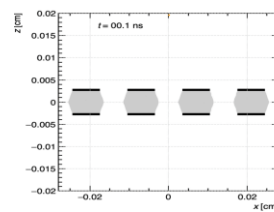
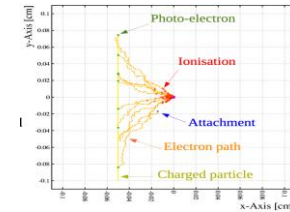
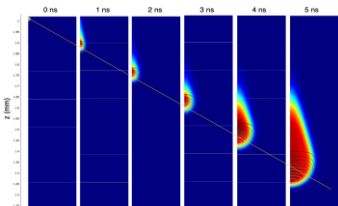


DRD1 WG4

Detector Physics Modelling and Simulation

WG4 Conveners:

*Marcello Abbrescia, Maryna Borysova, Paulo Fonte,
Supratik Mukhopadhyay, Ozkan Sahin, Rob Veenhof,
Piet Verwilligen*



Short Introduction to WG4

Detector Physics, Simulation & Software Tools

- **Transversal workgroup:**

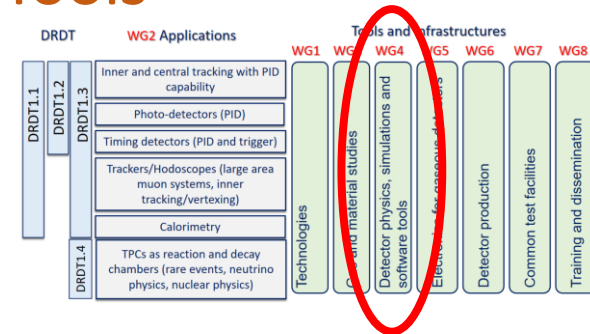
- Groups people working on simulations in various Work-Packages
- Platform to exchange progress & best practice
- In a sense a "Service" to the community

- **WG4 Aims at:**

- Understanding & modelling Physical Processes in Gaseous Det (GD)
- Development of Suitable Simulation & Software Tools

- **Importance within DRD1:**

- Advanced simulations indispensable for GD Detector R&D
- Confirm / Challenge current understanding of Detector Physics
- *Note:* SW Tools developed within GD community now used for other detection technologies (Liquid / Solid State)



Outline of WG4 in Ext-Proposal

- §4.4 – 10 pages – 321 lines – 1 Figure – 1 Table – Thanks for Reading!
- *Not aiming at next 3-4 years – but providing a view for the next decade!*
- **4.4.1 Introduction** (0.5 pages)
- **4.4.2 State-of-the-Art** (2 pages)
 - *Understanding of Detector Physics inside Wire Detectors (WD), TPC, RPC, MPGD & the state of the art of their simulations and understanding of physics processes*
 - *Not yet a full understanding (or sometimes poor understanding) of “Large-Charge” and “High Rate” phenomena in RPC and MPGDs*
 - *E.g. avalanche-to-streamer transition in RPC*
 - *E.g. Discharge formation and propagation in MPGD*
 - *Known blind spots: electro-luminescence, (negative) ion drift, new gas cross-sections ...*
 - *Note: Not all physics that is rather well understood is implemented in simulation tools available in the public domain*
- **4.4.3 Needs of the Community** (7 pages)
 - What we understood from the survey...
 - 2/3 interested in contributing to the understanding of gaseous detector physics
 - 1/3 willing to contribute to software development
 - **2 tasks** dedicated to the improvement of the CORE Simulation
 - **9 tasks** we envision within WG4 (and should find a home in Applications)

Tasks associated to WG4

- "Core" Software Tool development (2 Tasks)

	Ref.	Description	Deliverable
4.1.X GARFIELD Modernization	4.1.1	<i>Review Core code for Multi-Threading and Heterogeneous Computing (CPU – GPU), optimized C++ code for modern CPUs, ...</i>	Core Code
	4.1.2	<i>Add Community Tools (Validation, Automatic Pull-Request Tests, Builds, ...)</i>	Software Tools
	4.1.3	<i>Review & Accelerate G++ integrated neBEM</i>	Core Code
4.2.X GARFIELD Framework Improvement	4.2.1	<i>Recommended Set of Ion Mobilities</i>	New SW release
	4.2.2	<i>Secure long-term solution for Magboltz</i>	New SW release
	4.2.3	<i>Miscellaneous: better Event Displays, Improve Documentation, Provide Examples</i>	New SW release

We would like / need to collaborate with CERN IT department for Core Code and for the deployment of modern software tools. We would need people willing to push these developments forward and can follow PhD students (partly) working on these topics ...

Tasks associated to WG4

- Application specific Software Development (Part I)

	Ref.	Description	Deliverable
4.3.X Simulation of Large Avalanches / Space Charge Effects	4.3.a.1	<i>Implementation of Space-Charge</i>	SW
	4.3.a.2	<i>Implementation of E-Field update (on the fly)</i>	SW
	4.3.a.3	<i>Clustering of particles for Large Avalanches</i>	SW
	4.3.b.1	<i>Simulate Discharges using code 4.3.a</i>	SW
4.4.X Simulation of Resistive GDs	4.4.a.1	<i>Signals: Time-dependent weighting fields (neBEM)</i>	SW
	4.4.b.1	<i>Rate-Capability simulation (Equiv. Network)</i>	SW
	4.4.b.2	<i>Framework for large-size detectors (cells)</i>	SW
	4.4.c.1	<i>Model / Sim Dark Count Rate and Ageing</i>	SW

Very important Software development required and once in place several (most) applications will benefit. Community will be allowed to simulate / compare / study effects that could not be studied before ... Still funding & manpower should be driven inside App WPs

Tasks associated to WG4

- Application specific Software Development (Part II)

	Ref.	Description	Deliverable
4.5.1 Large Vol	4.5.1	<i>Simulation of Large Gas Volumes (Distortions – TPC)</i>	SW
4.6.1 Eco-Gas	4.6.1	<i>Modelling and Simulation of Eco-Gases (X-sections)</i>	SW
4.7.1 Penning	4.7.1	<i>Meas & Extraction of Penning coef Ternary Mixtures)</i>	SW
4.8.1 Fast-Sim	4.8.1	<i>Parametrized Fast Simulation</i>	SW
4.9.1 Luminesc	4.9.1	<i>γ-x-section & Simulation of Electroluminescence</i>	SW
4.10.1 Neg Ion	4.10.1	<i>Simulation of Negative Ions (Drift – Detachment)</i>	SW
4.11.1 Quench	4.11.1	<i>Simulation Ionization Quenching Factors Nuclei</i>	SW

Here these tasks fit naturally into the various Work Packages for the Applications. Funding and (Wo)manpower to work on these tasks should be included in the WP proposals. WG4 acting as a platform for exchange of expertise and help

Outlook - Work to be done now

- Strengthen links between WG4 Tasks and WG2 Applications
 - Contact Institutes to understand who is interested / willing to work on the various topics ...
 - Of special concern are "CORE" Tasks 1 & 2
 - Garfield Code modernization & use of GPUs
 - Garfield Framework improvements
- } Need Programming Experts
CERN IT / Your Institute?
- Underline that this software is currently used also in Simulation of Solid State Detectors => Make Link to DRD3 (*also Liquid DRD2 – Photon DRD4?*)
 - => *Would be extremely beneficial to find External Funding*
 - E.g. Marie Curie (EC MSCA) Training Network
 - Need strong involvement of Industry / return for Society
 - => *Need help here*
 - Proposal Team – significant amount of time required to write proposal
 - Contacts with Industry / Industrial or Societal Application
 - Example: simulation of Large Avalanches in SiPMs for LIDAR
 - Other Ideas? Please contact us!

Let's have some discussion now

- Your input & comments here ...