Rapid, continuous radiocarbon analysis of carbonate archives using laser ablation

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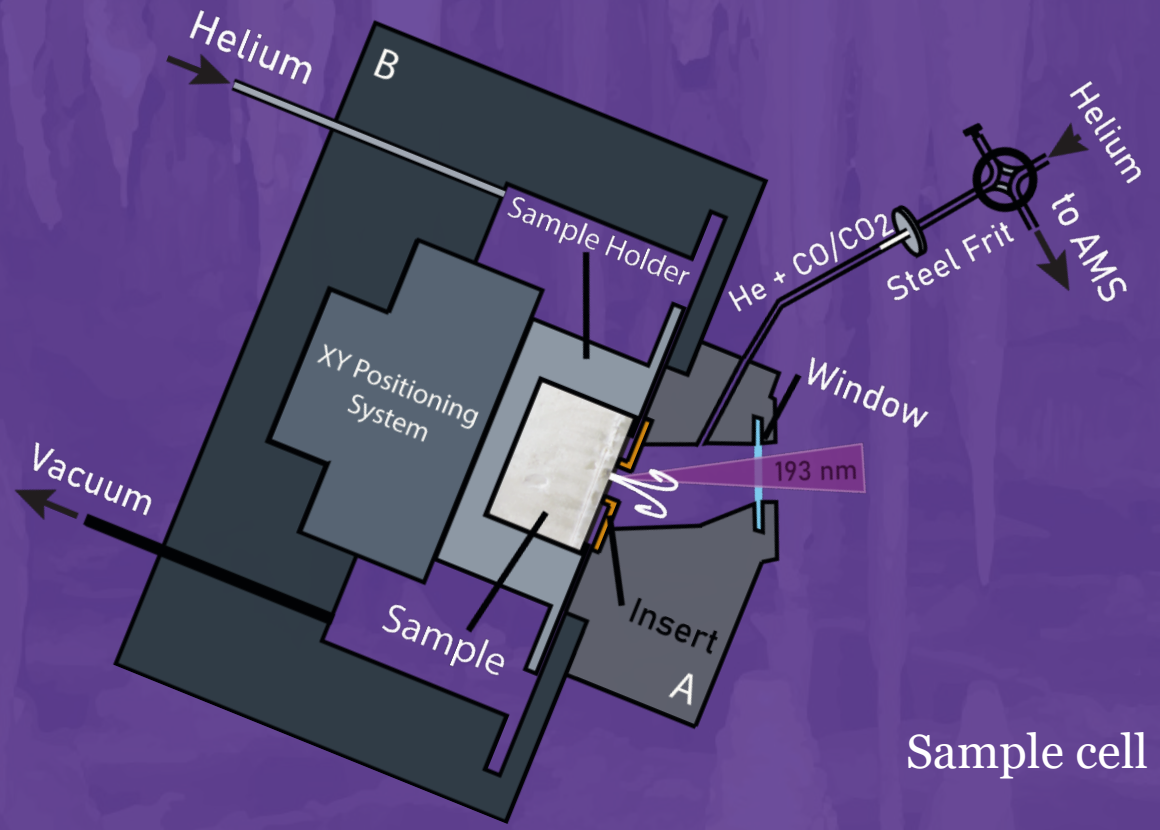
Laser-Ablation-AMS



Sample cell

	Original Setup	Modified
fluence on sample	1-2.5 J·cm^{-2}	8-23 J·cm^{-2}
cell volume	600 µL	900 µL
spot size	680 x 110 µm^2	140 x 75 µm^2
ablation rate	100 µg/min	50-100 µg/min
carbon flow	6 µg/min	3.5-7 µg/min
max. ion current	7 µA	9 µA
blank level	0.011±0.002 up to 36'000 y	0.009 ± 0.002 up to 38'000 y

pulsed ArF excimer laser (GAM LASER, USA)
laser repetition rate: up to 250 Hz
(Yeman, C. (2019))

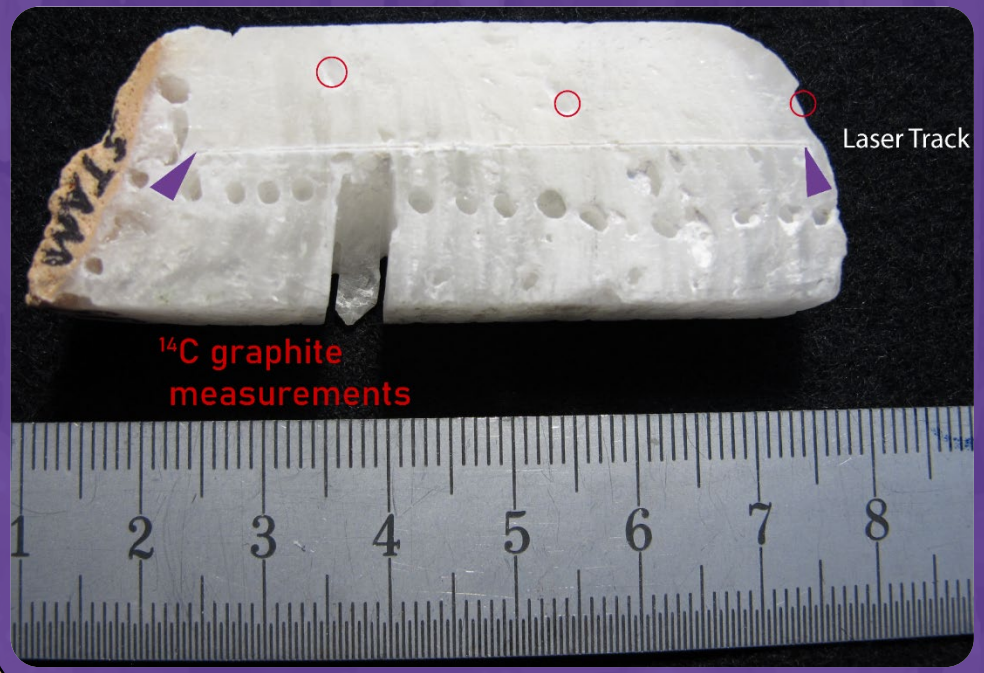
Carbonate conversion efficiency: 70 ± 4%
(Welte et. al. (2017))

Stalagmite STAM-4

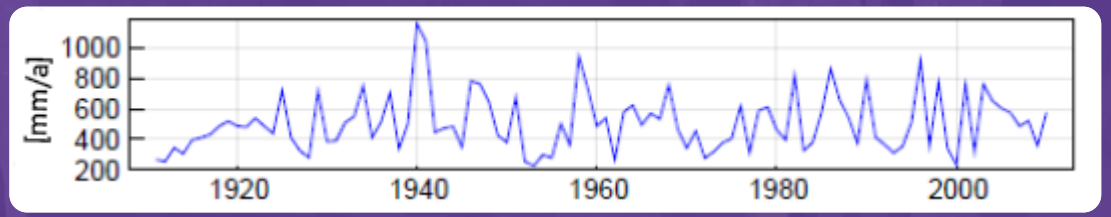
STAM-4 has been chosen as a sample because it is a fast grown stalagmite. Could a continuous ^{14}C record be used to detect a subannual signal?

Previous measurements:

- Uranium/Thorium: inconclusive (too young, did not contain enough Thorium)
- 14C graphite-based measurements have been taken and the results agree well with those from LA-AMS



Growth Rate



Cloşani Cave

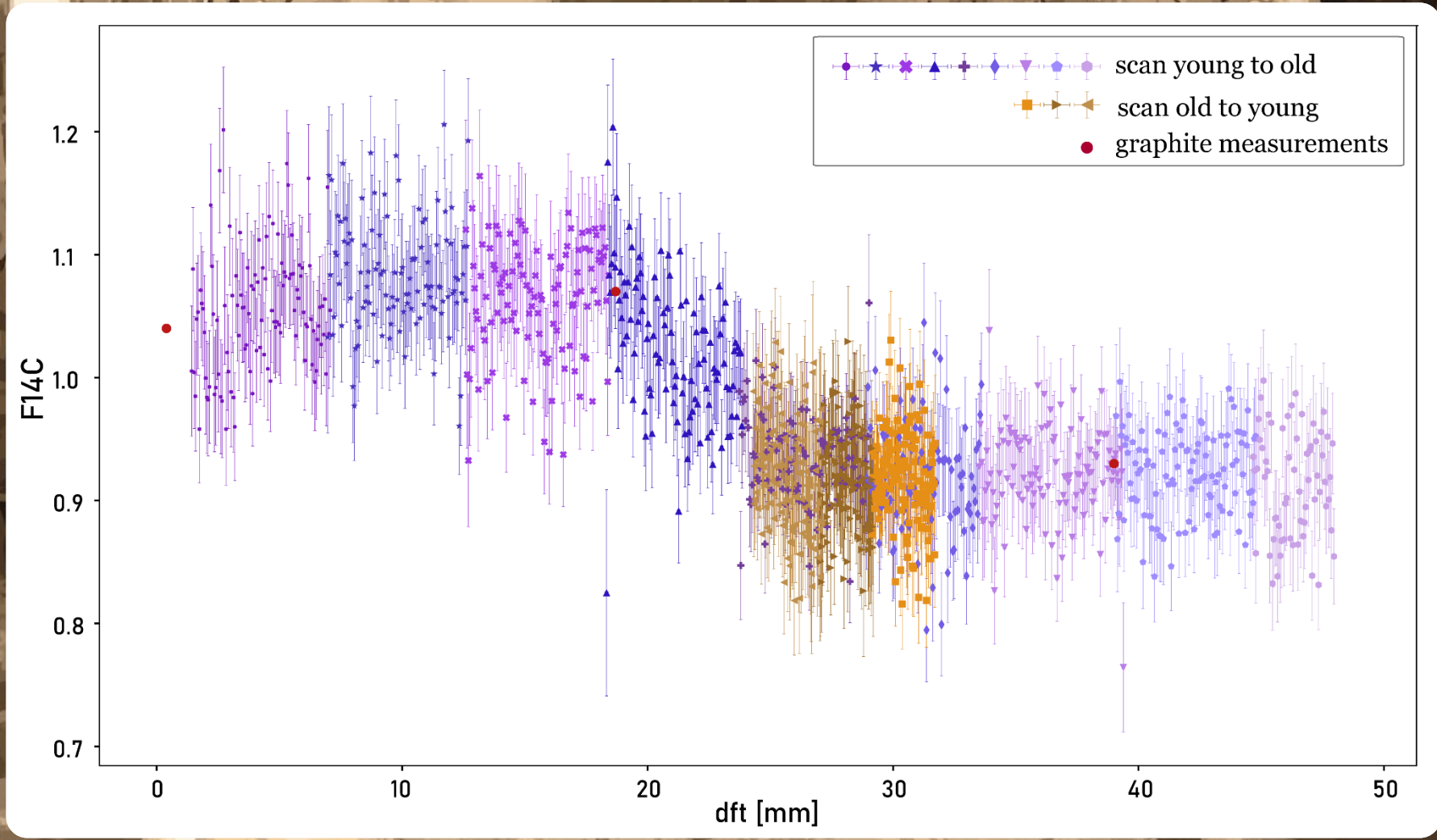
- 45.1°N, 22.8°E southern slope of Carpathians in SW Romania
- 433 m above sea level (msl)
- In Upper Jurassic limestone mainly calcite (93%), dolomite (7%)
- 1458 m long over a vertical range of 15 m (Warken et. al. (2018))

Radiocarbon Record of Stalagmite STAM-4

velocities:
young → old:
v = 5 µm/s
(equals ~19 pts/mm)
old → young:
v = 2 µm/s
(equals ~48 pts/mm)

data points are correlated to sample location with a python script.

Sample measuring time: about 6 h
(+ 3 h standards)



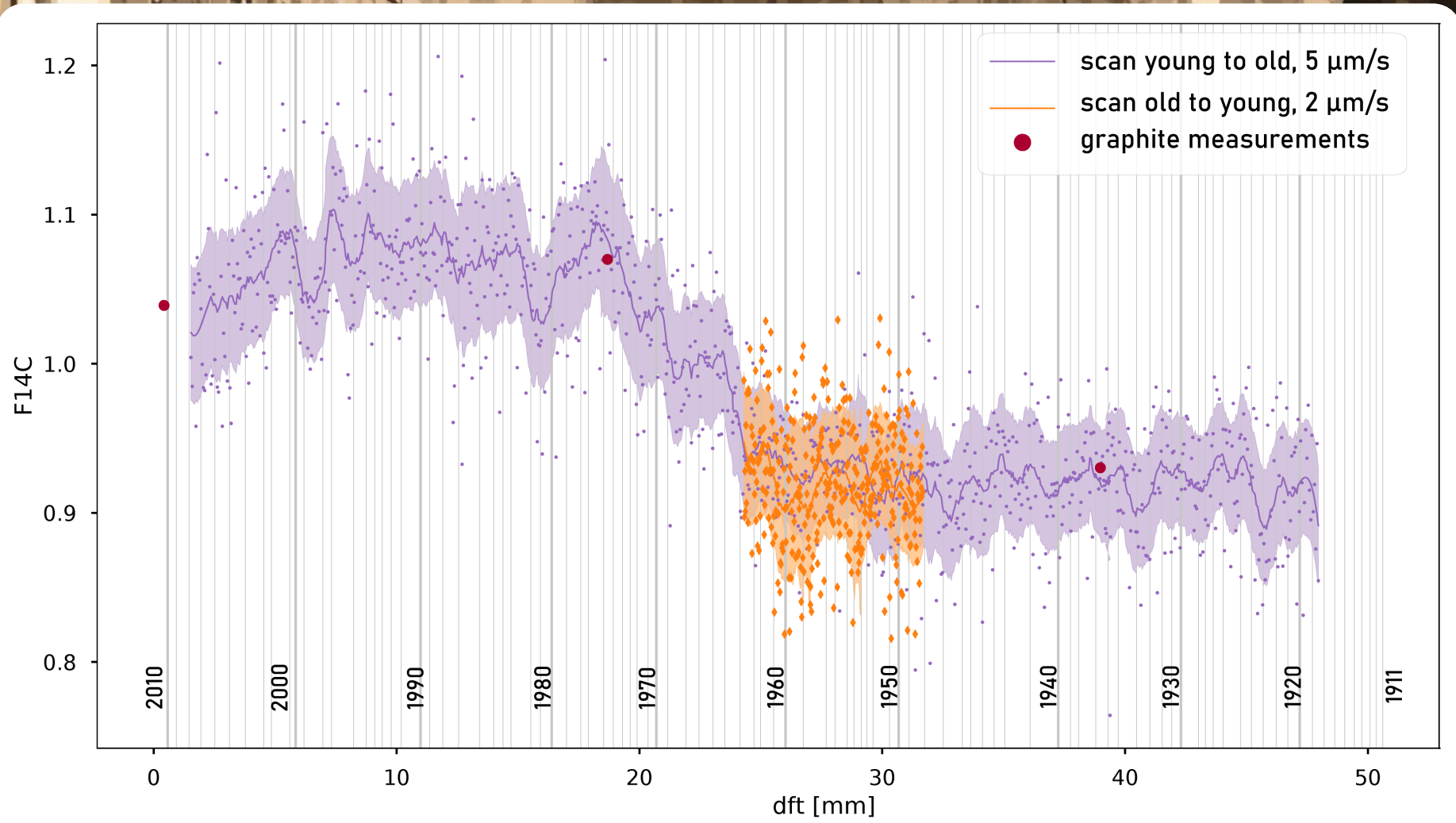
Exploratory Analysis of STAM-4

Savitzky-Golay filter with polynomes of degree 3 and window width of 33 for scan with 5 µm/s and 67 for scan with 2 µm/s.

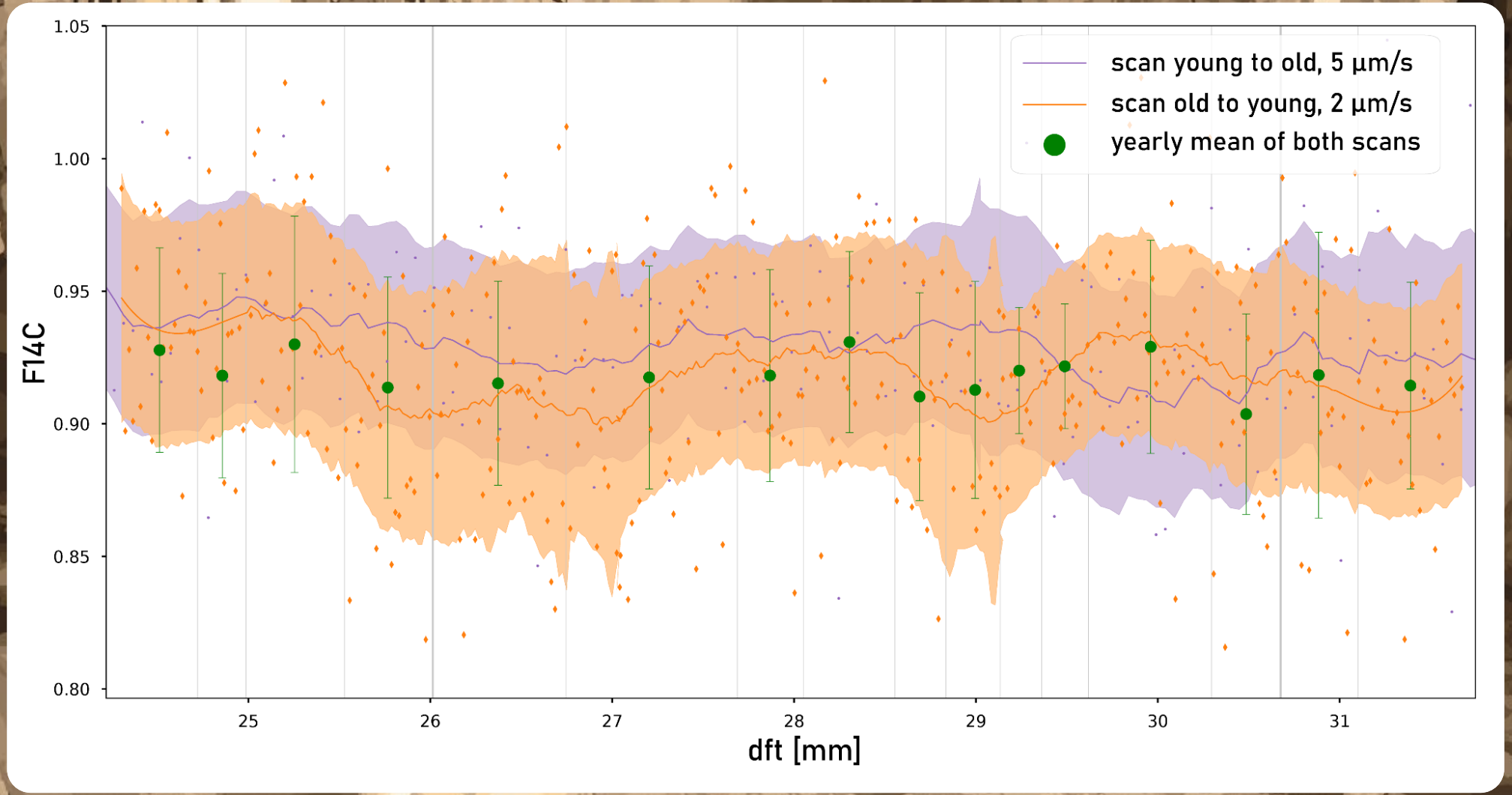
Preliminary layer width measurement using high resolution scan picture.

Further analysis required to see what kind of signal we can detect in STAM-4.

While a subannual signal seems unlikely in this case, interesting features are found e.g. around 1980.



Zoom-in of Savitzky-Golay filter



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