# "Preglow" investigation in ECR discharge @ 37 GHz, 100 kW

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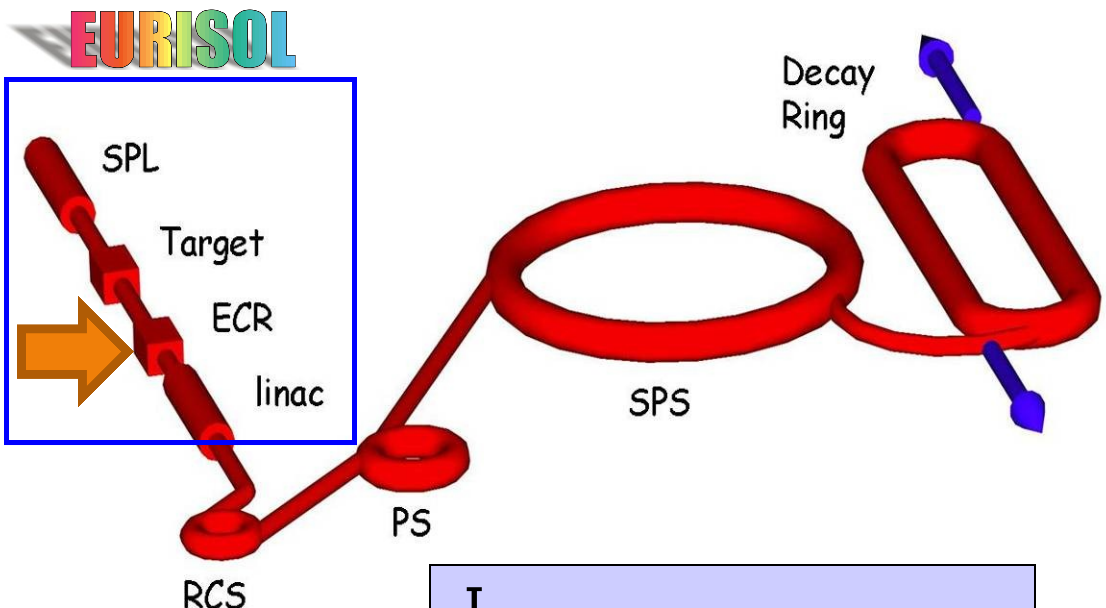
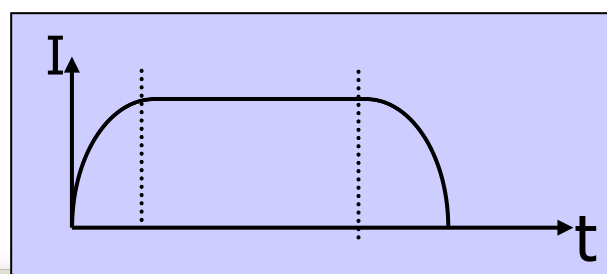
# Outline

- Introduction and review of previous preglow investigations
- New experimental results @ 37 GHz
- Future plans

# Motivation: CERN Beta-beam and EURISOL

- Short pulse MCI source (20-100 μs)




**Decay ring**

B = 5 T

$L_{ss}$ = 2500 m

$$^{6}_{2}He \rightarrow ^{6}_{3}Li\, e^{-} \nu$$

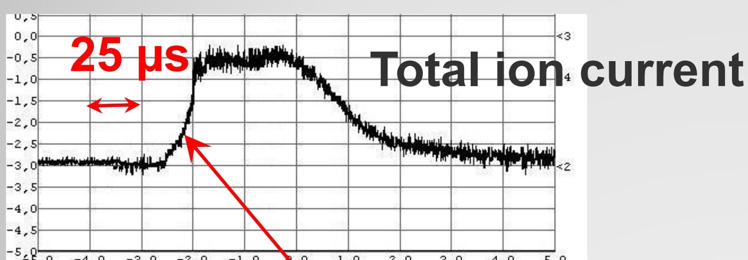
$$^{18}_{10}Ne \rightarrow ^{18}_{9}F\, e^{+} \nu$$

# Two ways of short pulse creation

Short pulse ECR Ion Source

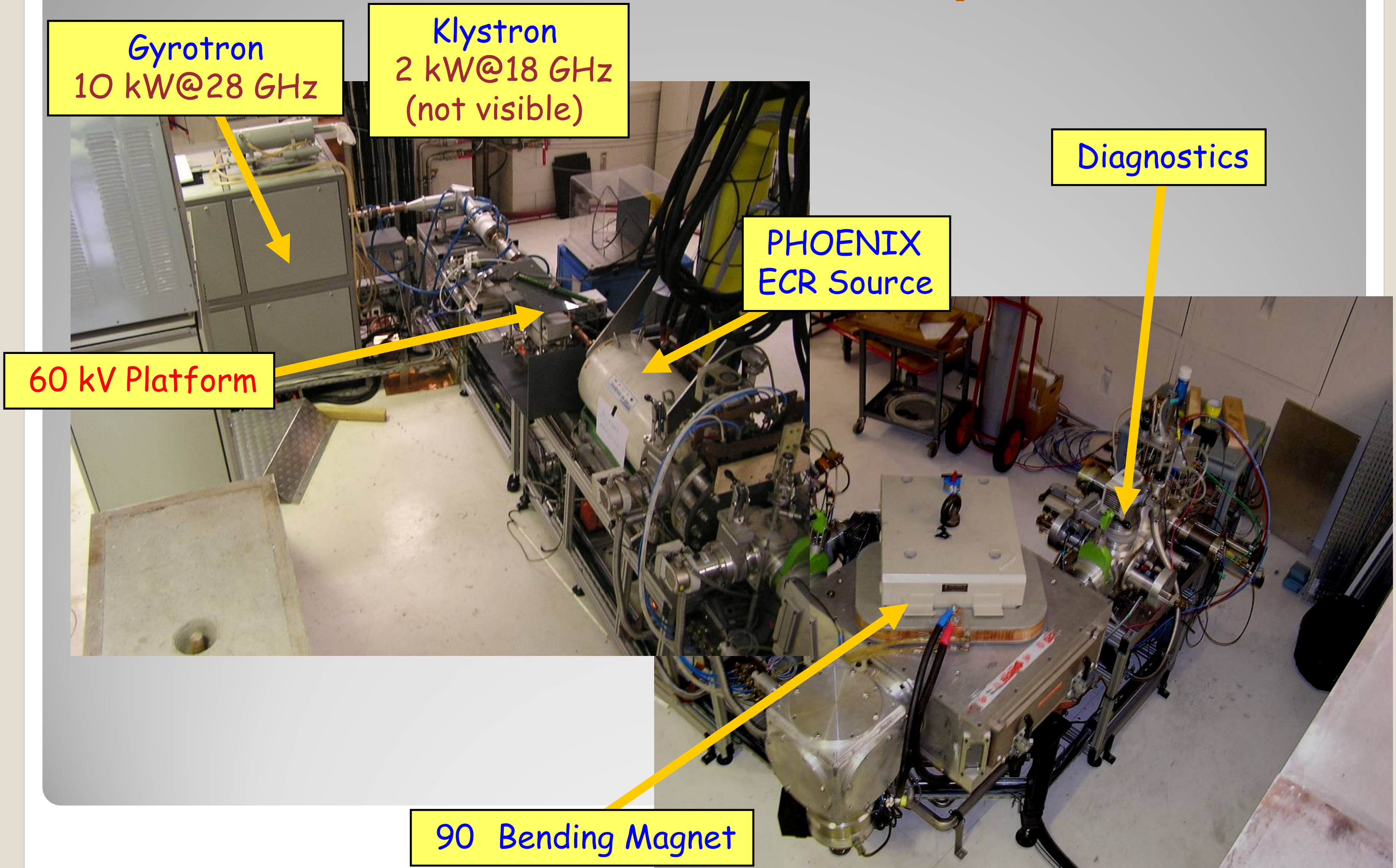
Quasi-stationary generation of MCI
(Quasi-gasdynamic Ion Source)

Nonstationary generation of MCI
(preglow & afterglow effects)

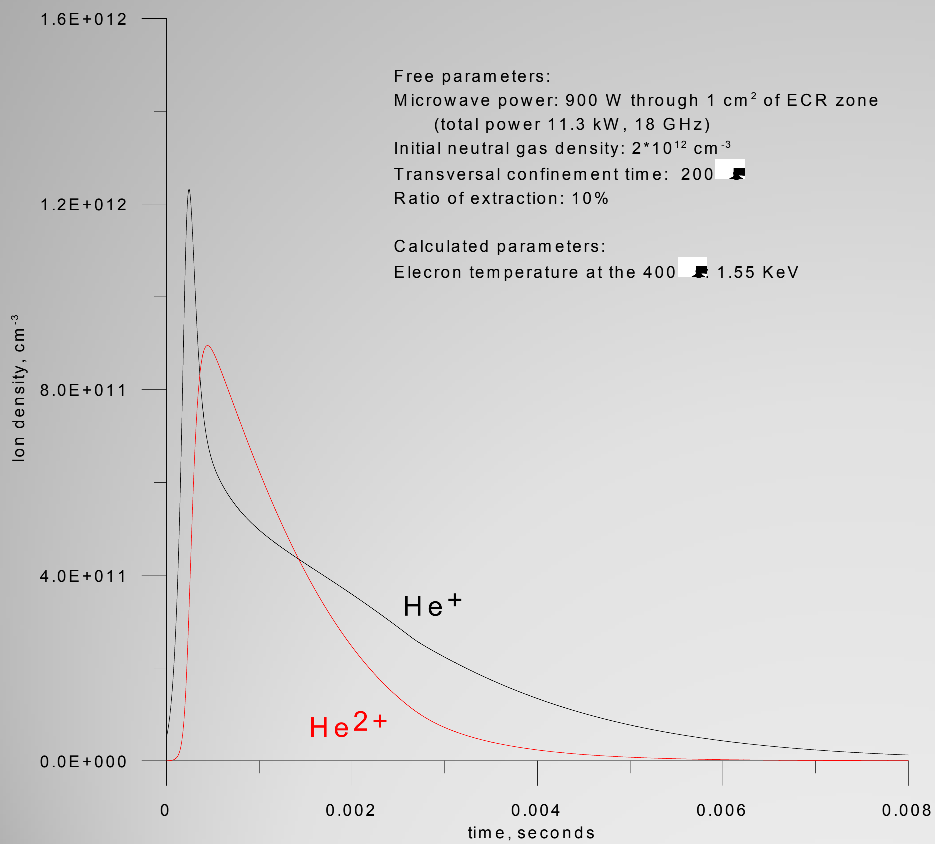


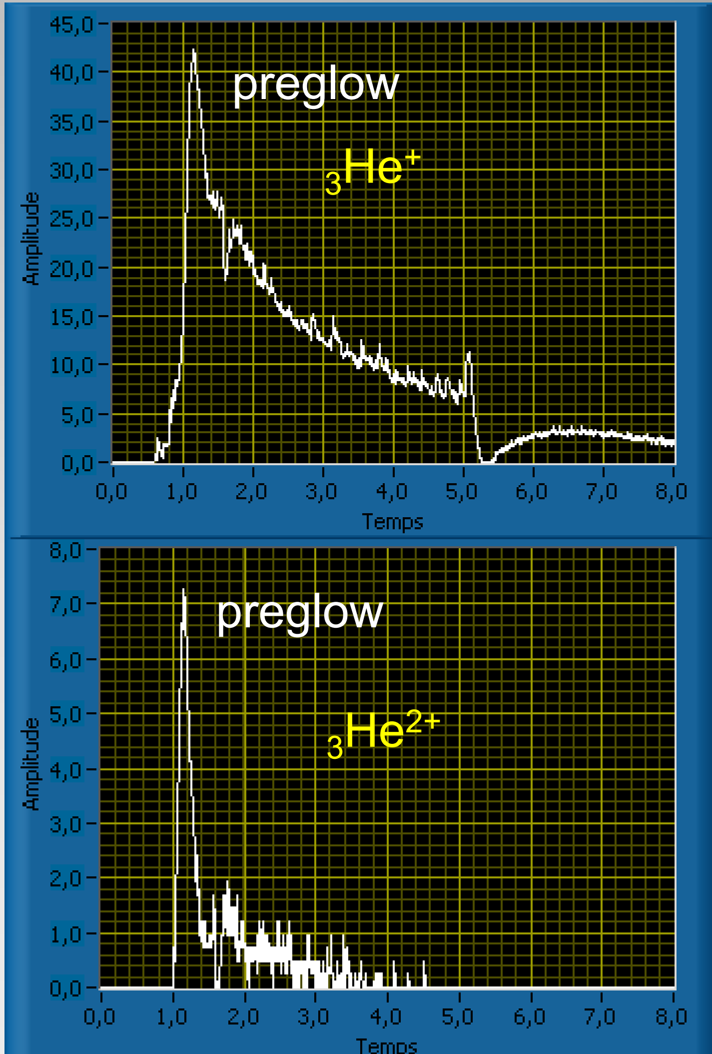

Rising time~15 µs

# Grenoble MCI sources,28 GHz



# «Preglow» effect



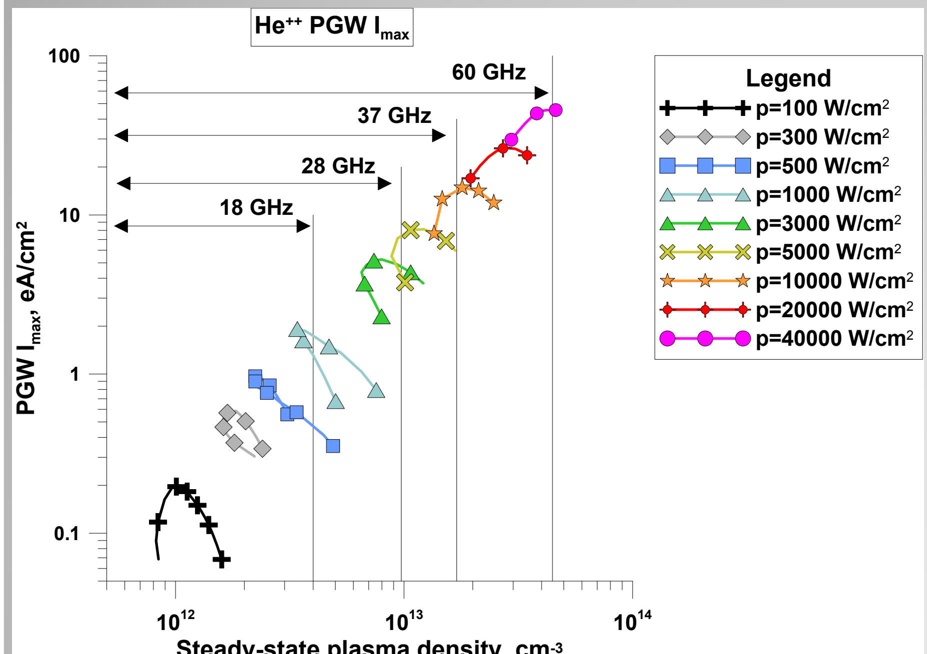



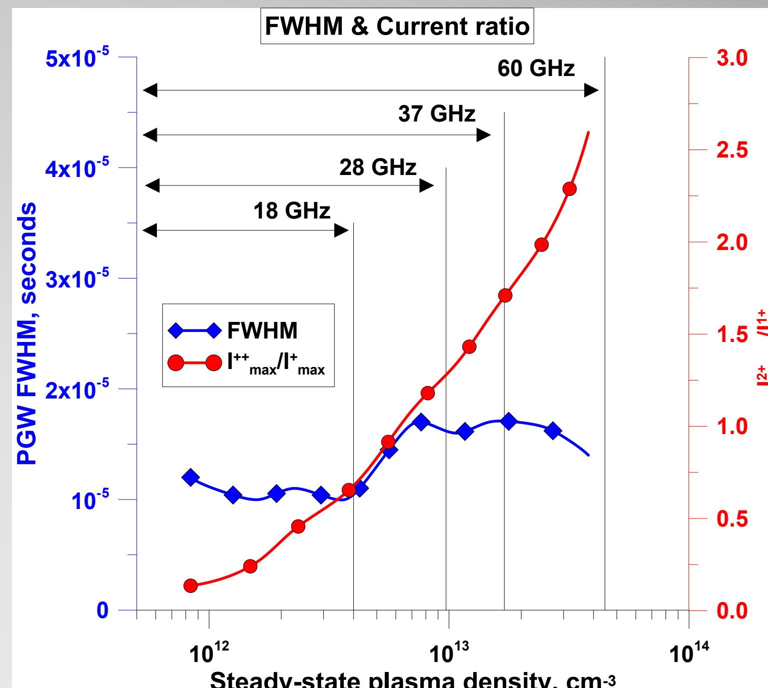

*T. Thuillier, T. Lamy, L. Latrasse, R. Geller, I. Izotov, A. Sidorov, V. Skalyga, V. Zorin, M. Marie-Jeanne. Study of pulsed electron cyclotron resonance ion source plasma near breakdown : The Preglow. Review of Scientific Instruments, 79, 02A314 (2008).*

## Experimental and theoretical investigation of Preglow in classical ECRIS

1. Phoenix 18 GHz, France, Grenoble, LPSC + IAP RAS, Russia.
2. Phoenix V2 28 GHz, France, Grenoble, LPSC + IAP RAS , Russia.
3. ECRIS, 14 GHz, Finland, University of Jyvaskyla (JYFL) + IAP RAS , Russia.

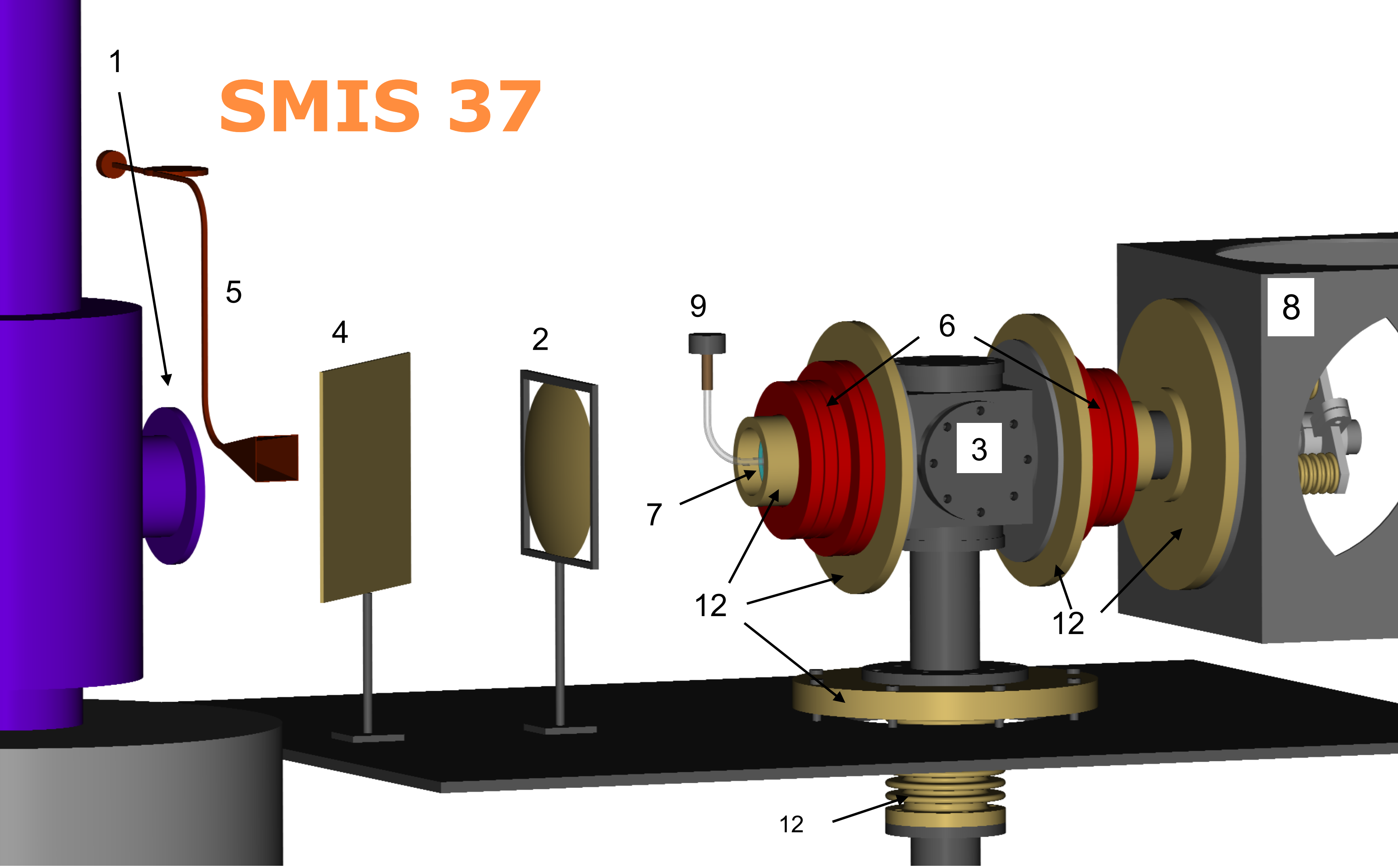
# Theoretical scaling for Preglow parameters



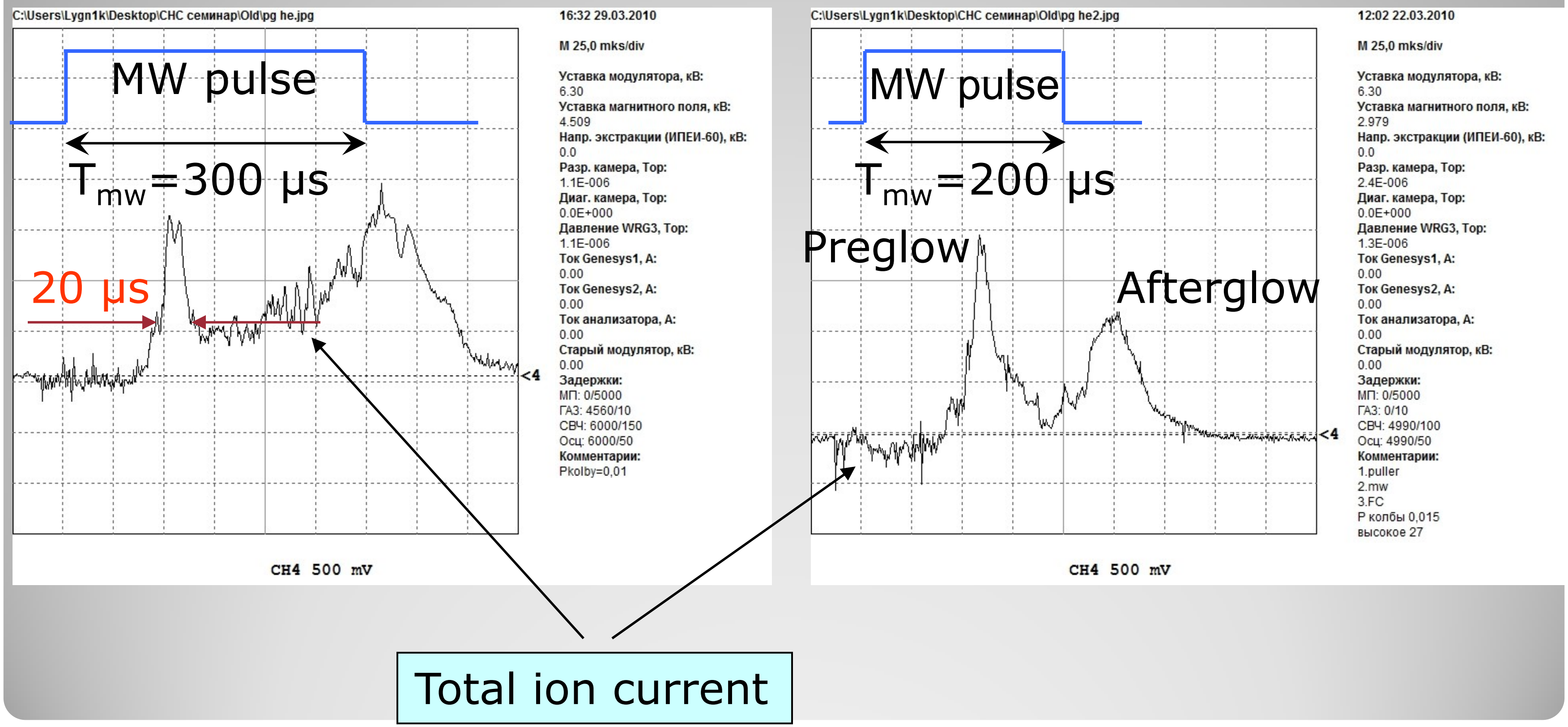

In short preglow peak effective generation of multicharged ions is possible under conditions of high frequency powerful heating

# SMIS 37

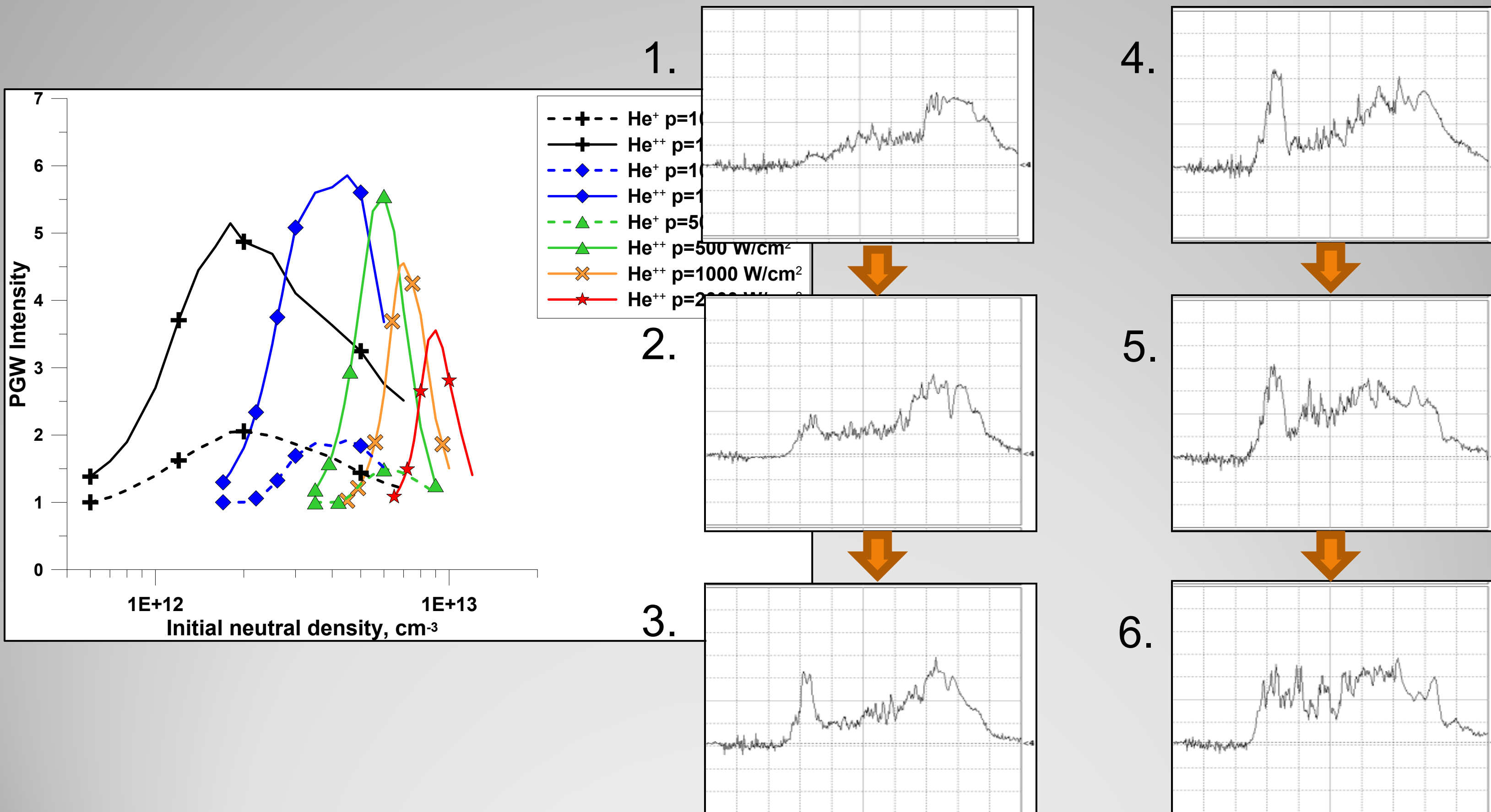



1 - Gyrotron (37.5 GHz, 100 kW), 2 – focusing lens, 3 – plasma chamber, 4 - coupler, 5 – MW detector, 6 – magnetic coils, 7 – MW quartz window, 8 – diagnostic chamber, 9 – pulsed neutral gas input, 10 – plasma electrode, 11 - puller, 12 – high voltage insulator

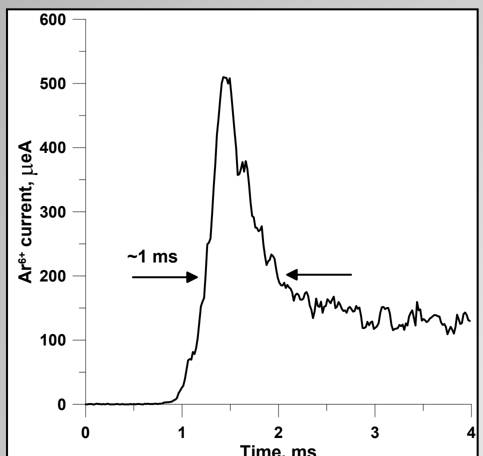
# «Preglow» effect @ 37 GHz



# Preglow intensity vs pressure



# Ion currents

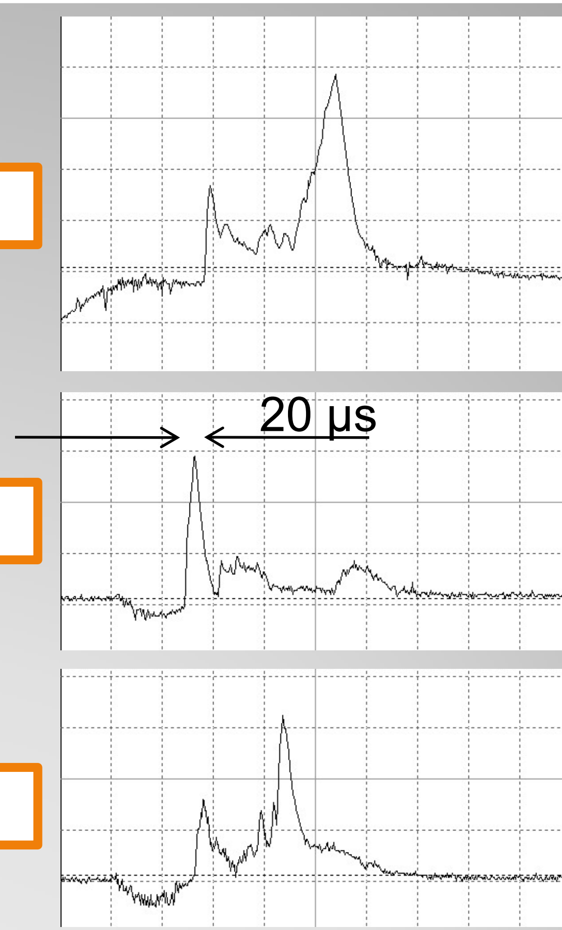



Preglow @ 28 GHz
PHOENIX

He++

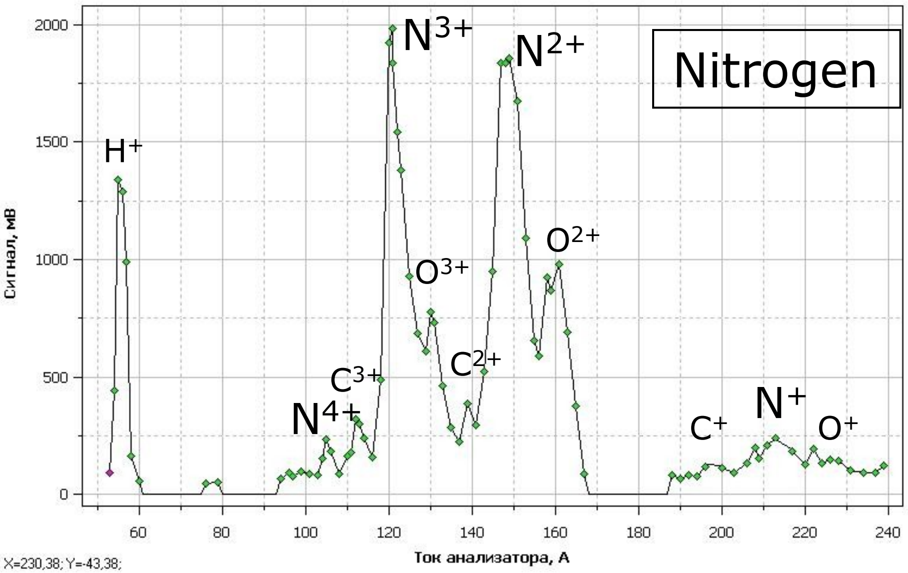
N3+

Ar3+

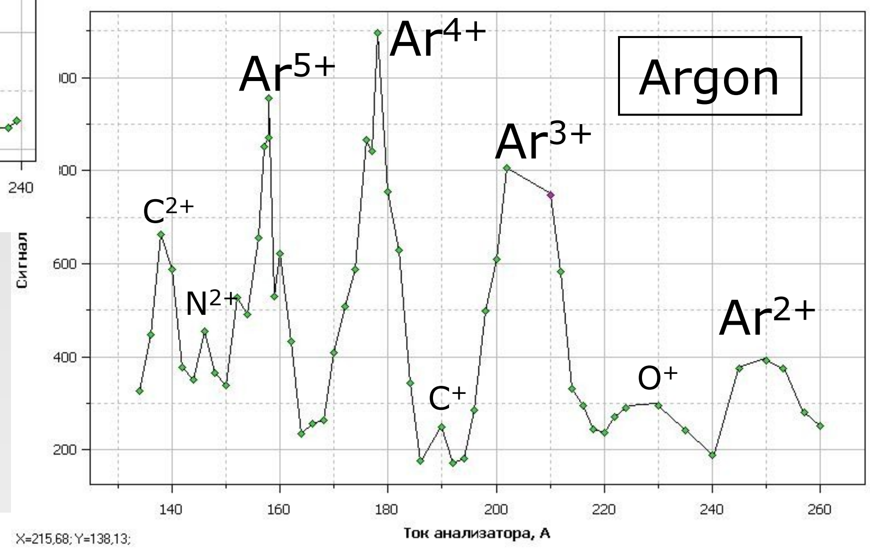



Preglow @ 37 GHz
SMIS 37

# Ion charge state distribution in Preglow peak

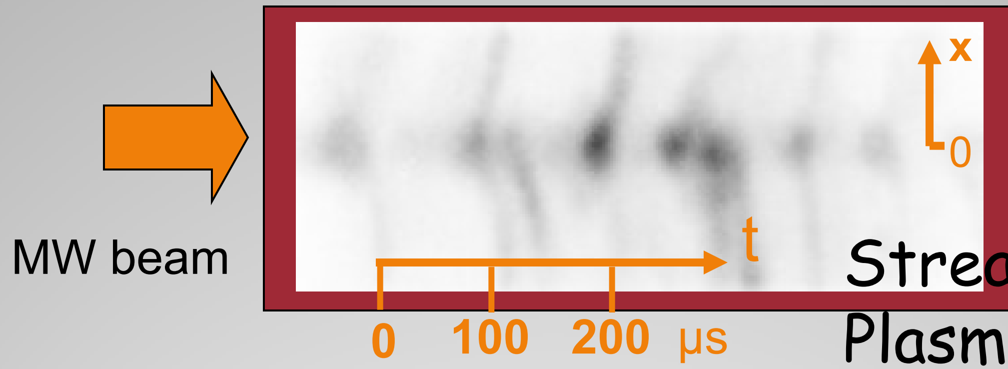



$N^{3+}$ maximum




$Ar^{4+}$ maximum

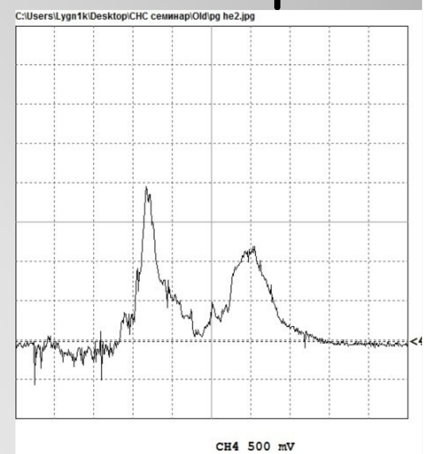
# MHD perturbations (long pulse)




Streak photos

Plasma was confined in a mirror trap

$$\tau_{MHD} = \frac{1}{\gamma_{MHD}}$$

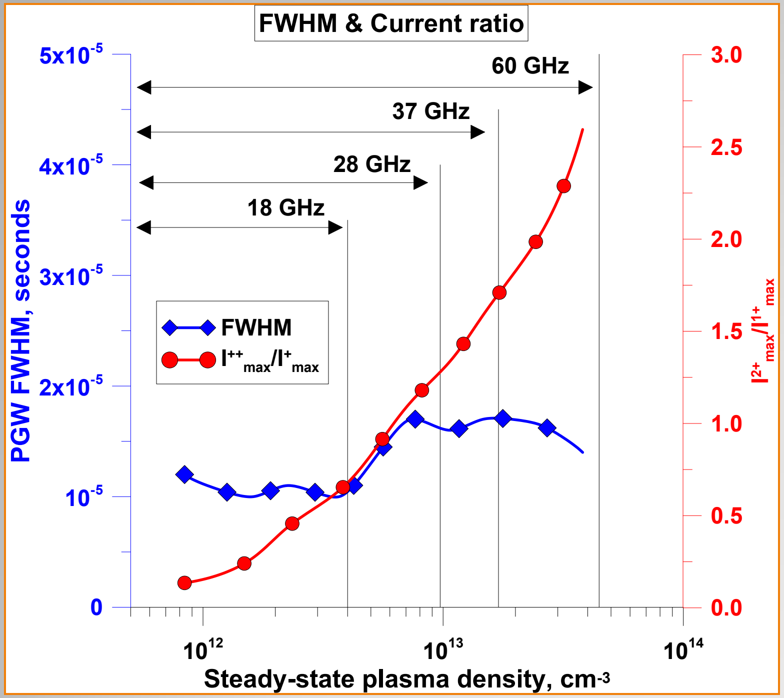



$\tau_{MHD}$ doesn't depend on electron density

T – decreasing with increasing of gas density $N_a$

If T< $\tau_{MHD}$ , we can forget about MHD stabilization about "min B", about hexapole

# Prospects for improvement




14 – 28 GHz

Long duration + high charge

37 GHz

Short duration + medium charge

60 – 75 GHz

Short duration + high charge

# Future investigations

1. SMIS 75 @ 75 GHz

2. SEISM prototype @ 60 GHz
   (**S**ixty GHz **E**CR **I**on **S**ource using **M**egawatt Magnets)

3. Efficiency study

# Conclusion

1. Preglow could be observed in any kind of ECR ion source
2. Tuning of Preglow parameters is very complicated
3. Short Preglow peaks with high average charge could be produced