

# Report via EVO – WG4

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Hello World !



Alain Bellerive

# Outline

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- C++ GarfieldMainFrame
- New Garfield in C++ for MPGD
- The Geant4 Parameterization Framework
- List of WG4 activities
- Plan for an RD51 'Software School'
- Summary
- Discussion

# C++ GarfieldMainFrame

First version 2008 by Rob Veenhof

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- C++ GarfieldMainFrame
- Basic C++ wrapper of Fortran code
- Basic objects (wires and planes)

```
cell = new Cell();
```

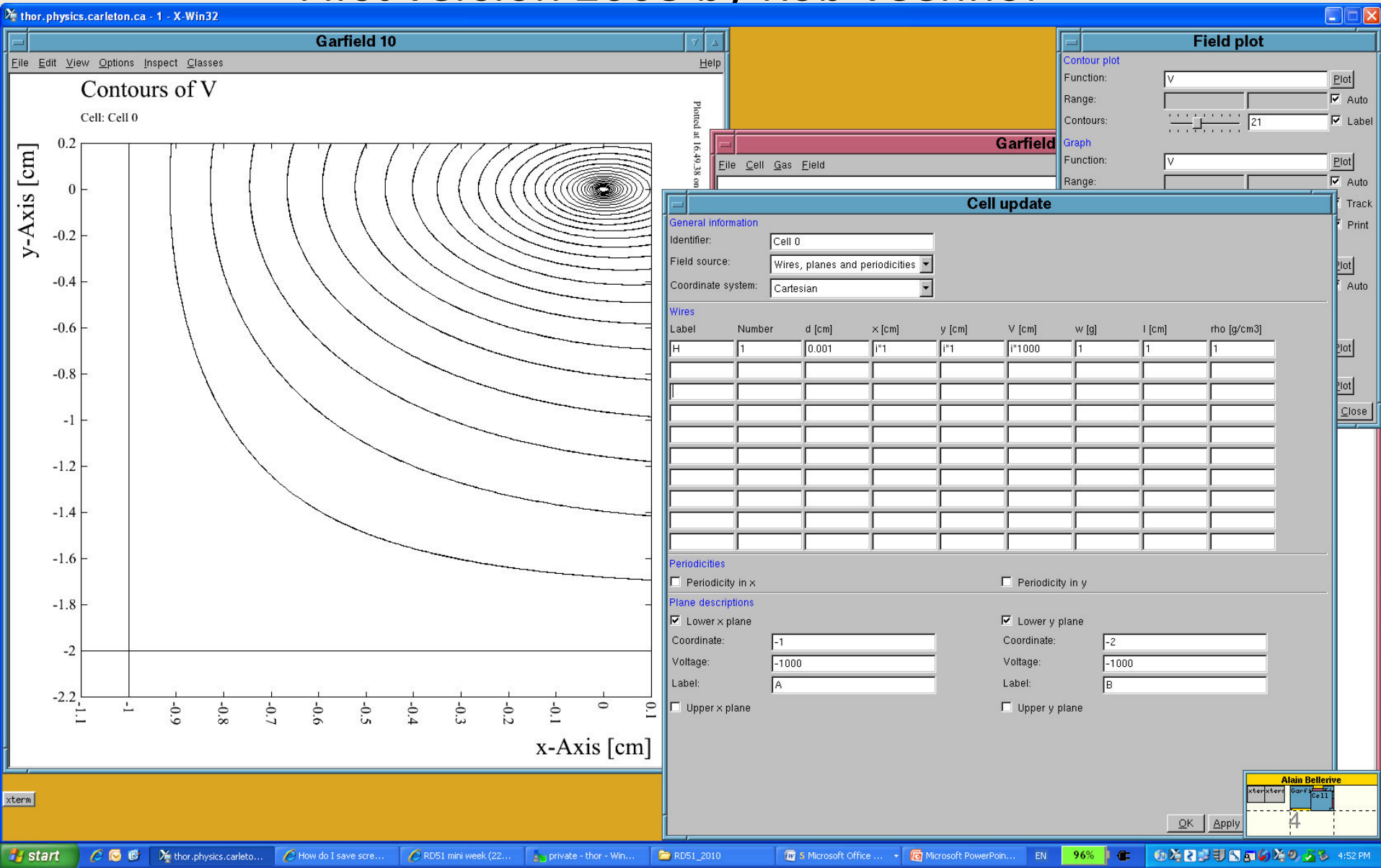
```
dl = new DriftLine();
```

```
track = new Track();
```

- To allow interface with **ROOT**
- Objects for **Geant4**

# C++ GarfieldMainFrame

## First version 2008 by Rob Veenhof



# New Garfield in C++ for MPGD

Heinrich Schindler and Rob Veenhof

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- In development (hopefully more soon)!!!
- Totally **new** C++ code specific for MPGD
- More robust

Objects:

AvalancheMC or AvalancheMicroscopic

ComponentFieldMap

FieldView

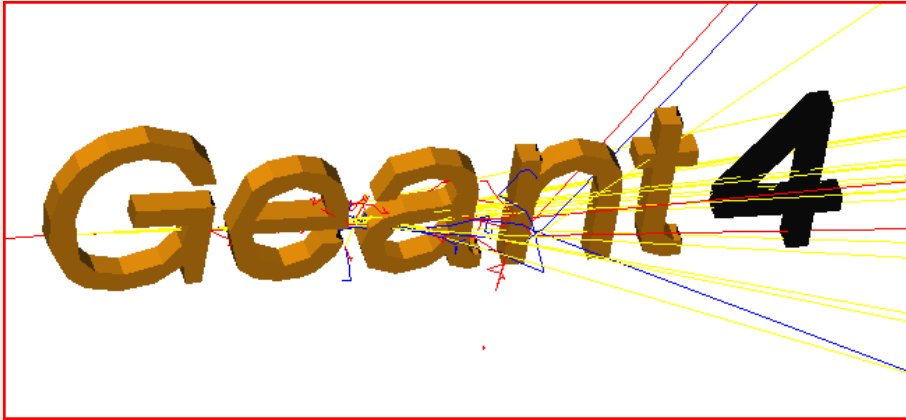
# New Garfield in C++ for MPGD

Heinrich Schindler and Rob Veenhof

## Allow specific study of MPGD:

- Field calculation (100 micron scale)
- Gas properties
- Calibration
- Understanding small scale physics
- Generic charge collection, transport and gain
- Avalanche, signals etc...
- Several application domains

# Interface to Geant4



For the design of complex and large scale detectors

## Strengths:

- Detector Construction/Geometry
- Visualization
- Accessibility
- Lots of built in features

## Weaknesses:

- Transport through Gases
  - Accuracy
  - Speed
- Limited support for EM fields
  - Only uniform fields or user entered field maps

Weaknesses severely limit simulations of gas detectors!

# The Team

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A. Bellerive: Hardcoded (2007)

S. Guindon: Interface with C++ GarfieldMainFrame (2008)

N. Shiell & A. Bellerive: G4 FastSim GarfieldModel (2009)

R. Veenhof: Author C++ GarfieldMainFrame

P. Gumplinger: Consultant (TRIUMF lab)

Plan: Release 2010...

# Allow Garfield to propagate primary and daughter particles in gas volume for Geant4 !!!

- Primary Particle
- Detector geometry
- Visualization



- Primary Particle
- Ionized electron Paths
- Trajectory

Need to create Garfield Simulation in Geant4:

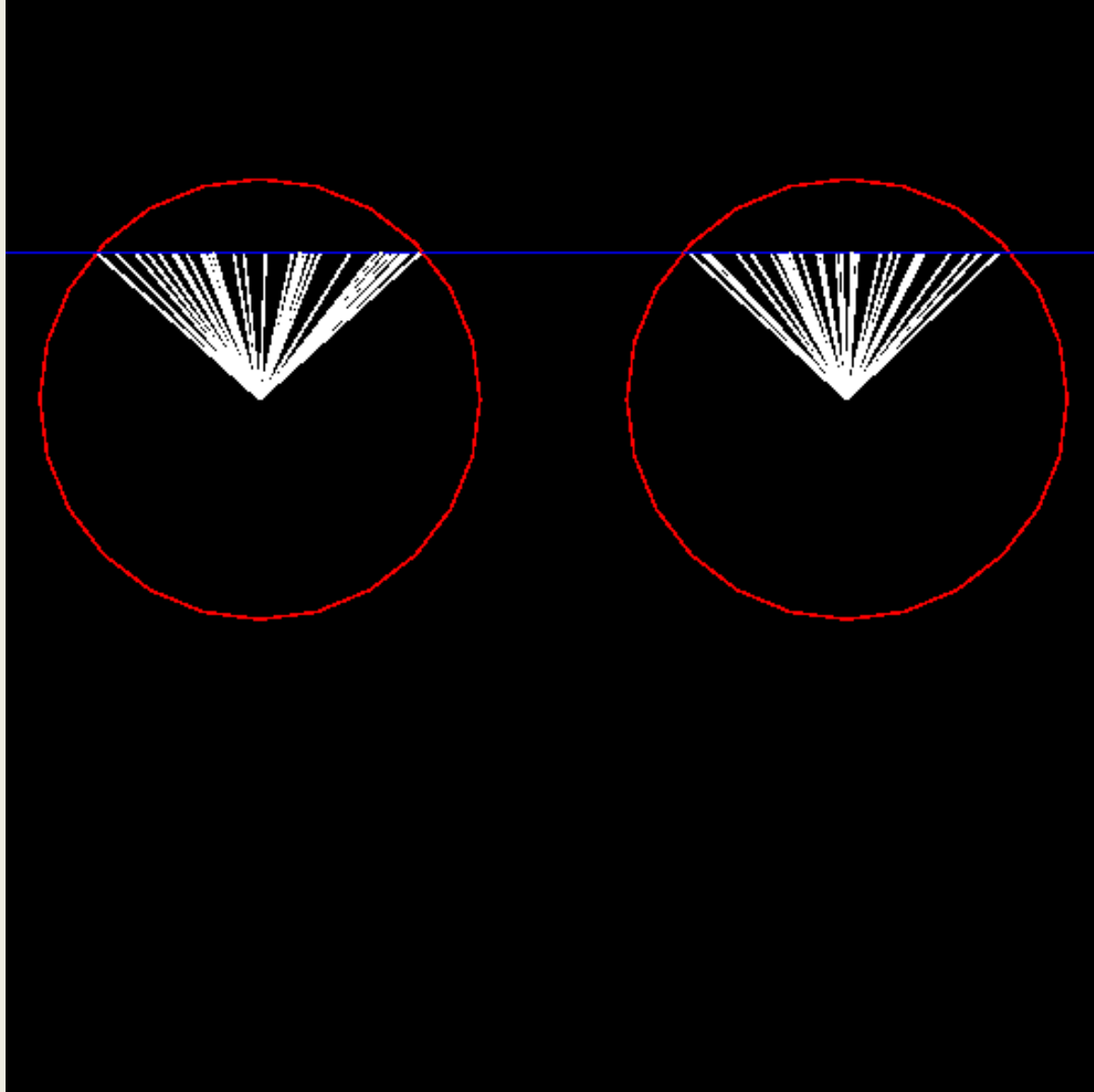
- Cell
- Gas
- DriftLine
- Track

Want to do this using  
**G4FastSimulationModel:**

- Define constructors
- Define pure virtual functions
  - isApplicable
  - ModelTrigger
  - Dolt

# Example: Results

Visualization of Electron Paths in Geant4:



# Example: Code!!!

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Simple version of the code described in the RD51 talk:

<http://www.physics.carleton.ca/~alainb/G4Parameterizing.pdf>

G4VFastSimulationModel which invokes GARFIELD to propagate a particle when it enters a gas detector.

Get the file at:

<http://www.physics.carleton.ca/~alainb/G4MuonTube.tar.gz>

In your local GEANT directory, create a directory named N02 and copy G4MuonTube.tar.gz in this directory.

All instruction in G4alainb\_README

# List of WG4 activities

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- A little bit of management...
- Who does what!?!
  - Coordinate the activities of WG4
  - Identify links between simulation and other WG's
  - Benchmark measurements and characterization
  - Possibility to organize a 'Software School' in 2010

# RD51 – Micropattern Gas Detectors

WG1 MPGD Technology & New Structures	WG2 Characterization	WG3 Applications	WG4 Software & Simulation	WG5 Electronics	WG6 Production	WG7 Common Test Facilities
Design optimization  Development of new geometries and techniques	Common test standards  Characterization and understanding of physical phenomena in MPGD	Evaluation and optimization for specific applications	Development of common software and documentation for MPGD simulations	Readout electronics optimization and integration with MPGD detectors	Development of cost-effective technologies and industrialization	Sharing of common infrastructure for detector characterization
Large Area MPGDs	Common Test Standards	Tracking and Triggering	Algorithms	FE electronics requirements definition	Common Production Facility	Testbeam Facility
Design Optimization New Geometries Fabrication	Discharge Protection	Photon Detection	Simulation Improvements	General Purpose Pixel Chip		
Development of Rad-Hard Detectors	Ageing & Radiation Hardness	Calorimetry	Common Platform (Root, Geant4)	Large Area Systems with Pixel Readout	Industrialization	Irradiation Facility
Development of Portable Detectors	Charging up and Rate Capability	Cryogenic Detectors	Electronics Modeling	Portable Multi-Channel System	Collaboration with Industrial Partners	
	Study of Avalanche Statistics	X-Ray and Neutron Imaging		Discharge Protection Strategies		
		Astroparticle Physics Appl.				
		Medical Applications				
		Synchrotron Rad Plasma Diagn. Homeland Sec.				

# List of WG4 activities

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1. **Simple programs** (magboltz, garfield, maxwell)  
Algorithm  
Pattern Recognition / Track fitting  
Basic survey of other tools
2. **Common data analysis framework of test beam data**  
C++ ROOT based interface  
Resolution study  
Space and time residual analysis  
Pad response function determination  
n(electron) effective calculation  
Electronics (analytic pulse height calculation or simulation)

# Common C++ data analysis framework of test beam data

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e.g. LTPC test beam data (simulation, track fitter, data analysis)

**Micromegas readout:** Carleton (Dixit, YunHa, Turnbull+ students)  
& Saclay (David Attie + new students).

**GEM readout:** Akira Sugiyawa (Saga) + students, Keisuke Fujii (KEK)

**TPC Silicon envelop:** Stephen Hansel (Vienna)

**GEM + Timepix:** Jochen Kaminski (Bonn) - To analyze

**Micromegas + Timepix:** Jan Timmerman (NIKHEF) - To analyze

**ILC TPC Marlin simulation & analysis framework:**

Christoph Rosemann (DESY), Peter Wienemann (Bonn), Martin Killenberg(Bonn)

# List of WG4 activities

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## 3. Development of new tools for MPGD simulation

- C++ based

- Field calculation

- Calibration

- Gas properties

- Geometry and visualization (GEANT4)

- Understanding small scale physics

- Design large-scale (sLHC, ILC)

- Generic charge collection, transport and gain

# List of WG4 activities

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4. **Applications** (only a few listed here and identify links with industry as well as other national labs):

Photon or neutron specific detectors

Medical imaging – Nuclear – Underground - Collider

GOSSIP

Homeland security

TimePix + SiProd + InGrid (integrated electronics & detector)

Thick or large area MPGD

# List of WG4 activities

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## 5. Couple the simulation and measurements, construction and characterization

Plan activities with other WG's

Discharge

Transparency

Avalanche

Timing

Resistive anode

MPGD hole size, shape, gap, etc...

Two-track resolution

Radiation damage

# List of WG4 activities

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## 6. Design of electronics (coupled with expensive commercial tools)

Electronic Design Automation (EDA) software

Xilinx and Altera IDE suites with High level Data Link (HDL) simulator

FPGA dynamic probe

Schematics tool

Analog circuit simulation

Signal integrity analysis

Most recent version of Labviews

Conceptual logic of Application-Specific Integrated Circuit (ASIC)

# Summary

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- Plan of Activities C++ specific (interface with ROOT, Geant4)
- Itemized WG4 (seek feedback) / Management
- Future: identify links between simulation and other WG's and survey the needs
- Software School (October 2010 ???)  
WHO and WHY (contents and contacts)
- How to get funding agency to acknowledge RD51

# Discussion

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