Production of pre-clinical activities of ^{11}C for PET imaging using a HRR laser-driven proton source

Aarón Alejo

aaron.alejo@usc.es | XVI CPAN Days | Nov 2024

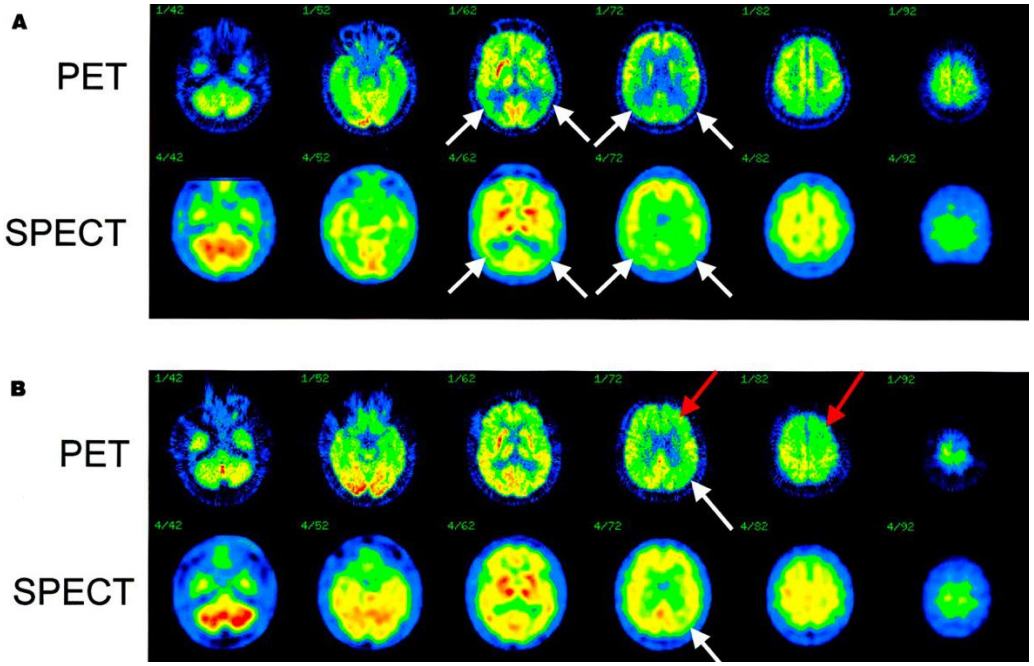
Production of pre-clinical activities of ^{11}C for PET imaging using a HRR laser-driven proton source

Aarón Alejo

aaron.alejo@usc.es | XVI CPAN Days | Nov 2024

PET imaging

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging



PET imaging

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging

→ β^+-emitters production facilities are large and expensive

⇒ Single facility must provide radionuclides to large areas.

PET imaging

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging

→ β^+-emitters production facilities are large and expensive

⇒ Single facility must provide radionuclides to large areas.

→ This limits the potential radionuclides to those with longer lifetimes

Radioisotope	Half-life (mins)	
^{11}C	20	✗
^{13}N	10	
^{15}O	2	
^{18}F	110	✓

PET imaging

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging

→ β^+-emitters production facilities are large and expensive

⇒ Single facility must provide radionuclides to large areas.

→ This limits the potential radionuclides to those with longer lifetimes

→ Can we increase the number of production centres using **compact, cost-effective accelerators**?

Radioisotope	Half-life (mins)	
^{11}C	20	✗
^{13}N	10	
^{15}O	2	
^{18}F	110	✓

Why a laser-accelerator alternative?

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging

→ β^+-emitters production facilities are large and expensive

⇒ Single facility must provide radionuclides to large areas.

→ This limits the potential radionuclides to those with longer lifetimes

→ Can we increase the number of production centres using **compact, cost-effective accelerators**? **Laser Accelerators**

Why a laser-accelerator alternative?

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging

→ β^+-emitters production facilities are large and expensive

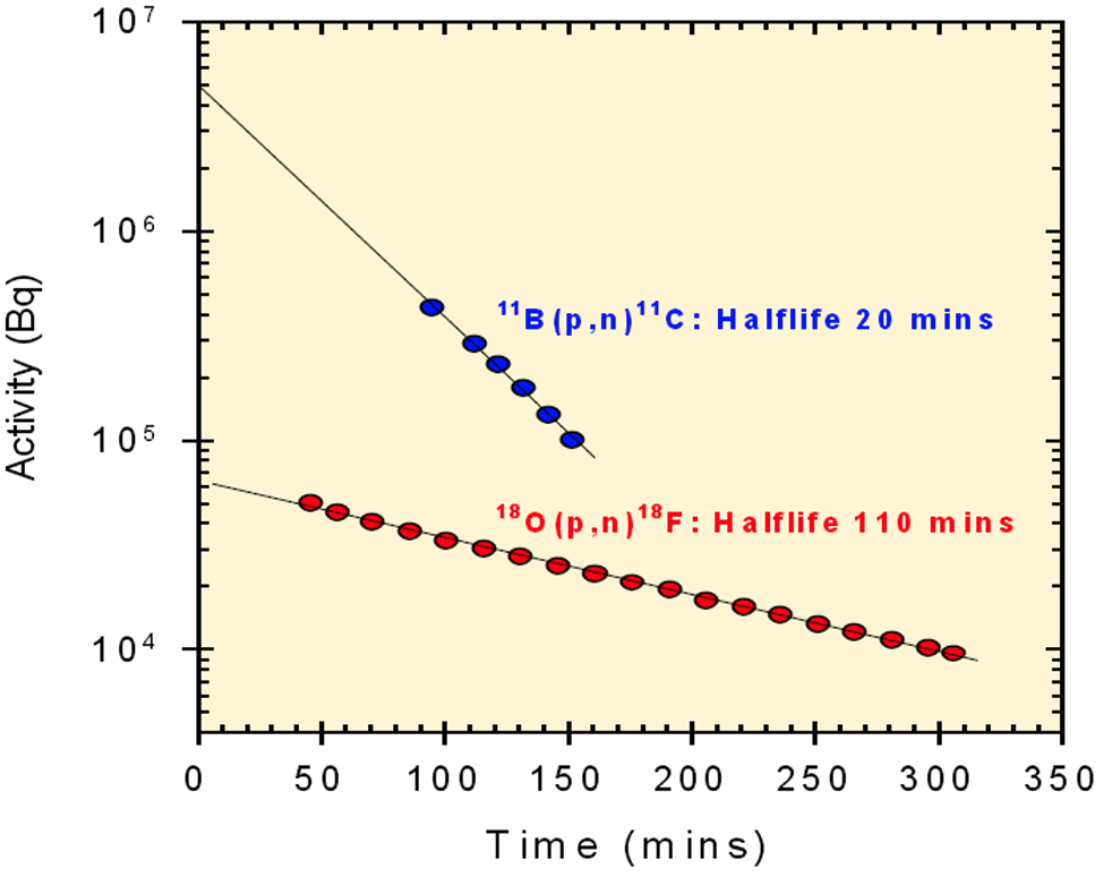
⇒ Single facility must provide radionuclides to large areas.

→ This limits the potential radionuclides to those with longer lifetimes

→ Can we increase the number of production centres using **compact, cost-effective accelerators**? **Laser Accelerators**

→ Pioneering studies by Ledingham *et al*. using the Vulcan laser

→ The activation achieved was 100kBq – 1MBq/shot, but the repetition rate was limited to 1 shot/20 minutes.



KWD Ledingham *et al.*, Journal of Physics D 37.16 (2004);
KWD Ledingham *et al.*, Nuclear Physics A 752 (2005)

Why a laser-accelerator alternative?

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging

→ β^+-emitters production facilities are large and expensive

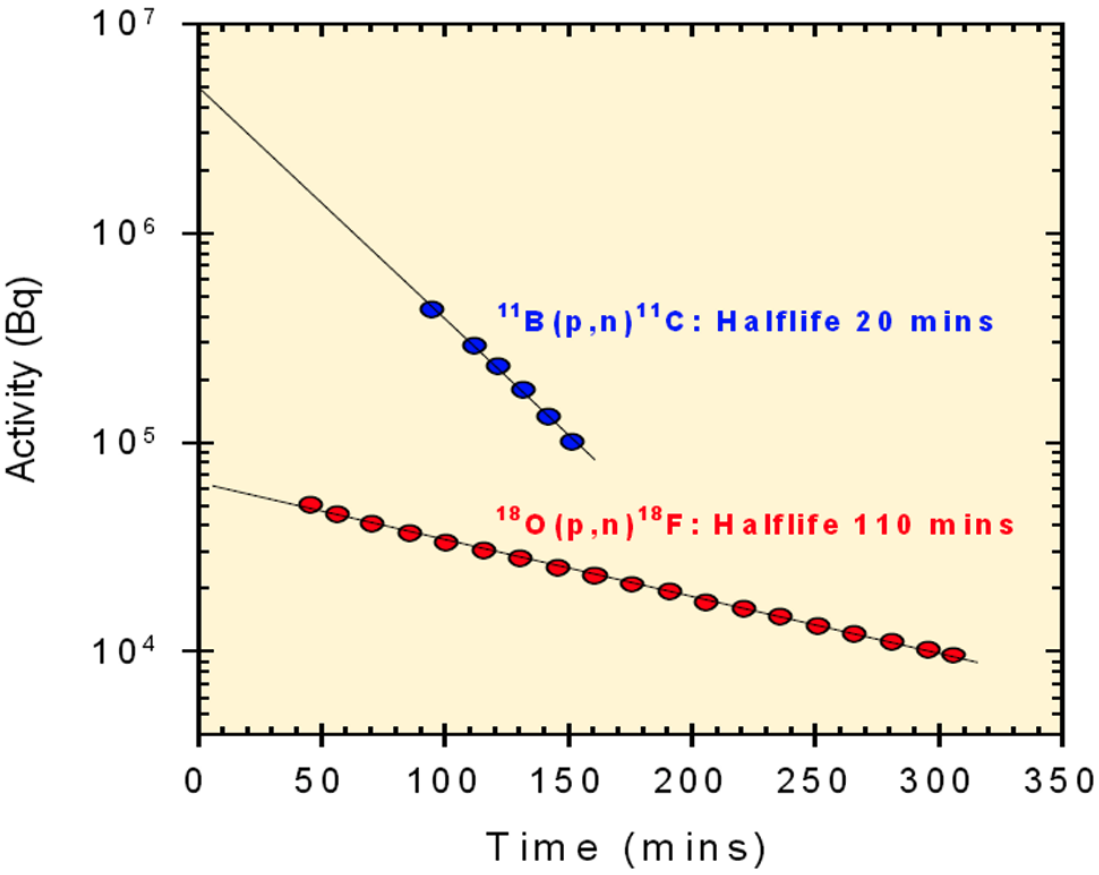
⇒ Single facility must provide radionuclides to large areas.

→ This limits the potential radionuclides to those with longer lifetimes

→ Can we increase the number of production centres using **compact, cost-effective accelerators**? **Laser Accelerators**

→ Pioneering studies by Ledingham *et al*. using the Vulcan laser

→ The activation achieved was 100kBq – 1MBq/shot, but the repetition rate was limited to 1 shot/20 minutes.



KWD Ledingham *et al.*, Journal of Physics D 37.16 (2004);
KWD Ledingham *et al.*, Nuclear Physics A 752 (2005)

Why a laser-accelerator alternative?

→ Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging

→ β^+-emitters production facilities are large and expensive

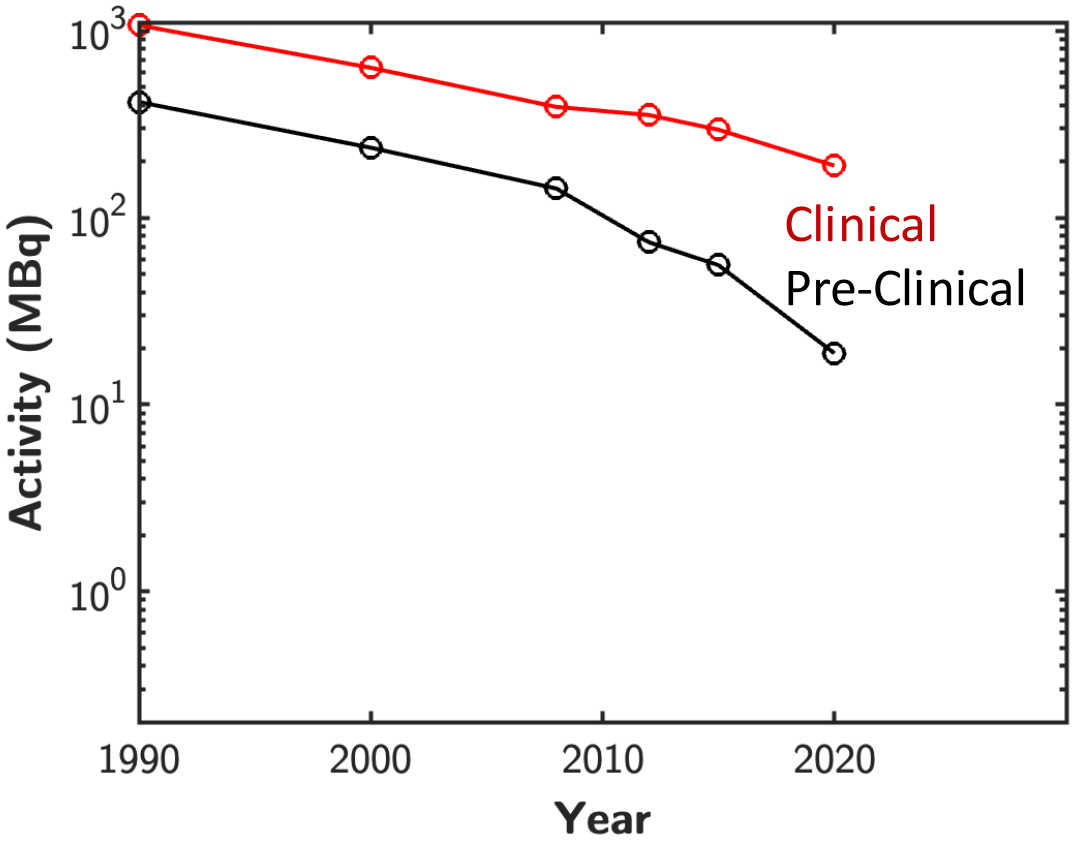
⇒ Single facility must provide radionuclides to large areas.

→ This limits the potential radionuclides to those with longer lifetimes

→ Can we increase the number of production centres using **compact, cost-effective accelerators**? **Laser Accelerators**

→ Pioneering studies by Ledingham *et al*. using the Vulcan laser

→ The activation achieved was 100kBq – 1MBq/shot, but the repetition rate was limited to 1 shot/20 minutes.

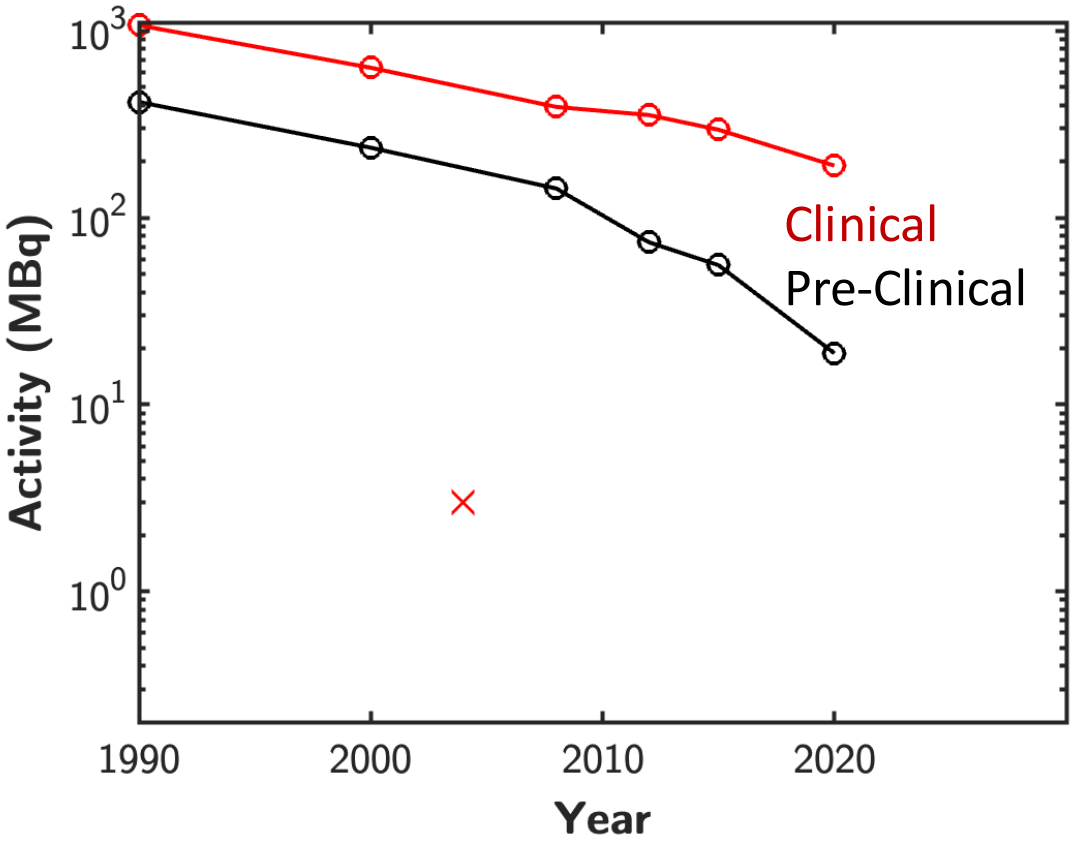


KWD Ledingham *et al.*, Journal of Physics D 37.16 (2004);
KWD Ledingham *et al.*, Nuclear Physics A 752 (2005)

Why a laser-accelerator alternative?

- → Amongst other techniques, Positron Emission Tomography is one of the main tools for medical imaging
- → β^+-emitters production facilities are large and expensive

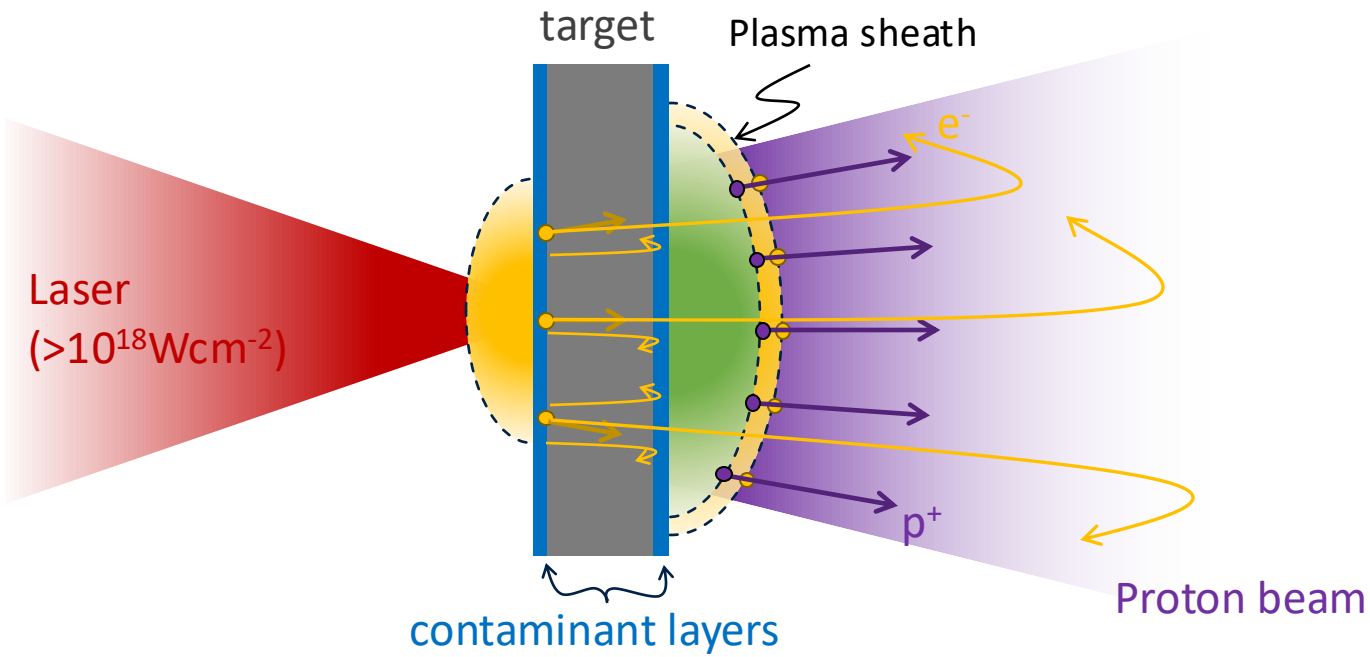
  ⇒ Single facility must provide radionuclides to large areas.
- → This limits the potential radionuclides to those with longer lifetimes
- → Can we increase the number of production centres using **compact, cost-effective accelerators**? **Laser Accelerators**
- → Pioneering studies by Ledingham *et al*. using the Vulcan laser
  - → The activation achieved was 100kBq – 1MBq/shot, but the repetition rate was limited to 1 shot/20 minutes.
  - → It was acknowledged activation levels useful for medical imaging (**100s MBq**) could be achieved with HRR systems



KWD Ledingham *et al*., Journal of Physics D 37.16 (2004);
KWD Ledingham *et al*., Nuclear Physics A 752 (2005)

Continuous laser-driven proton source

Ion acceleration



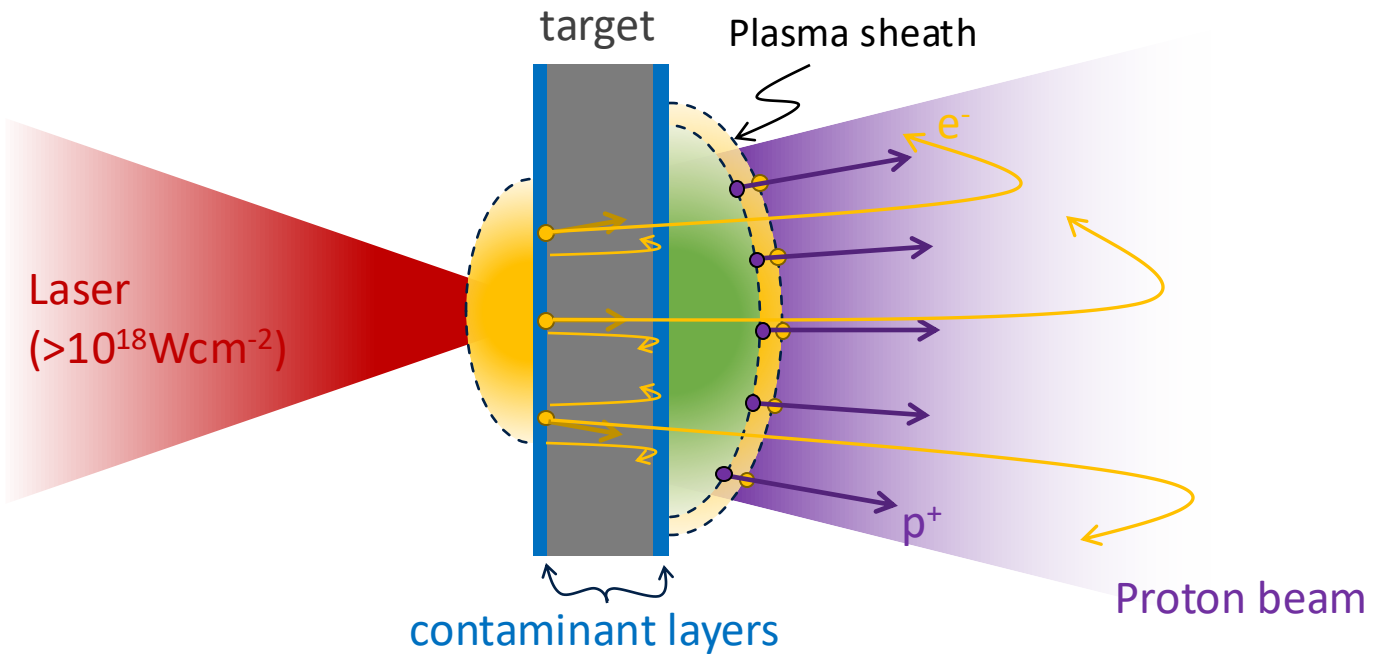
→ Maxwell-like energy spectrum up to multi-MeV energies

→ Divergence of up to tens of degrees divergence

→ Cut-off energy scales with laser intensity as $\propto I_L^{1/2-1}$

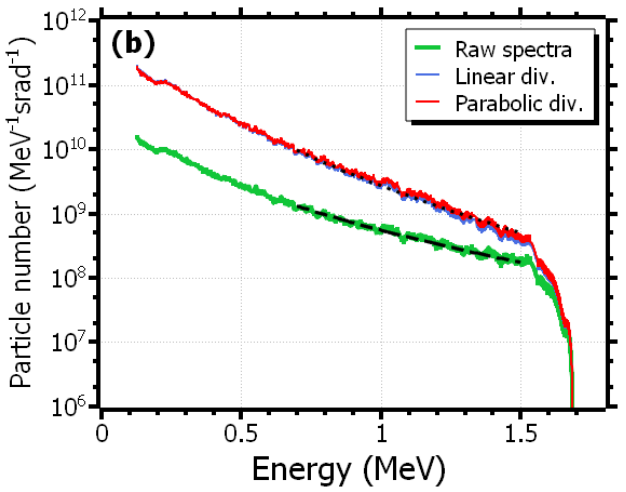
→ The ion beam is multi-species, dominated by the lightest species (protons)

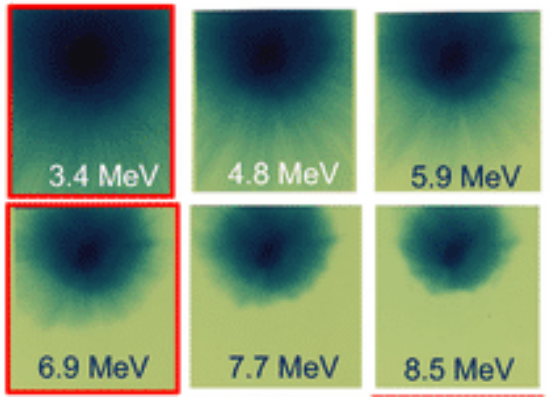
Ion acceleration



- → Maxwell-like energy spectrum up to multi-MeV energies
- → Divergence of up to tens of degrees divergence
- → Cut-off energy scales with laser intensity as $\propto I_L^{1/2-1}$
- → The ion beam is multi-species, dominated by the lightest species (protons)

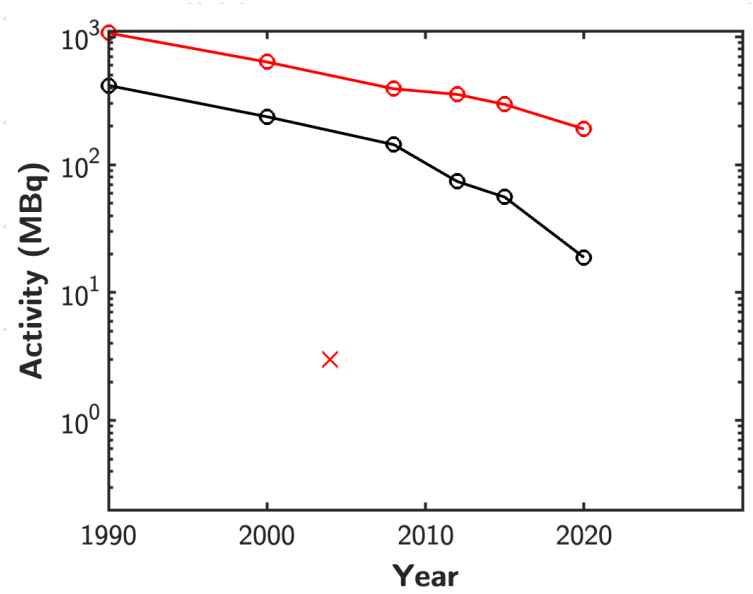
	Laser-driven	Conventional (IBA Proteus One)
Emittance (mm mrad)	0.002	0.5
Duration (ps)	<1 → 100s	10^7 (10μs)
Source size (μm)	10 - 200	1000
Rep. Rate (Hz)	1 → 10s	1000
Beam energy (MeV)	≤100	230
Beam charge (pC)	10^3	4.5





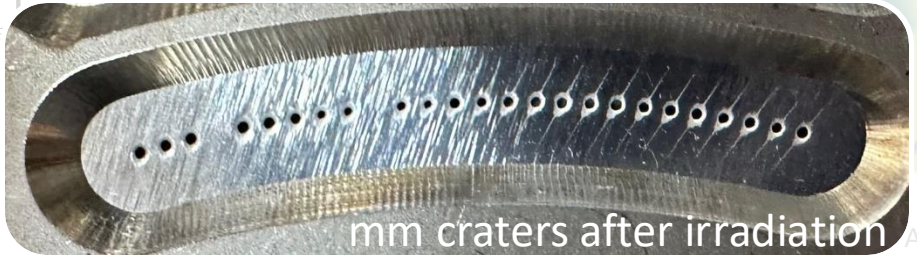
Ion acceleration

	Laser-driven	Conventional (IBA Proteus One)
Emittance (mm mrad)	0.002	0.5
Duration (ps)	<1 → 100s	10^7 (10μs)
Source size (μm)	10 - 200	1000
Rep. Rate (Hz)	1 → 10s	1000
Beam energy (MeV)	≤100	230
Beam charge (pC)	10^3	4.5



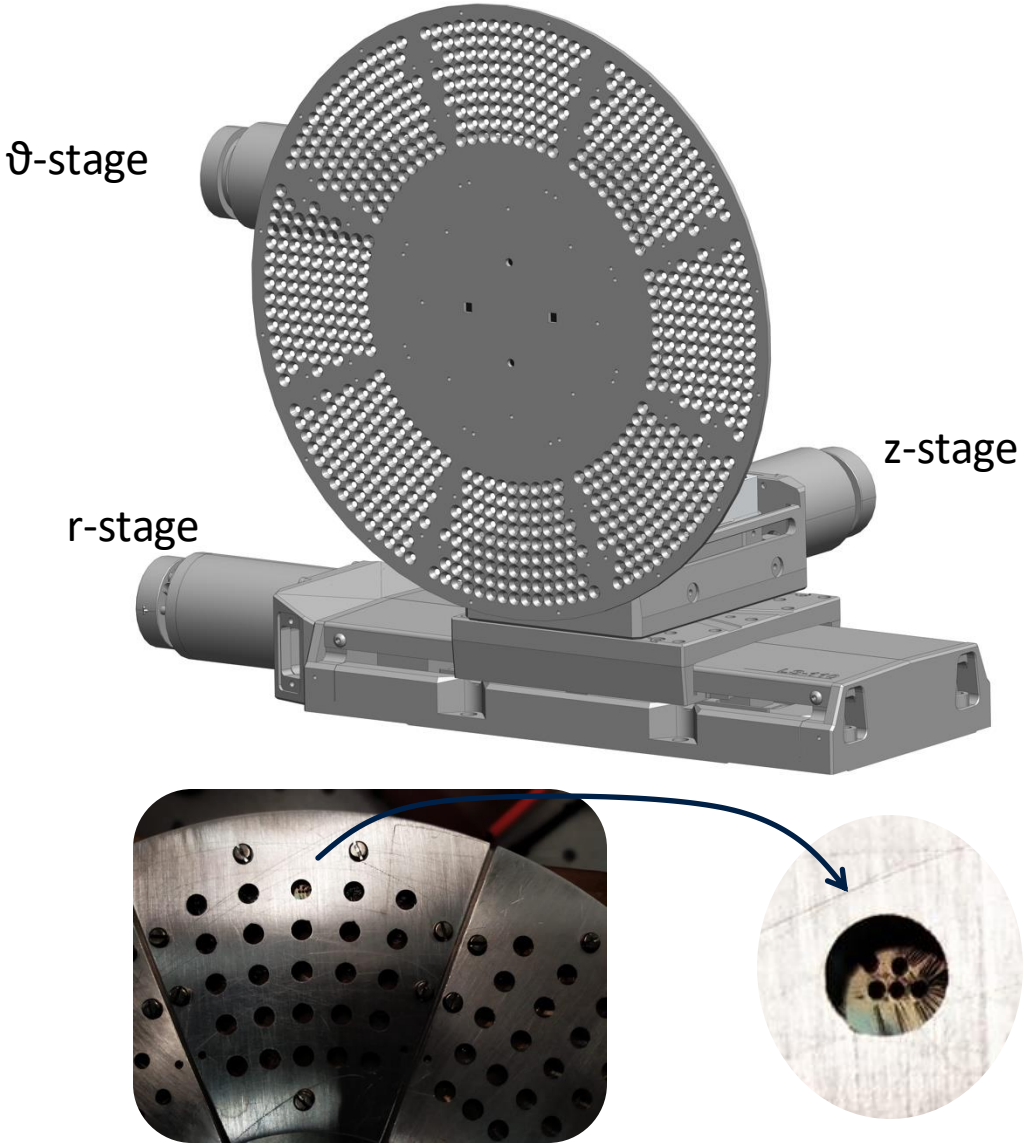
e.g. isotope production for medical applications will require 10s of MBq

⇒ **1000s of shots** + **High rep rate**



mm craters after irradiation

Target wheel

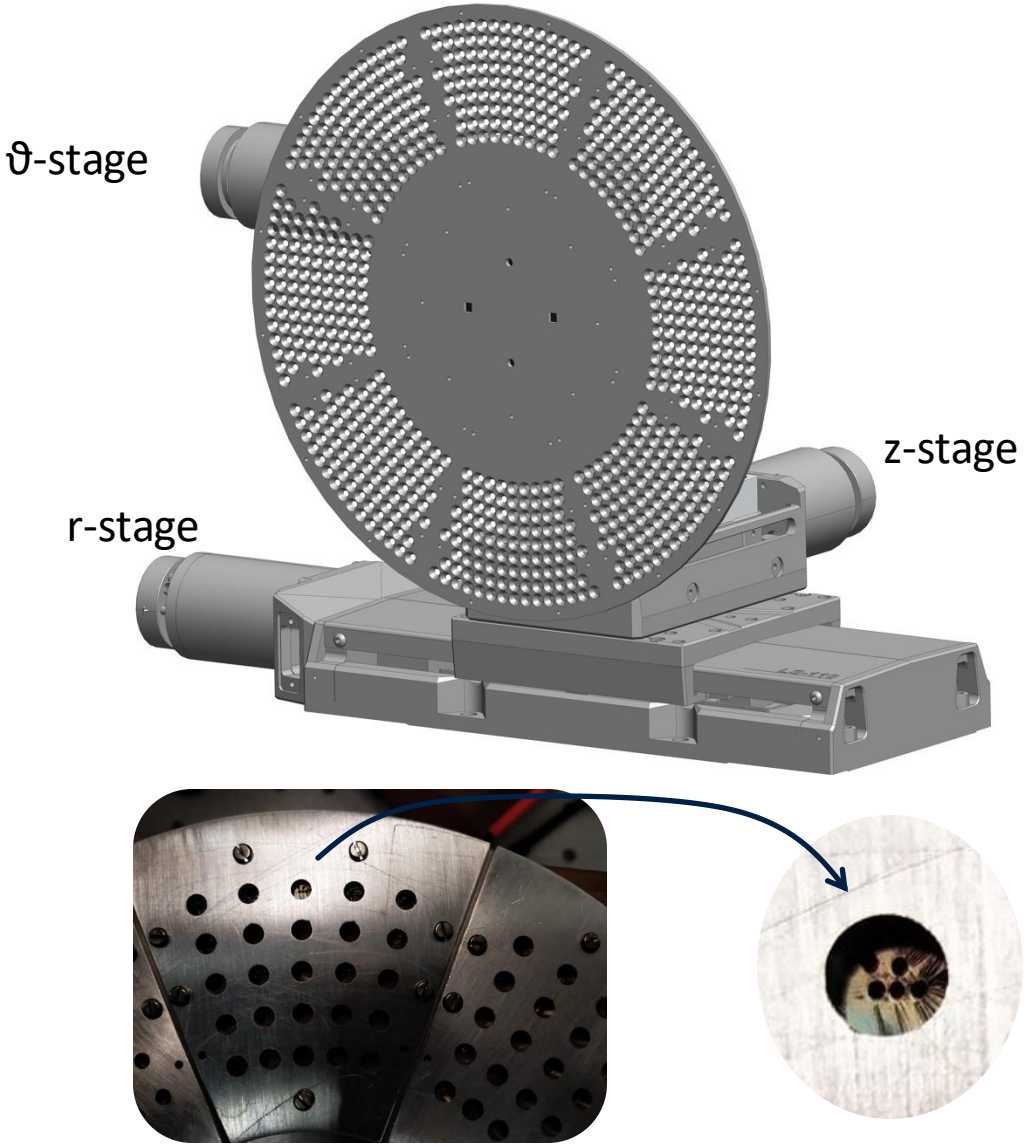


→ Capable of hosting 1000s of shots @ 10Hz operation

→ Flexibility in terms of target material and thickness

[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Target wheel



→ Capable of hosting 1000s of shots @ 10Hz operation

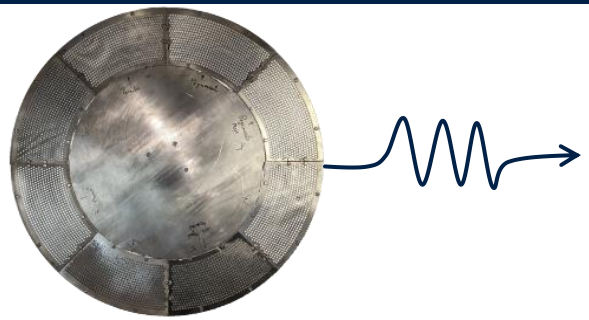
→ Flexibility in terms of target material and thickness

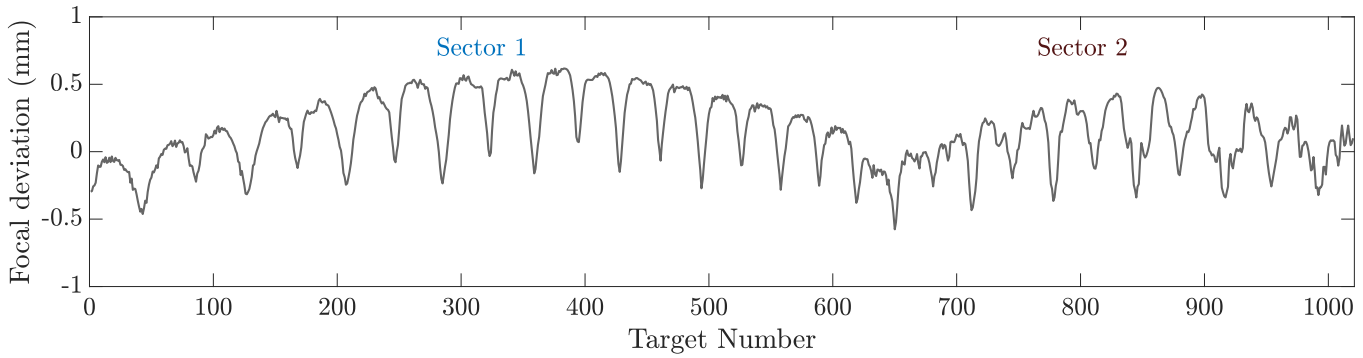
→ The wheel is precisely-manufactured to keep as flat as possible

- However, manufacturing precision introduces significant deformation between different regions (>100µm)
- Such deformation is beyond the Rayleigh range of our focusing optic (~15µm)

[J. Peñas *et al.*, HPLSE 12:2 (2024)]

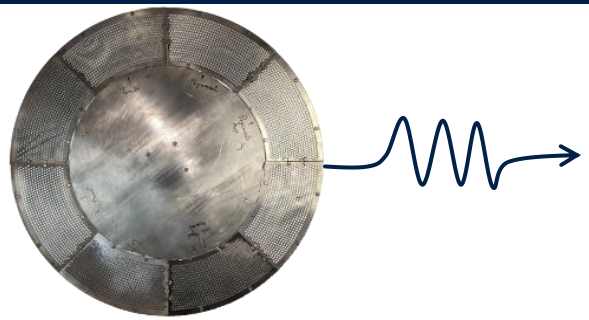
Target wheel. Pre-mapping

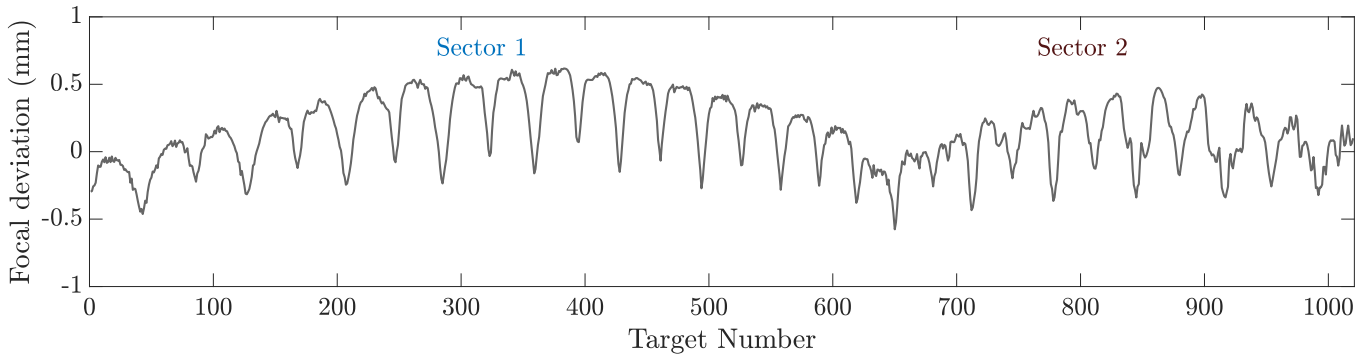




[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Target wheel. Pre-mapping



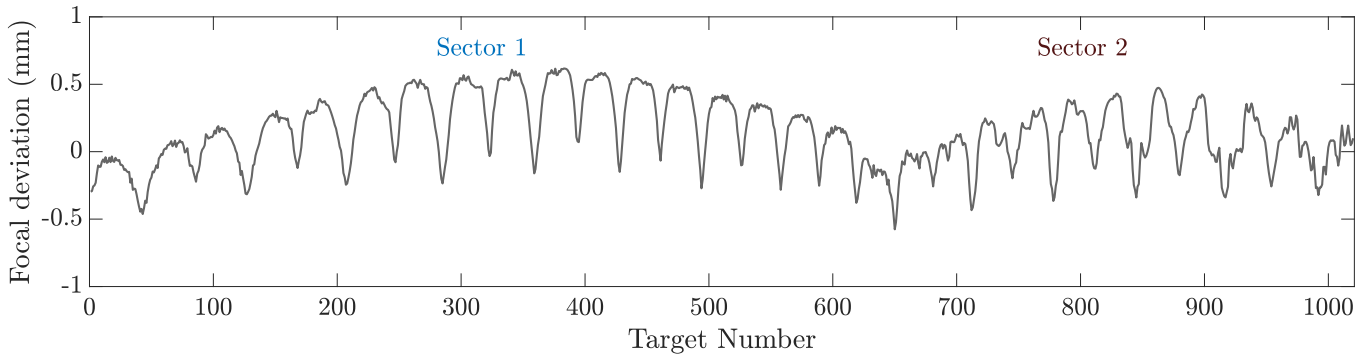


σ(deviation) ≅ 600 μm

⋙ Rayleigh range

[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Target wheel. Pre-mapping

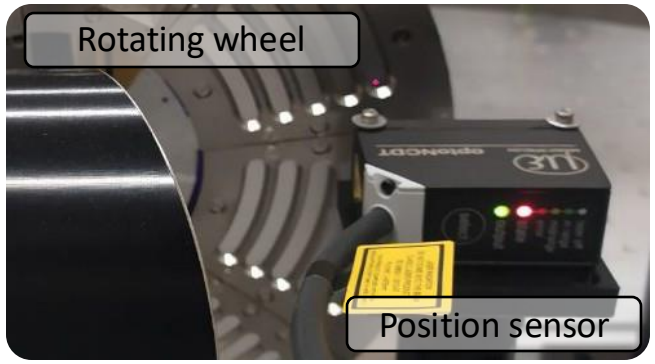


σ(deviation) ≅ 600 μm

⋙ Rayleigh range

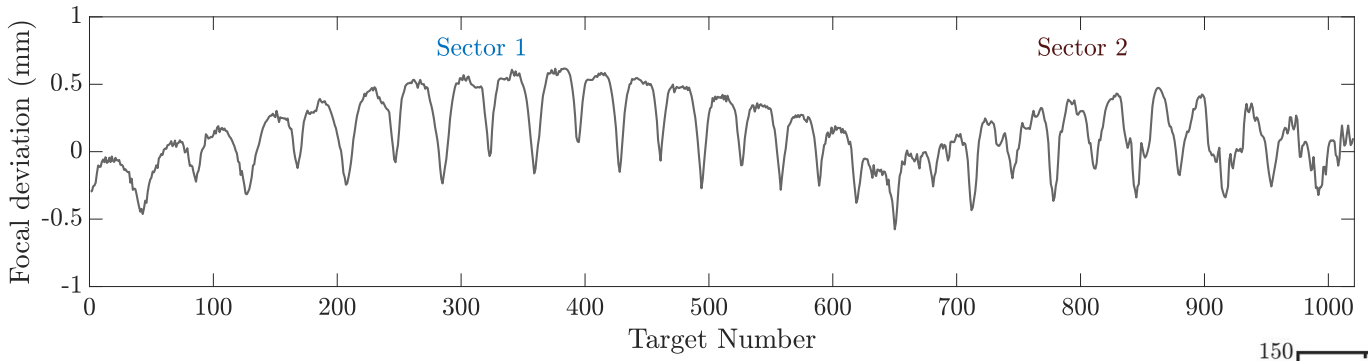
→ Pre-map target surface

→ The retrieval of an entire map takes about **5 minutes**.



[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Target wheel. Pre-mapping

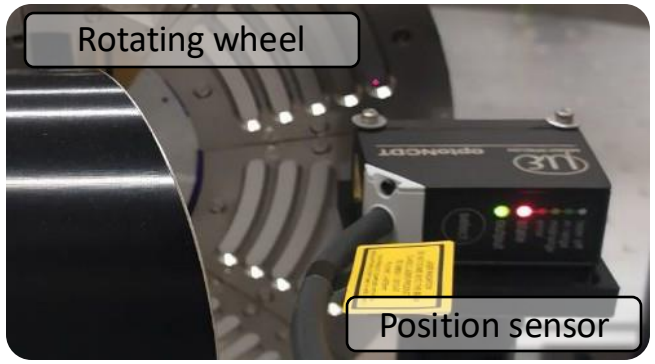


σ(deviation) ≅ 600 µm

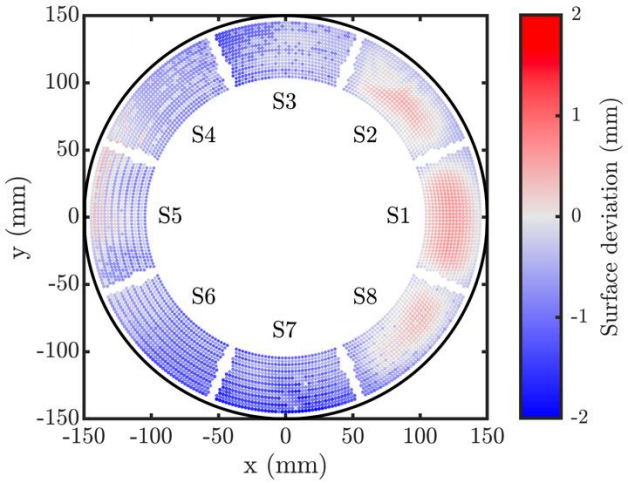
⋙ Rayleigh range

→ Pre-map target surface

→ The retrieval of an entire map takes about **5 minutes**.

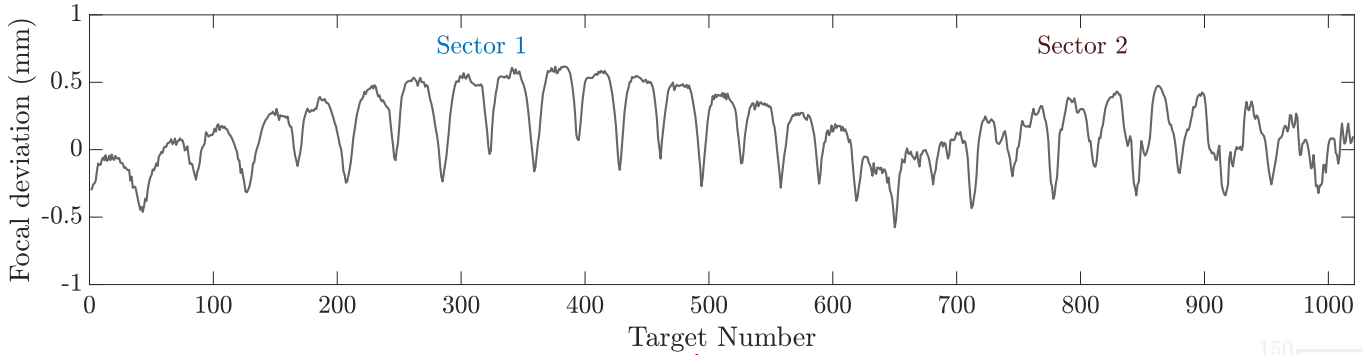


Automatise correction motion



[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Target wheel. Pre-mapping



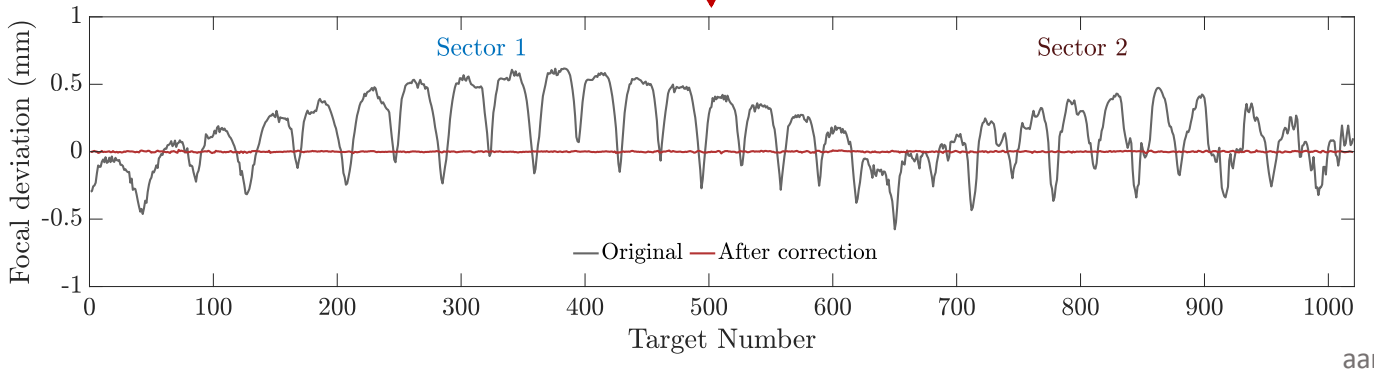
σ(deviation) ≅ 600 µm

⋙ Rayleigh range

→ Pre-map target surface

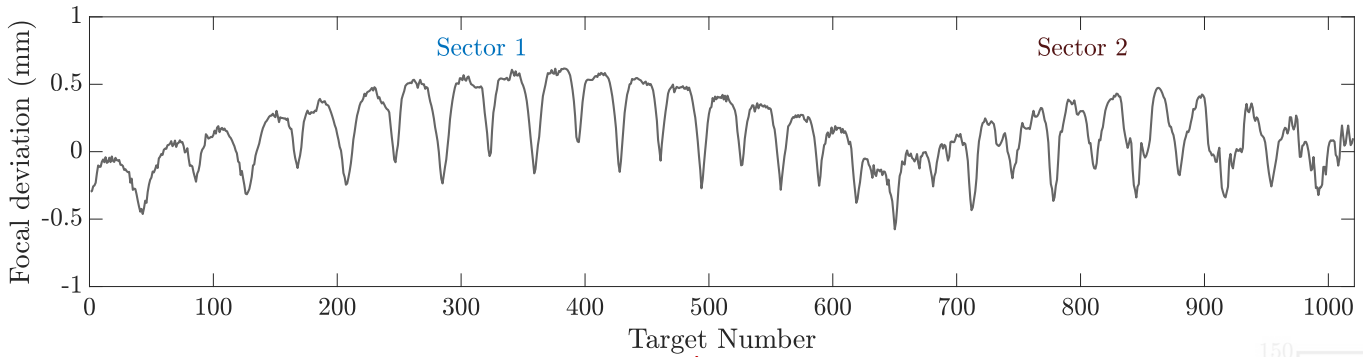
→ The retrieval of an entire map takes about **5 minutes**.

Automatise correction motion



[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Target wheel. Pre-mapping



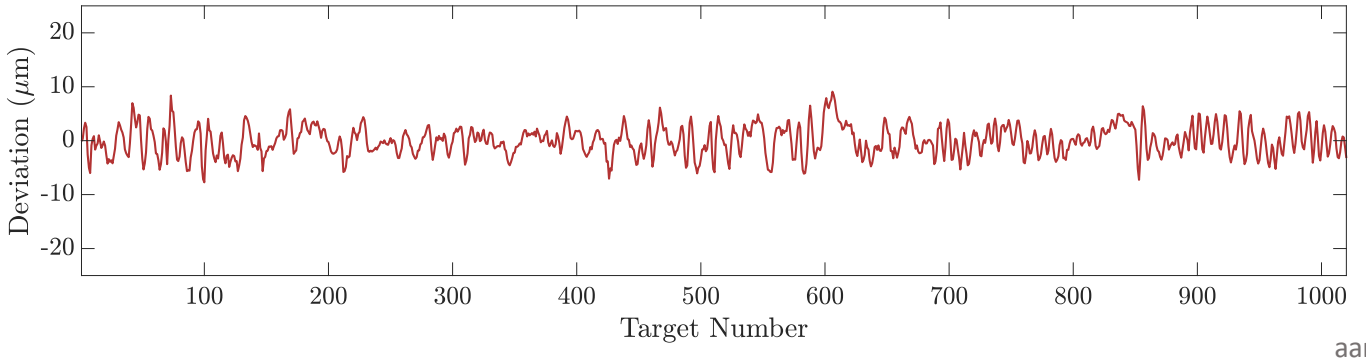
σ(deviation) ≅ 600 µm

⋙ Rayleigh range

→ Pre-map target surface

→ The retrieval of an entire map takes about **5 minutes**.

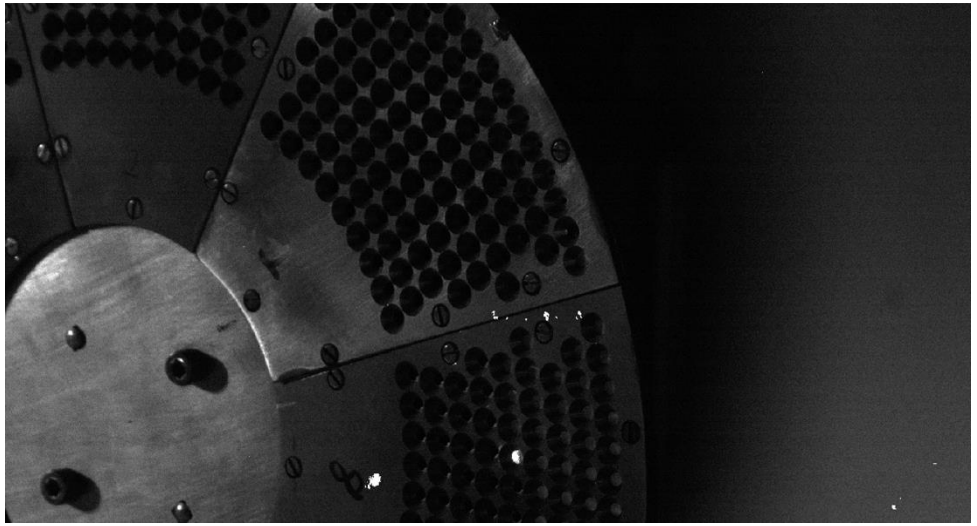
Automatise correction motion



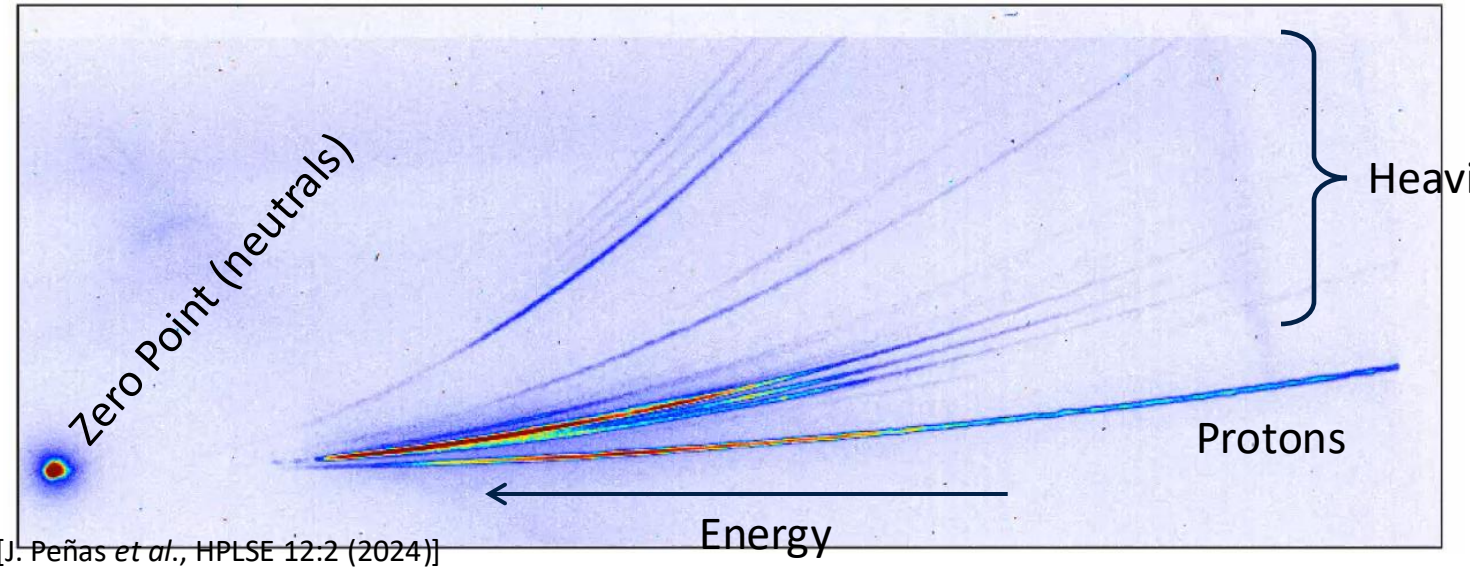
σ = 3.5µm!

[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Continuous proton acceleration

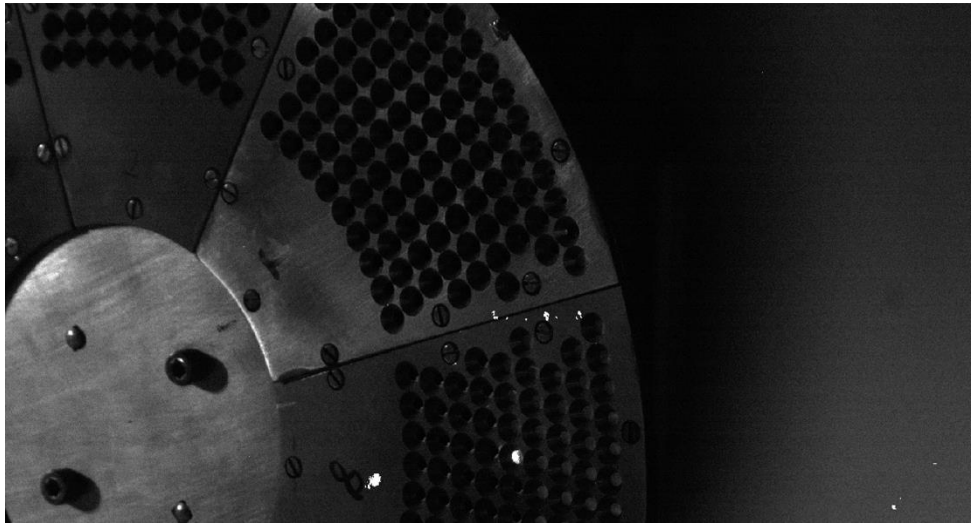


- → Experimentally demonstrated operation at 10Hz at 50TW L2A2 (USC).
- → **2022 campaign**: Following the 10 Hz demonstration, we wanted to test operation under more extreme conditions, using the 1Hz, 1PW laser at CLPU
- → Successfully accelerated ions at rates of up to 1Hz and laser energies up to 25J
- → Stable ion acceleration at these energies, **but struggle to operate at maximum rate due to EMP.**

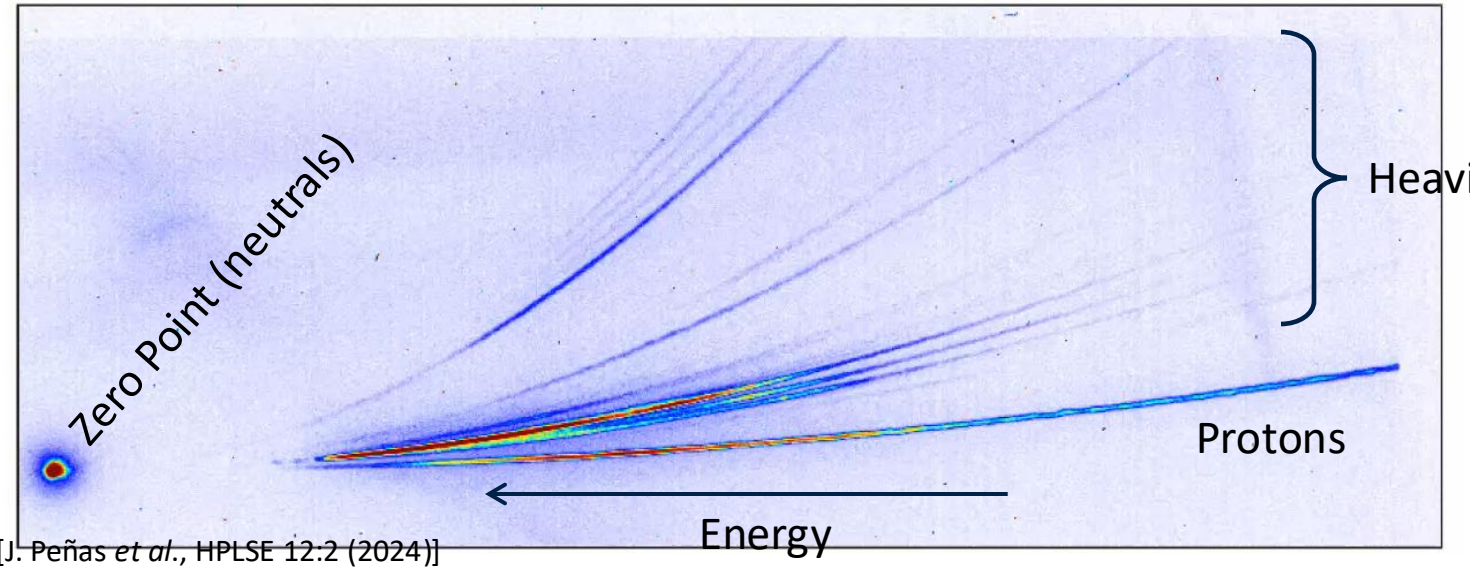


[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Continuous proton acceleration

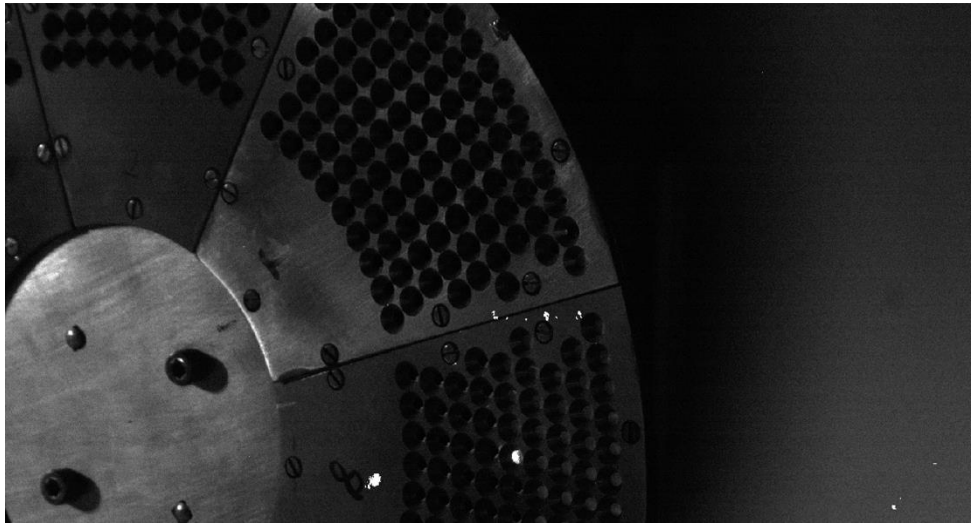


- → Experimentally demonstrated operation at 10Hz at 50TW L2A2 (USC).
- → **2022 campaign**: Following the 10 Hz demonstration, we wanted to test operation under more extreme conditions, using the 1Hz, 1PW laser at CLPU
- → Successfully accelerated ions at rates of up to 1Hz and laser energies up to 25J
- → Stable ion acceleration at these energies, **but struggle to operate at maximum rate due to EMP.**

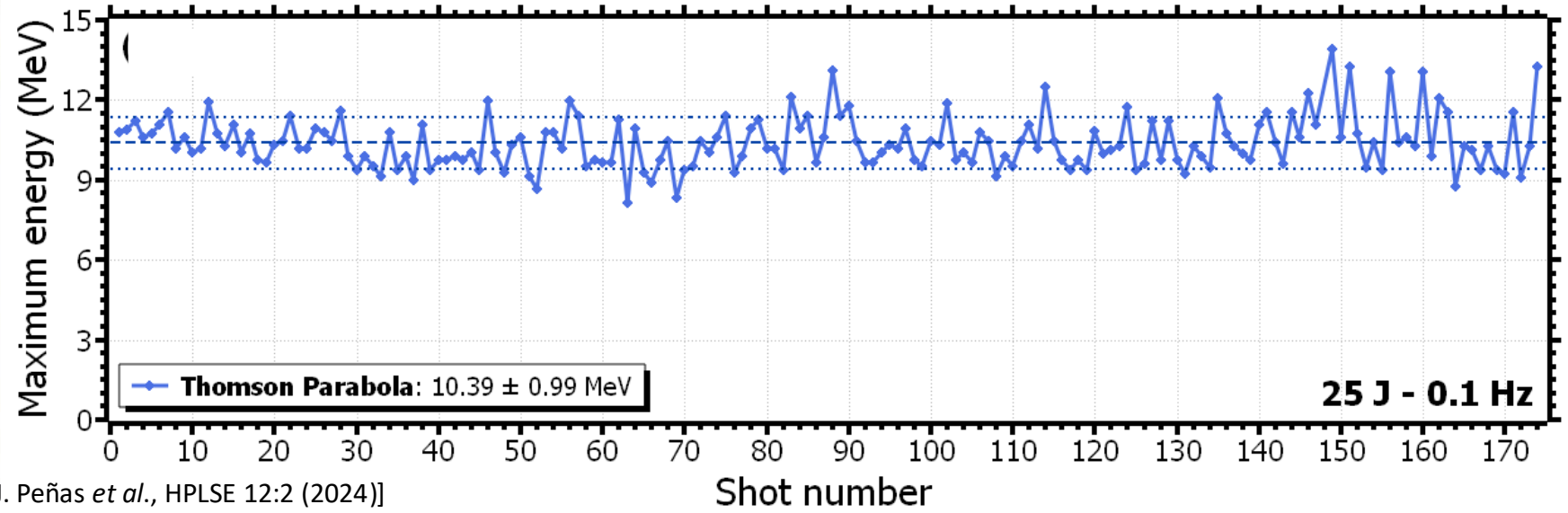


[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Continuous proton acceleration

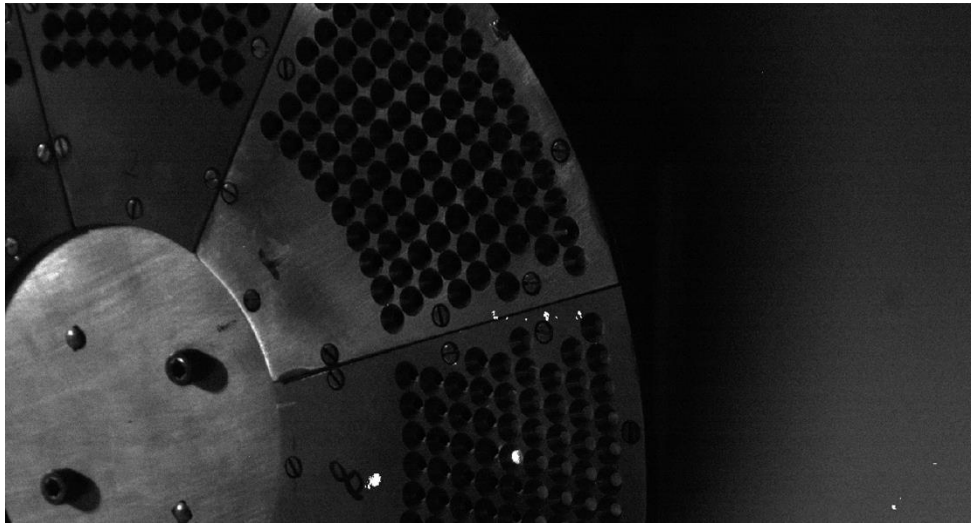


- → Experimentally demonstrated operation at 10Hz at 50TW L2A2 (USC).
- → **2022 campaign**: Following the 10 Hz demonstration, we wanted to test operation under more extreme conditions, using the 1Hz, 1PW laser at CLPU
- → Successfully accelerated ions at rates of up to 1Hz and laser energies up to 25J
- → Stable ion acceleration at these energies, **but struggle to operate at maximum rate due to EMP.**

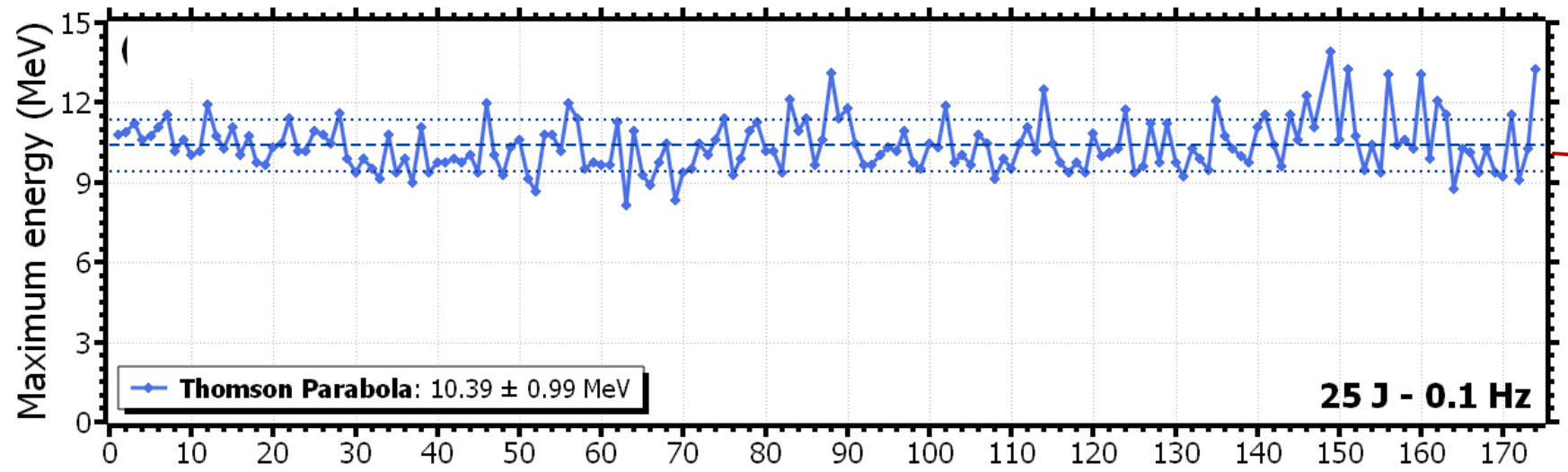


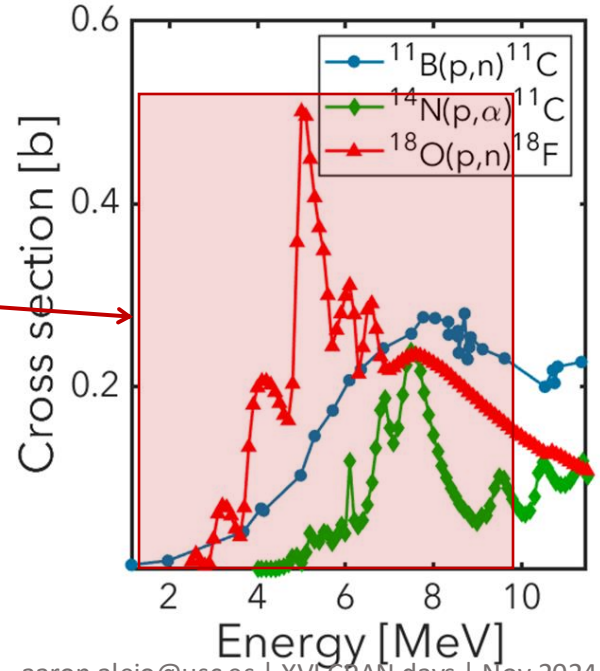
[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Continuous proton acceleration



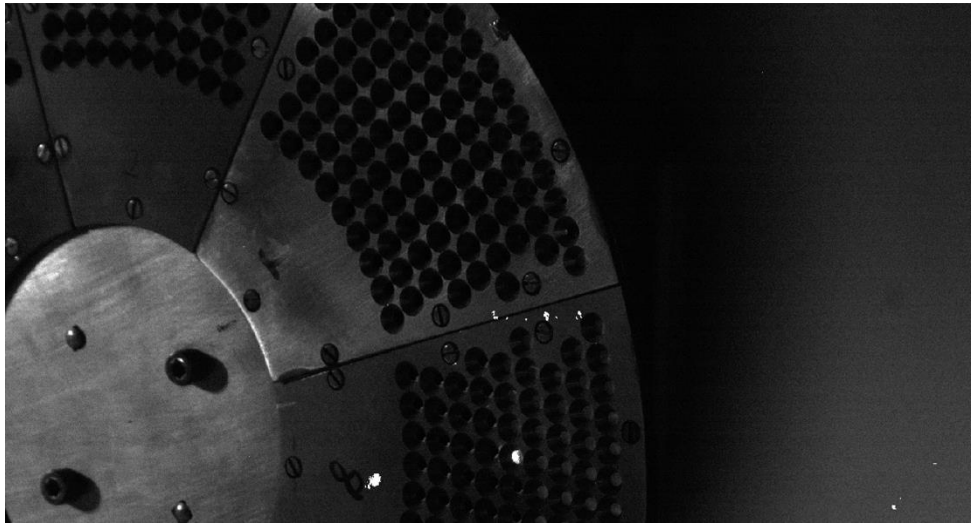
- → Experimentally demonstrated operation at 10Hz at 50TW L2A2 (USC).
- → **2022 campaign**: Following the 10 Hz demonstration, we wanted to test operation under more extreme conditions, using the 1Hz, 1PW laser at CLPU
- → Successfully accelerated ions at rates of up to 1Hz and laser energies up to 25J
- → Stable ion acceleration at these energies, **but struggle to operate at maximum rate due to EMP.**



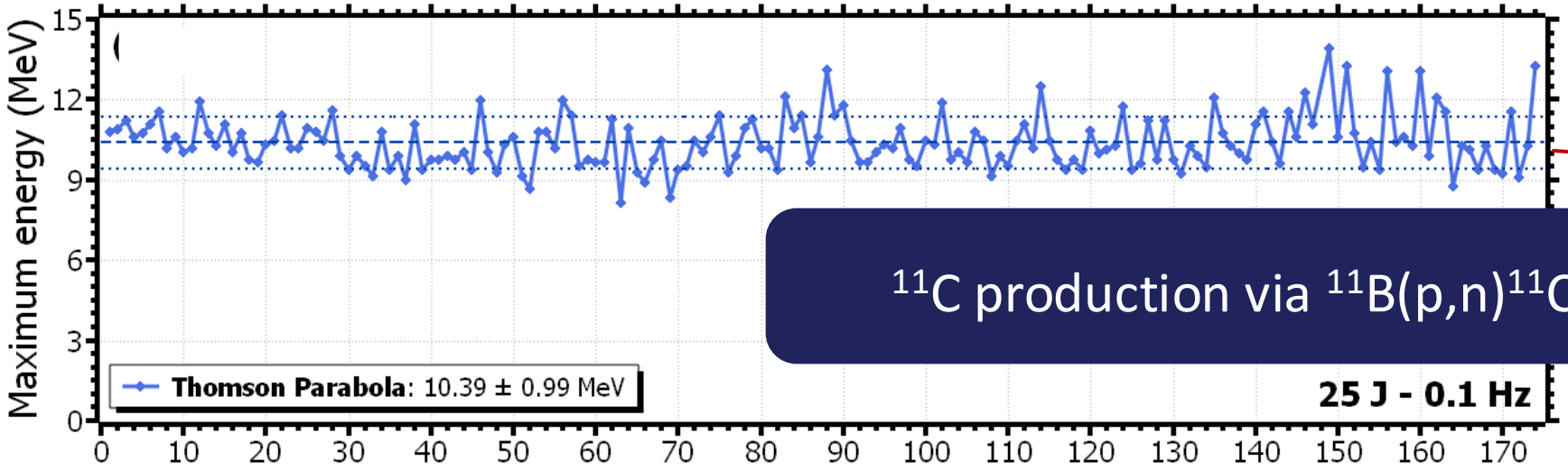


[J. Peñas *et al.*, HPLSE 12:2 (2024)]

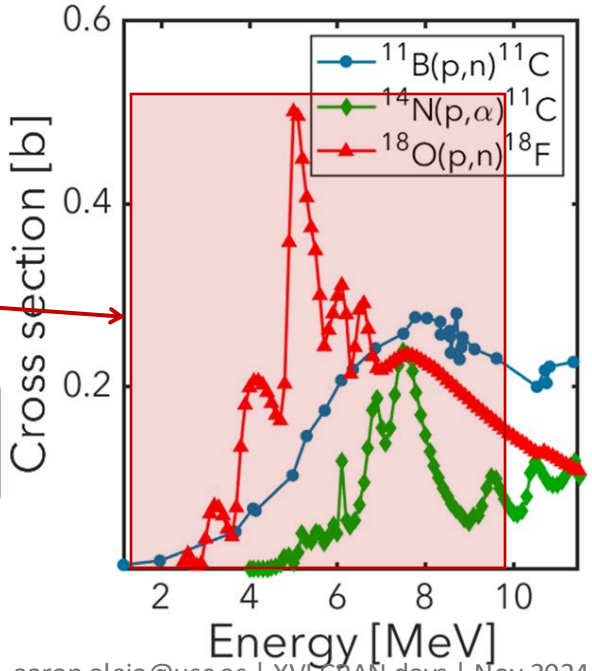
Continuous proton acceleration



- → Experimentally demonstrated operation at 10Hz at 50TW L2A2 (USC).
- → **2022 campaign**: Following the 10 Hz demonstration, we wanted to test operation under more extreme conditions, using the 1Hz, 1PW laser at CLPU
- → Successfully accelerated ions at rates of up to 1Hz and laser energies up to 25J
- → Stable ion acceleration at these energies, **but struggle to operate at maximum rate due to EMP.**



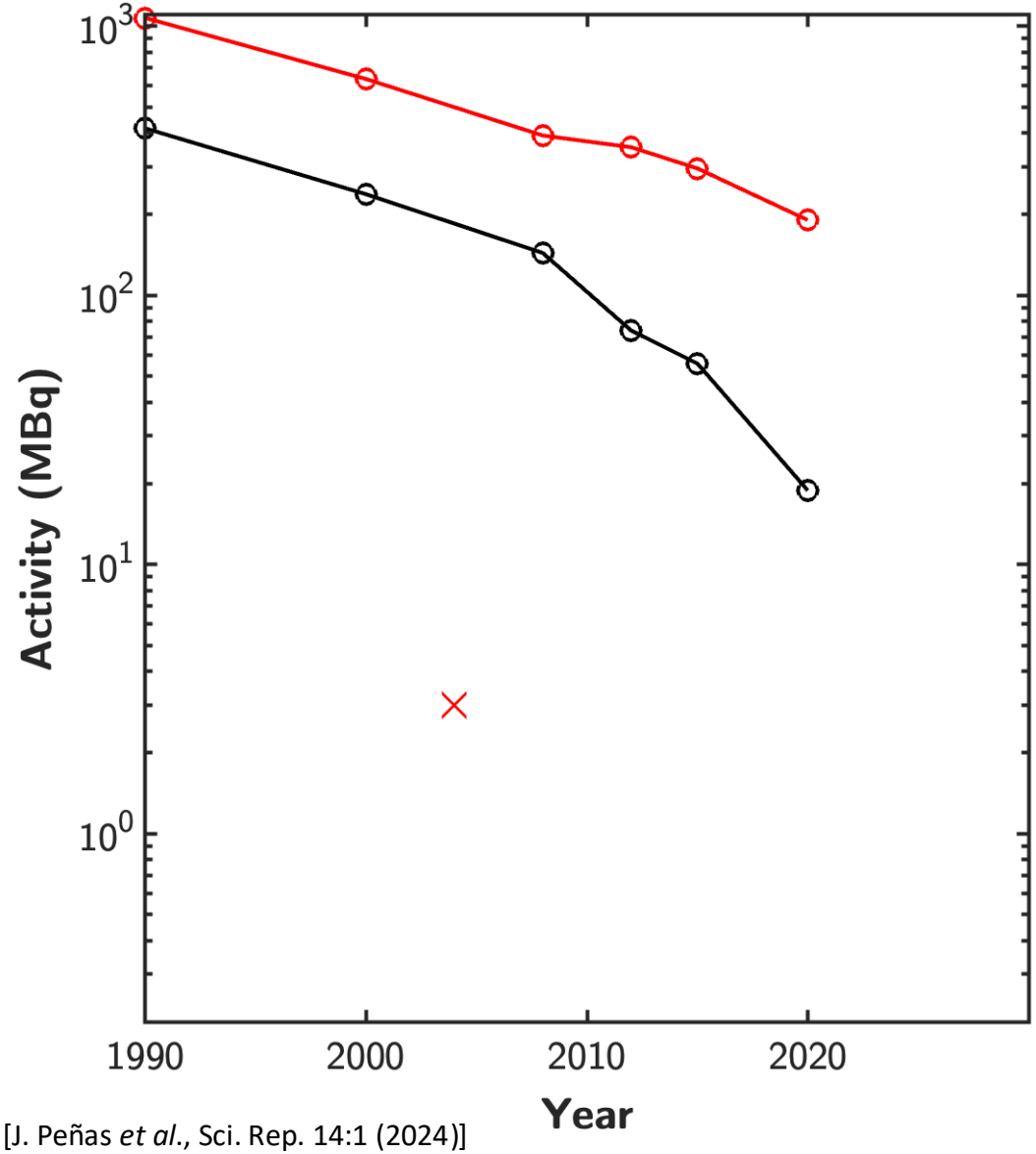
^{11}C production via ^{11}B(p,n)^{11}C ?



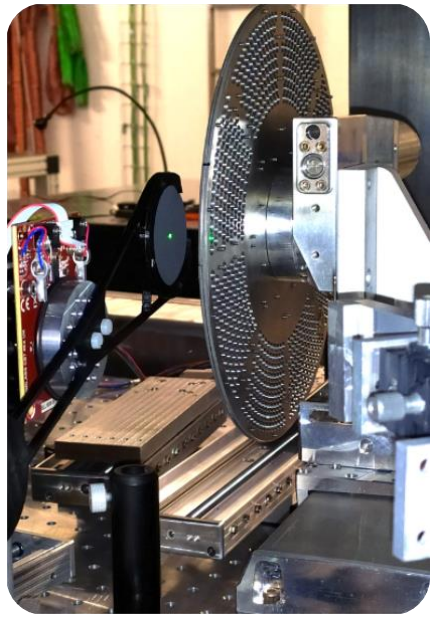
[J. Peñas *et al.*, HPLSE 12:2 (2024)]

Towards **pre-clinical** ^{11}C production

Demonstration of ^{11}C isotope production

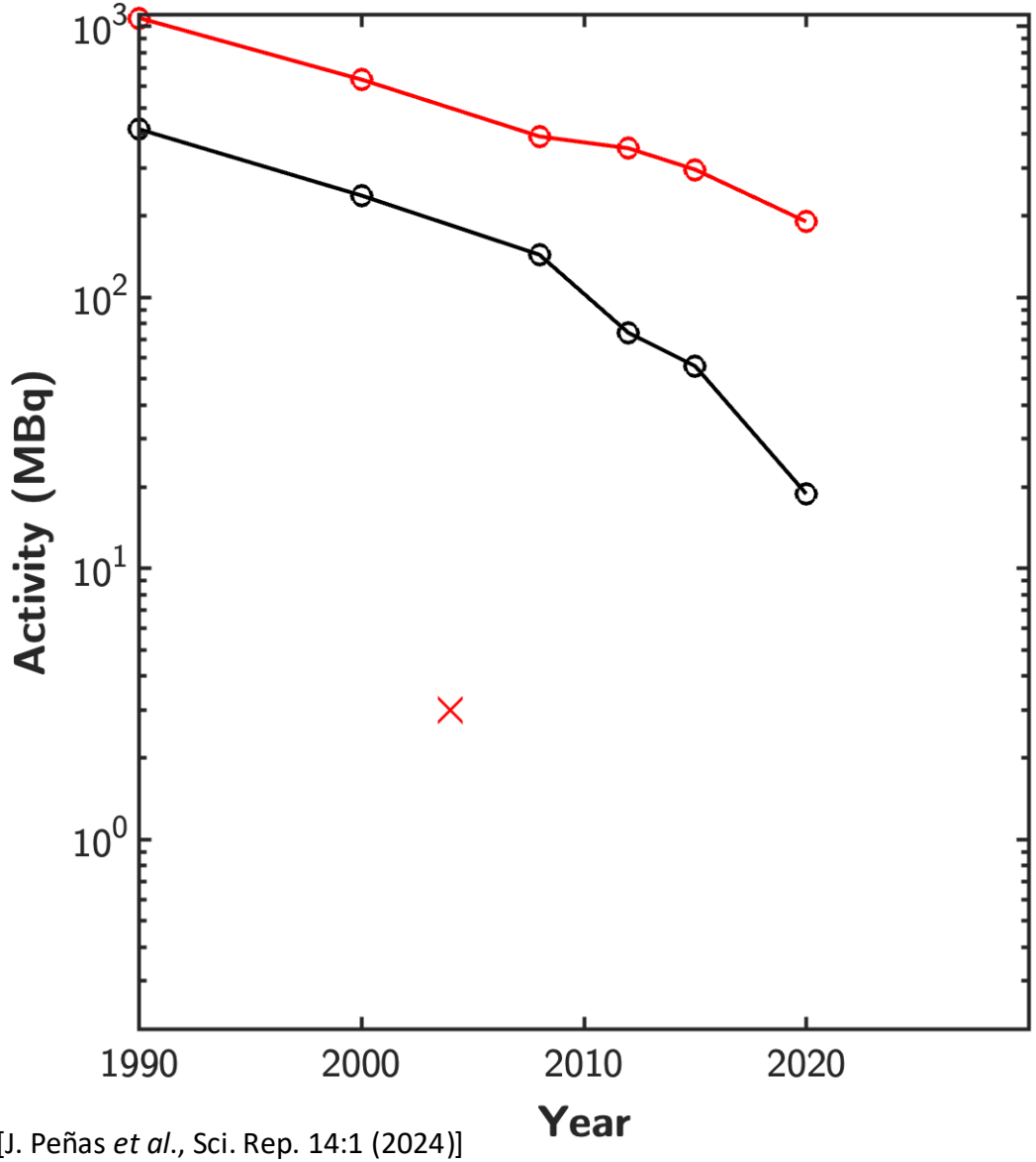


[J. Peñas *et al.*, Sci. Rep. 14:1 (2024)]

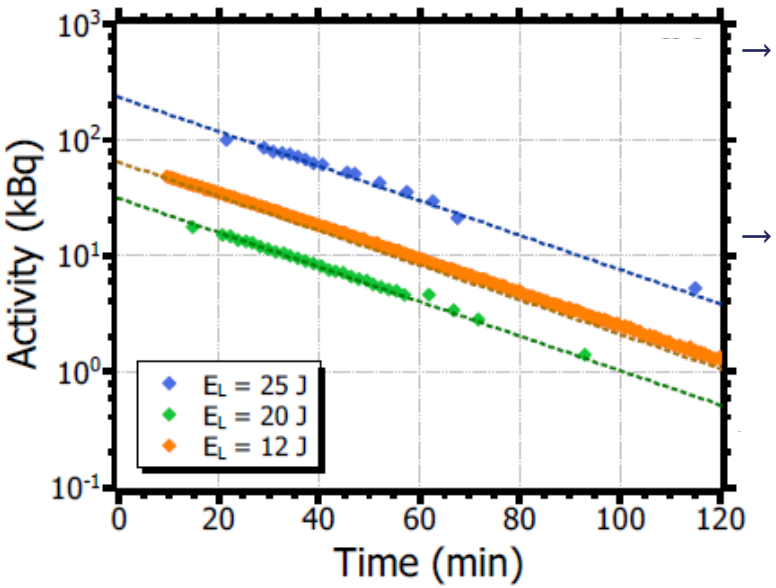


→ Demonstrated continuous ^{11}C production in multi-shot operation.

Demonstration of ^{11}C isotope production



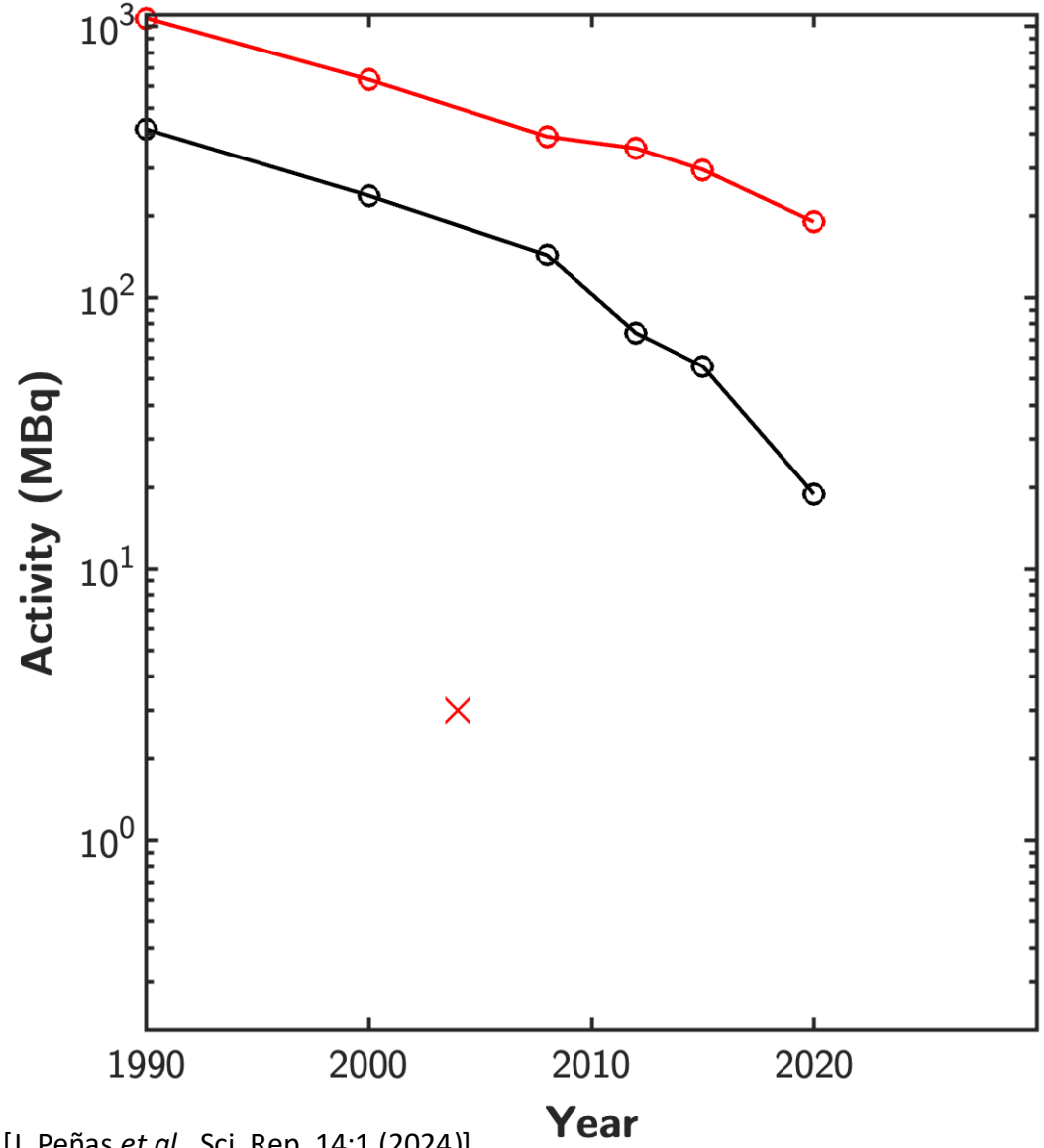
[J. Peñas *et al.*, Sci. Rep. 14:1 (2024)]



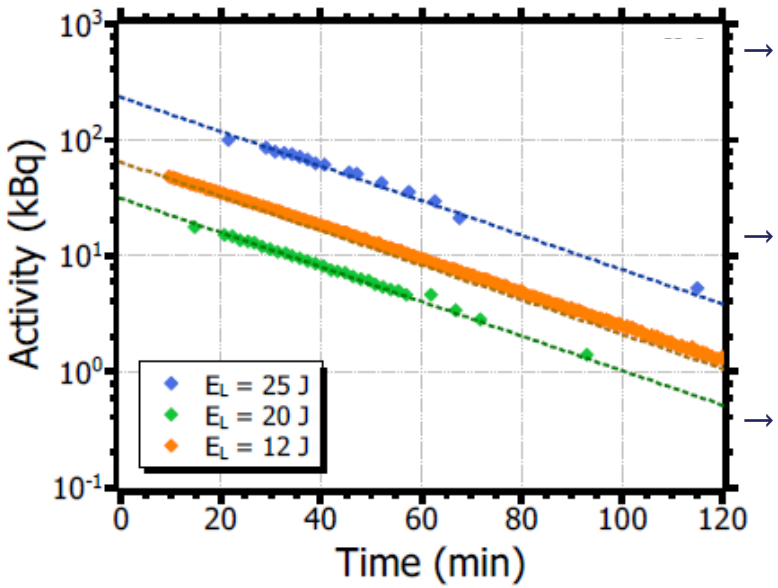
→ Demonstrated continuous ^{11}C production in multi-shot operation.

→ Reproducing the decay curve and half-life of ^{11}C.

Demonstration of ^{11}C isotope production



[J. Peñas *et al.*, Sci. Rep. 14:1 (2024)]



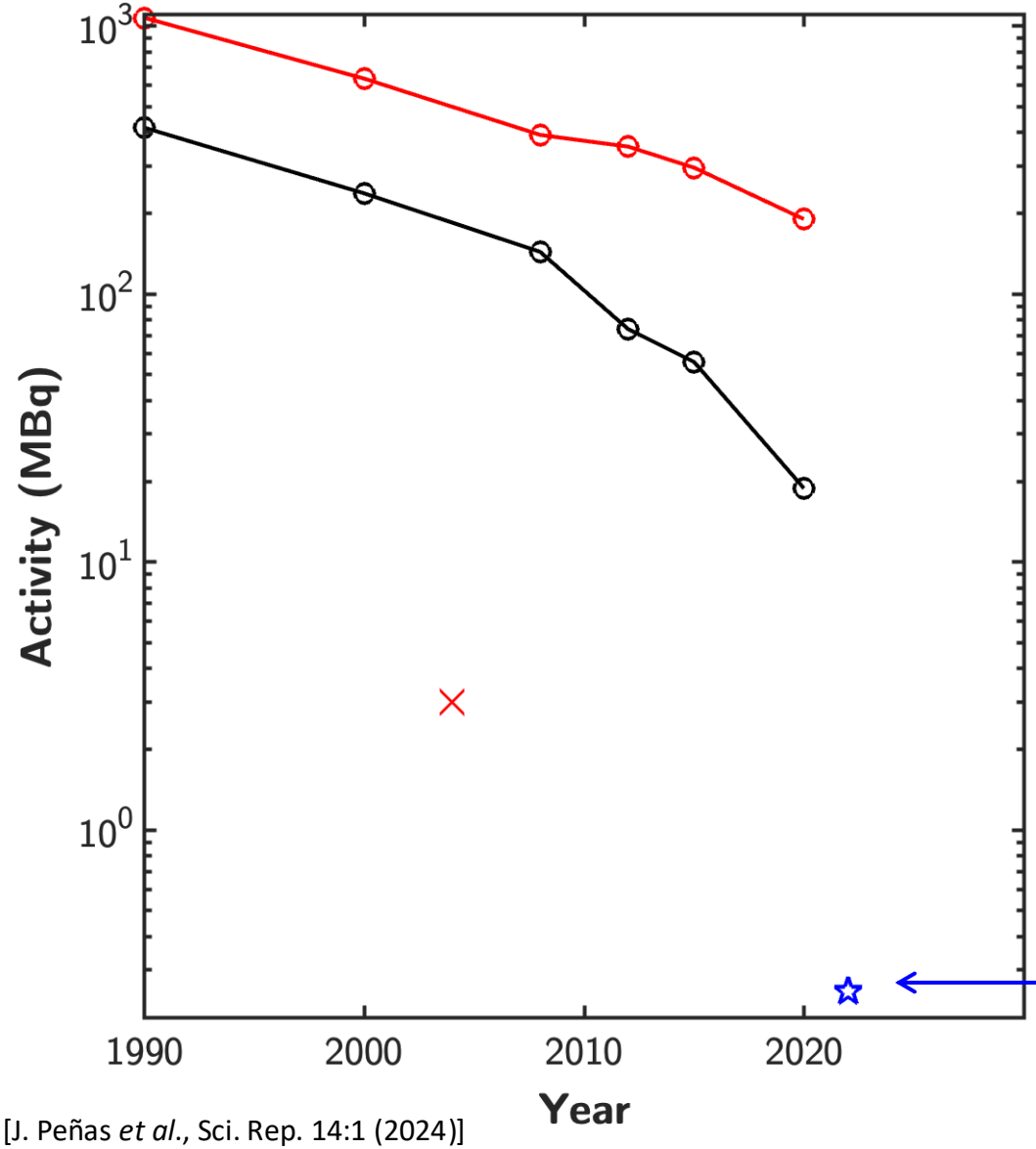
→ Demonstrated continuous ^{11}C production in multi-shot operation.

→ Reproducing the decay curve and half-life of ^{11}C.

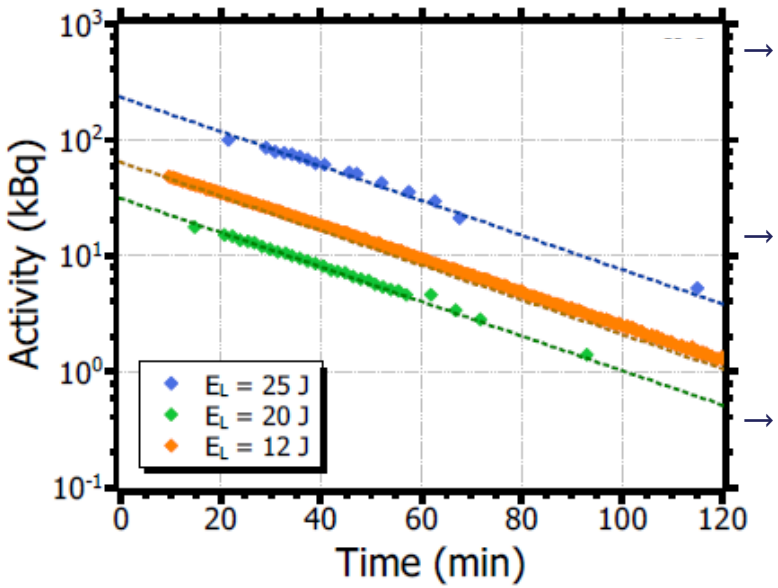
→ Achieved activities **above 230kBq** from a 20-shot burst.

Laser energy [J]	Repetition Rate [Hz]	# shots	Activity per shot [kBq]	Total activity [kBq]
12	0.2	40	1.8	68.6
20	0.1	10	3.2	31.5
25	0.1	20	12.4	233.8

Demonstration of ^{11}C isotope production



[J. Peñas *et al.*, Sci. Rep. 14:1 (2024)]



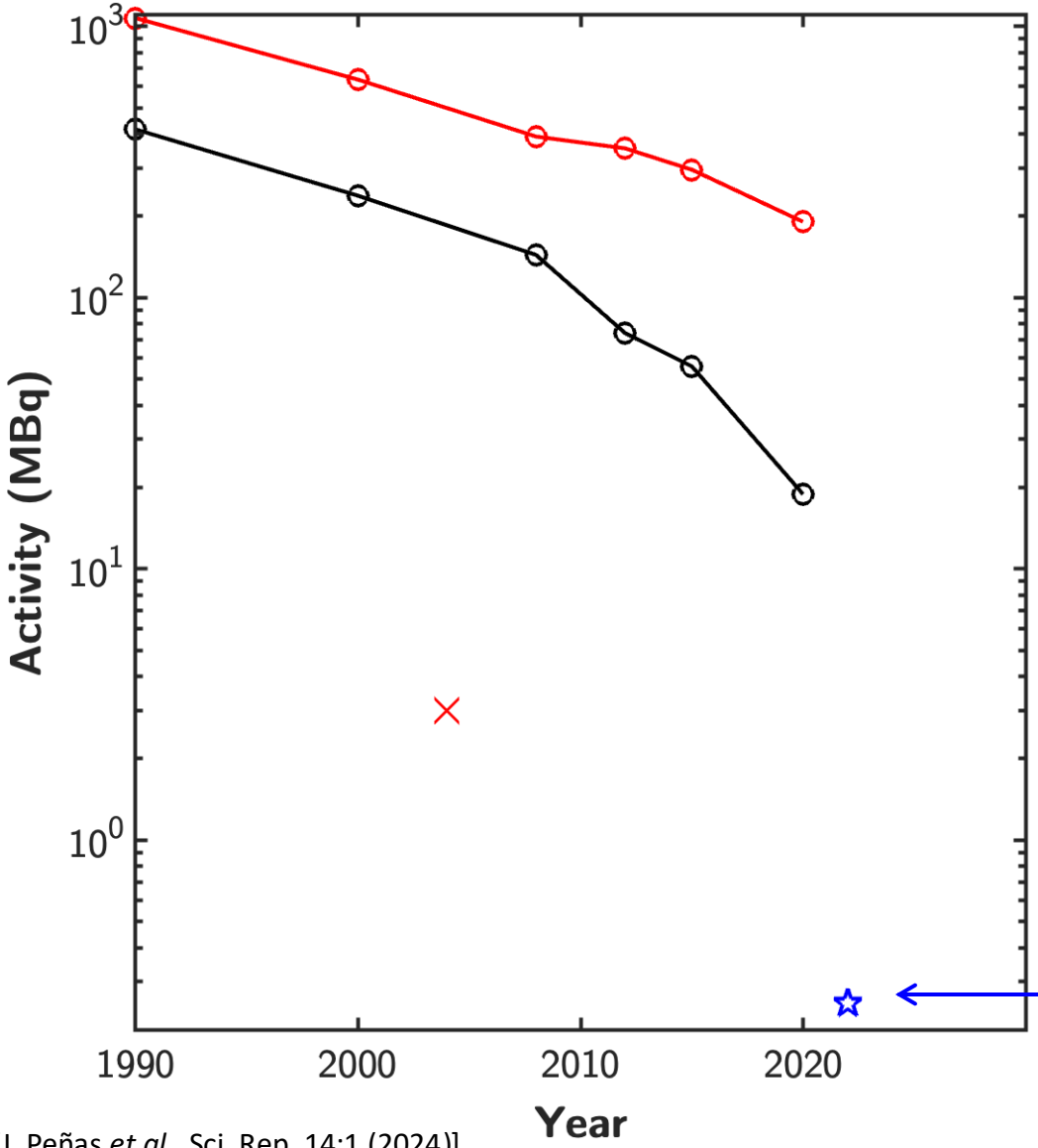
→ Demonstrated continuous ^{11}C production in multi-shot operation.

→ Reproducing the decay curve and half-life of ^{11}C.

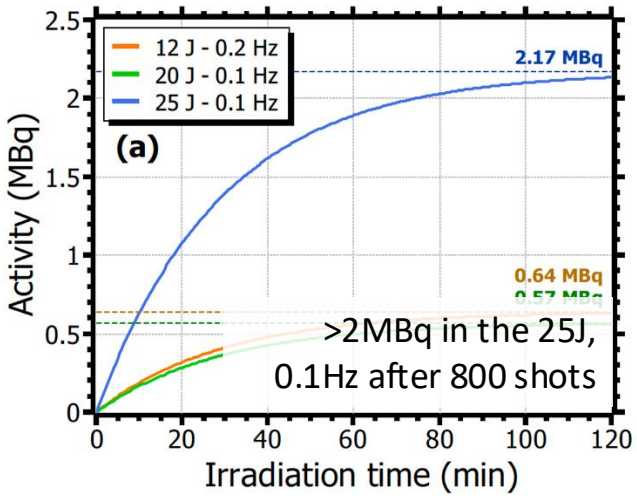
→ Achieved activities **above 230kBq** from a 20-shot burst.

Laser energy [J]	Repetition Rate [Hz]	# shots	Activity per shot [kBq]	Total activity [kBq]
12	0.2	40	1.8	68.6
20	0.1	10	3.2	31.5
25	0.1	20	12.4	233.8

Demonstration of ^{11}C isotope production



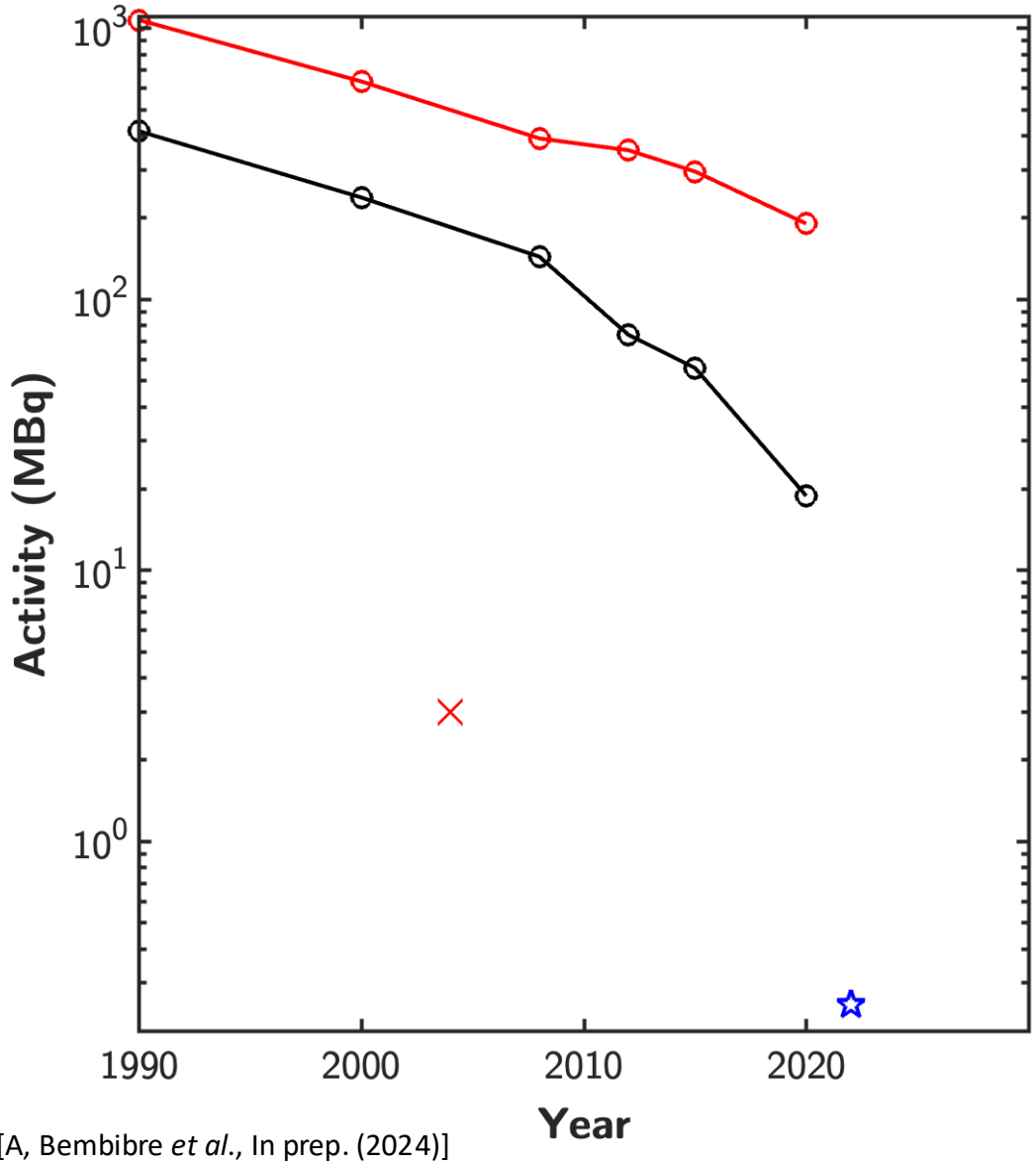
[J. Peñas *et al.*, Sci. Rep. 14:1 (2024)]



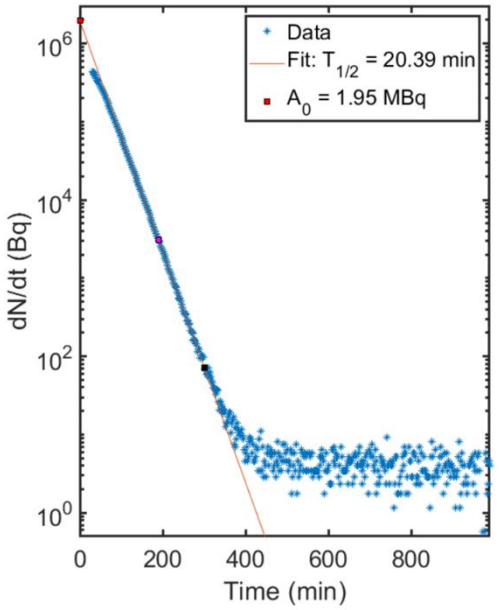
Laser energy [J]	Repetition Rate [Hz]	# shots	Activity per shot [kBq]	Total activity [kBq]
12	0.2	40	1.8	68.6
20	0.1	10	3.2	31.5
25	0.1	20	12.4	233.8

On the path to generate **pre-clinical activity** levels from LD sources

Extended ^{11}C isotope production

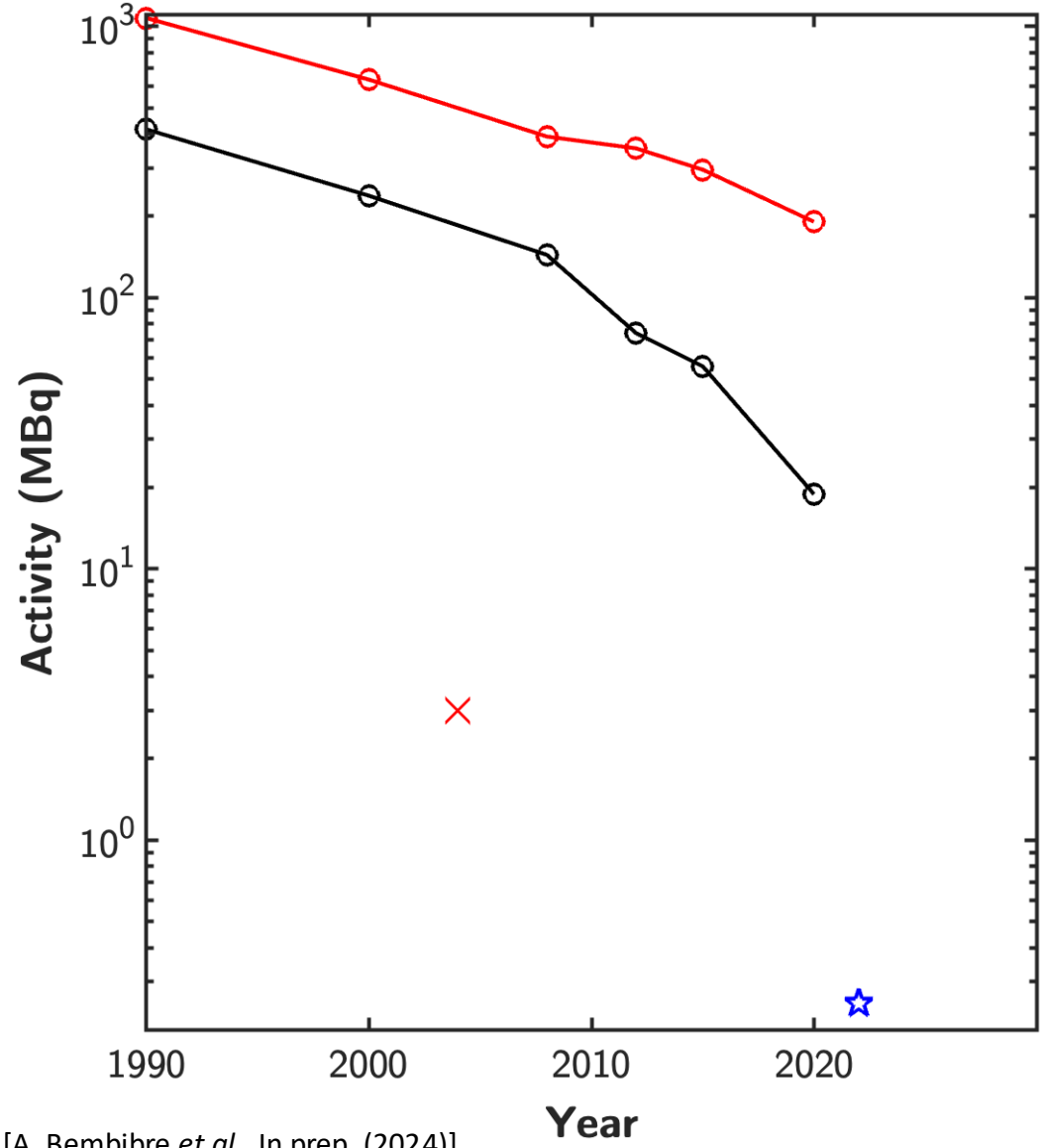


[A, Bembibre *et al.*, In prep. (2024)]



300 shots @ 0.2Hz, 25J

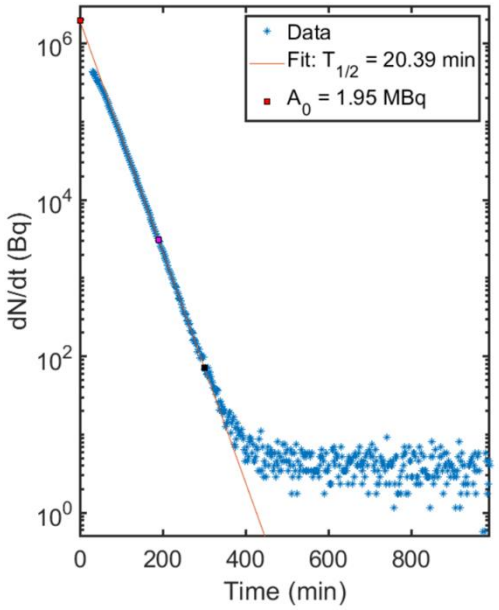
Extended ^{11}C isotope production



[A, Bembibre *et al.*, In prep. (2024)]

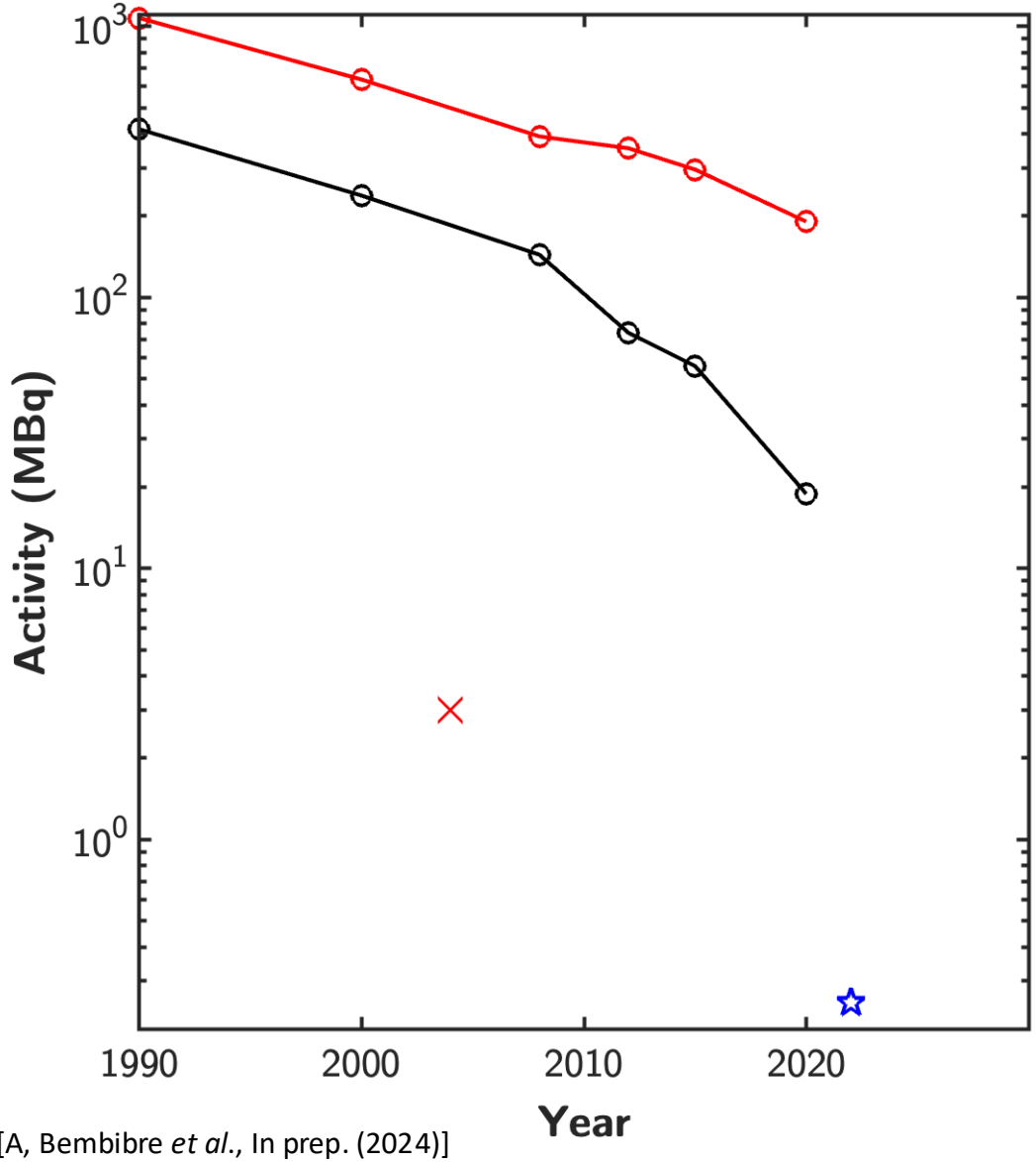
→ Recent (April 2024) dedicated experiment at CLPU to produce nuclear radio-isotopes in the context of the PROBONO cost action.

→ Greater activities achieved through extended accumulation of shots, demonstrating **>MBq production**



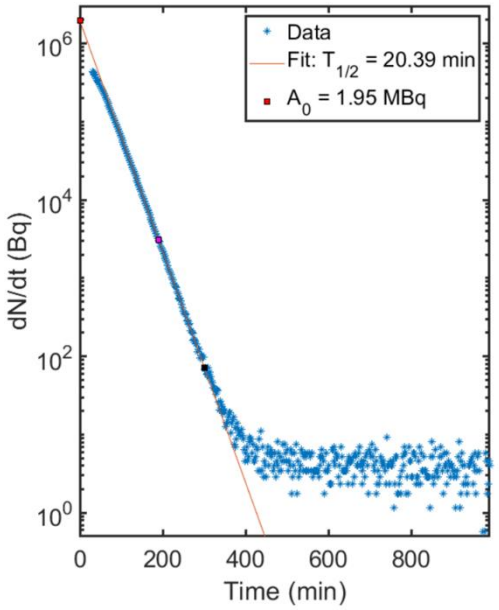
300 shots @ 0.2Hz, 25J

Extended ^{11}C isotope production

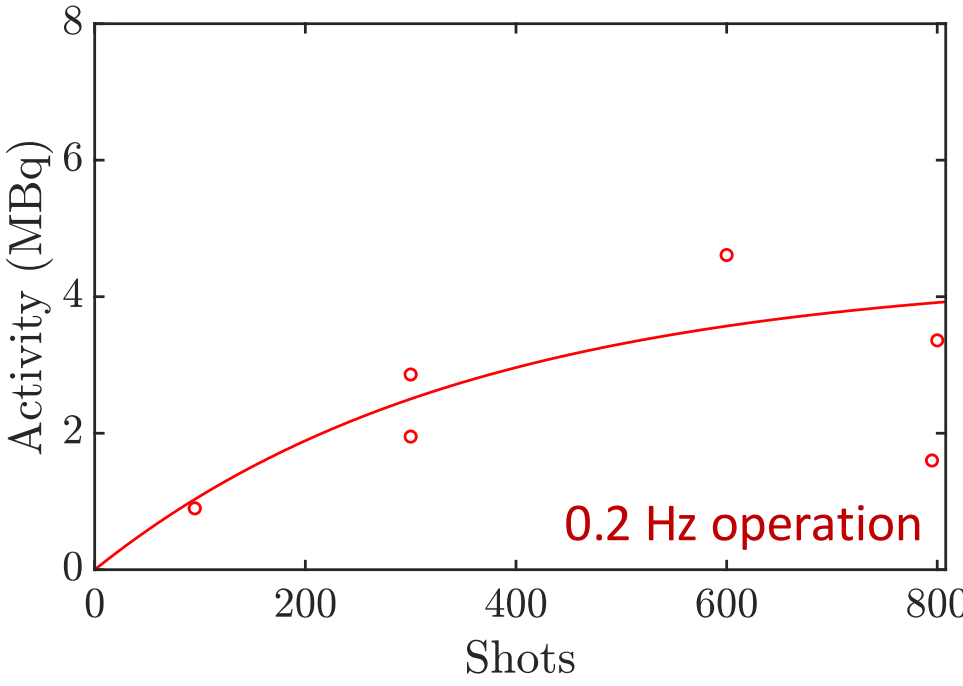


[A, Bembibre *et al.*, In prep. (2024)]

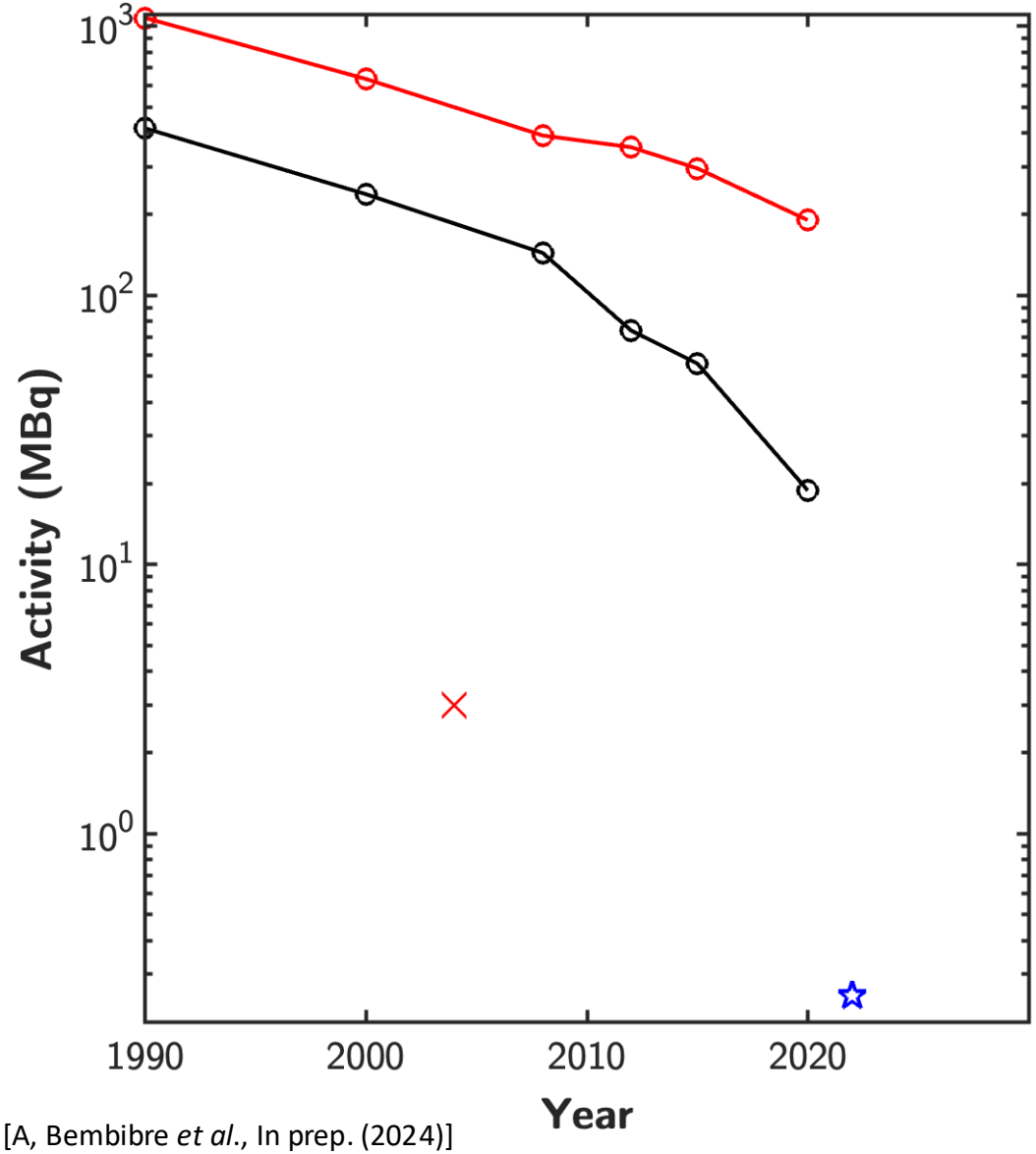
- → Recent (April 2024) dedicated experiment at CLPU to produce nuclear radio-isotopes in the context of the PROBONO cost action.
- → Greater activities achieved through extended accumulation of shots, demonstrating **>MBq production**
- → Reproduced the expected dependence of the activity produced on the number of shots



300 shots @ 0.2Hz, 25J



Extended ^{11}C isotope production

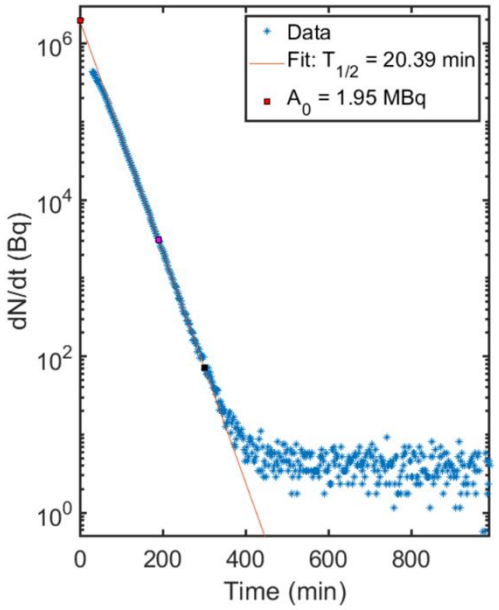


[A, Bembibre *et al.*, In prep. (2024)]

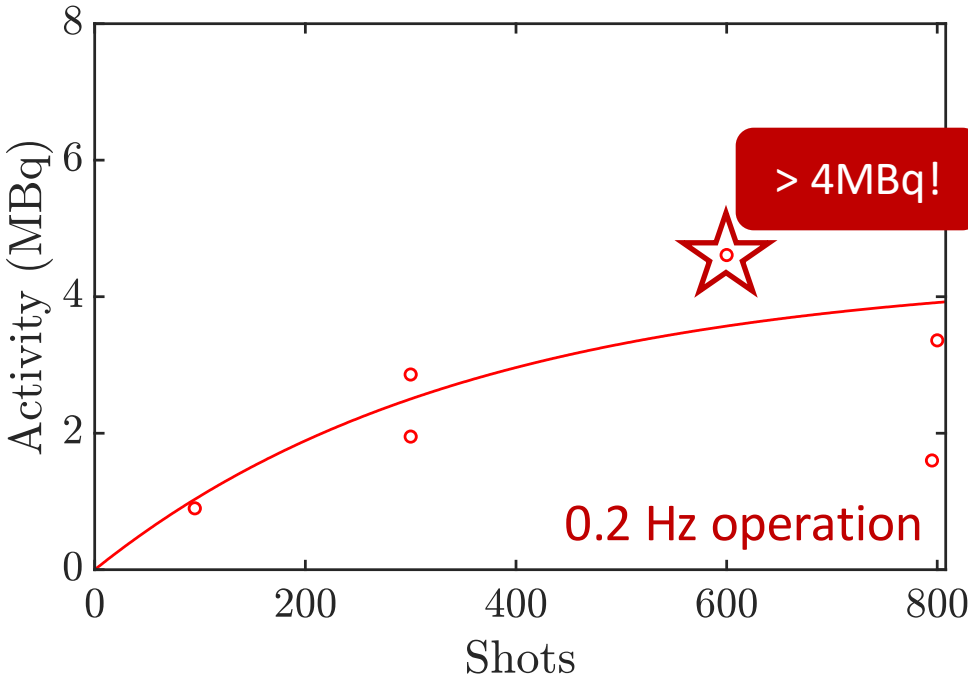
→ Recent (April 2024) dedicated experiment at CLPU to produce nuclear radio-isotopes in the context of the PROBONO cost action.

→ Greater activities achieved through extended accumulation of shots, demonstrating **>MBq production**

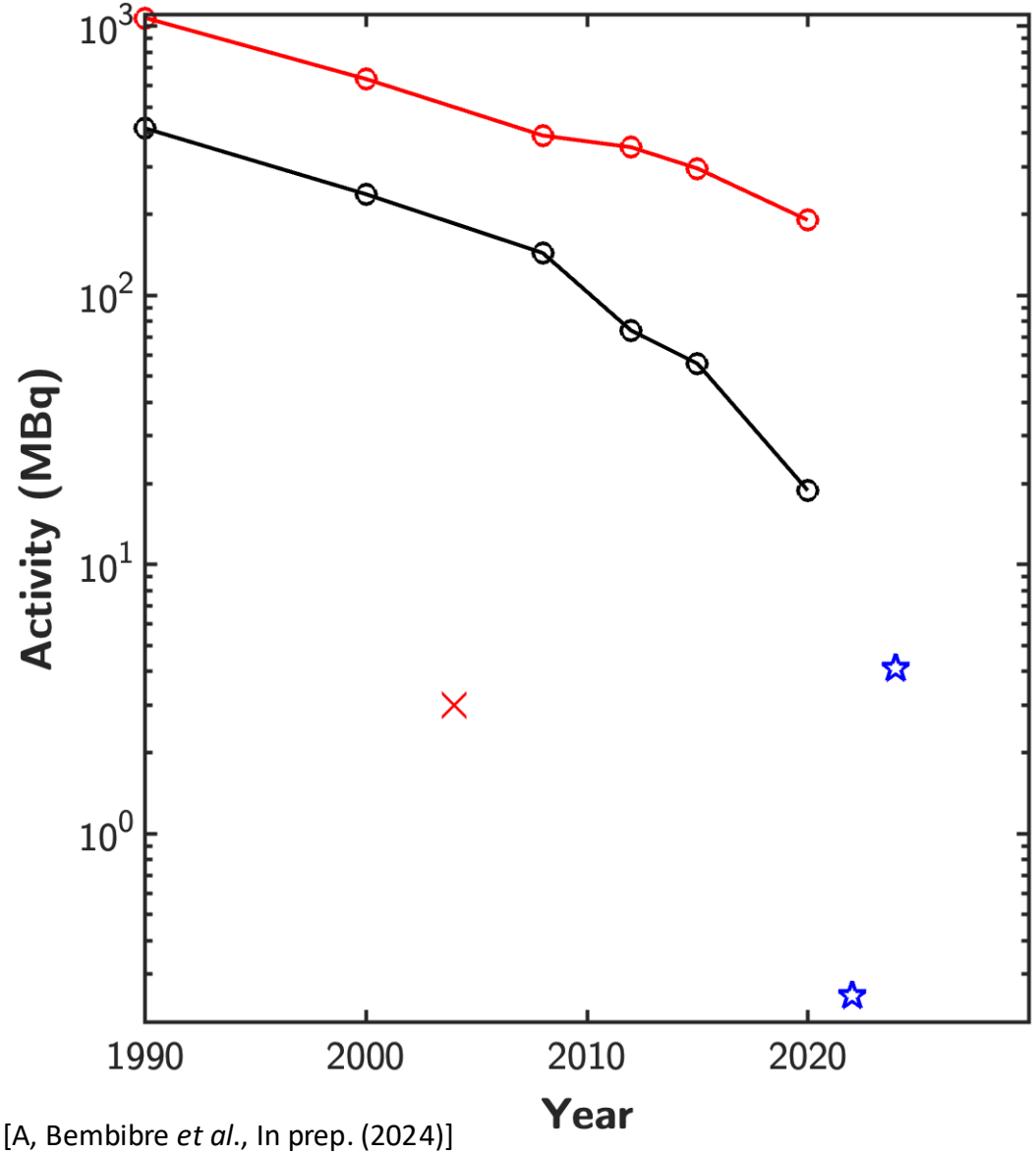
→ Reproduced the expected dependence of the activity produced on the number of shots



300 shots @ 0.2Hz, 25J



Extended ^{11}C isotope production

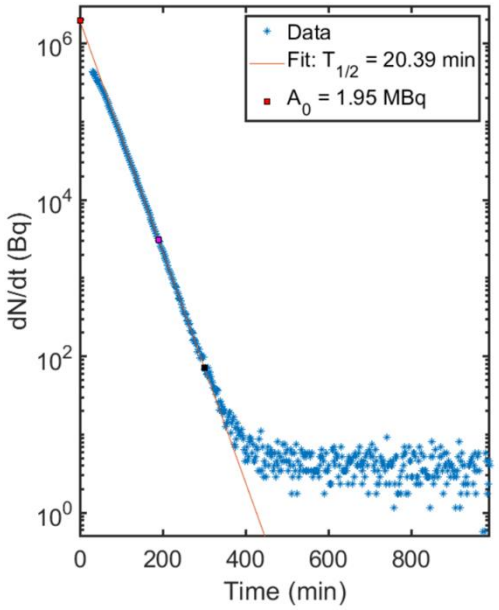


[A, Bembibre *et al.*, In prep. (2024)]

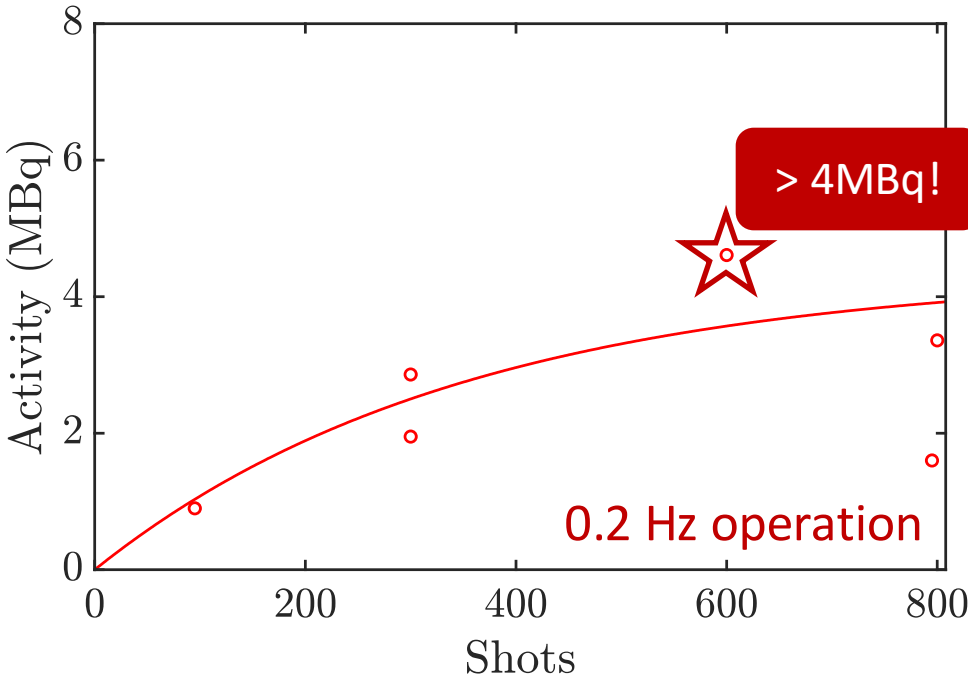
→ Recent (April 2024) dedicated experiment at CLPU to produce nuclear radio-isotopes in the context of the PROBONO cost action.

→ Greater activities achieved through extended accumulation of shots, demonstrating **>MBq production**

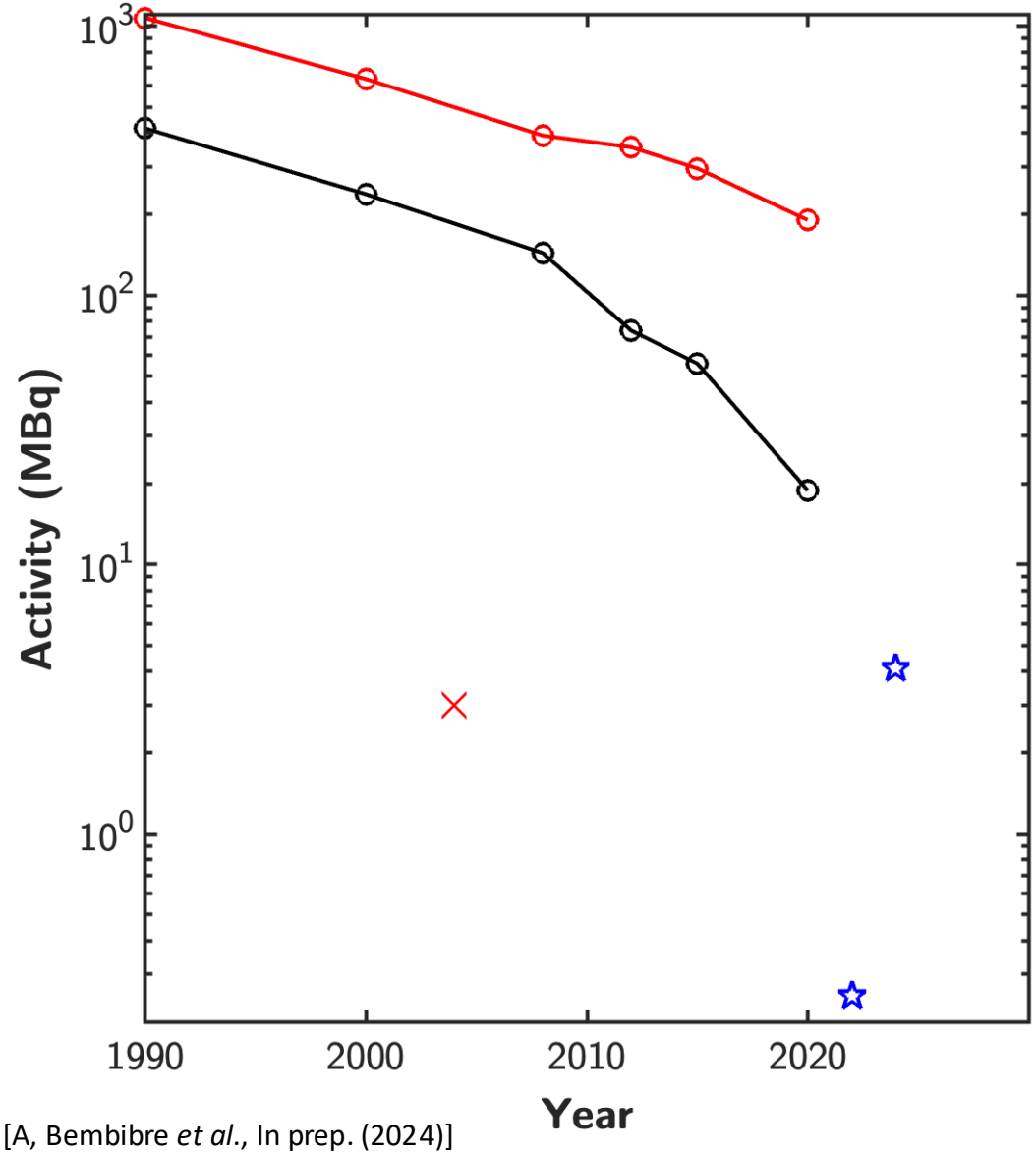
→ Reproduced the expected dependence of the activity produced on the number of shots



300 shots @ 0.2Hz, 25J



Extended ^{11}C isotope production

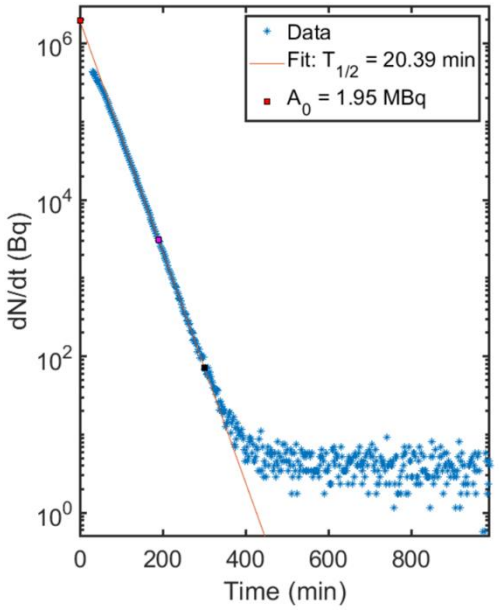


[A, Bembibre *et al.*, In prep. (2024)]

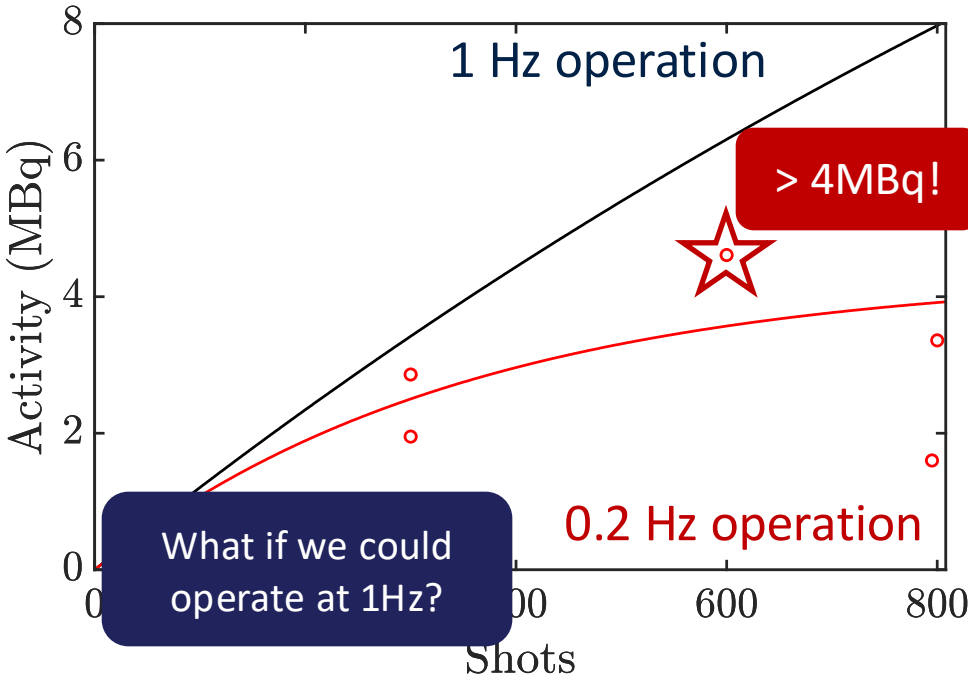
→ Recent (April 2024) dedicated experiment at CLPU to produce nuclear radio-isotopes in the context of the PROBONO cost action.

→ Greater activities achieved through extended accumulation of shots, demonstrating **>MBq production**

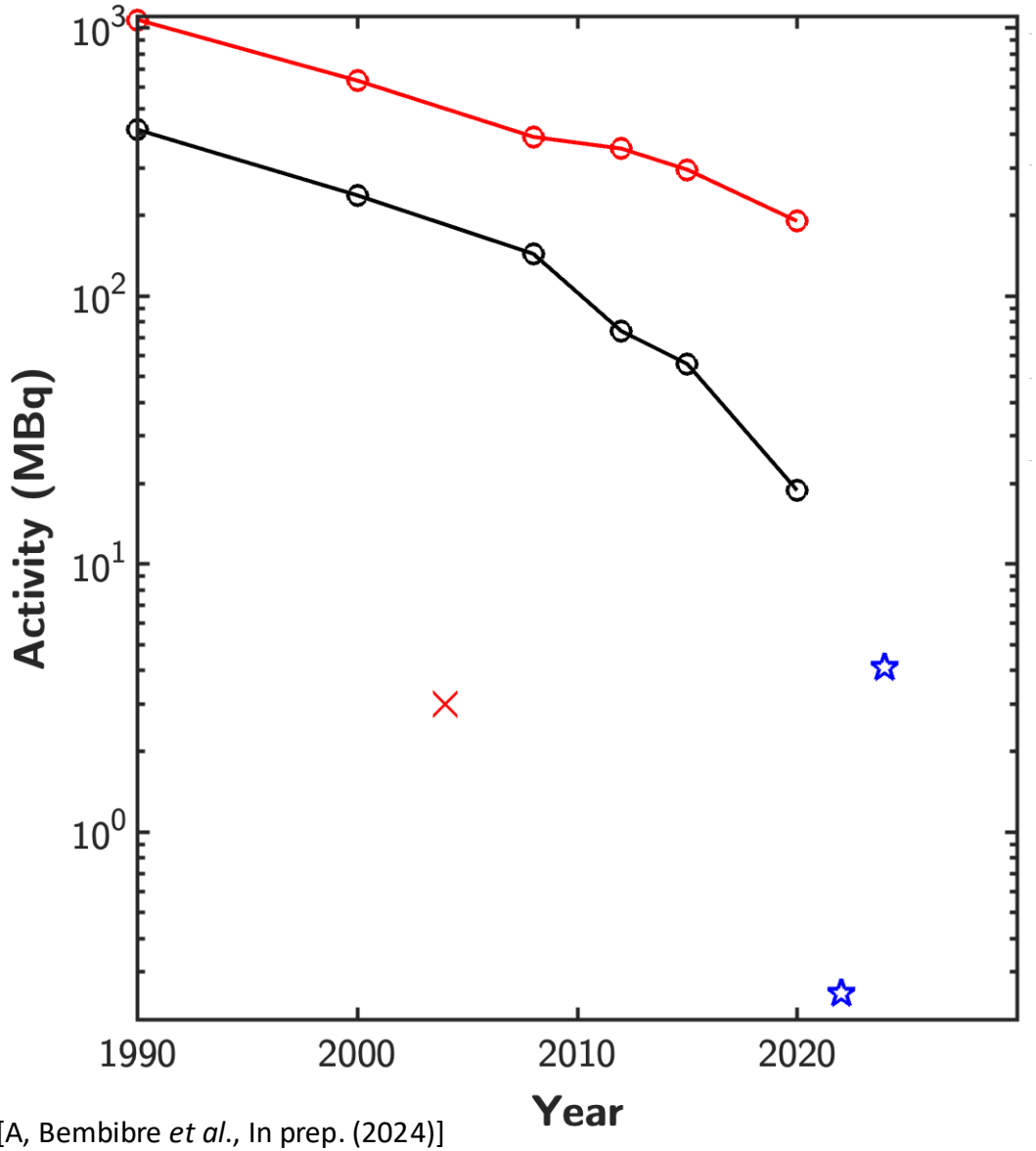
→ Reproduced the expected dependence of the activity produced on the number of shots



300 shots @ 0.2Hz, 25J

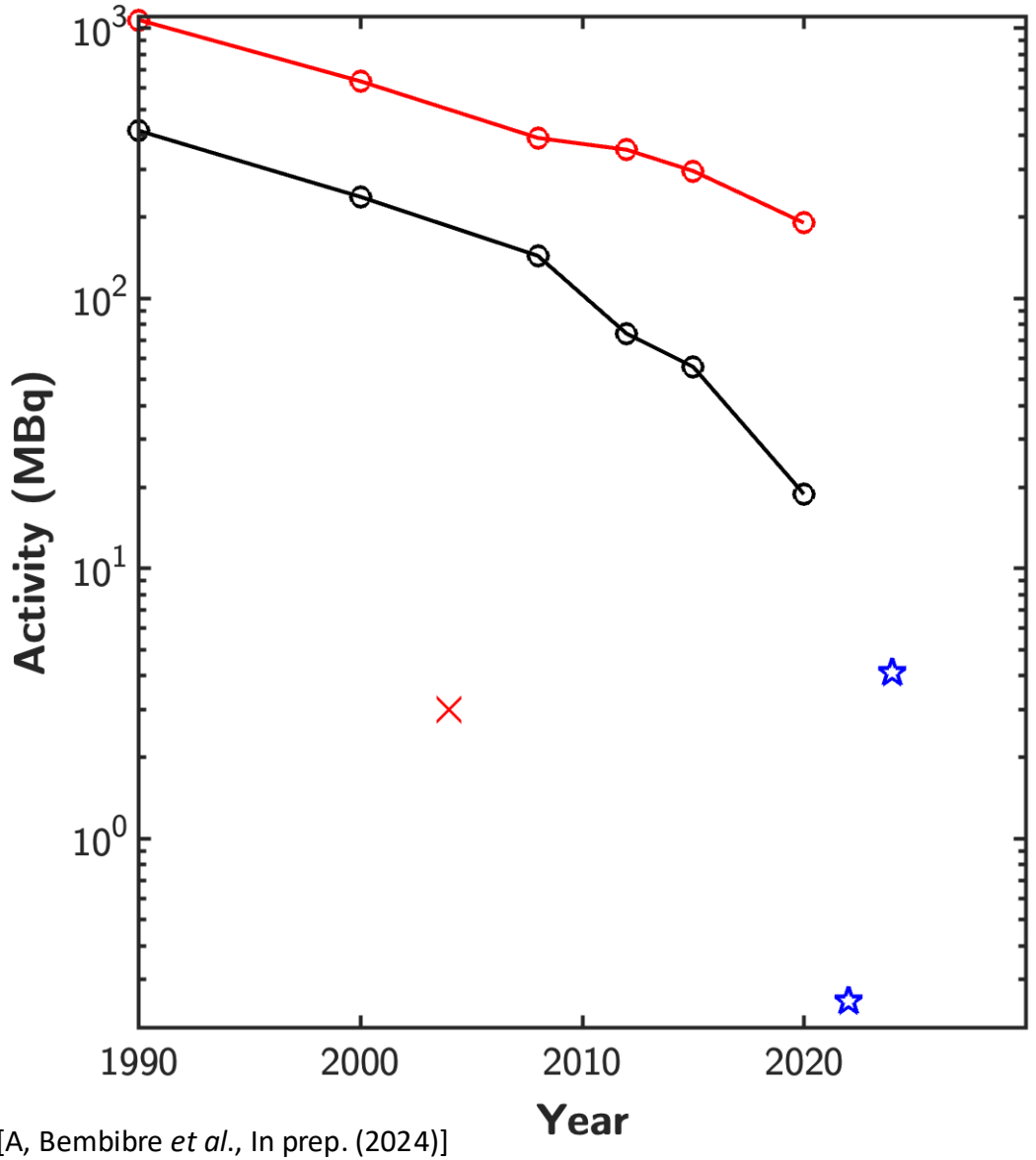


1Hz ^{11}C isotope production



[A, Bembibre *et al.*, In prep. (2024)]

1Hz ^{11}C isotope production

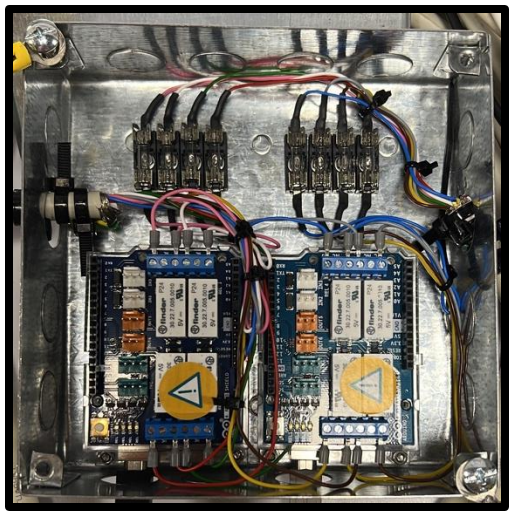


[A, Bembibre *et al.*, In prep. (2024)]

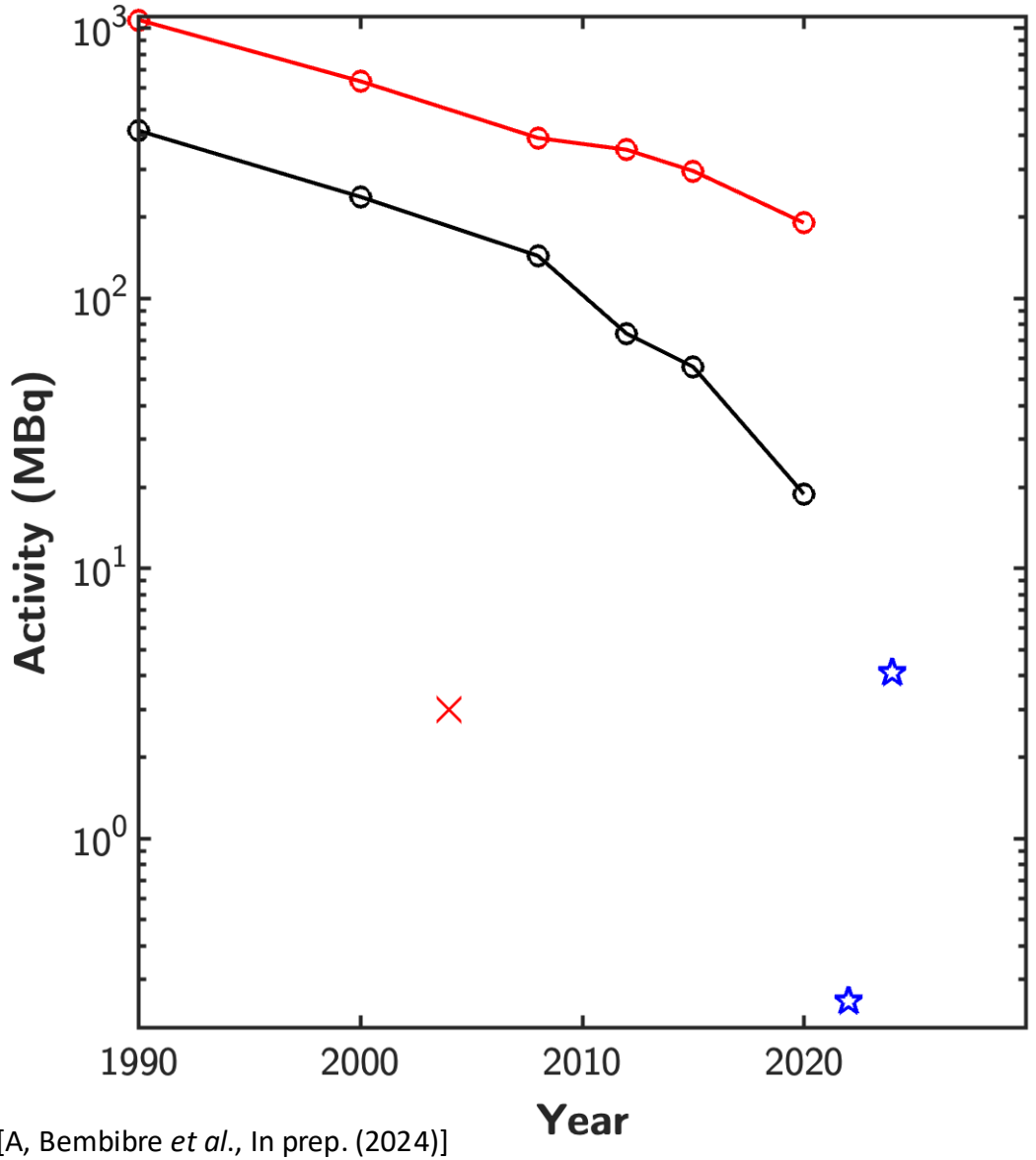
→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

→ Several improvements on the wheel to minimize impact of EMP.

→ Relay system to physically disconnect the motors and controller during the shots.



1Hz ^{11}C isotope production



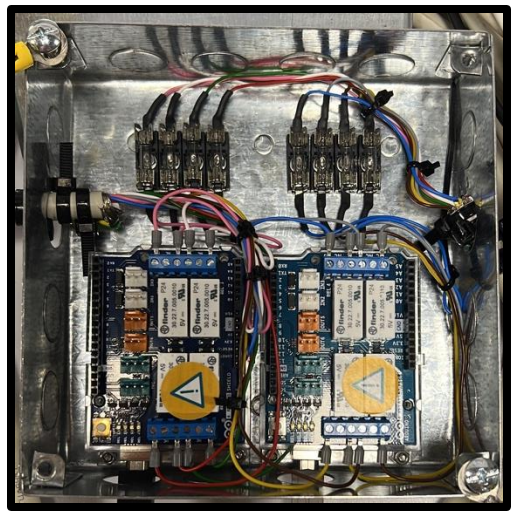
[A, Bembibre *et al.*, In prep. (2024)]

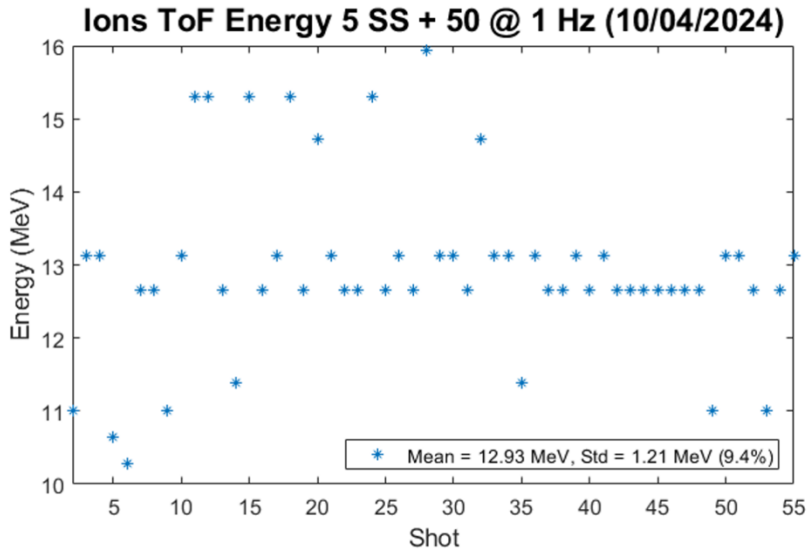
→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

→ Several improvements on the wheel to minimize impact of EMP.

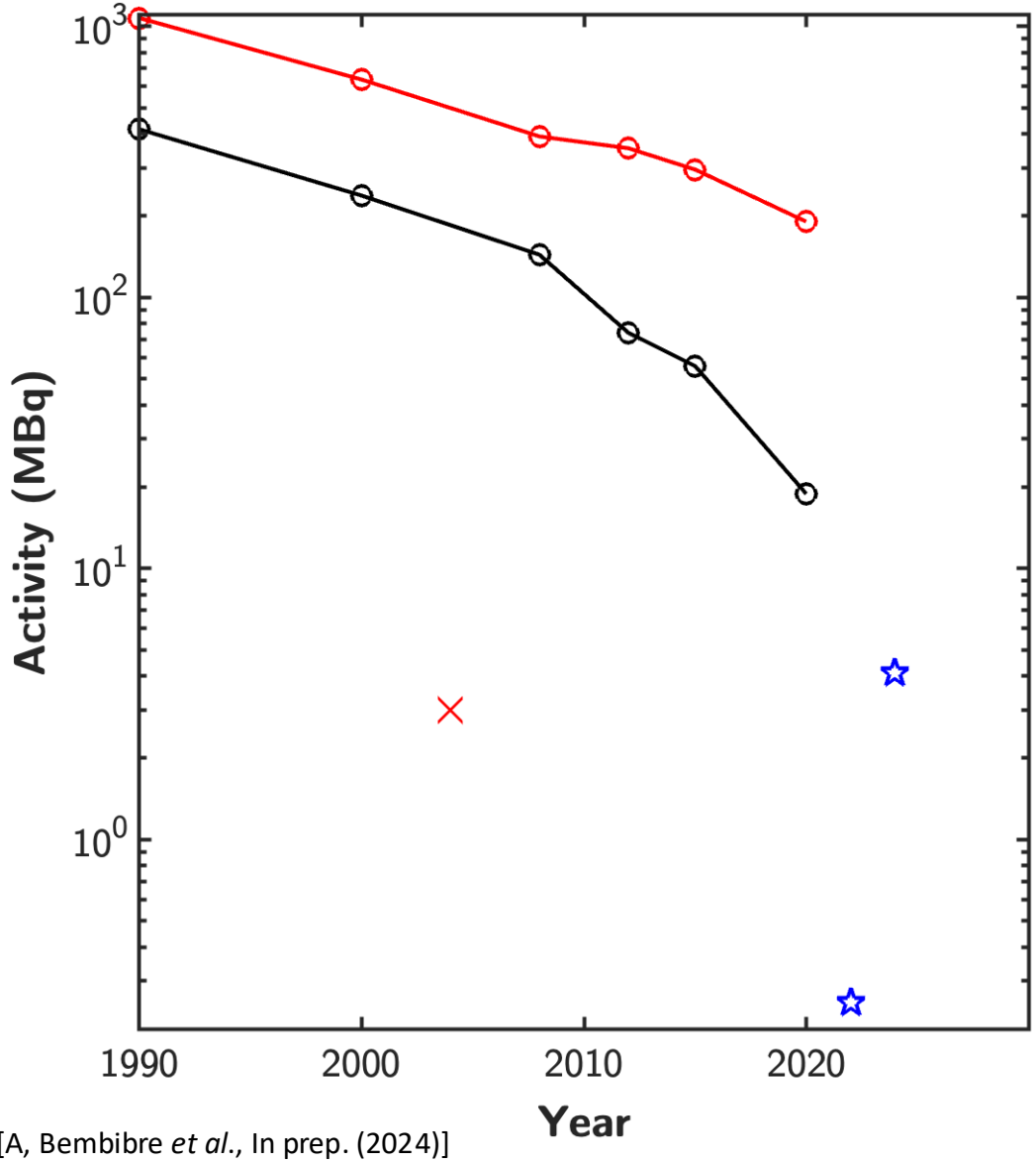
→ Relay system to physically disconnect the motors and controller during the shots.

→ Ongoing analysis indicates that target can operate in a stable manner at 1Hz…





1Hz ^{11}C isotope production



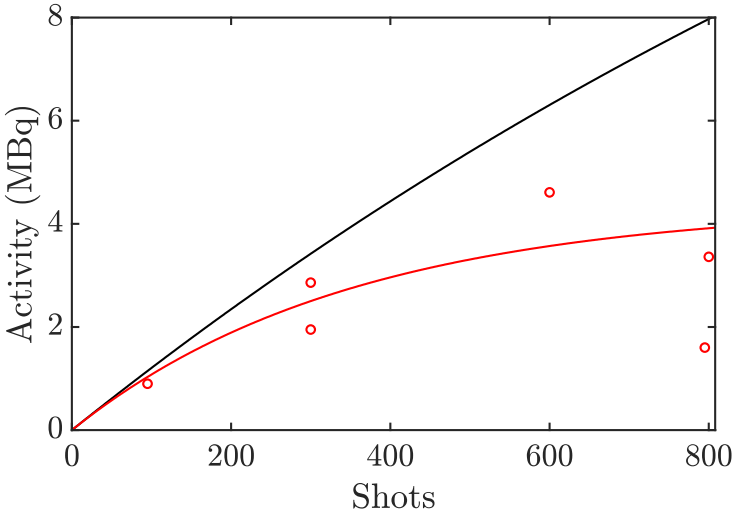
[A, Bembibre *et al.*, In prep. (2024)]

→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

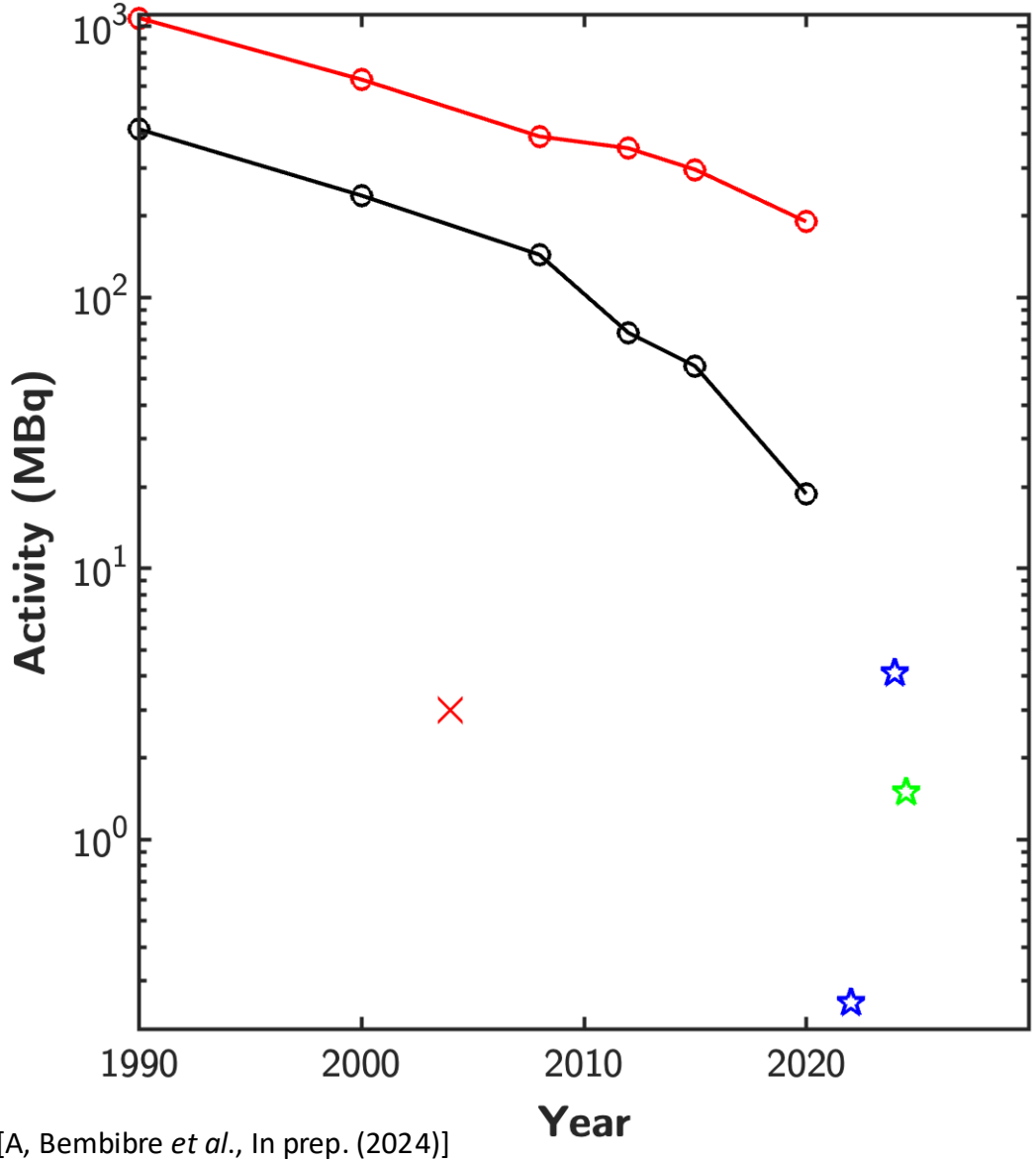
→ Several improvements on the wheel to minimize impact of EMP.

→ Relay system to physically disconnect the motors and controller during the shots.

→ Ongoing analysis indicates that target can operate in a stable manner at 1Hz…



1Hz ^{11}C isotope production



[A, Bembibre *et al.*, In prep. (2024)]

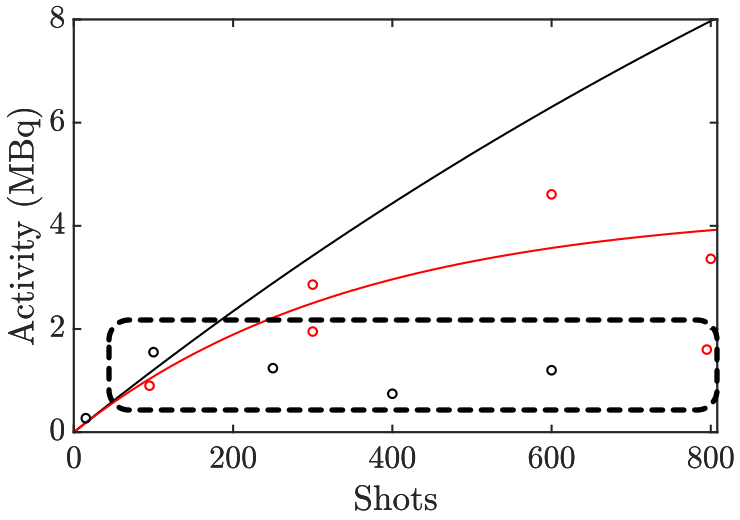
→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

→ Several improvements on the wheel to minimize impact of EMP.

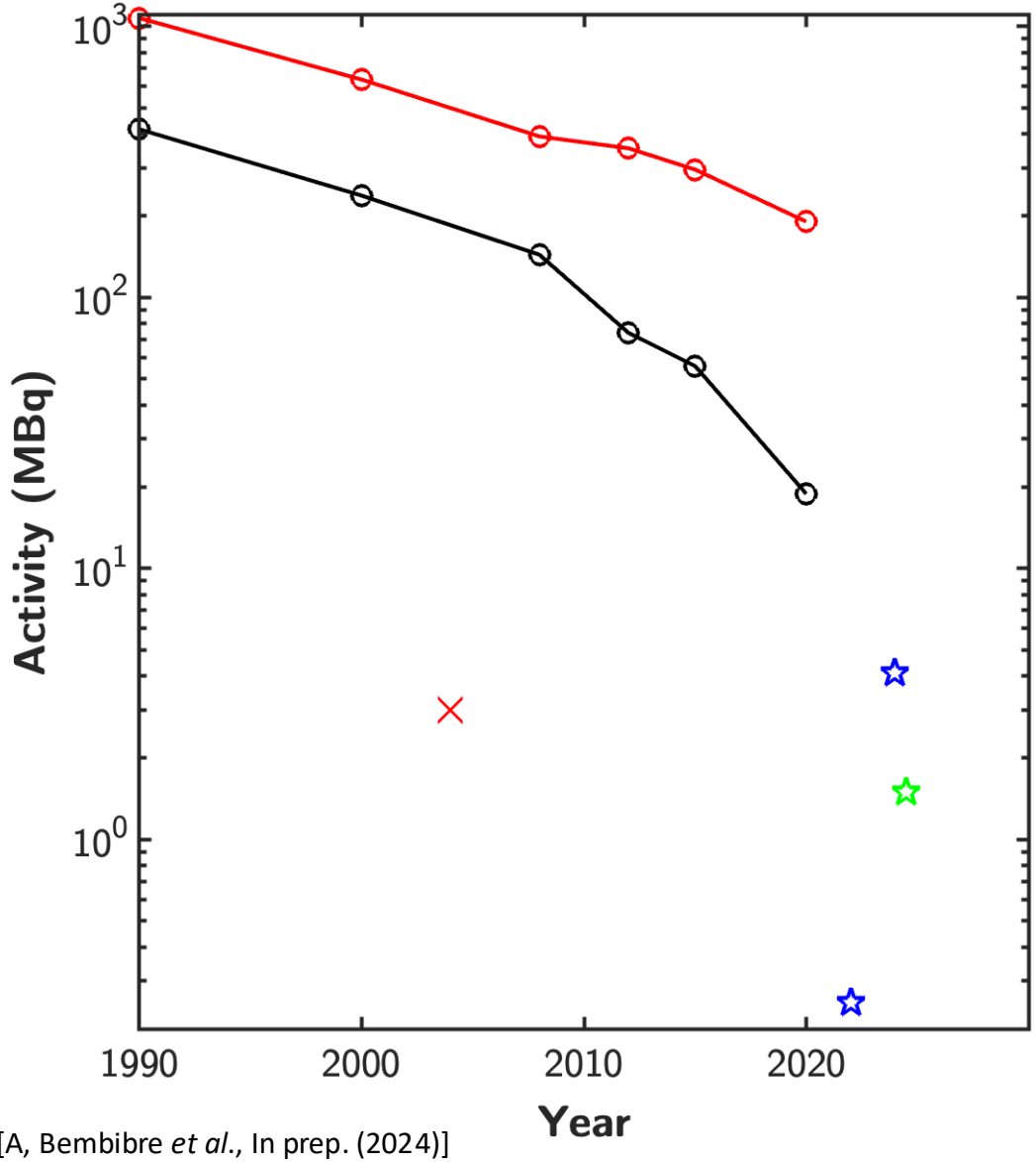
→ Relay system to physically disconnect the motors and controller during the shots.

→ Ongoing analysis indicates that target can operate in a stable manner at 1Hz…

→ Produced activities are **significantly lower** than those predicted for the new operation



1Hz ^{11}C isotope production



[A, Bembibre *et al.*, In prep. (2024)]

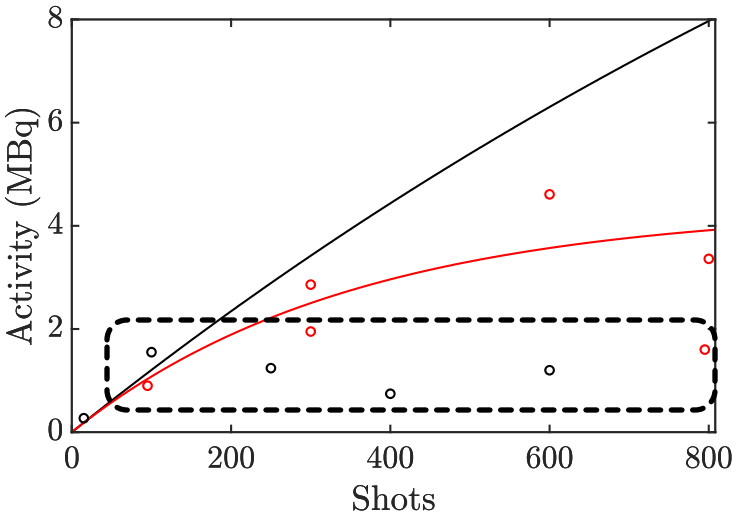
→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

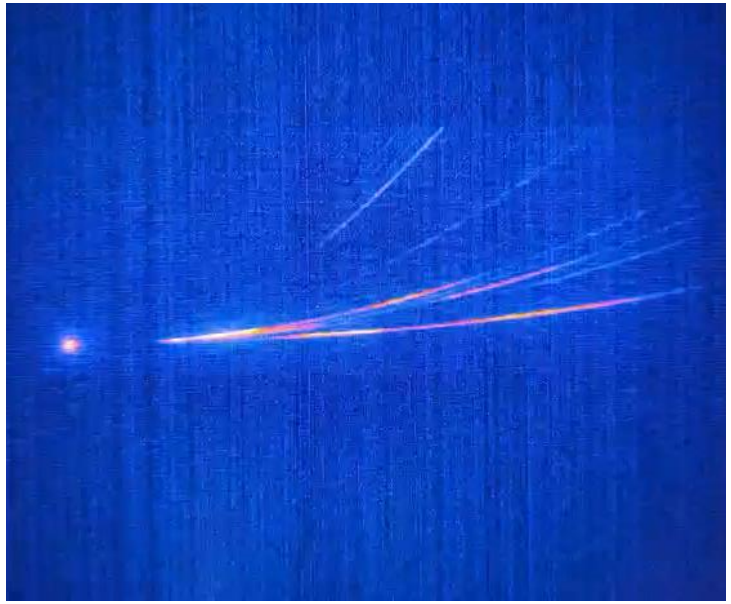
→ Several improvements on the wheel to minimize impact of EMP.

→ Relay system to physically disconnect the motors and controller during the shots.

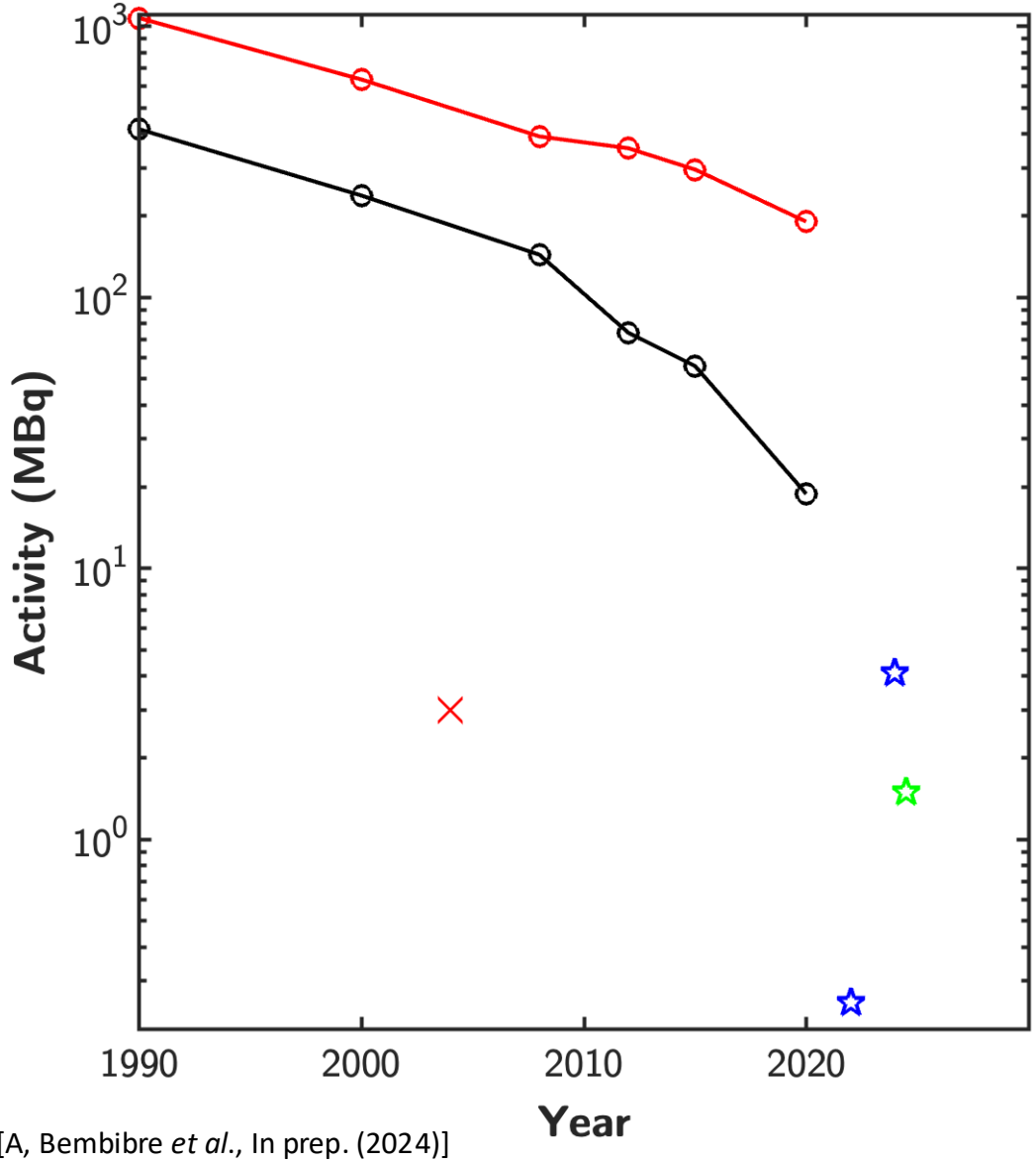
→ Ongoing analysis indicates that target can operate in a stable manner at 1Hz…

→ Produced activities are **significantly lower** than those predicted for the new operation





1Hz ^{11}C isotope production



[A, Bembibre *et al.*, In prep. (2024)]

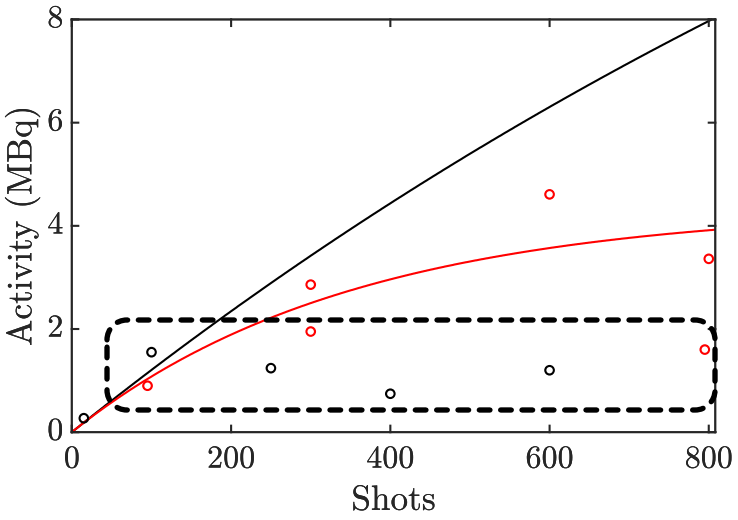
→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

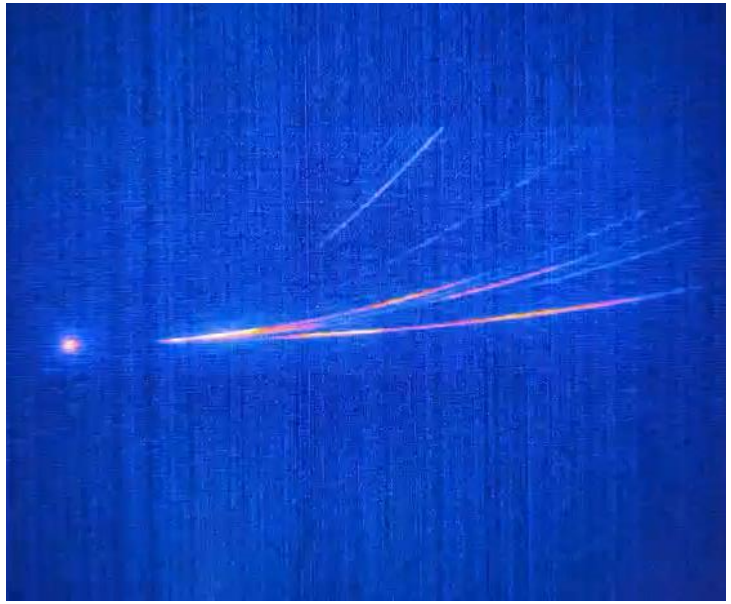
→ Several improvements on the wheel to minimize impact of EMP.

→ Relay system to physically disconnect the motors and controller during the shots.

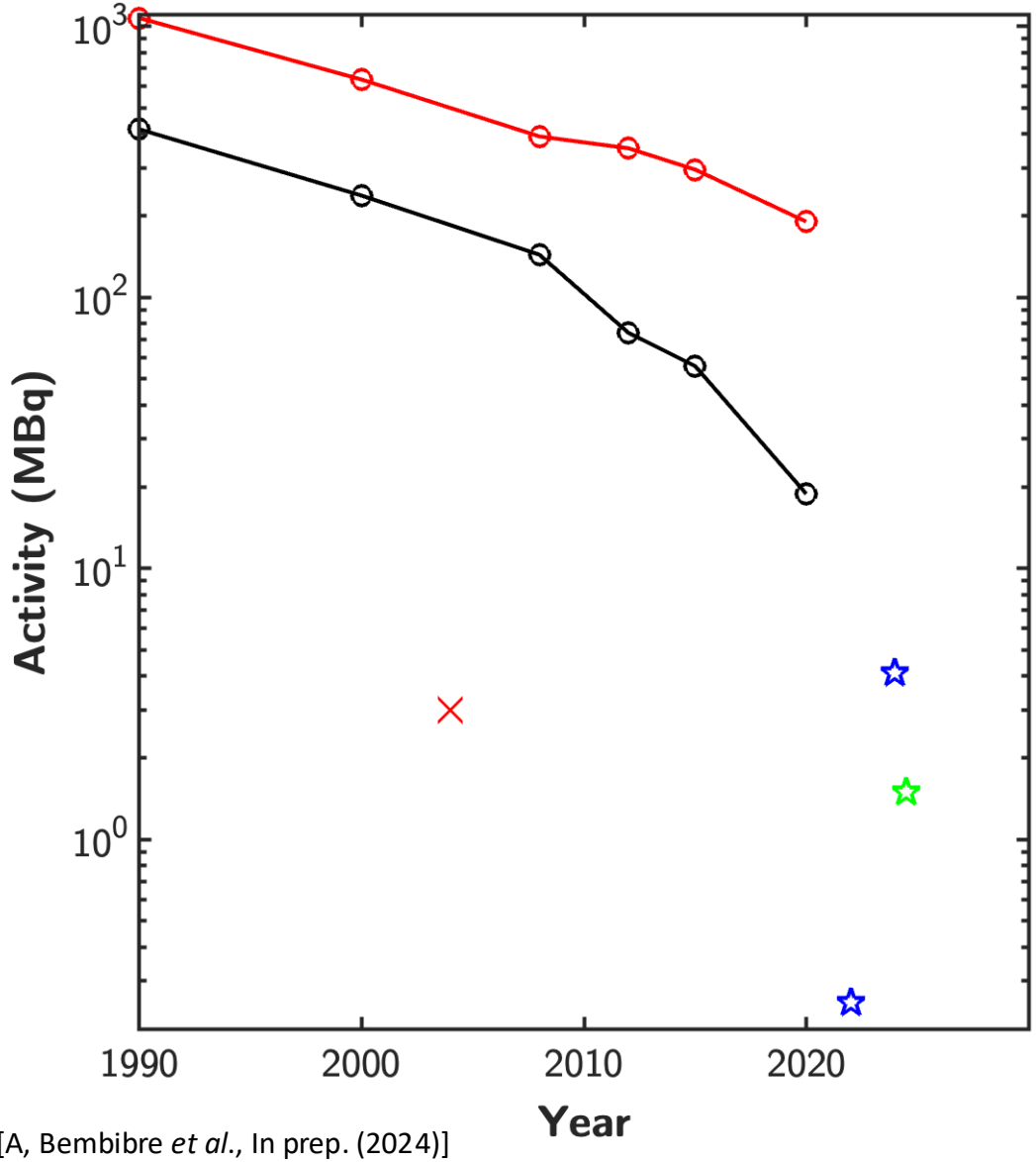
→ Ongoing analysis indicates that target can operate in a stable manner at 1Hz…

→ Produced activities are **significantly lower** than those predicted for the new operation





1Hz ^{11}C isotope production



[A, Bembibre *et al.*, In prep. (2024)]

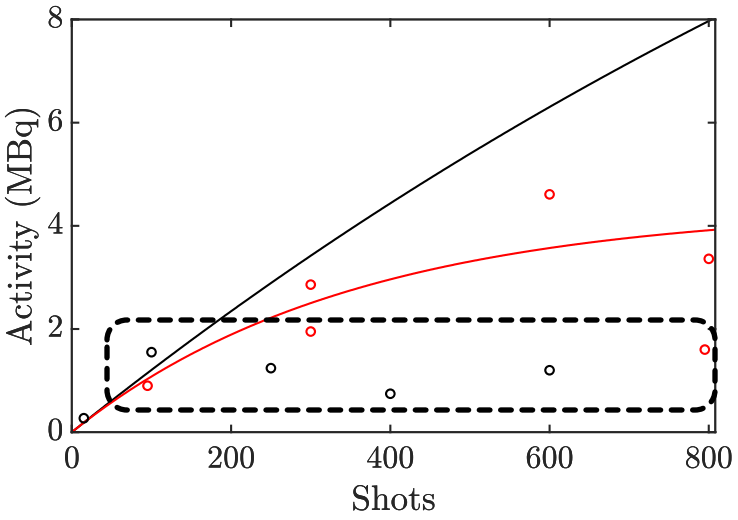
→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

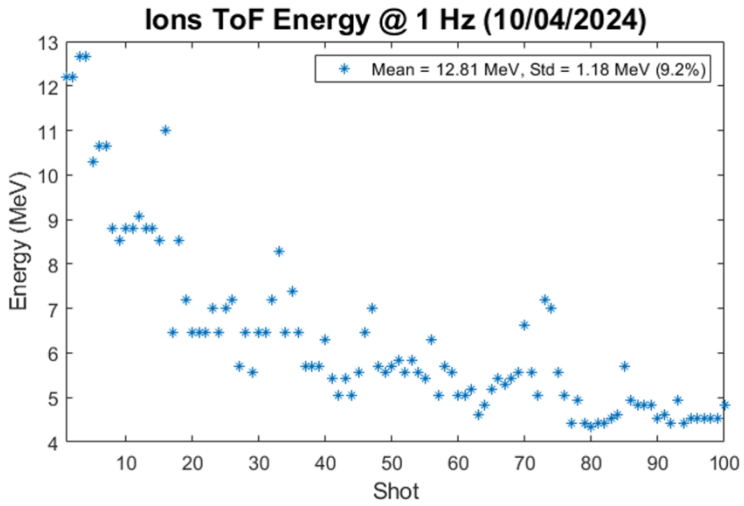
→ Several improvements on the wheel to minimize impact of EMP.

→ Relay system to physically disconnect the motors and controller during the shots.

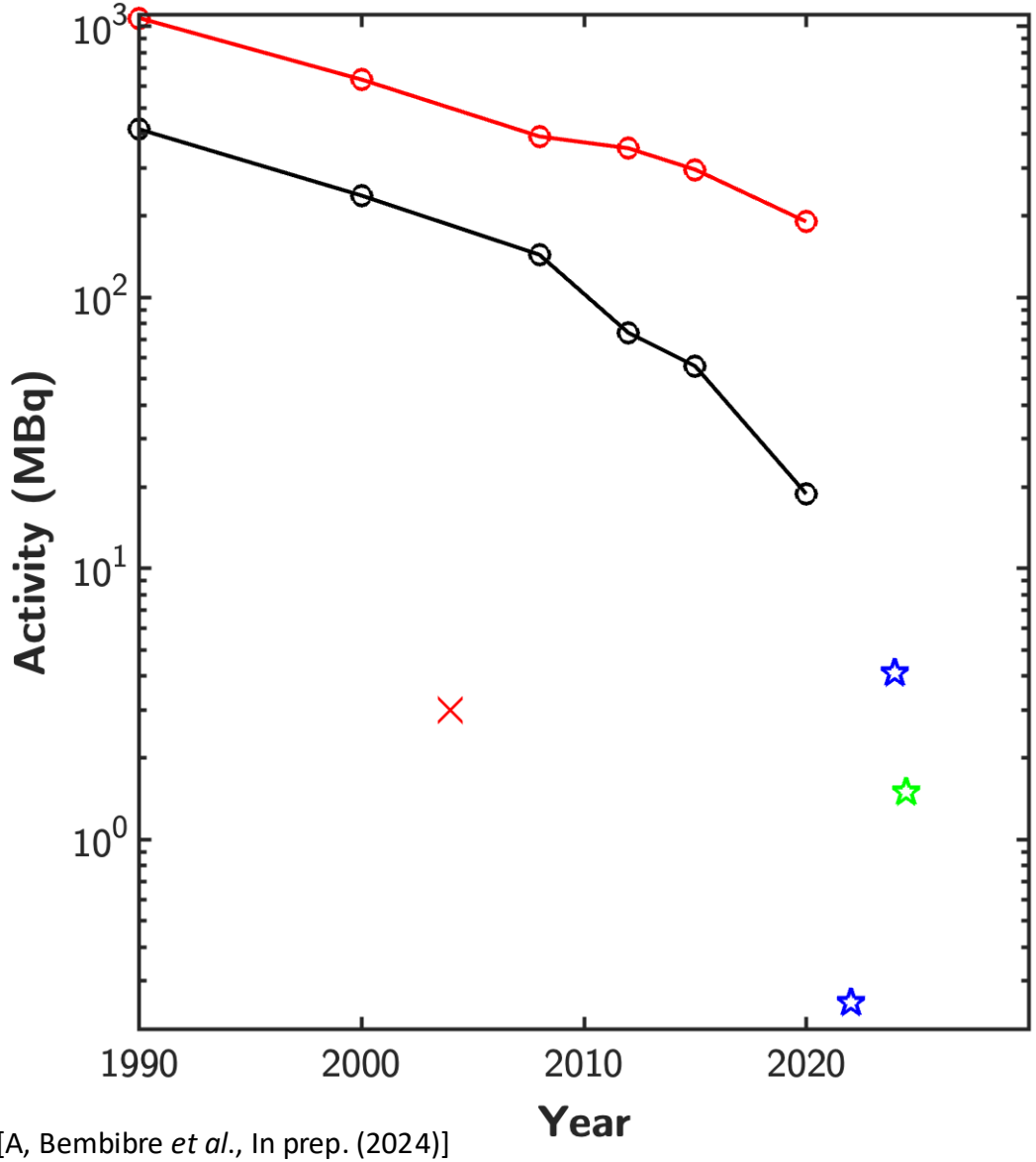
→ Ongoing analysis indicates that target can operate in a stable manner at 1Hz…

→ Produced activities are **significantly lower** than those predicted for the new operation





1Hz ^{11}C isotope production



[A, Bembibre *et al.*, In prep. (2024)]

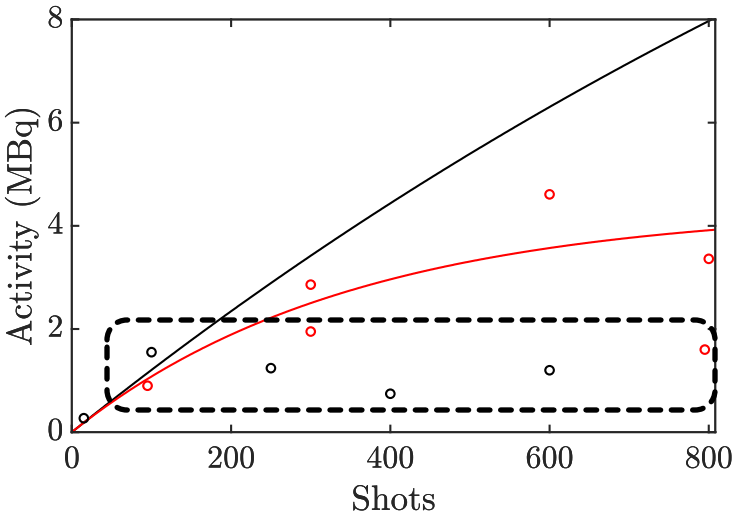
→ In the follow-up campaign (July 2024), we tested again the target operation at 1Hz rates at CLPU

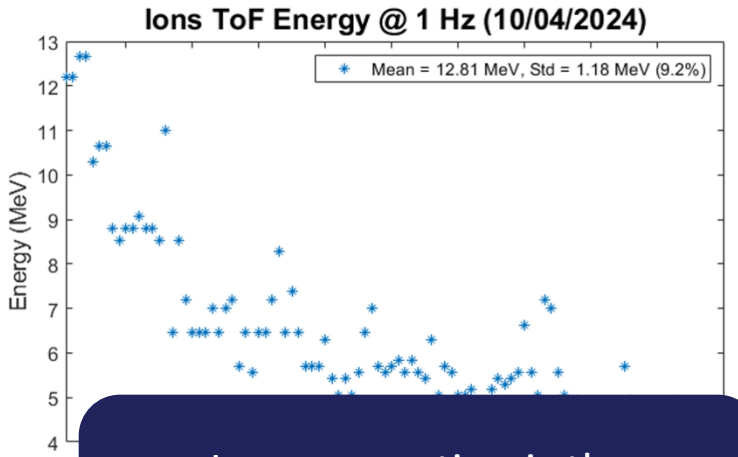
→ Several improvements on the wheel to minimize impact of EMP.

→ Relay system to physically disconnect the motors and controller during the shots.

→ Ongoing analysis indicates that target can operate in a stable manner at 1Hz…

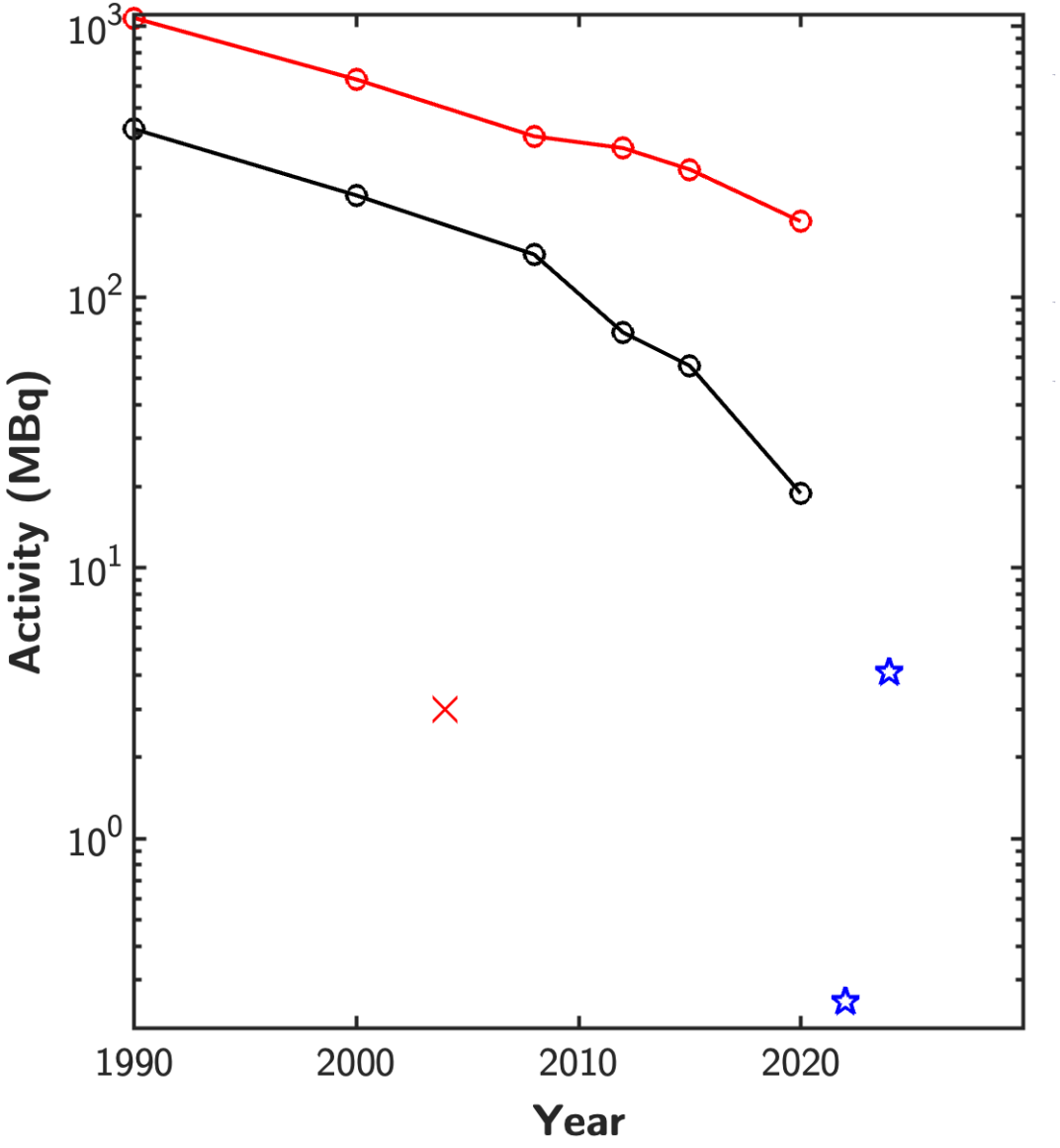
→ Produced activities are **significantly lower** than those predicted for the new operation



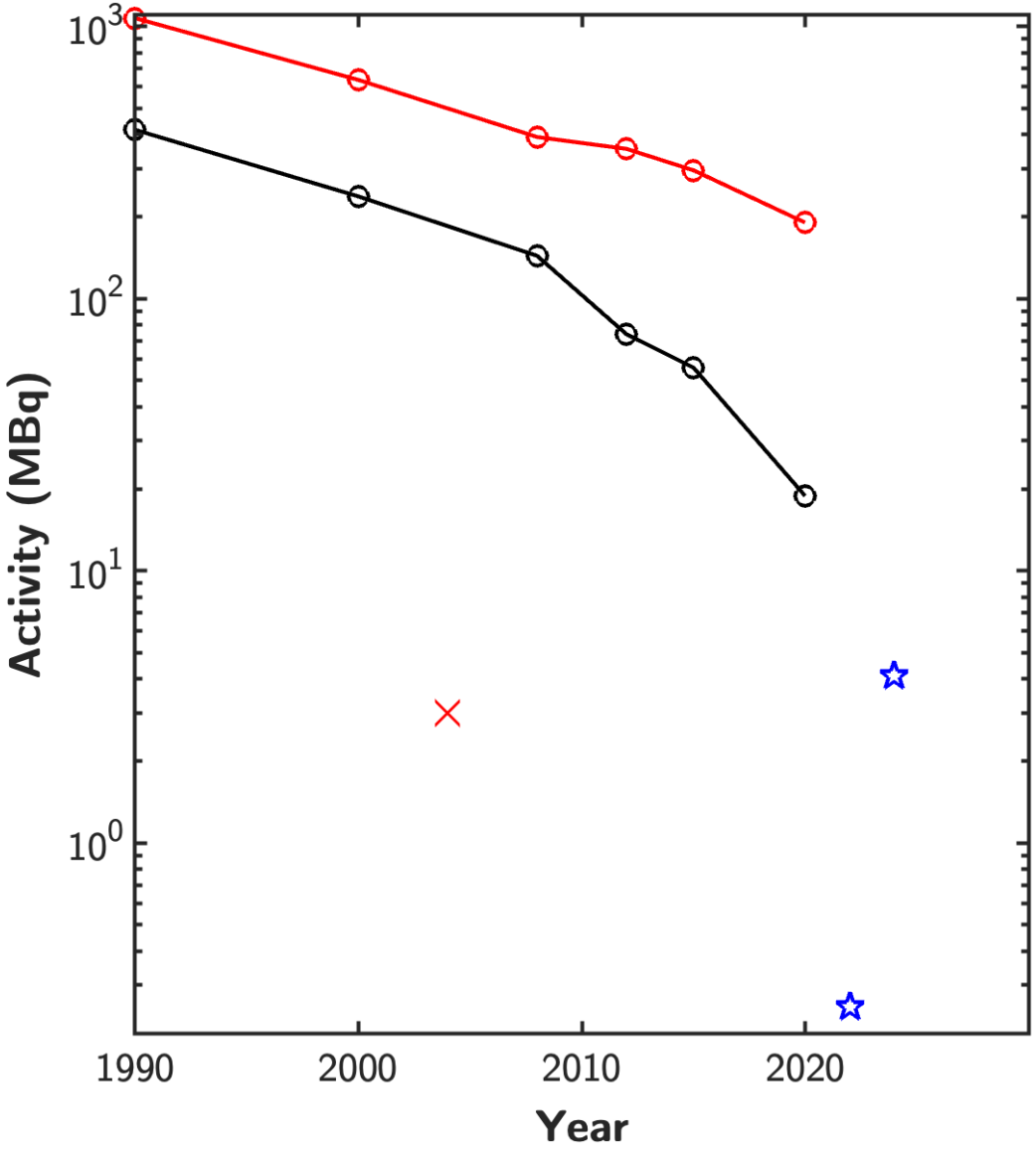


Laser operation is the current bottleneck

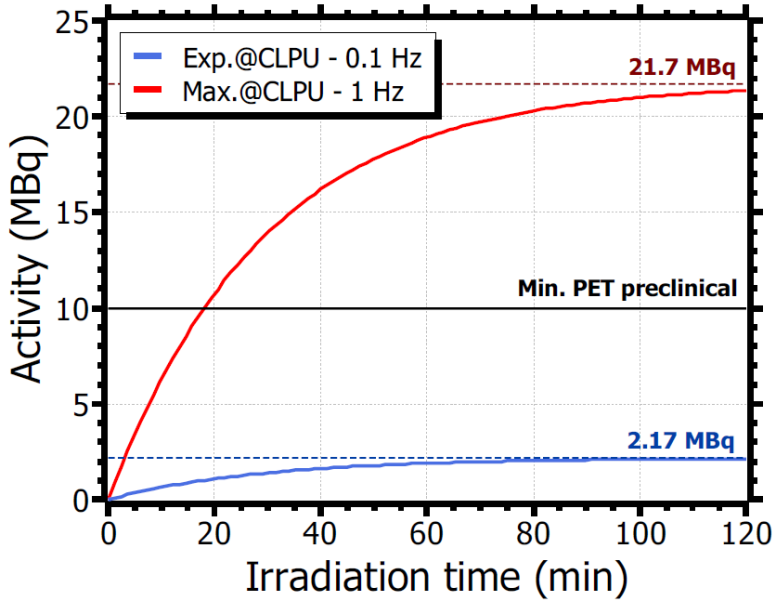
Future perspective: towards clinical



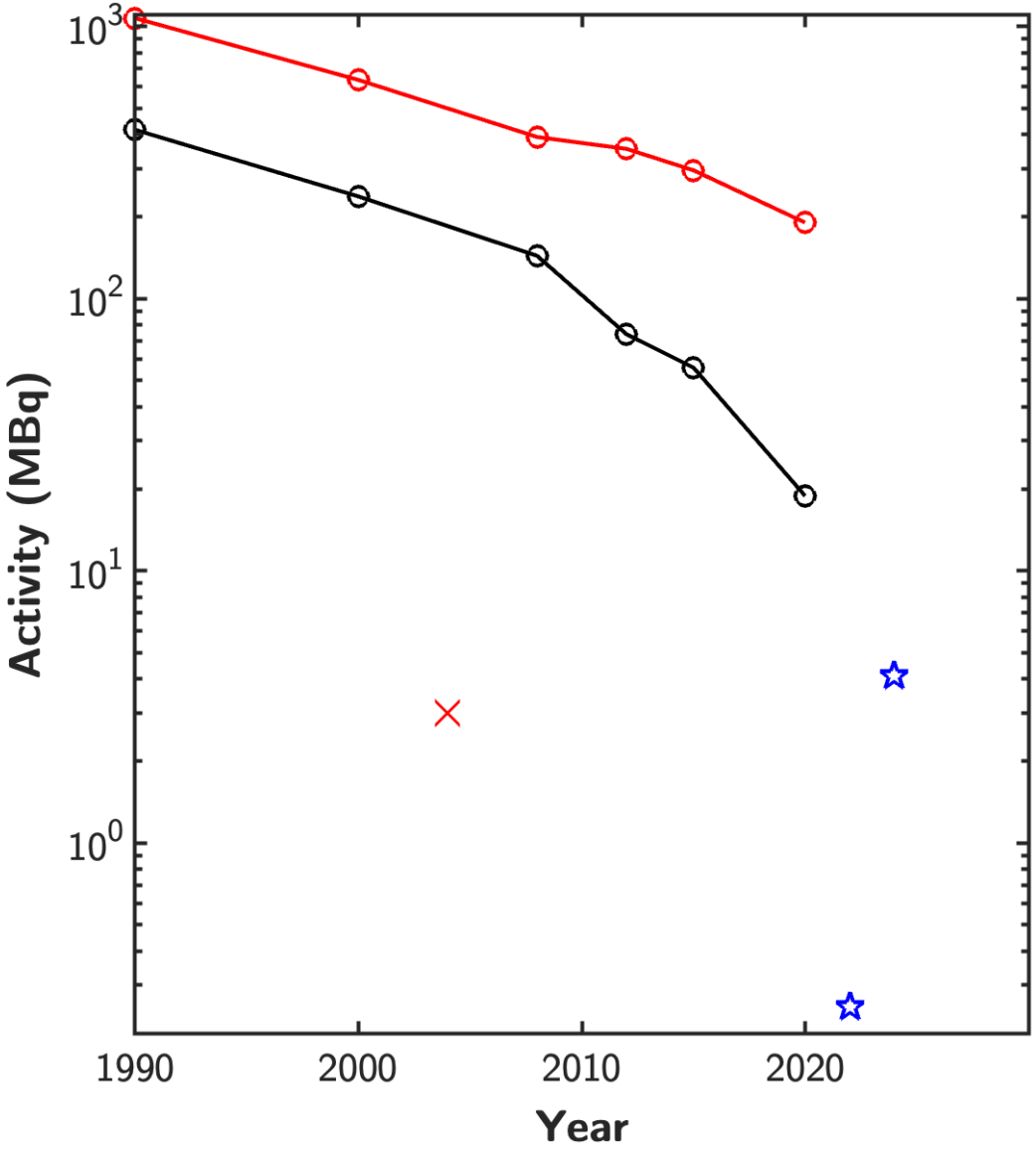
Future perspective: towards clinical



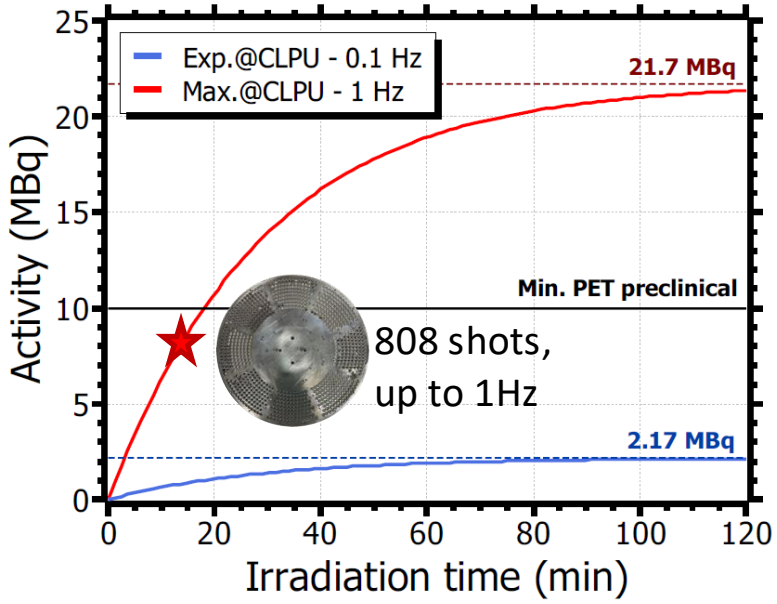
→ Next step: demonstration of continuous and stable ion acceleration at 1Hz using closed-loop corrections of heating effects



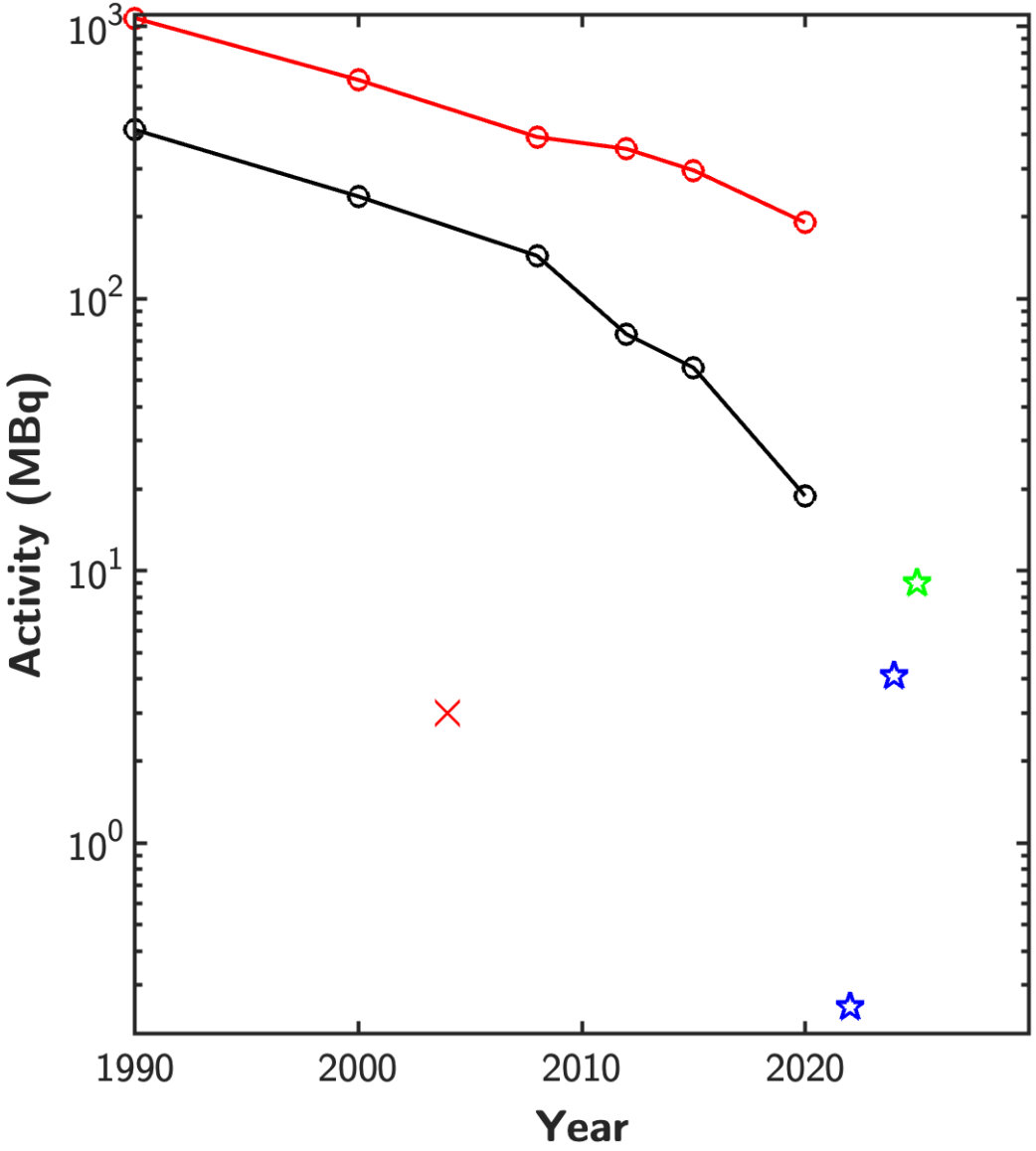
Future perspective: towards clinical



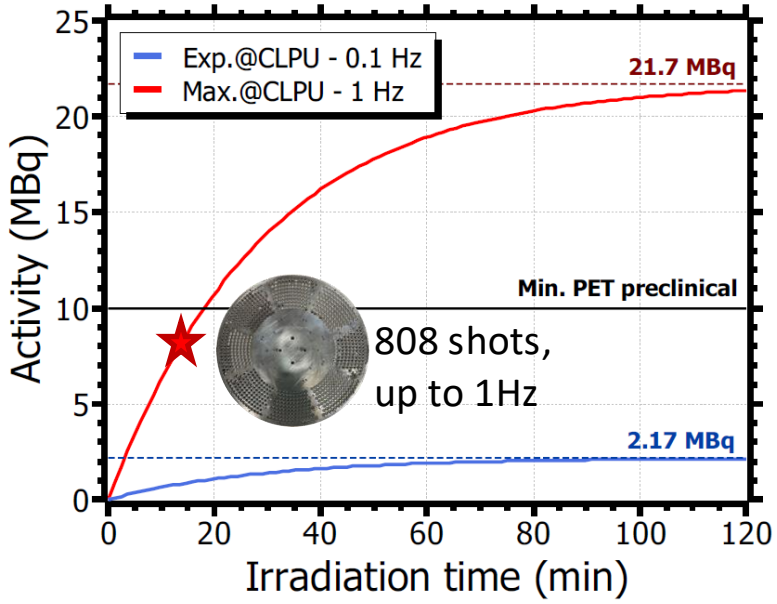
→ Next step: demonstration of continuous and stable ion acceleration at 1Hz using closed-loop corrections of heating effects



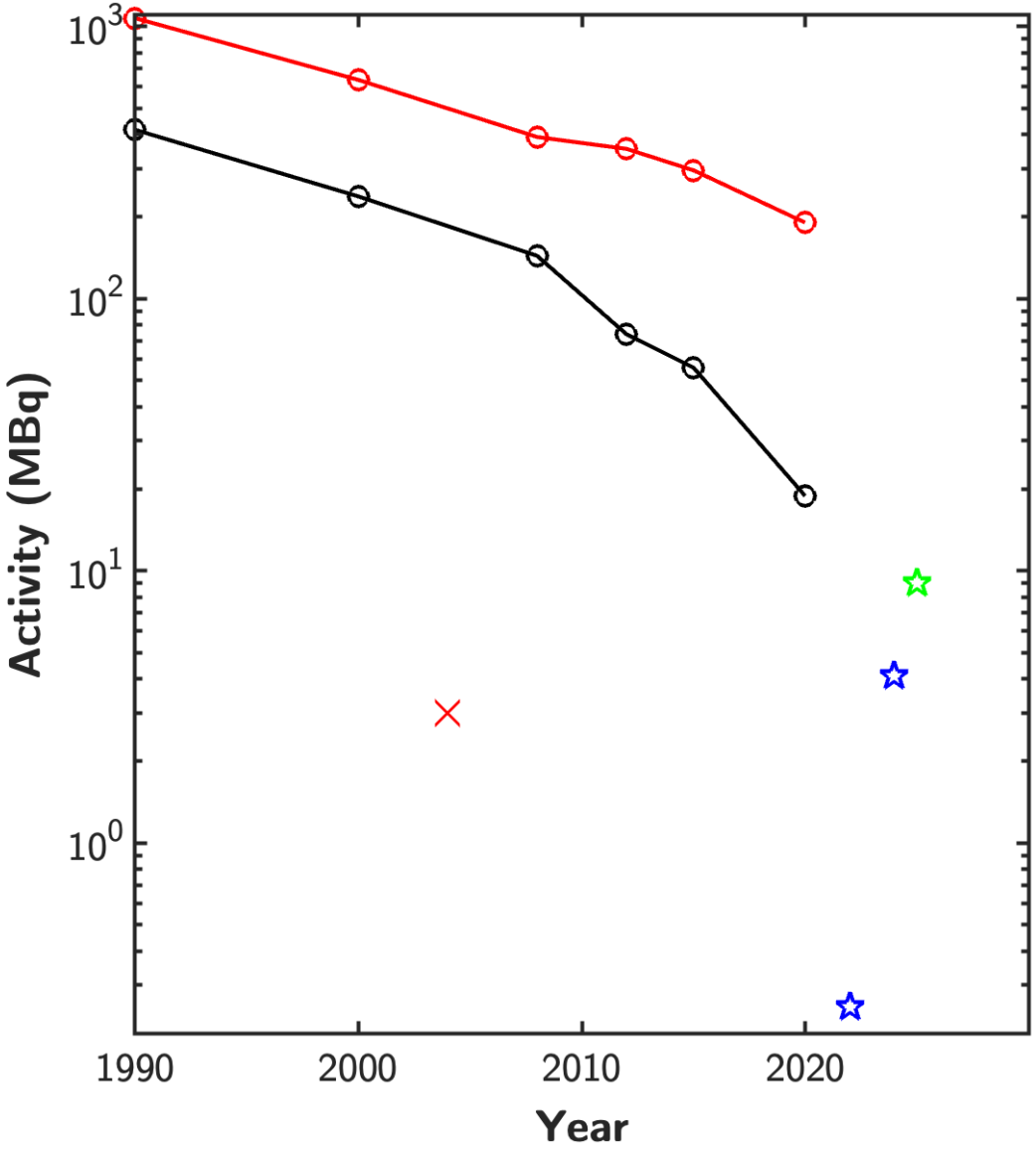
Future perspective: towards clinical



→ Next step: demonstration of continuous and stable ion acceleration at 1Hz using closed-loop corrections of heating effects

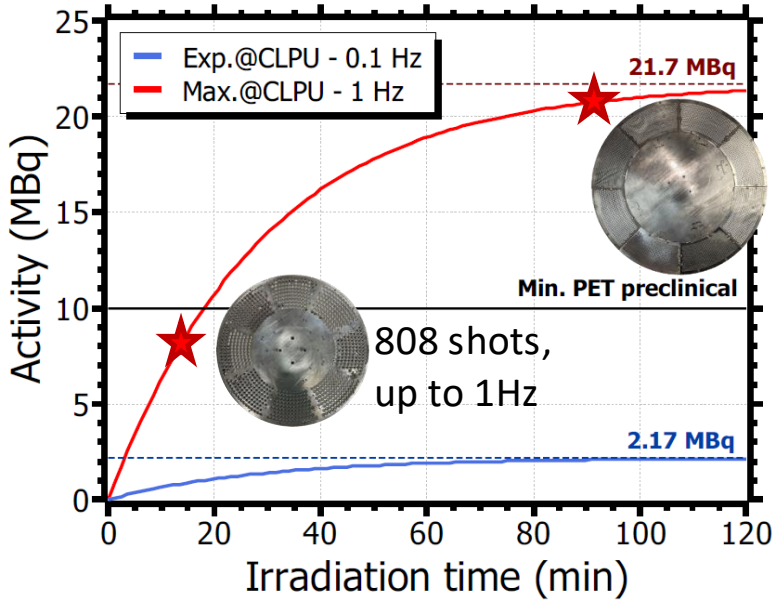


Future perspective: towards clinical



→ Next step: demonstration of continuous and stable ion acceleration at 1Hz using closed-loop corrections of heating effects

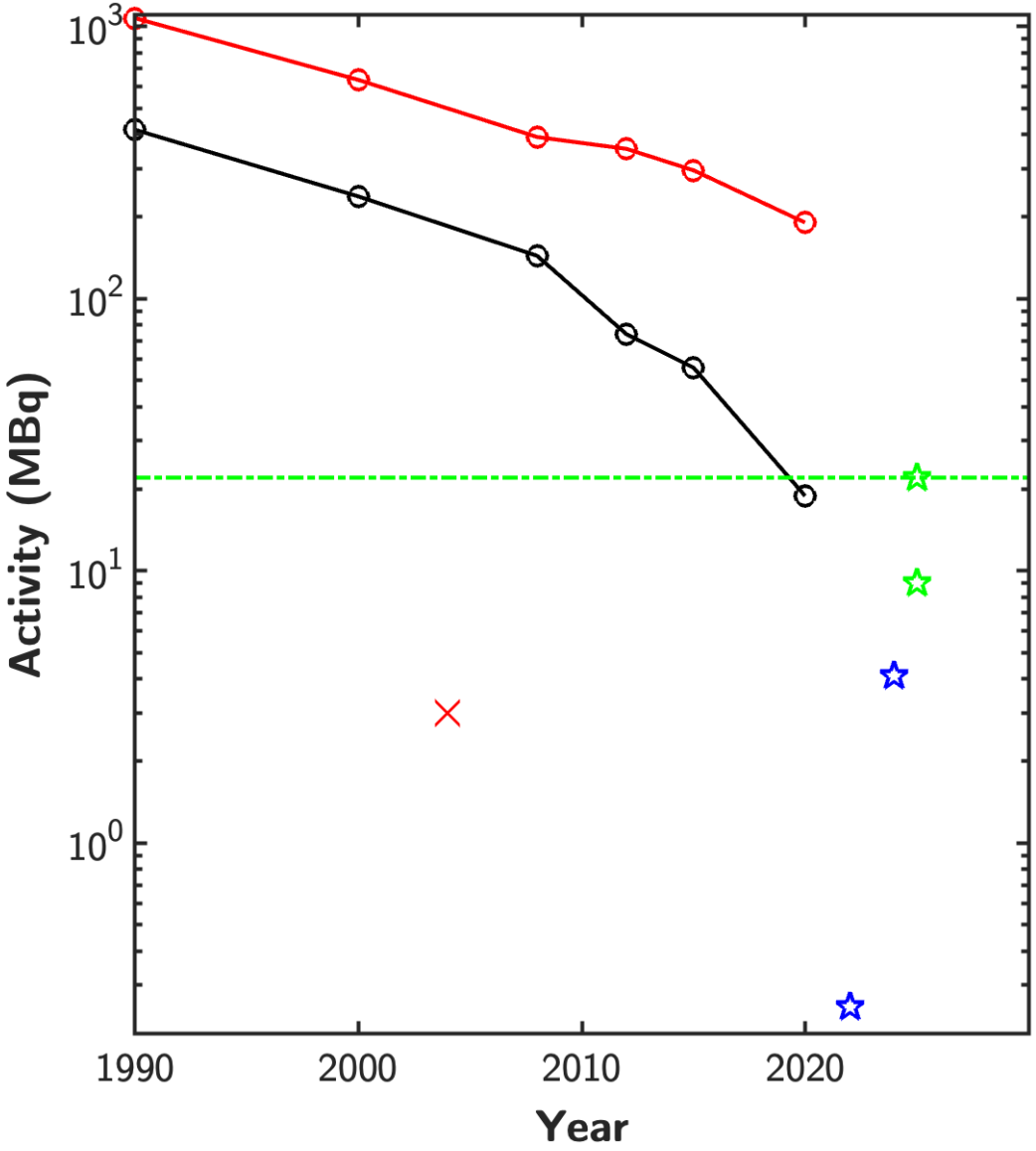
⇒ Pre-clinical activity production (≳ 10MBq)



5400 shots, up to 10Hz

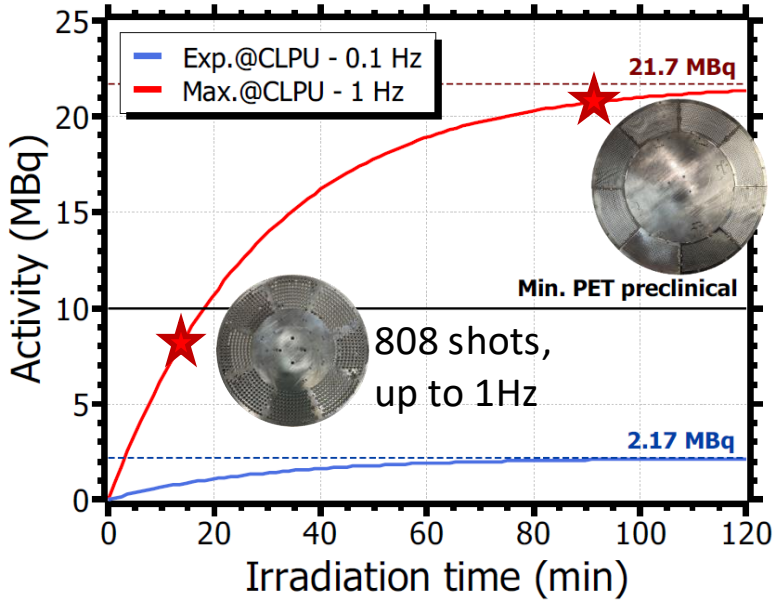
808 shots, up to 1Hz

Future perspective: towards clinical



→ Next step: demonstration of continuous and stable ion acceleration at 1Hz using closed-loop corrections of heating effects

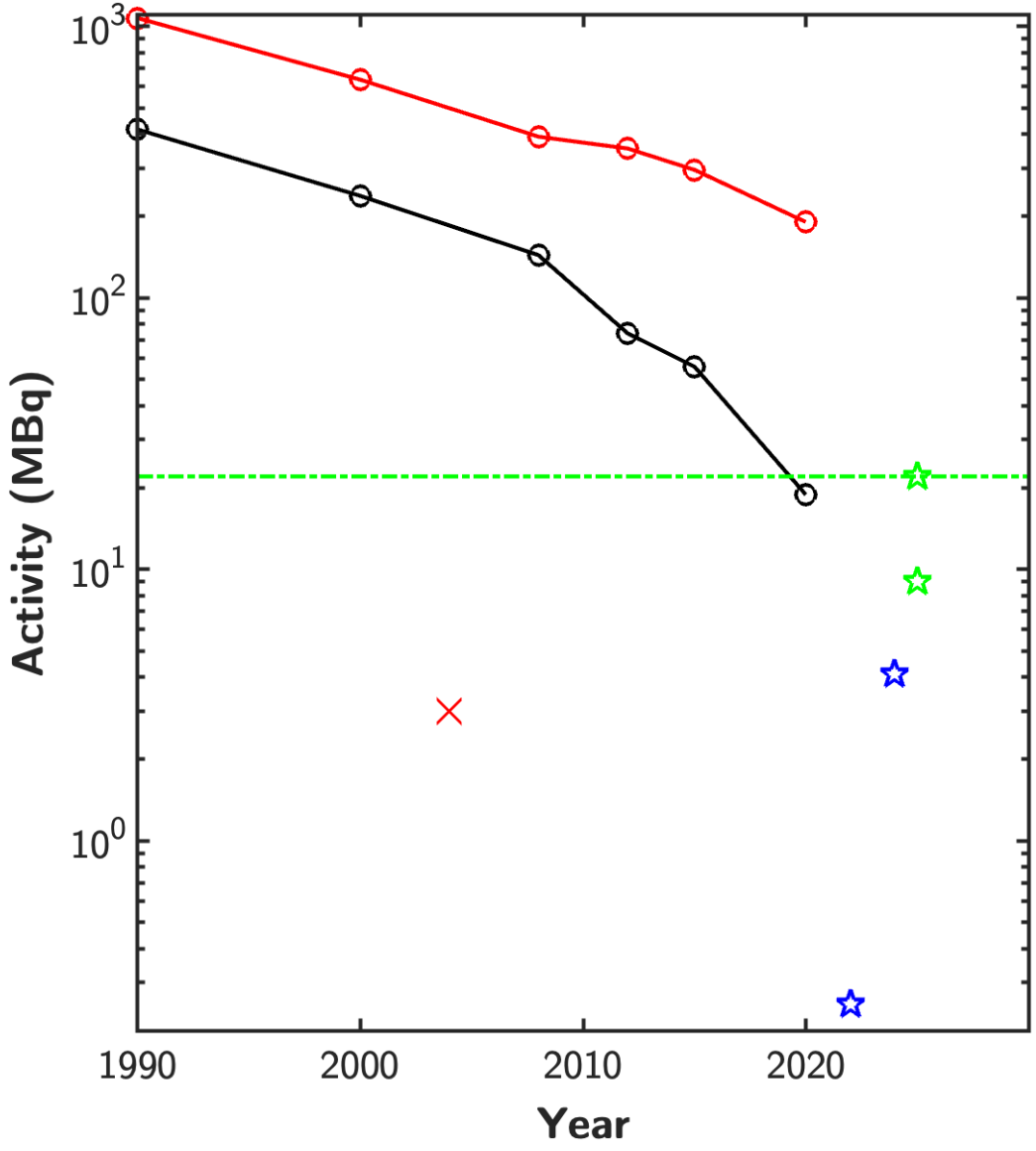
⇒ Pre-clinical activity production (≳ 10MBq)



5400 shots, up to 10Hz

808 shots, up to 1Hz

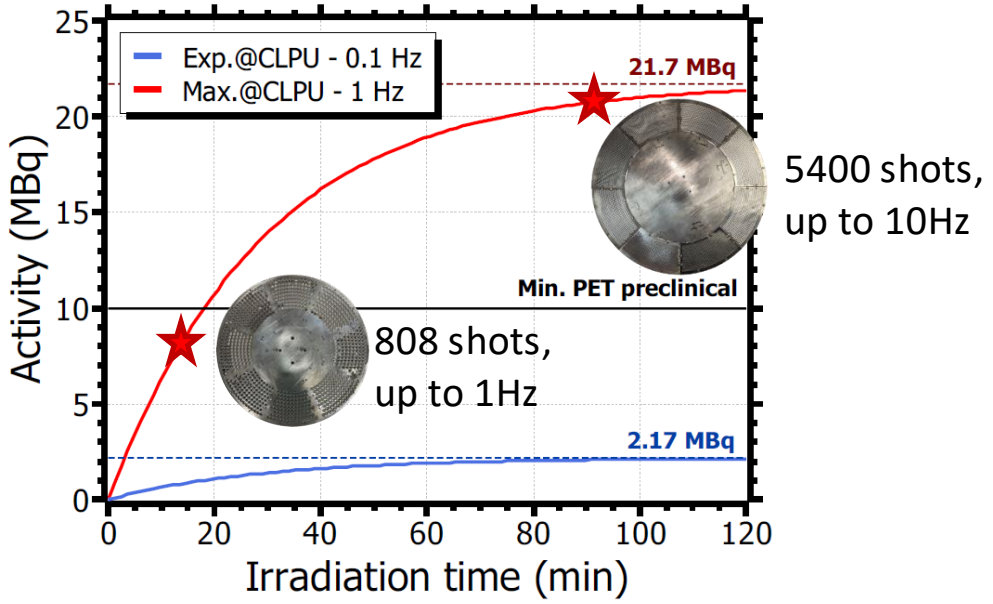
Future perspective: towards clinical



→ Next step: demonstration of continuous and stable ion acceleration at 1Hz using closed-loop corrections of heating effects

⇒ Pre-clinical activity production (≳ 10MBq)

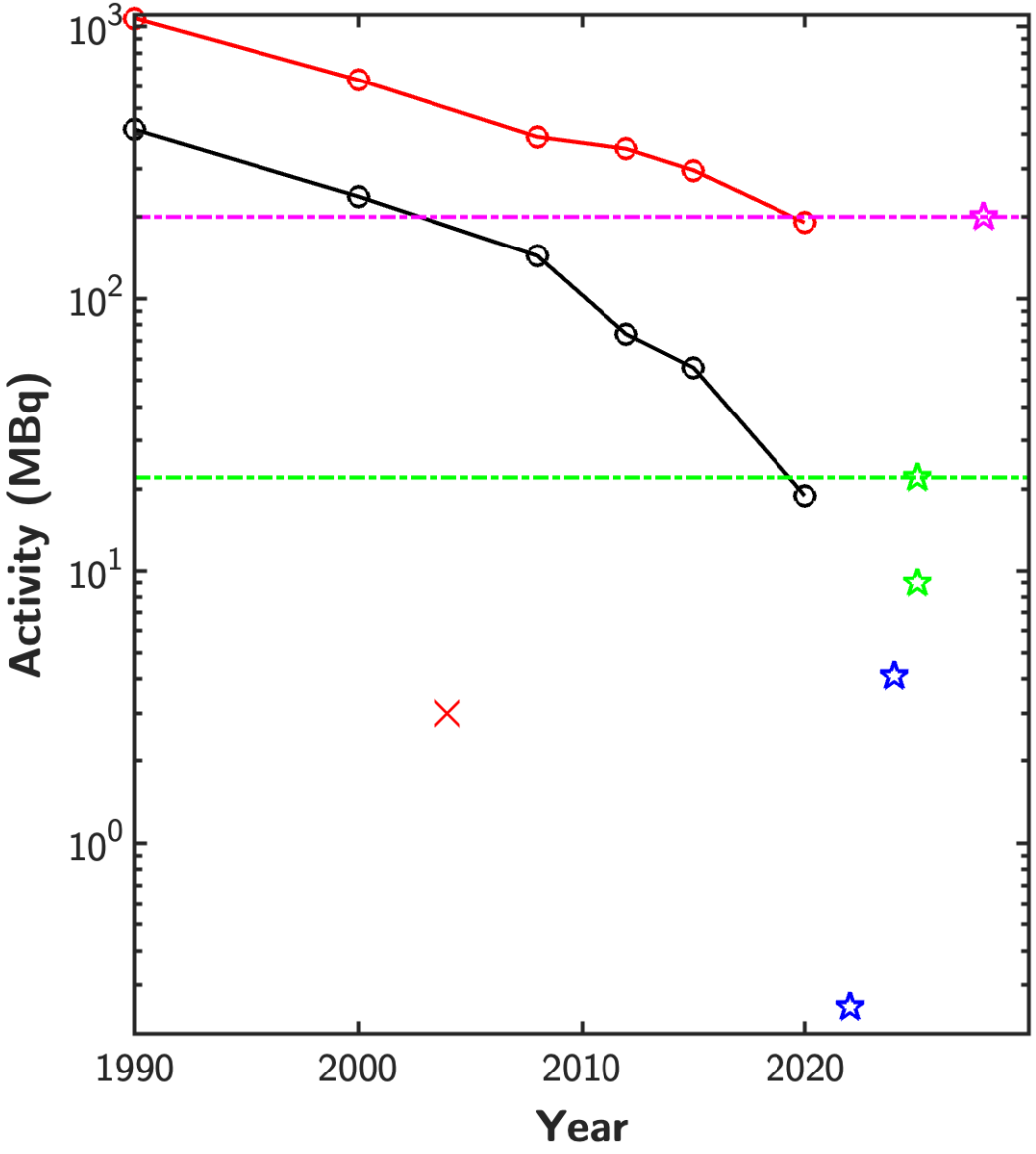
→ Extraction of isotopes from irradiated sample ⇒ medical interest



5400 shots, up to 10Hz

808 shots, up to 1Hz

Future perspective: towards clinical



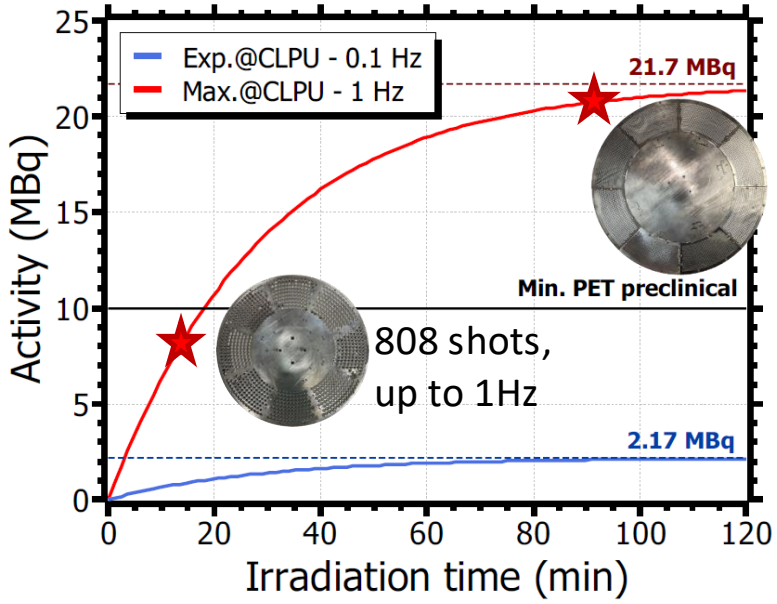
→ Next step: demonstration of continuous and stable ion acceleration at 1Hz using closed-loop corrections of heating effects

⇒ Pre-clinical activity production (≳ 10MBq)

→ Extraction of isotopes from irradiated sample ⇒ medical interest

→ Demonstration of extended production at **10 Hz PW-scale**

⇒ Towards clinical activity production (≳ 100MBq)



5400 shots, up to 10Hz

808 shots, up to 1Hz

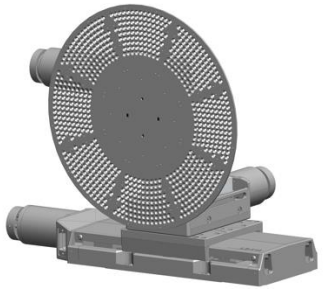
Conclusions

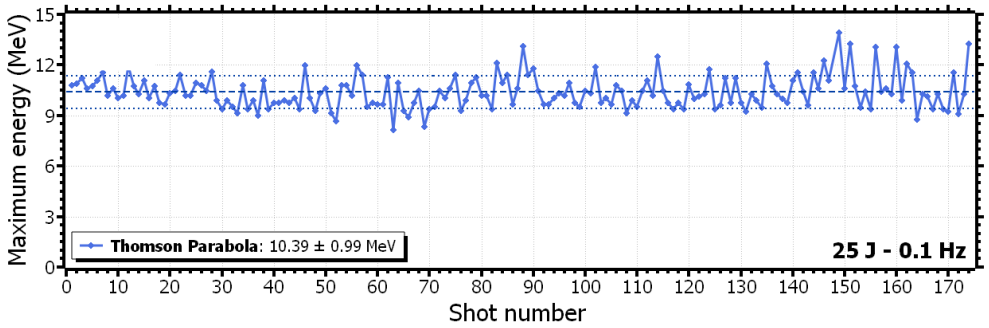
Conclusions

Conclusions

→ Development of target wheel capable of operation at rates up to 10Hz, based on an automatic alignment system

⇒ **Stable laser-driven proton source for applications.**

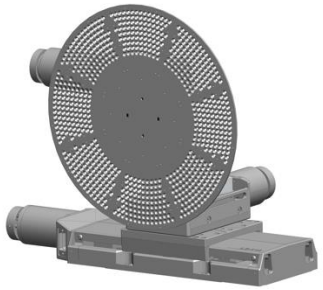


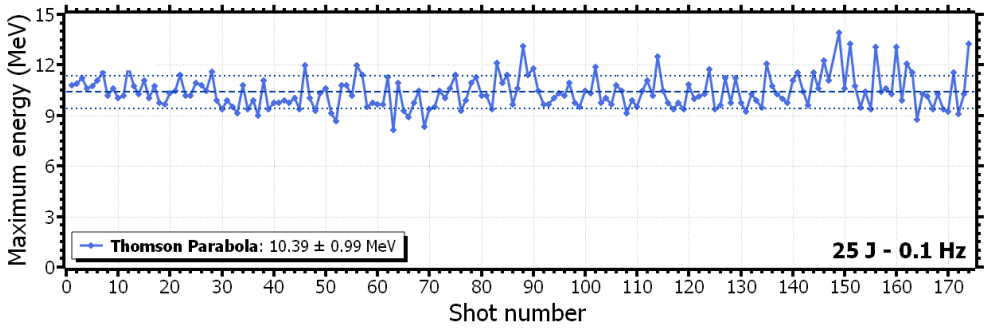


Conclusions

→ Development of target wheel capable of operation at rates up to 10Hz, based on an automatic alignment system

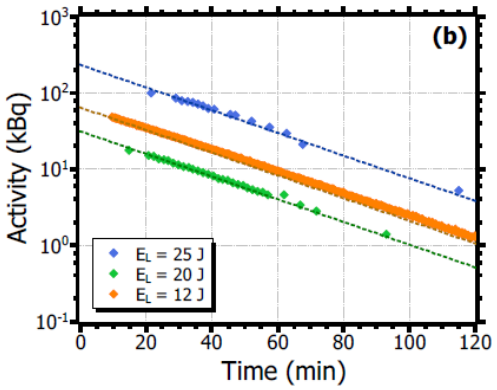
⇒ **Stable laser-driven proton source for applications.**

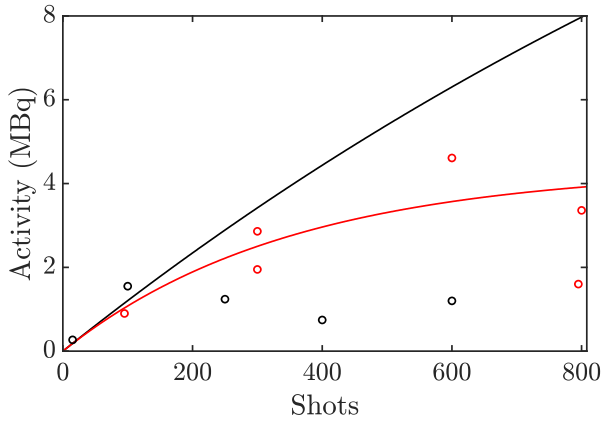




→ Successful use of target wheel at PW-scale system for ^{11}C production

⇒ Activities up to ≳4MBq measured, with rep-rate limited by laser operation

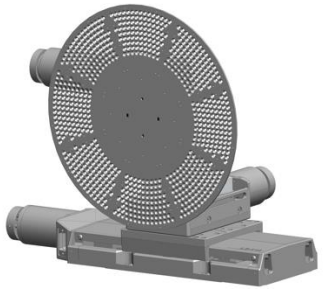


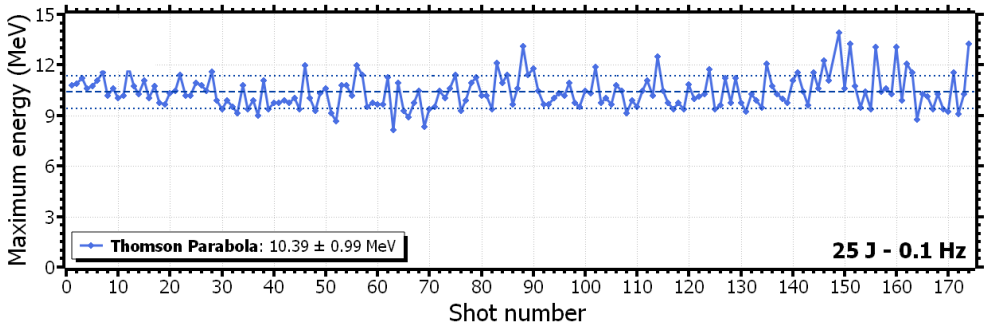


Conclusions

→ Development of target wheel capable of operation at rates up to 10Hz, based on an automatic alignment system

⇒ **Stable laser-driven proton source for applications.**

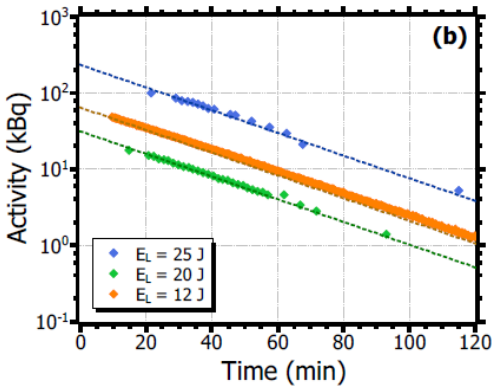


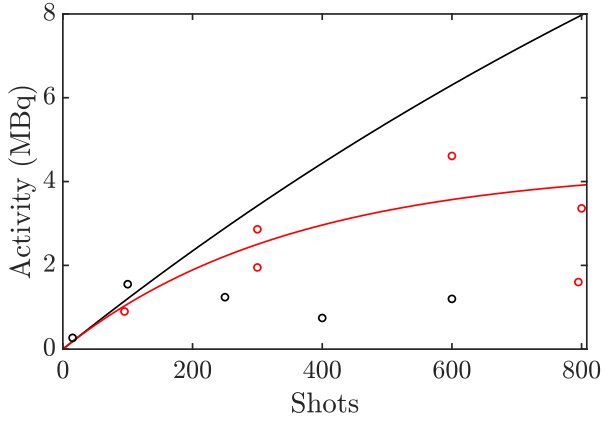


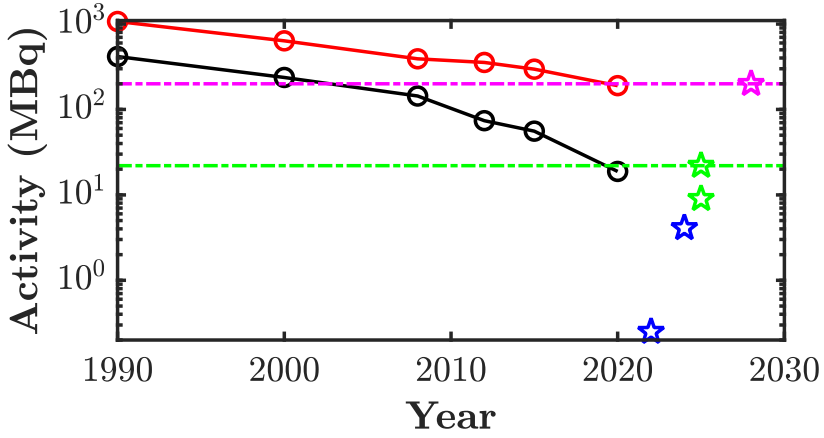
→ Successful use of target wheel at PW-scale system for ^{11}C production

⇒ Activities up to ≳4MBq measured, with rep-rate limited by laser operation

→ Clinical activation levels achievable in the mid-term







Acknowledgements

A. Bembibre, A. Reija, J. Peñas, J. Benlliure

H. Larreur, D. Dubresson, R. Margnes, M. Huault, D Raffestin, P. Nicoläi, D. Batani

M. Seimetz

C. Guerrero, M.A. Millán-Callado

K. Batani

L. Volpe, E. Filippov, J.A. Perez Hernández, J.L. Henares, J.I. Apiñaniz, C. Méndez

M. Dias Rodrigues, A. Bonasera

V. Kantarelou, L. Giuffrida

A. Bilewicz

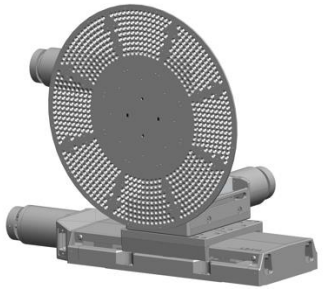
C. Morgat

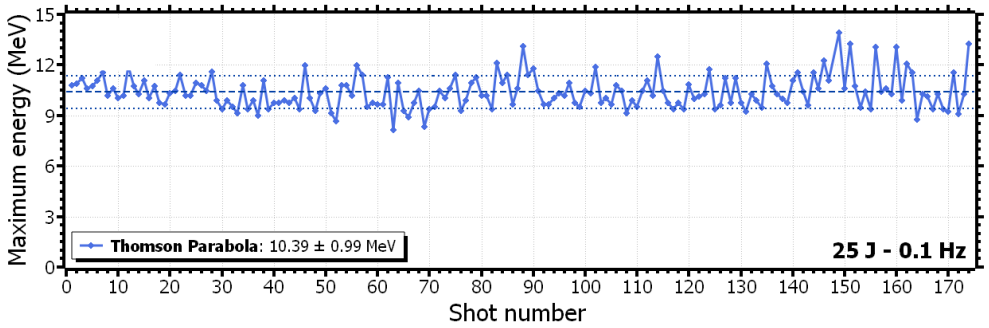
Conclusions

aaron.alejo@usc.es | XVI CPAN days | Nov 2024

→ Development of target wheel capable of operation at rates up to 10Hz, based on an automatic alignment system

⇒ **Stable laser-driven proton source for applications.**

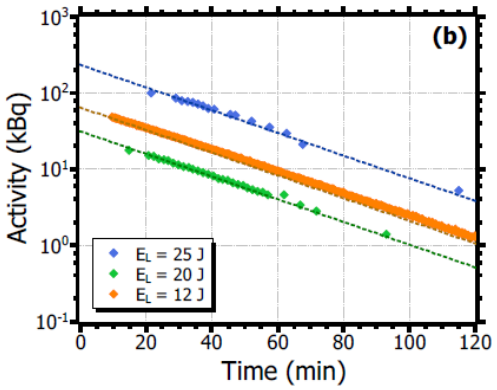


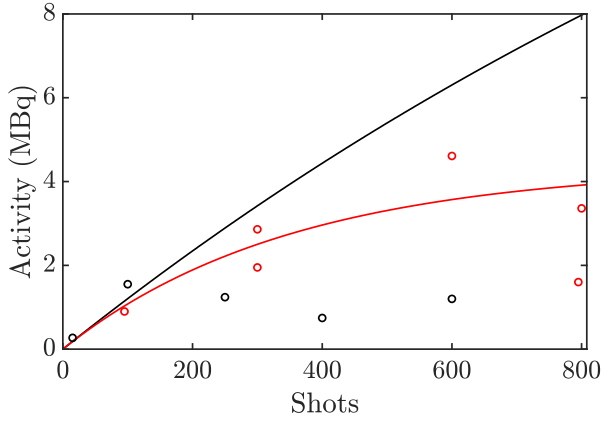


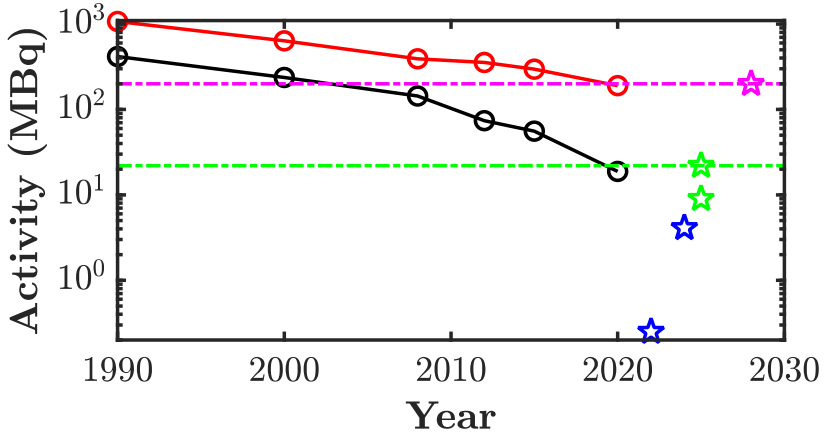
→ Successful use of target wheel at PW-scale system for ^{11}C production

⇒ Activities up to ≳4MBq measured, with rep-rate limited by laser operation

→ Clinical activation levels achievable in the mid-term







Thank you!

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES
AGENCIA ESTATAL DE INVESTIGACIÓN
EXCELENCIA MARÍA DE MAEZTU 2024-2030
XUNTA DE GALICIA
CENTROS gusiR
Cofinanciado pola Unión Europea
Fondos Europeos
CA21128 PROBONO

Acknowledgements

Work supported by the Xunta de Galicia grant ED431F2023/21, by “la Caixa” Foundation (ID 100010434) (fellowship code LCF/BQ/PI20/11760027) and grant RYC2021-032654I funded by MICIU/AEI/10.13039/501100011033 and by “European Union NextGenerationEU”.

This work has been carried out within the framework of the COST Action CA21128- PROBONO “PROton BOron Nuclear fusion: from energy production to medical applications”, supported by COST (European Cooperation in Science and Technology - www.cost.eu).

María de Maeztu grant CEX2023- 001318-M funded by MICIU/AEI /10.13039/501100011033.

This work has received financial support from the Xunta de Galicia (CIGUS Network of Research Centres) and the European Union