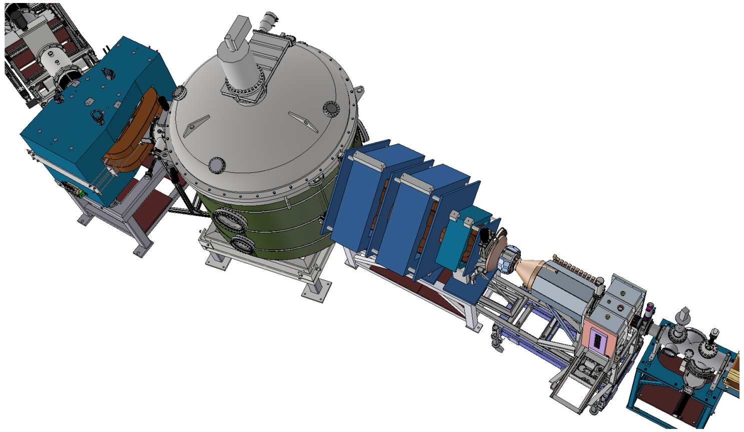
UNIVERSITY OF JYVÄSKYLÄ



SAGE @ MARA

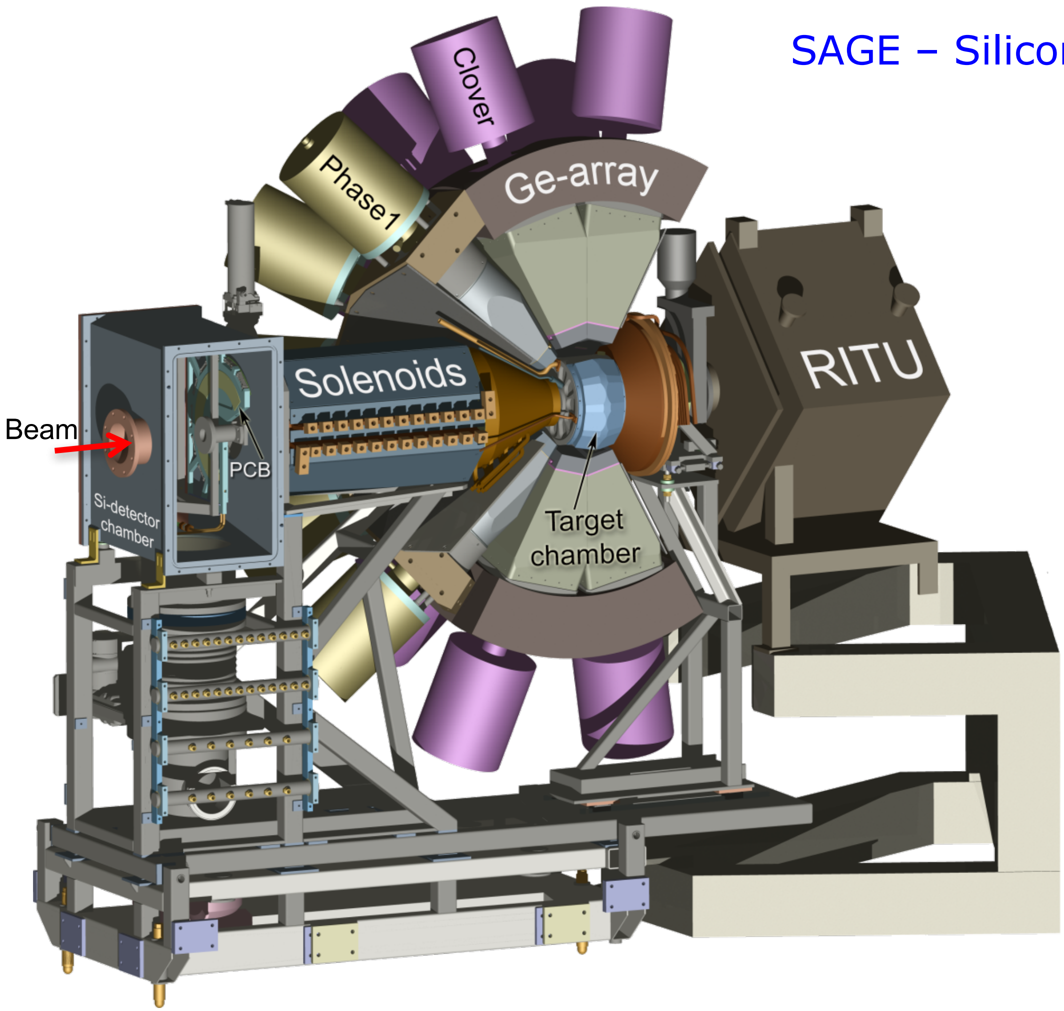
Mikael Sandzelius

ESNT workshop

Saclay 23-27 October 2017

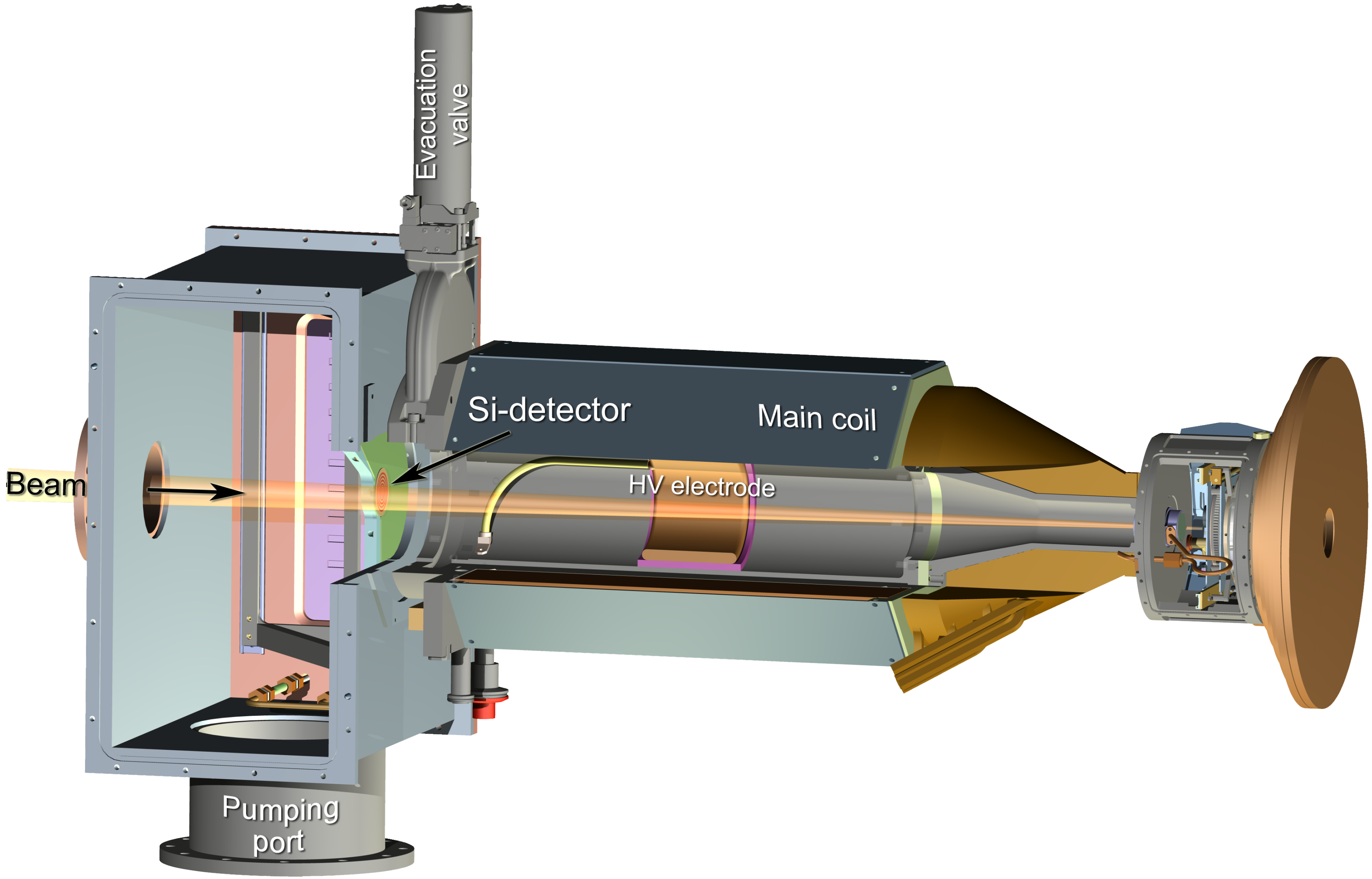
The SAGE Spectrometer

SAGE – Silicon And GErmanium

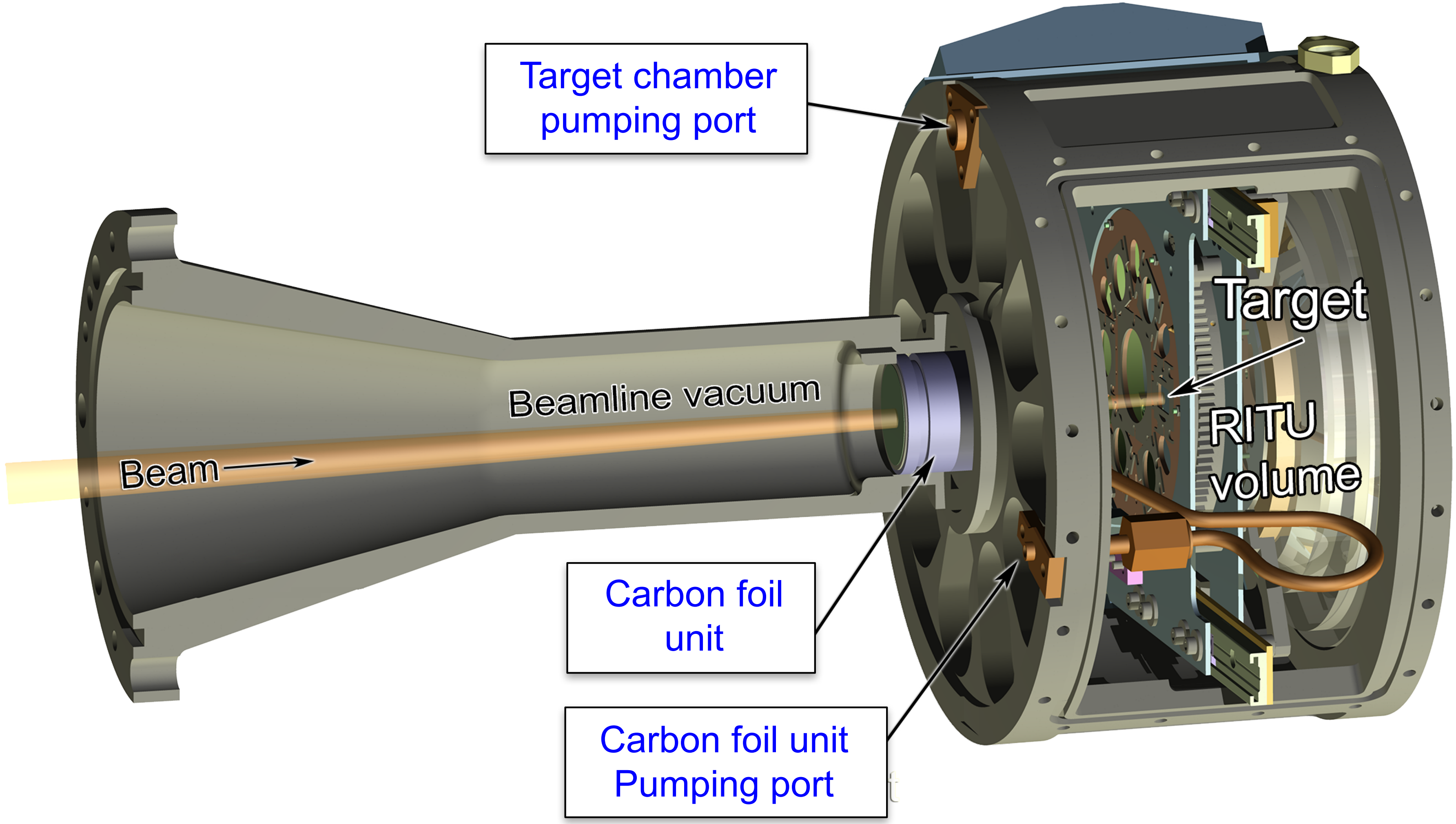


J. Pakarinen, P. Papadakis, J. Sorri, R.D. Herzberg, *et al.*, Eur. Phys. J. A 50 (53) 2014

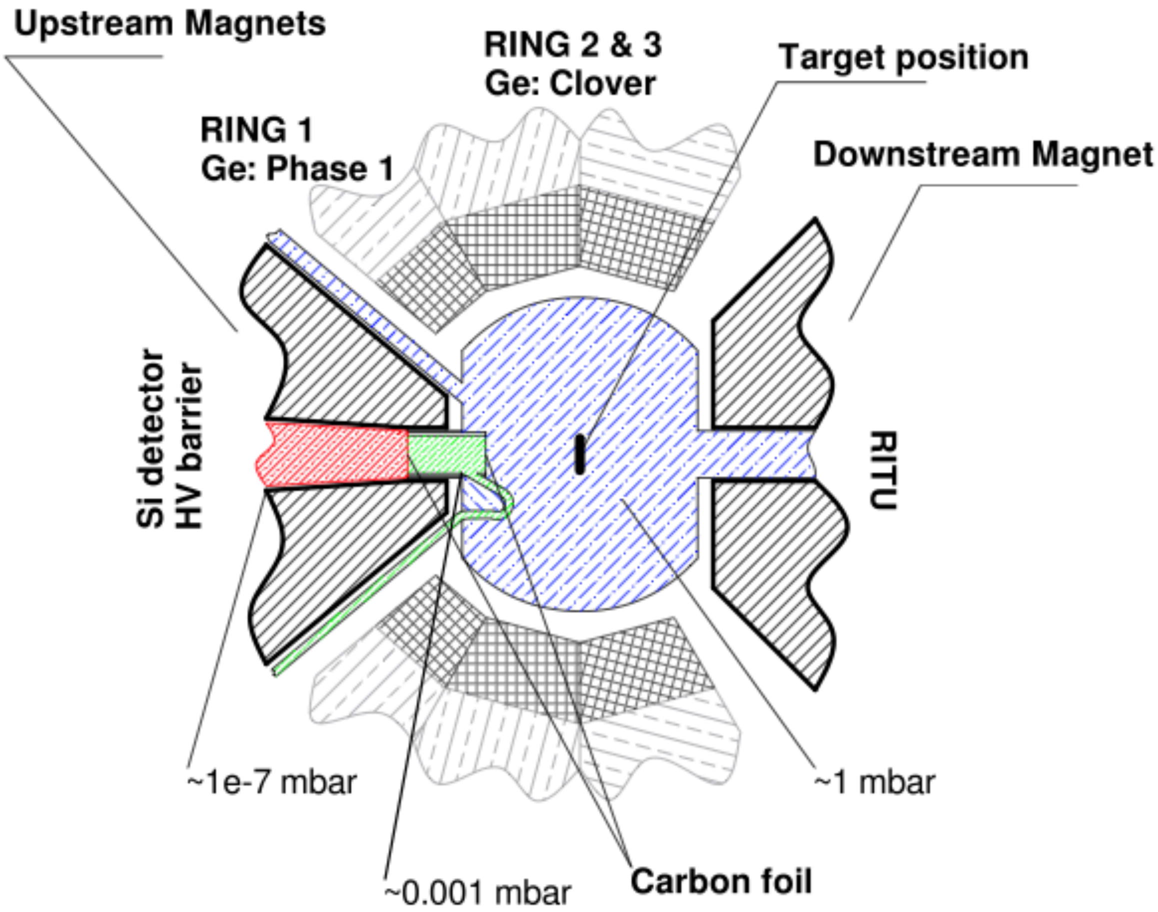
SAGE


Evacuation
valve
Si-detector
Main coil
Beam
HV electrode
Pumping
port

SAGE target position



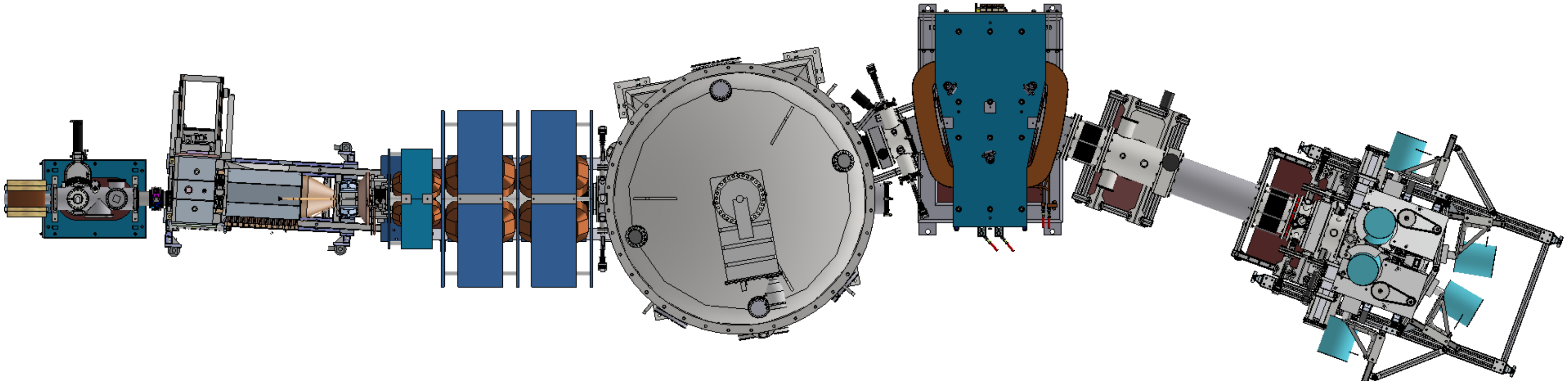
SAGE pressure gradient – RITU mode

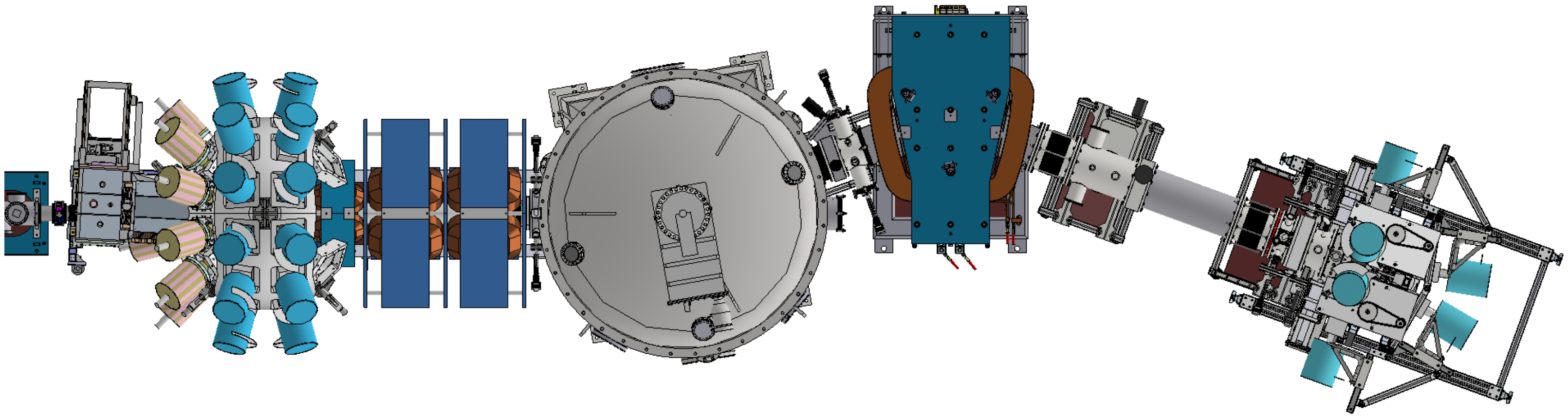


Carbon foil unit

The bottleneck!

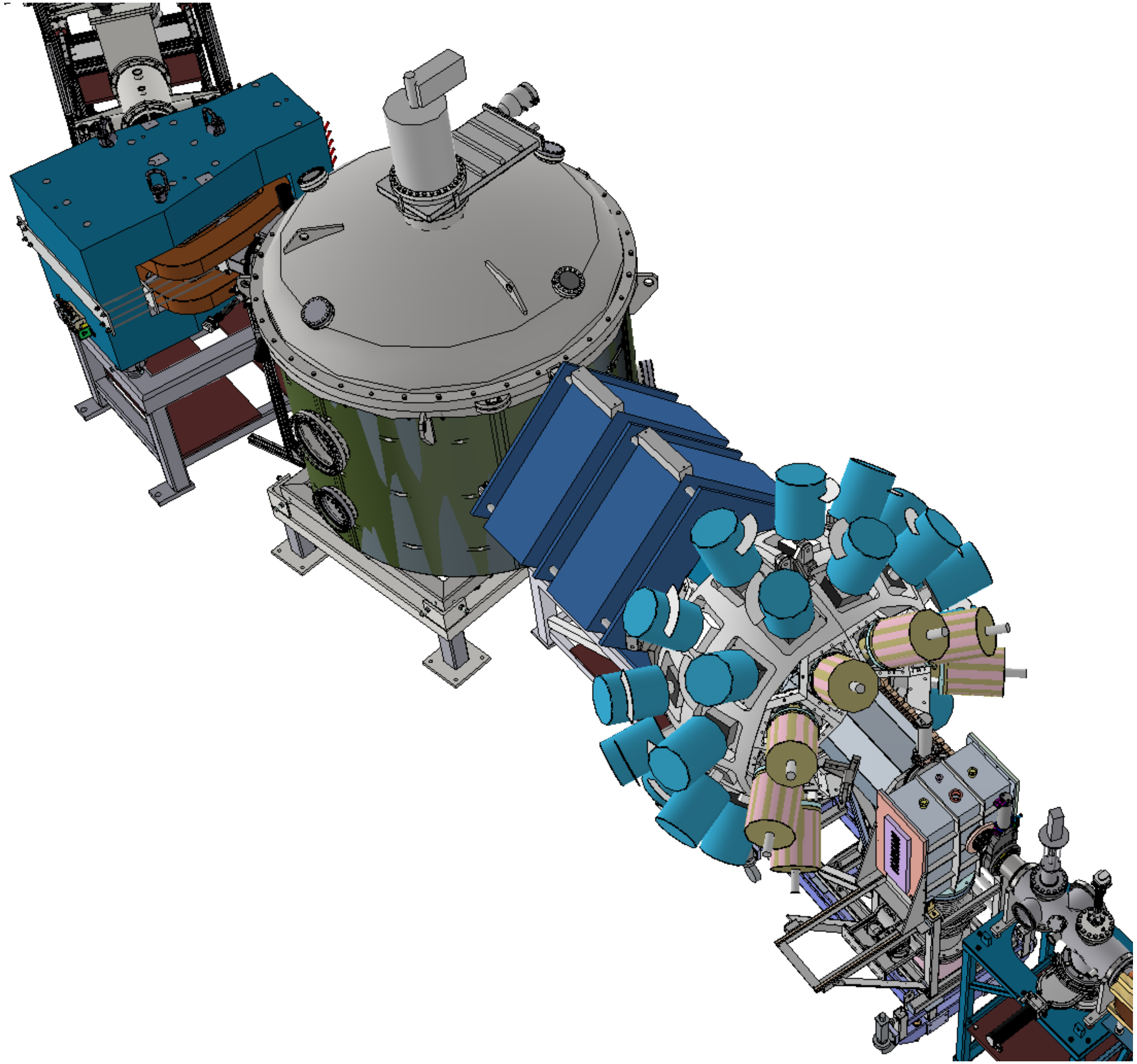
SAGE and MARA



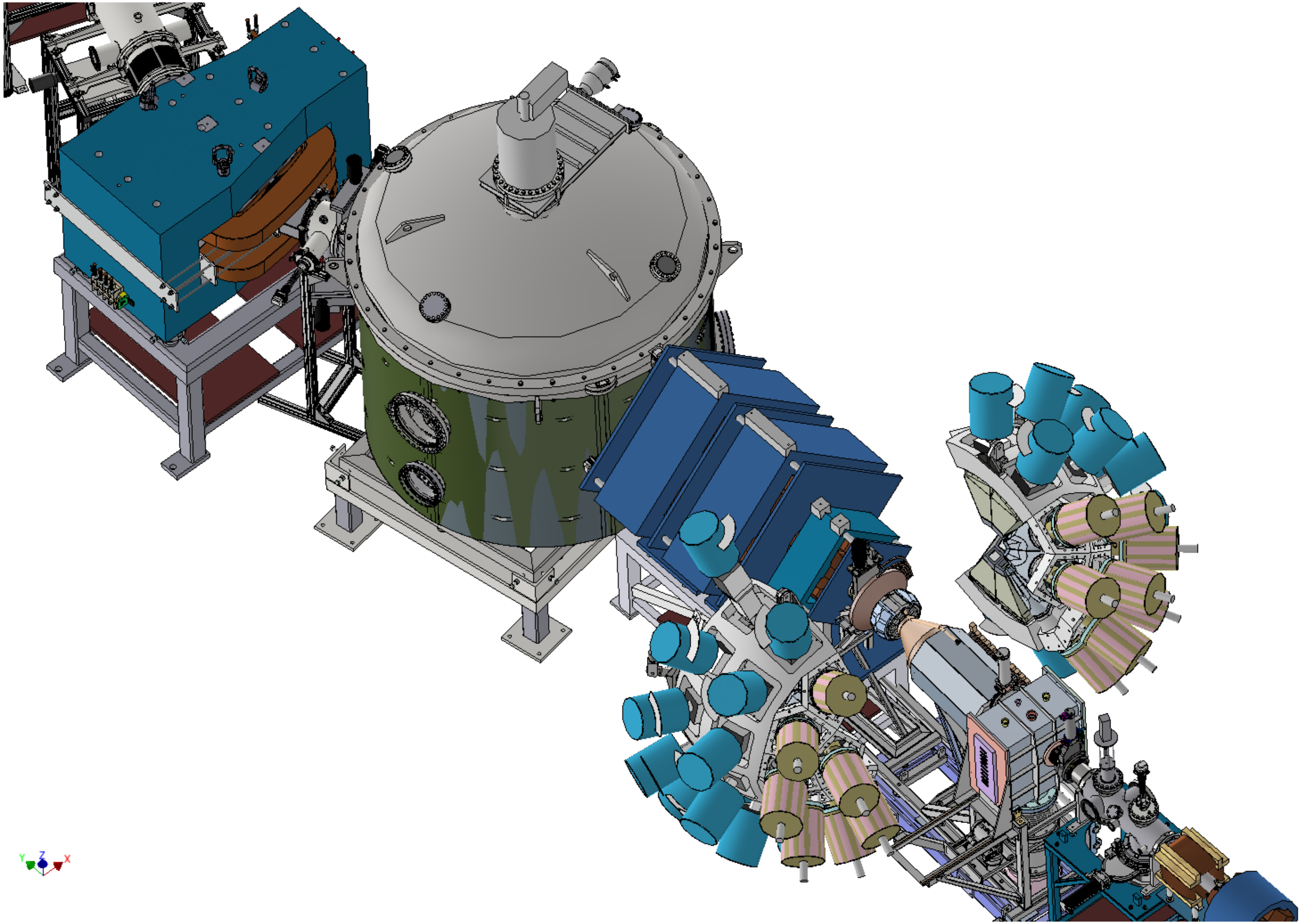


Pictures courtesy of Juha Tuunanen

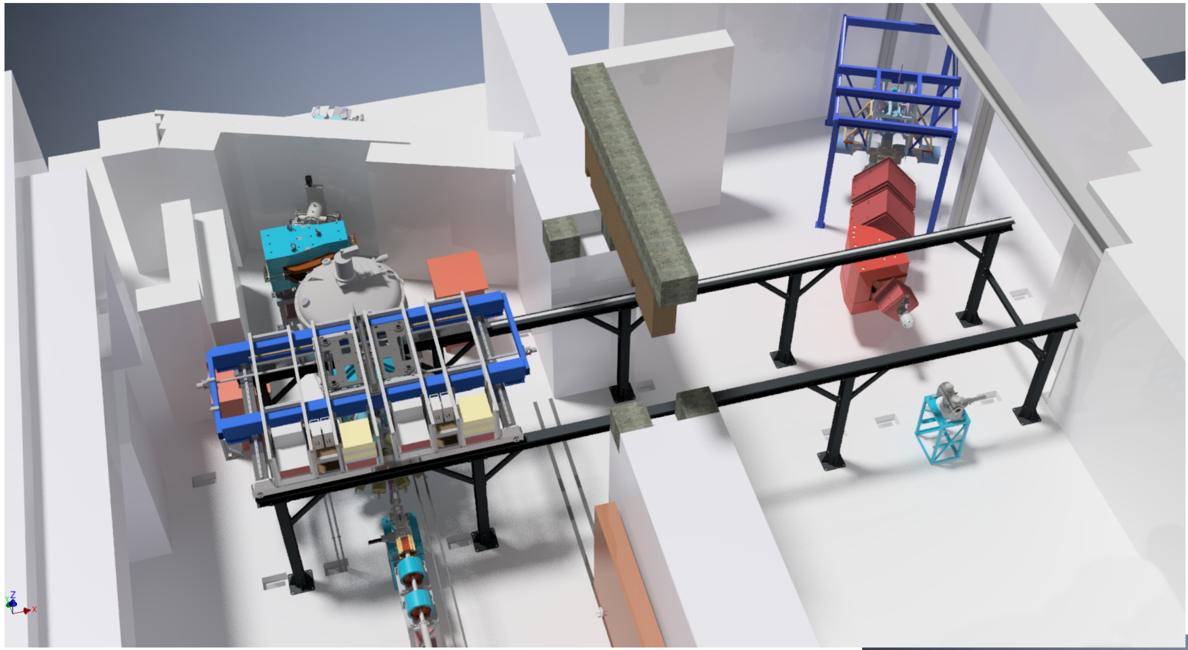
SAGE with Jurogam-III and MARA



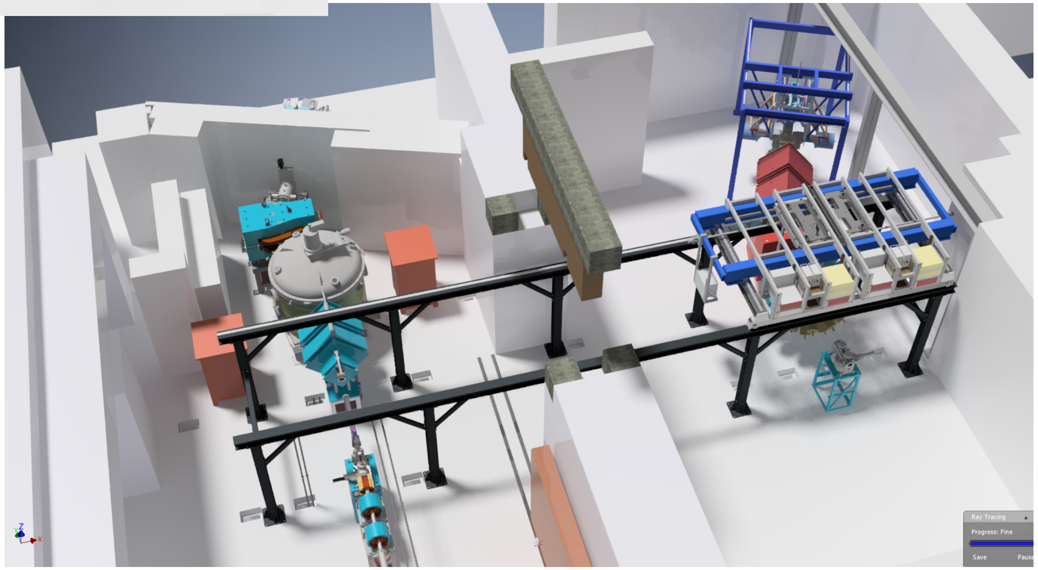
SAGE with Jurogam-III and MARA



Jurogam-III mobility

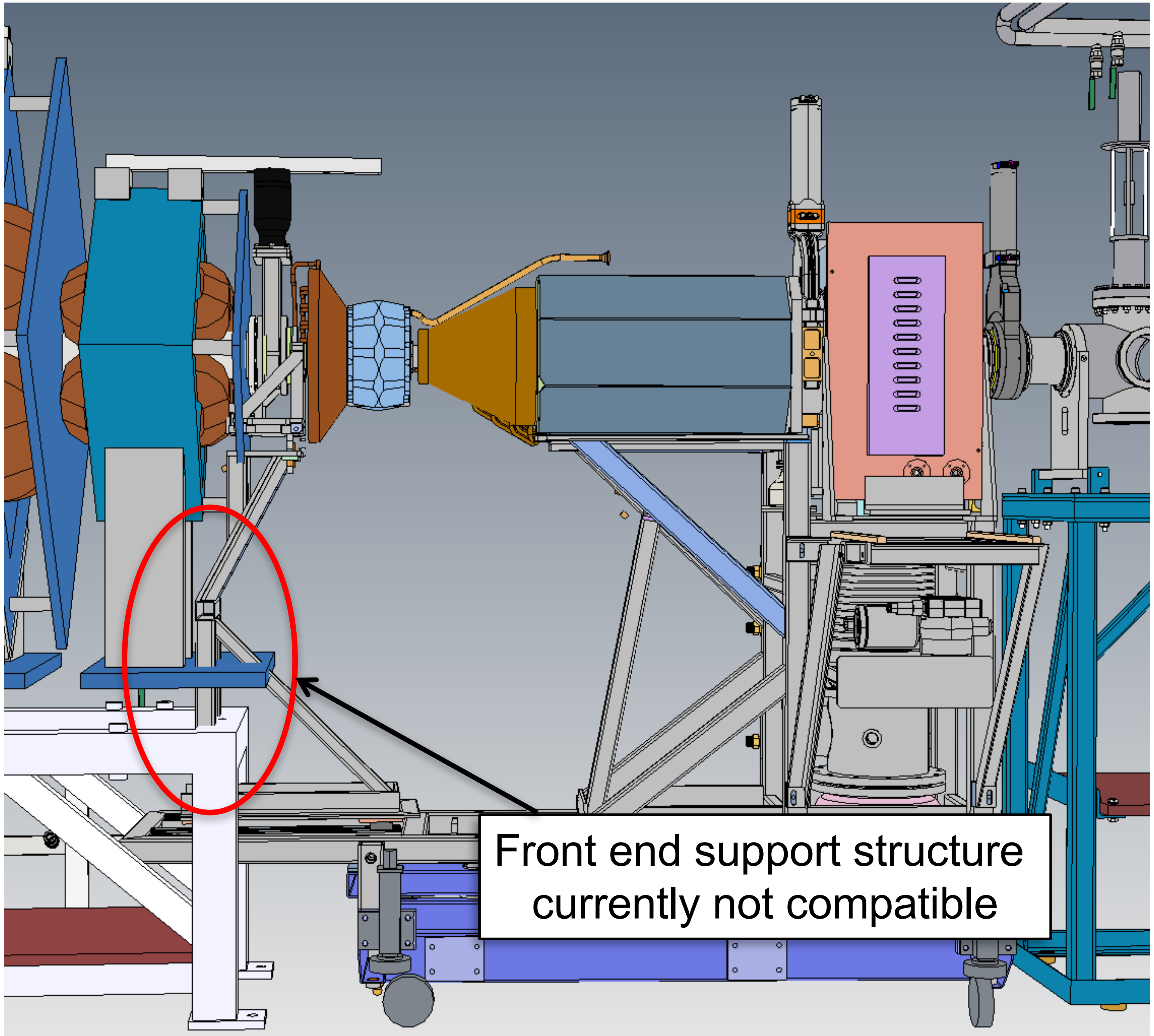


Common:
- DAQ
- LN_2
- HV

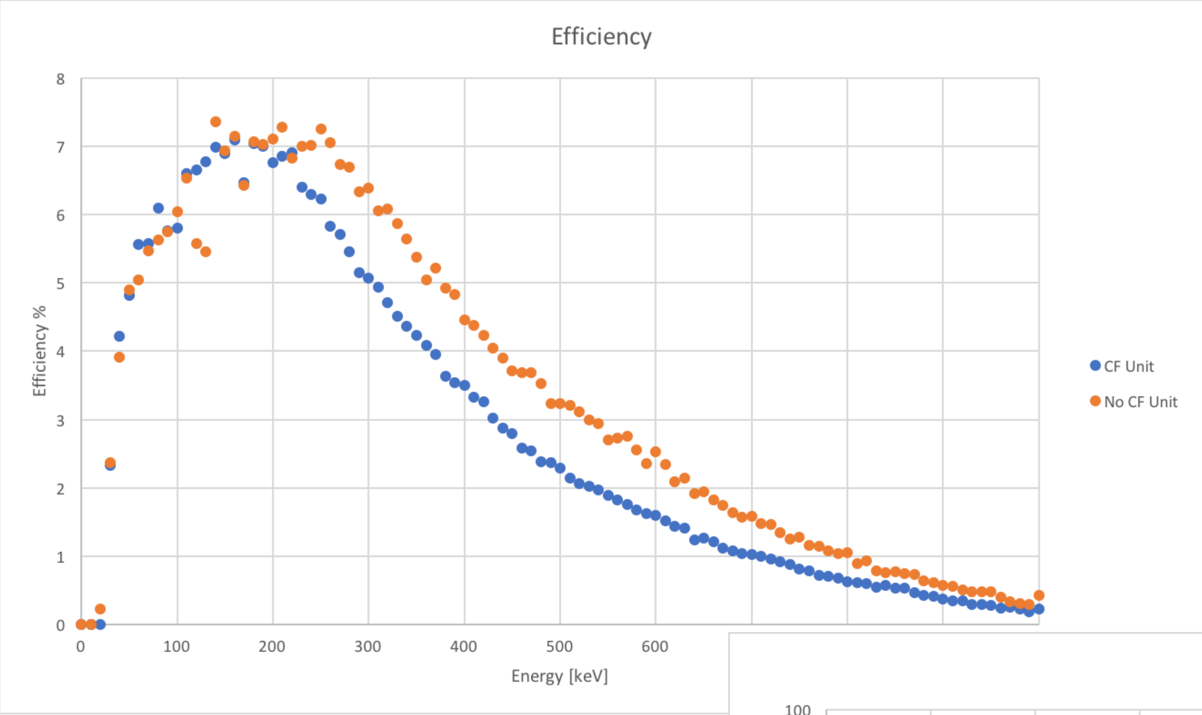


Will widen the scope of the program at JYFL into new regions of the nuclear chart

SAGE @ MARA target position

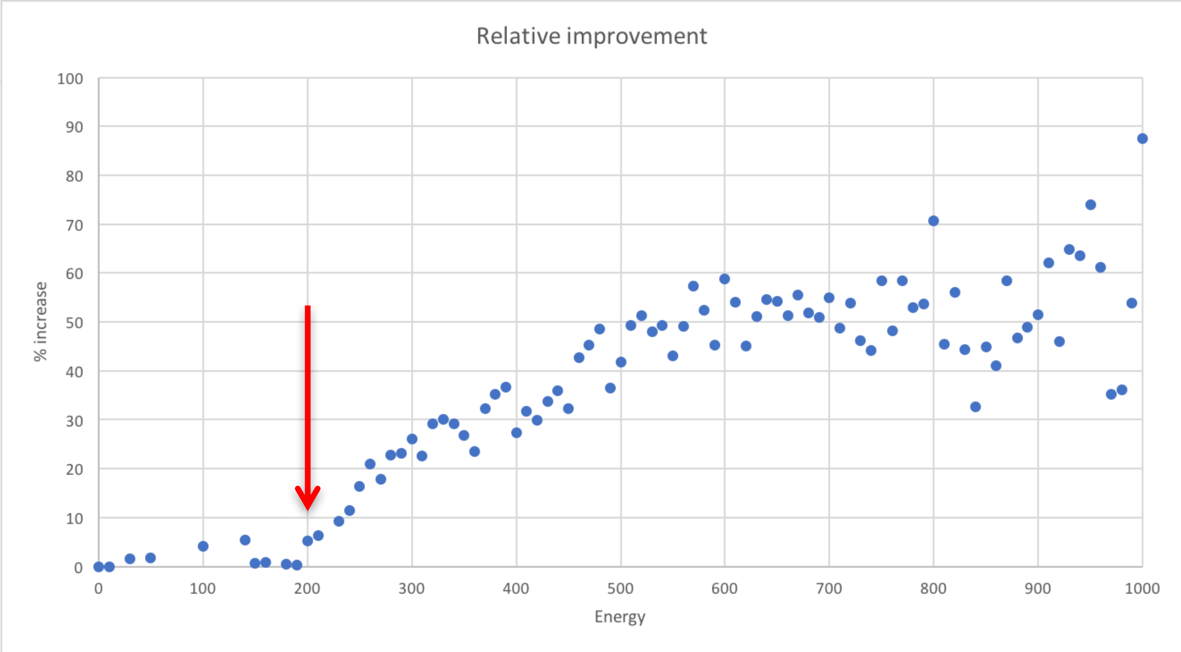


Increased electron efficiency



By as much as:

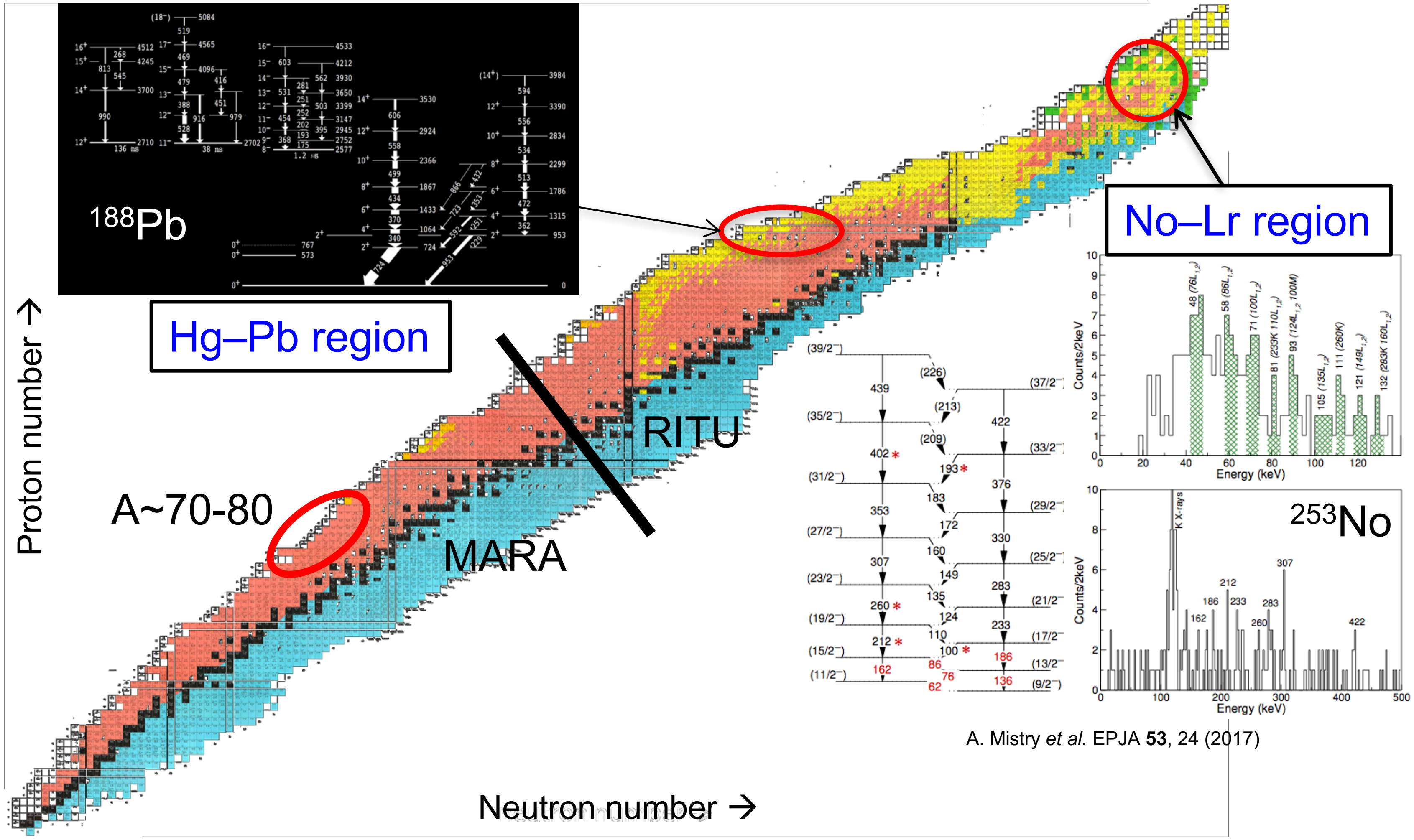
- ~30% at 320 keV
- ~50% above 600 keV



No use of C-foil unit starts to have a significant effect above 200 keV

Simulations by D. Cox

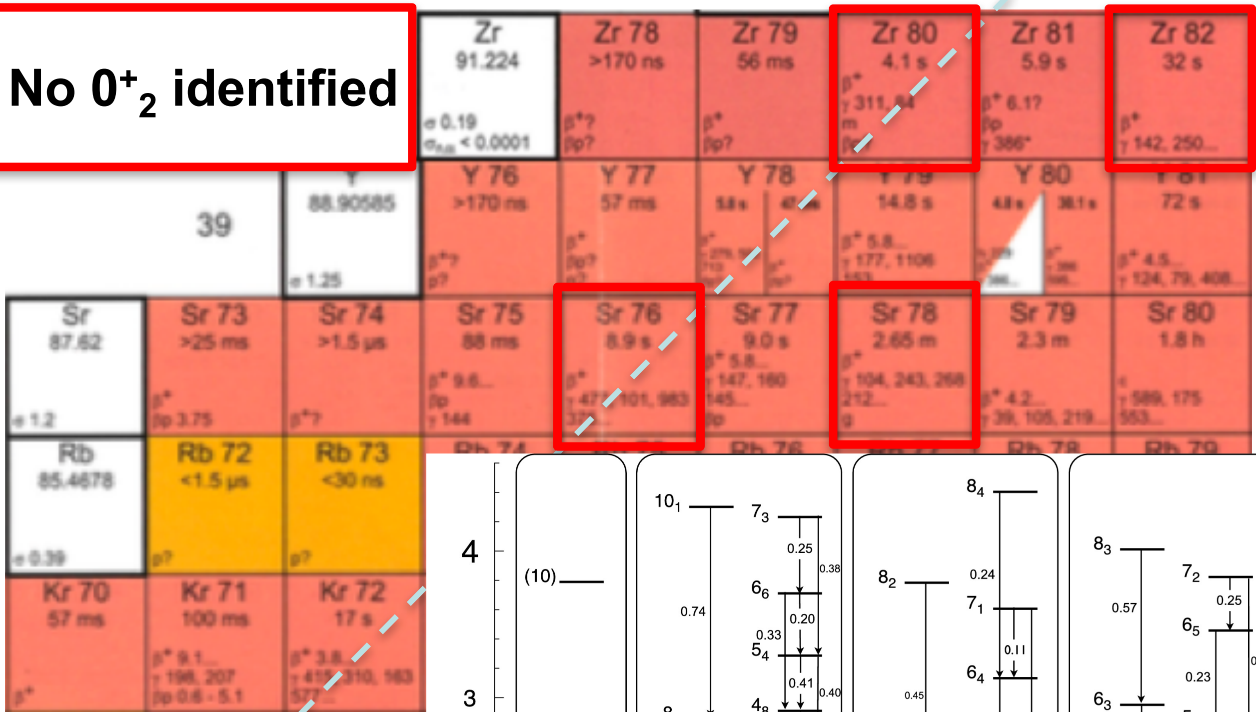
A few cases



A. Mistry *et al.* EPJA **53**, 24 (2017)

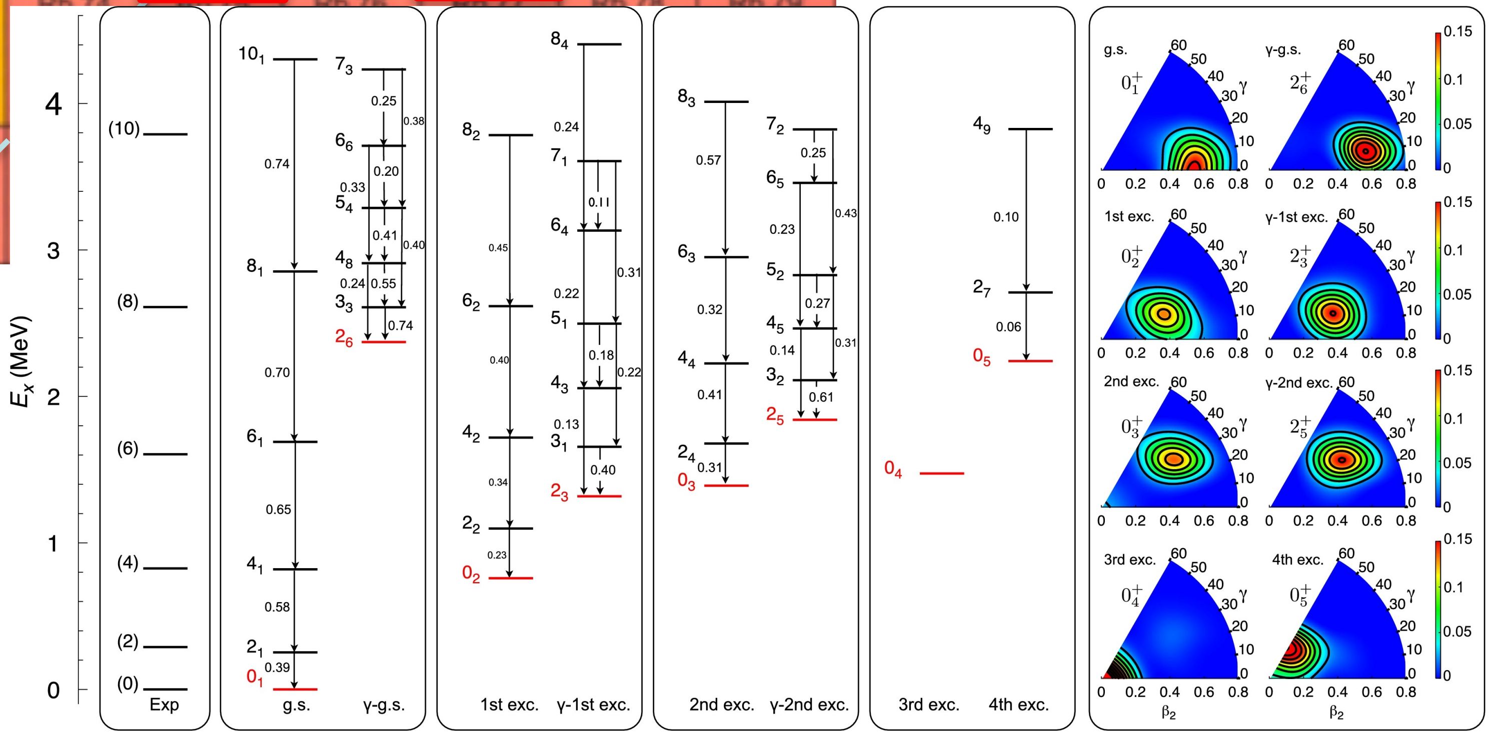
A few cases in the A~70-80 region

No 0^+_2 identified



N=Z

The rich canvas of ^{80}Zr



T. Rodriquez & J. Egido PLB **705**, 255 (2011)

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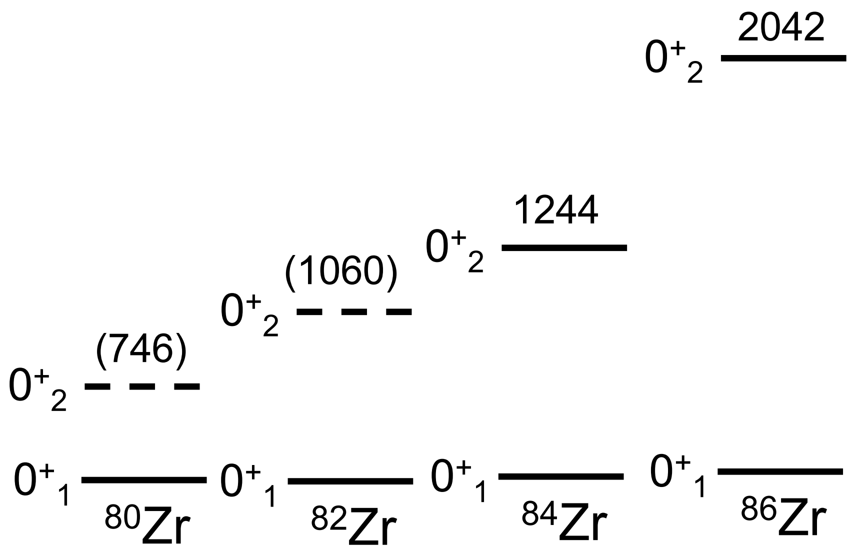
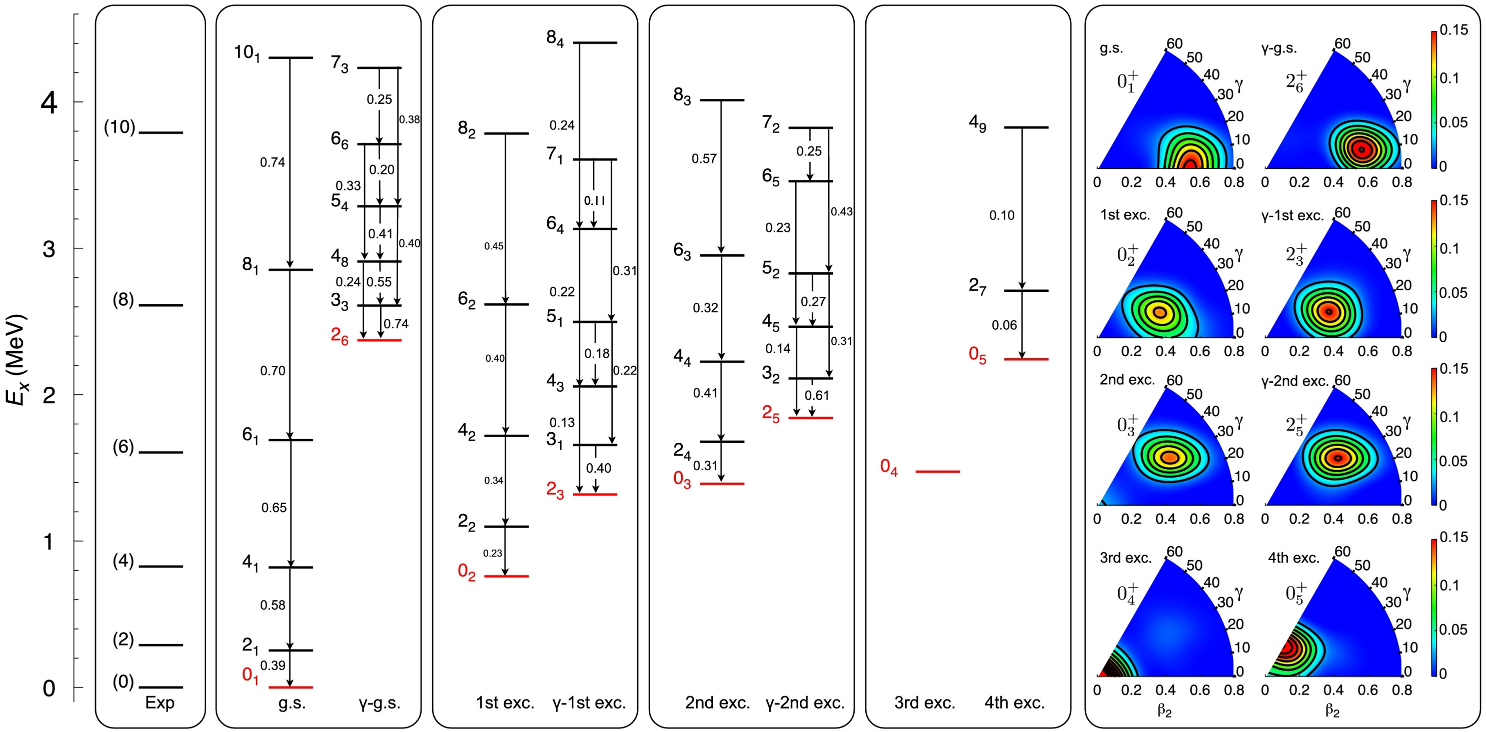
A few cases in the A~70-80 region



The rich canvas of ^{80}Zr



T. Rodriguez & J. Egido PLB **705**, 255 (2011)

Transmissions

$^{82}Kr + ^{104}Pd \rightarrow ^{184}Pb^* + 2n$
At 350 MeV beam energy and
~500 μg/cm^2 target thickness

MARA				RITU
Charge States				
1	2	3	4	
15%	30%	40%	50%	70-80%
20%	35%	-	-	-

Actually measured!

Transmissions

$^{58}Ni + ^{24}Mg \rightarrow ^{80}Zr^* + 2n$
At 190 MeV beam energy and
~500 μg/cm² target thickness

MARA				RITU
Charge States				
1	2	3	4	
15%	30%	40%	50%	70-80%
20%	35%	-	-	-

Inverse kinematics brings several benefits:

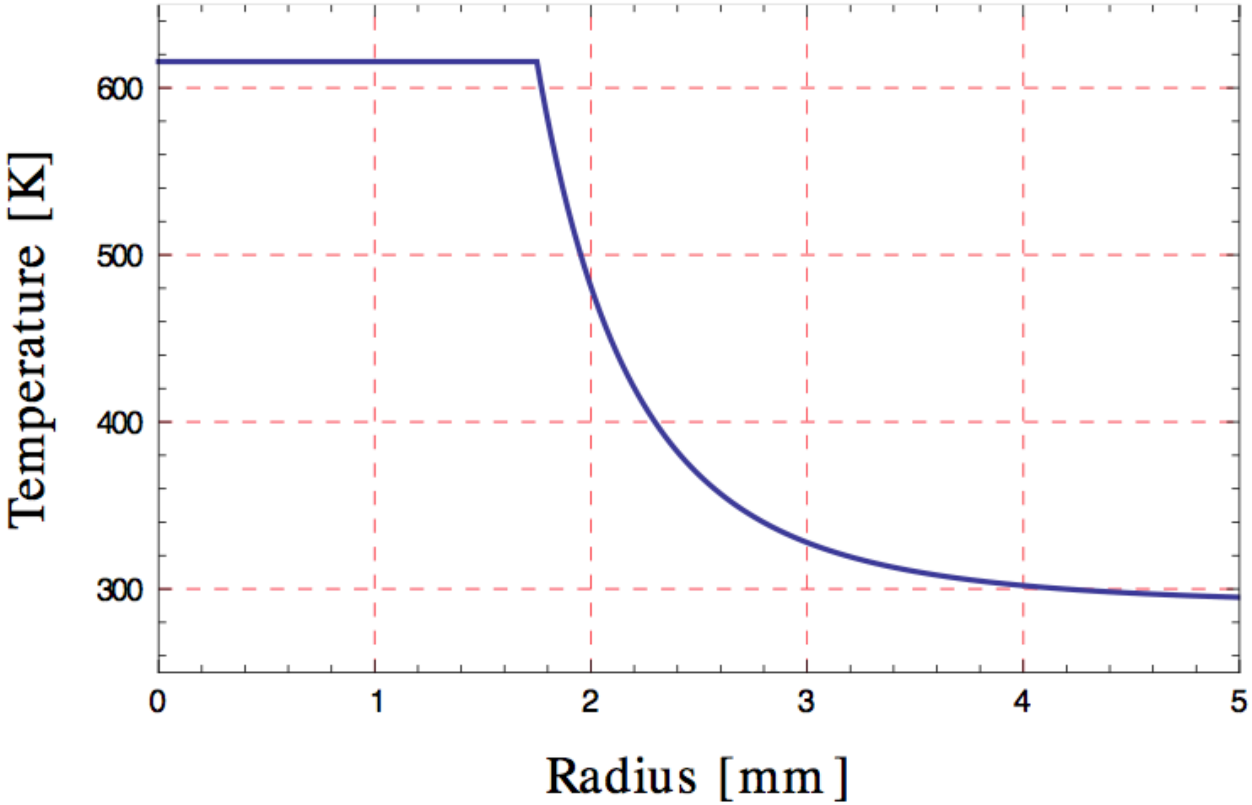
- Higher acceptance, smaller angular cone
- Higher transmission in fewer charge states

But higher v/c ~5.5% → shorter lifetimes **~10ns**

Target heating

Target thickness	500 $\mu g/cm^2$	Typical value
Heating power	0.074 W	Typical for 20 pnA
Beam spot area	8 mm^2	Specific to MARA
Target area	102 mm^2	Small frame

		Pressure [mBar]			
Element	T_{melt}[K]	1	0.1	0.01	Vacuum
Lead	600	307	402	602	647
Bismuth	545	307	400	576	615
Tin	505	307	387	554	611



By Juha Sorri

Transmissions

$^{48}Ca + ^{208}Pb \rightarrow ^{254}No^{*} + 2n$

$^{48}Ca + ^{209}Bi \rightarrow ^{255}Lr^{*} + 2n$

At ~219 MeV beam energy and
~500 µg/cm^2 target thickness

MARA				RITU
Charge States				
1	2	3	4	
8.5%	17%	22%	27%	~40%

MARA has only ~33% lower transmission than RITU

Summary

- Redesign of front end support is necessary
- Preliminary numbers show that an increase in electron efficiency will offset MARA's lower transmission.
- Coupling SAGE with MARA could open up possibilities to revisit old cases more 'cleanly'.
- Running SAGE in vacuum mode without a C-foil unit has appealing prospects, especially in the Hg-Pb and A~70-80 mass regions