Thursday March 9th

10h00 – 12h00	Registration at the conference center The Strip at the High Tech Campus Eindhoven
12h00 – 13h00	Lunch
13h00	**Welcome** Opening by Dr. P.E. Wierenga Senior Vice President Philips Research Europe - Eindhoven
13h15	**Start session 1 "Electronic Paper"**
13h15 – 13h35	**"Development of 5.1-inch High Speed SVGA Bistable BiNem® LCD for Electronic Paper Applications"** Jacques Angelé, Nemoptic
13h35 – 13h55	**"Experience the brighter world of visual DNA™"** Michael Ryan, Ntera
13h55 – 14h15	**"Video-speed electronic paper based on electrowetting"** Rob Hayes, Liquavista
14h15 – 14h35	**"A new generation of e-readers takes off"** Alex Henzen, Irex
14h35 – 14h55	**"A Computer Simulation and material for Electrophoretic Displays"** Kimiya Takeshita, Mitsubishi Chemical
14h55 – 15h25	Coffee break
15h25	**Start session 2 "3D Displays"**
15h25 – 15h45	**"Novel autostereoscopic displays with user interaction"** Klaus Hopf, Fraunhofer Institute for Telecommunications (HHI)
15h45 – 16h05	**"Optimization of wavelength selective parallax barrier displays"** William Hopewell, NewSight Corporation
16h05 – 16h25	**"Design of wide viewing freedom flat panel 2D/3D displays"** Paul May, Ocuity Limited
16h25 – 16h45	**"Uniformity improvement through fractional view systems"** Oscar Willemsen, Philips Research Europe
16h45 – 17h05	**"True 3D displaying with the Holovizio System"** Tibor Balogh, Holografika Kft.
17h05	**Start session 3 "Student Award"**
17h05 – 17h35	**"Student award presentation"** **Model for the properties and behaviour of electronic paper** Tom Bert, TFCG Microsystems – Elintec, Ghent University
17h35	Informal drinks
18h30	Dinner
Estimated time: 21h00	Busses to Eindhoven

Friday March 10th

09h00	**Start session 4 "Flexible Displays"**
9h00 – 9h20	**"TFT Backplanes on Flexible Foils: A Status Report"** Nicholas Colaneri, Flexible Display Center, Arizona State University
9h20 – 9h40	**"Inorganic LTPS TFTs on metal for flexible AM-OLED displays"** François Templier, CEA-LETI
9h40 – 10h00	**"Organic transistors and their application in active-matrix displays"** Gerwin Gelinck, Polymer Vision
10h00 – 10h20	**"Polymers behind the scenes: on how structured polymers enhance your displays"** Dirk J. Broer, Technical University Eindhoven, Dept. Polymer Technology (SKT)
10h20 – 10h50	Coffee break (including 10h30 the SID-MEC General meeting)
10h50	**Start session 5 "Signal Processing"**
10h50 – 11h10	**"The impact of new display technologies on HDTV broadcasting in Europe"** Richard Salmon, HDTV Systems Project
11h10 – 11h30	**"Mobile Display Signal Processing"** Petri Nenonen, Nokia Research Center
11h30 – 11h50	**"Design consideration of field sequential display"** Erno Langendijk, Philips Research Europe
11h50 – 12h10	**"Display System Architecture for LCD-TV"** Gerben Hekstra, Philips Research Europe
12h10 – 12h30	**"Precise measurement of the light emission temporal behaviour of flat panel displays"** Pierre Boher, Eldim
12h30 – 13h30	Lunch
13h30 – 14h00	**Introduction MiPlaza and open innovation** Gerjan van de Walle and Hans Naus, High Tech Campus Eindhoven
14h00 – 14h05	Announcements
14h05 – 15h30	Visit MiPlaza, demonstrations and sponsor booths in sub-groups
15h30 – 16h30	Visit to the OTB company: OLED manufacturing line near Eindhoven airport

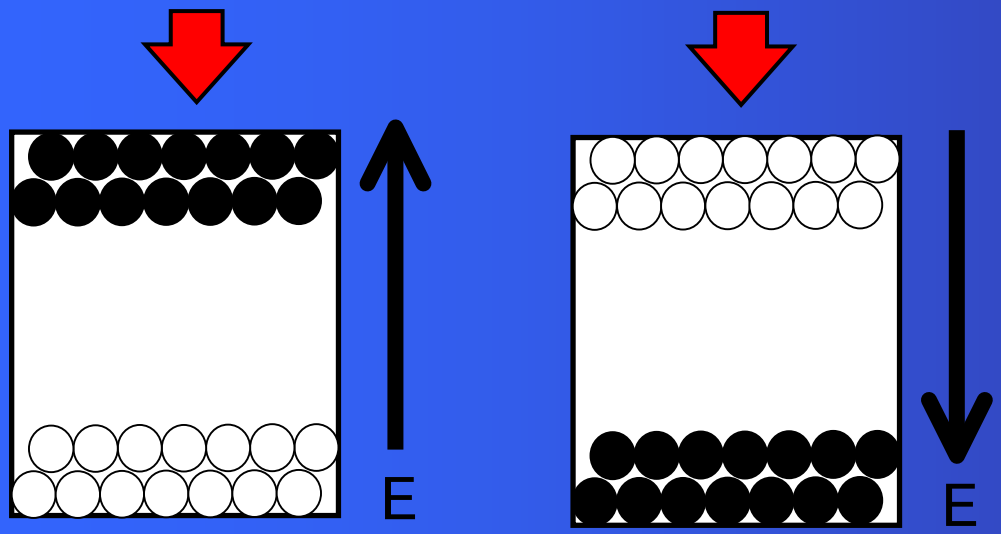
Model for the properties and behavior of electronic paper

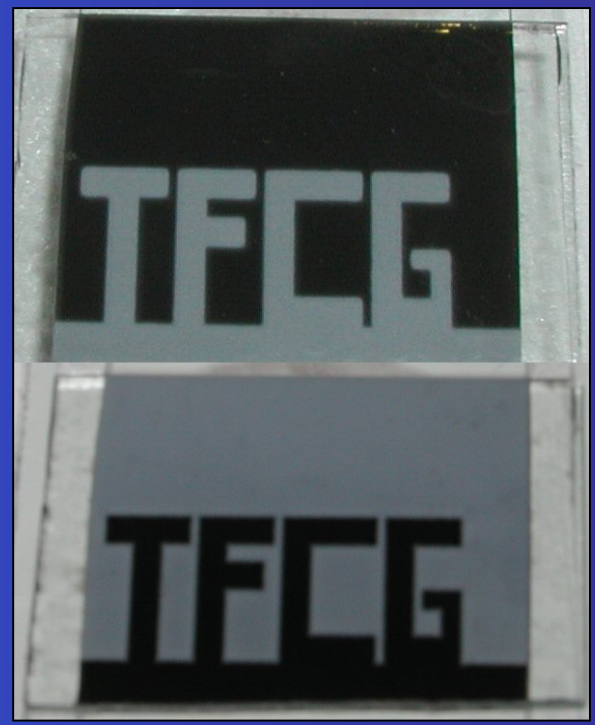
T. Bert, V. Degezelle, G. Van Steenberge, S. Van Put, P. Geerinck & H. De Smet

TFCG Microsystems – Elintec
Ghent University

EPID

Basic functioning





EPID

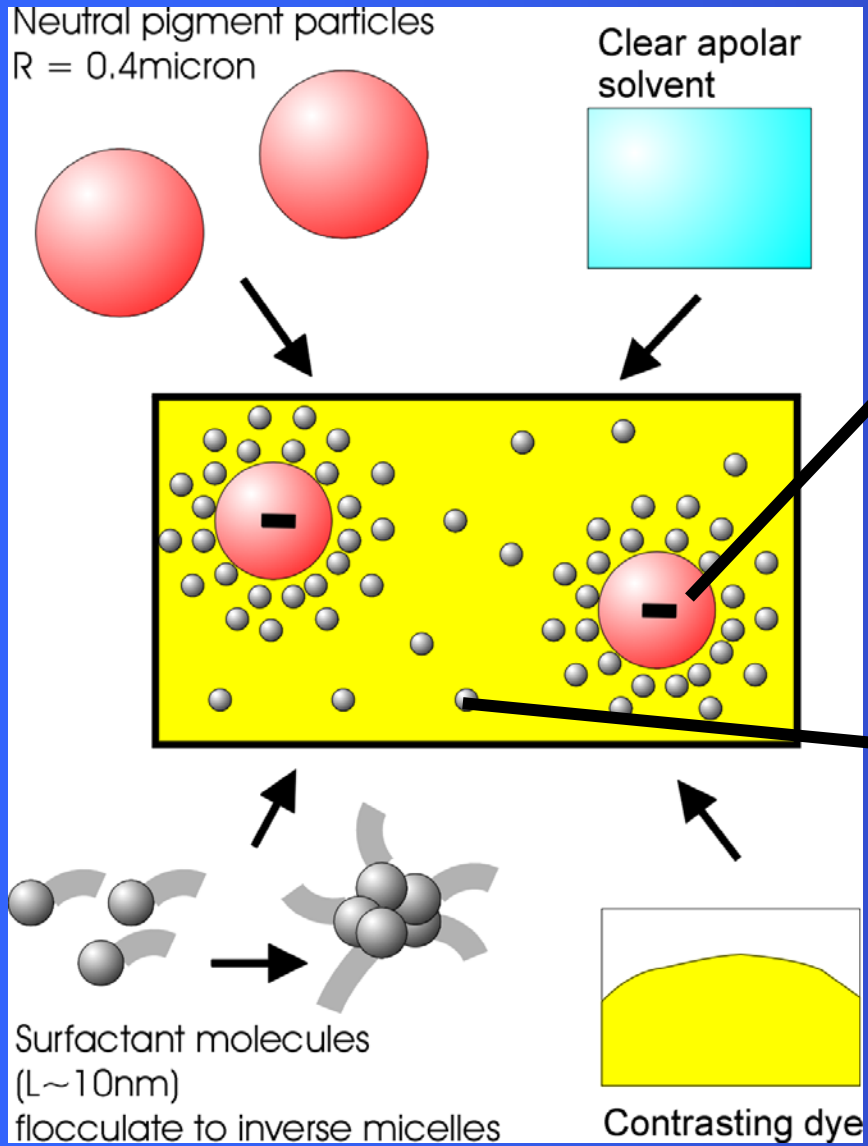
Benefits and Drawbacks

- bistability
- lightweight
- readibility
- flexibility

- switching speed
- no threshold
- no colour
- **electrochemical complexity**

EPID

Particles inside an EPID

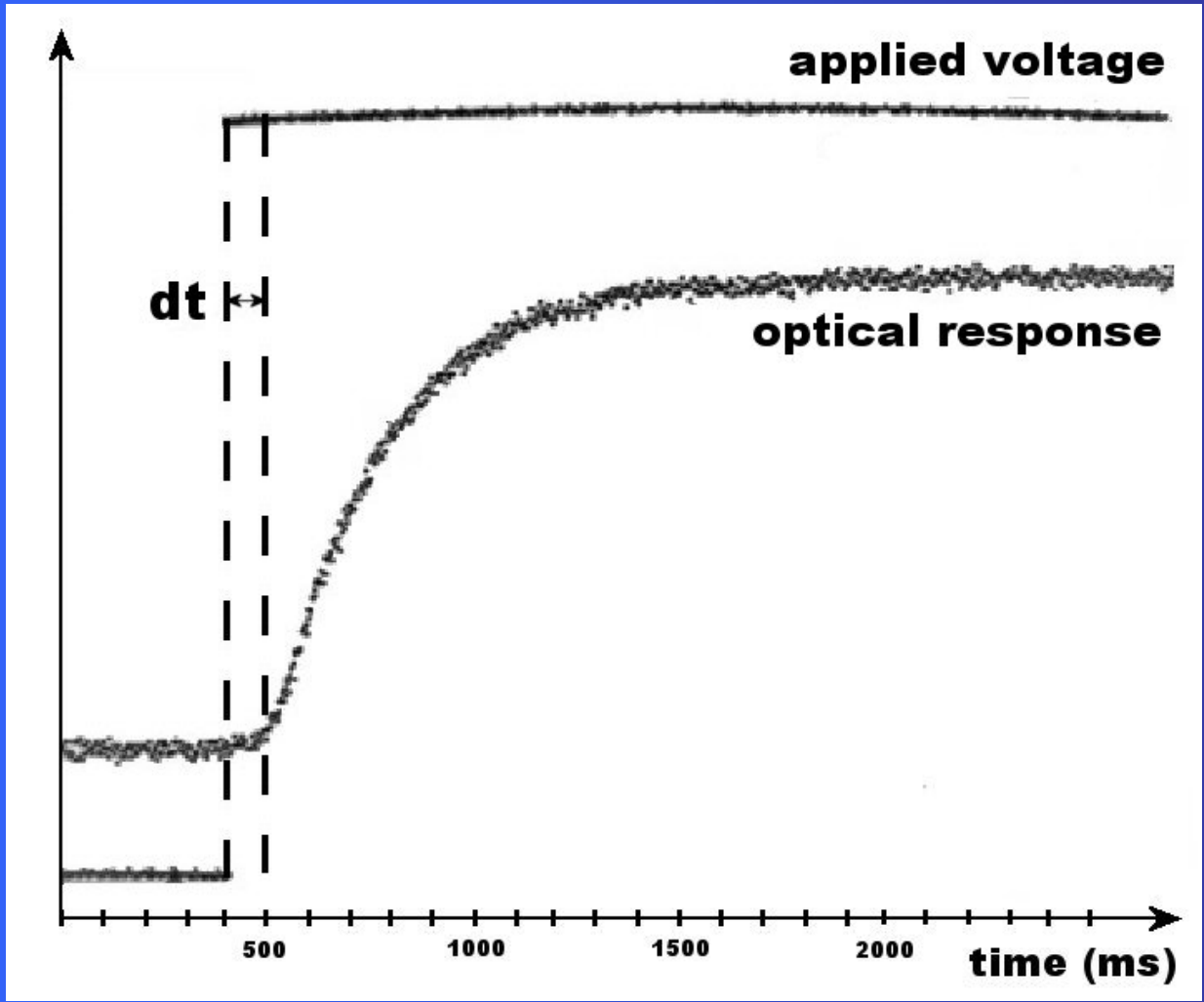


Pigments:
optical response

Micelles:
electrical response
and …

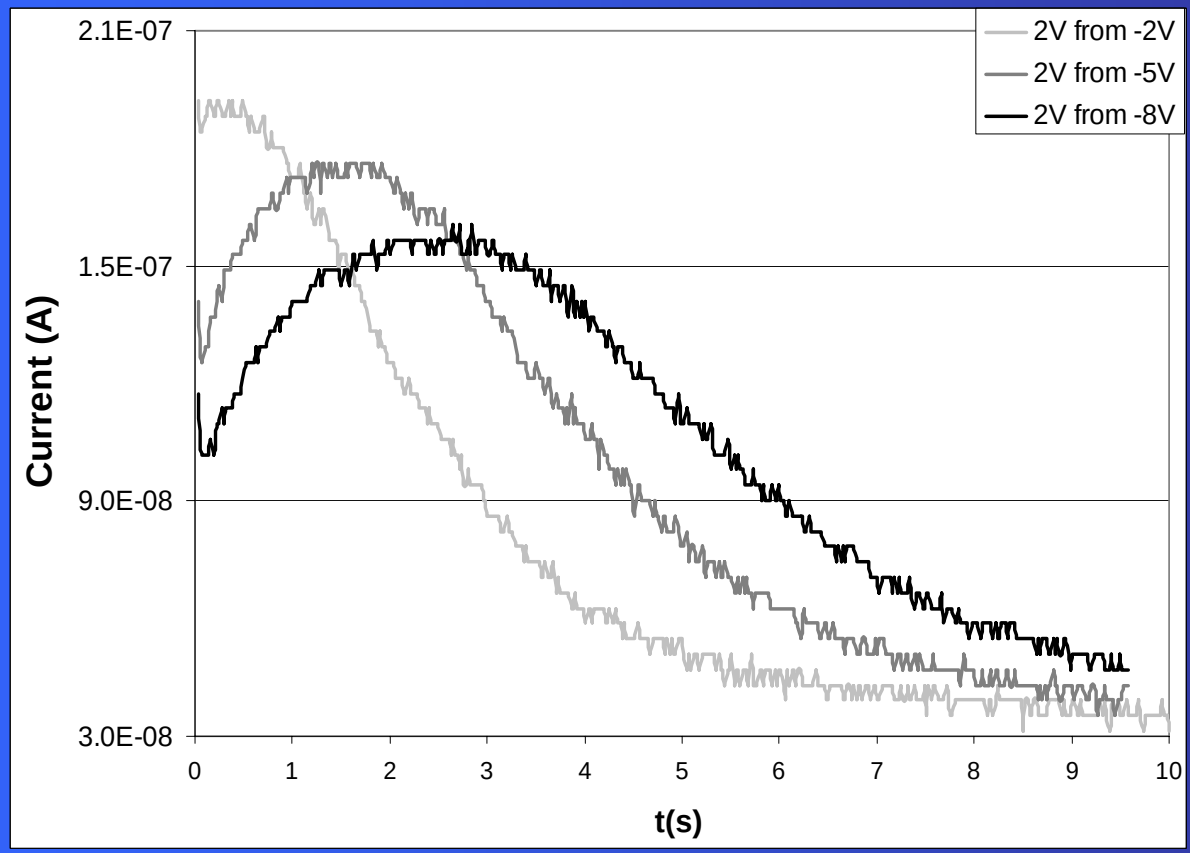
EPID

Optical response & delay time



EPID

Electrical dependence on previous voltage



Current peak broadens, becomes lower, later and more pronounced.

Need for model

- Optimization of switching speed is pure chemical and physical process
- Intelligent display design
- Investigation of other display materials

There is a need for better understanding of display properties and a means to model behavior

Theory

Assumptions

- Gaussian distribution: average value measures drift, standard deviation measures diffusion.
- one-dimensional simulation: pixel dimension parallel to the field is much smaller than perpendicular.

$$n(x,t) = \frac{N}{\sqrt{2\pi} v_{diffusion} t} e^{-\frac{1}{2}\frac{(x - v_{drift} t)^2}{\left(v_{diffusion} t\right)^2}}$$

From charged particle distribution:
transient currents, voltage dependence, …

$$v(x,t,V_1,V_2) = \frac{dx}{dt} = \frac{\frac{dn(x,t,V_1,V_2)}{dt}}{\frac{dn(x,t,V_1,V_2)}{dx}}$$

$$J(t,V_1,V_2) = \int_0^d v(x,t,V_1,V_2)\,n(x,t,V_1,V_2)\,dx$$

Theory

Optical response

From pigment distribution: delay time, switching speed,…

$$I(t,V_1,V_2) = I_0 s \int_0^t R(t_d)\left[\int_0^d n(x,t-t_d,V_1,V_2)e^{-\alpha a(d-x))}dx + \int_d^\infty n(x,t-t_d,V_1,V_2)dx\right]dt_d$$

Theory

Field Screening

$$\varepsilon_0 \varepsilon_r \nabla E = \varepsilon_0 \varepsilon_r \frac{dE}{dx} = \rho(x) = n(x)e$$

$$\Delta E(t) \approx \frac{NQ}{\varepsilon} \frac{1}{\sqrt{2D}} \frac{1}{\left(t + \frac{Q * cst}{8\pi\varepsilon D V_1} \right)^{1/2}}$$

Reduce charge to increase field strength: centrifugation

Theory

Delay time

$$R(t_d) = \frac{1}{\sqrt{2\pi}\sigma_{delay}} e^{-\frac{1}{2}\frac{(t_d - T_{delay})^2}{(\sigma_{delay})^2}}$$

$$T_{delay} = \frac{\Delta s}{\mu} \frac{1}{\frac{V_2}{d} - N\sqrt{\frac{4\pi Q}{\varepsilon * cst}}\sqrt{V_1}}$$

Theory

Physical Parameters

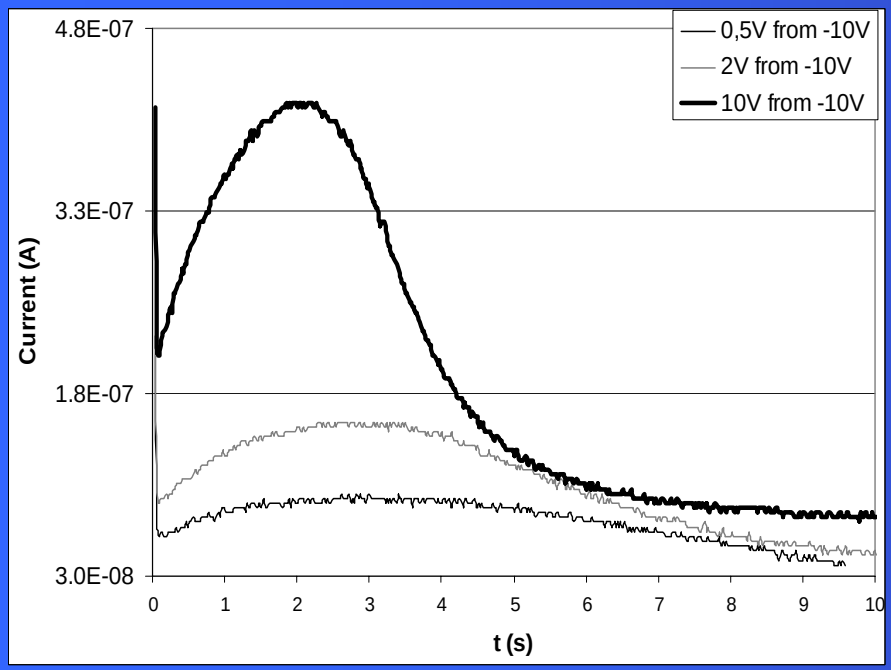
$$D = \frac{kT}{q}\mu$$

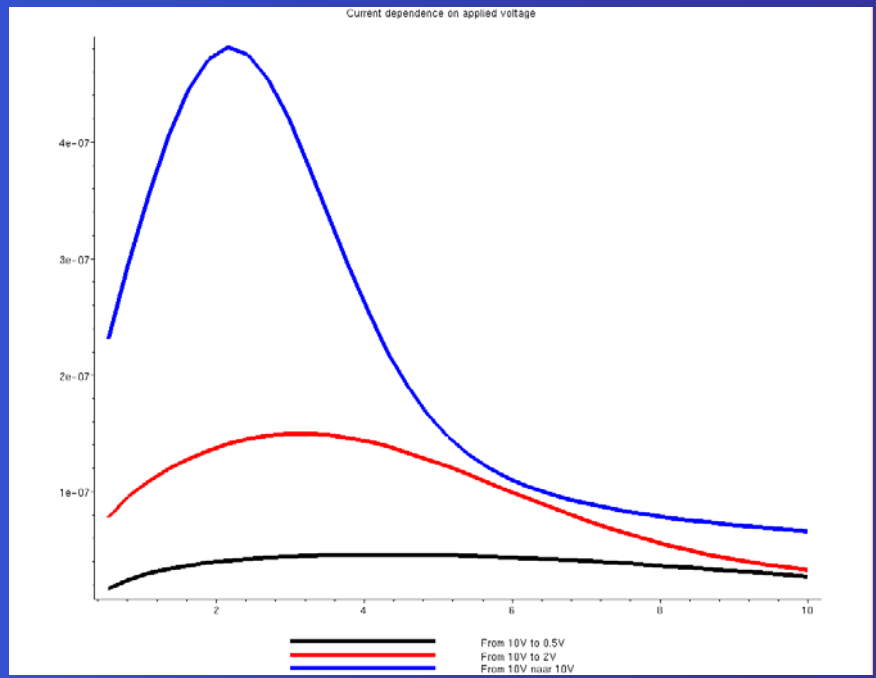
$$\mu = \frac{Q}{6\pi\eta R}$$

Link between model parameters (diffusion velocity, drift velocity,…) and real parameters (viscosity, temperature, charge, pigment radius,…)

Results

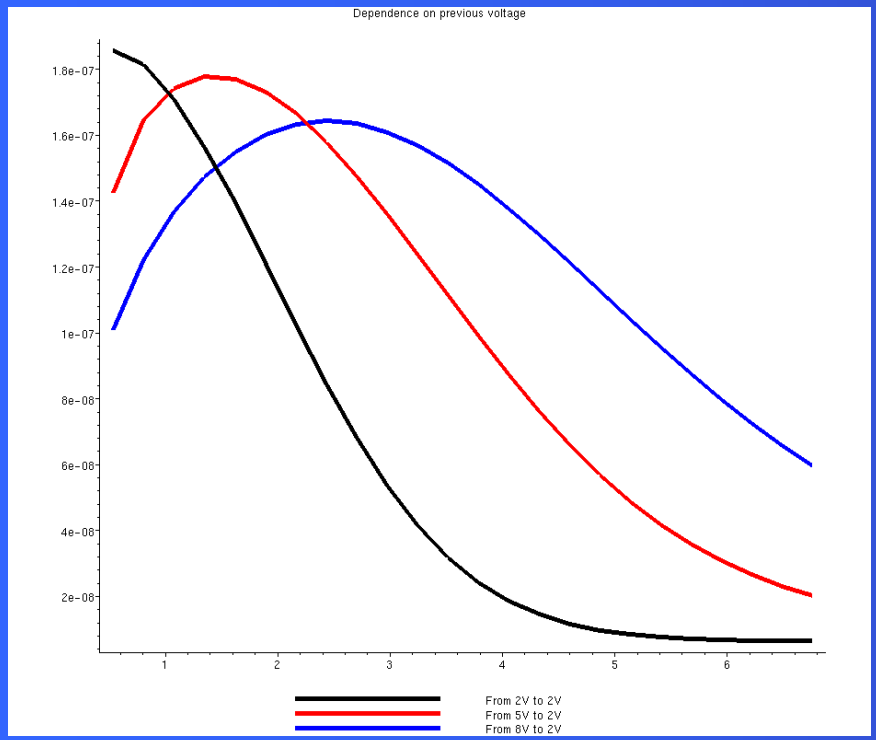
Dependence on applied voltage

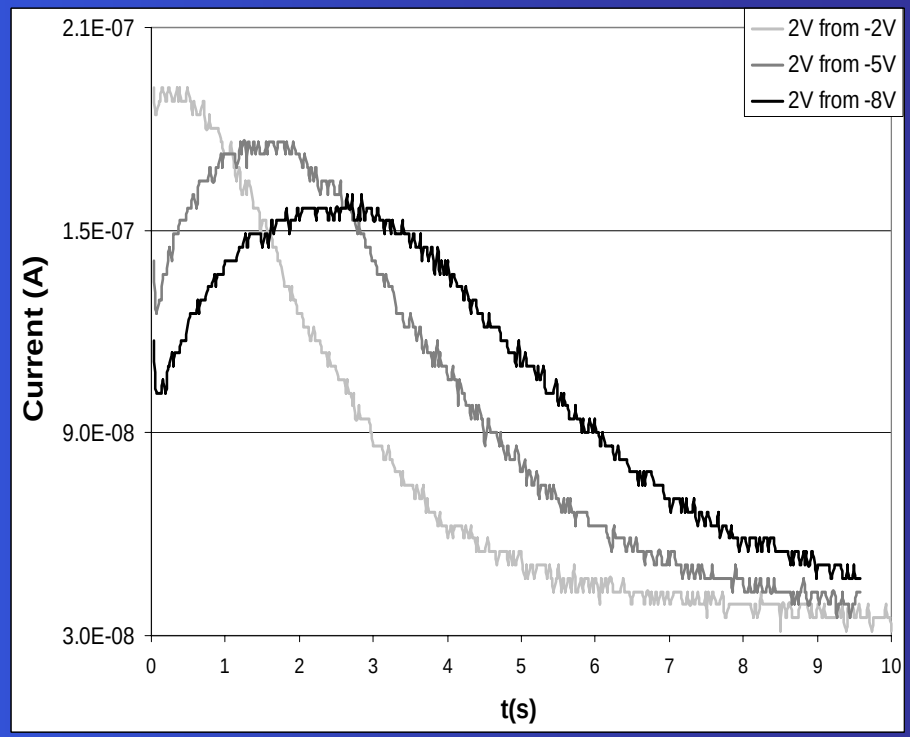




Results

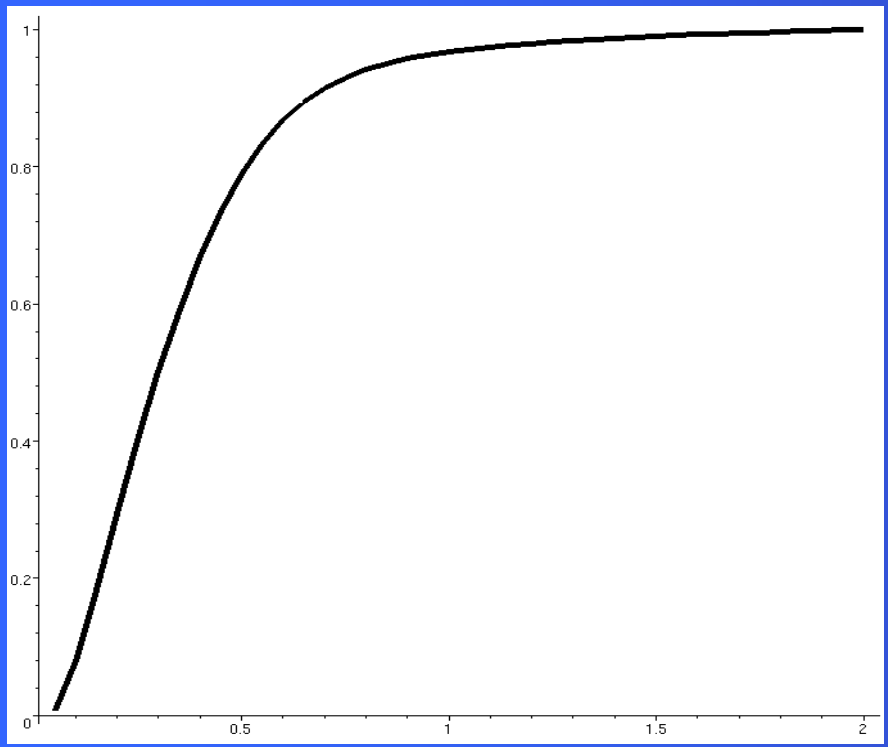
Dependence on previous voltage

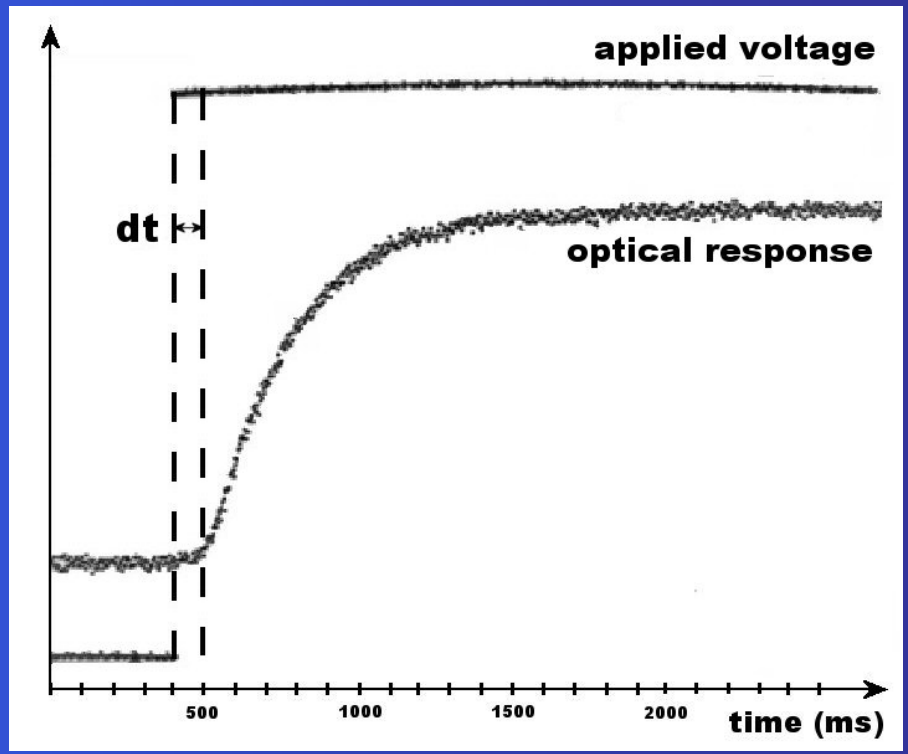




Results

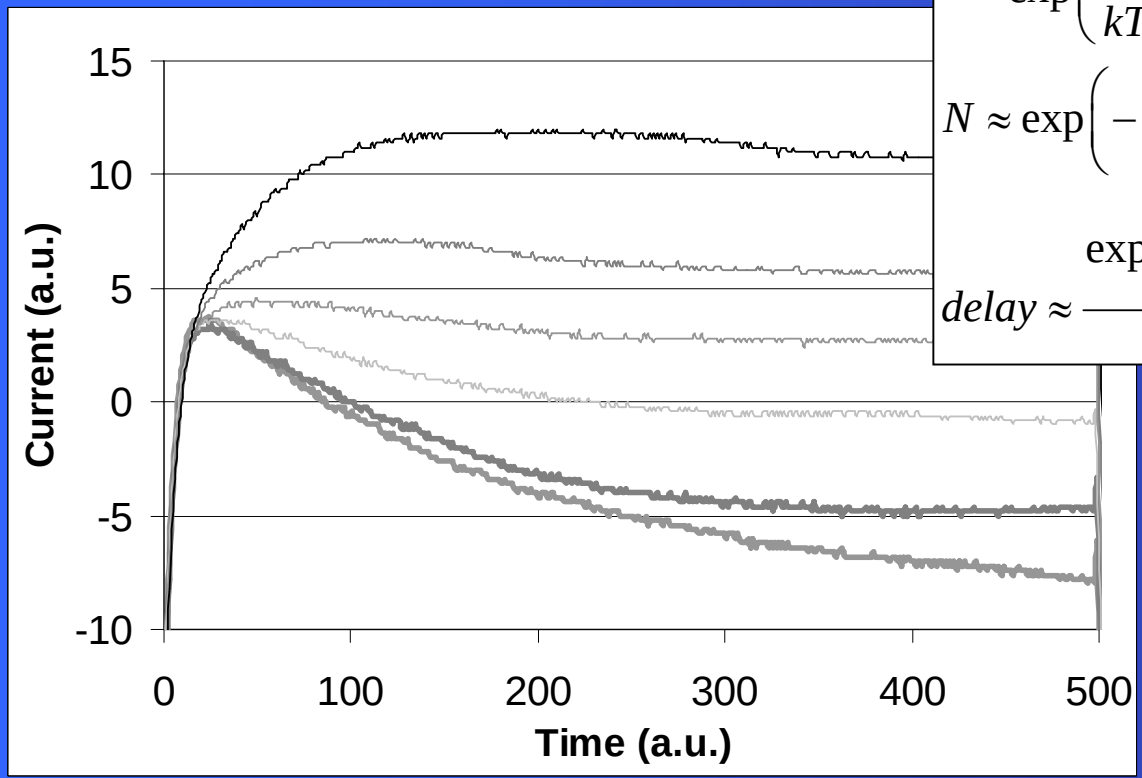
Optical response





Results

Temperature dependence



$$\eta \approx \exp\left(\frac{E_1}{kT}\right)$$

$$\nu \approx \frac{T}{\exp\left(\frac{E_1}{kT}\right)} = T\exp\left(-\frac{E_1}{kT}\right)$$

$$N \approx \exp\left(-\frac{E_2}{kT}\right)$$

$$delay \approx \frac{\exp\left(\frac{E_1}{kT}\right)\exp\left(-\frac{E_2}{kT}\right)}{T} = \frac{\exp\left(-\frac{E_2 - E_1}{kT}\right)}{T}$$

Conclusion

Electrical & Optical simulation of EPIDs

Physical, measurable parameters are used

Importance of field screening and centrifugation

→ Optimize displays production