



NNL ENDF/B-VIII.1 (β 4) Validation Testing – ICSBEP Suite

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Los Alamos National Laboratory

NNL Validation

- NNL ICSBEP benchmark suite: 121 benchmarks, 685 cases
- MC21 calculation uncertainty ~10pcm
- Validation comparisons:

1. Reactivity change (Δk) relative to benchmark k_{eff}

$$\Delta k = k_{calc} - k_{bm}$$

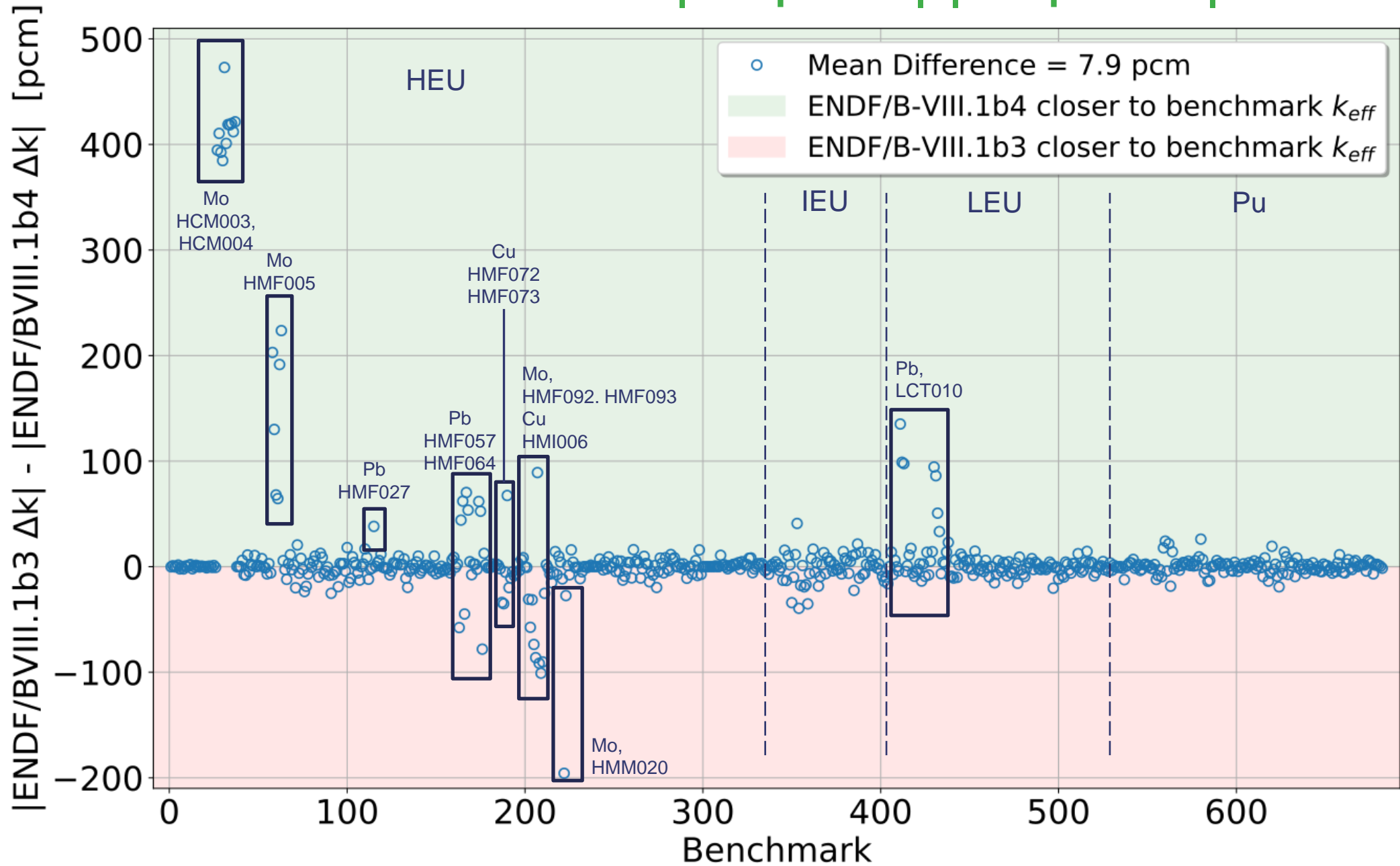
2. Figure of merit indicating change in $\frac{C}{E} - 1$

- Positive FOM: 8.1 β X closer to benchmark k_{eff}
- Negative FOM: 8.1 β X further from benchmark k_{eff}

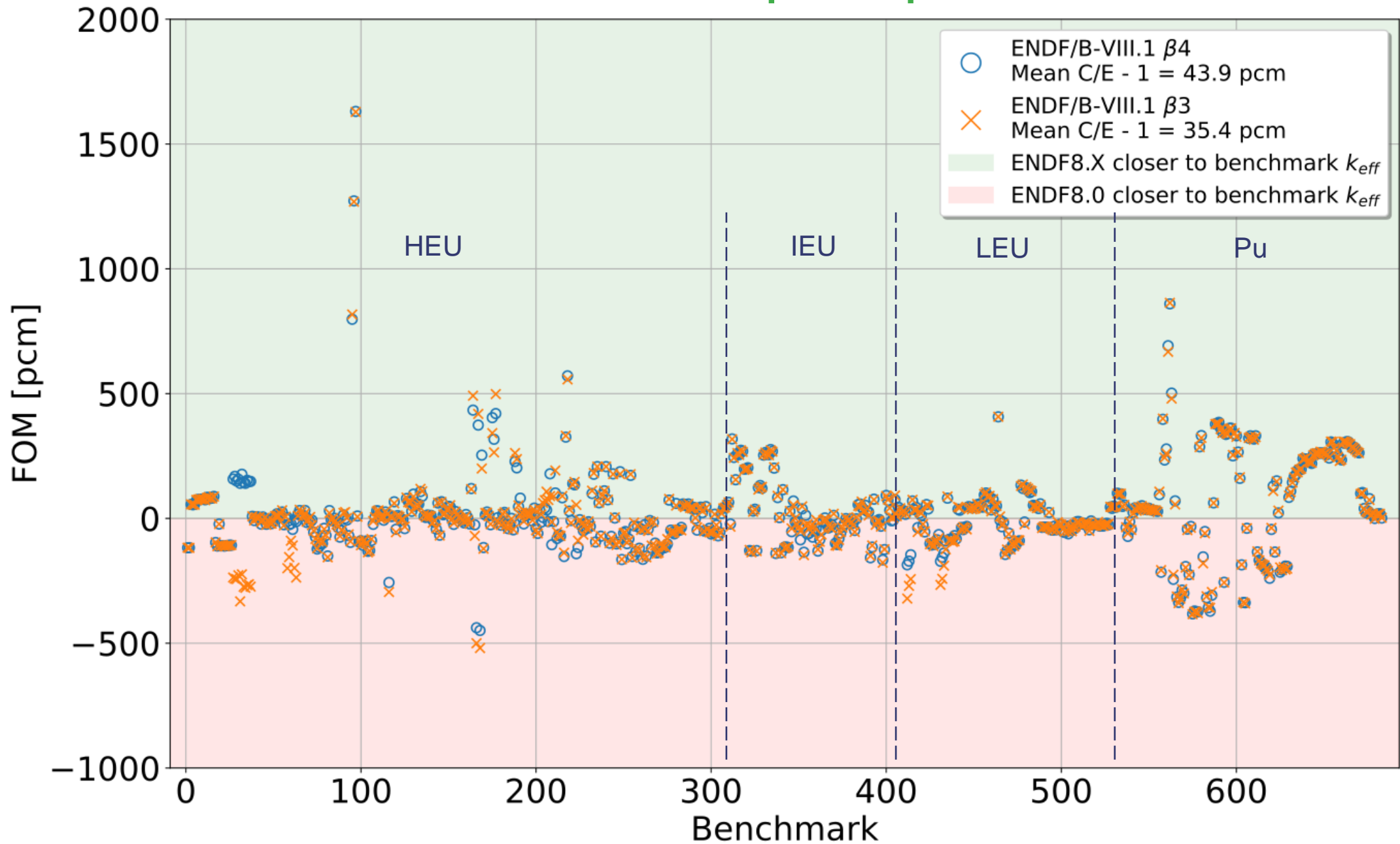
$$FOM = \left| \frac{C}{E} - 1 \right|_{8.0} - \left| \frac{C}{E} - 1 \right|_{8.1\beta 4}$$

3. Correlation of $\frac{C}{E} - 1$ with ATLF, ATFF

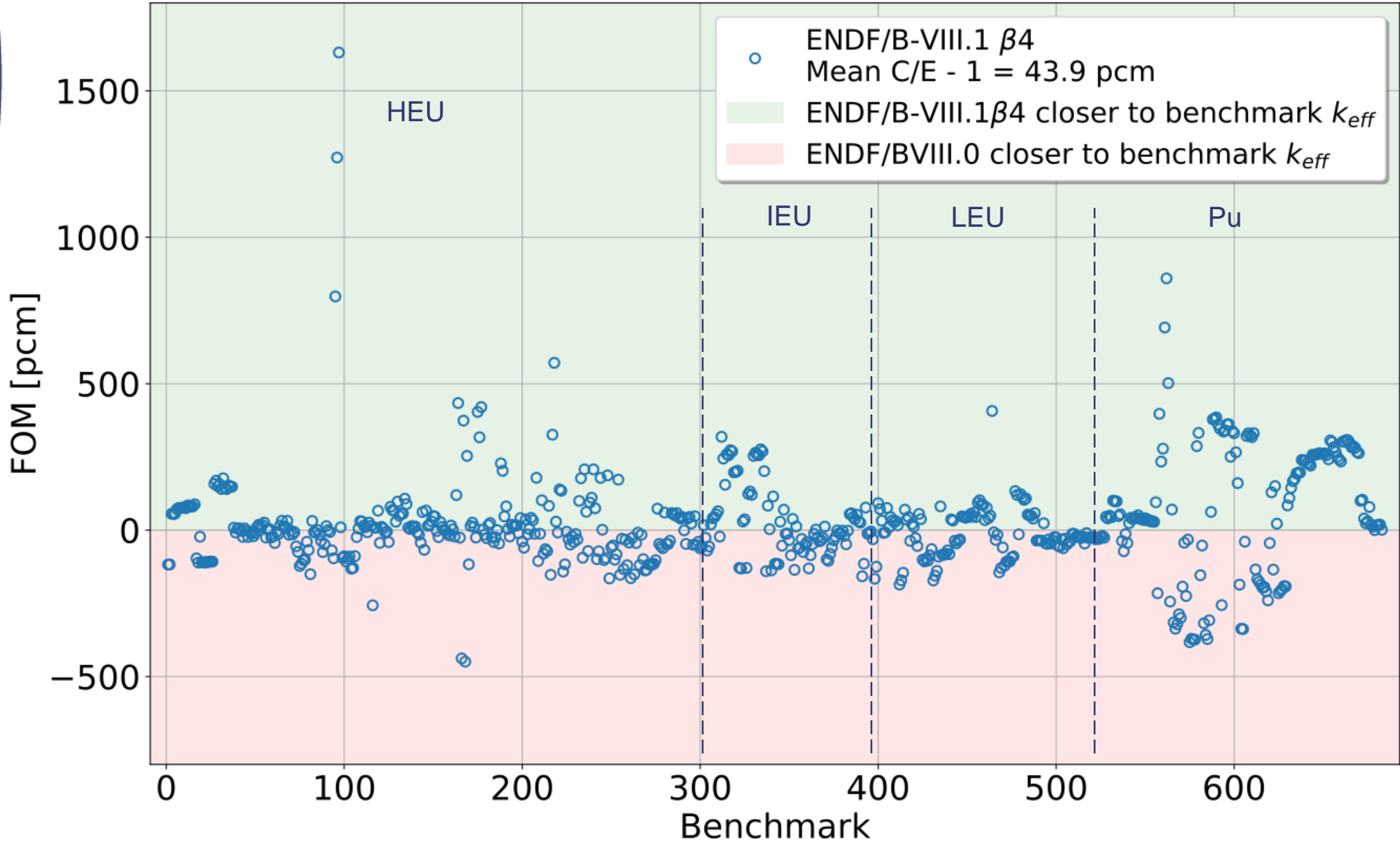
Benchmark Suite $|8.1\beta_3 \Delta k| - |8.1\beta_4 \Delta k|$



Benchmark Suite β_3 & β_4 FOM

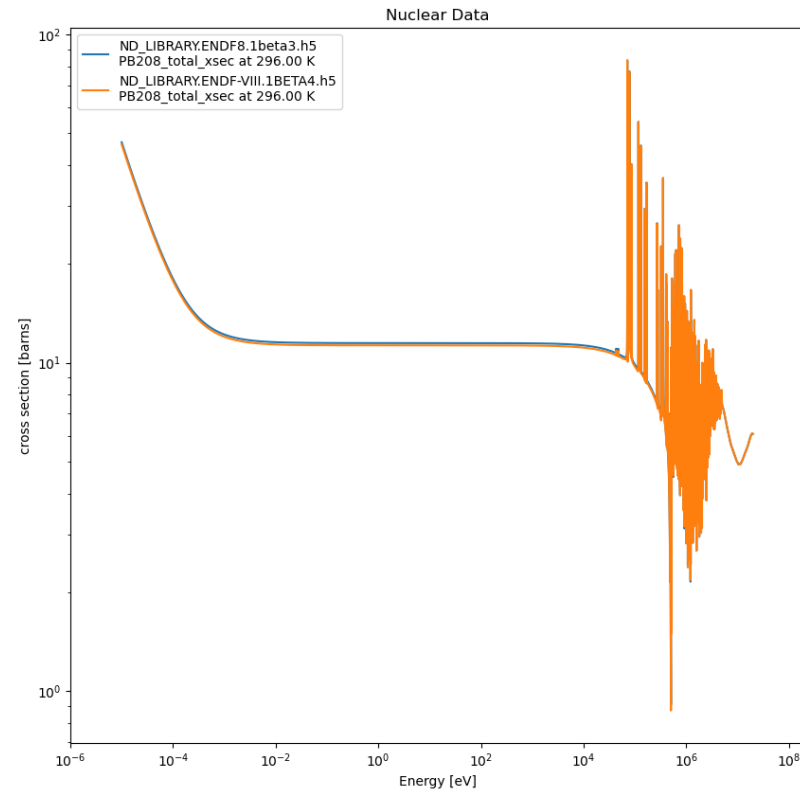
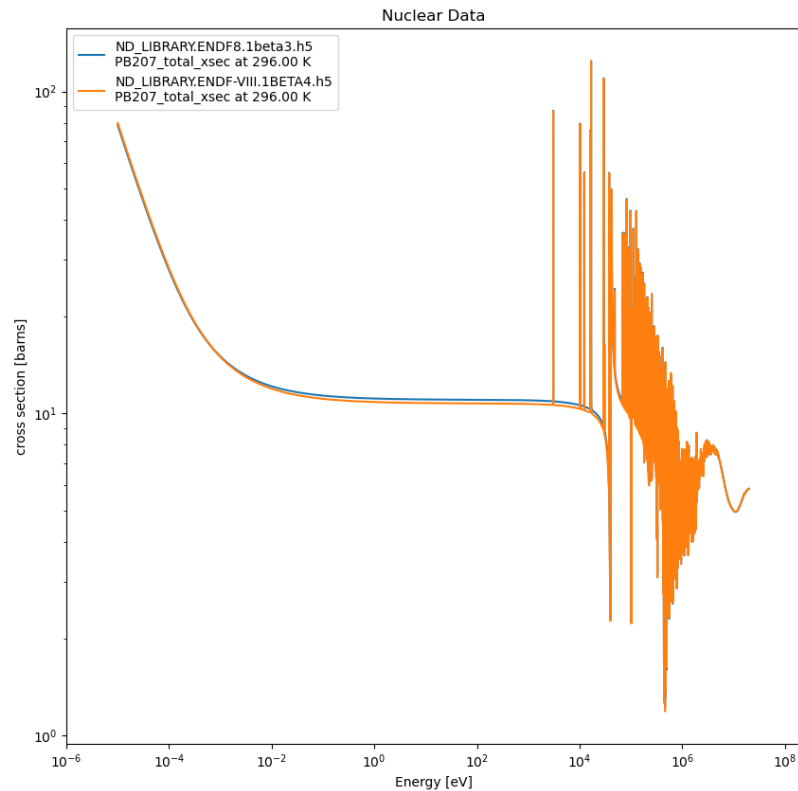


Benchmark Suite β_4 FOM



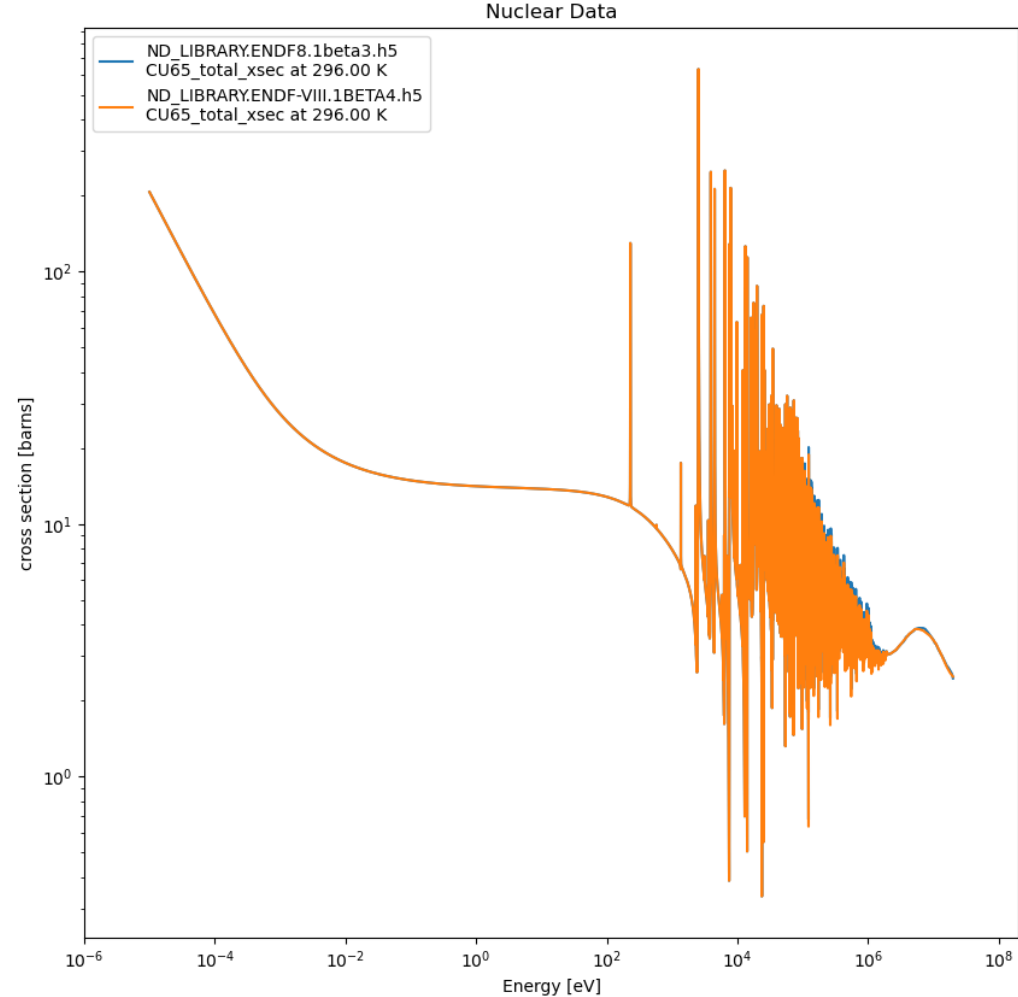
Conclusions β_4 to β_3 : Pb207 & Pb208

- Updates to Pb207, Pb208 show overall varied but closer agreement over 8.1 β_3
 - HMF027: 38pcm closer agreement
 - HMF057: 21pcm average closer agreement (6 cases)
 - HMF064: 12pcm average closer agreement (3 cases)



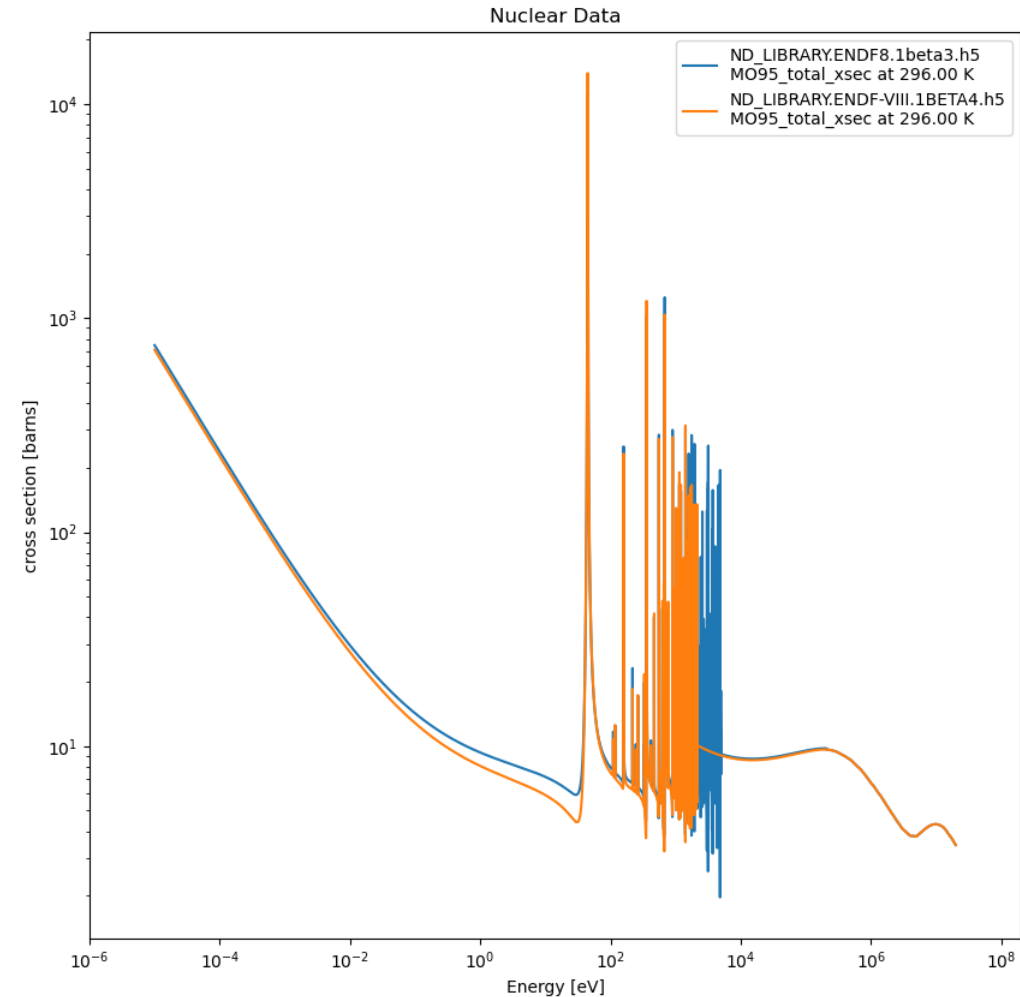
Conclusions β_3 to β_4 : Cu65

- Update to Cu show varied agreement by benchmark
 - HMF072 – ZEUS – Steel & HEU core, Cu reflector, 25pcm average further agreement
 - HMF073 – ZEUS – HEU core, Cu Reflector, 67pcm closer agreement
 - HMI006, an HEU & graphite core, copper reflected benchmark shows closer agreement (89pcm) in case01 and further agreement in case02, case03, and case04 (94pcm average)



Conclusions β_3 to β_4 : Mo95

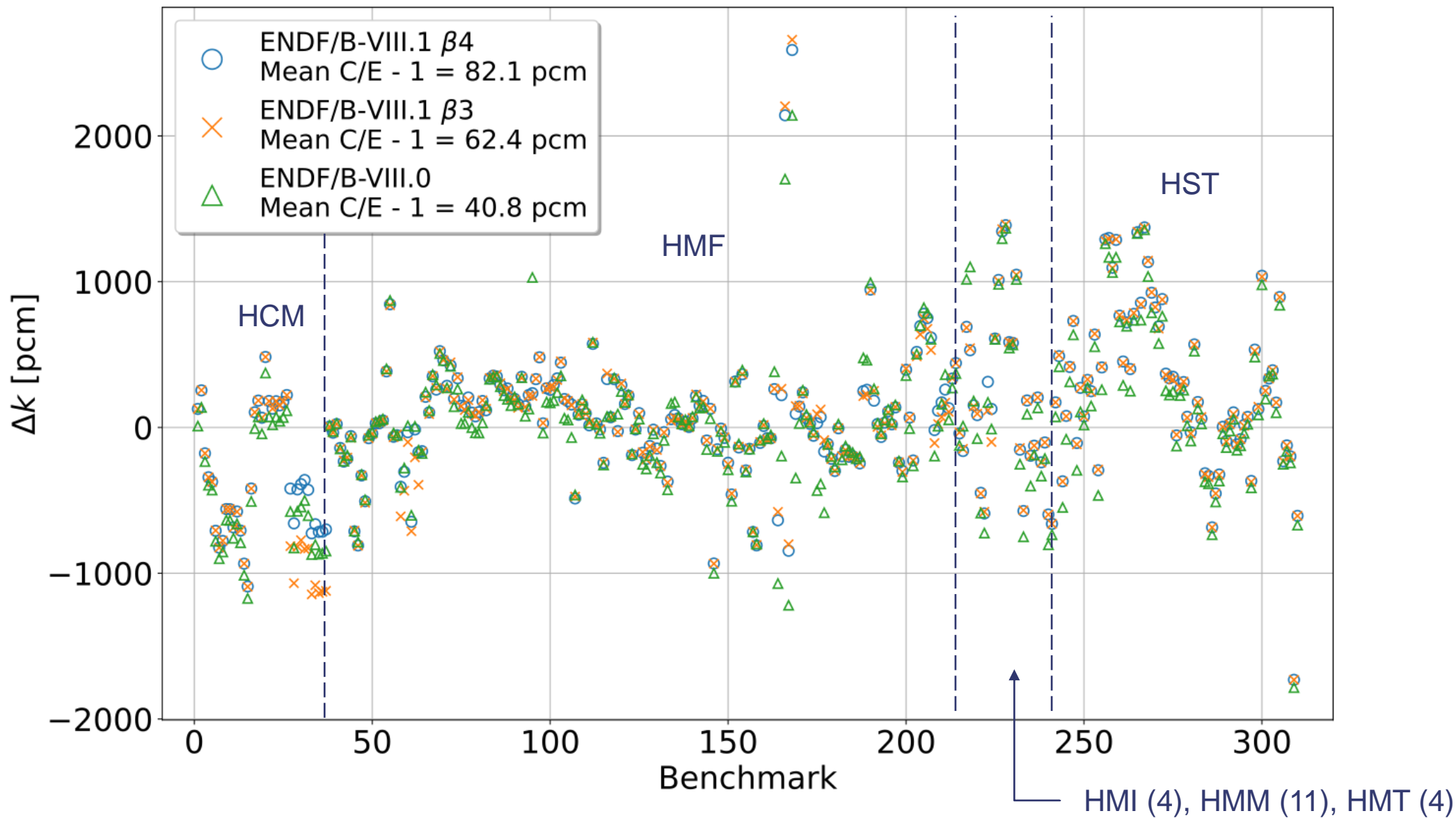
- Varied agreement in some benchmarks
 - HMF005: 147pcm average closer agreement (6 cases)
 - HMF092: 48pcm average further agreement (3 cases)
 - HMF093: 86pcm further agreement
 - HMM020: 112pcm further agreement
- Significantly closer agreement in:
 - HCM003: 409pcm average closer agreement (6 cases)
 - HCM004: 418pcm average closer agreement (5 cases)



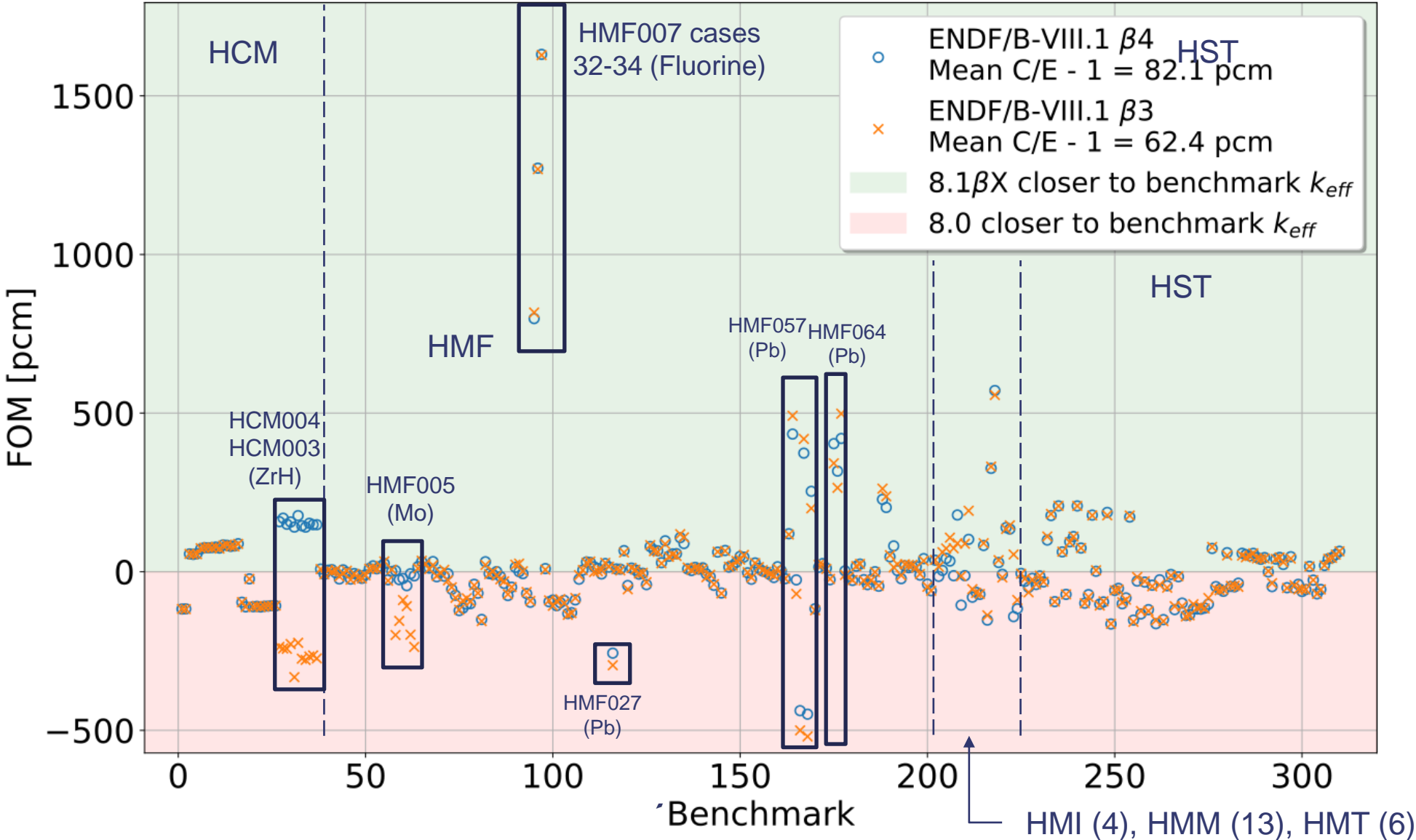
Supporting Slides



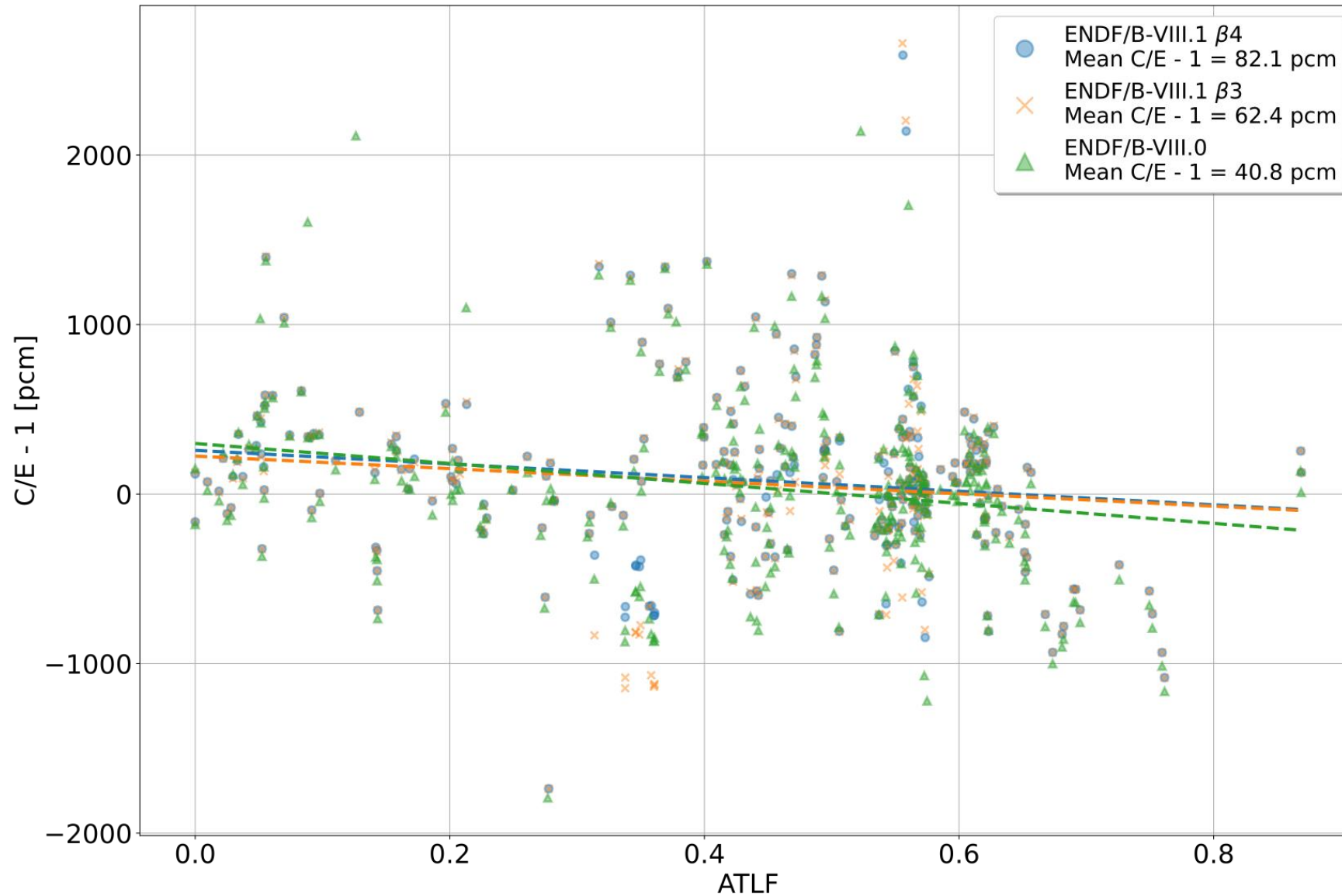
HEU Benchmarks Δk



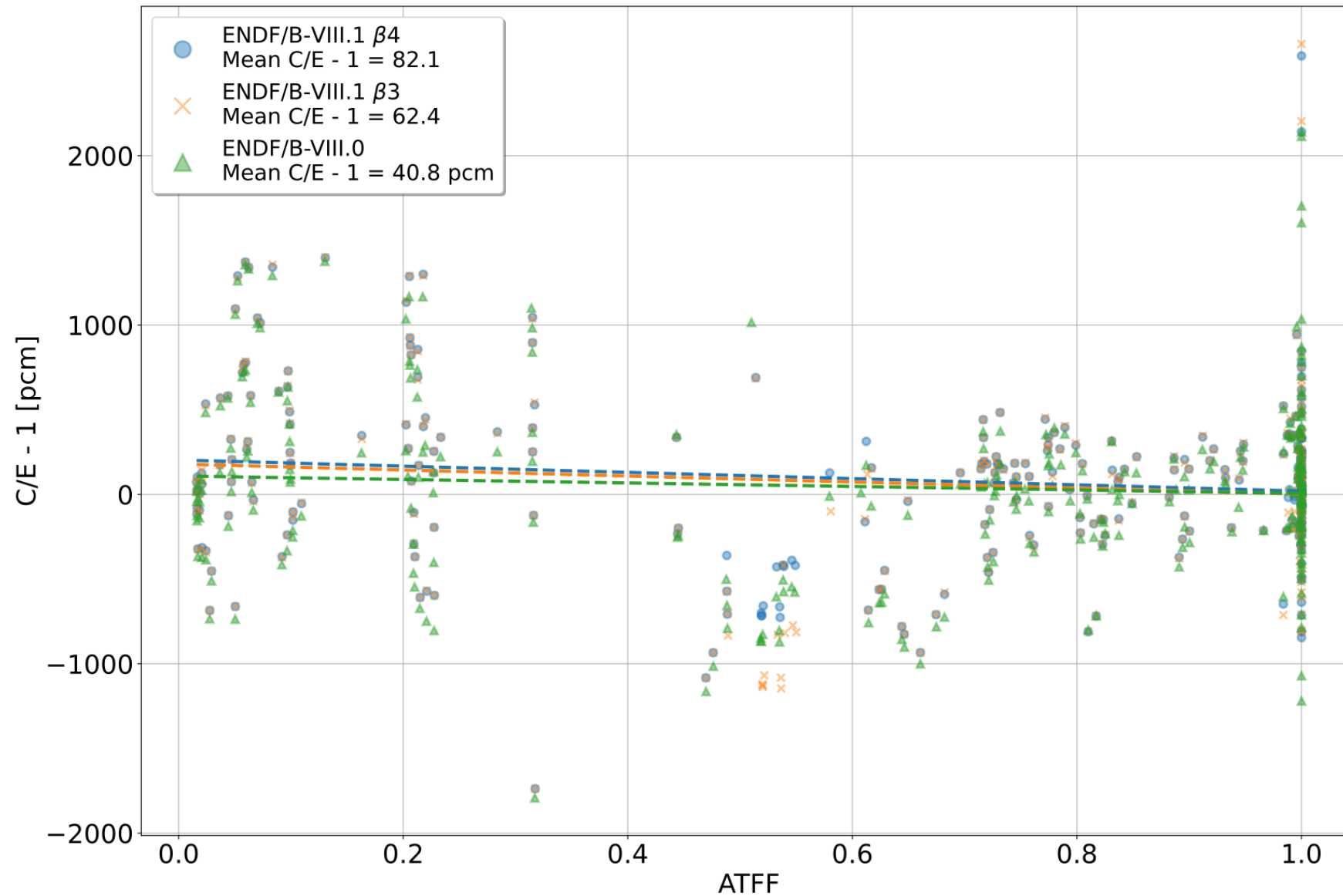
HEU Benchmarks FOM



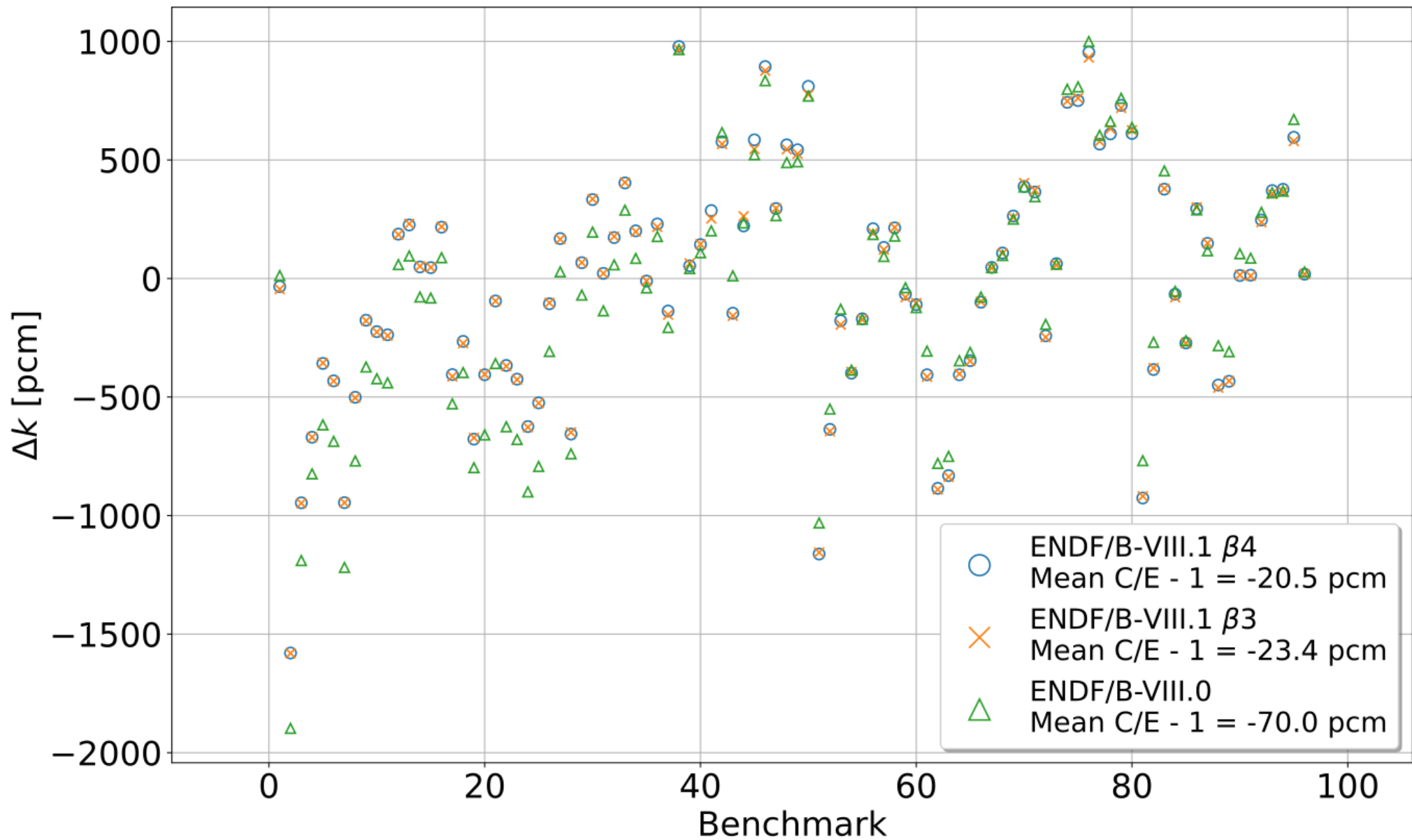
HEU Benchmarks ATLF vs. C/E - 1



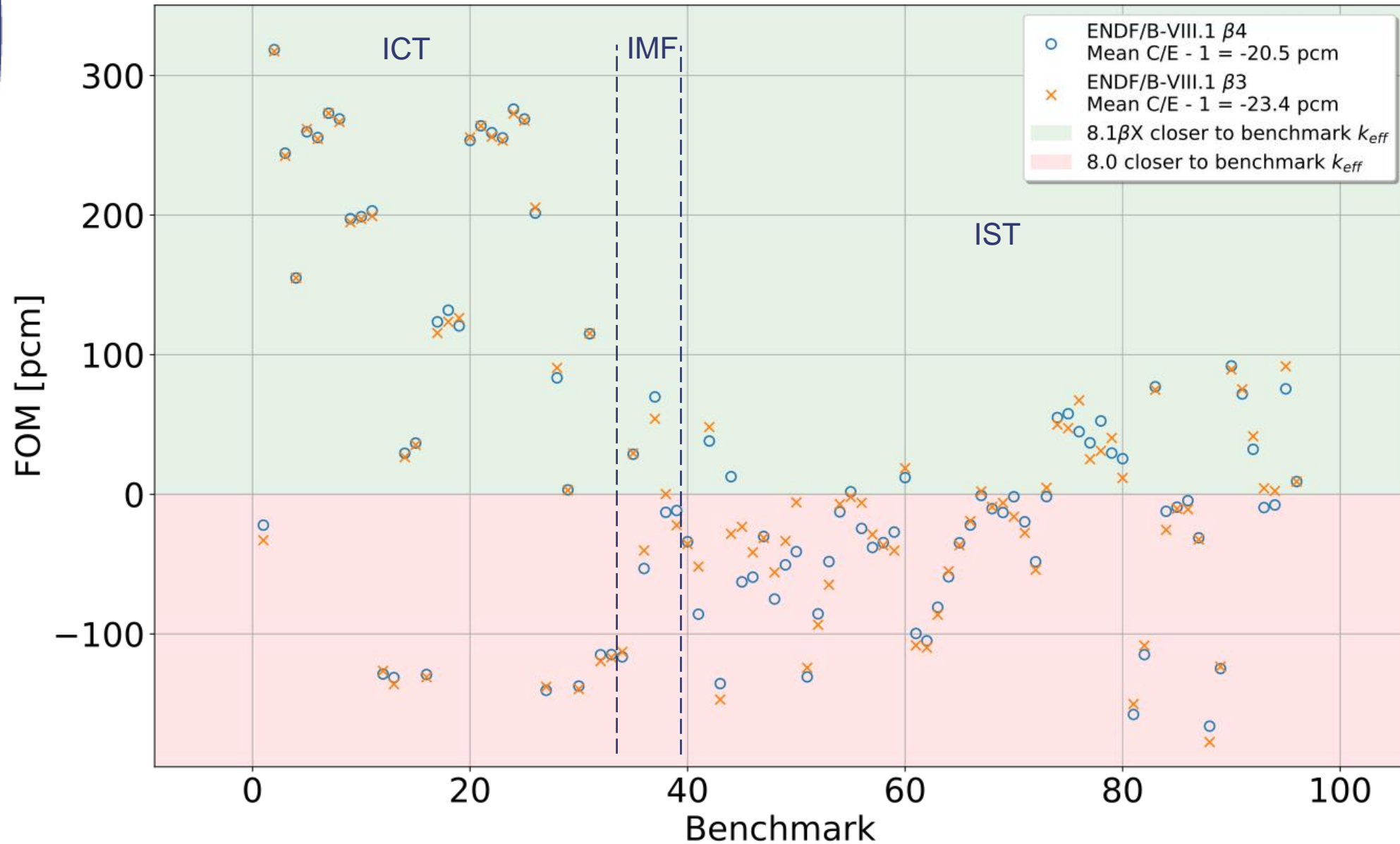
HEU Benchmarks ATFF vs. C/E - 1



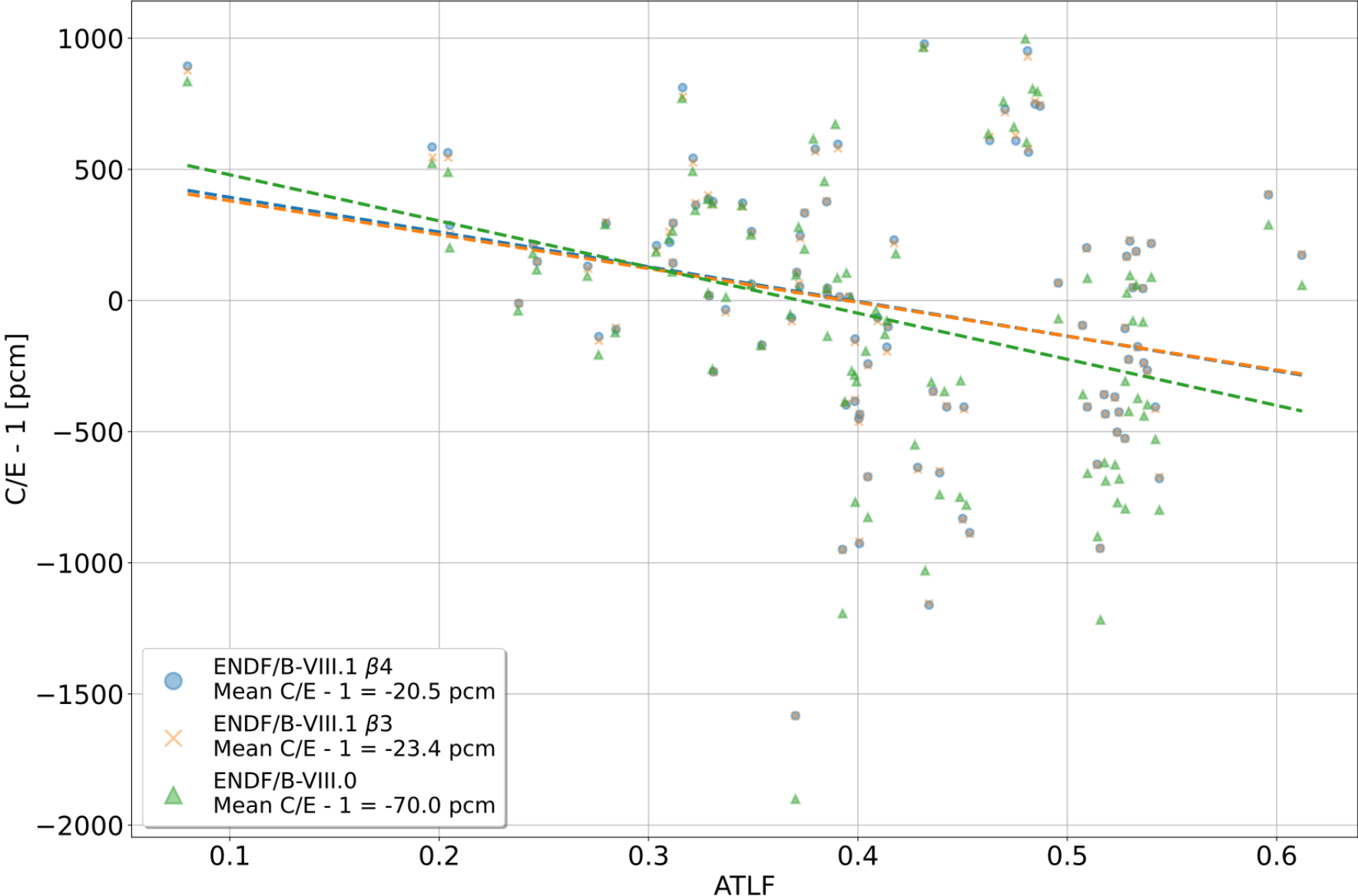
IEU Benchmarks Δk



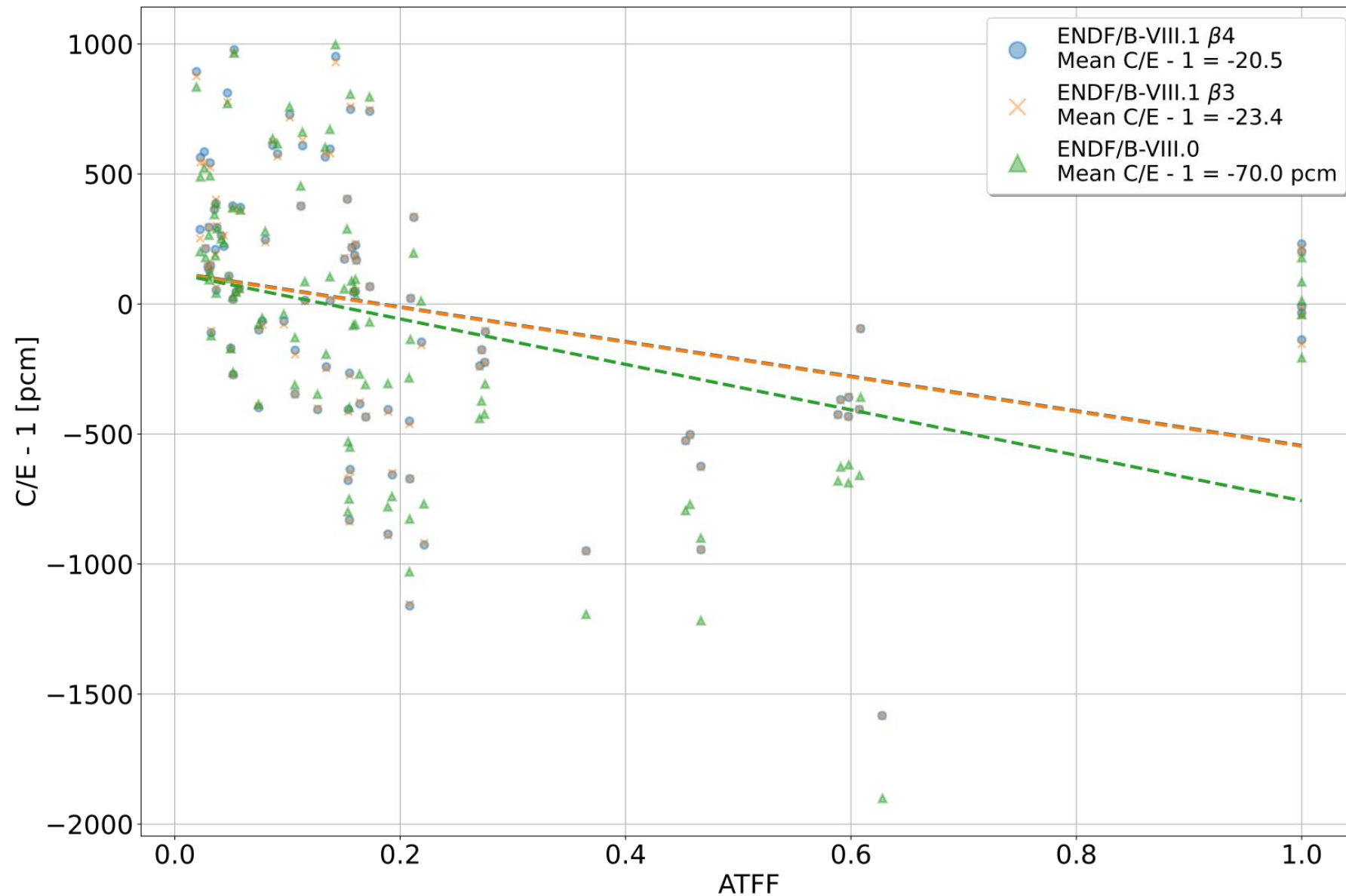
IEU Benchmarks $\Delta|C/E - 1|$



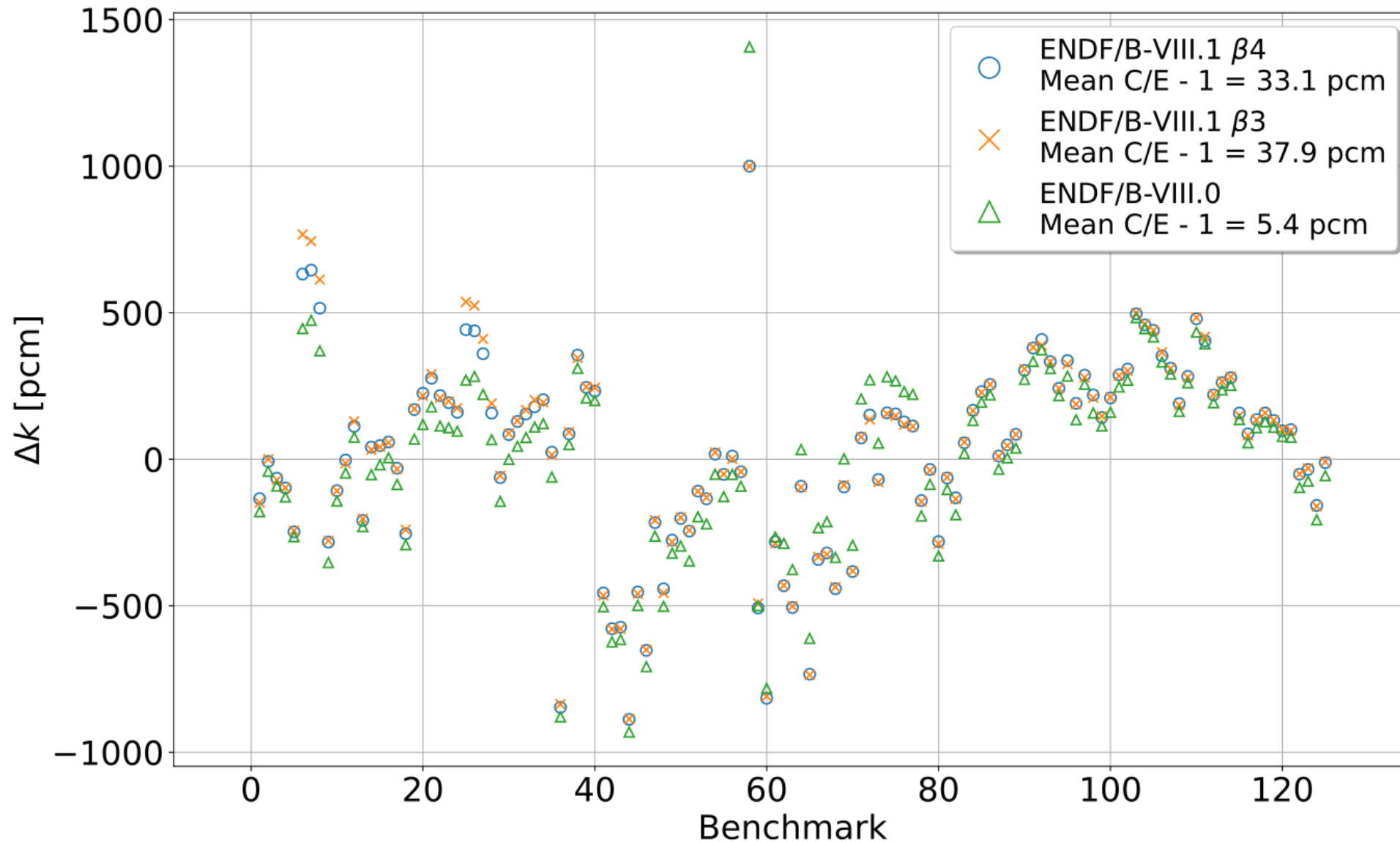
IEU Benchmarks ATLF vs. C/E - 1



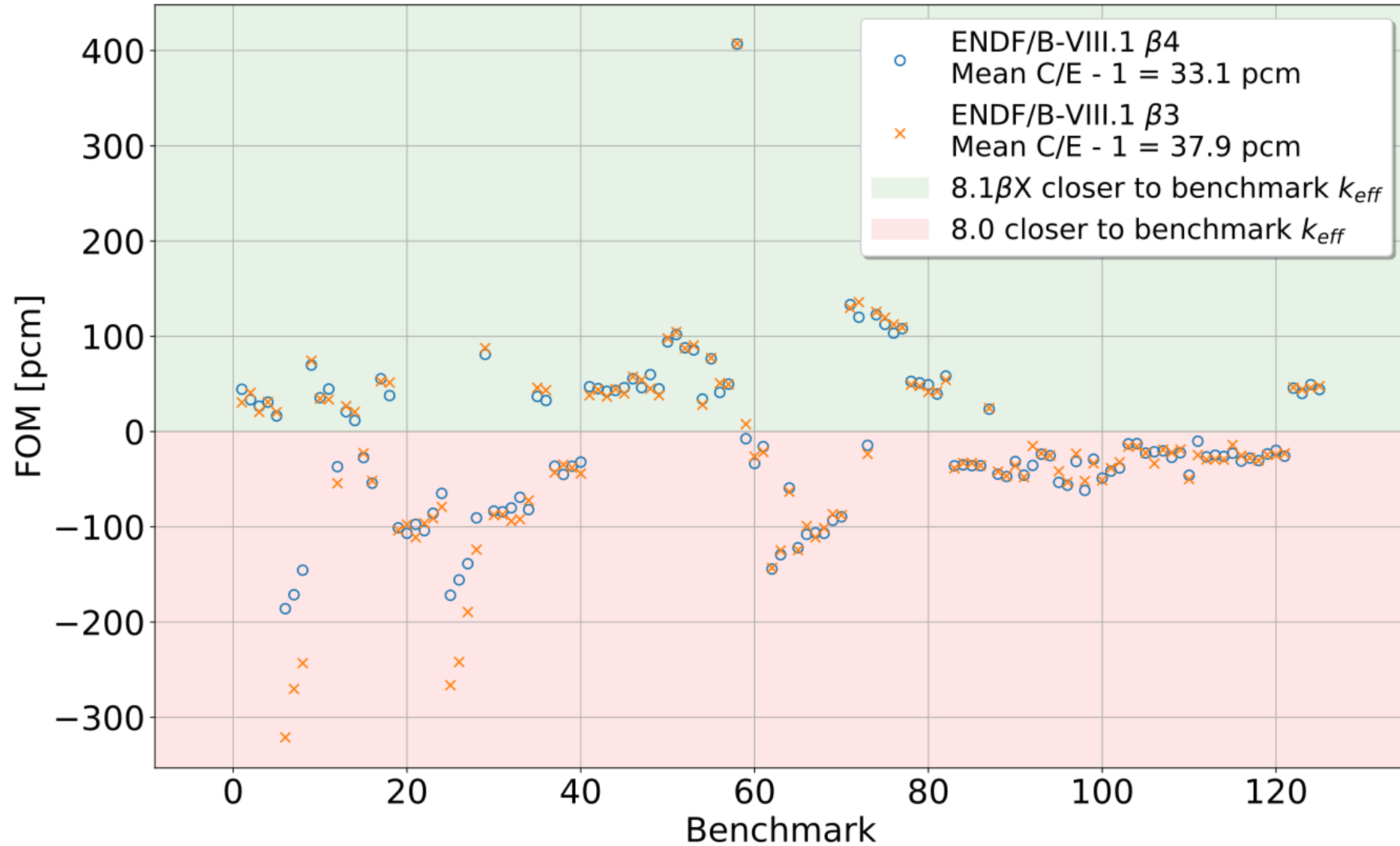
IEU Benchmarks ATFF vs. C/E - 1



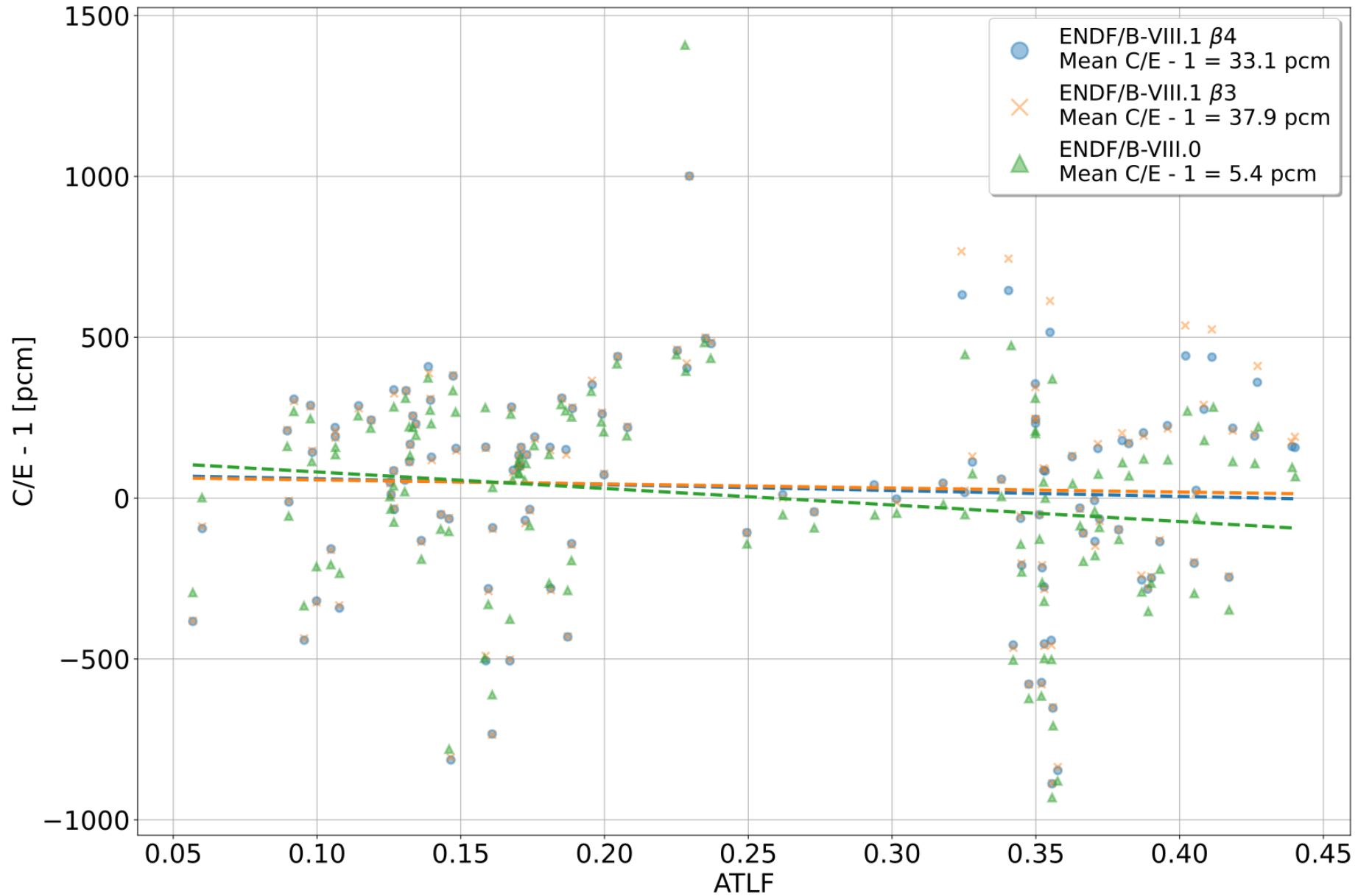
Thermal LEU Benchmarks Δk



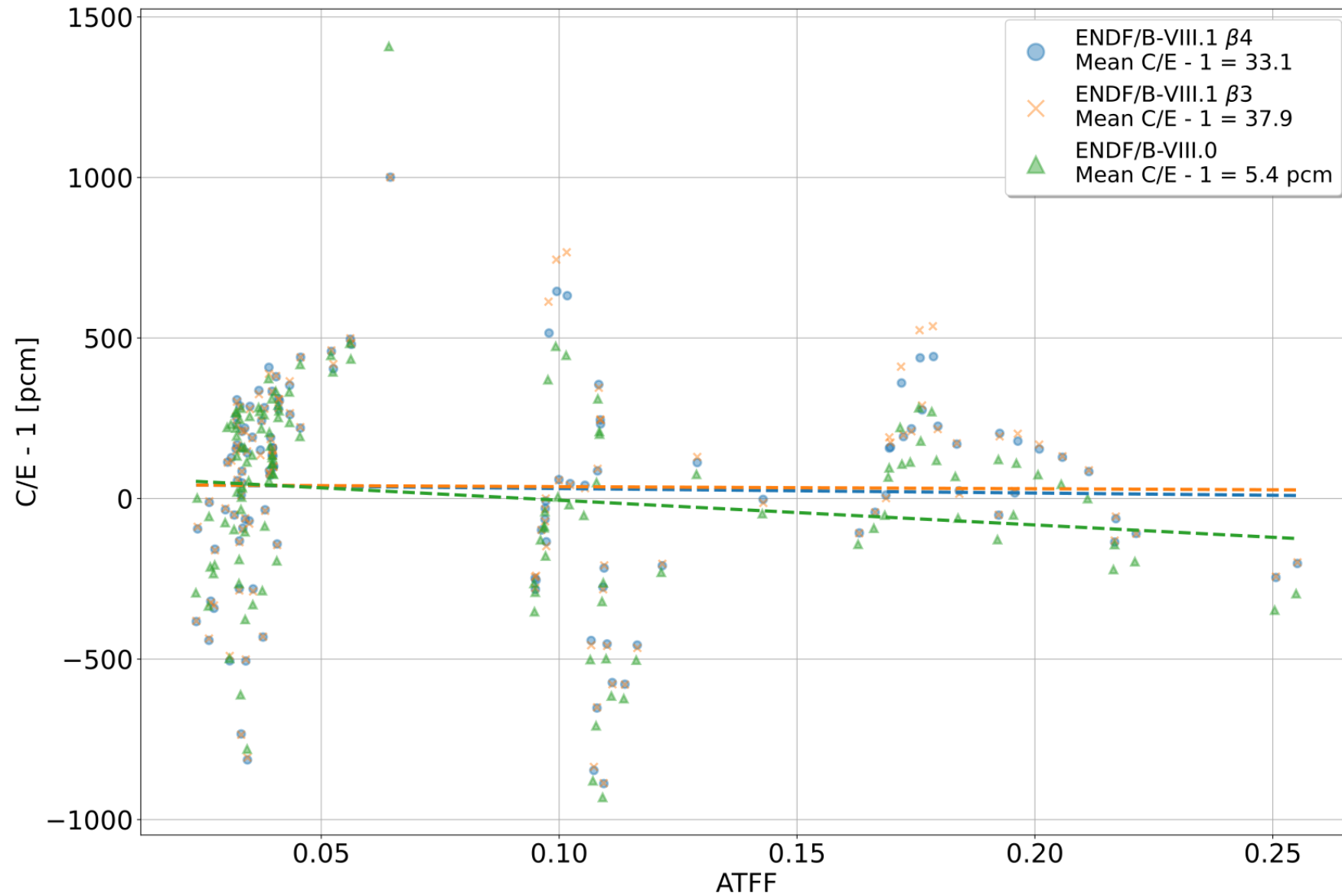
Thermal LEU Benchmarks FOM



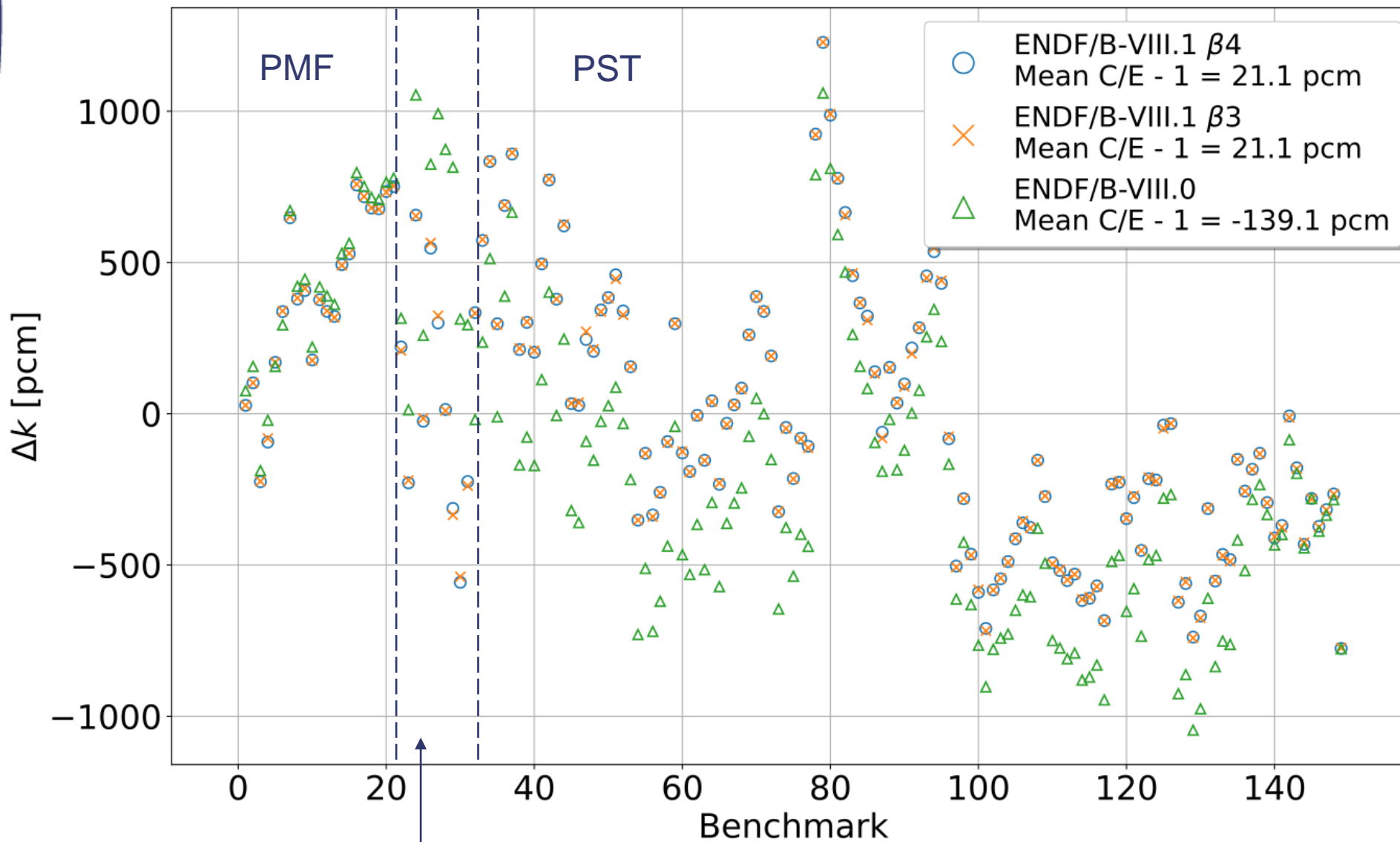
Thermal LEU Benchmarks ATLF vs. C/E - 1



Thermal LEU Benchmarks ATFF vs. C/E - 1



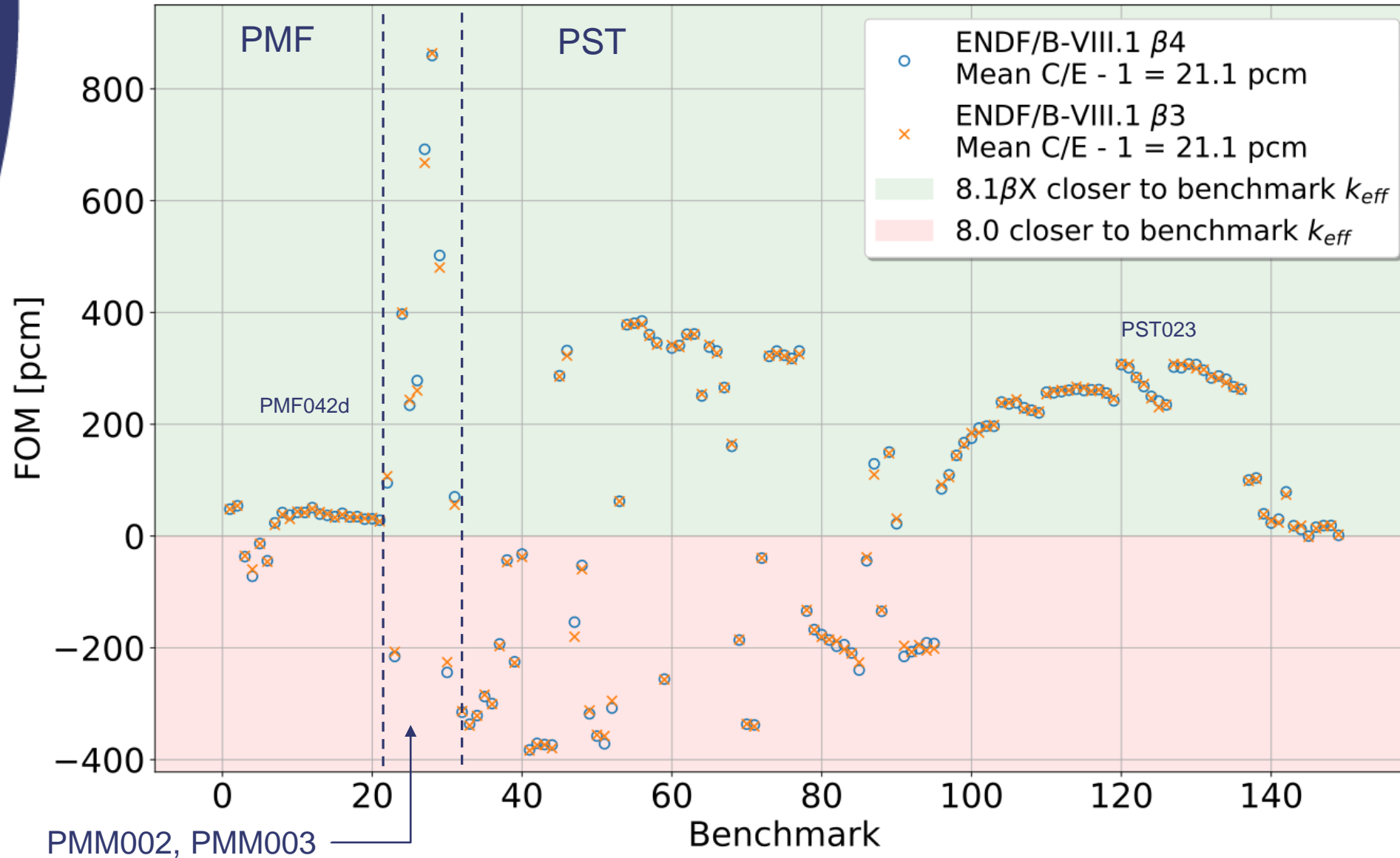
Pu Benchmarks Δk



PMM002, PMM003

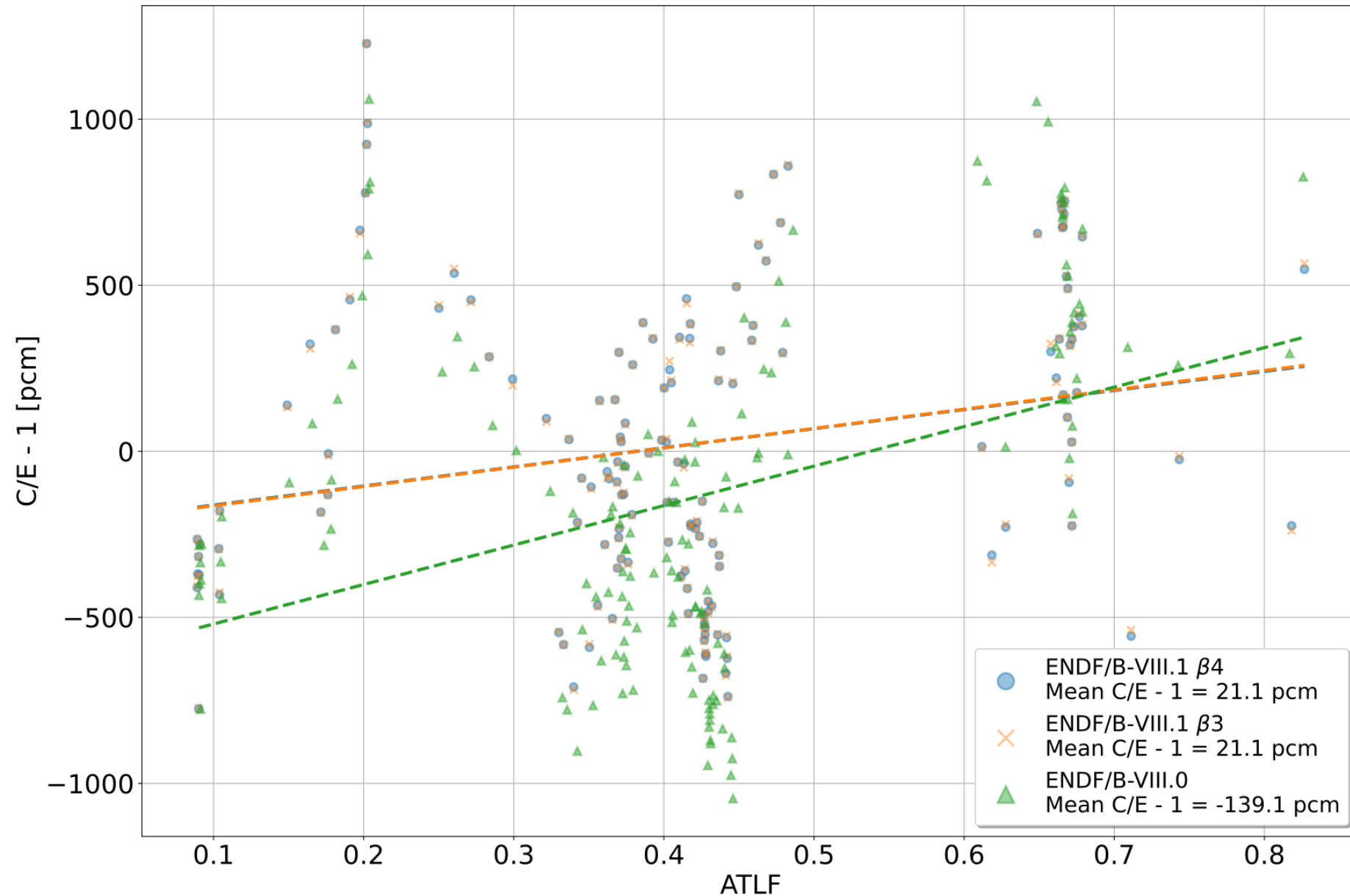
- PST:
- PST001 (6)
 - PST002 (7)
 - PST003 (7)
 - PST004 (13)
 - PST005 (9)
 - PST006 (3)
 - PST018 (9)
 - PST022 (17)
 - PST023 (33)
 - PST038 (5)
 - PST039 (8)

Pu Benchmarks $\Delta|C/E - 1|$

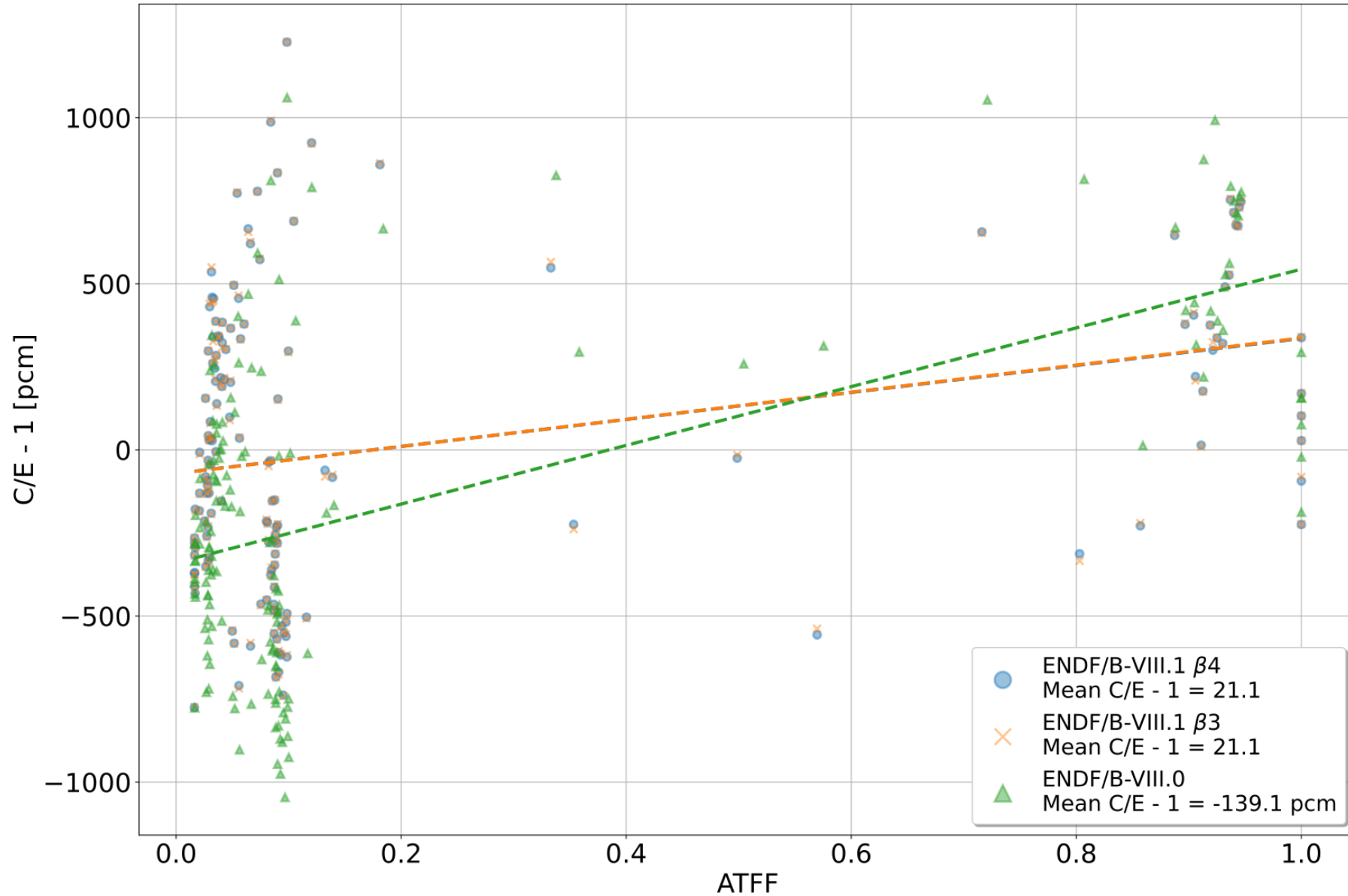


- PST:**
- PST001 (6)
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 - PST004 (13)
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 - PST018 (9)
 - PST022 (17)
 - PST023 (33)
 - PST038 (5)
 - PST039 (8)

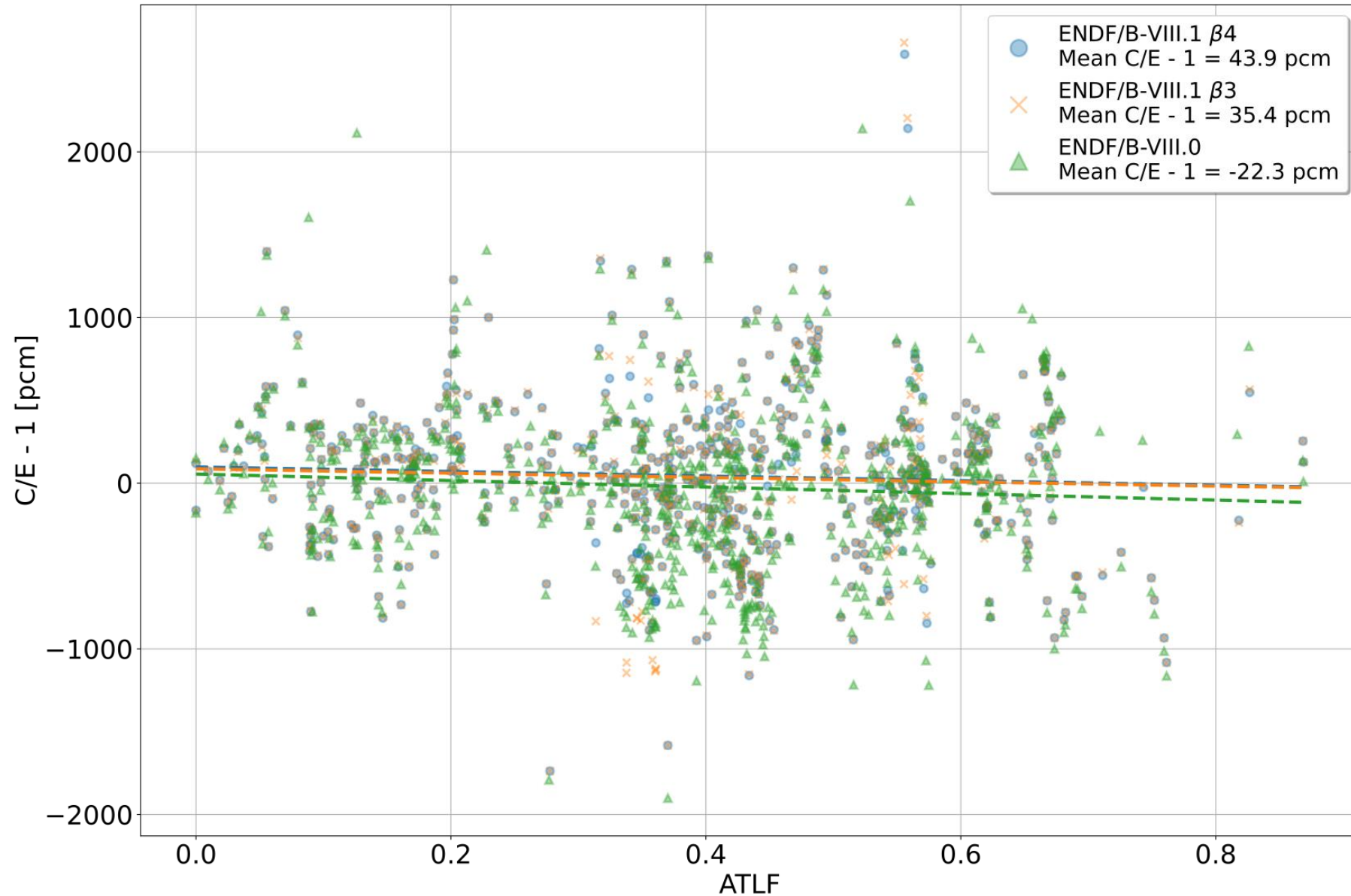
Pu Benchmarks ATLF vs. C/E - 1



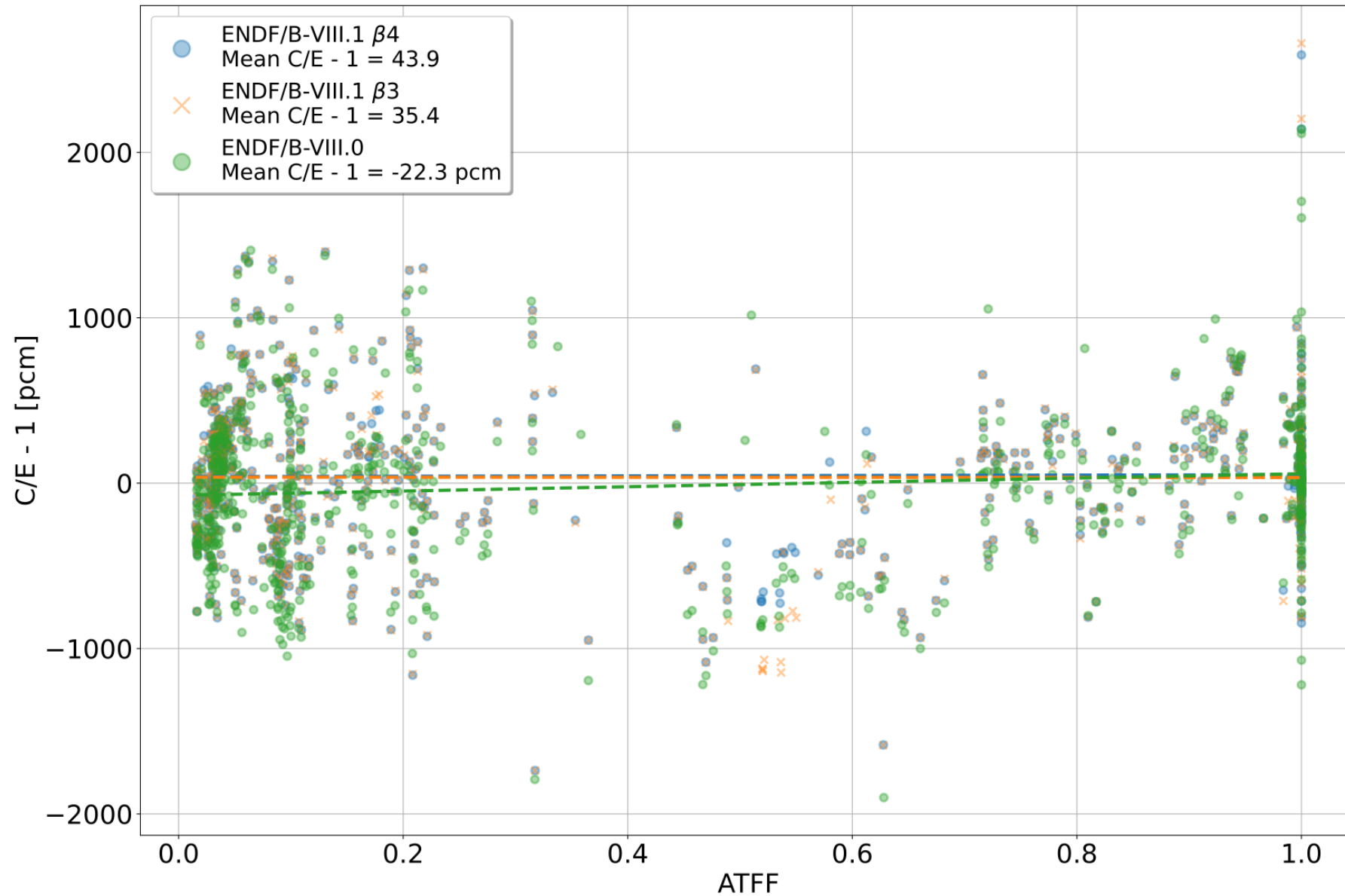
Pu Benchmarks ATFF vs. C/E - 1



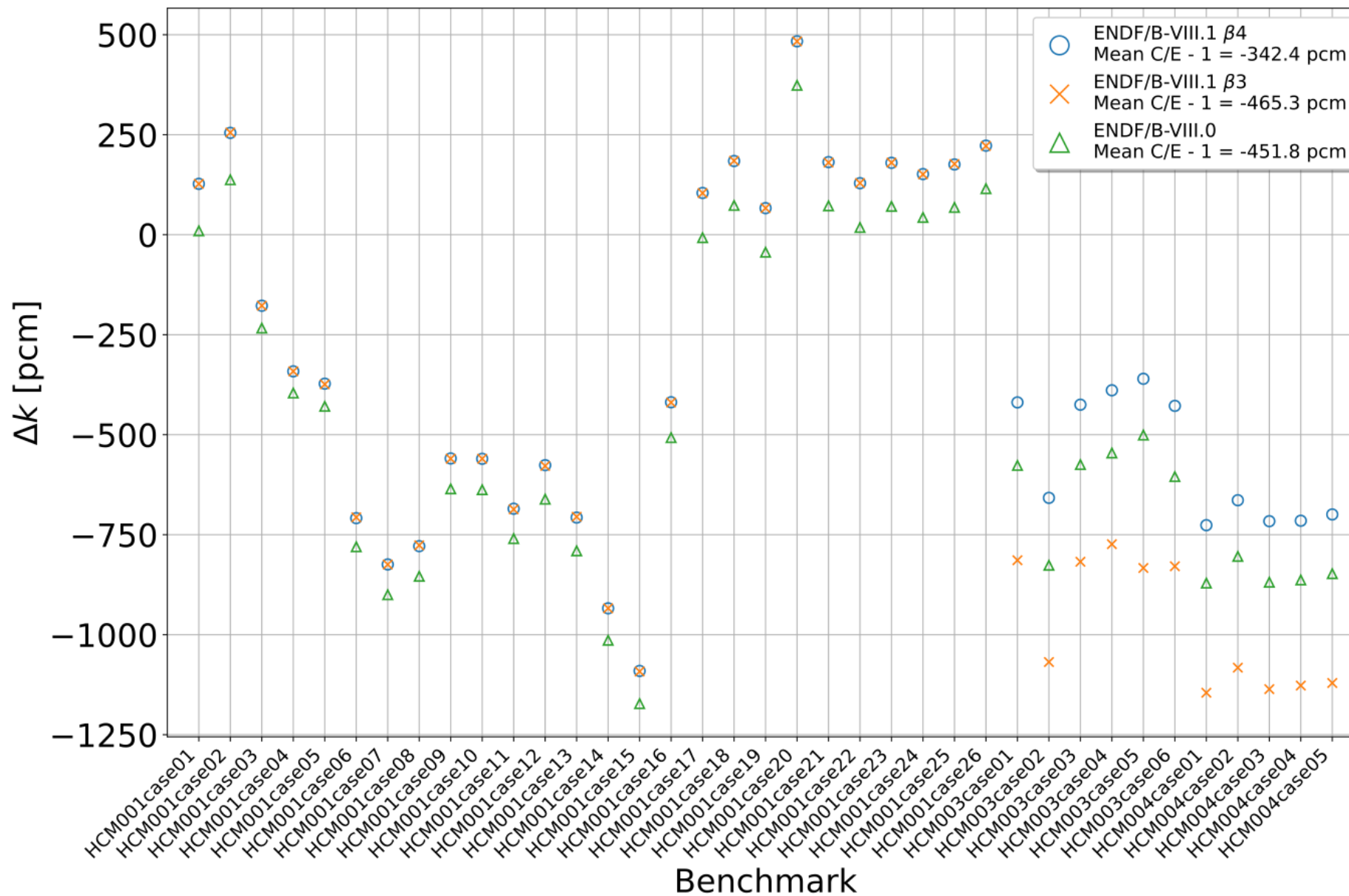
All Benchmarks ATLF vs. C/E - 1



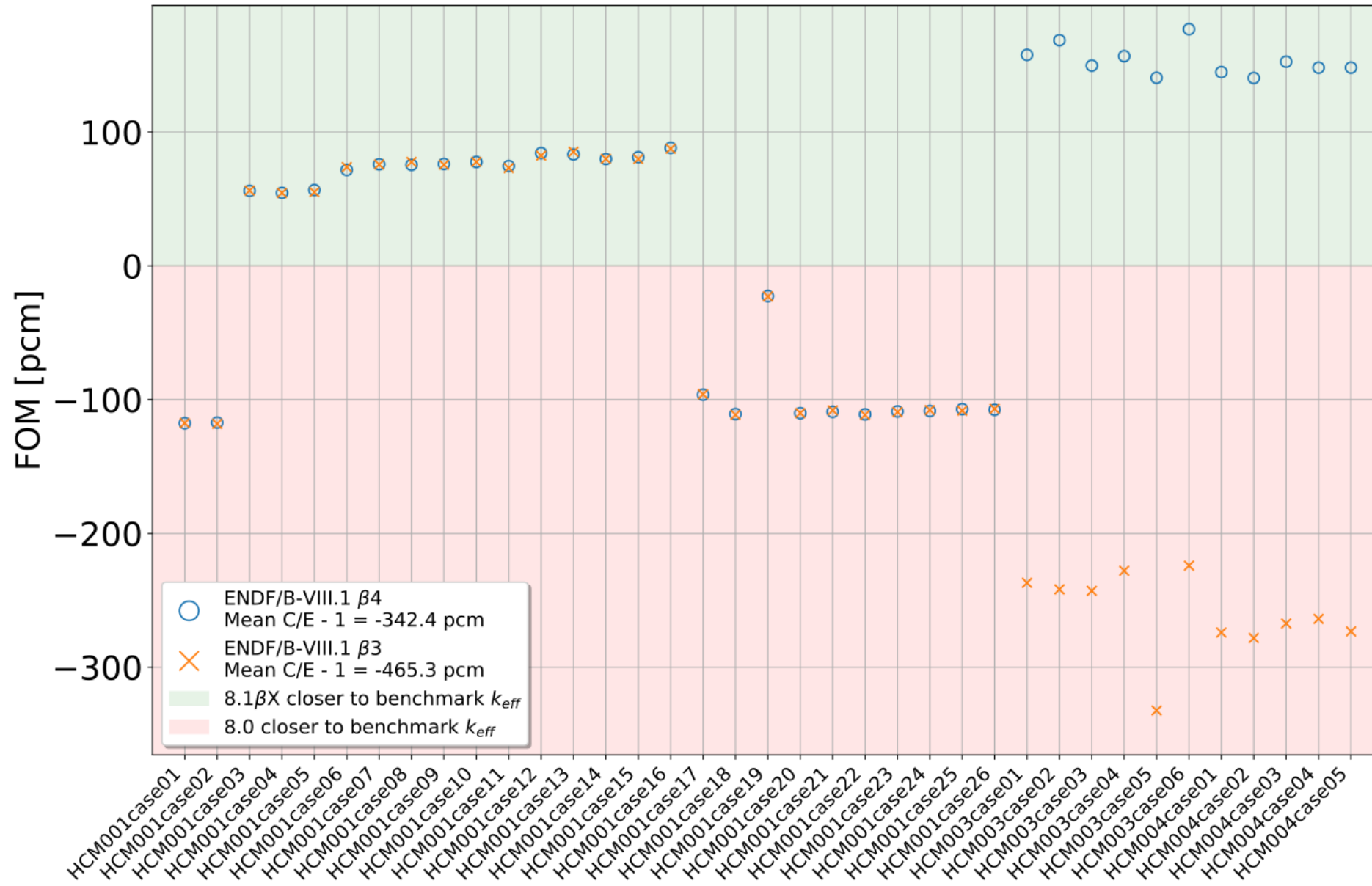
All Benchmarks ATFF vs. C/E - 1



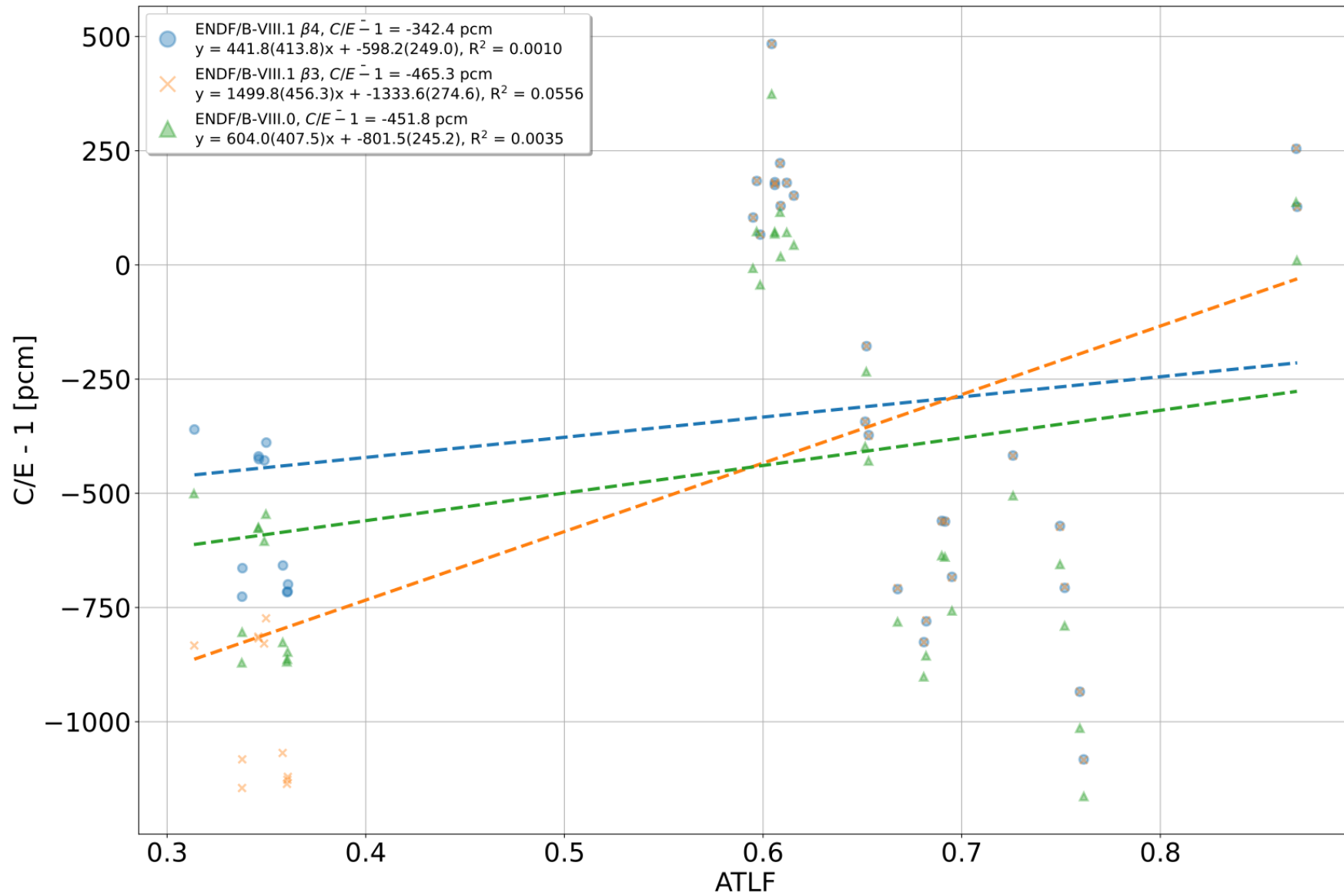
HCM Benchmarks Δk



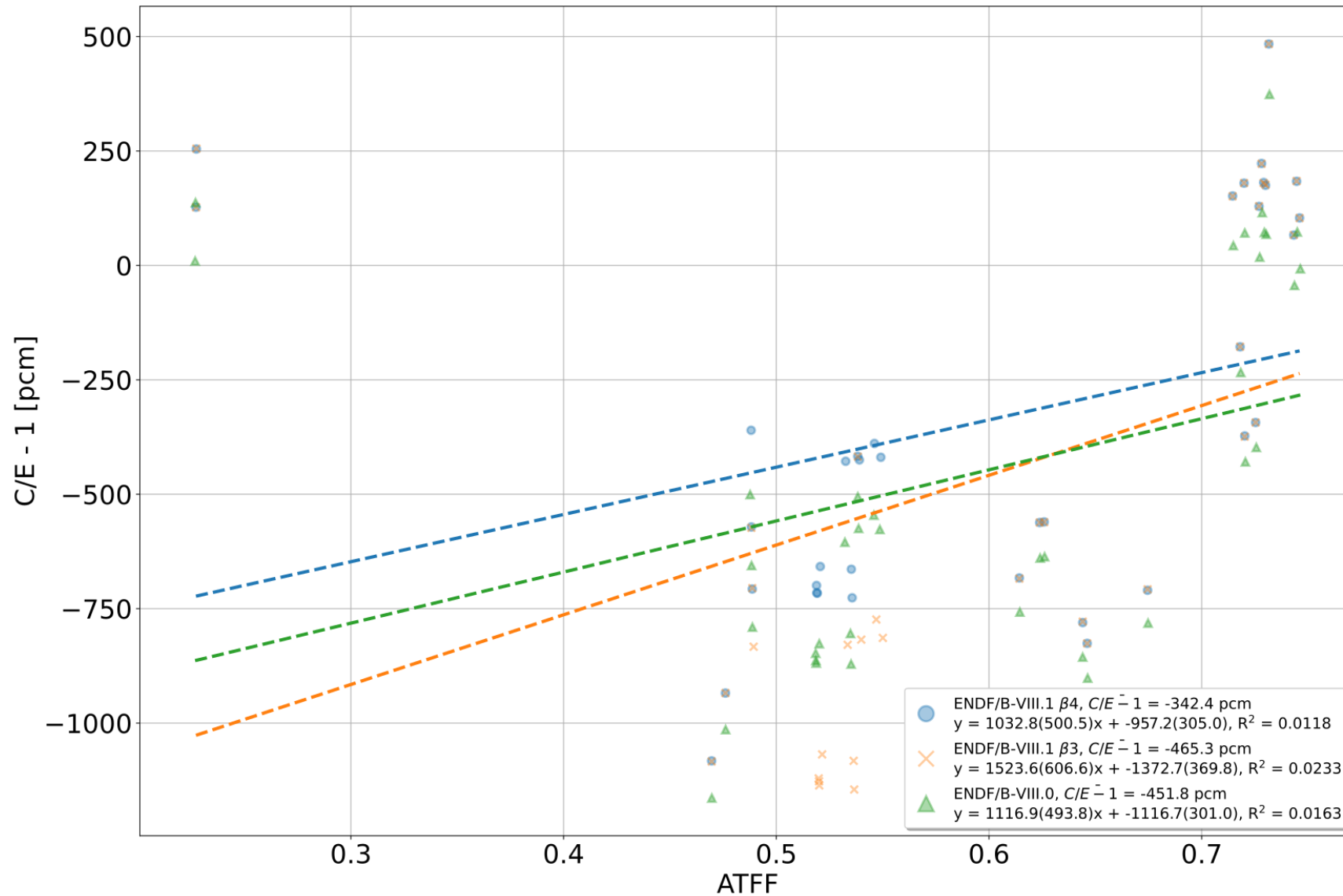
HCM Benchmarks FOM



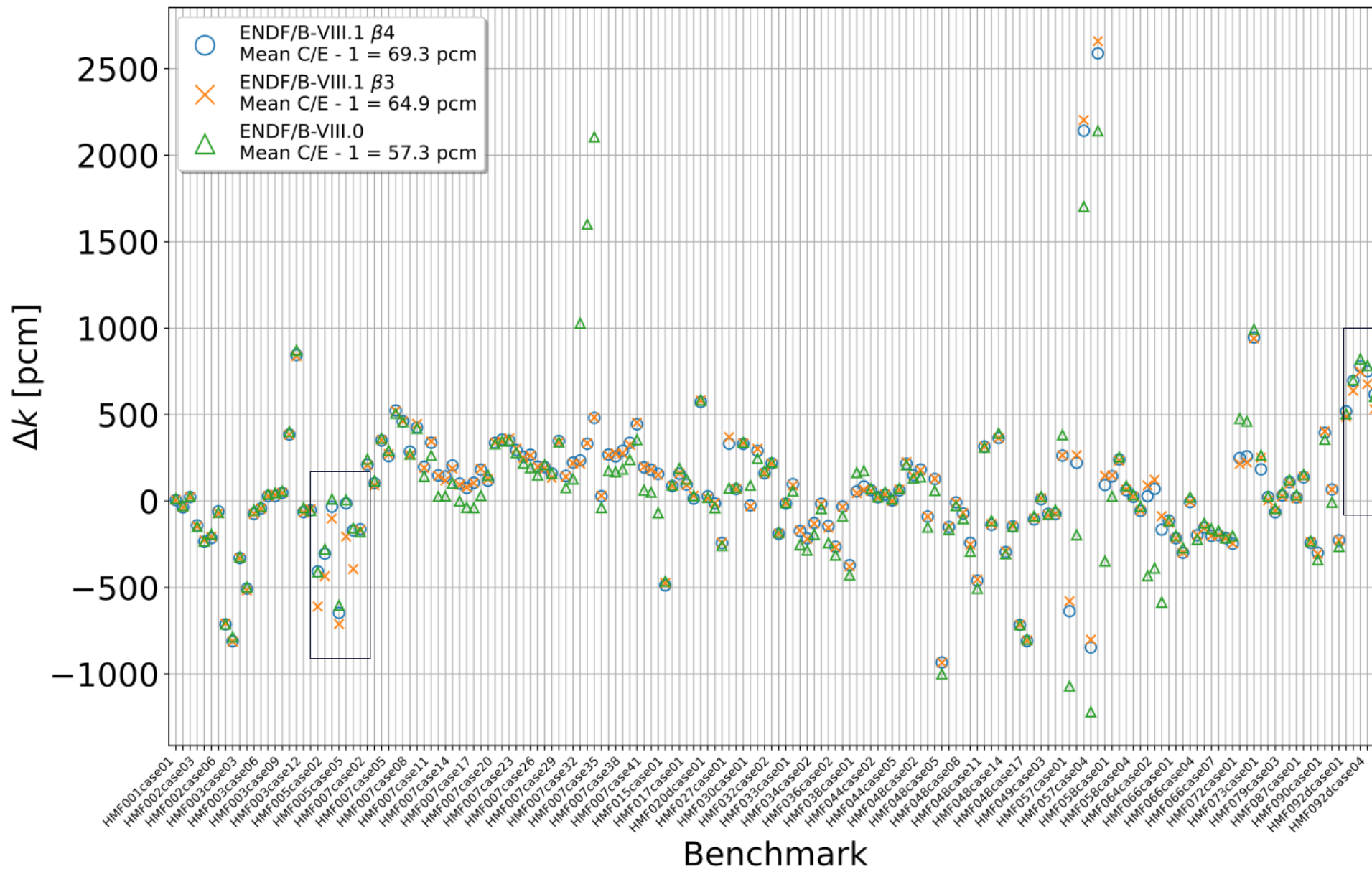
HCM Benchmarks ATLF vs. C/E - 1



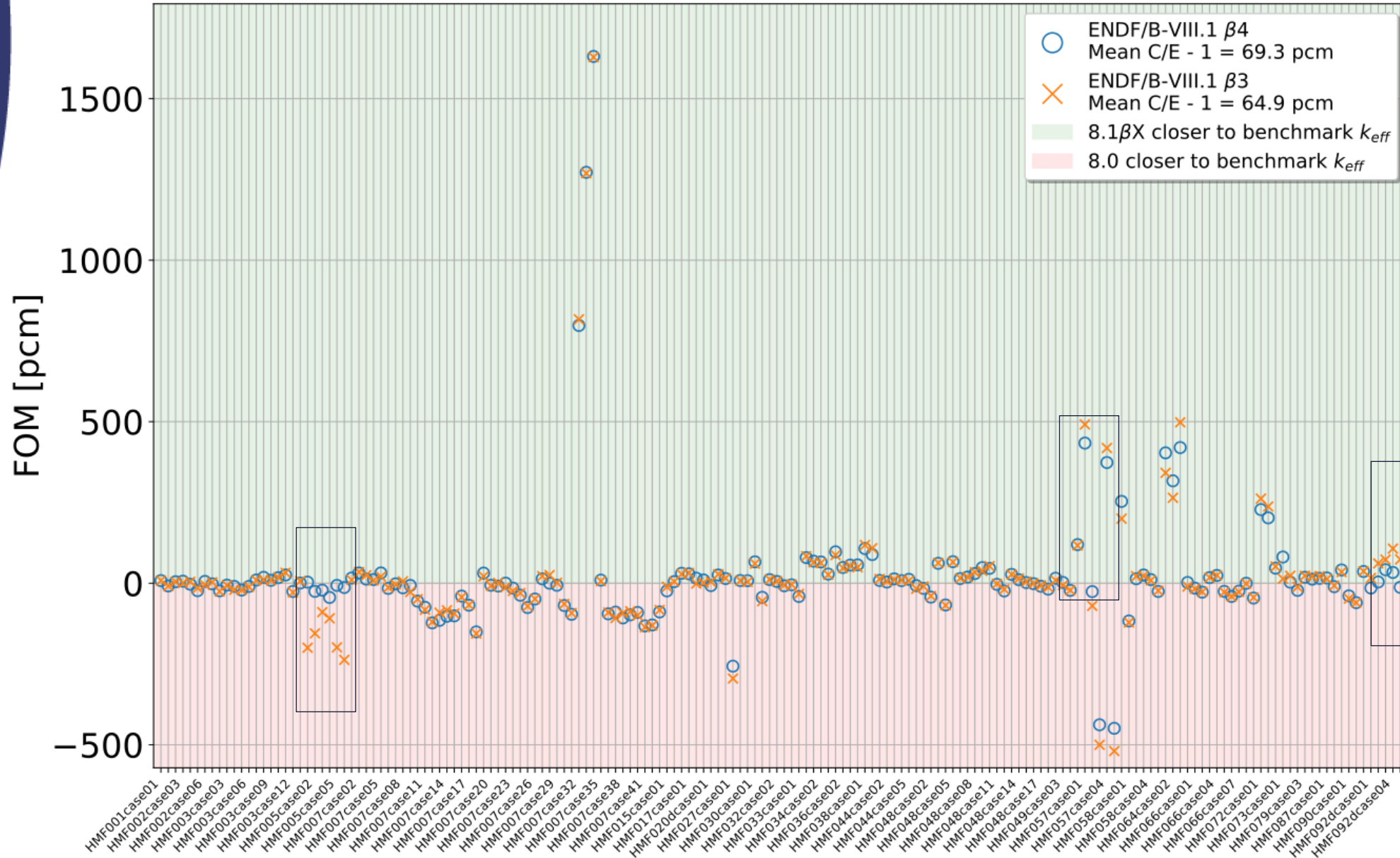
HCM Benchmarks ATFF vs. C/E - 1



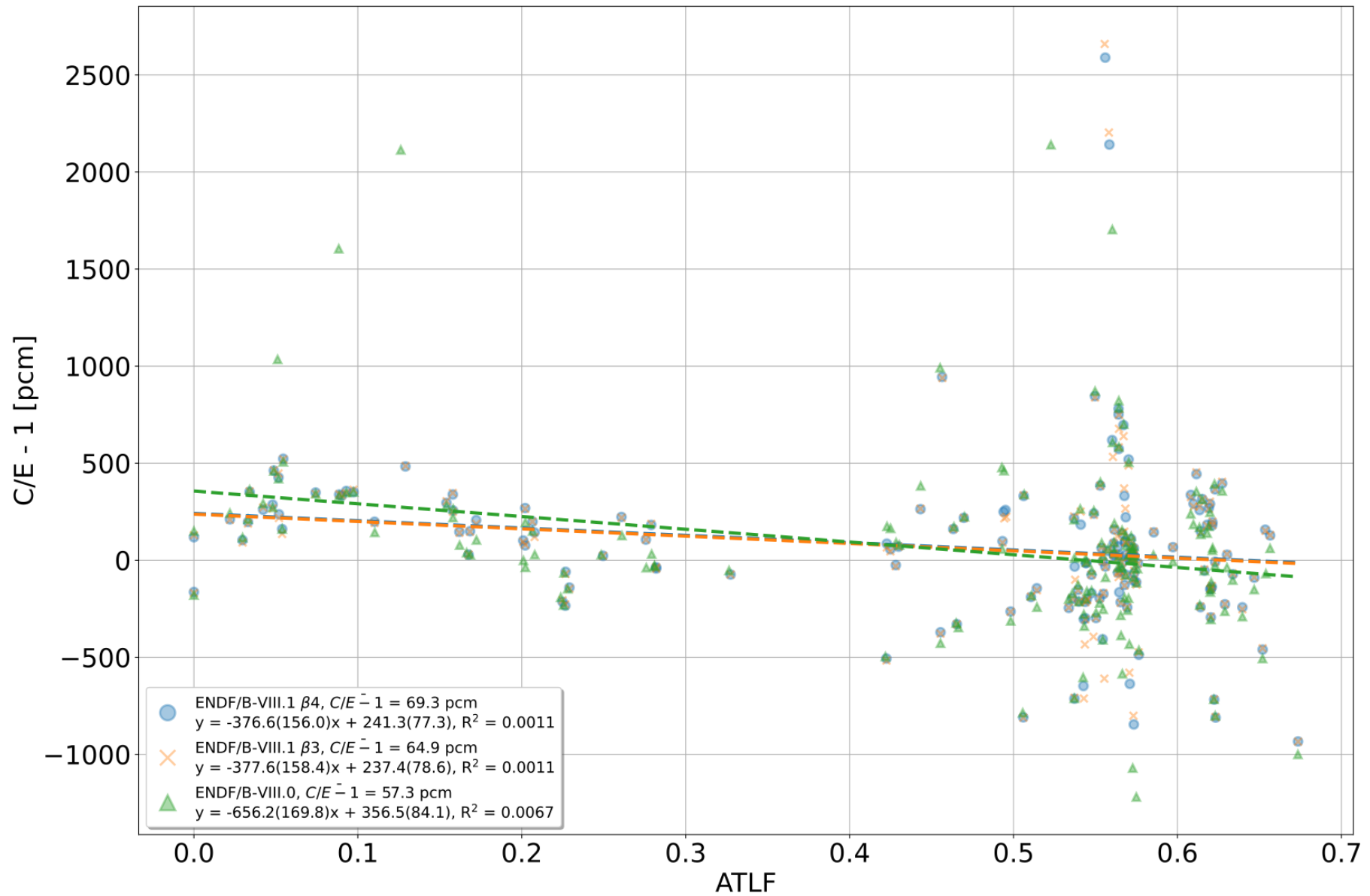
HMF Benchmarks Δk



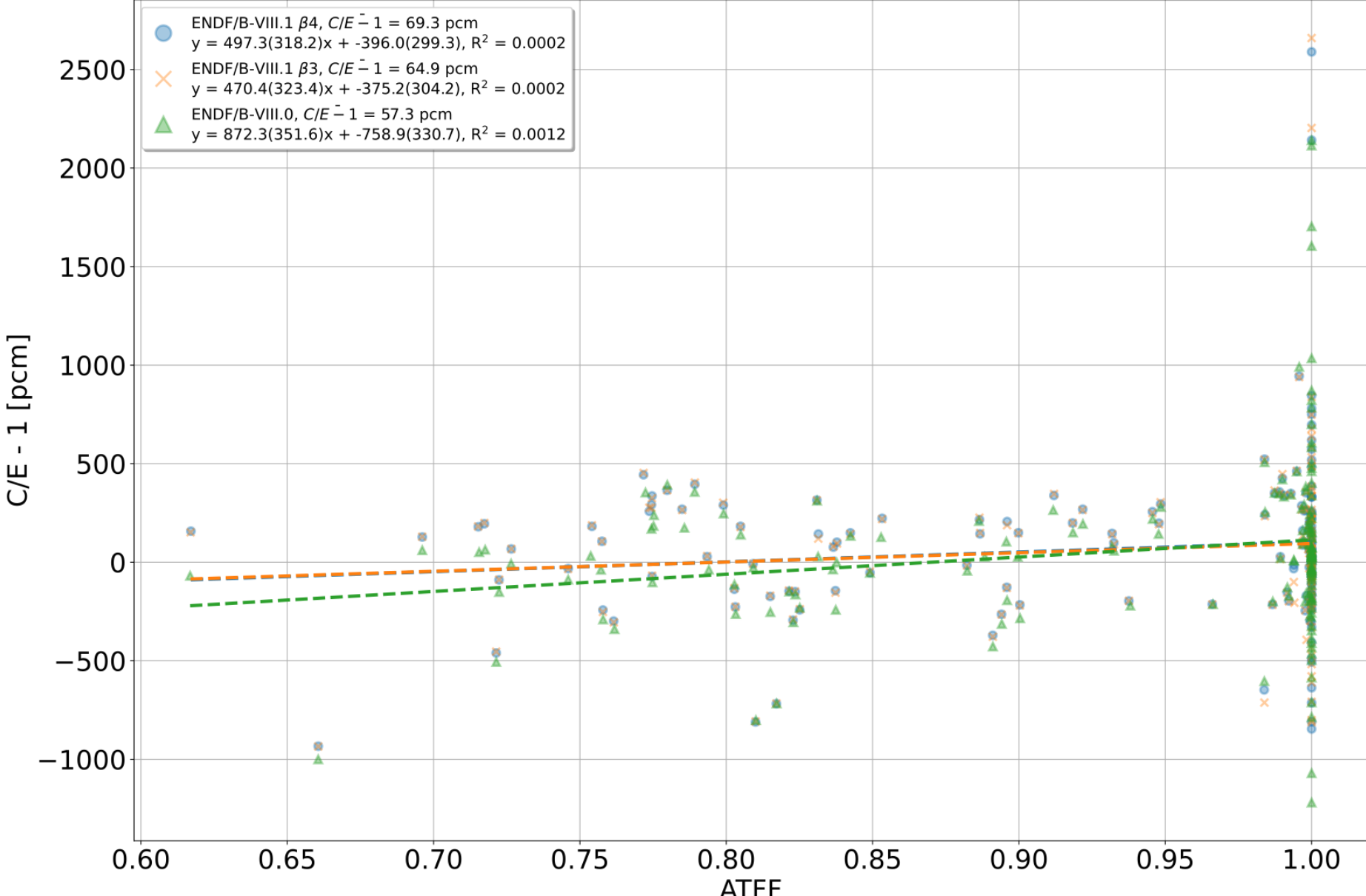
HMF Benchmarks FOM



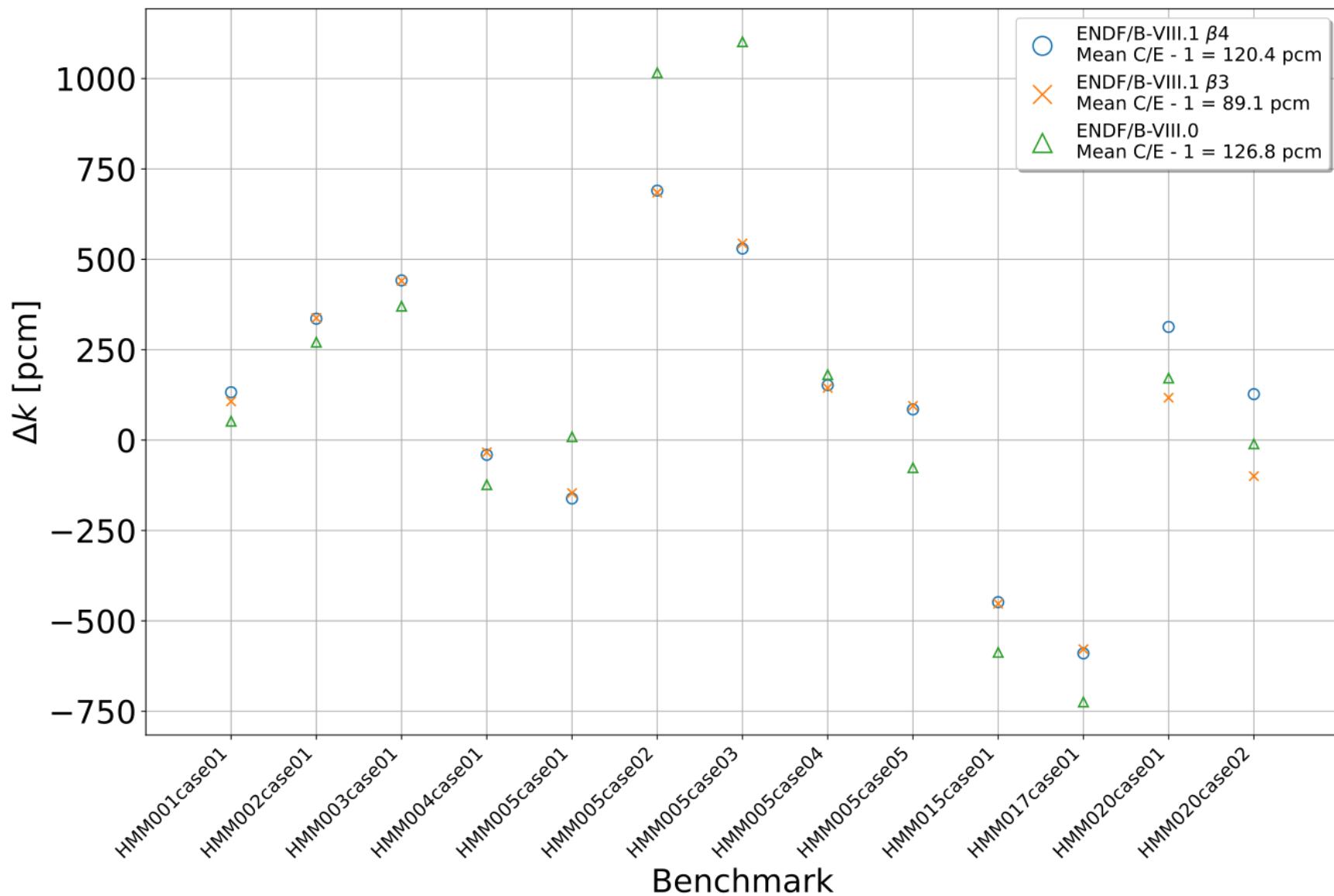
HMF Benchmarks ATLF vs. C/E - 1



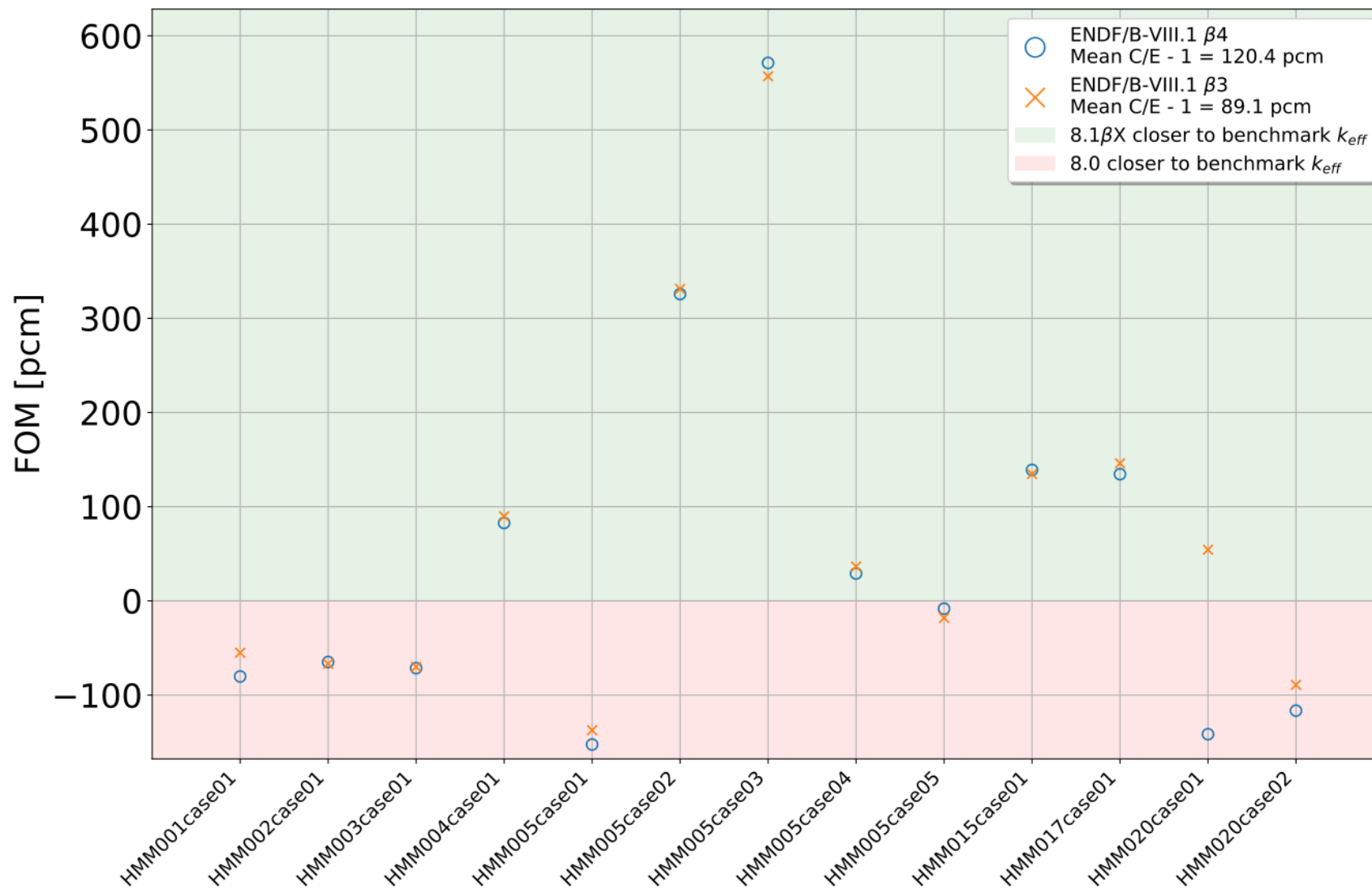
HMF Benchmarks ATFF vs. C/E - 1



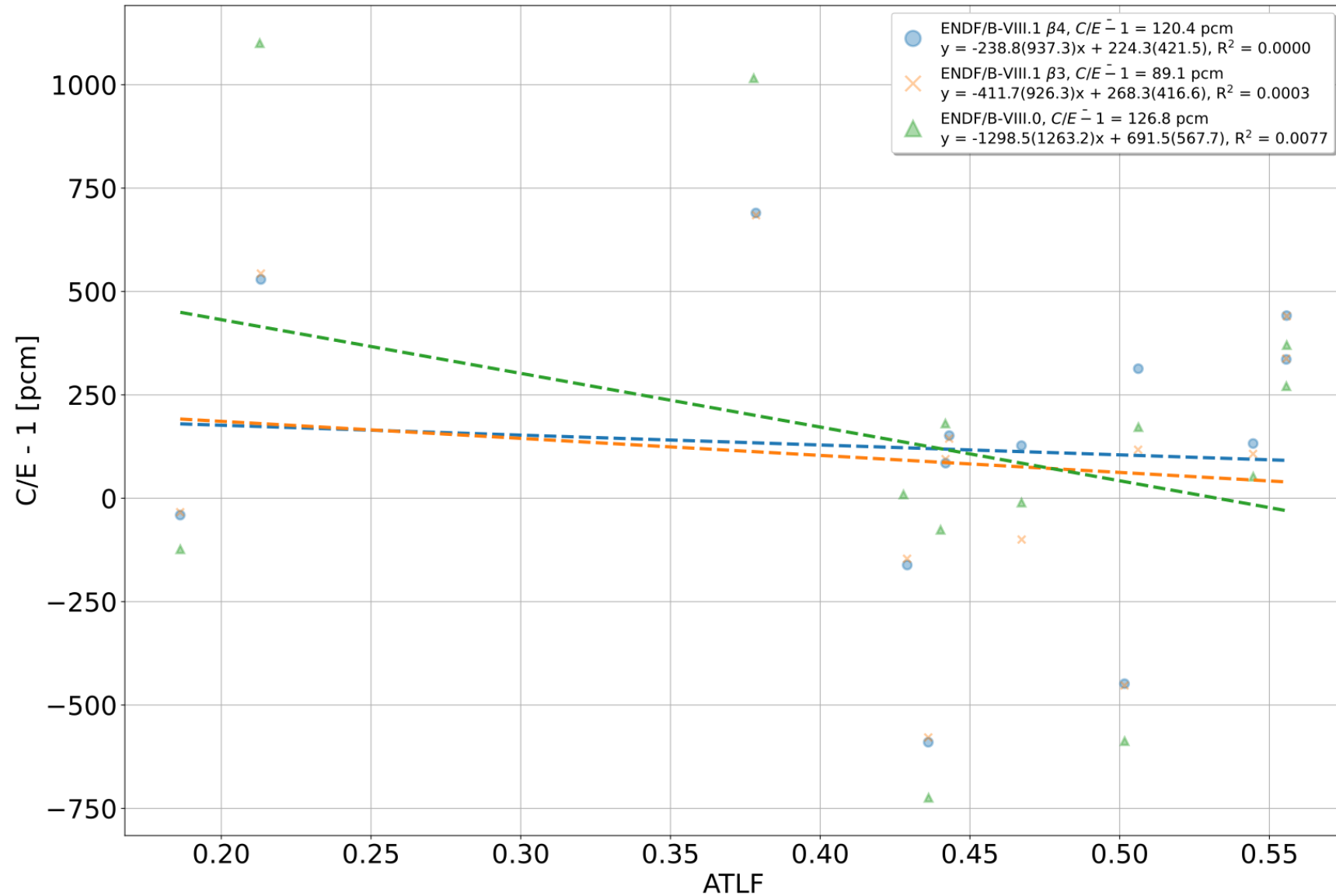
HMM Benchmarks Δk



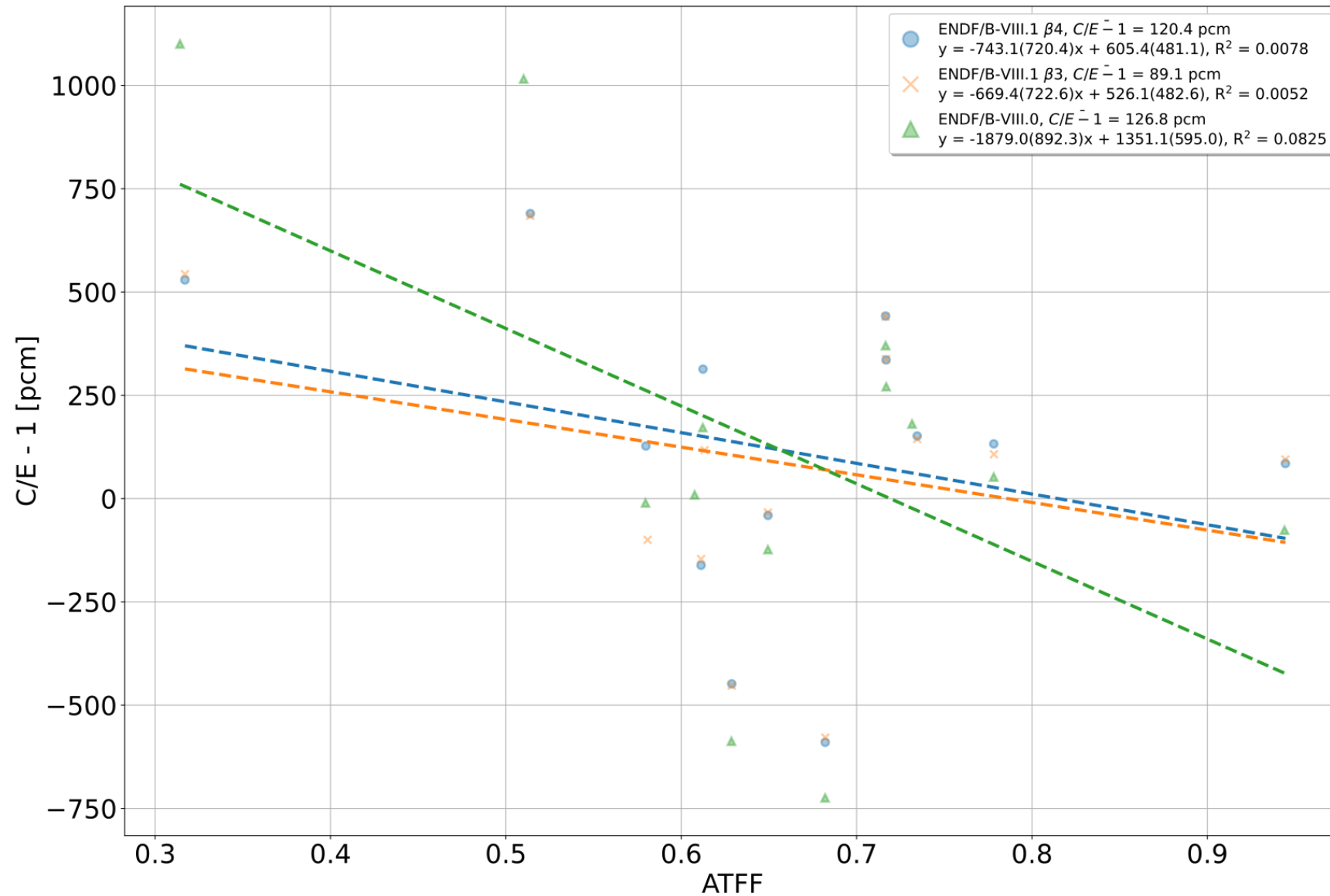
HMM Benchmarks FOM



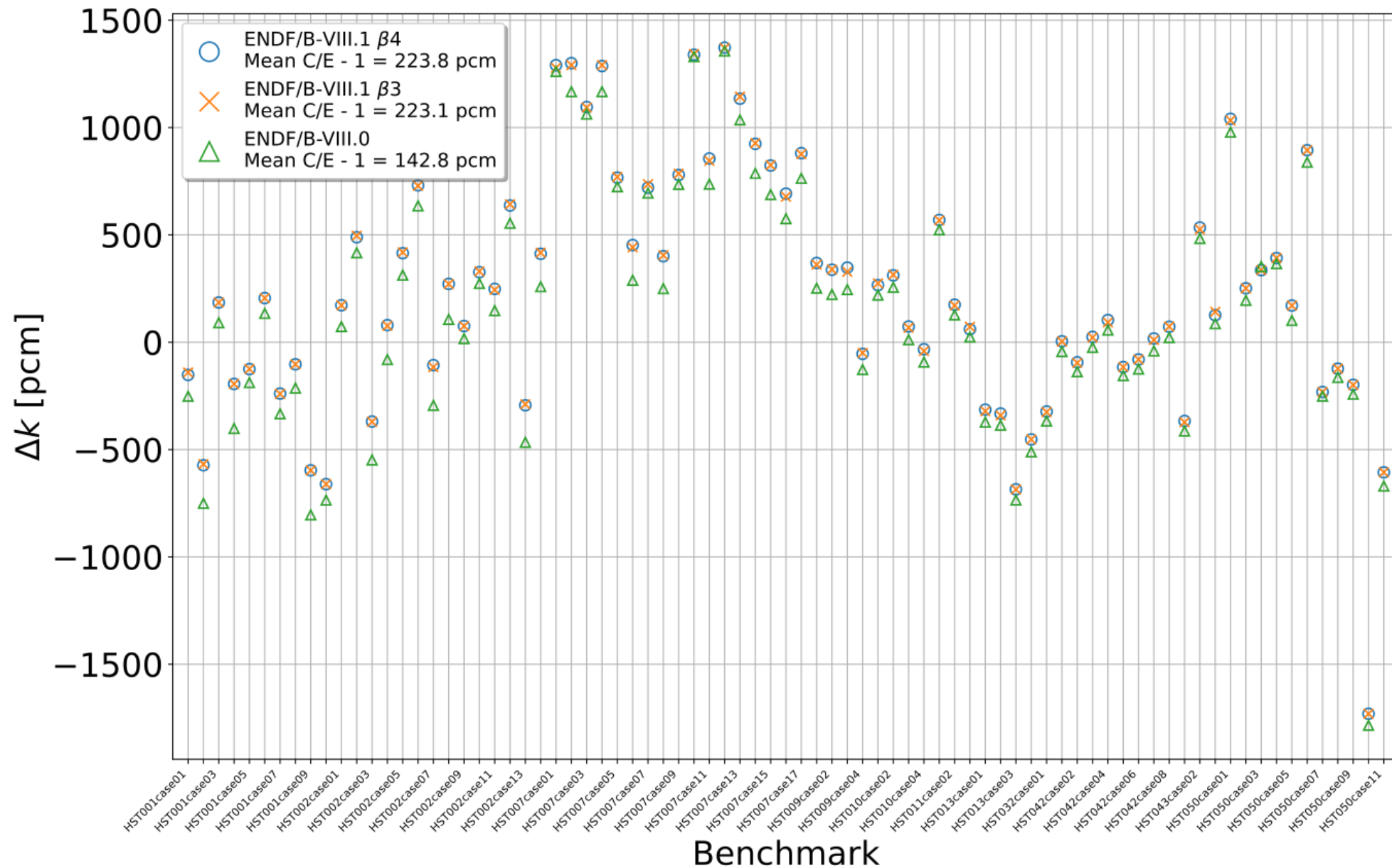
HMM Benchmarks ATLF vs. C/E - 1



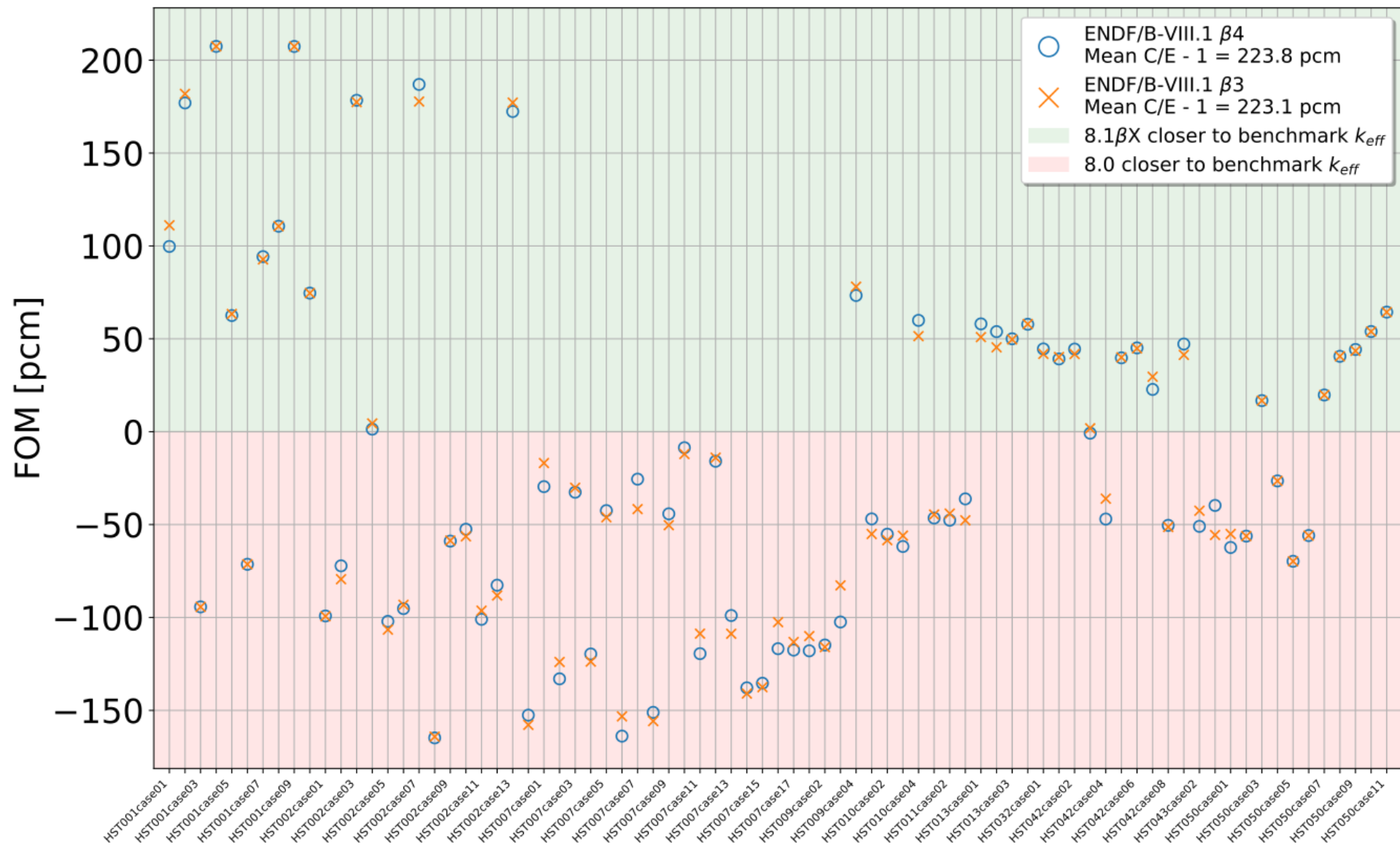
HMF Benchmarks ATFF vs. C/E - 1



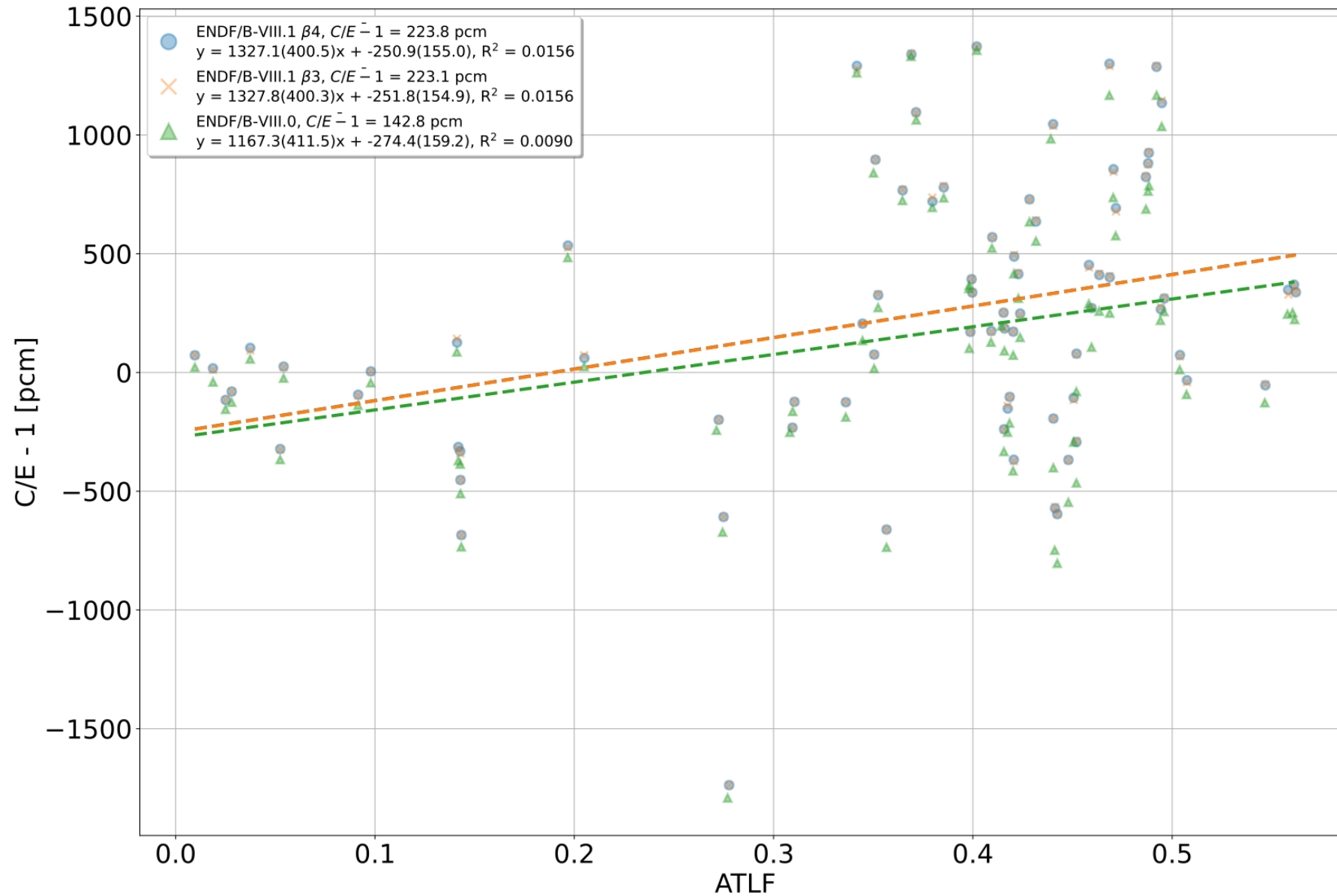
HST Benchmarks Δk



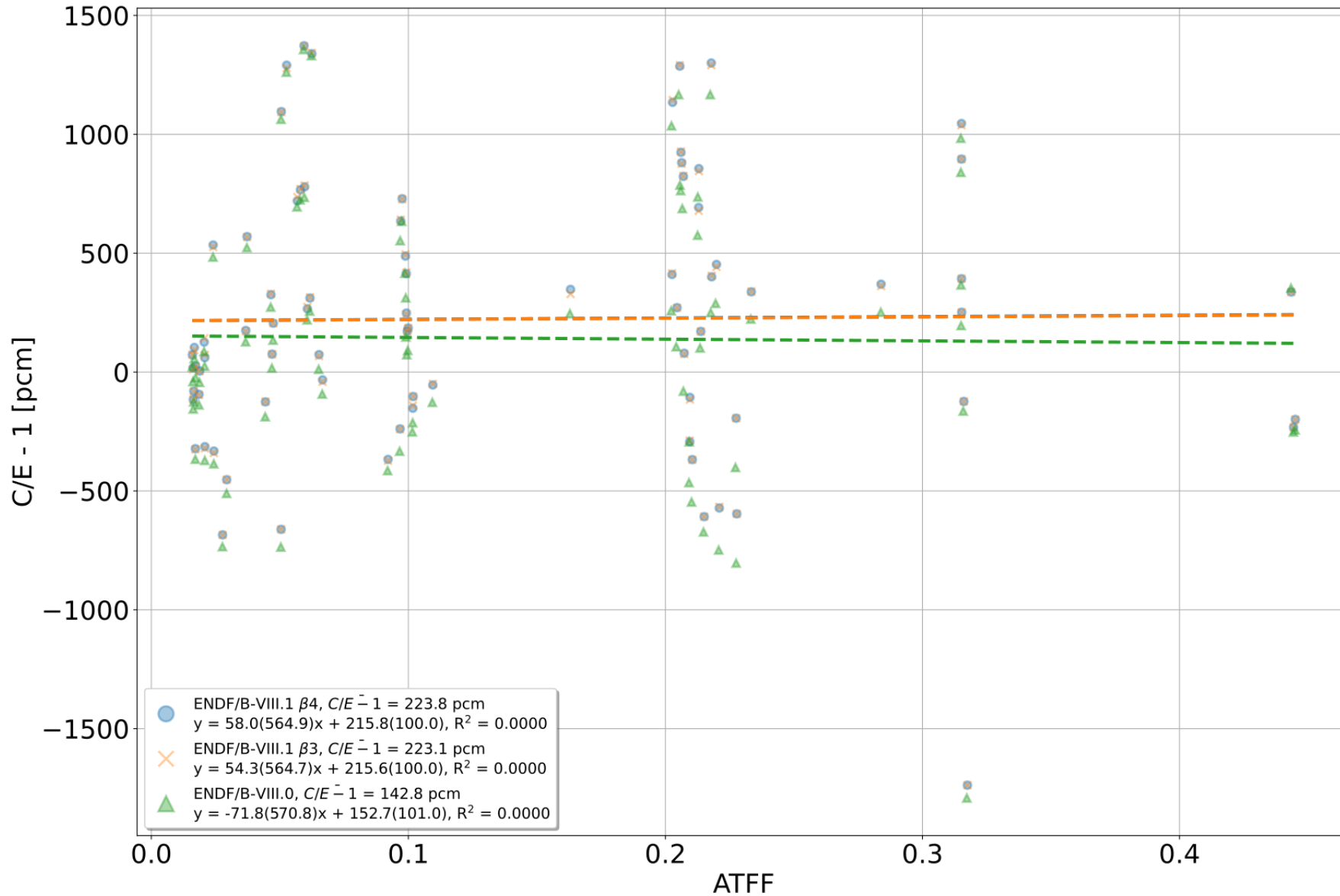
HST Benchmarks FOM



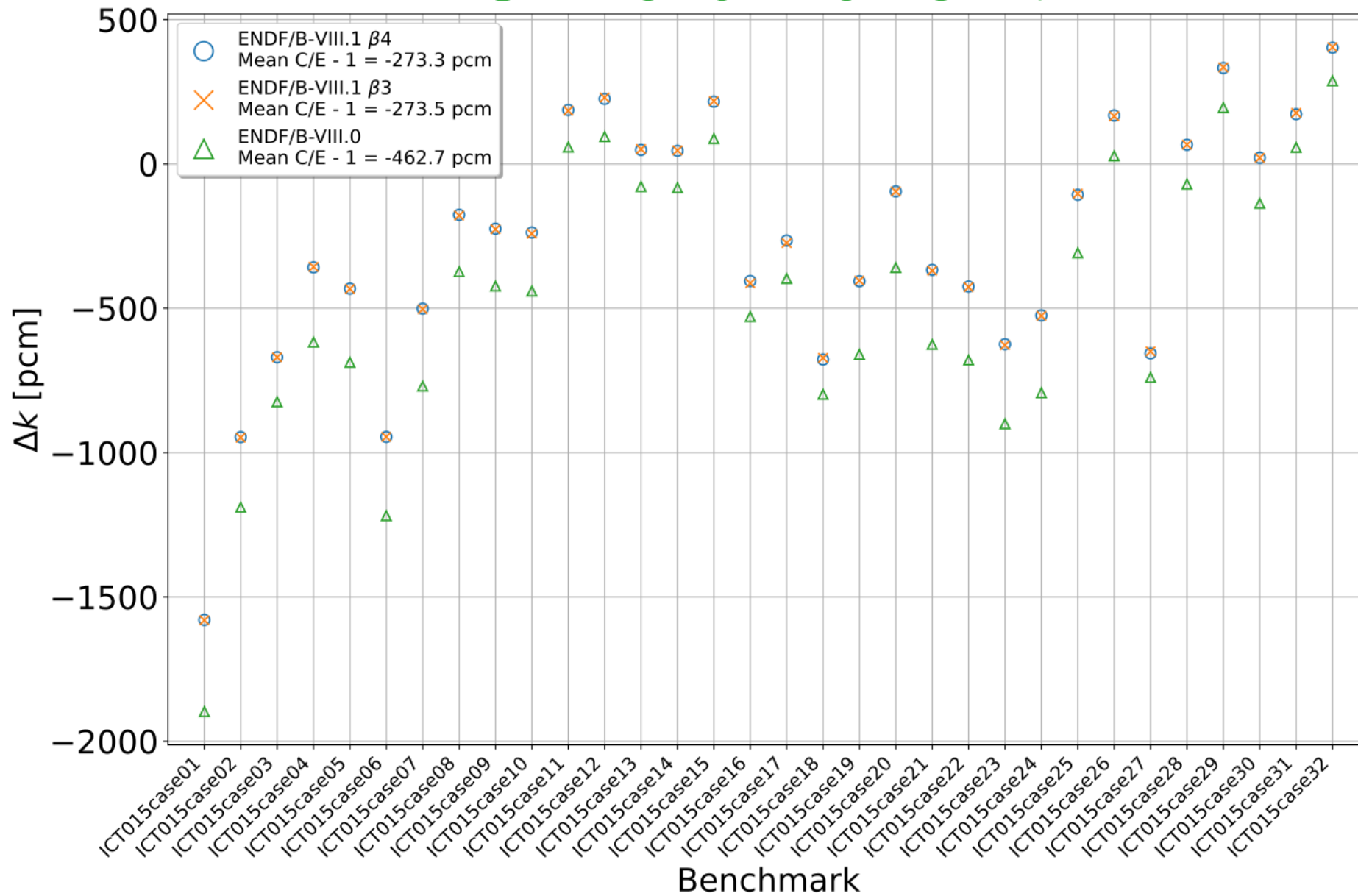
HST Benchmarks ATLF vs. C/E - 1



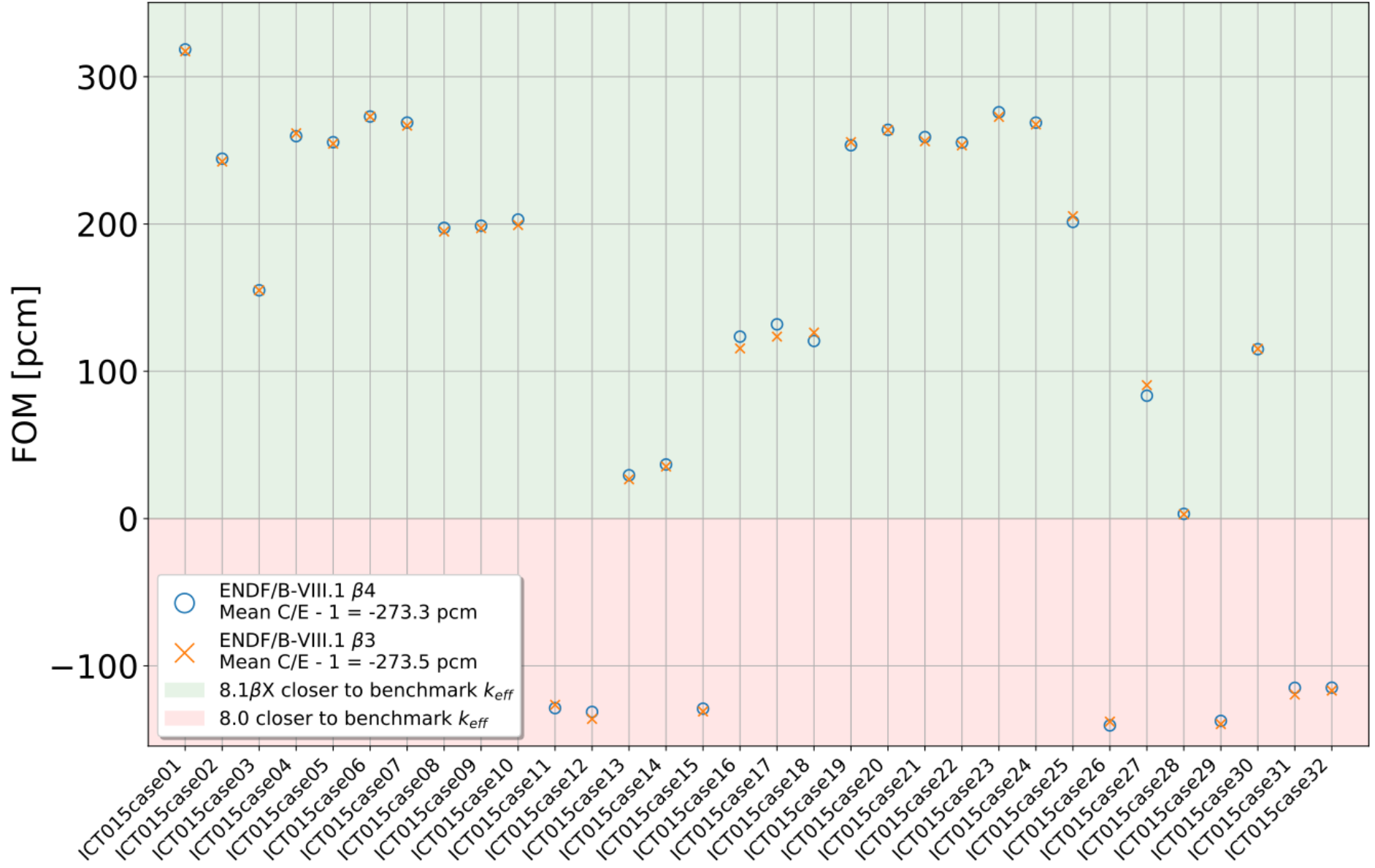
HST Benchmarks ATFF vs. C/E - 1



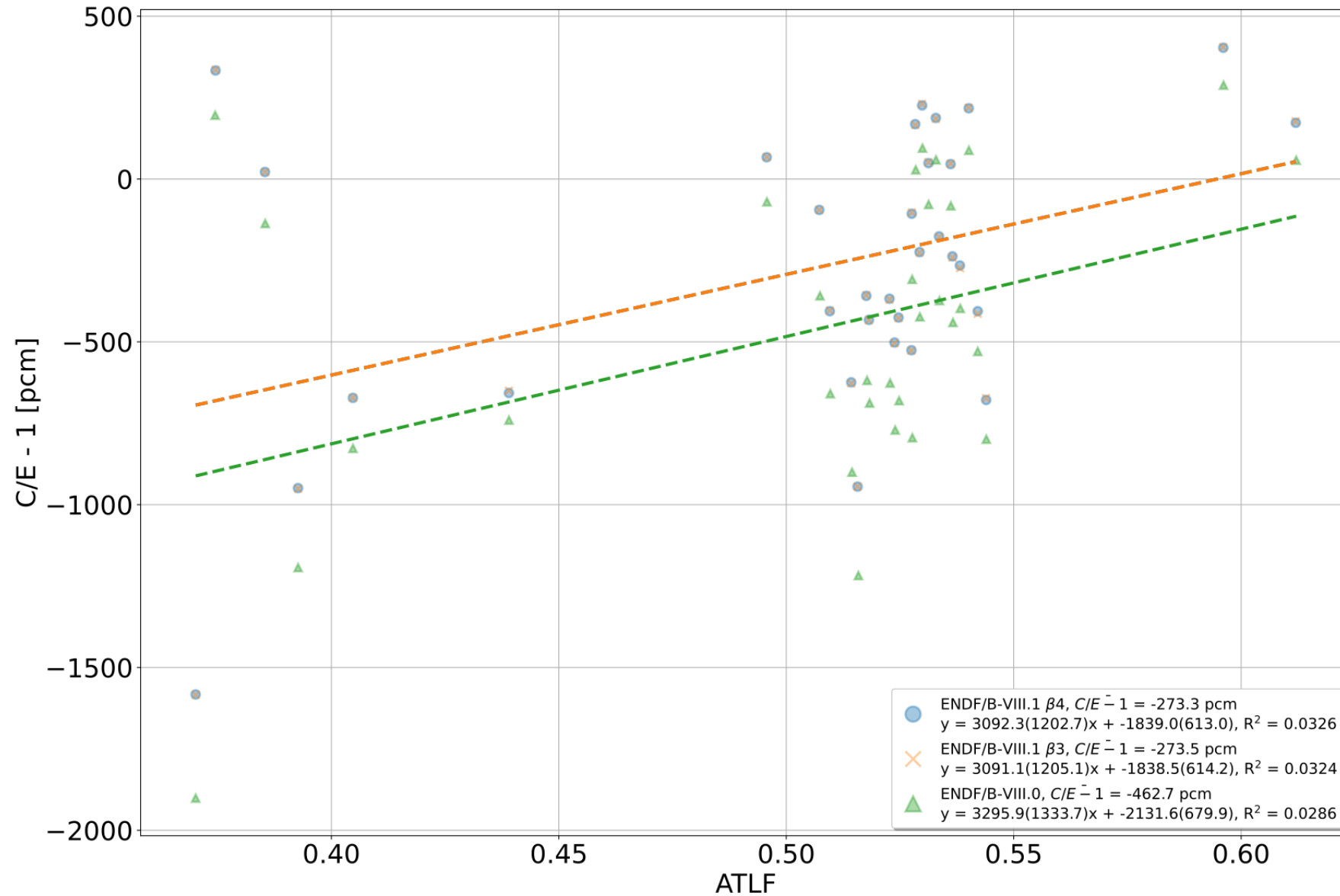
ICT Benchmarks Δk



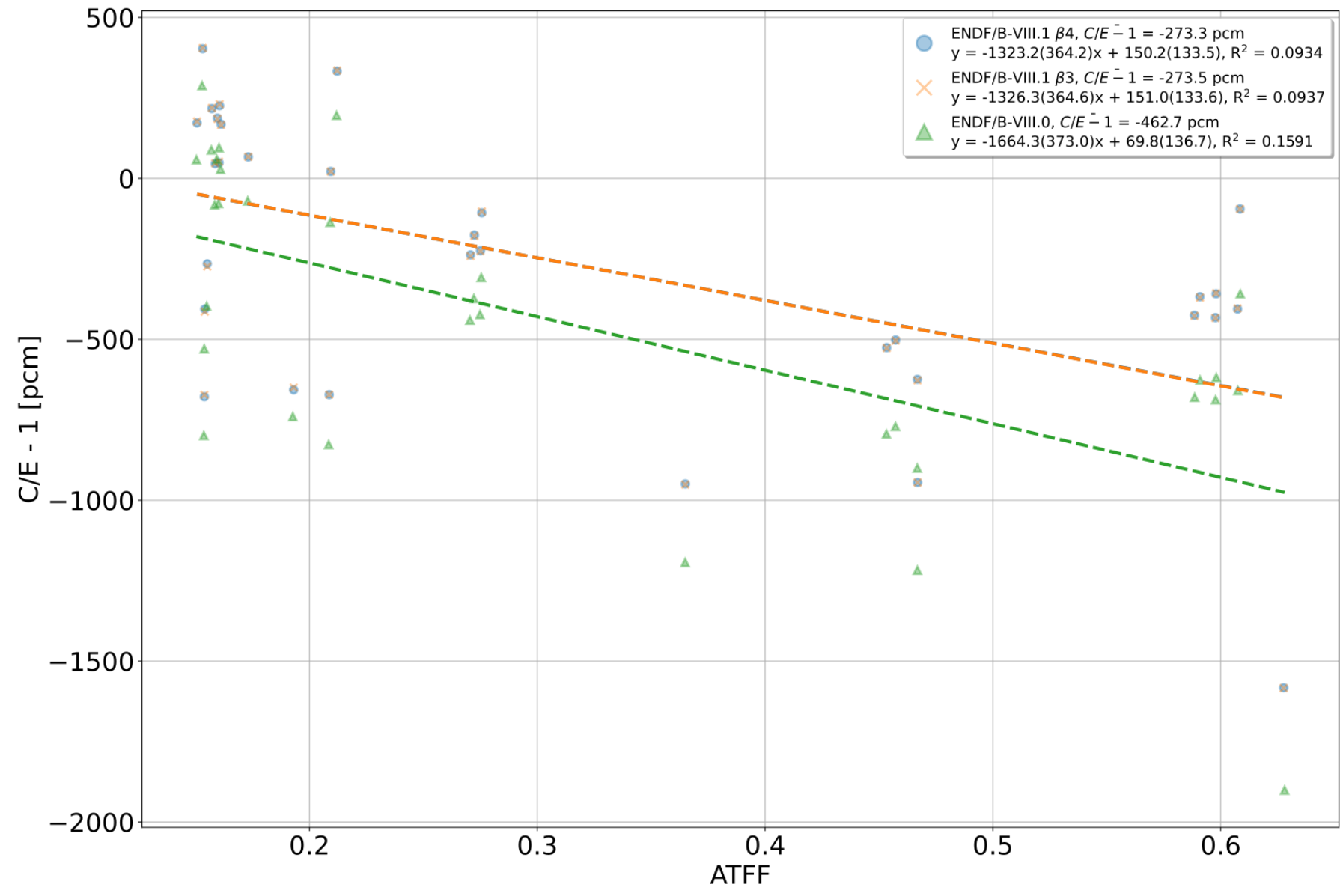
ICT Benchmarks FOM



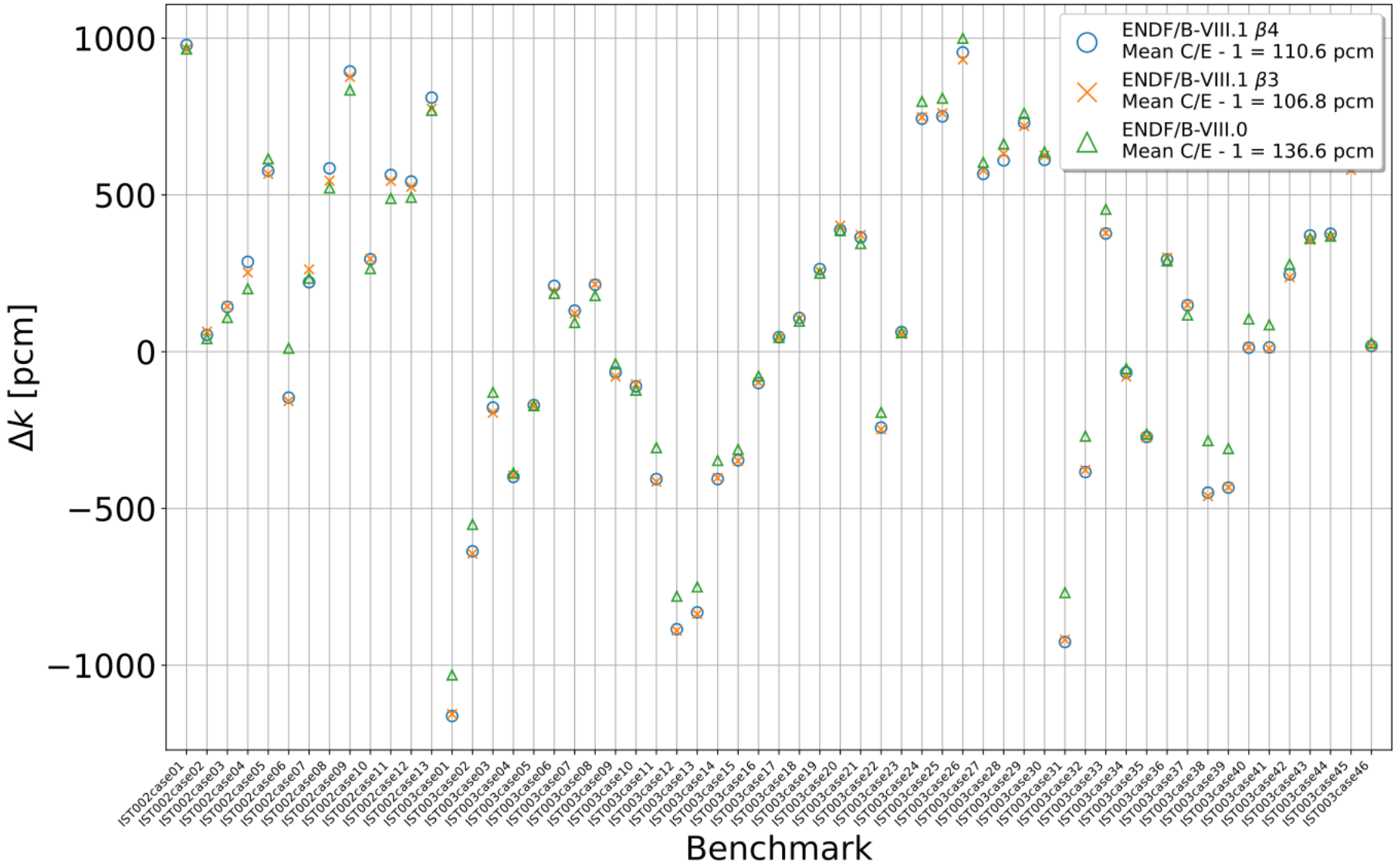
ICT Benchmarks ATLF vs. C/E - 1



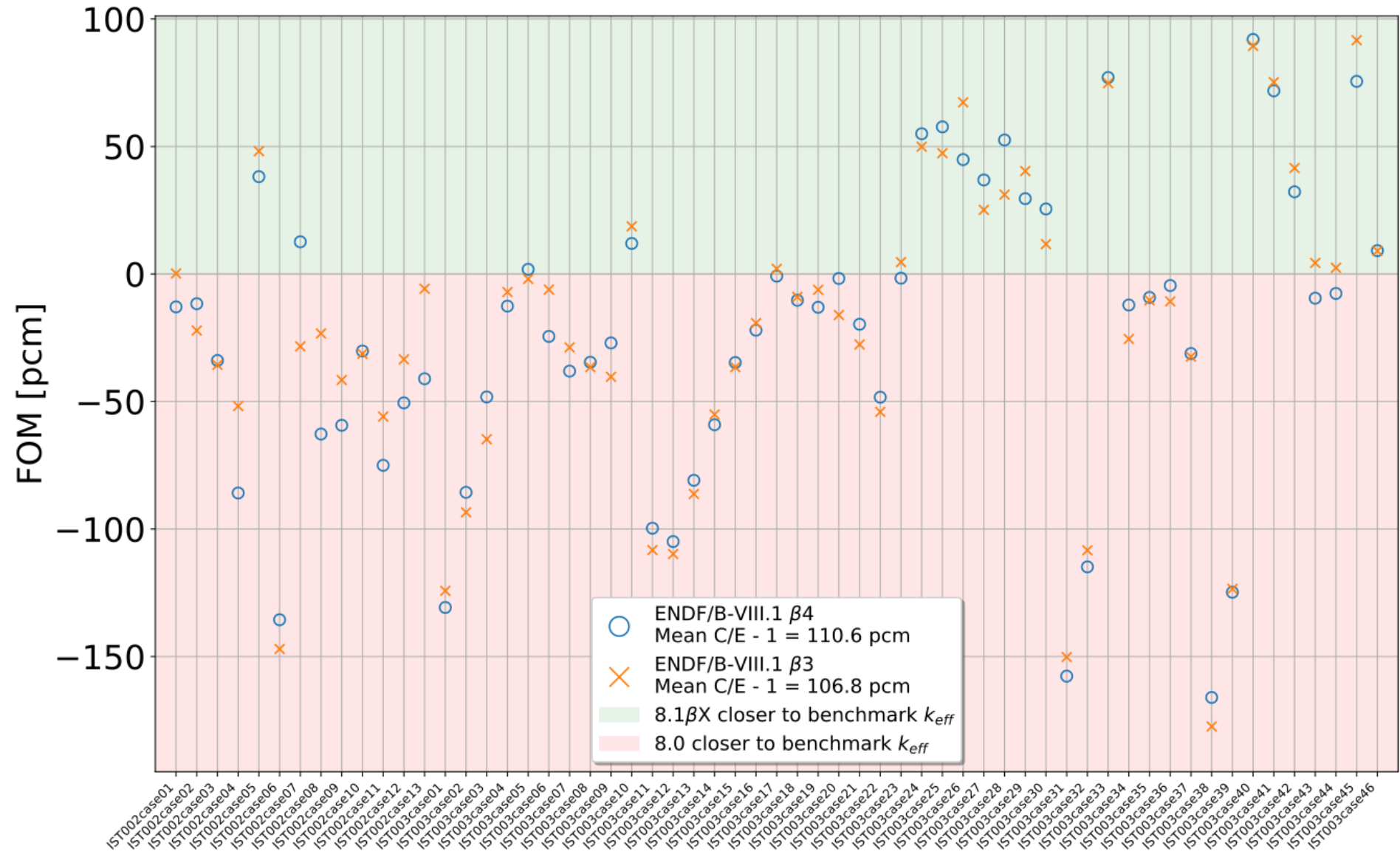
ICT Benchmarks ATFF vs. C/E - 1



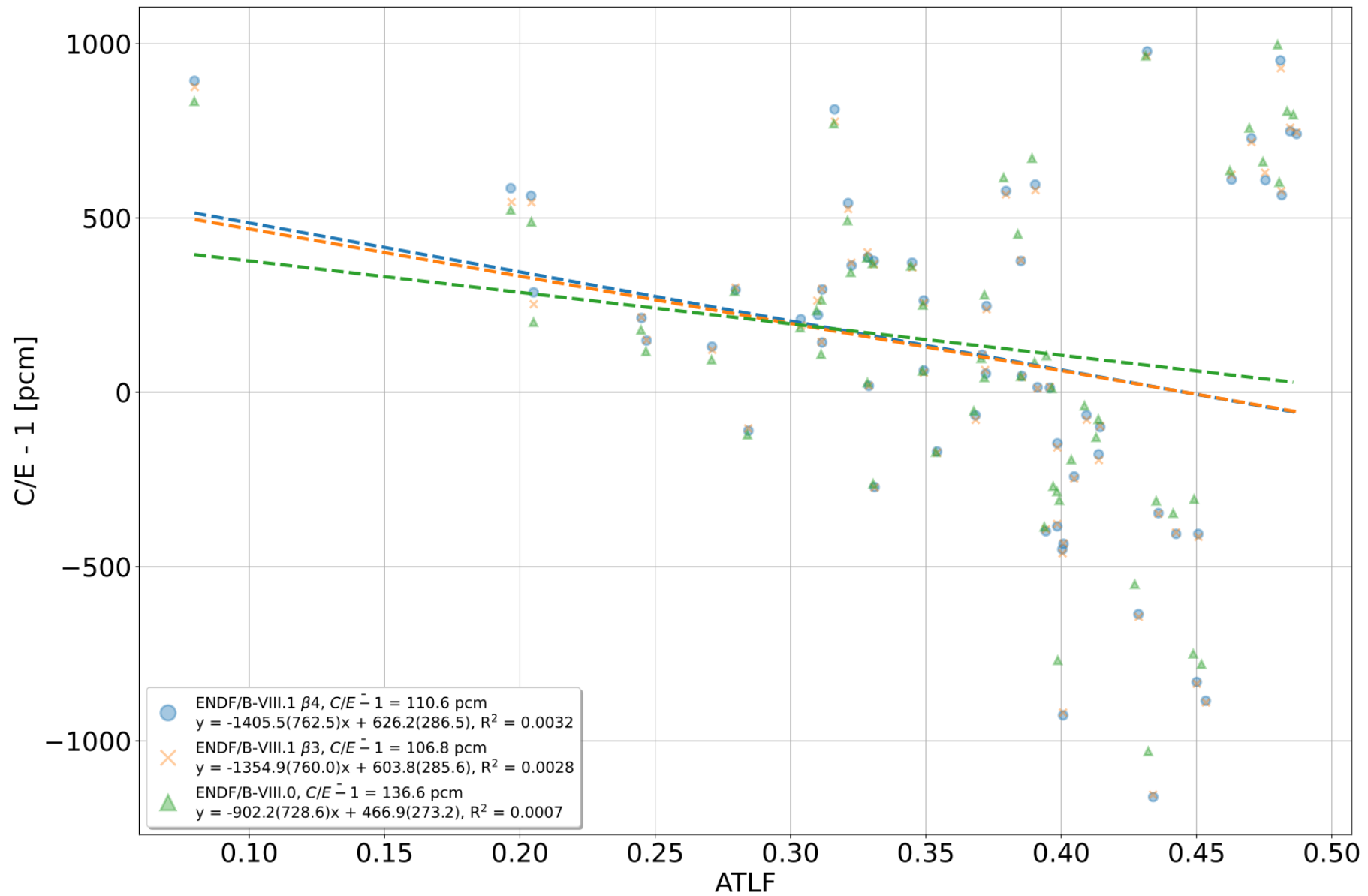
IST Benchmarks Δk



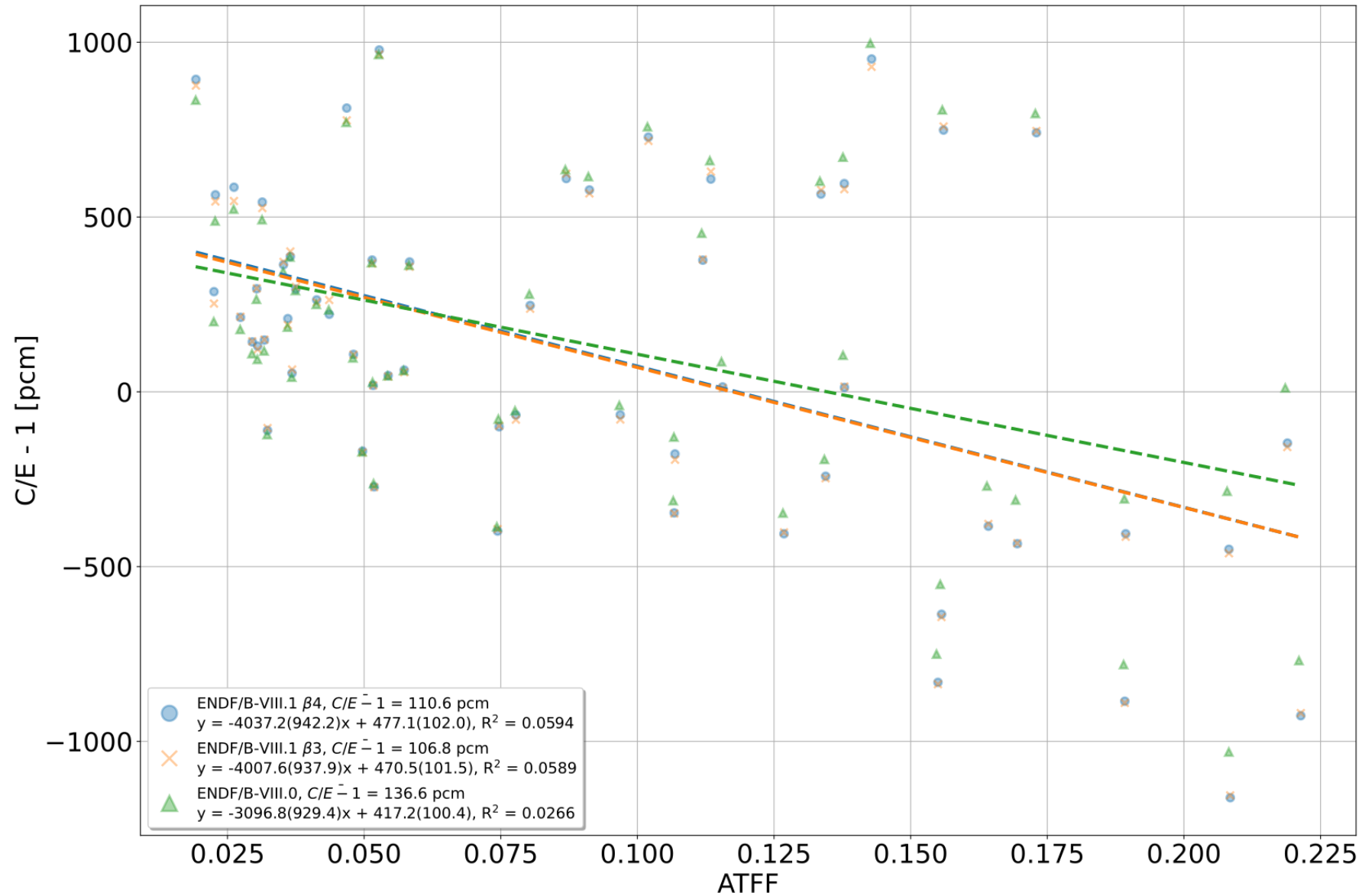
IST Benchmarks FOM



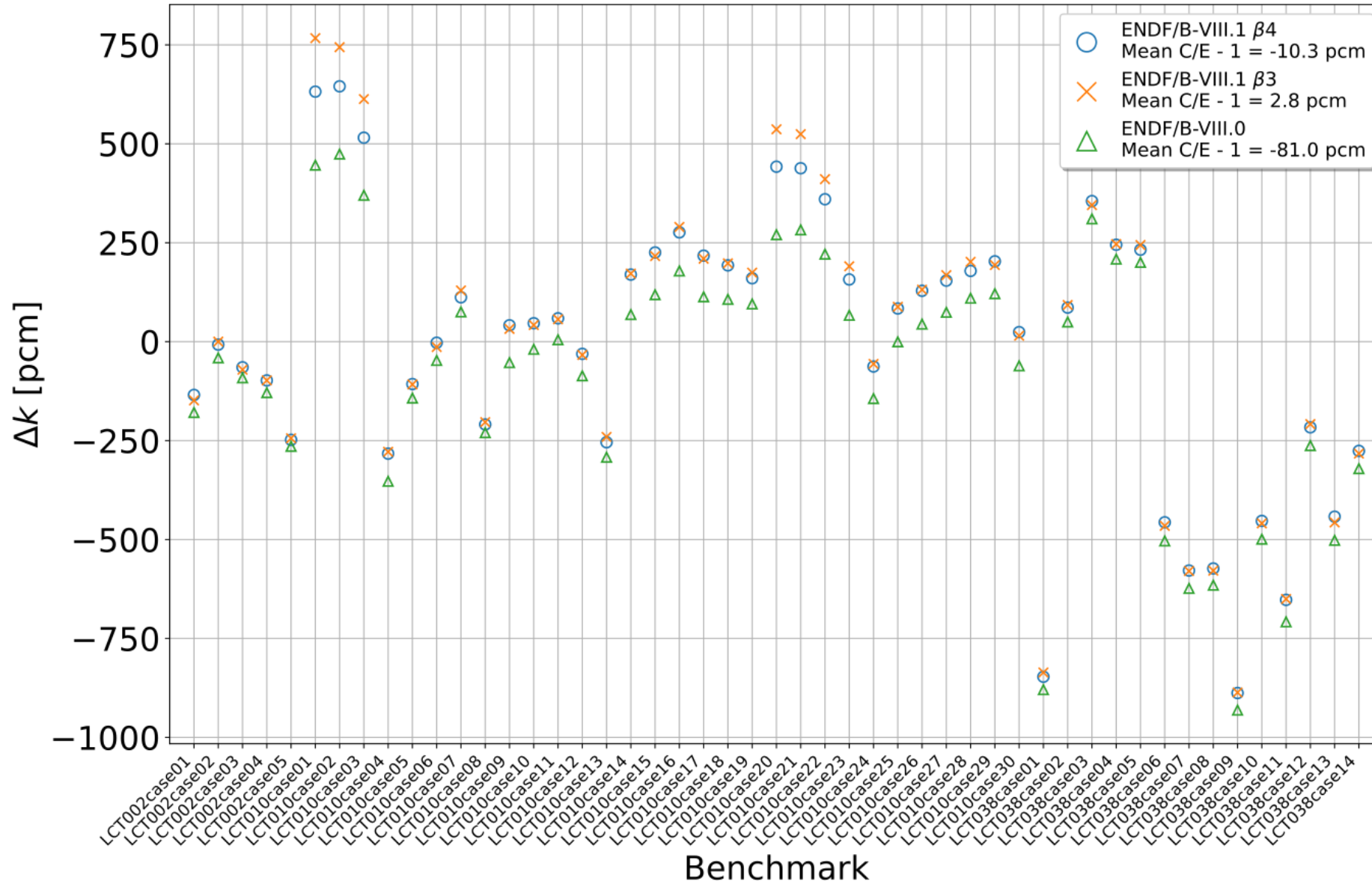
IST Benchmarks ATLF vs. C/E - 1



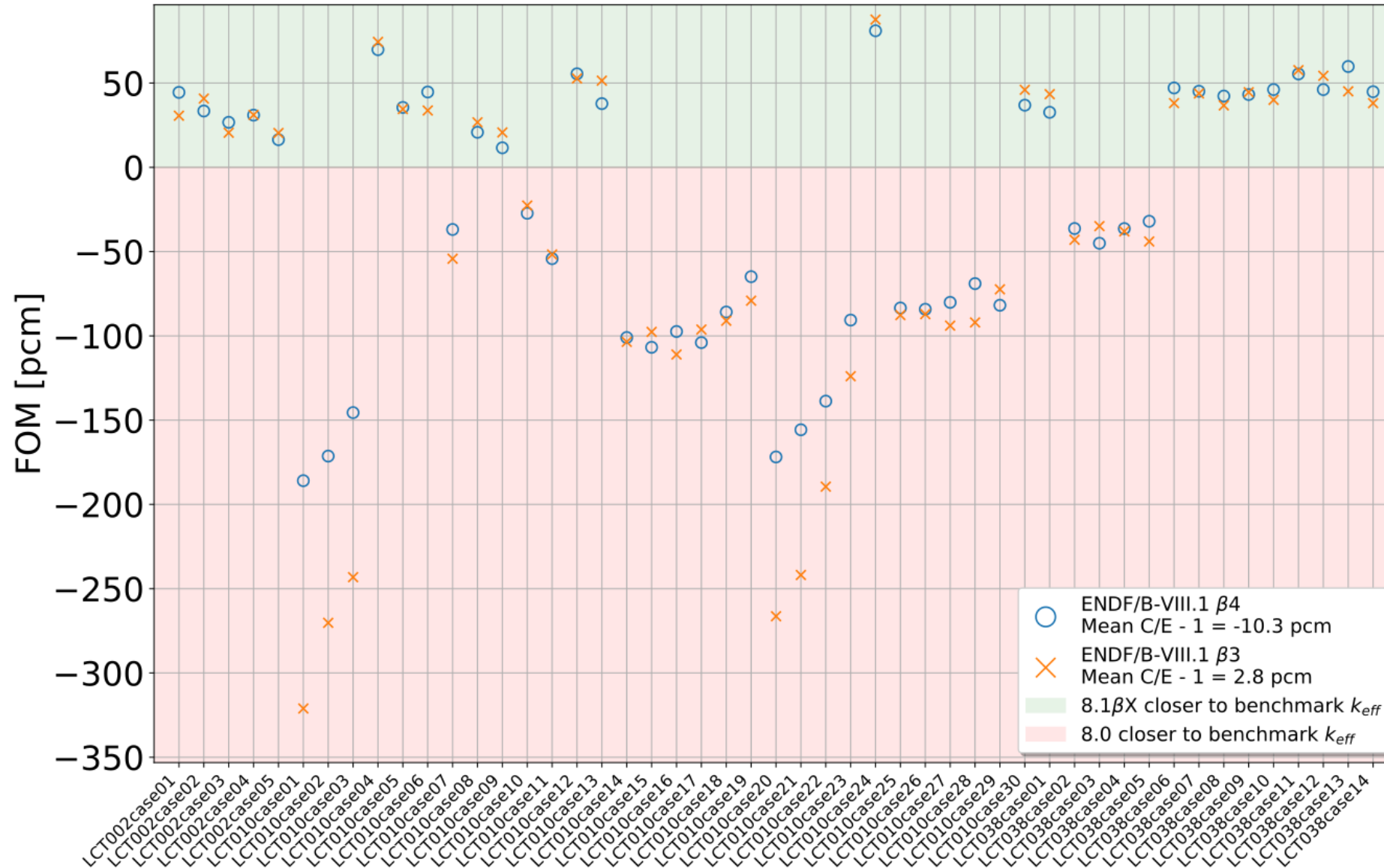
IST Benchmarks ATFF vs. C/E - 1



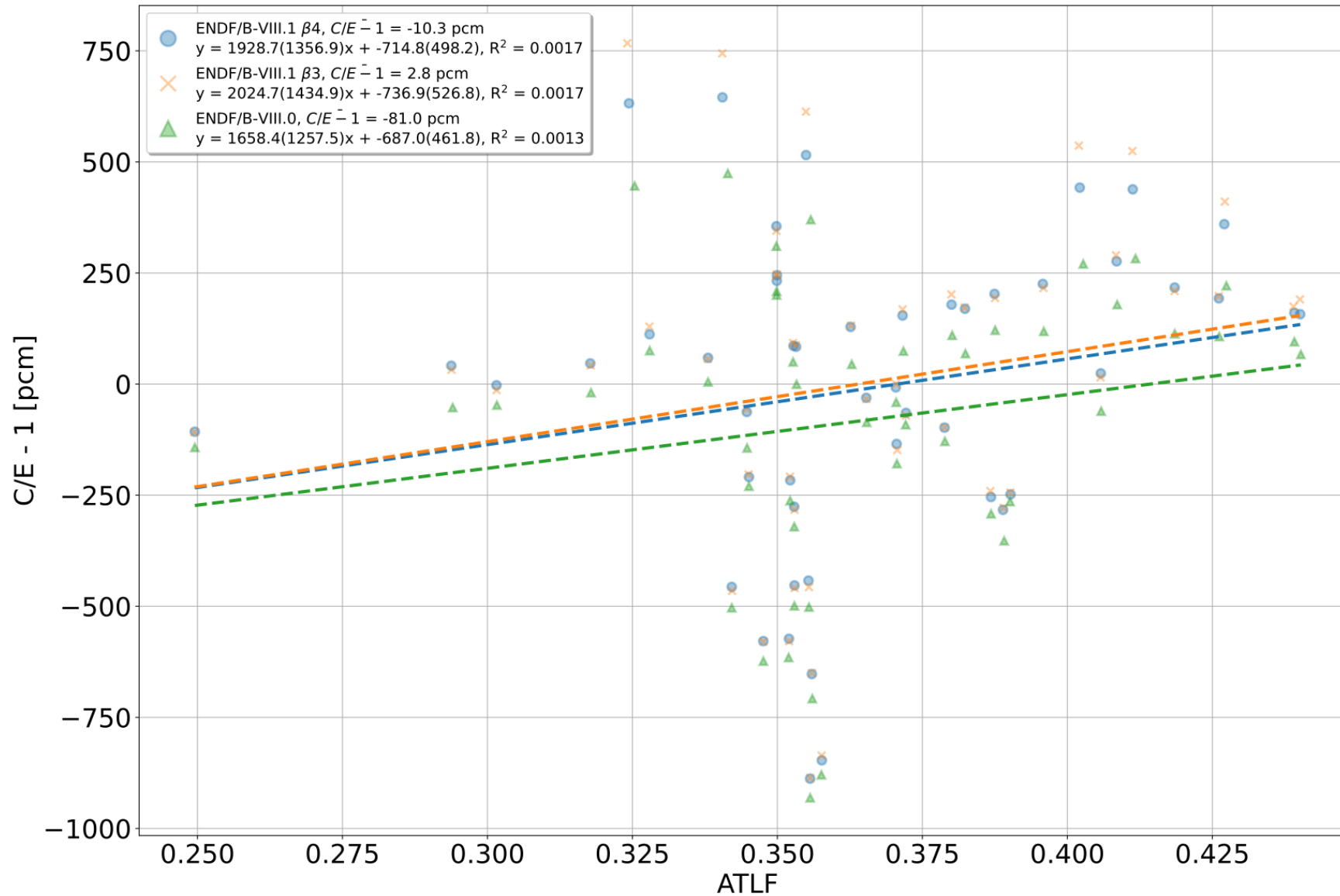
LCT Benchmarks Δk



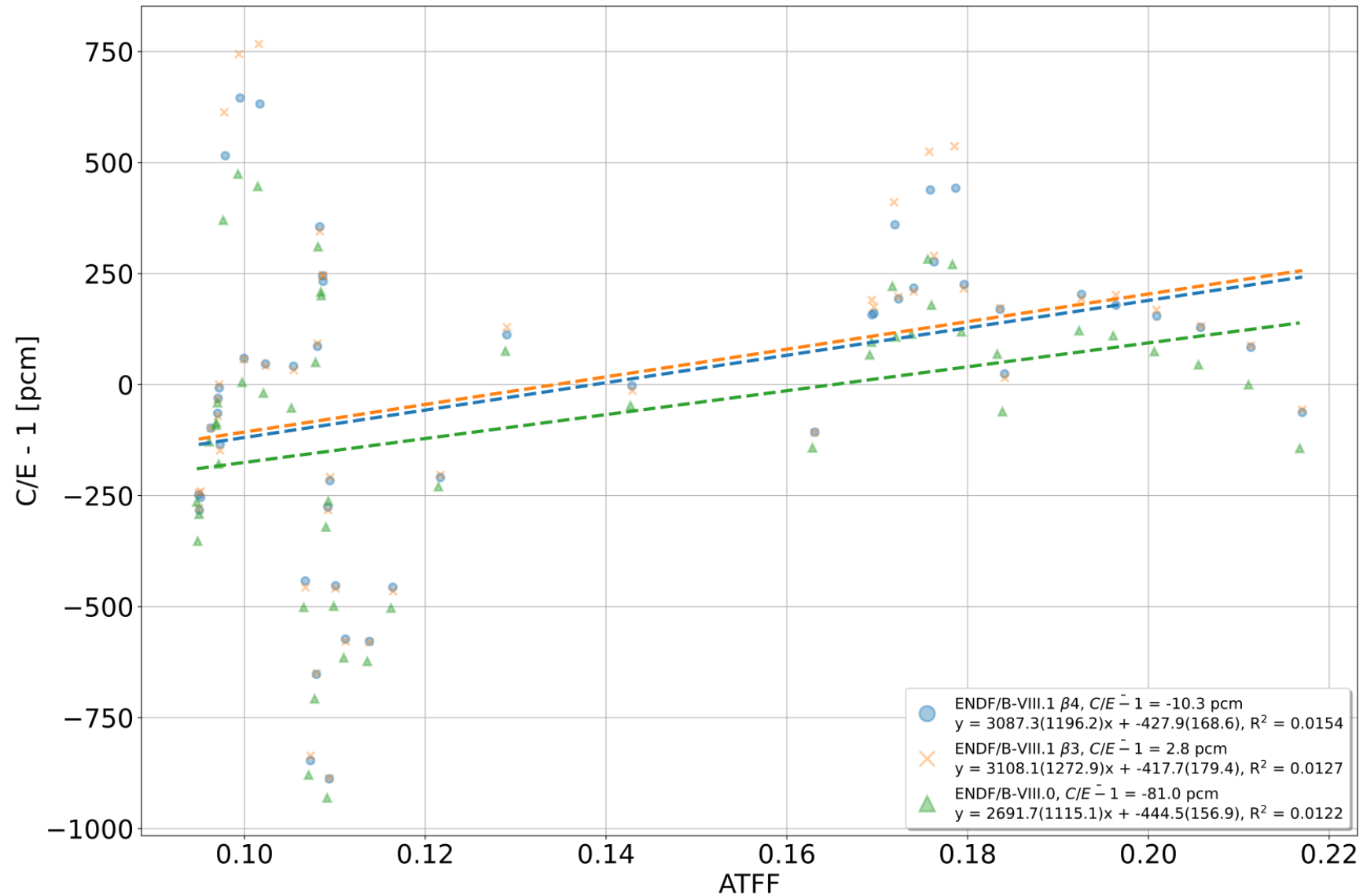
LCT Benchmarks FOM



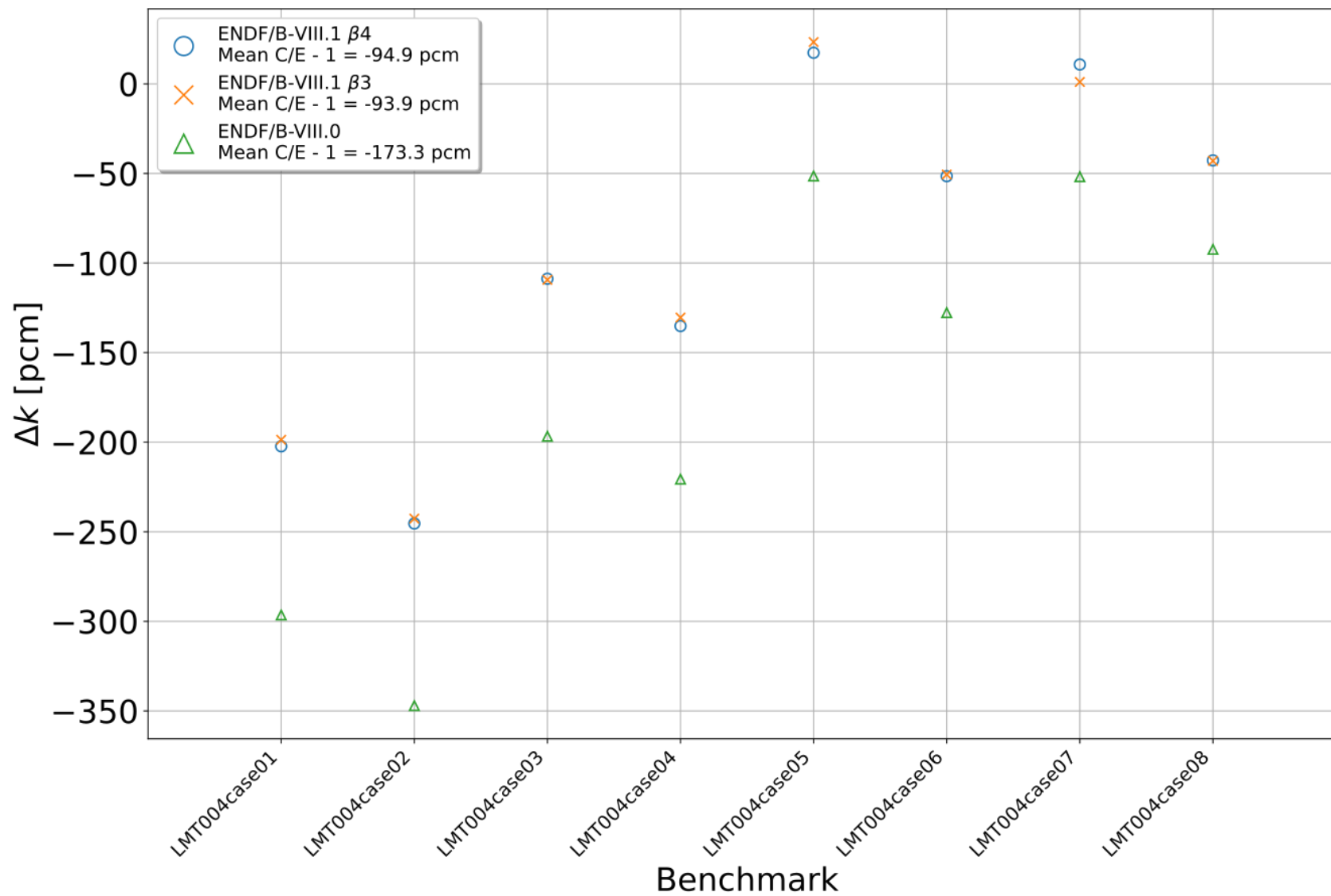
LCT Benchmarks ATLF vs. C/E - 1



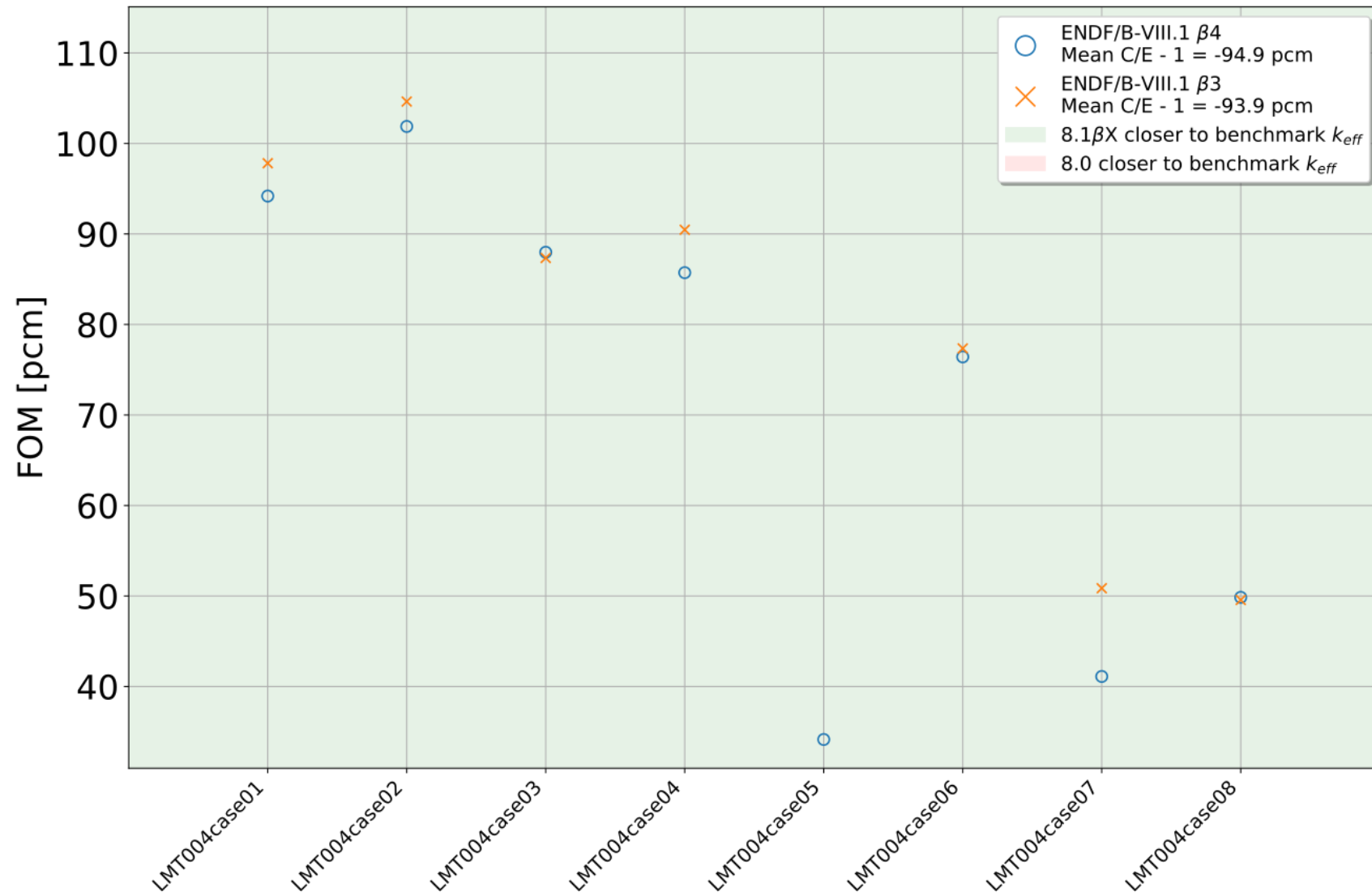
LCT Benchmarks ATFF vs. C/E - 1



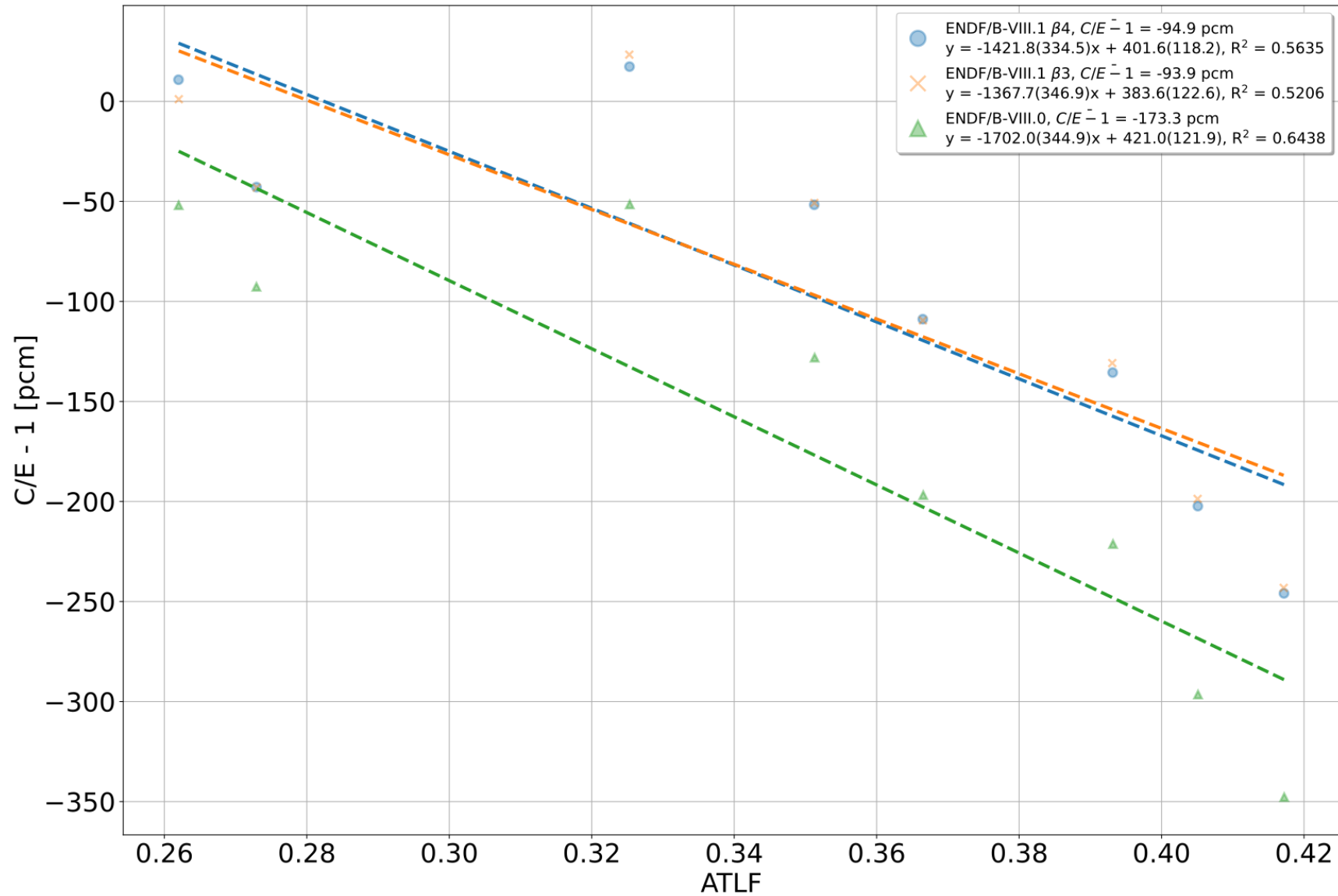
LMT Benchmarks Δk



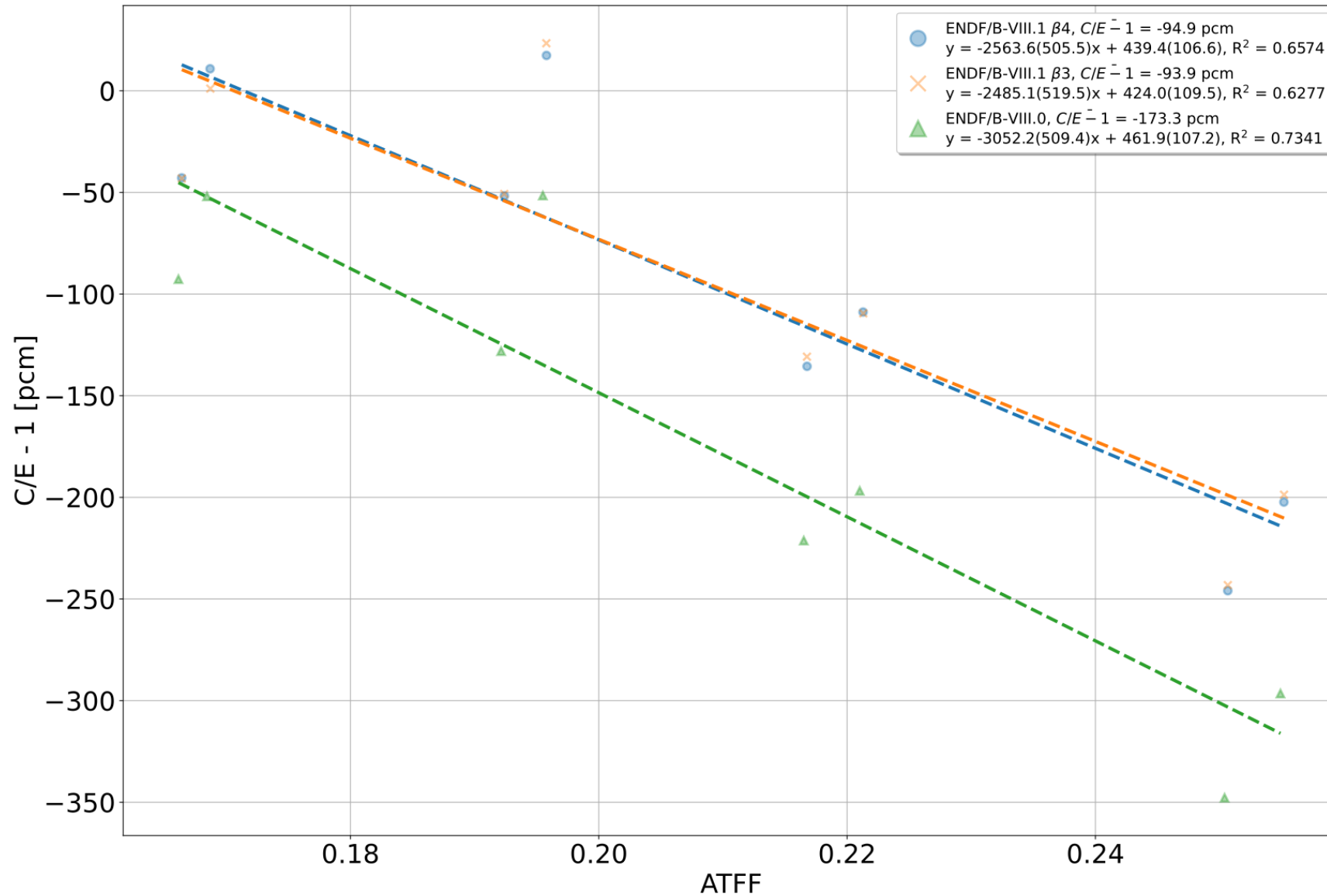
LMT Benchmarks FOM



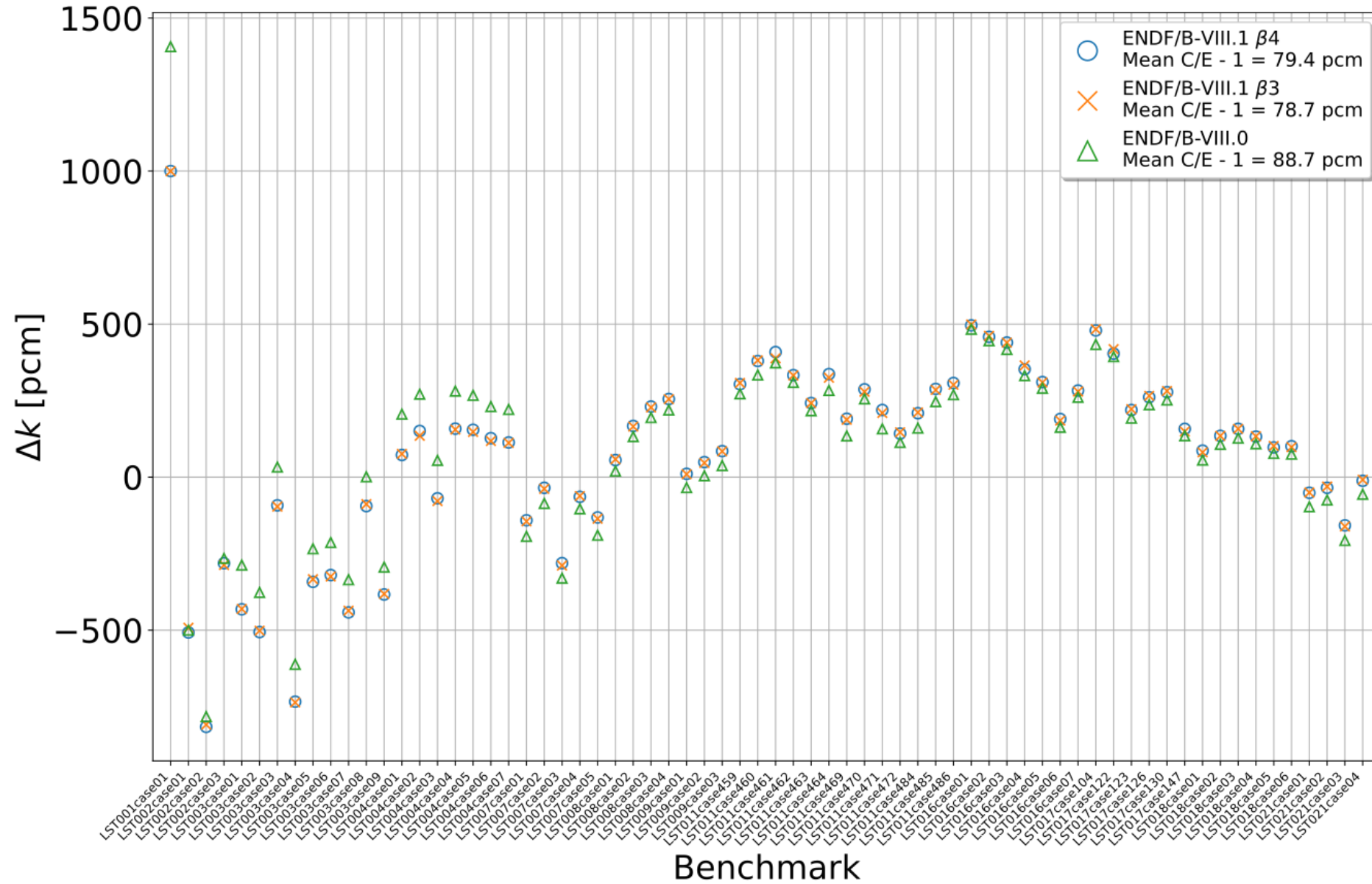
LMT Benchmarks ATLF vs. C/E - 1



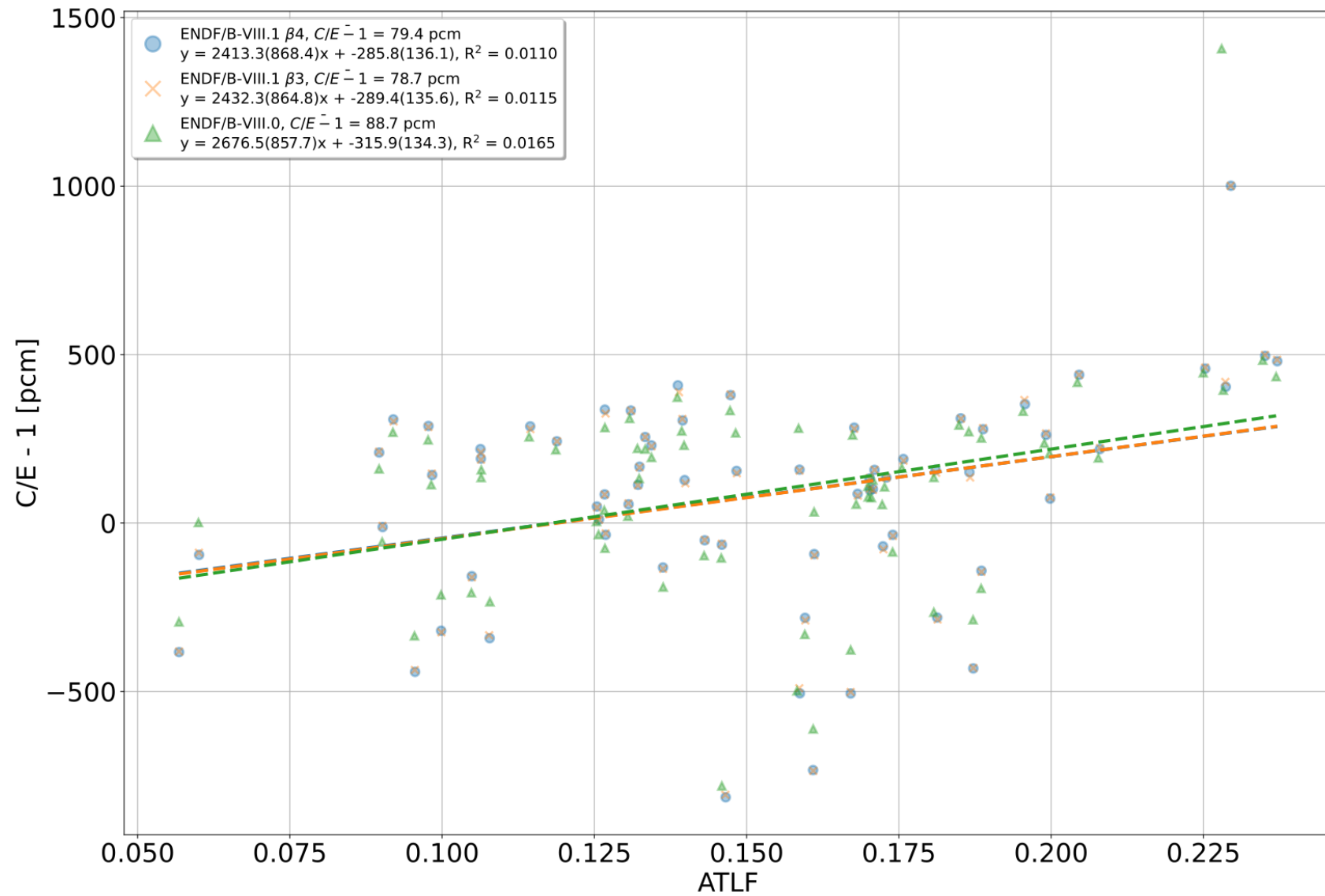
LMT Benchmarks ATFF vs. C/E - 1



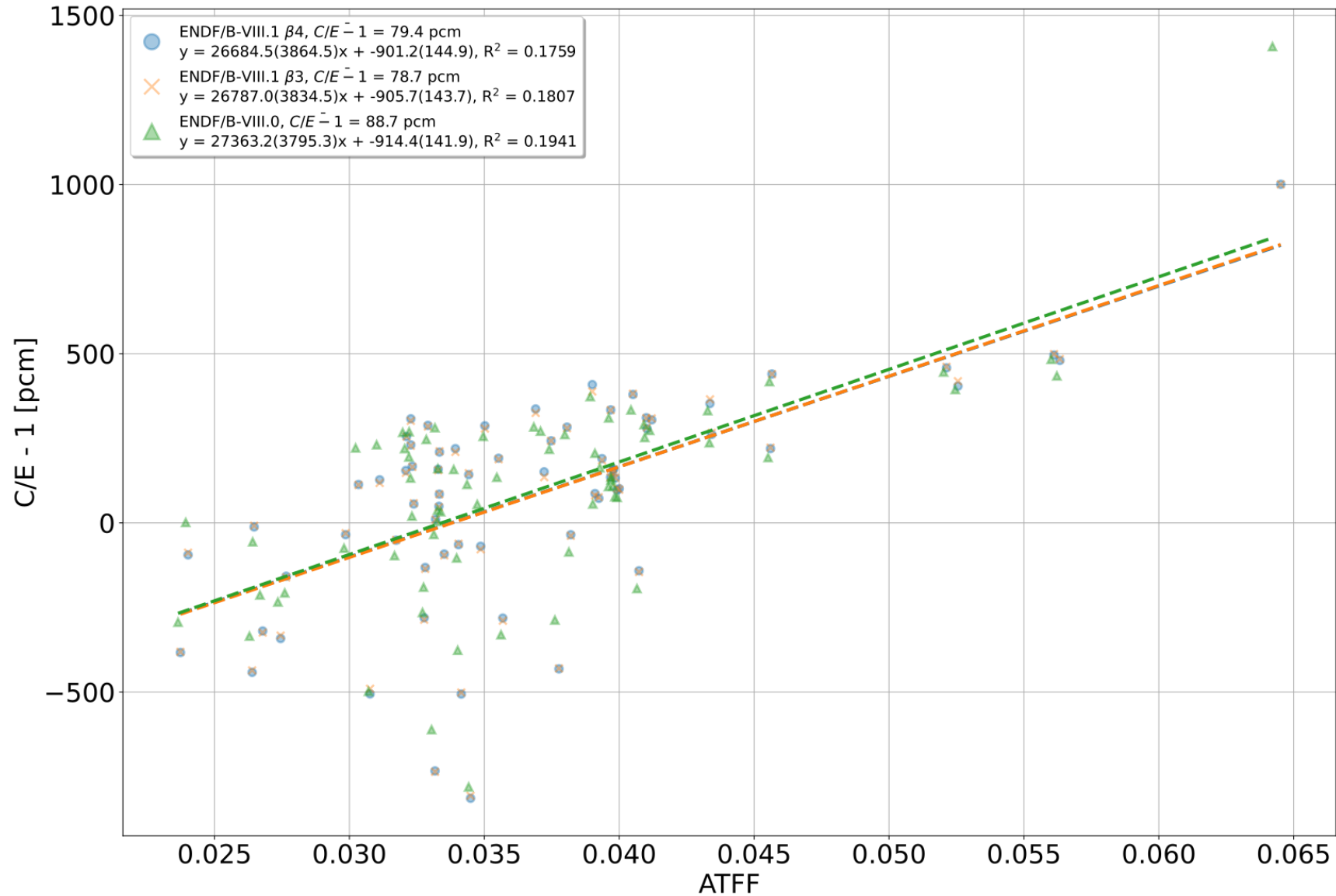
LST Benchmarks Δk



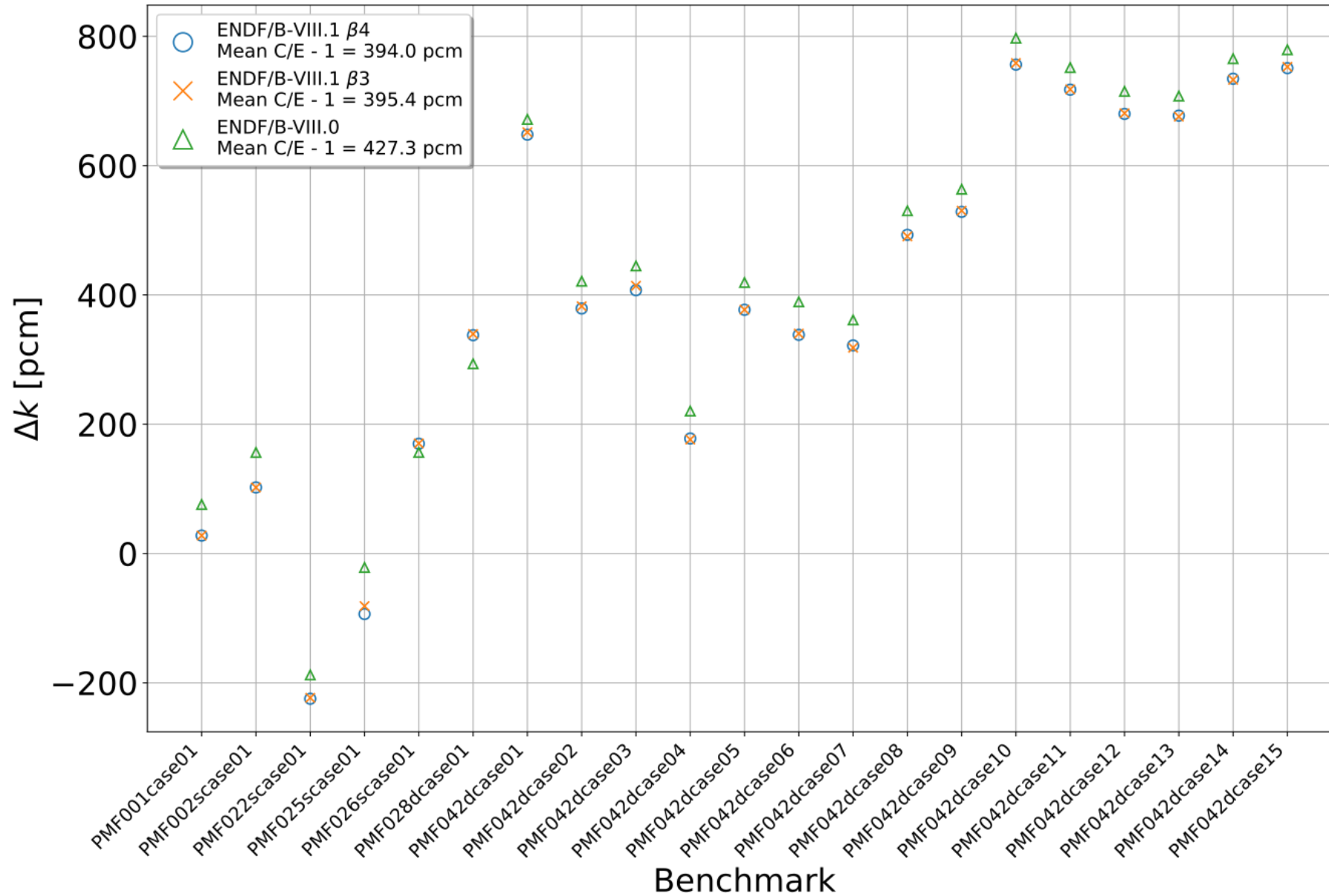
LST Benchmarks ATLF vs. C/E - 1



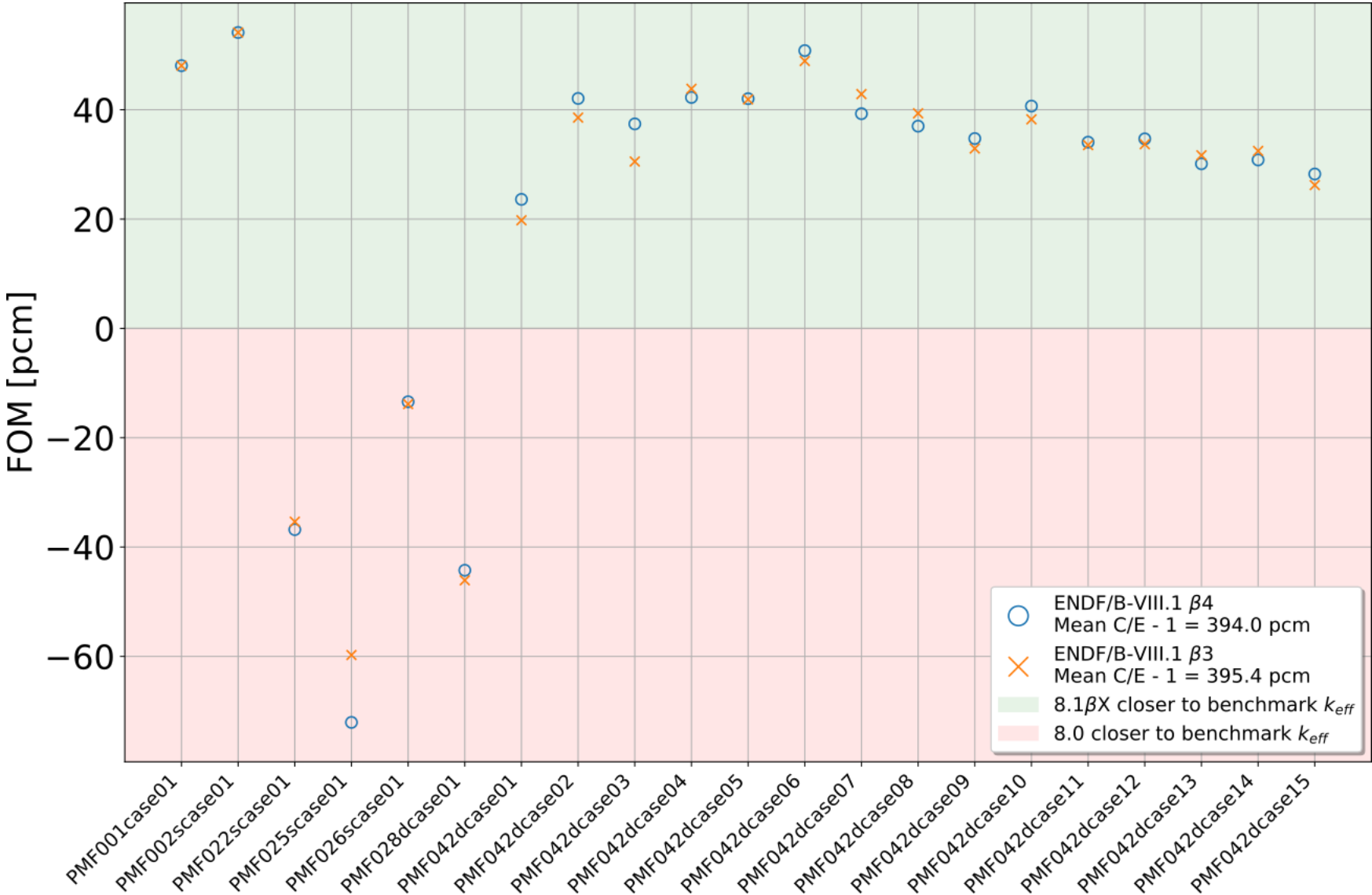
LST Benchmarks ATFF vs. C/E - 1



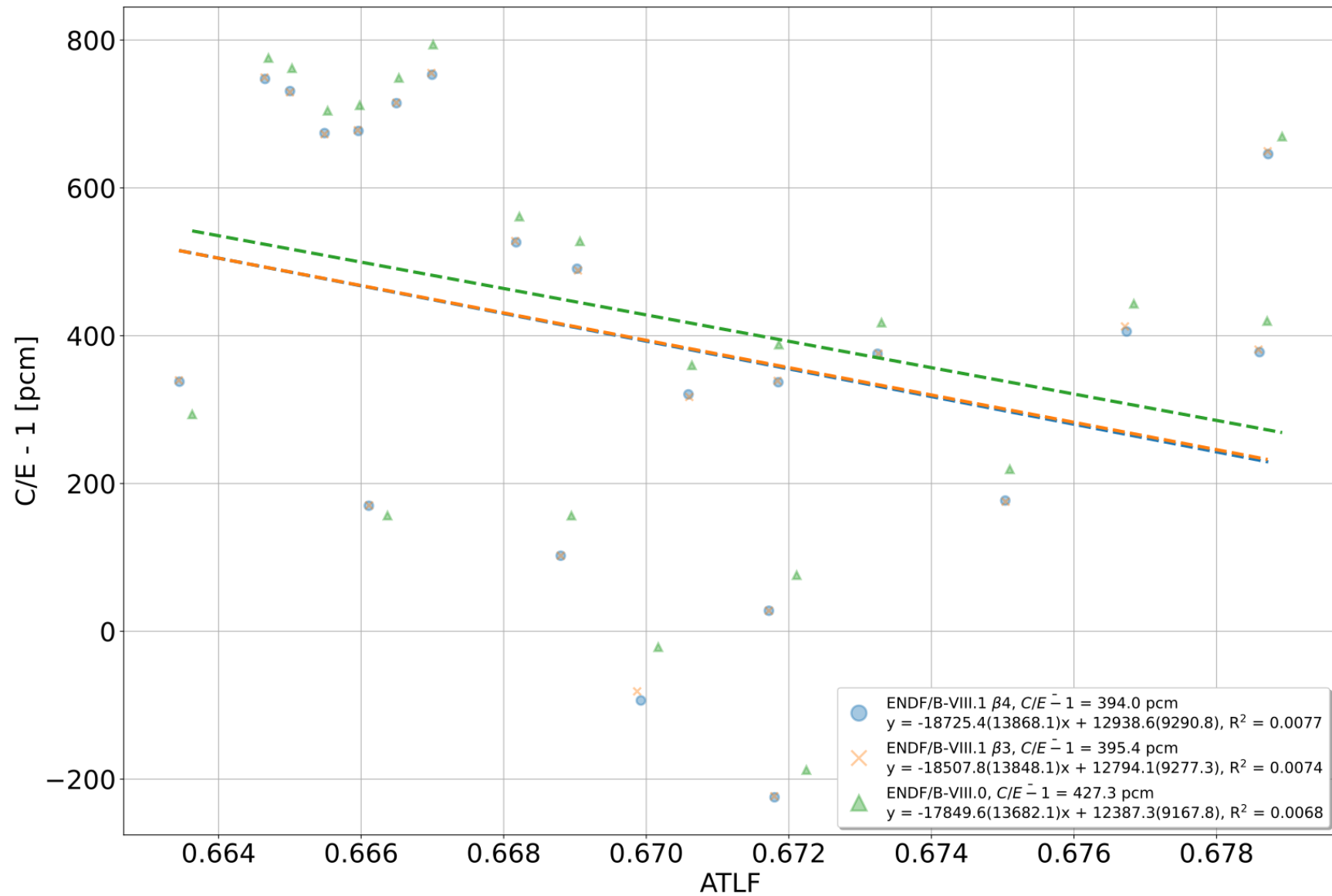
PMF Benchmarks Δk



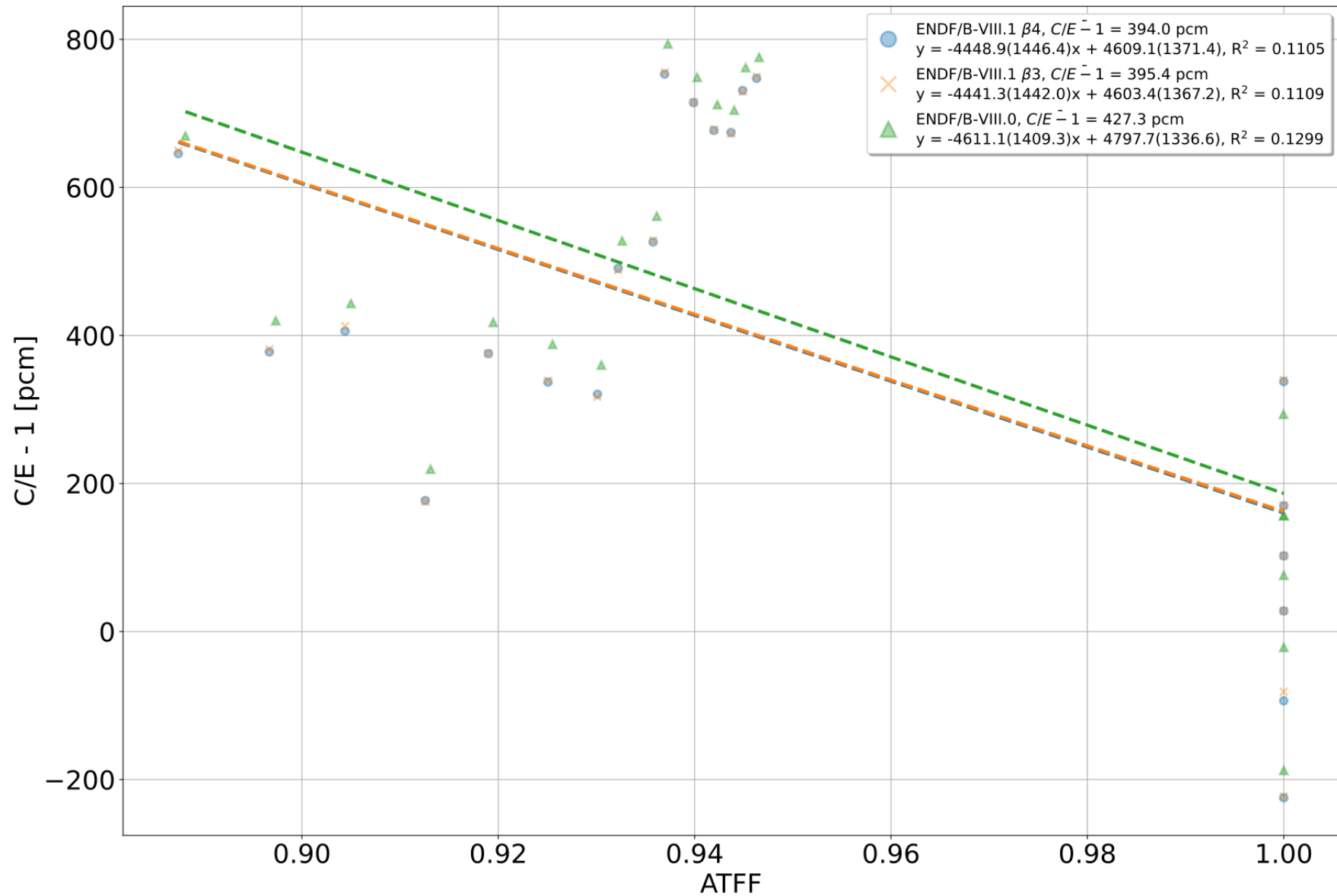
PMF Benchmarks FOM



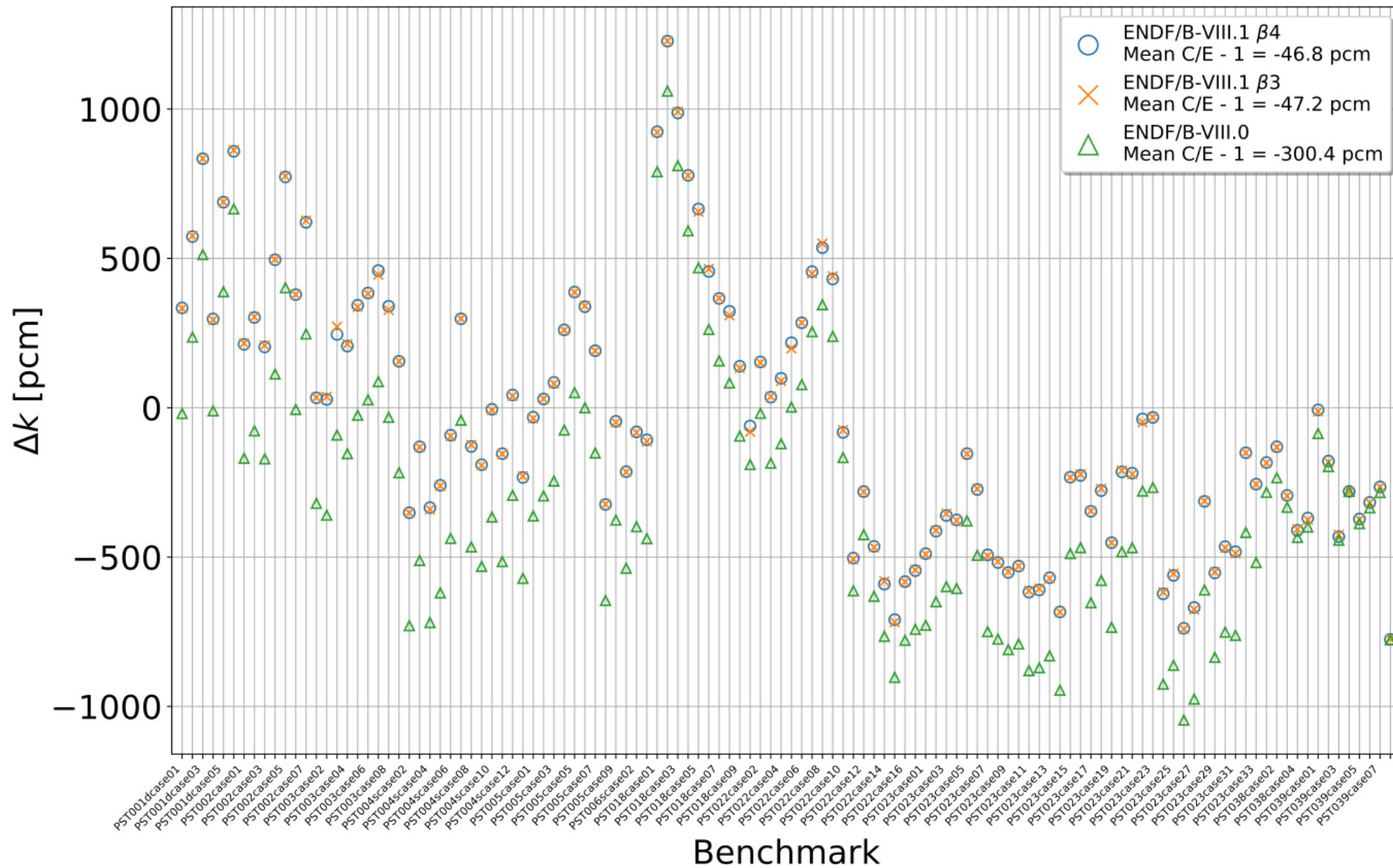
PMF Benchmarks ATLF vs. C/E - 1



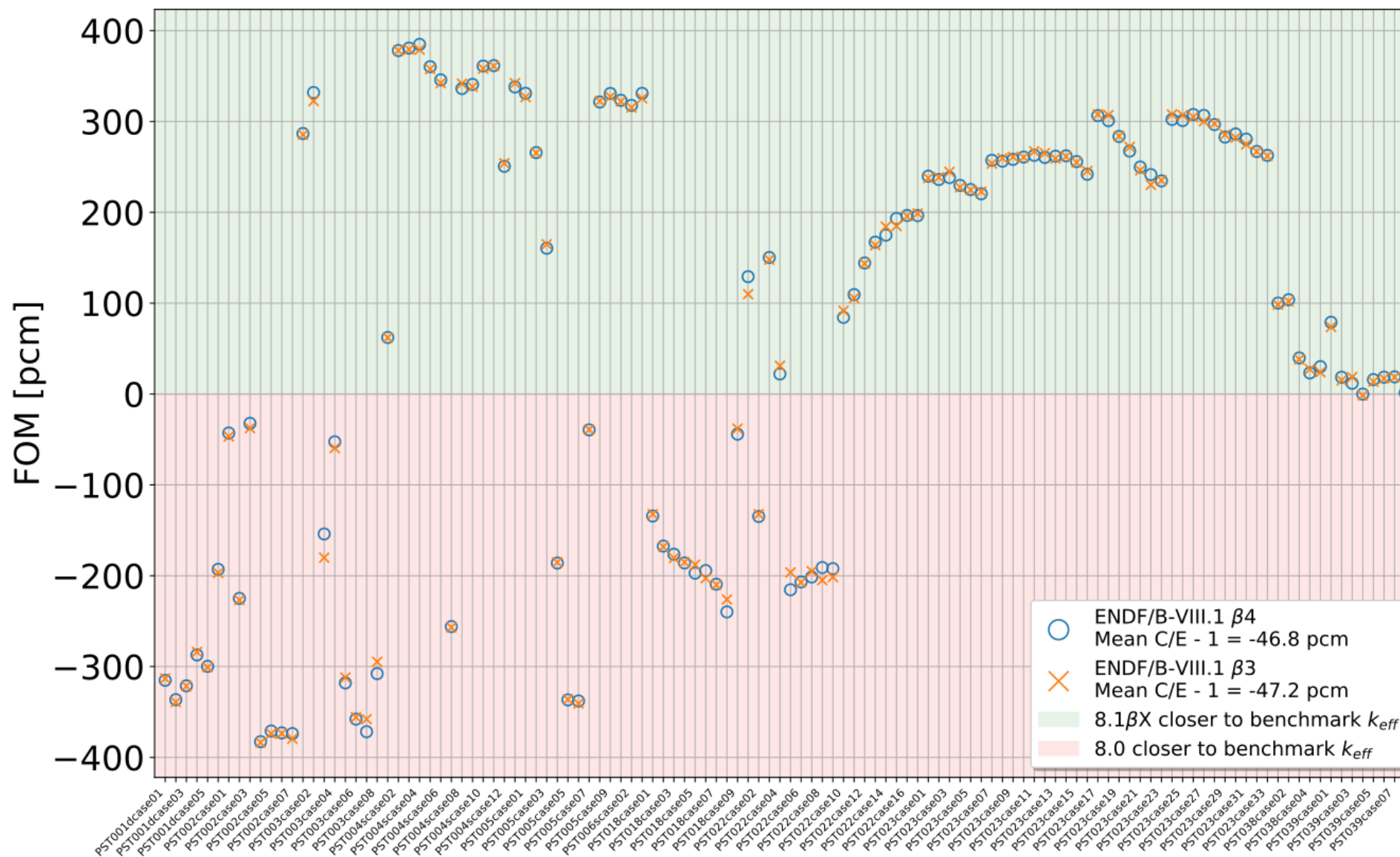
PMF Benchmarks ATFF vs. C/E - 1



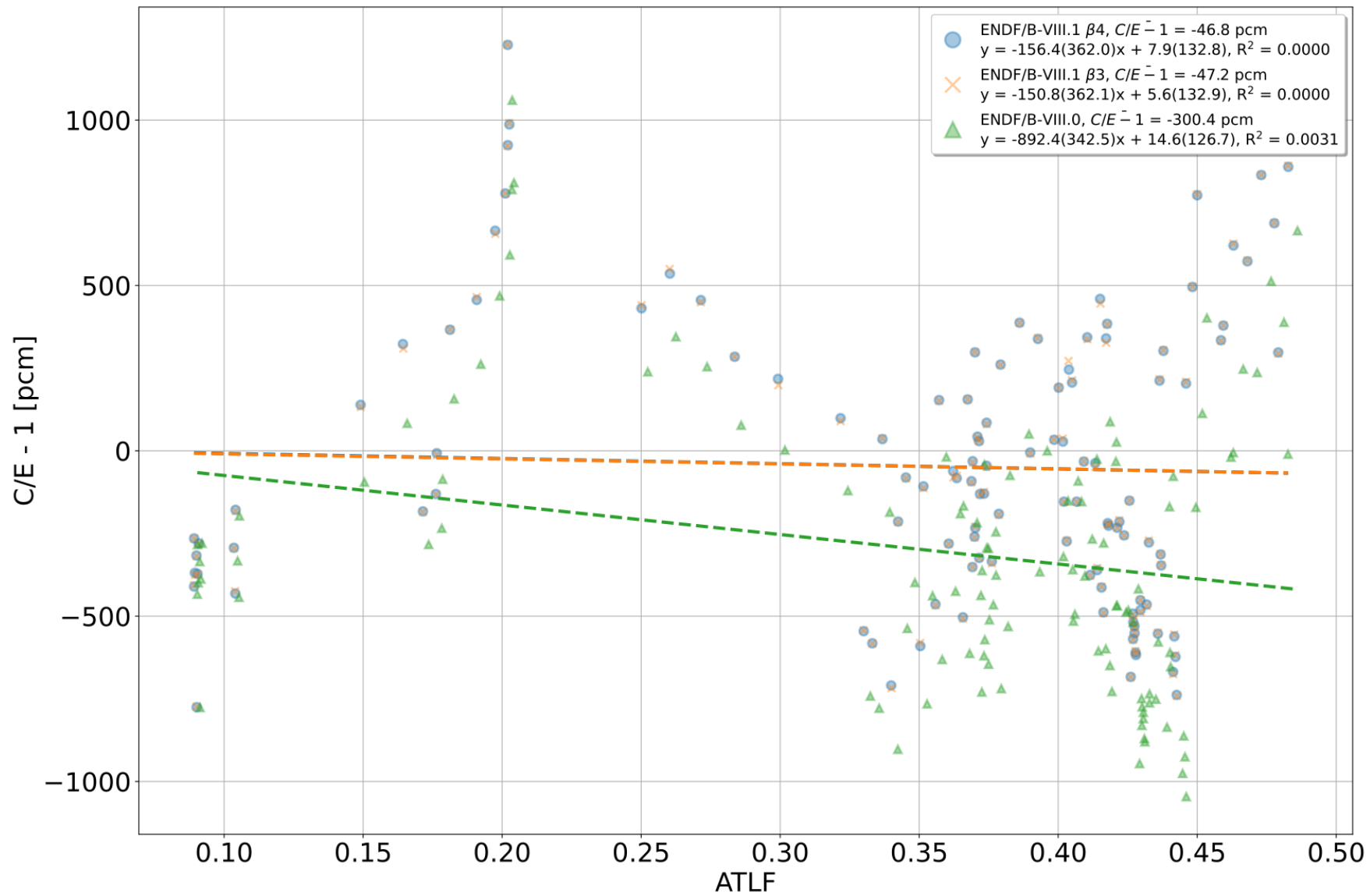
PST Benchmarks Δk



PST Benchmarks FOM



PST Benchmarks ATLF vs. C/E - 1



PST Benchmarks ATFF vs. C/E - 1

