WP 13.2.1
Establishing new resistive materials for high rate RPCs

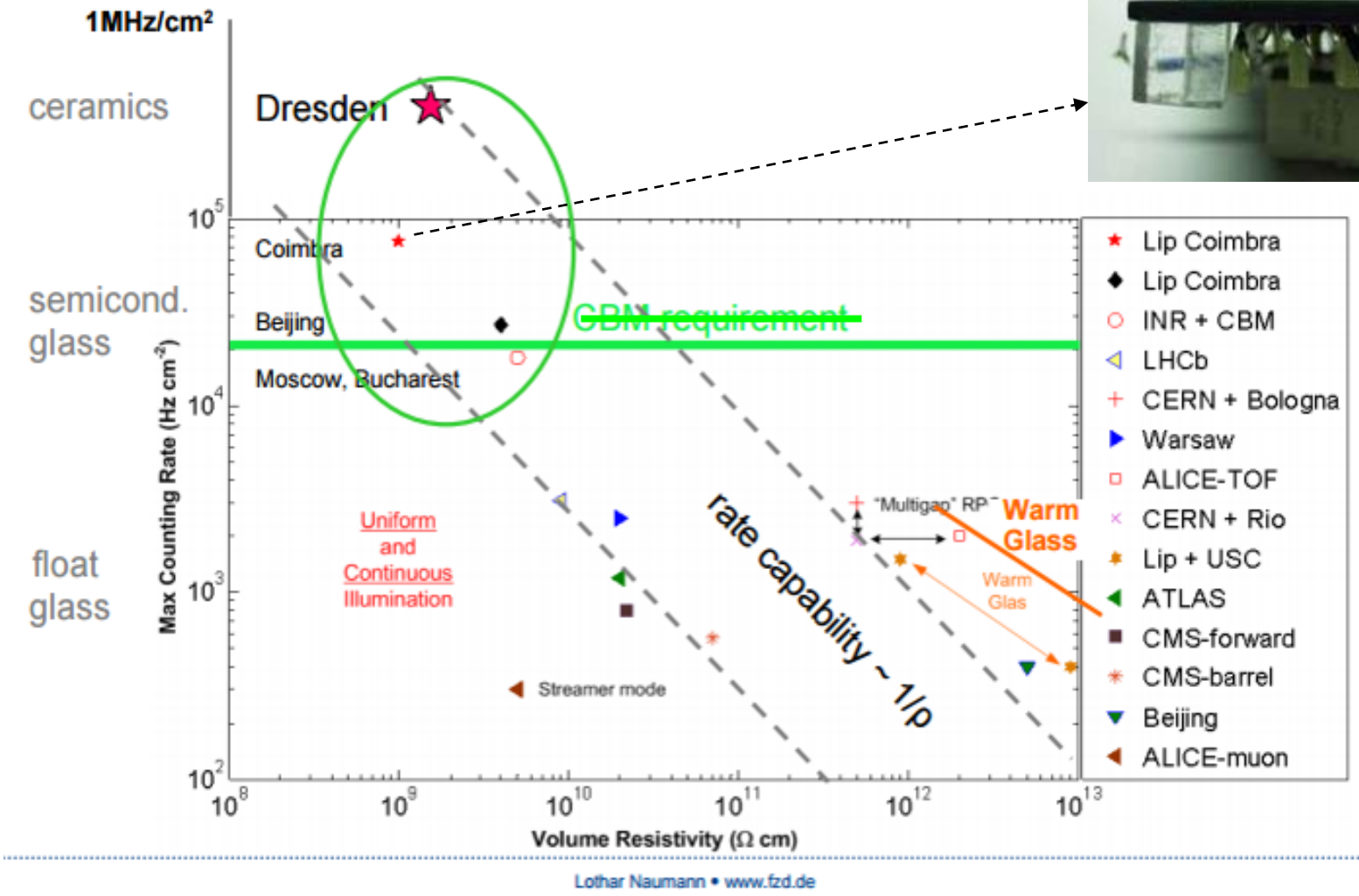
DESCRIPTION
- a list of low resistivity materials like HPL, Glass, Ceramics and new plastics is established;
- their resistivity (bulk, surface) and homogeneity are studied;
- their ageing properties due to large integrated doses are also determined;
- the materials are qualified by determining the rate response and the ageing properties of RPCs (single and multi-gap) by exposing these materials to intense sources/beams

DELIVERABLES
"Validation of new resistive materials for high rate RPCs through the study of the rate and ageing properties of small RPC prototypes (single and multi-gap-detectors) exposed to intense sources/beams." [M36]

The contributing partners and their roles

LIP-Coimbra	Beneficiary
IN2P3-Lyon	Development and tests of new resistive materials, Participation to test-beams
INFN-Bari	Participation to test-beams of high-rate RPCs
INFN-LNF	Characterization of new resistive materials
IN2P3 - Clermont-Ferrand	Participation to test-beams of high-rate RPCs

RPC rate capability ~1/ρ



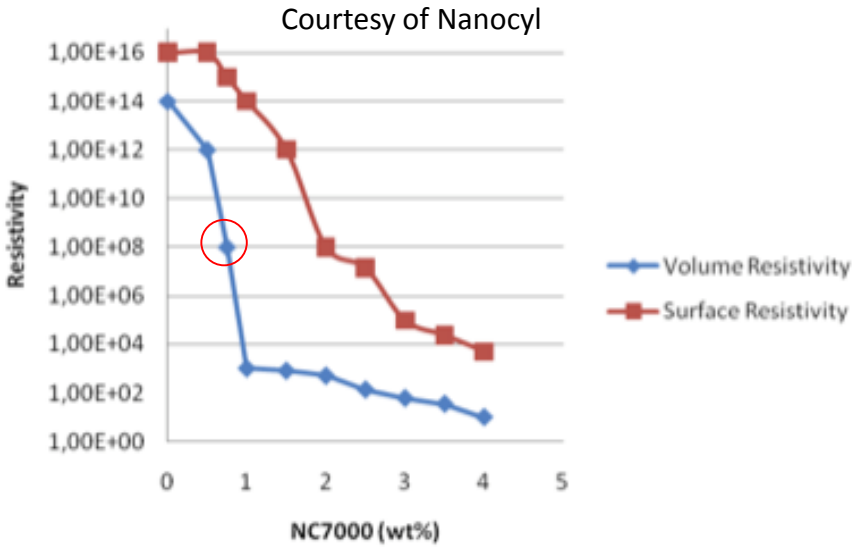
Research scattered over many groups/years
Very different test conditions
Results mostly not crosschecked

Current research on new materials by the participants

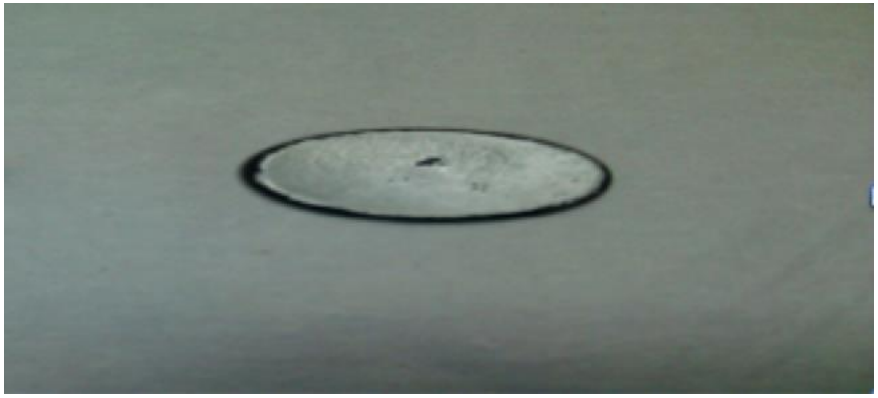
Materials loaded with carbon nanotubes (CNT)

Peek plastic

Courtesy of Nanocyl



Glass (in study)



Fundamental distinction in RPCs

RPCs FOR TIMING (<100 ps) ⇐ this project
- Very large gain required for good timing
- Very thin gas gaps (~0.3mm)
- Multigap structure for efficiency
- Fast electronics (optimized for timing)

RPCs FOR TRIGGER (~1ns) ⇐ also this project
- Only efficiency matters (time is in principle easy)
- Low gas gain allowed, as far as efficiency is sufficient
- Electronics may be optimized for sensitivity

Challenges (interdependent)

- Inventory/procurement of materials
  - High pressure laminate
  - Glass
  - Ceramics
  - Plastics
  - ???
- Electrical resistivity measurements
  - Electronic vs. ionic conductivity
  - Homogeneity/weak spots
- Characterization as RPC electrodes
  - Mechanical properties: rigidity, hardness/machinability, porosity
  - Dark count rate for the operating E field (function of the electronics/timing or trigger)
  - Larger practical area?
- Optimization of electronics
  - Optimum filtering vs. rate capability/channel (to be defined) vs. timing requirement
- Ageing
  - Direct radiation damage of the materials
  - Damage of the operating RPC electrodes by polymerization/etching
- Definition of minimum standards/procedures for testing/crosschecking

Global schedule

	Year 1	Year 2	Year 3	Year 4
Definition of standards/procedures				
Inventory and procurement of materials				
Exploratory tests electrical/RPC				
Electronics development				
Detailed tests in lab of chambers made out of the best candidate materials				
Address ageing				
Beam test of small but realistic systems				
Conclusion and reporting				

Detailed 1st year schedule

	Q1	Q2	Q3	Q4
General discussions Distribution of tasks				
Definition of standards/procedures				
Inventory and procurement of materials				
Exploratory tests electrical/RPC				
Electronics development (in common with 13.2.2)				

Extra funding

	2015	2016	2017	2018	2019
Bari	INFN	INFN	INFN	INFN	INFN
Clermont-Ferrand	IN2P3	IN2P3	IN2P3	IN2P3	IN2P3
LIP			Likely	Likely	Likely
LNF	INFN	INFN	INFN	INFN	INFN
Lyon	IN2P3 (CMS)	IN2P3 (CMS)	IN2P3 (CMS)	IN2P3 (CMS)	IN2P3 (CMS)