MoEDAL

Monopole and Exotics Detection At the LHC

ISS

Vlad Popa
Institute for Space Science

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Outlook:

- Introduction: basic information on MoEDAL
- Detection techniques
- Expected sensitivity (results)
- MoEDAL timeline
- A virtual tour inside MoEDAL

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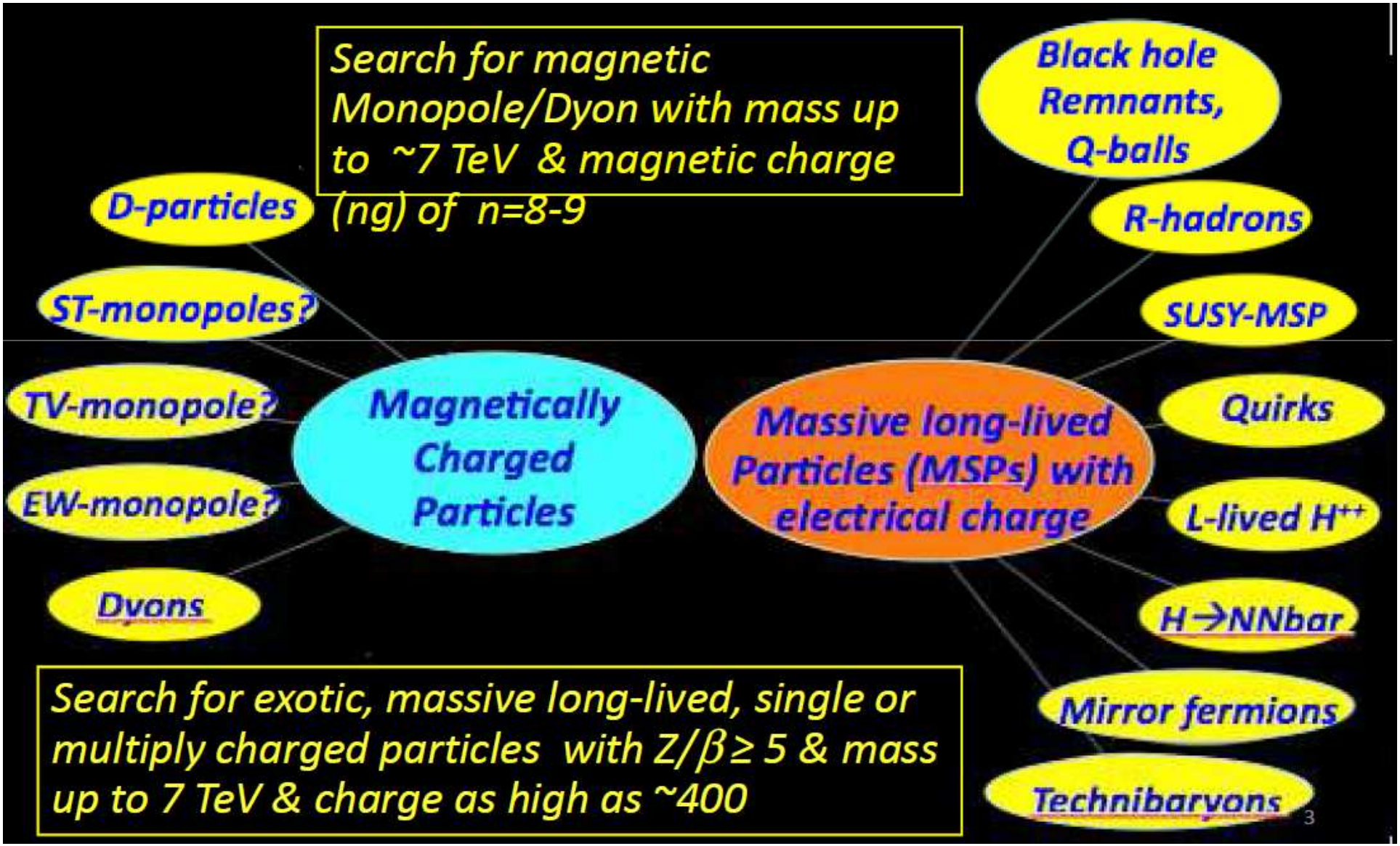
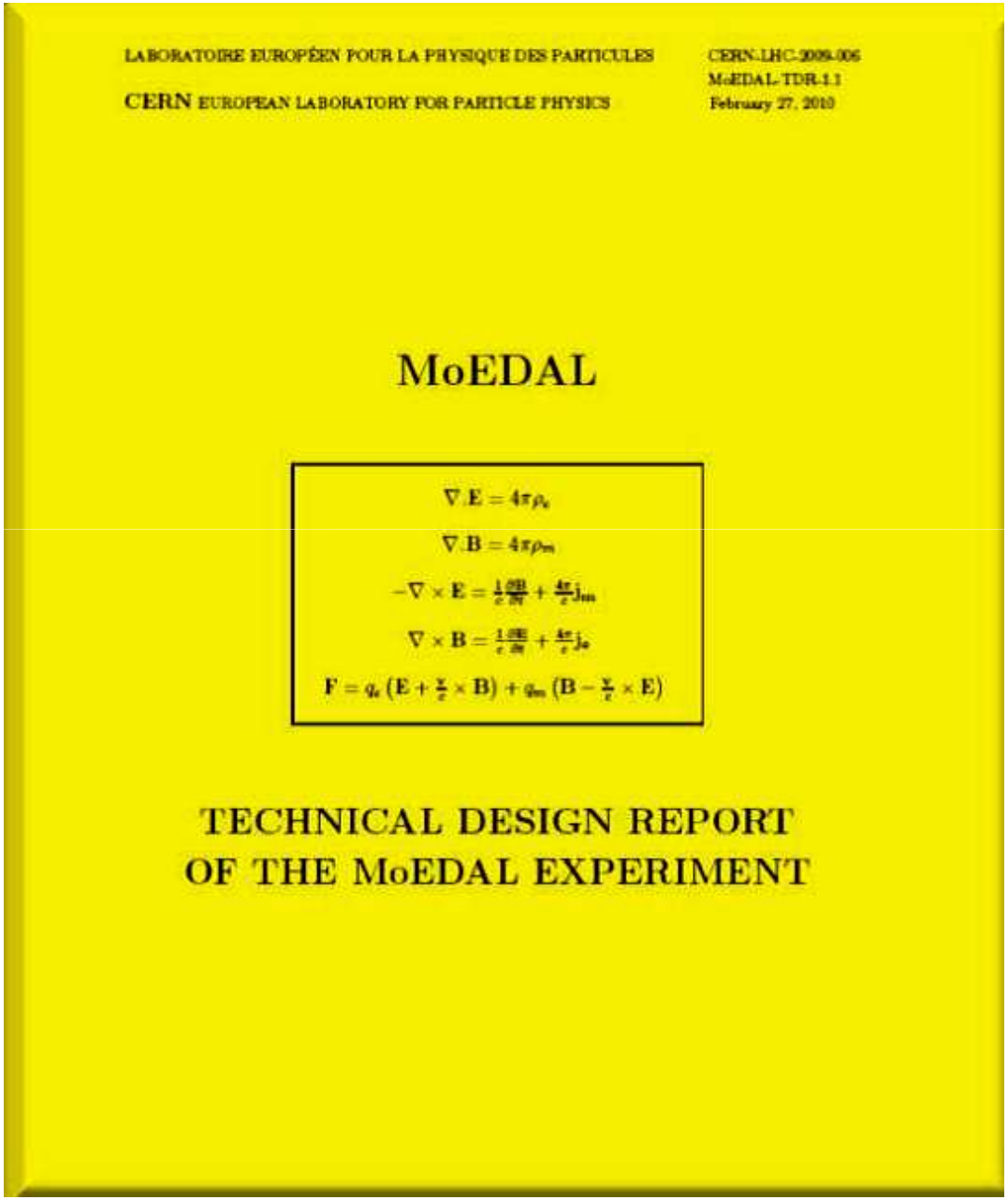
MoEDAL's main physics goal is to look for Magnetic Monopoles produced in *pp* interactions at LHC energies, but not only…



MoEDAL is the 7th LHC experiment, approved in May 2010.



MoEDAL shares intersection point 8 on the LHC ring with LHCb

DETECTOR SYSTEMS

1)The main NTD array ($Z/\beta > \sim 5$)

2)The Very High Charge Catcher NTD array ($Z/b > \sim 50$)

3)The Monopole Trapping detector

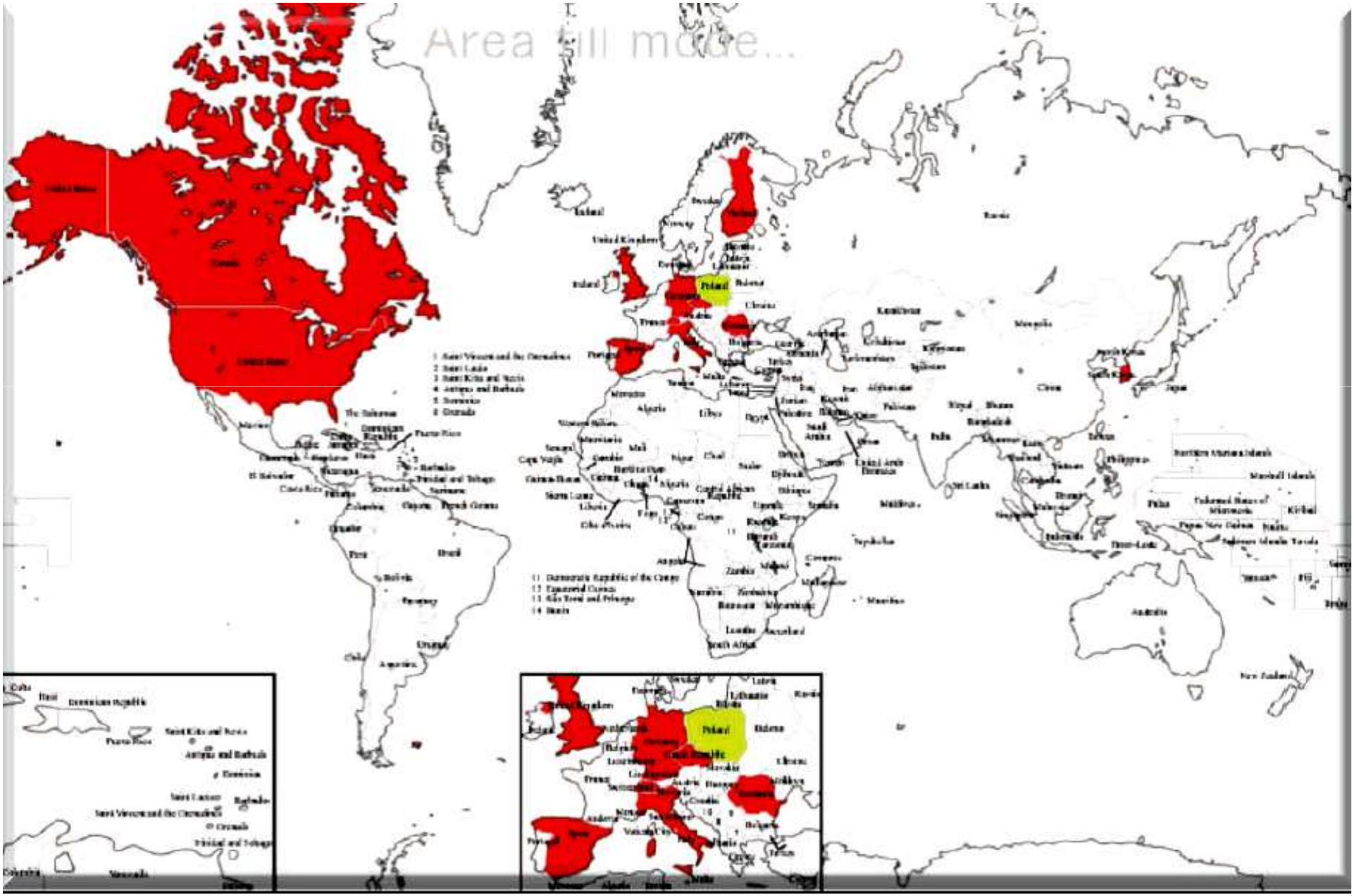
} *New ideas (Dec 2011)*

4)The TimePix radiation background monitor

MoEDAL is unlike any other LHC experiment:

- *The largest deployment of passive Nuclear Track Detectors (NTDs) at an accelerator (250 m^2)*
- *The 1st time that trapping detectors will be deployed at LHC*

~ 50 physicists from 20 institutes in 12 countries (Sweden recently joined)



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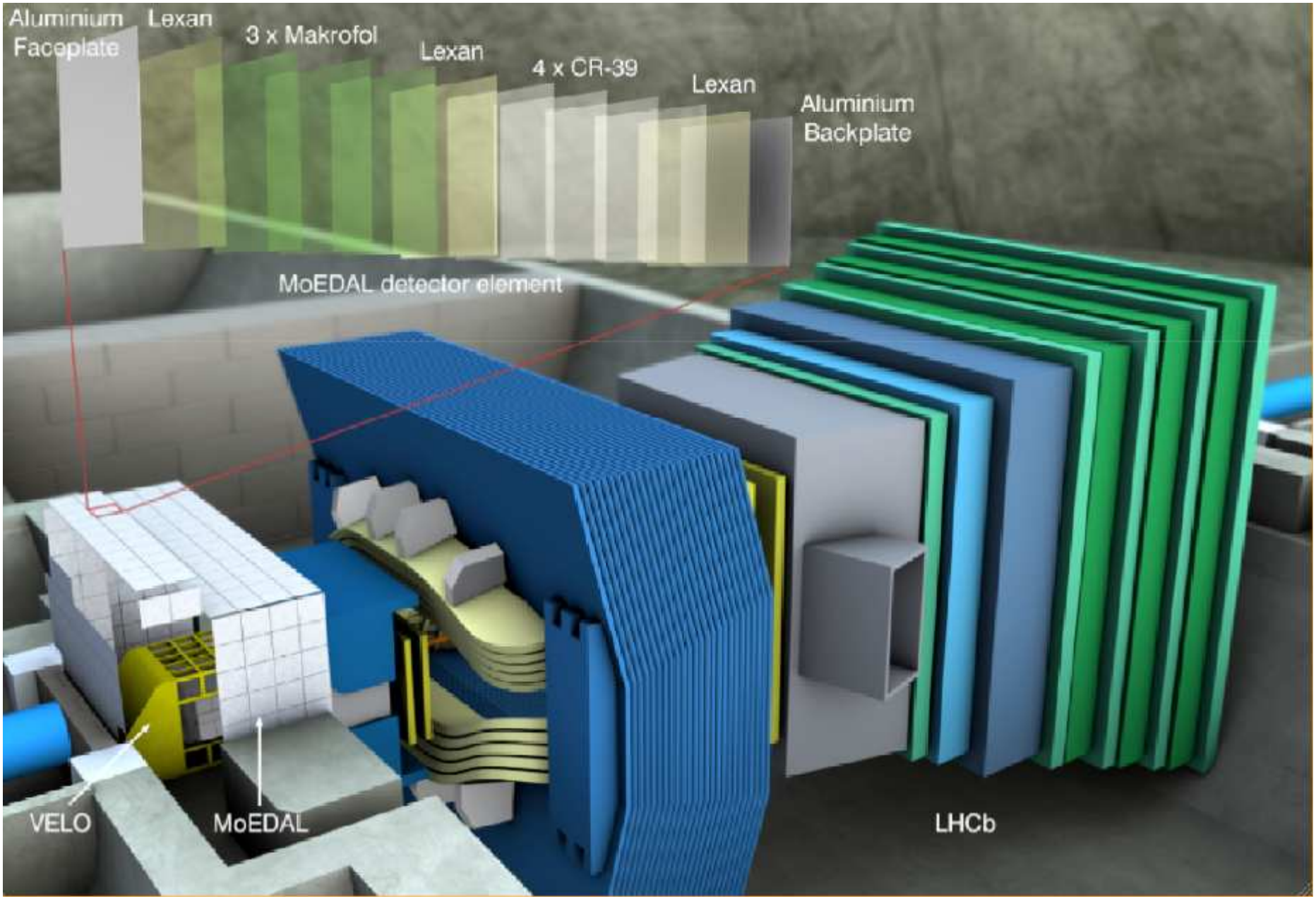
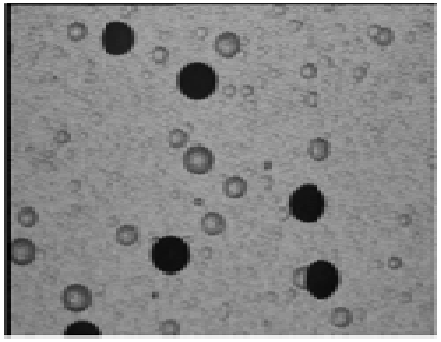
1. The main NTD array, Z/β≥5



NTD's calibration, etching and scanning

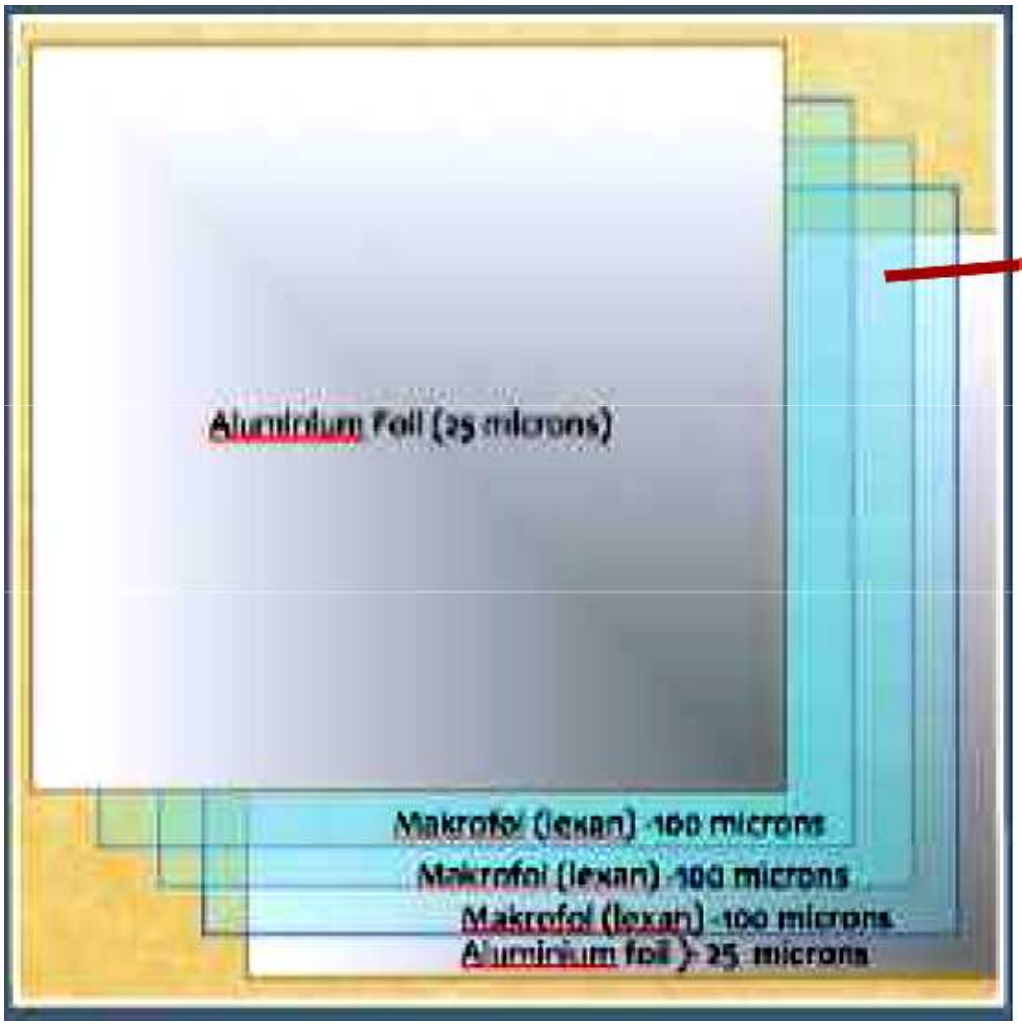


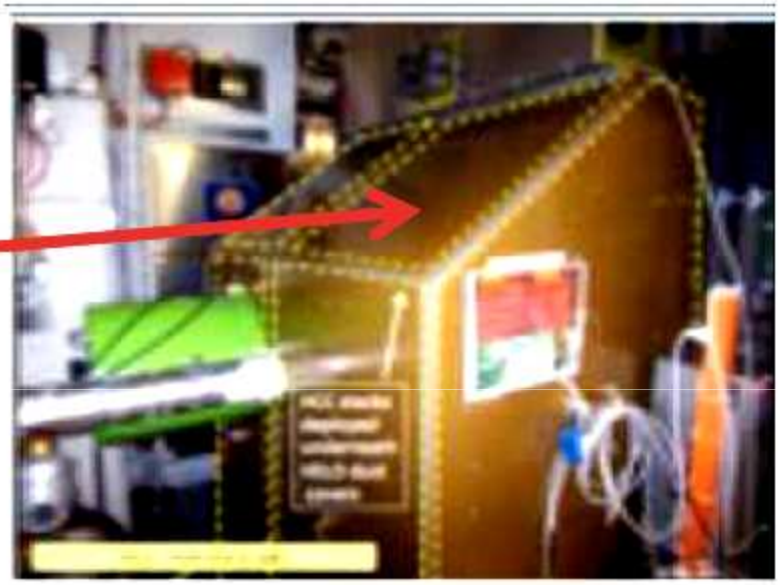
Calibrations (BNL, Fe, 1AGeV)

Chemical etching (INFN Bologna)

Fast scanning with stereo microscopes

2. The Very High Charge Catcher (flexible) NTD array, Z/β≥50…





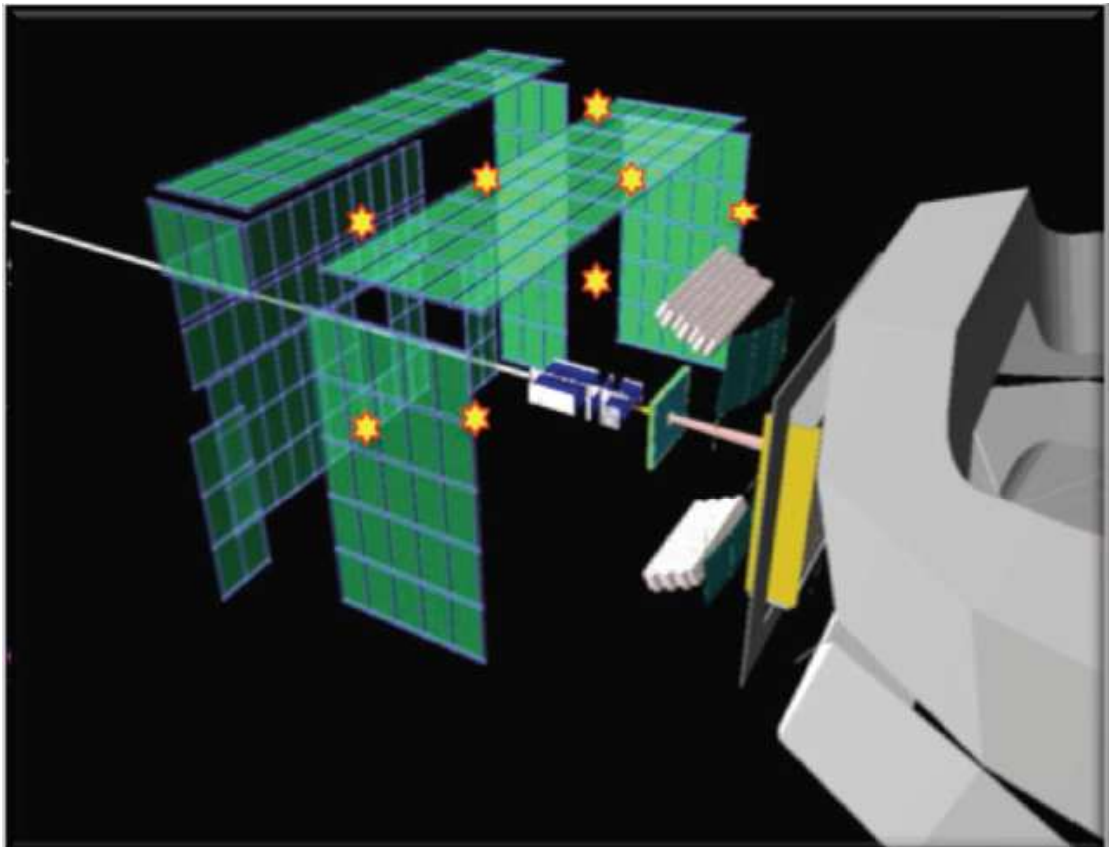
… to be deployed close to the vertex

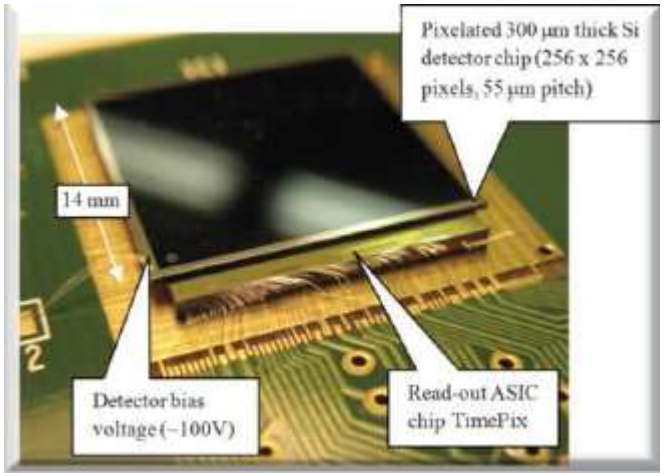
3. The monopole trapping detectors will be deployed in the LHCb cavern. They will consists in closely packed Al bars. The binding energy of monopoles in nuclei with finite magnetic dipole moments ~ few 100 keV.

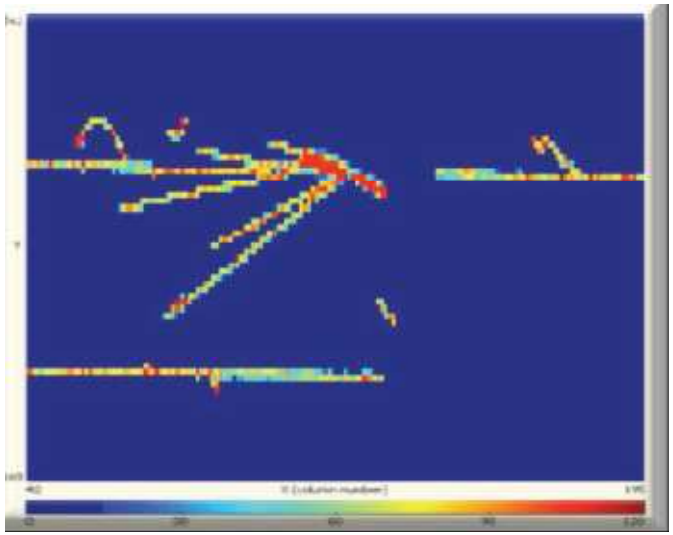
After exposure some of them will be transferred to the SQUID magnetometer at ETH Zurich, able to detect magnetic fields corresponding to $g_D \geq 0.1$.

Other trapping detectors will be moved to SNOLAB (2km underground) in order to measure possible Massive Supersymetric Particle decays.

The TimePix radiation background monitor







- *Timepix (MediPix) chips are used to measure online the radiation field + measure the spallation product bkg.)*
- *The TimePix chip is essentially an electronic bubble chamber*

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Accele-Rator	Reaction	Beam Energy Gev	√s GeV	Mass limit GeV	Cross Section cm^2	MM Charge	TECN	Year	Ref.
LBL	pA	6.2	3.76	<1	1.e-40	1	EMUL	1959	14
CERN	pA	28.0	7.6	<3	1.e-35	<4	CNTR	1961	15a
AGS	pA	30.0	7.86	<3	2.e-40	<2	CNTR	1963	15
CERN	pA	28.0	7.6	<3	1.e-40	<2	EMUL	1963	15b
IHEP	pA	70.0	11.9	<5	1.e-41		EMUL	1972	16
FNAL	pA	400	28.3	<13	5.e-42	<24	CNTR	1974	17a
ISR	pp	60	60	<30	1.e-36	<3	PLAS	1975	25
FNAL	pA	400	28.3	<12	5.e-43	<10	INDU	1975	17
FNAL	pA	300	24.5		2.e-30		OSPK	1975	17b
IHEP	pA	70	11.9	<5	1.e-40	<2	CNTR	1976	17c
CERN	pp	56	56	<30	1.e-37	<3	PLAS	1978	26
CERN	pp	63	63	<20	1.e-37	<24	CNTR	1978	17d
SLAC	e+e-	29	29	<30	4.e-38	<3	PLAS	1982	27
CERN	pp	52	52	<20	8.e-36		CNTR	1982	24
CERN	e+e-	34	34	10	4.e-38	<6	PLAS	1983	29
CERN	pp	540	540		1.e-31	1,3	PLAS	1983	18
SLAC	e+e-	29	29		3.e-38	<3	PLAS	1984	28
FNAL	pap	1800	1800	<800	3.e-38	>=1	PLAS	1987	18a
CLEO	e+e-	10.6	10.6	<4	9.e-37	<0.15	CLEO	1987	18b
CERN	e+e-	50-52	50-52	<24	8.e-37	1	PLAS	1988	18c
DESY	e+e-	35	35	<17	1.e-38	<1	CNTR	1988	30
KEK	e+e-	50-61	50-61	<29	1.e-37	1	PLAS	1989	31
FNAL	pp	1800	1800	<850	2.e-34	>=0.5	PLAS	1990	23
CERN	e+e-	88-94	88-94	<45	3.e-37	1	PLAS	1992	32
CERN	e+e-	88-94	88-94				PLAS	1993	33
CERN	PbA	160A	17.9	<8.1	1.9e-33	>=2	PLAS	1997	18d
AGS	AuAu	11A	4.87	<3.3	0.65e-33	>=2	PLAS	1997	18d
FNAL	pap	1800	1800	260-420	7.8e-36	2-6	INDU	2000	19
FNAL	pap	1800	1800	265-410	0.2e-36	1-6	INDU	2004	20
HERA	e+p	300	300		0.5e-37	1-6	INDU	2005	22
FNAL	pap	1800	1800	369	0.2e-36	>=1	CNTR	2006	34

Monopole searches have been performed at many particle accelerators….

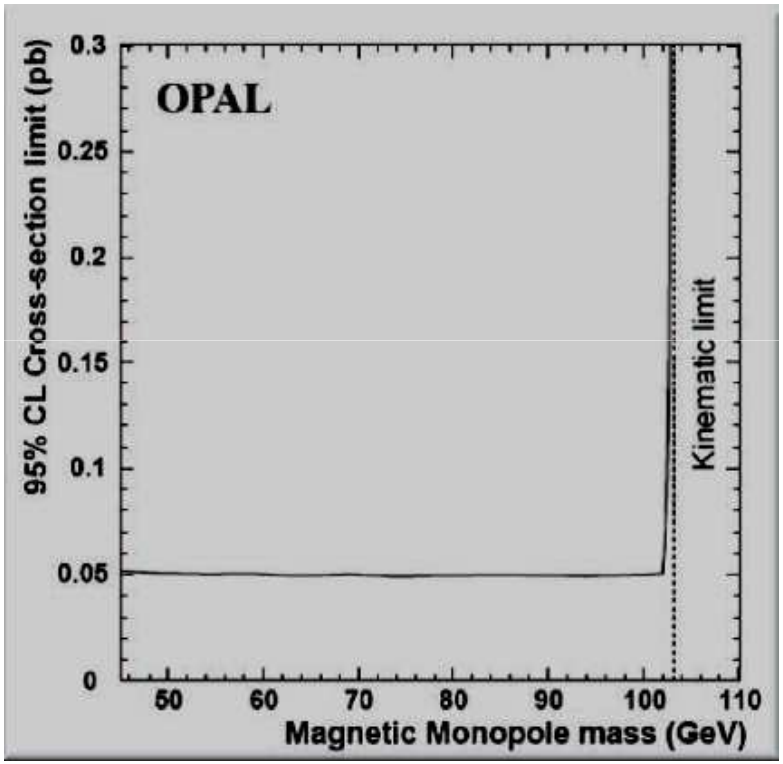
14 experiments used plastic NTDs

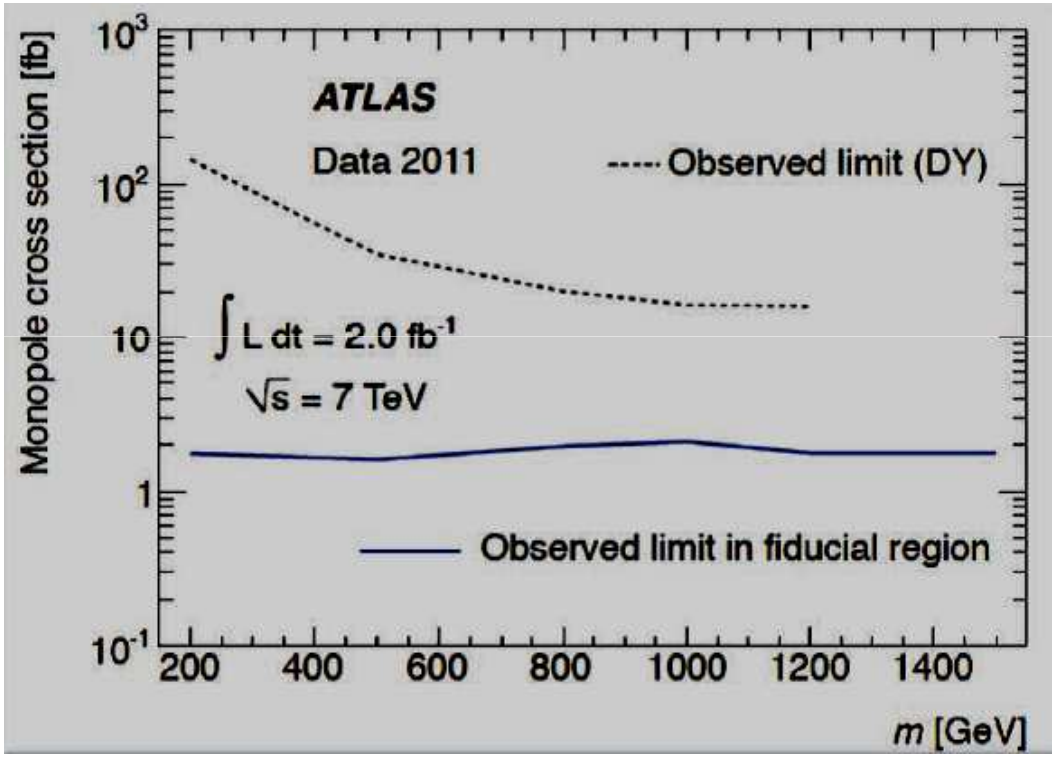
3 experiments used emulsions

3 experiments used induction

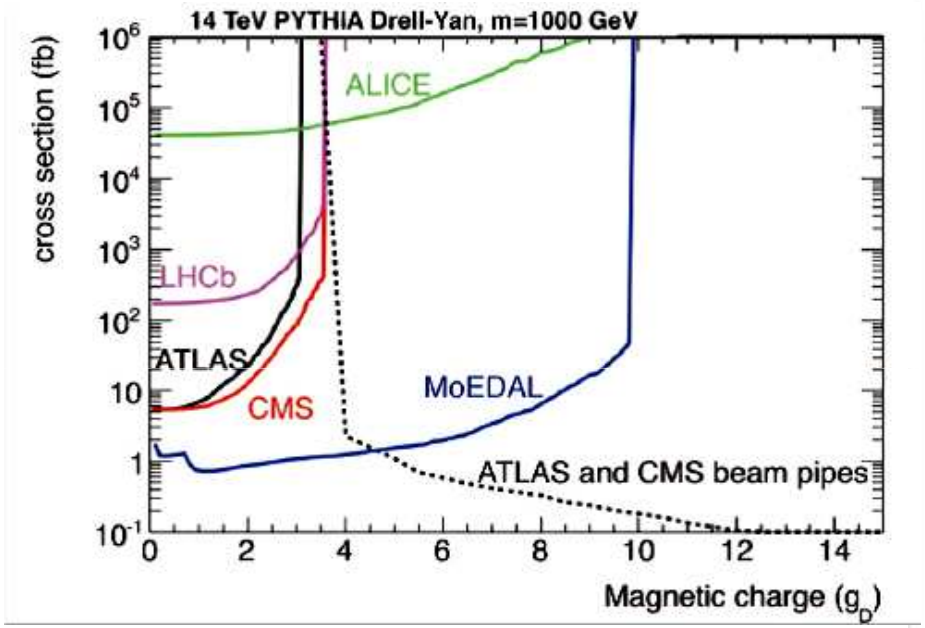
11 experiments used counters

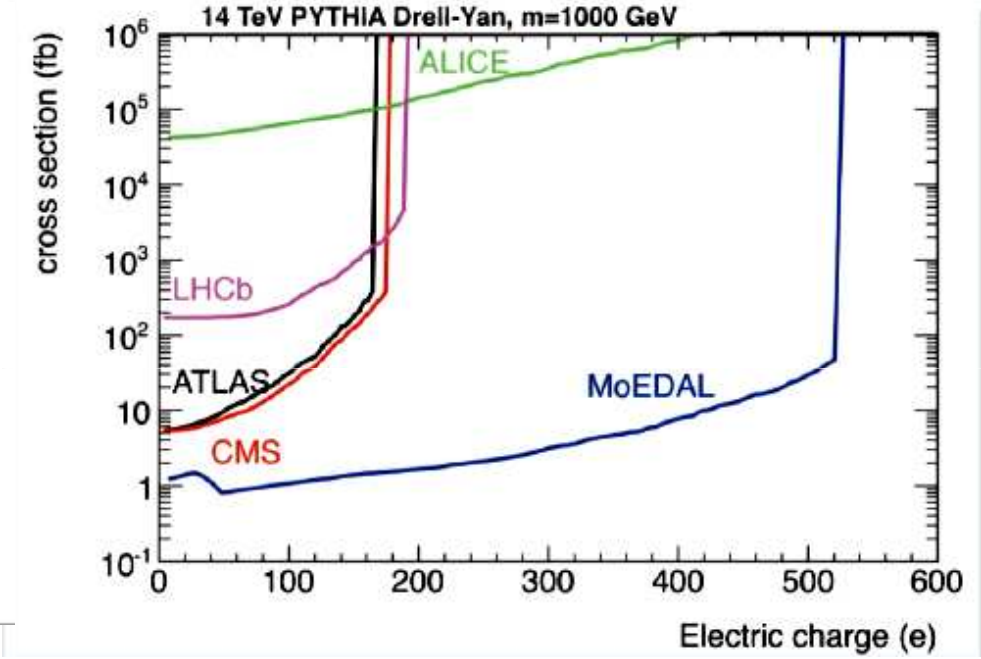
Some recent results from recent (past 5 years) experiments





MoEDAL sensitivity for monopoles and highly ionizing exotic massive particles (4 years of exposure, ~ 20 fb^{-1} integrated *L* at 14 TeV)





MoEDAL is background free (in the Standard Model), so a single event could significate a discovery. This is not the case of the other LHC experiments.

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First detectors (10 sqm of plastic) deployed in Nov. 2009)

We deployed a larger area of plastic (~80 m^2) in Jan. 2011

Test deployment of TimePix detectors in Feb. 2012

Test Deployment of MMT sub-detector in Sept. 2012

Full deployment is planned for the year long shutdown starting in 2013/2014.

In 2015 expect to have our first "official" run to be continued until we reach a ΣL of $\geq$ ~$10 fb^{-1}$ at 14 TeV.

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