The Frequency scaling with miniature COMIC ion sources

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1 - The COMIC principle

2 - The Multi Beam Sputtering machine : MBS-20

3 - COMIC 5.8 GHz

4 - SuperCOMIC 5.8 GHz High intensity

5 - Conclusions et perspectives
The Frequency scaling with miniature COMIC ion sources

1 - The COMIC principle

| Source | 18.5 KV |
| Extraction electrode | 16.5 KV |
| Grounded electrode | |
| FC | 0.38 mA  
Argon ~ some mA/cm² |

Extraction plane

Area of maximum power coupling

Forward diffusion inside the magnetic field

|E| < 10⁵ kV/m (1 W)
The Multi Beam Sputtering: a new thin film deposition approach

1 - The COMIC source: a commercial product for FIB

1 - i-FIB:

"ECR Plasma FIB
50 times faster than the most powerful Ga FIB"

Orsay Physics

COMIC source inside 0.3 mm extraction hole

1 µA re-focused on 1 µm
The Multi Beam Sputtering: a new thin film deposition approach

2 - The MBS-20 functioning with 20 Xe beams (with $O_2$ pressure)

263 +/- 7 nm
Profilometer measurements
Static substrate
$Ta_2O_5$ on Silicium
The Multi Beam Sputtering: a new thin film deposition approach

2 - The MBS-20 preliminary results: focus control

9 mm
beam exit hole

14/12.0 kV – 4.2 mA

12 mm
Ta targets

~ 35 mm
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2 - The MBS-20 preliminary results: co-evaporation

Multi beam (18)
Multi target (6 times three components: Cu, Mn, Ta, Ni, Co, Fe)
Multi current (~ 50 and 200 µAe)

Fe-Ni deposition

Fe 20% – Ni 20% – 20 nm

Hc ~ 5.3 Oe
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**3 - COMIC 5.8 GHz**

Diagram showing dimensions and frequencies:
- **5.8 GHz**: 31 mm height, 15 mm width, 2 mm depth
- **2.45 GHz**: 20 mm height, 11 mm width, 11 mm depth

Diagram labeled with **COMIC 5.8 GHz**.
The Multi Beam Sputtering: a new thin film deposition approach

3 - COMIC 5.8 GHz

11 µA, 6.6W, 13.5 kV-12.7 kV, Ar

Extracted current with 0.3 mm extraction hole versus injected power at 2.45 and 5.8 GHz

Ar gas
2 \(10^{-6}\) mbar at 2.45 GHz
1 \(10^{-5}\) mbar at 5.8 GHz
15 kV, accel-accel extractor
The Multi Beam Sputtering: a new thin film deposition approach

4 - SuperCOMIC 5.8 GHz: HV - HI investigation

6 mm extraction hole, 2.4 mA, 12 W
Ar, 2 \times 10^{-4} \text{ mbar}

\begin{center}
\begin{tikzpicture}
\begin{axis}[
    width=\textwidth,
    height=8cm,
    xlabel=W,
    ylabel=mA,
    xmin=0, xmax=12.5,
    ymin=0, ymax=3,
    xtick={0,2.5,5,7.5,10,12.5},
    ytick={0,0.5,1,1.5,2,2.5,3},
    xticklabels={0, 1.5 W, 6 W, 12.5},
    yticklabels={0, 8.5 mA/cm^2},
    grid=both,
    legend pos=north east,
]
\addplot[blue, mark=diamond] coordinates {
(0,0) (1.5,1.5) (6,2.5) (10,3)
};
\addplot[red, thick] coordinates {
(1.5,1.5) (1.5,3)
(6,2.5) (6,3)
};
\end{axis}
\end{tikzpicture}
\end{center}
5 - Conclusions

1 - Multi source system operational
   20 sources, twelve months, no maintenance

2 - « Fine » stoechiometry / rugosity / thickness control
   Complex deposition up to 6 compounds, ultra thin deposition

3 - Scalable technology
   - Number of ion sources (smaller sizes)
   - Better current density
   - High voltage extraction