Survey analysis
WG1 Technologies

P. Colas, **I. Deppner**, L. Moleri , F. Resnati, M. Tytgat, P. Wintz

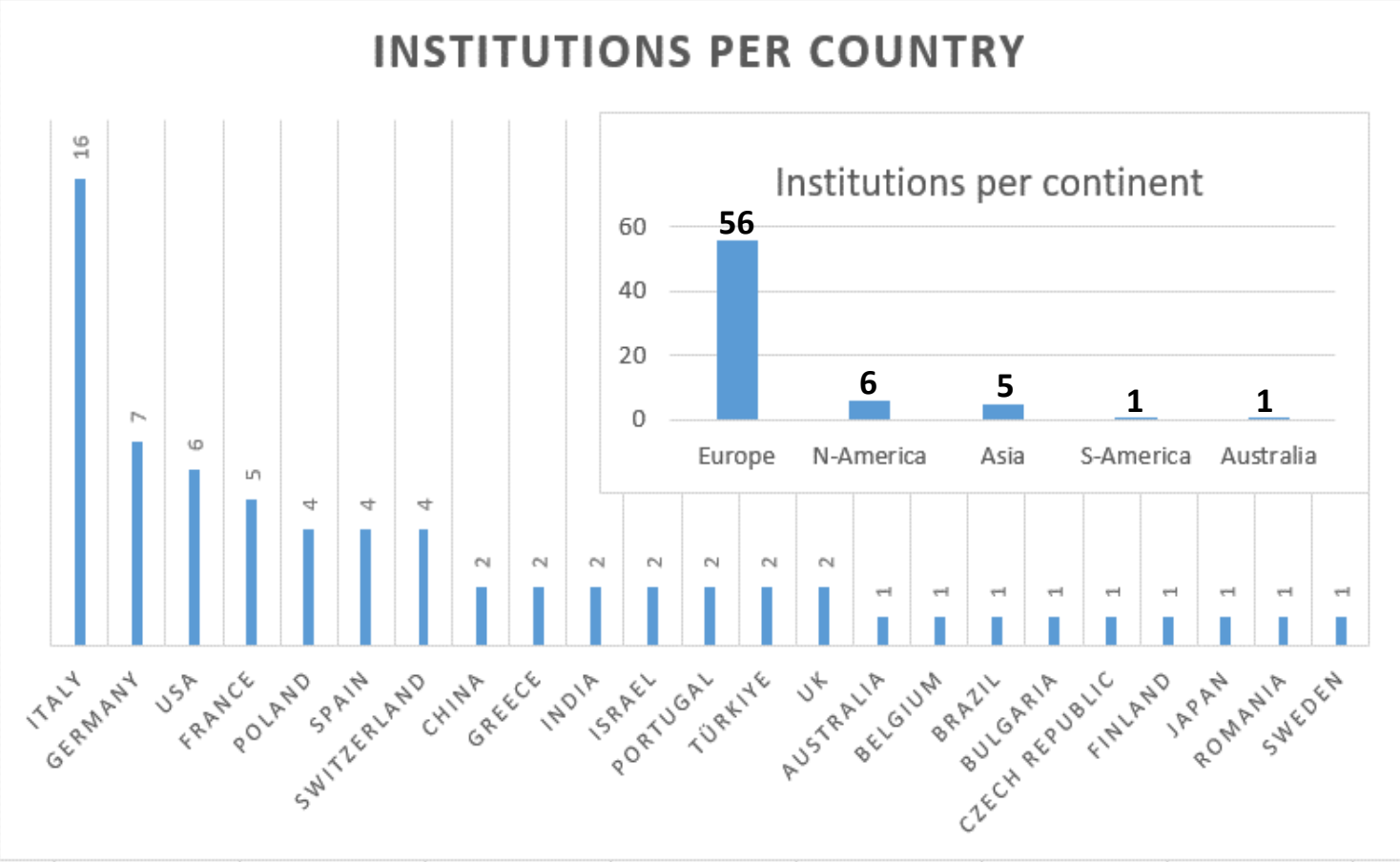
Paul.Colas@cea.fr - TPC/MPGD - moderator
filippo.resnati@cern.ch - MPGD
p.wintz@fz-juelich.de - Wire
deppner@physi.uni-heidelberg.de - RPC
michael.tytgat@cern.ch - RPC/MPGD
mole.luca@gmail.com TGC

Technology WG1

2 direct Questions regarding to technology to the participants of the survey

- Technologies of interest
- Comments/Notes (Please add any relevant comment/remark on technologies of interest)

69 institutions from **23** countries fill in the survey



S-America: IFUSP: Instituto de Física da Universidade de São Paulo/Brazil

Australia: This survey response reflects the broad efforts towards MPGD research in Australia, not a single-institution contribution

Question: What can we do to attract more institutions from outside Europe?

Technologies of interest

177 times a technology was selected (in mean 2.5 technologies per institution)

A. MPGD: 52 **(75.4%)**

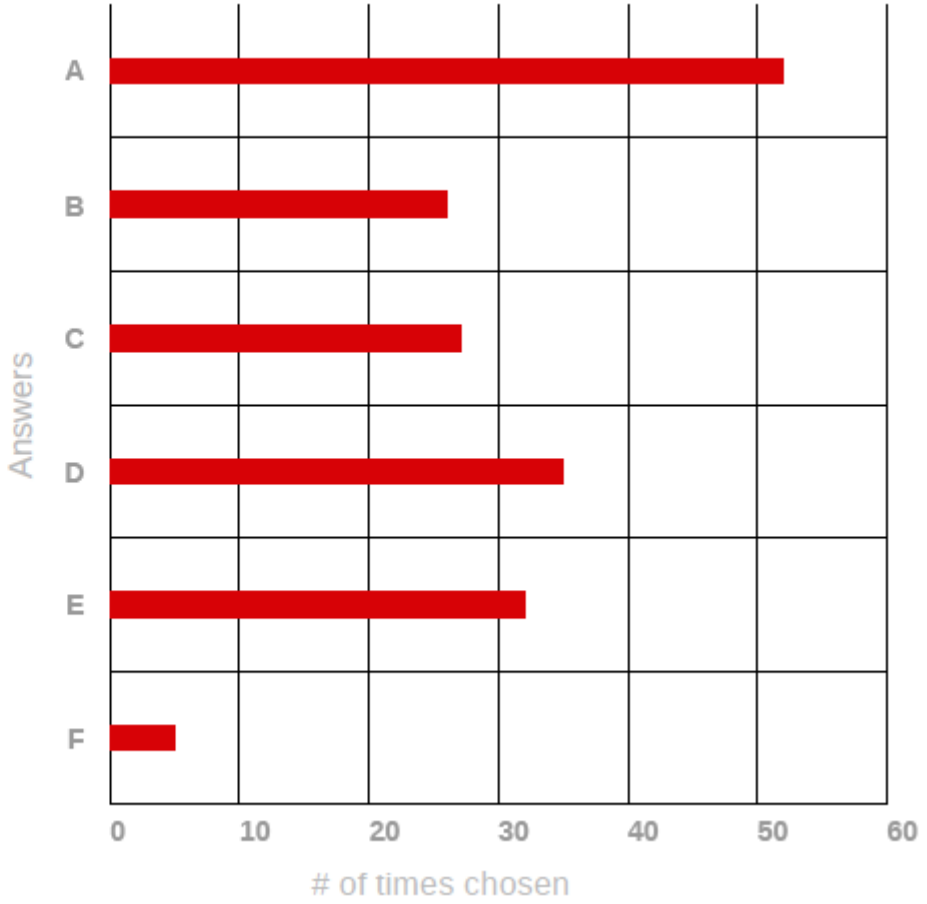
B. RPC and MRPC: 26 **(37.7%)**

C. Wire chambers (incl. Straws, TGC, CSC, ..): 27 **(39.1%)**

D. Large Volume Detectors (drift chambers, TPCs): 35 **(50.7%)**

E. New amplifying structures: 32 **(46.4%)**

F. Other: 5 **(7.2%)**



Technologies of interest

	MPGD	RPC/MRPC	WC	LVD	NAS	other
Australia	1			1	1	
Belgium	1	1			1	
Brazil	1		1	1		
Bulgaria		1				
China	1	1		2	1	
Czech Republic	1			1		
Finland	1			1		
France	5	2	2	4	3	1
Germany	5	3	3	3	4	
Greece	2		1		1	
India	2	2	2	1		
Israel	2	1	2	2	2	
Italy	11	5	3	6	6	2
Japan	1	1	1			
Poland	4	1	3	2	3	
Portugal	1	1	1	1		
Romania	1					1
Spain	2	2		3	2	1
Sweden	1					
Switzerland	2	2	4	3	1	
Türkiye	2	1	1		1	
UK	1		1	1	1	
USA	6	1	2	3	5	

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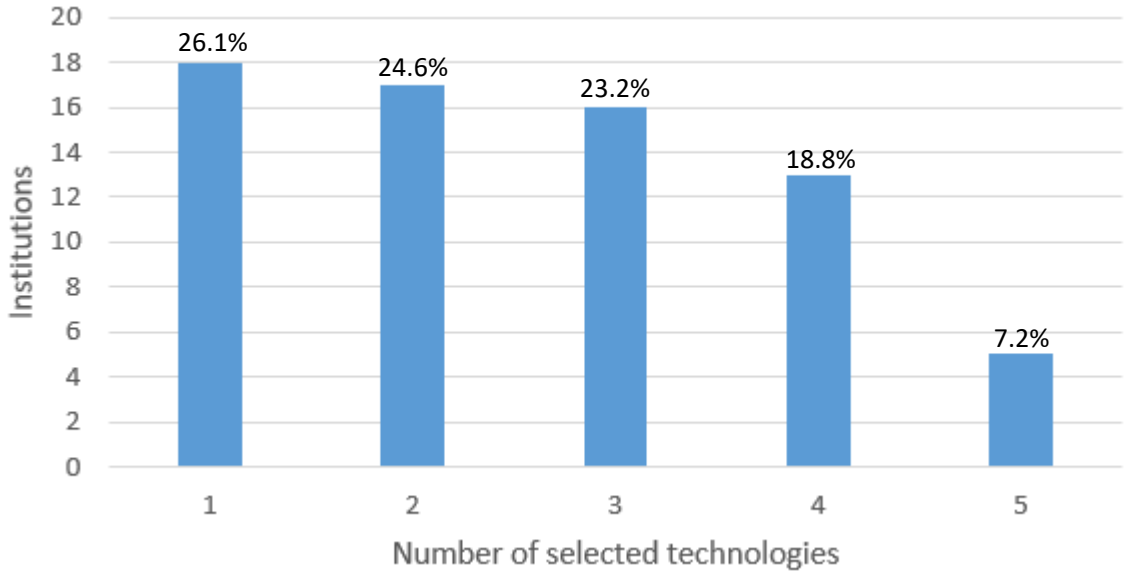
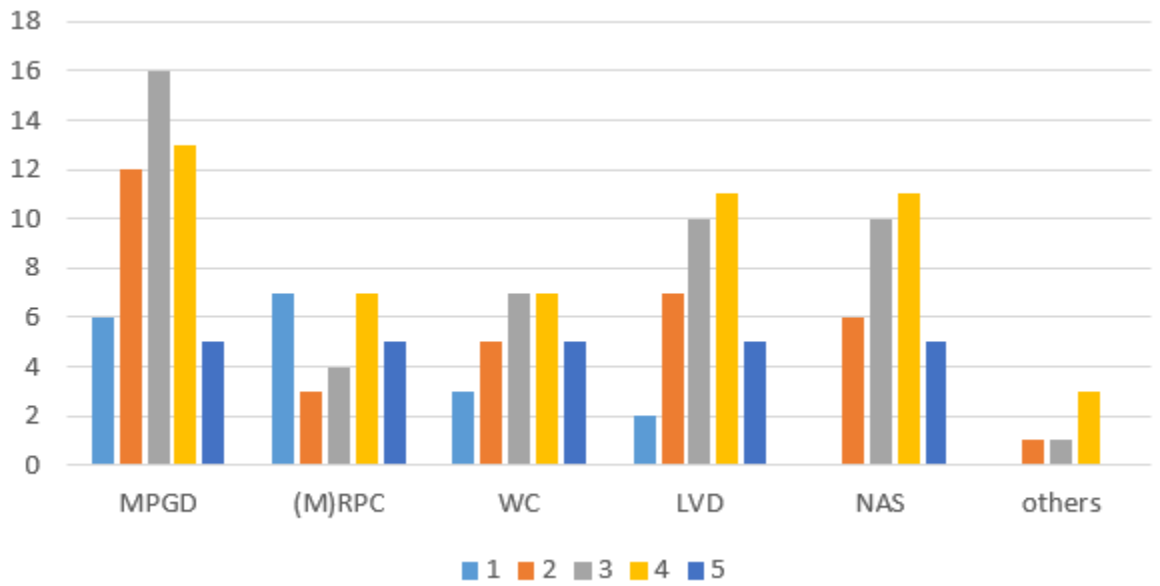
MPGD: Micro pattern gaseous detectors
RPC/MRPC: RPC and MRPC
WC: Wire chambers (incl. Straws, TGC, CSC, ..)
LVD: Large Volume Detectors (drift chambers, TPCs)
NAS: New amplifying structures
Others:

Others (5)

- Hybrid detectors (eg gas amplification and silicon pixels) for light and charged particles detection with fast timing
- Neutron spectrometry with Bonner spheres
- Innovative gas mixtures for electroluminescence and negative ion drift (WG3)
- Data acquisition system, front-end electronics, ASIC design, Monte Carlo simulation tools, tracking algorithms (WG5)

Technologies of interest - some statistics





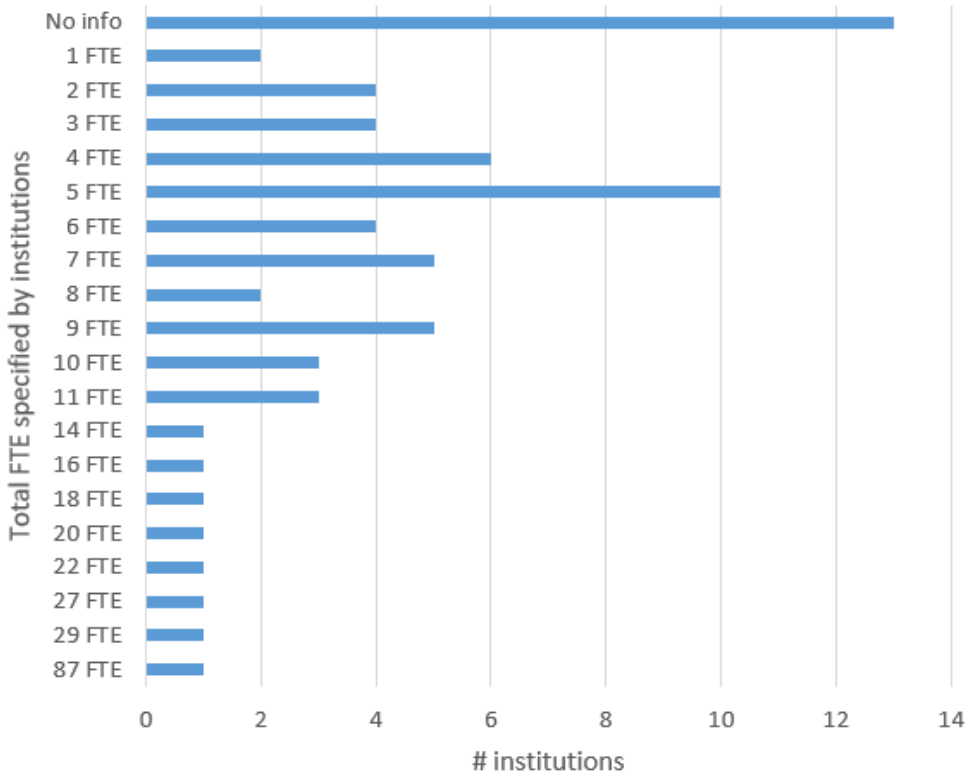
Institution which selected all 5 technologies

- Institute of Plasma Physics and Laser Microfusion (Poland) – 87 FTEs
- CERN (Switzerland) – 18 FTEs
- GSI (Germany) – 6 FTEs
- IJCLab/IN2P3/CNRS (France) – no info on FTEs
- Hebrew University of Jerusalem (Israel) – no info on FTEs

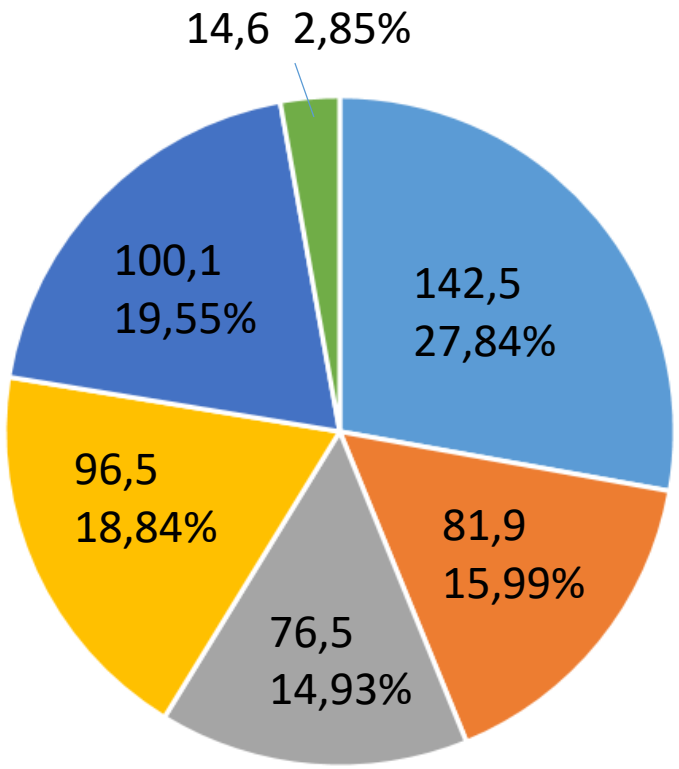
Available Personnel

56 institutions gave information on personnel (only those institution were considered in this analysis)

512 FTEs in total



Personnel distribution to technologies



Assumption: Personnel equally distributed among technologies within an institution

Observation:
FTEs homogenously distributed over all technology.
However, observation could be biased by assumption

MPGD RPC and MRPC Wire chambers Large Volume Detectors New amplifying structures Other

Available Facilities

443 times a available facility was selected (in mean **6.4** potential available facilities per institution)

	DCL	M&PW	AF	CR	GS-DP	MW	EW	AL	ML	RAS	IF	TB	Other
Australia	1			1	1	1	1			1	1	1	1
Belgium	1		1	1		1				1			
Brazil	1			1		1	1	1		1	1	1	
Bulgaria	1												1
China	2	2	2	2	1		1	2		2	1		
Czech Republic										1	1		1
Finland	1	1	1	1		1				1			
France	5	4	4	4	2	4	4	1	1	5		2	1
Germany	5	4	5	5	4	6	6		1	7	3	4	1
Greece	1			1	1	1	1			1	2	2	
India	2		1	2		1				2			
Israel	2	2	1	2	2	2	1	2		2	1		
Italy	16	5	8	15	8	15	15	3	5	13	6	3	2
Japan	1			1						1	1		
Poland	4		1	4		3	2	2		3			
Portugal	2	1	1	2	1	2	1			2	1		
Romania		1		1		1	1			1	1		
Spain	2		1	2	1	1			1	2	1		2
Sweden													
Switzerland	2	2	2	3	2	3	3	2	2	3	3	3	
Türkiye	2	1	1	1	1	2	1	1	1	2	1		
UK	1	1	2	2	1	1	2	2	1	1		1	1
USA	5	3	5	6	5	6	5	1		4	1	2	

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N-America
S-America
Asia
Australia
Europe

Question: How much of the available resources can be used by the DRD1 collaboration?

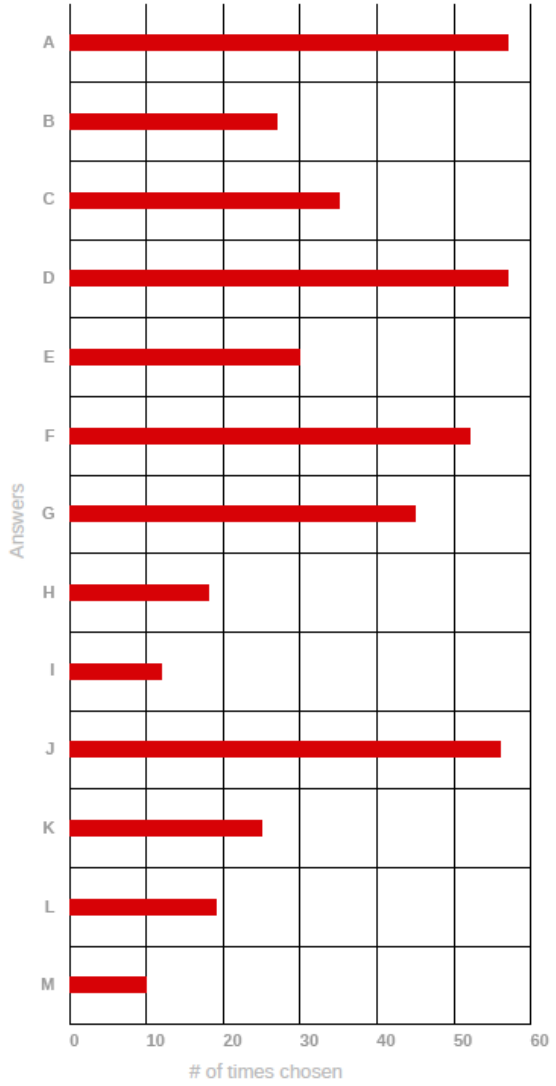
Question: Is more Manufacturing and large scale Production Workshop infrastructure needed?

Available Facilities

Available Facilities (pick-up list)

Answered: 69

- A. Detector Characterization Laboratory: 57 (82.6%)
- B. Manufacturing and Production Workshop: 27 (39.1%)
- C. Assembly Facilities: 35 (50.7%)
- D. Clean Rooms: 57 (82.6%)
- E. Gas system design and production: 30 (43.5%)
- F. Mechanical Workshop: 52 (75.3%)
- G. Electronics Workshop: 45 (65.2%)
- H. Analysis Laboratory: 18 (26.1%)
- I. Metrology Laboratory: 12 (17.4%)
- J. Radioactive Sources (active, passive): 56 (81.2%)
- K. Irradiation Facilities: 25 (36.2%)
- L. Test Beam: 19 (27.5%)
- M. Other: 10 (14.5%)



Do you have production capabilities at your institute?

- **A. Yes**: 34 (49.28%)
- **B. No**: 35 (50.72%)

If yes , please list them in the facility section at the beginning of the survey and specify **if they are accessible to external users**

See more details from WG6

Available Facilities

Other Available Facilities

- Precise wire-winding (10µm precision, also on lage area O(2m)) , Lithography and metallic coating (approx. 50x50cm) by evaporation
- Underground laboratory (Stawell Underground Physics Laboratory), trace element analysis
- Femto-second laser with variable wavelength (250 nm – 2500 nm)
- Computing infrastructure (GRID center + High Performance Computing Cluster with GPUs).
- 4.3km of underground facilities fully dedicated to science and technology and surface facilities
- Cryogenics facility (cryostats)
- 2MeV Van de Graaff accelerator for protons, alphas and deuterons. We also use it to produce neutrons by hitting deuterium and tritium targets with protons and deuterons.
- Facilities for X-ray analysis, SEM and confocal microscopy, the SQUID, the facility for electrical characterization of materials at low temperature
- Optical instrumentation
- Underground laboratory and associated services (radiopurity screening facilities, ...)

Test beam facilities:

CERN, GSI, Frascati, GANIL, Paul Scherrer Institut
TJNAF, Jefferson Lab, Demokritos, IJCLab/IN2P3/CNRS,
Australian National University, INFN Sezione di Padova
IFU de São Paulo, University of Hawaii, NTU Athens
PI, University of Bonn, Università & INFN Sezione di Pavia
University of Manchester

Question: are **all** this test beam facilities available for external groups/institutions belonging to DRD1 and what are the conditions?

Applications of Technologies

	A: MTaTS	B: IaCT	C: Cal	D: PD	E: TOF	F: TPC	G: FRaAbHEP	H: Others
A: MPGD	55,8%	51,9%	21,2%	48,1%	30,8%	34,6%	61,5%	17,3%
B: (M)RPC	80,8%	50,0%	23,1%	42,3%	53,8%	15,4%	76,9%	11,5%
C: WC	63,0%	74,1%	18,5%	48,1%	40,7%	14,8%	63,0%	22,2%
D: LVD	45,7%	68,6%	11,4%	51,4%	28,6%	48,6%	60,0%	17,1%
E: NAS	53,1%	59,4%	25,0%	59,4%	43,8%	40,6%	65,6%	15,6%
F: Others	60,0%	40,0%	20,0%	40,0%	20,0%	60,0%	60,0%	40,0%

Red color means higher correlation, blue less

See more details from WG2

	A: MPGD	B: (M)RPC	C: WC	D: LVD	E: NAS	F: Others
A: MTaTS	69,0%	50,0%	40,5%	38,1%	40,5%	7,1%
B: IaCT	81,8%	39,4%	60,6%	72,7%	57,6%	6,1%
C: Cal	91,7%	50,0%	41,7%	33,3%	66,7%	8,3%
D: PD	92,6%	40,7%	48,1%	66,7%	70,4%	7,4%
E: TOF	72,7%	63,6%	50,0%	45,5%	63,6%	4,5%
F: TPC	90,0%	20,0%	20,0%	85,0%	65,0%	15,0%
G: FRaAbHEP	86,5%	54,1%	45,9%	56,8%	56,8%	8,1%
H: Others	90,0%	30,0%	60,0%	60,0%	50,0%	20,0%

A: MTaTS	(Muon) Tracking and Triggering Systems
B: IaCT	Inner and central tracking with particle identification capability (drift, straw, TPC,..)
C: Cal	Calorimetry
D: PD	Photon detection
E: TOF	Time of Flight
F: TPC	TPCs for rare event searches
G: FRaAbHEP	Fundamental research and applications beyond HEP (including industrial applications)
H: Others	Other

A. (Muon) Tracking and Triggering Systems: 42 (20.69%)

B. Inner and central tracking with particle identification capability (drift, straw, TPC,..): 33 (16.26%)

C. Calorimetry: 12 (5.91%)

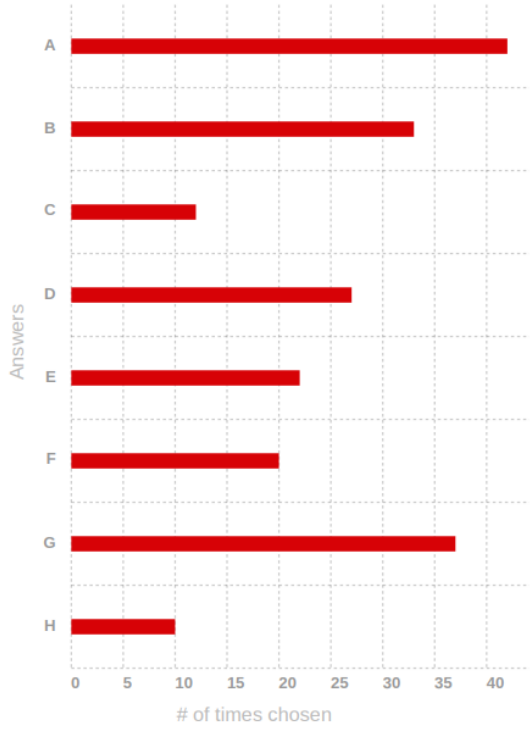
D. Photon detection: 27 (13.30%)

E. Time of Flight : 22 (10.84%)

F. TPCs for rare event searches: 20 (9.85%)

G. Fundamental research and applications beyond HEP (including industrial applications): 37 (18.23%)

H. Other: 10 (4.93%)



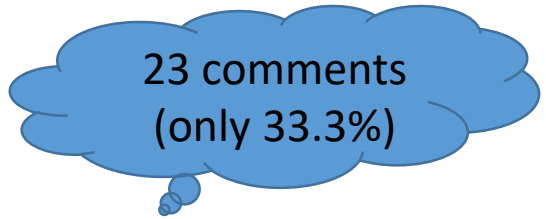
Summary

Thank you for your attention

- **69** institutions from **23** countries fill in the survey
- **All** different types of gaseous detectors are well covered by the current community
- **2 Questions** regarding to technology to the participants of the survey
  - Technologies of interest
  - Comments/Notes (only 33,3% expressed comments)
- **177** times a technology was selected (in mean 2.5 technologies per institution)
- Technologies are homogenous distributed over Institutions/Countries and Continents
- Since many institutes are working on multiple technologies it is not always clear from the survey which type is used for what application
- Concerning the facilities, more information is needed from the institutes to understand the details of their infrastructure and the public access options

Backup

Technology of interest /Comments/Notes



General:
Gas Group (MPGD, RPC, Wire), -> CERN
GridPix

MPGD:
Single photon detectors based on THGEM + MM technologies for medical imaging purposes
ML-ThGEM.
MPGD-based wide area detectors
Resistive Micromegas; Implementation of resistive Micromegas and uRWell on hadron sampling calorimetry;
MPGDs for operation in liquid xenon and argon
Fast Timing MPGD
Triple-GEMs and Resistive MPGDs for high-rate operation
Glass GEMs

RPC and MRPC:
There are on-going R&D for high rate RPCs for tracking purposes
Muography telescope is under construction.

Wire Chambers:
(MWPCs and STRAW tubes) for developing detectors can be used for tracking ToF
Straw tube, MDT"

Large Volume Detectors:
High pressure TPC

Others:
Hybrid detectors (eg gas amplification and silicon pixels) for light and charged particles detection with fast timing
Neutron spectrometry with Bonner spheres

Technologies of interest - some statistics

Table shows the percentage of institutions which selected a different technology in addition

	A: MPGD	B: (M)RPC	C: WC	D: LVD	E: NAS	F: Other
A: MPGD		30,8%	36,5%	59,6%	57,7%	9,6%
B: (M)RPC	61,5%		50,0%	34,6%	46,2%	0,0%
C: WC	70,4%	48,1%		51,9%	44,4%	0,0%
D: LVD	88,6%	25,7%	40,0%		62,9%	11,4%
E: NAS	93,8%	37,5%	37,5%	68,8%		9,4%
F: Other	100,0%	0,0%	0,0%	80,0%	60,0%	