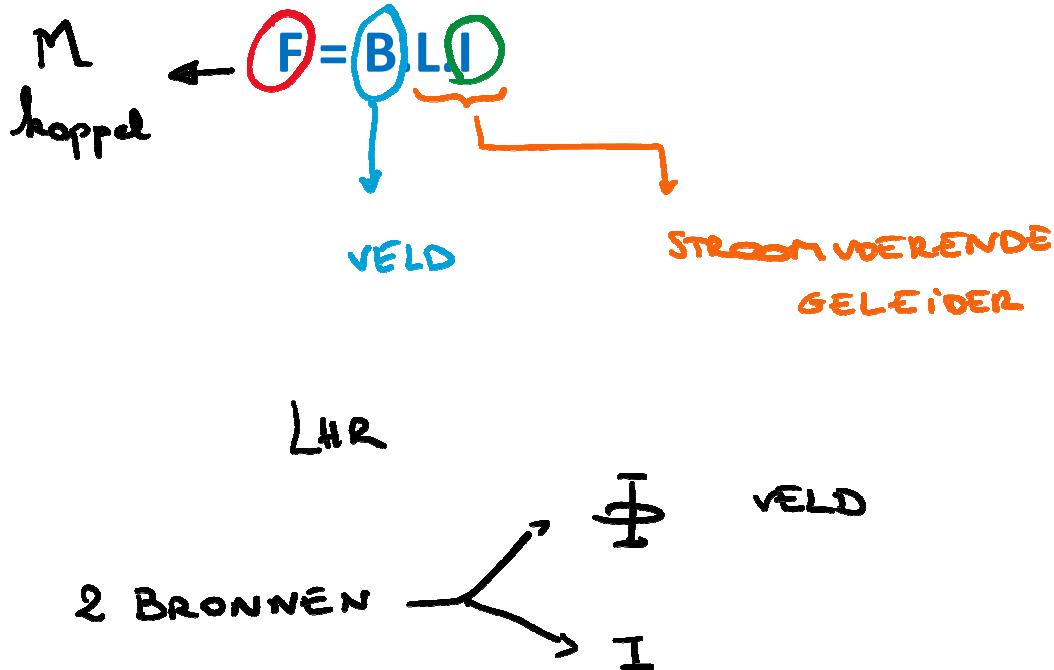
Hoofdstuk 2

Asynchrone machines

L. Butaye

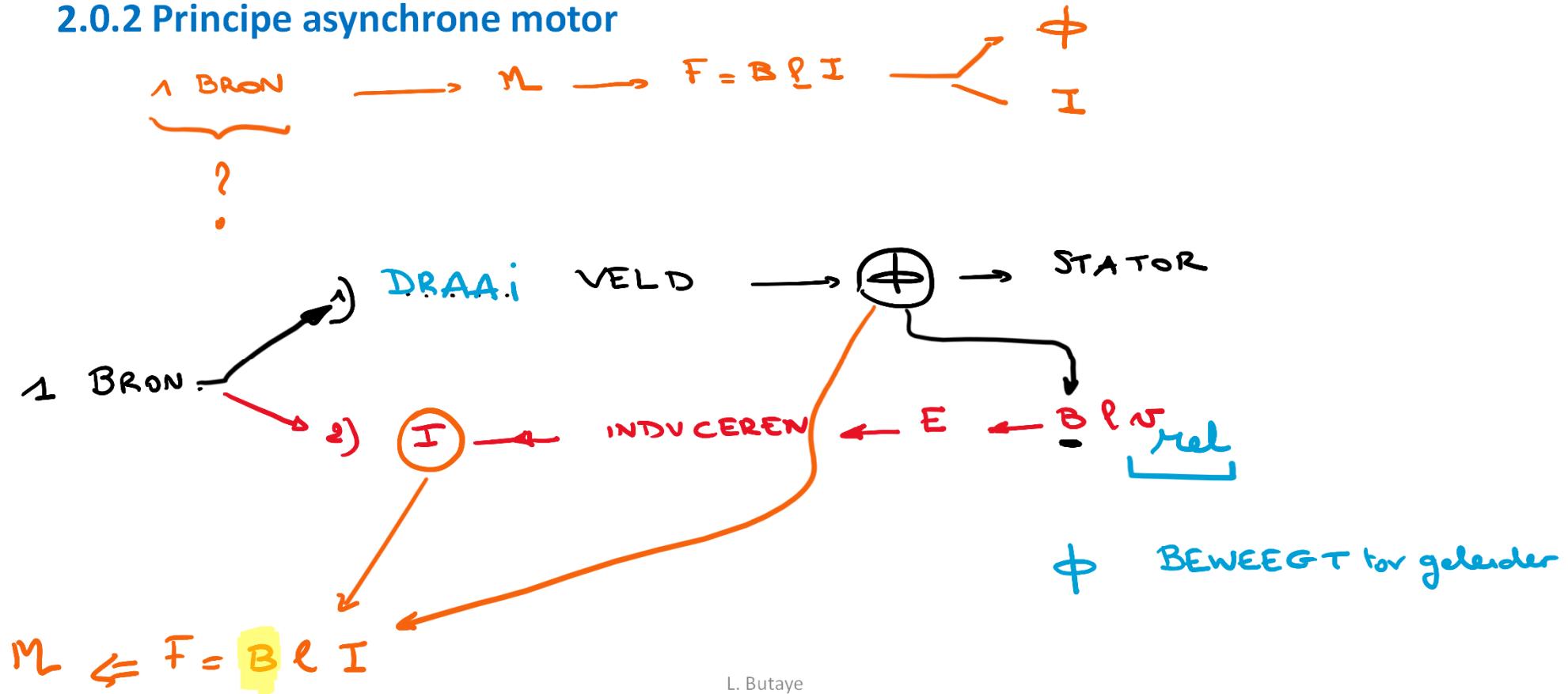
2.0. Asynchrone machine versus DC-machine

2.0.1 Principe DC-motor



2.0. Asynchrone machine versus DC-machine

2.0.2 Principe asynchrone motor



2.0. Asynchrone machine versus DC-machine

2.0.3 Naamgeving

asynchrone motor
asynchrone machine

$\phi \rightarrow n_s$ synchron toerental
 $n_{rel} \rightarrow E \rightarrow I \rightarrow n_r = \text{rotor toerental}$

$n_r < n_s$

STEL $n_r = n_s \rightarrow n_{rel} = 0 \rightarrow B \downarrow \sigma = 0 \rightarrow E = 0 \rightarrow I = 0$
 $f = 0$
 $M = 0$

L. Butaye

INDUCTIE motor
machine
I
geïnduceerde

2.0. Asynchrone machine versus DC-machine

2.0.4 Voordelen

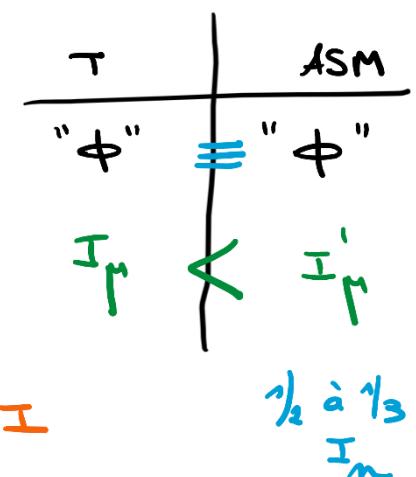
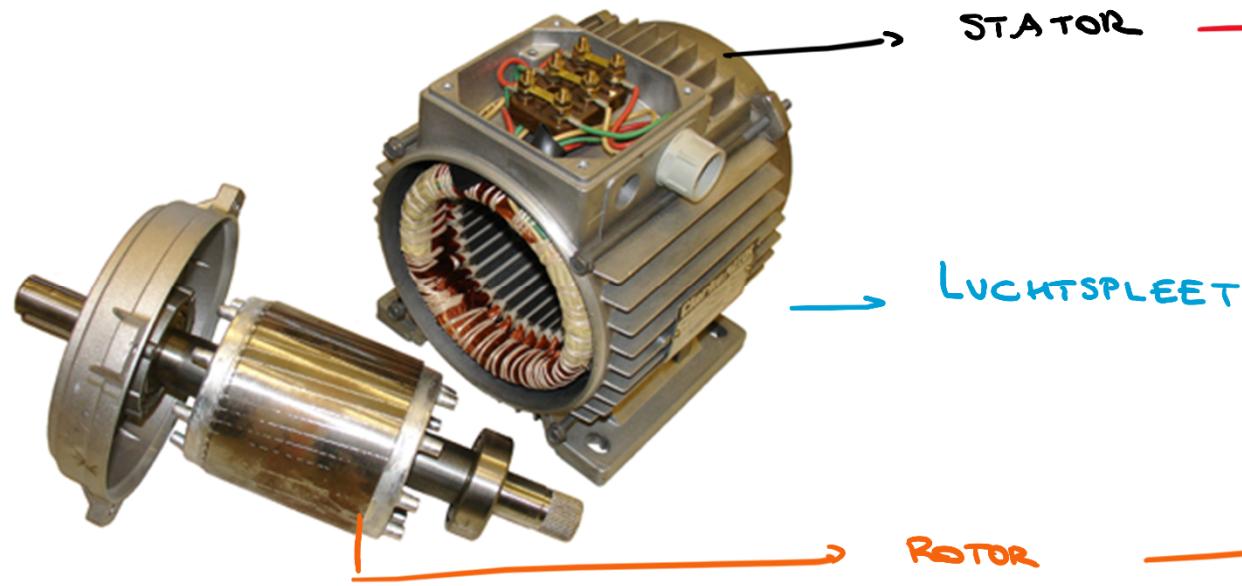
Nadelen

$I_{aansloop} > ?$

$M_{aansloop} < ?$

2.1 De bouw van de asynchrone machine

2.1.0. Onderdelen



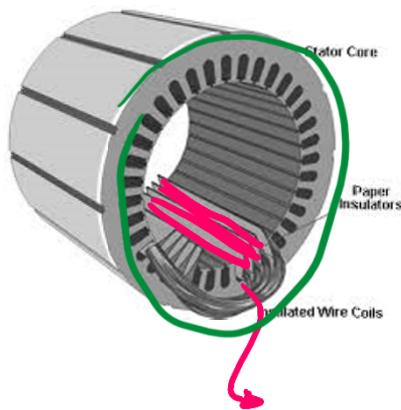
2.1 De bouw van de asynchrone machine

2.1.1. De stator

DRAAIVELD

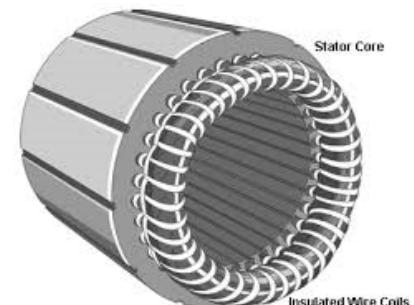
n_s

polen



3F - wikkeling \propto 3F - spanning

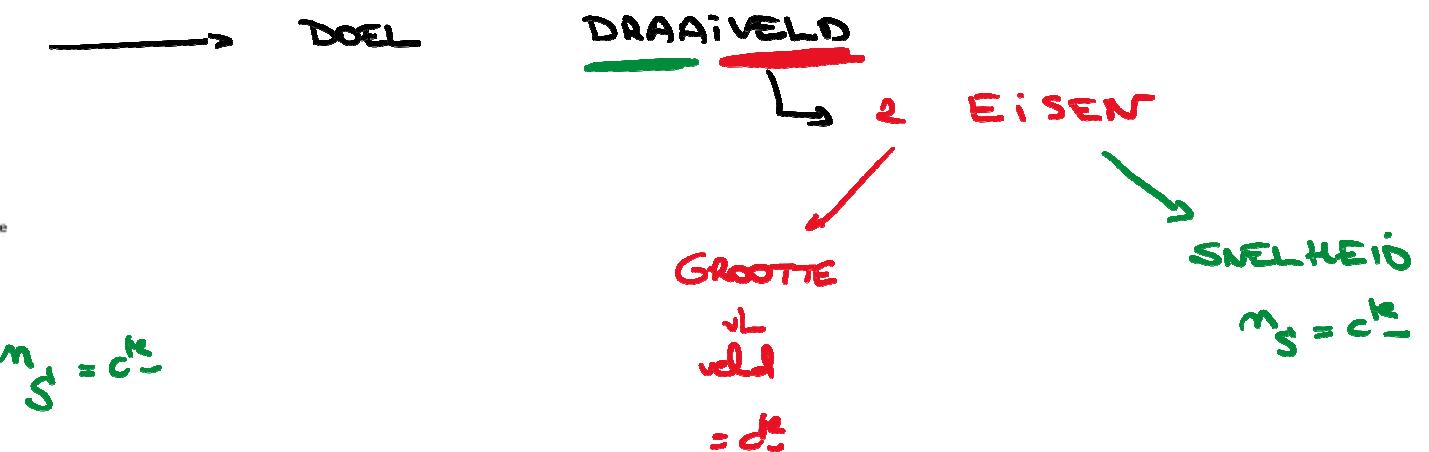
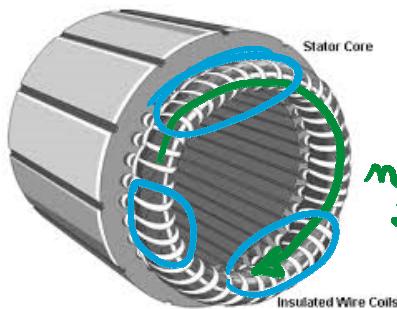
L. Butaye



2.1 De bouw van de asynchrone machine

2.1.1. De stator

DOEL



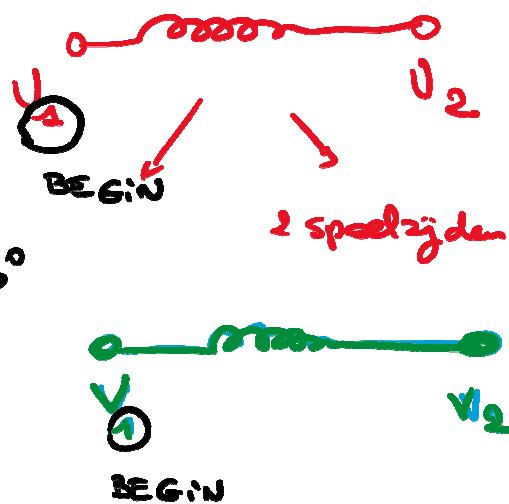
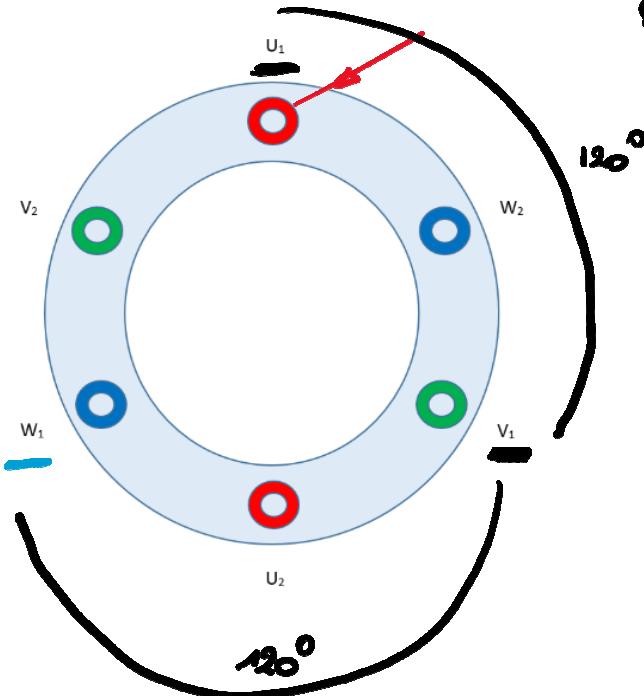
→ hoe?

- ① 3F. SPANNING $\leq U = f = 120^\circ$
- ② 3F - WIKKELING
- ③ $\frac{1}{2} \angle \frac{1}{2} \angle 120^\circ$

L. Butaye

2.1 De bouw van de asynchrone machine

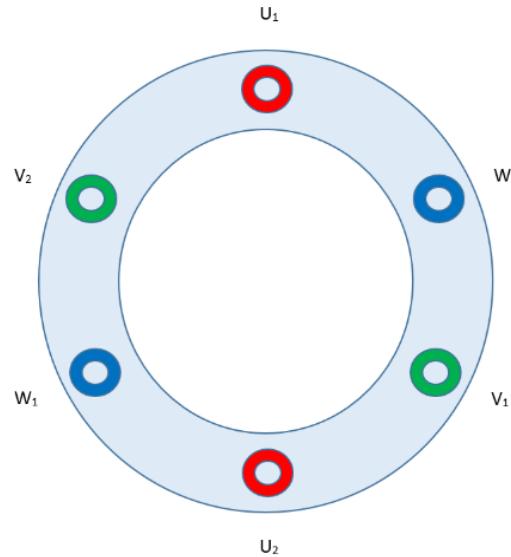
2.1.1. De stator



→ 2 polig draairichting
→ 1 grote uitschuifing

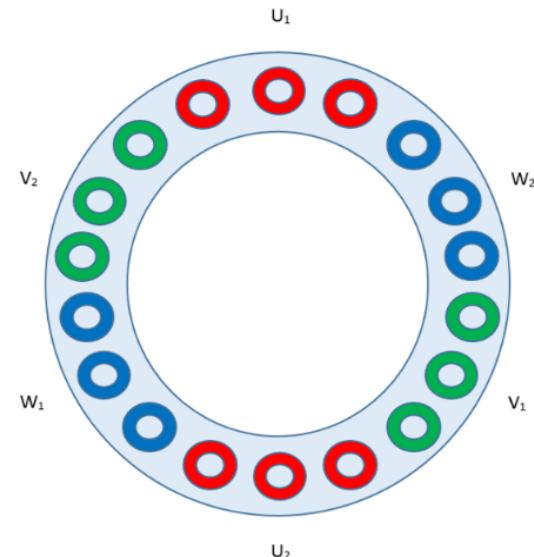
2.1 De bouw van de asynchrone machine

2.1.1. De stator



eenpaals

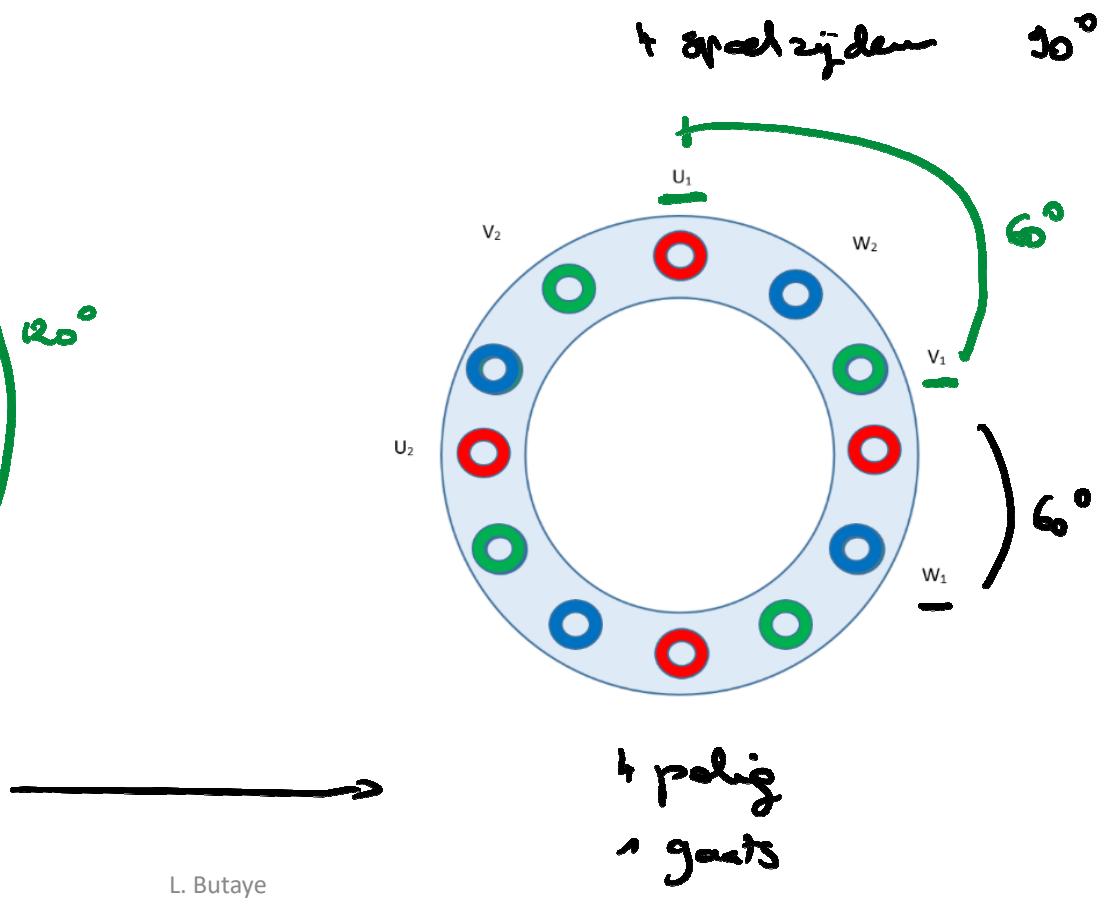
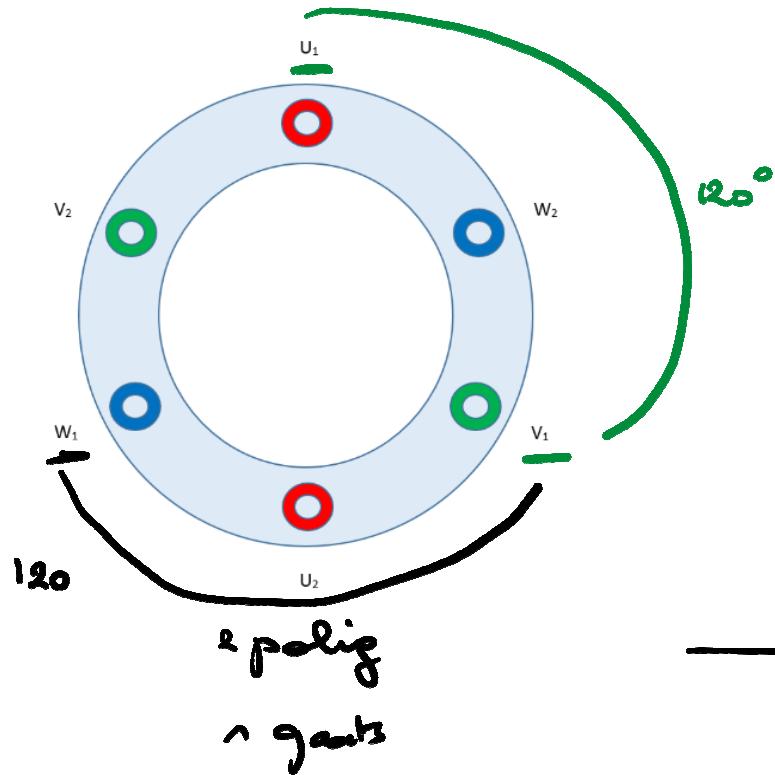
2 polig



3 gaats

2.1 De bouw van de asynchrone machine

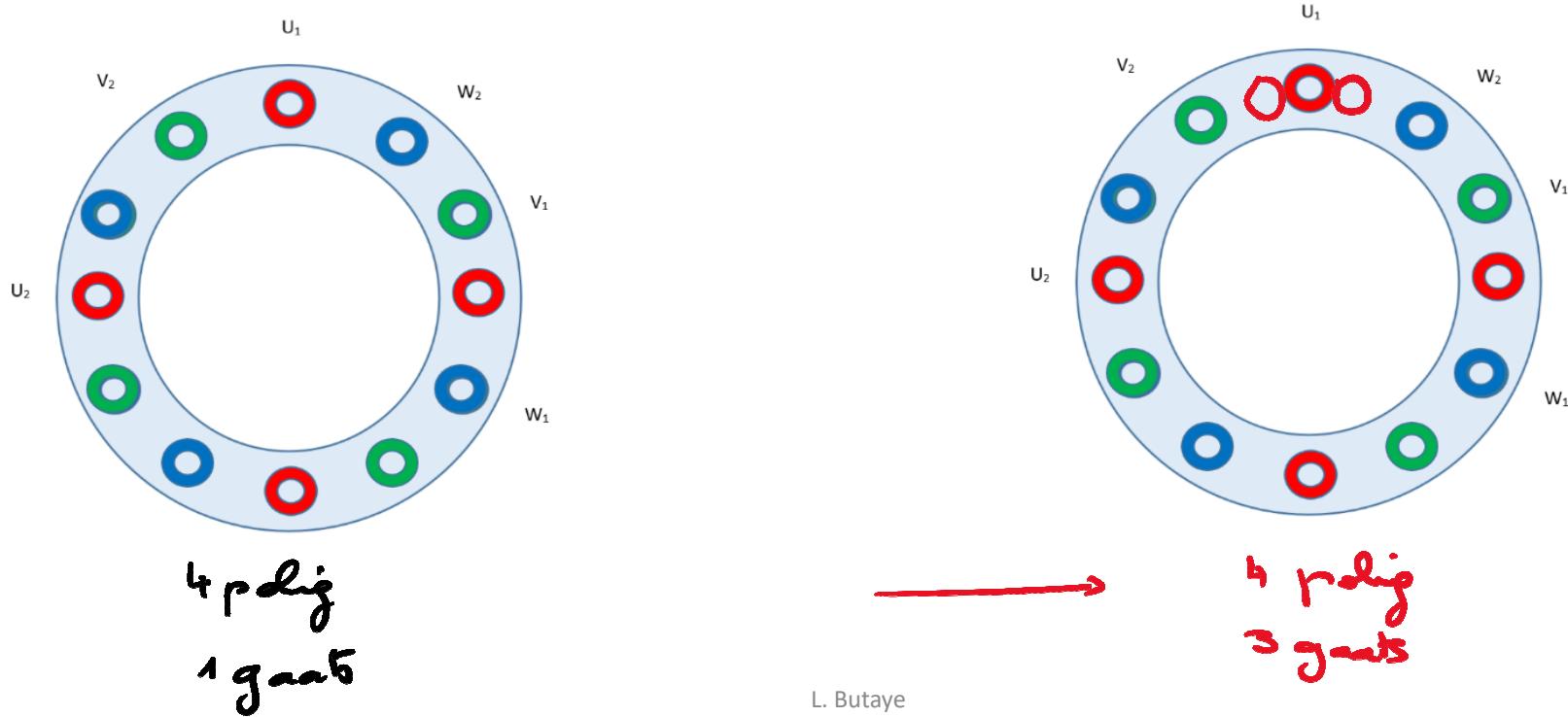
2.1.1. De stator



L. Butaye

2.1 De bouw van de asynchrone machine

2.1.1. De stator

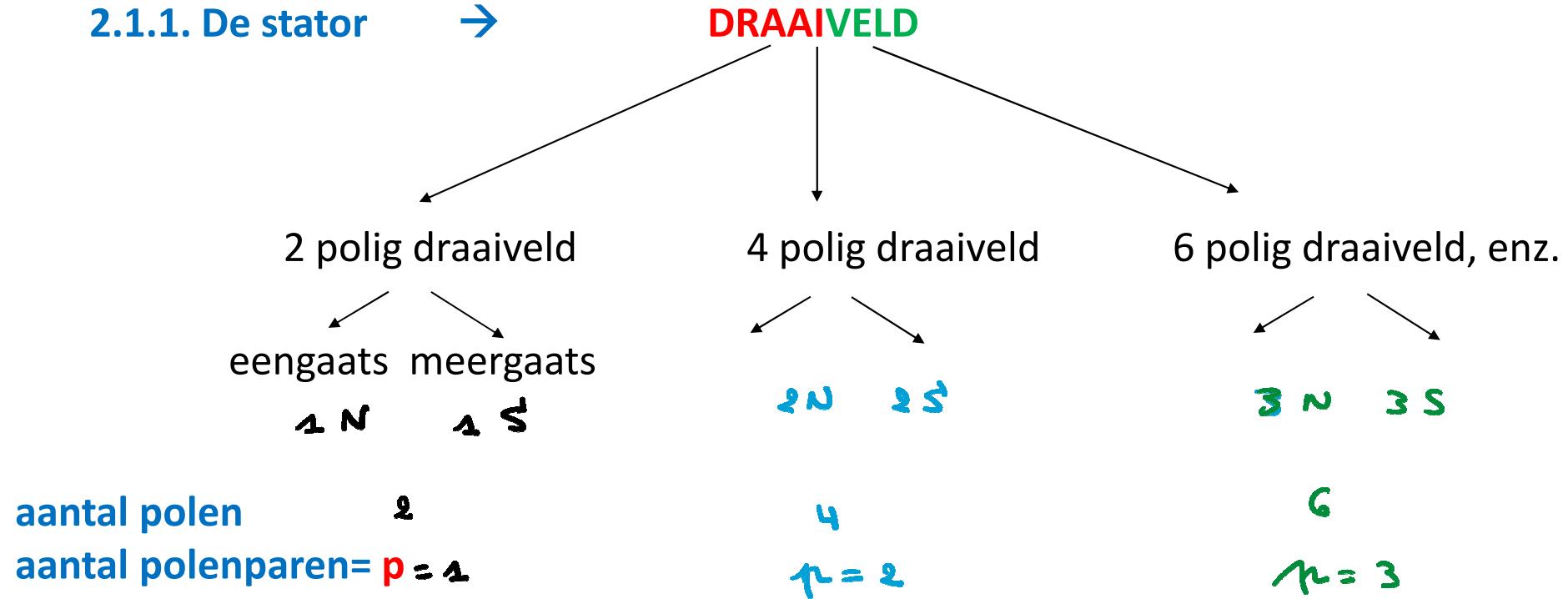


2.1 De bouw van de asynchrone machine

2.1.1. De stator

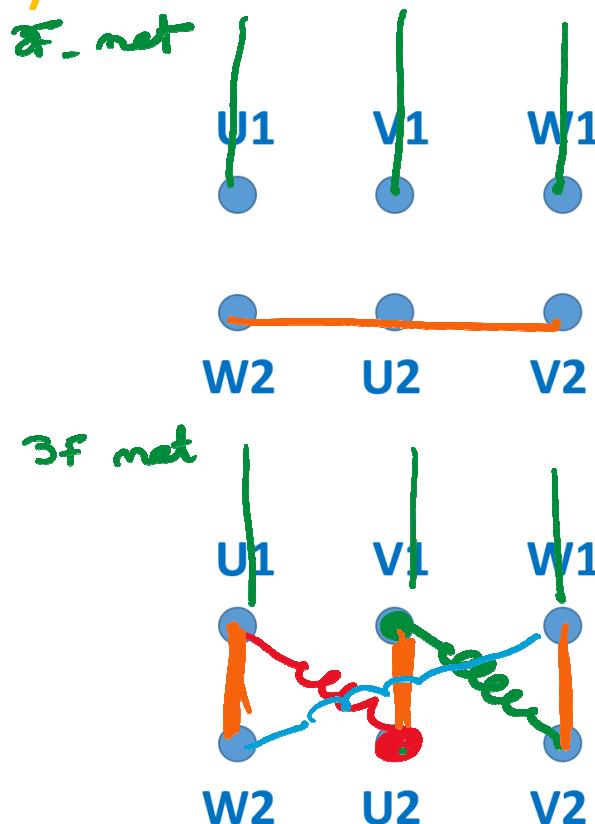
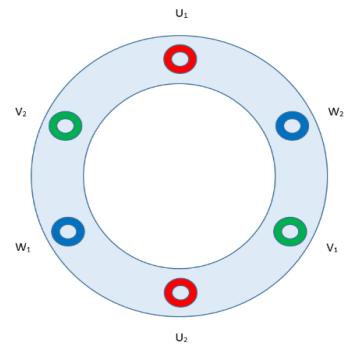
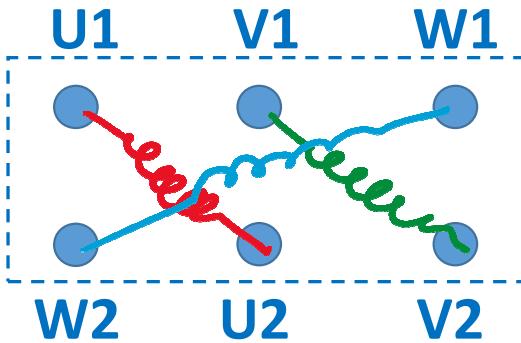


DRAAIVELD

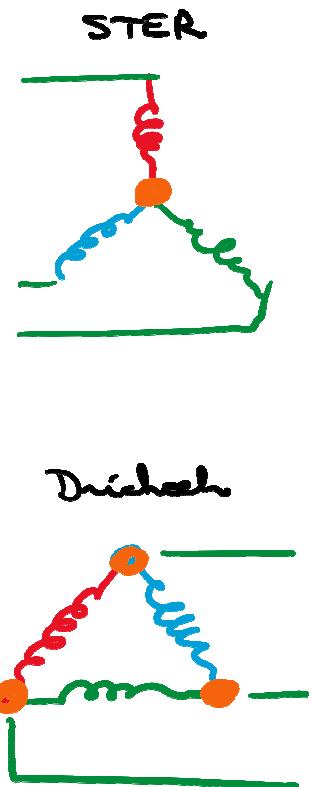


2.1 De bouw van de asynchrone machine

2.1.1. De stator



L. Butaye



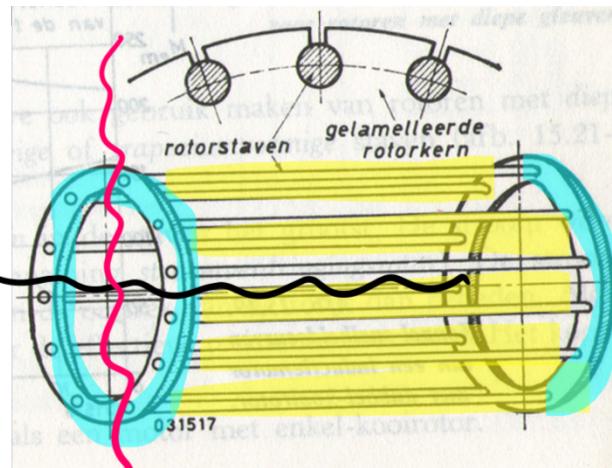
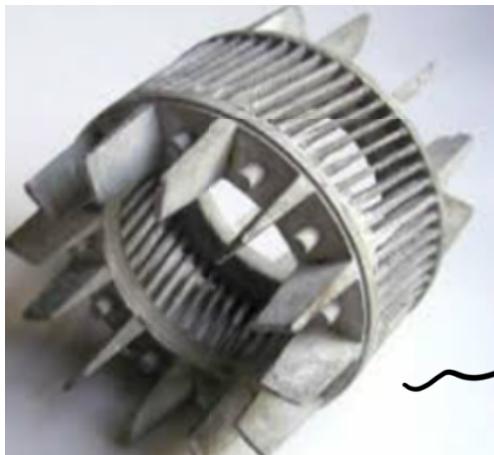
2.1 De bouw van de asynchrone machine

2.1.2. De rotor $\rightarrow I \leftarrow E = Bl \omega_{rel}$

2.1 De bouw van de asynchrone machine

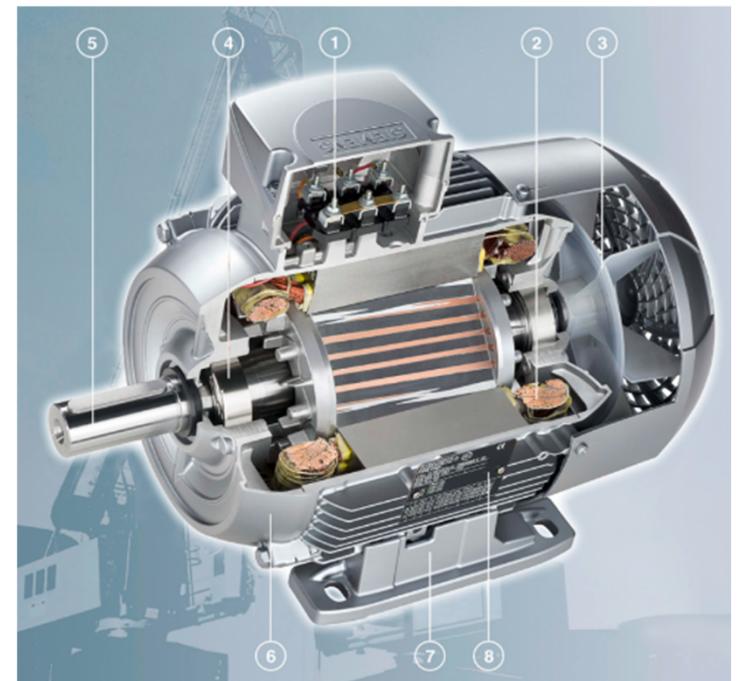
2.1.2. De rotor

Kooirotormachines - kooiankermachines - kortsluitrotormachines



$$\tau_s = \tau_r$$

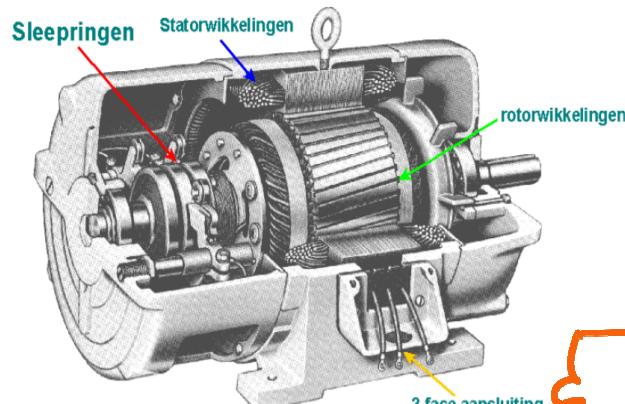
L. Butaye



2.1 De bouw van de asynchrone machine

2.1.2. De rotor

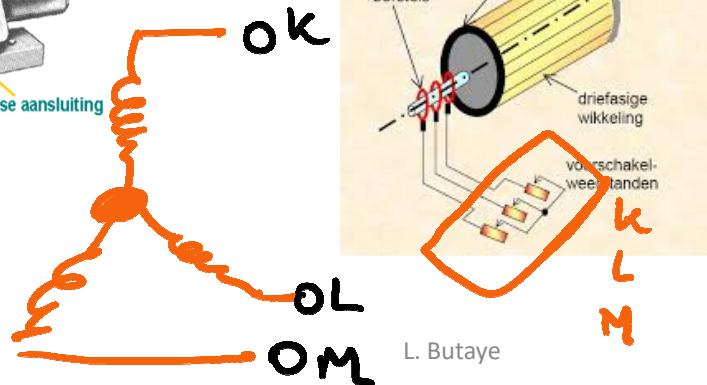
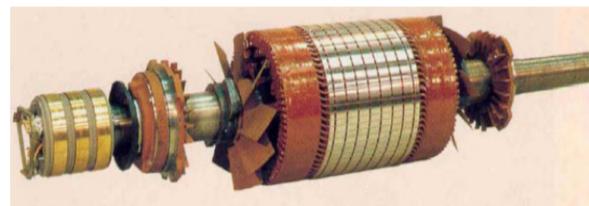
Sleepringmachines



BEWIKKELD
IN STER

→ 4-pulsig
SATOR → 2-pulsig msh
motor

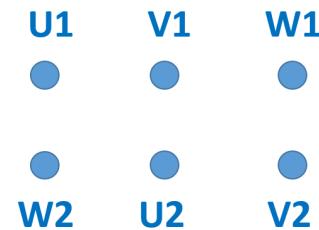
Rotor



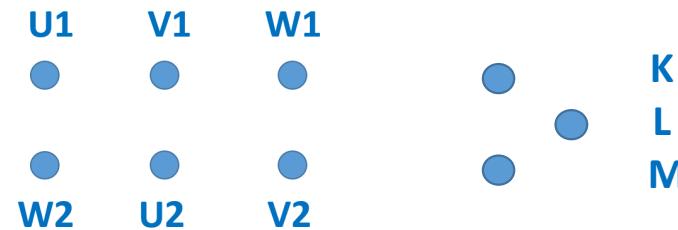
2.1 De bouw van de asynchrone machine

2.1.3. Samengevat

Kooirotormachines - kooiankermachines - kortsluitrotormachines

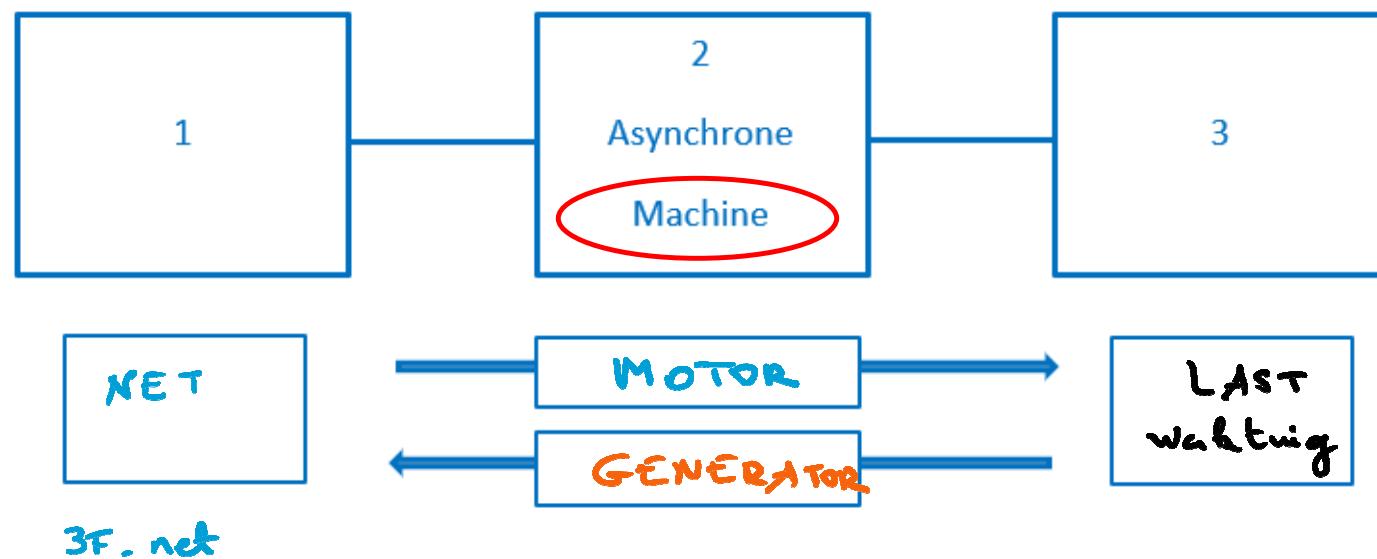


Sleepingmachines



2.2 Aandrijfsystemen en werkingsmodes

2.2.1. Algemeen

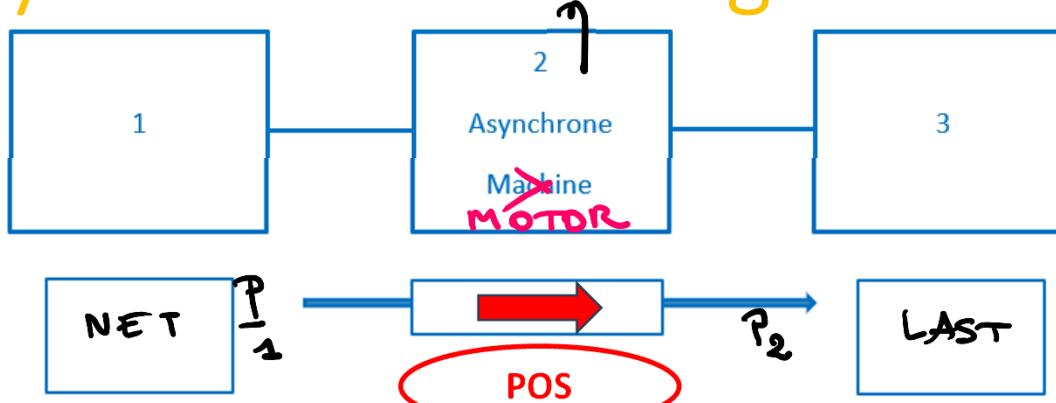


2.2 Aandrijfsystemen en werkingsmodes

$$v = \omega \cdot R$$

met/s

2.2.2. Motorwerking



$$\frac{ds}{dt} = v$$

$$P_1 = \sqrt{3} U_L I_L \cos \varphi_F$$

$\square = 3 U_L I_F \cos \varphi_F$

> 0

$\square > 0$

$$0 < \varphi_F < \pm 90^\circ$$

WD!!

ENERGiestroom

$$P_2 = \frac{W}{T} = \frac{F \cdot S}{T} = F \cdot v$$

antriebs
snelheid

$$= F \cdot w \cdot R$$

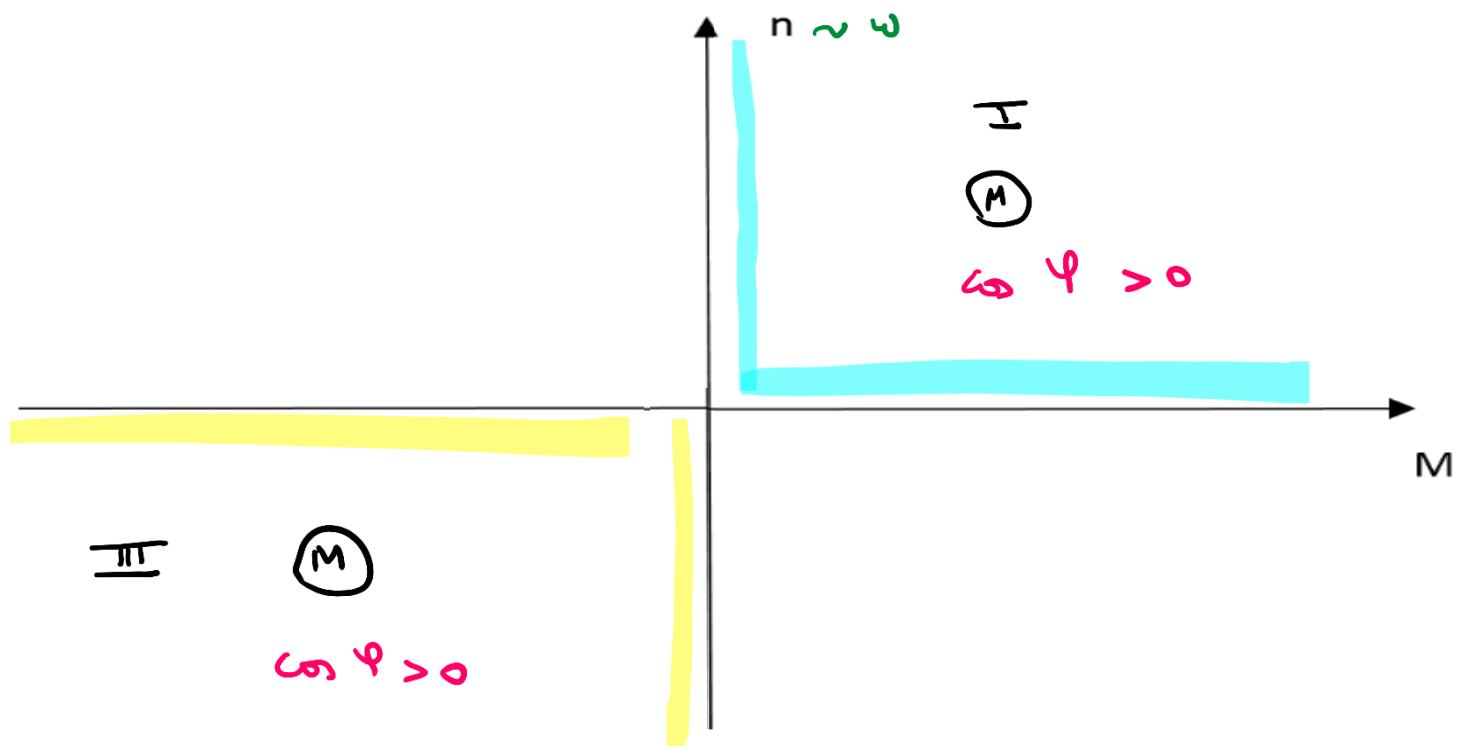
$$= M \cdot w > 0$$

\hookrightarrow $M > 0$ en $w > 0$ I

\rightarrow $M < 0$ en $w < 0$ III

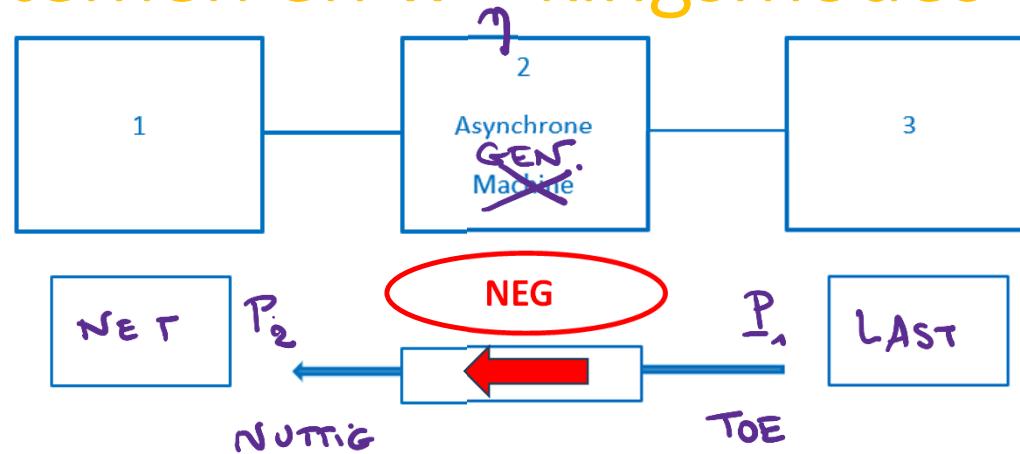
2.2 Aandrijfsystemen en werkingsmodes

2.2.3. Besluit



2.2 Aandrijfsystemen en werkingsmodes

2.2.4. Generatorwerking



$$P_2 = 3 U_{F_n} I_{F_n} \cos \varphi_{F_n}$$

$$<0 \longrightarrow <0$$

$$90^\circ < \varphi_F < 180^\circ \Rightarrow \text{VD}$$

$$\left(\underline{U}_{F_n}, \underline{I}_{F_n} \right)$$

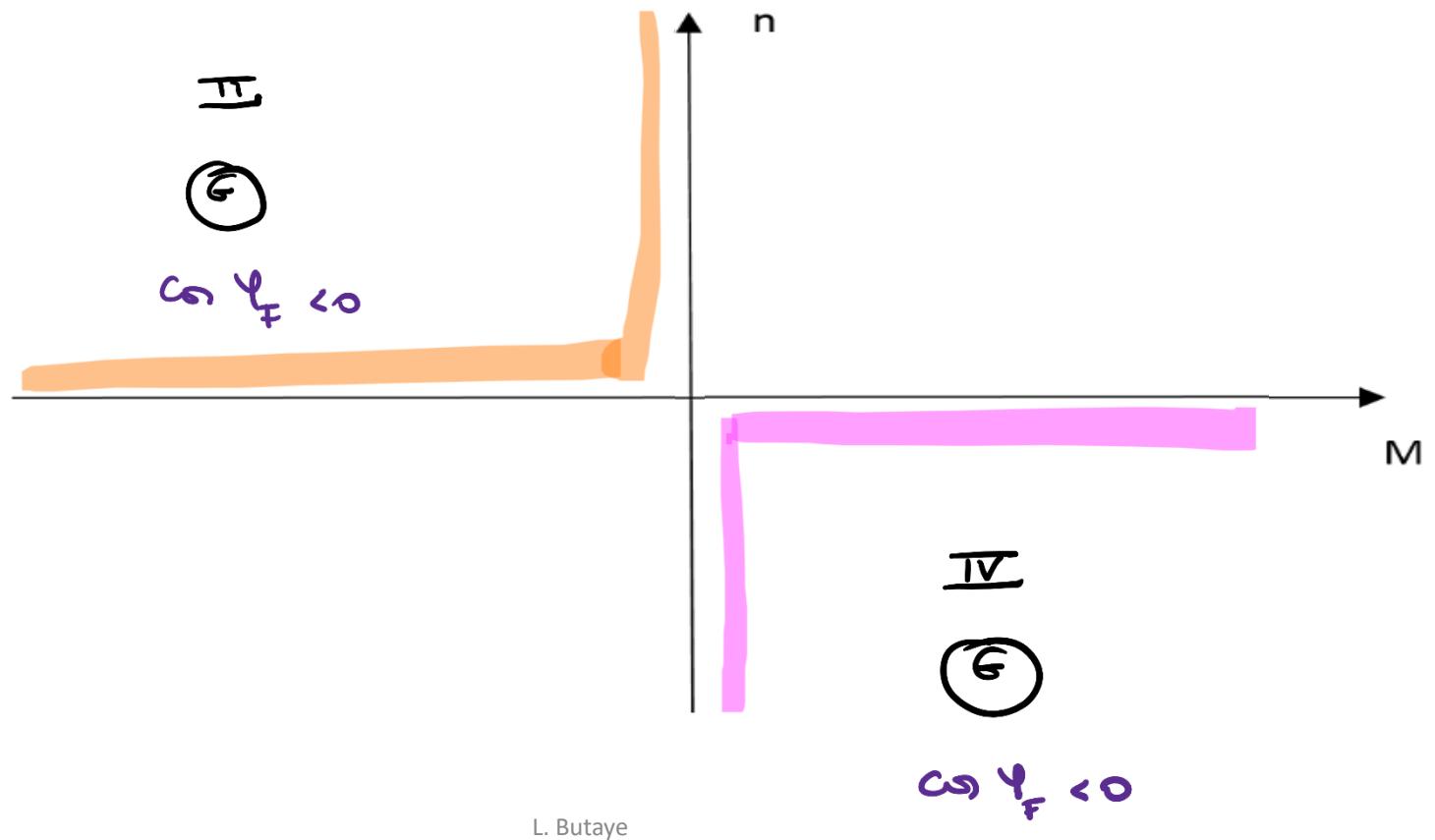
L. Butaye

$$I = M \cdot \omega < 0$$

$$\begin{cases} M > 0 \text{ en } \omega < 0 \rightarrow \overline{\text{IV}} \\ M < 0 \text{ en } \omega > 0 \end{cases}$$

2.2 Aandrijfsystemen en werkingsmodes

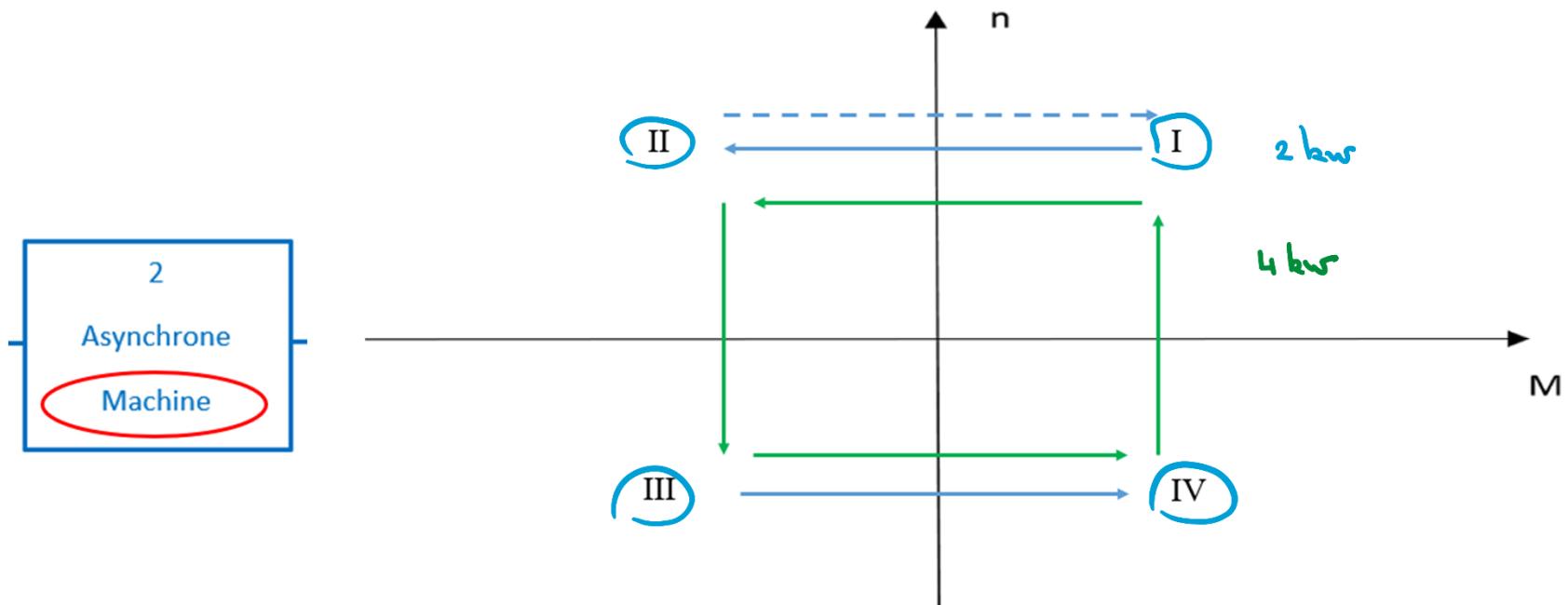
2.2.5. Besluit



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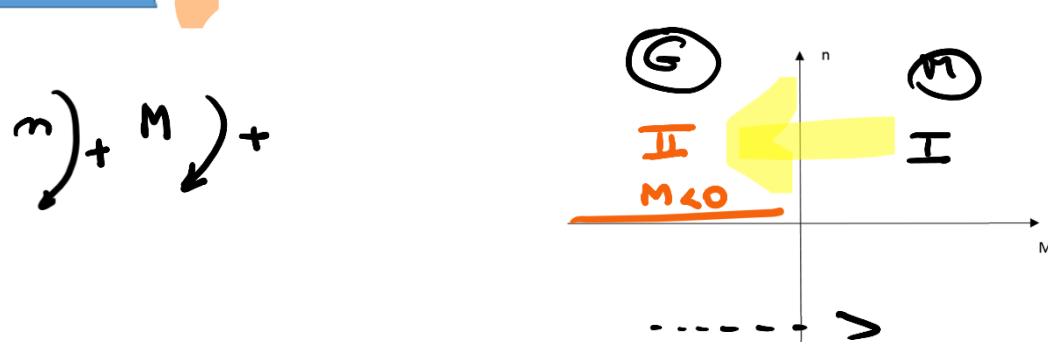
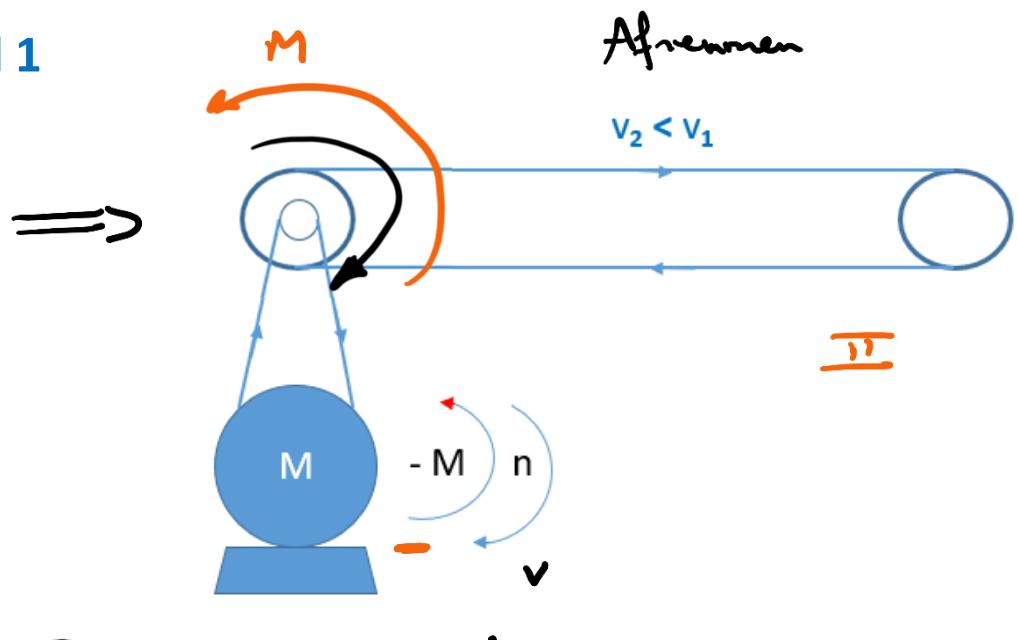
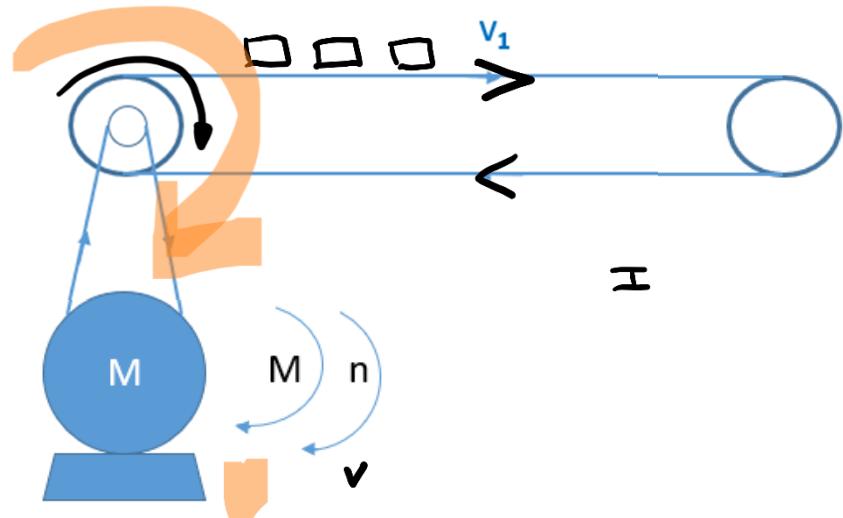
2.2 Aandrijfsystemen en werkingsmodes

2.2.4. Kwadrantenwerking



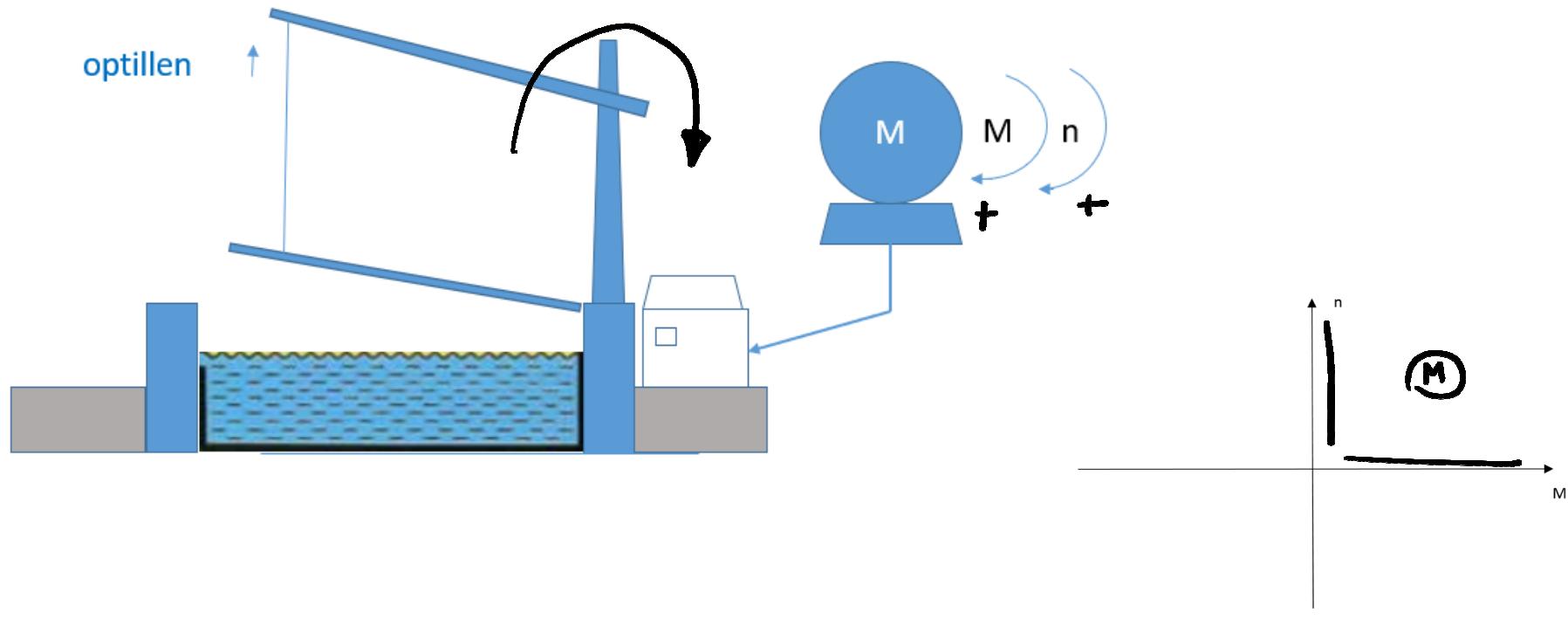
2.2 Aandrijfsystemen en werkingsmodes

2.2.4. Kwadrantenwerking – Voorbeeld 1



2.2 Aandrijfsystemen en werkingsmodes

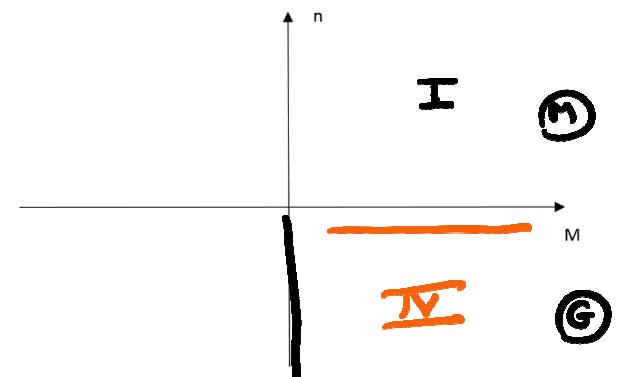
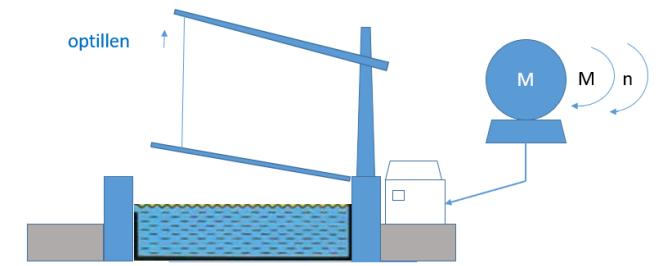
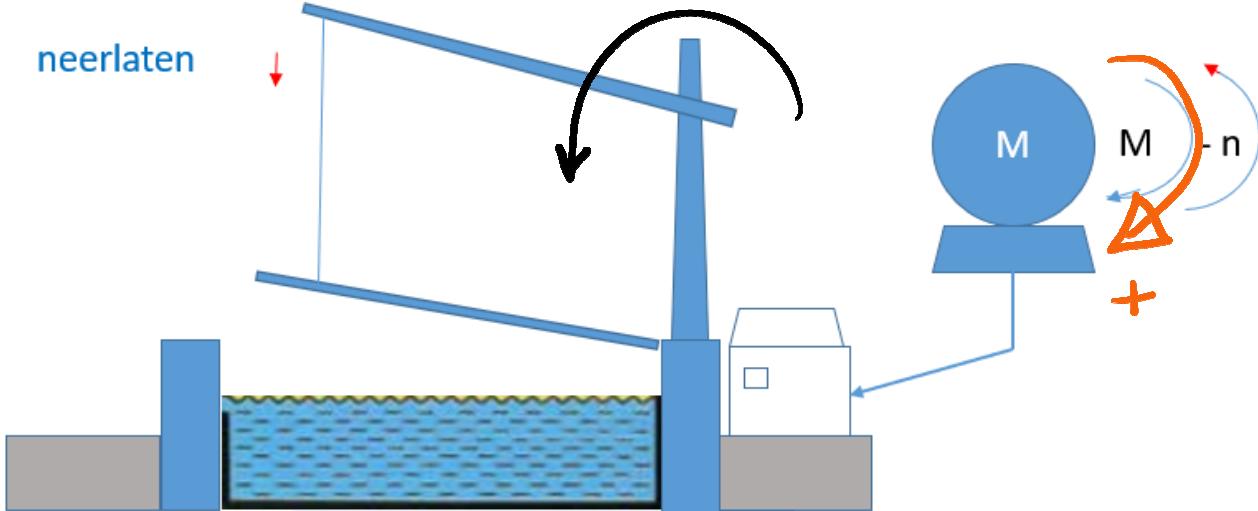
2.2.4. Kwadrantenwerking – Voorbeeld 2



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2.2 Aandrijfsystemen en werkingsmodes

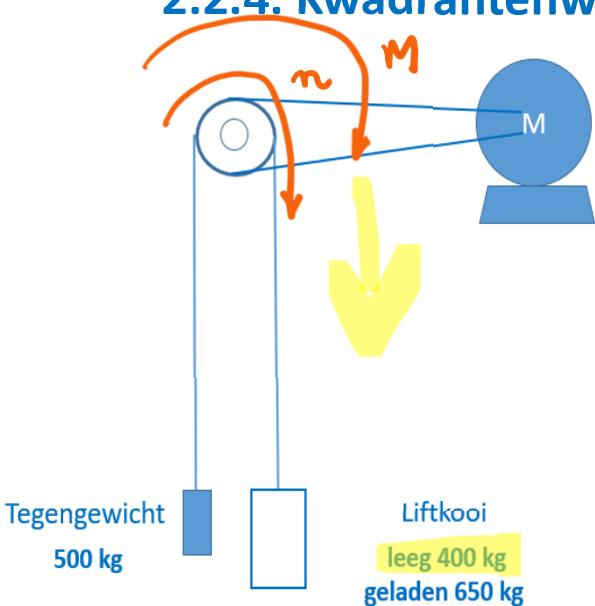
2.2.4. Kwadrantenwerking – Voorbeeld 2



L. Butaye

2.2 Aandrijfsystemen en werkingsmodes

2.2.4. Kwadrantenwerking – Voorbeeld 3

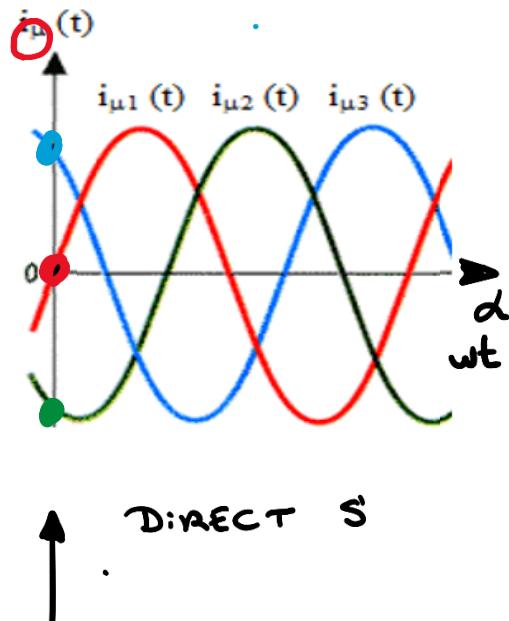


koppel	– toerental	kwadrant	bedrijf
	M	n	I Liftkooi leeg - neerwaarts
			Liftkooi vol - neerwaarts
			Liftkooi vol - omhoog
			Liftkooi leeg - omhoog

L. Butaye

2.3 Magnetisch draaiveld

2.3.1. Tweepolig draaiveld – uurwijzerzin – $\omega t = 0^\circ$



$\int \cdot \text{ t} j \cdot \Delta$

$$i_{\mu 1}(t) = I_{\mu m} \cdot \sin(\omega t + 0^\circ)$$

$$i_{\mu 2}(t) = I_{\mu m} \cdot \sin(\omega t - 120^\circ)$$

$$i_{\mu 3}(t) = I_{\mu m} \cdot \sin(\omega t - 240^\circ)$$

GROOTTE \rightarrow ZIN FIG

$$\phi_1 = 0$$

$$\phi_2 = \frac{\sqrt{3}}{2} \phi_m$$

$$\phi_3 = \frac{\sqrt{3}}{2} \phi_m$$

AFSPRAAK \rightarrow 00000

$$I_{\mu m}$$

L. Butaye

$$\omega t = 0^\circ$$

$$i_{\mu 1}(\omega t = 0^\circ) = 0$$

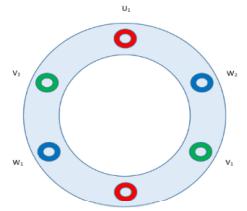
$$i_{\mu 2}(\omega t = 0^\circ) = -\frac{\sqrt{3}}{2} I_{\mu m}$$

$$\rightarrow$$

$$i_{\mu 3}(\omega t = 0^\circ) = +\frac{\sqrt{3}}{2} I_{\mu m}$$

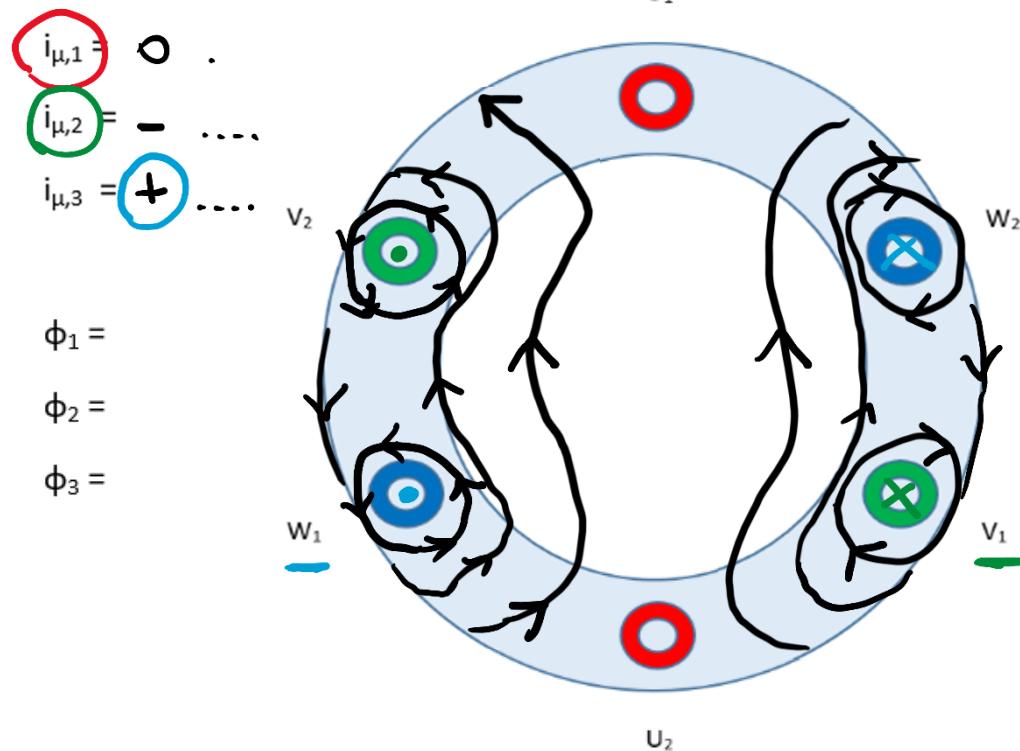
CONTROLE $\Sigma = 0$

$\rightarrow \phi_m$
LINEAIR



2.3 Magnetisch draaiveld

2.3.1. Tweepolig draaiveld – uurwijzerzin – $\omega t = 0^\circ$



min 2 Tijdstippen

1 Tijdstip

Conventie $I > 0 \rightarrow$

GROOTTE begin

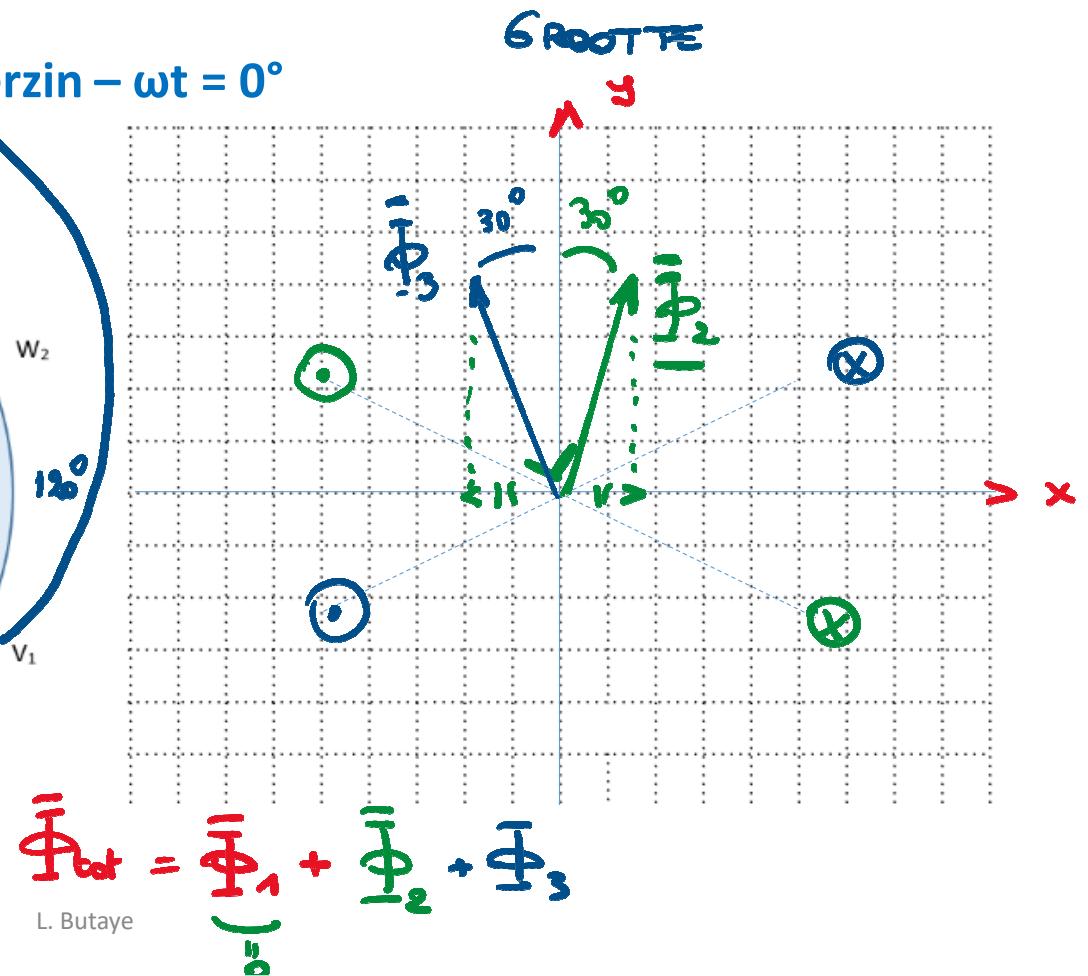
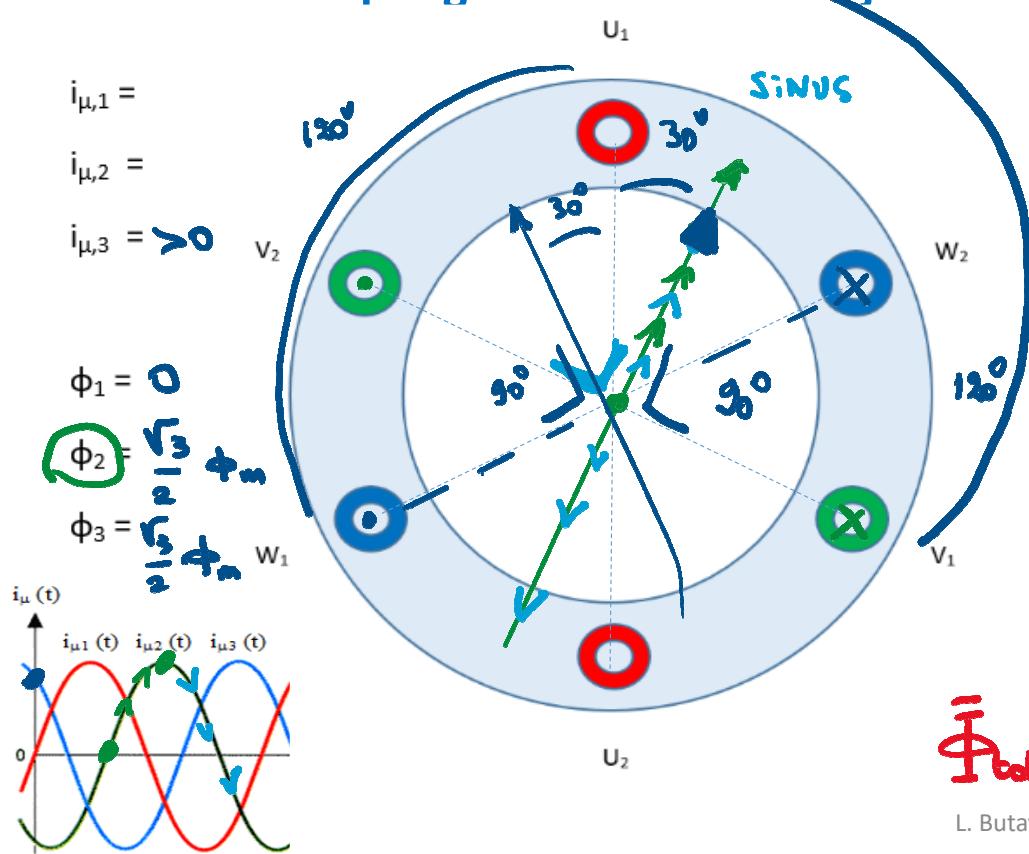
→ 2 polig vld

→ $\omega t = 0^\circ$

$\uparrow \hat{\Phi}_{tot}$

2.3 Magnetisch draaiveld

2.3.1. Tweepolig draaiveld – uurwijzerzin – $\omega t = 0^\circ$



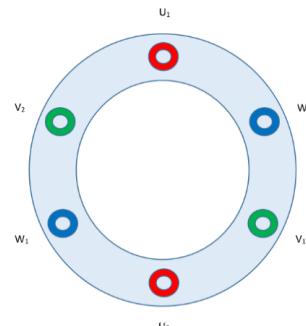
2.3 Magnetisch draaiveld

2.3.1. Tweepolig draaiveld – uurwijzerzin – $\omega t = 0^\circ$

$$\phi_1 =$$

$$\phi_2 =$$

$$\phi_3 =$$



$$\bar{\Phi}_{\text{tot}} \rightarrow \begin{cases} x \cdot \omega \\ y \cdot \omega \end{cases} \rightarrow \text{ALC}$$

$$|\bar{\Phi}_{\text{tot}}| = 0 + |\bar{\Phi}_2| \cdot \cos 30^\circ + |\bar{\Phi}_3| \cdot \cos 30^\circ \equiv \sqrt{3} \cdot \frac{\sqrt{3}}{2} \cdot \phi_m \cdot \frac{\sqrt{3}}{2}$$

$$+ \frac{\sqrt{3}}{2} \cdot \phi_m \cdot \frac{\sqrt{3}}{2}$$

L. Butaye

$$= \frac{3}{2} \cdot \phi_m = 1,5 \cdot \phi_m$$

2.3 Magnetisch draaiveld

2.3.1. Tweepolig draaiveld – uurwijzerzin – $\omega t = 0^\circ$ – BESLUIT

$$i_{\mu,1} =$$

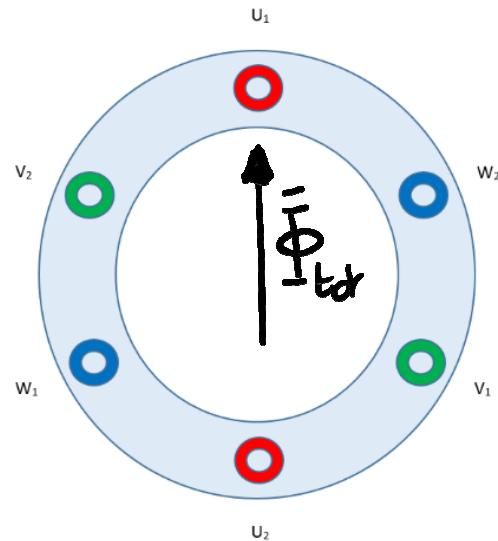
$$i_{\mu,2} =$$

$$i_{\mu,3} =$$

$$\phi_1 =$$

$$\phi_2 =$$

$$\phi_3 =$$



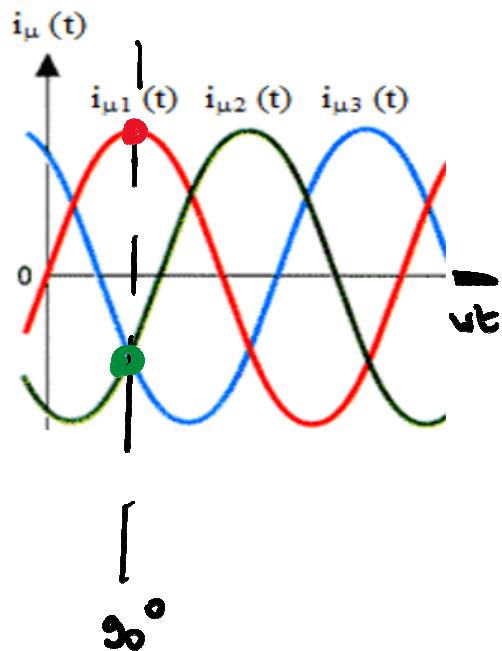
- 2 polig

- ORIENT ↑

- $|\vec{\Phi}_{tot}| = 1,5 \phi_m$

2.3 Magnetisch draaiveld

2.3.2. Tweepolig draaiveld – uurwijzerzin – $\omega t = 90^\circ$



$$i_{\mu_1} = I_{\mu_m} \cdot \sin(\omega t + 0^\circ)$$

$$i_{\mu_2} = I_{\mu_m} \cdot \sin(\omega t - 120^\circ)$$

$$i_{\mu_3} = I_{\mu_m} \cdot \sin(\omega t - 240^\circ)$$

GROOTTE

$$\phi_1 = \frac{\Phi_m}{2}$$

$$\phi_2 = \frac{\Phi_m}{2}$$

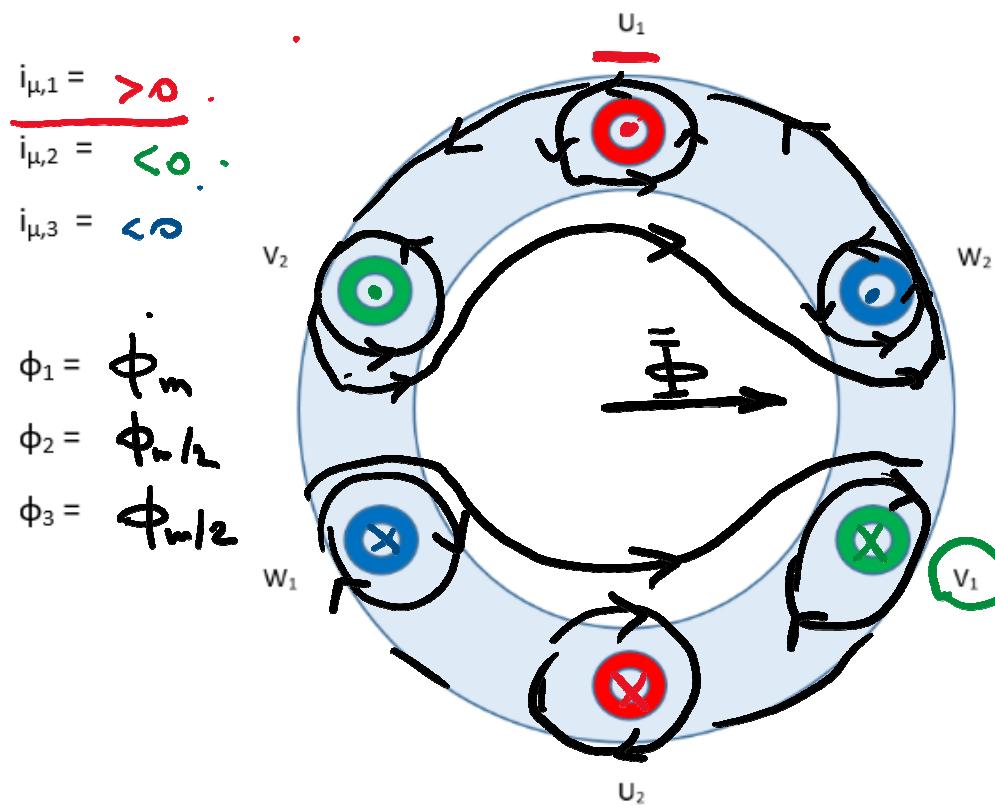
$$\phi_3 = \frac{\Phi_m}{2}$$

$$\xrightarrow{\omega t = 90^\circ}$$

$$\textcircled{O} \quad \frac{I_{\mu_m}}{2} = i_{\mu_2} = I_{\mu_m} \sin(90^\circ - 120^\circ) \\ i_{\mu_3} = I_{\mu_m} \sin(90^\circ - 240^\circ) \\ = I_{\mu_m} \sin(-150^\circ) \\ = \textcircled{O} \frac{I_{\mu_m}}{2}$$

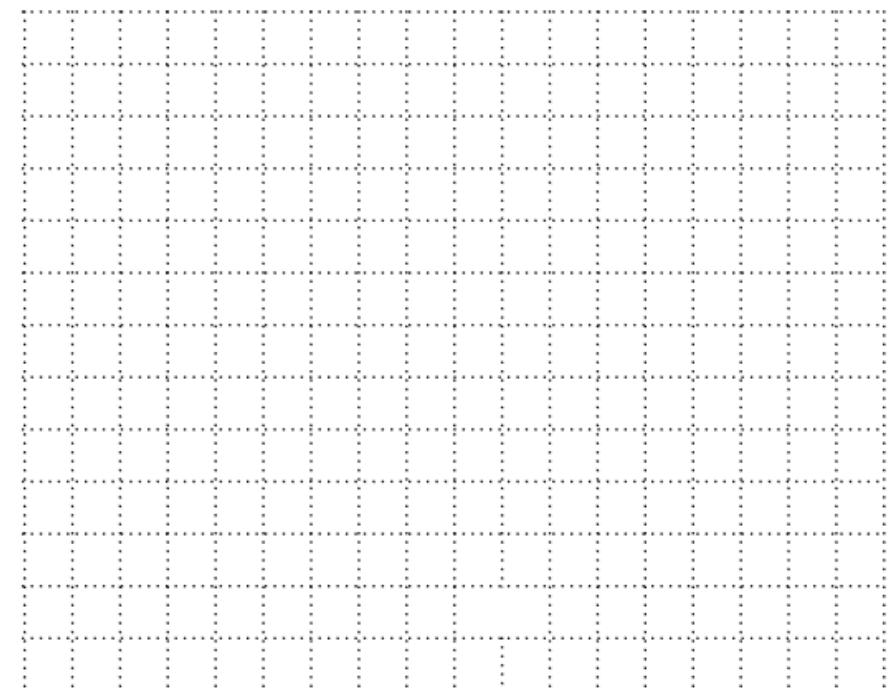
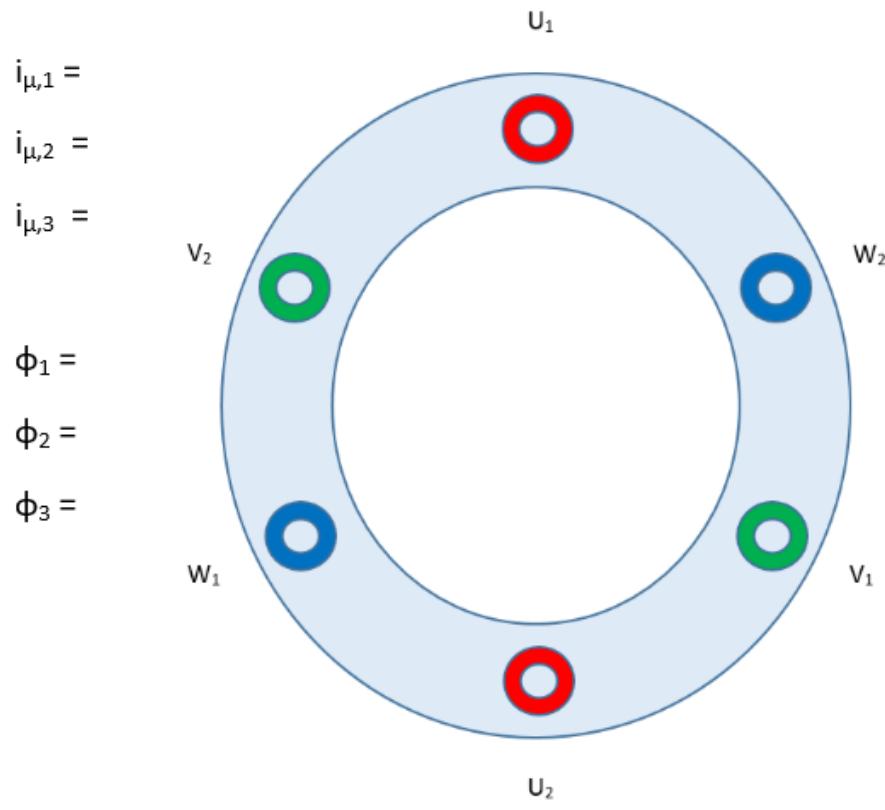
2.3 Magnetisch draaiveld

2.3.2. Tweepolig draaiveld – uurwijzerzin – $\omega t = 90^\circ$



2.3 Magnetisch draaiveld

2.3.2. Tweepolig draaiveld – uurwijzerzin – $\omega t = 90^\circ$



Butaye