MICROGAN ECR ION SOURCE IN A VAN DE GRAAFF ACCELERATOR TERMINAL

ABSTRACT:

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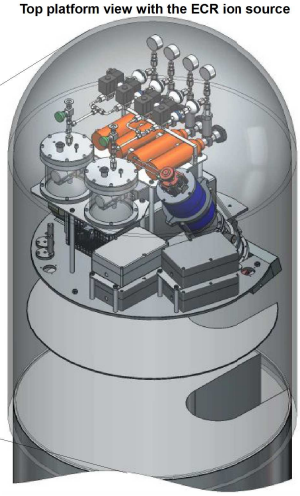
The Van de Graaff accelerator at IRMM works since many years providing proton, deuteron and helium beams for nuclear data measurements. The original ion source was of RF type with quartz bottle. This kind of source, as well known, needs regular maintenance for which the accelerator tank must be completely opened. The heavy usage at high currents of the IRMM accelerator necessitated an opening about once every month. Recently, the full permanent magnet Microgan ECR ion source from PANTECHNIK was installed into a new terminal platform together with a solid state amplifier of 50W, a dedicated dosing system for 4 gases (with respective gas bottles H2, D2, He and Ar), and a set of dedicated power supplies and electronic devices for the remote tuning of the source. The new system shows a very stable behaviour of the produced beam allowing running the Van de Graff without maintenance for several months.

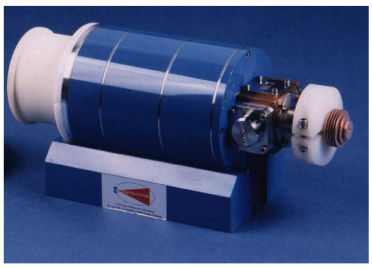
7 MeV VDG Column filled with up to 15 bars of Nitrogen

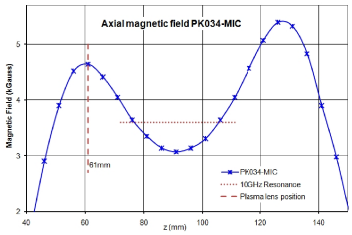
Top platform view with the ECR ion source



MICROGAN ECR ION SOURCE

10 GHz ECR ION Source using a full permanent magnet field structure





Usual garanteed intensities (in µAe)							VDG Requirements
Ions/Q	1+	2+	3+	4+	5+	8+	1+
H	7000						60
D							60
He	5000						60
O	4000	400	170				
P	2000	1200	700	200	20		
Ar	2000	1290	600	220		20	

VAN DE GRAAFF PLATFORM AND CONSTRAINS

Working at High Pressure:
- Proof for all parts of the reliability
- Special design (gas dosing valve)
- Dedicated hyperbaric test bench

Mechanical constrain:
- Small space = need to minimize equipments
- The machine opening is difficult and time costly =
* gas system with 4 different kind
* full remote control

Electrical constrain:
- About 100 W of AC 400Hz power available at the top of the platform = minimize the total consumption of the equipments

High Voltage (7MeV) constrain:
- Protection against HV sparks for all electronics
- Components placed in dedicated shielding box
- feed-through and CEM protection placed on each cable (power and signals)

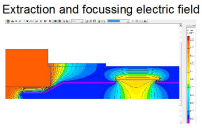
Total charges from the belt of the VdG (max; 200µA):
- Reduce the total ion beam produced
- by reducing the RF power (max. 50 W)
- by reducing the plasma lens aperture (phi 3 mm)

Some specific RF solutions:
- The RF amplifier is a 50W solid state type for 10GHz and is qualified for High Pressure working
- A dedicated Wave Guide (WR90) to coaxial (SMA or N type) feed-through has been developed. The outer is working at 15 bars while the inner side is under vacuum with a rate leak better than 1.10^{-9} mbar.l.s^{-1}.

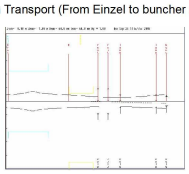
QuickField and Transport calculations

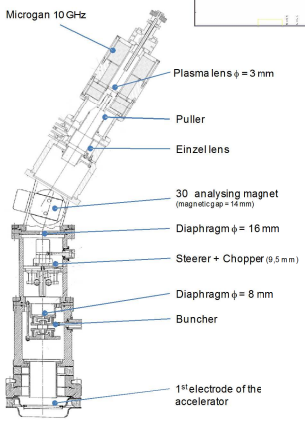
Simulations:

Extraction and focussing electric field



Beam Transport (From Einzel to buncher entry)





Command & Control

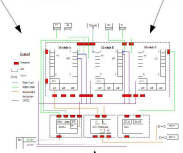
Equipments to C&C software:

Optic fiber network between electronic I/O A/N modules

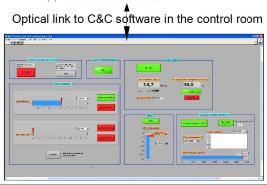
Platform Top view

Platform side view

C&C hardware principle



Optical link to C&C software in the control room



BEAM RESULTS: Intensities and Stability

3 MeV beams measured in a FC at the bottom of the VdG:

Identification done for each particle by mass analysis after the acceleration (RMN)

Ion	P colonne	Uextr	Iextr	P HF	Gaz 1	Vgaz1	Gaz 2	Vgaz2	Ueinzel	Ieinzel	30° Mag	ICF 25
Type	10-6 torr	turns	mA	W	Type	V	Type	V	V	mA	turns	µA
H^+	1.13	33.0	1.2	14.80	H2	2.680	-	0.000	27752	0.219	17	65
D^+	1.21	26.0	1.5	14.90	-	0.000	D2	1.600	20720	0.139	21	75
D_2^+	1.21	26.0	1.5	14.90	-	0.000	D2	1.600	20720	0.139	28	>100
He^+	0.92	26.0	<1	10.30	-	0.000	He	0.850	20314	0.113	28	62

48 hours H^+ beam stability without any operator adjustment:

"Night and day effect" (temperature variation) induced +/- 5% variation