XFEL VERTICAL TEST RESULTS AND EXTRAPOLATION TO ILC

Nick Walker for the XFEL Cavity Analysis Team

07.10.2014 LCWS14 Belgrade

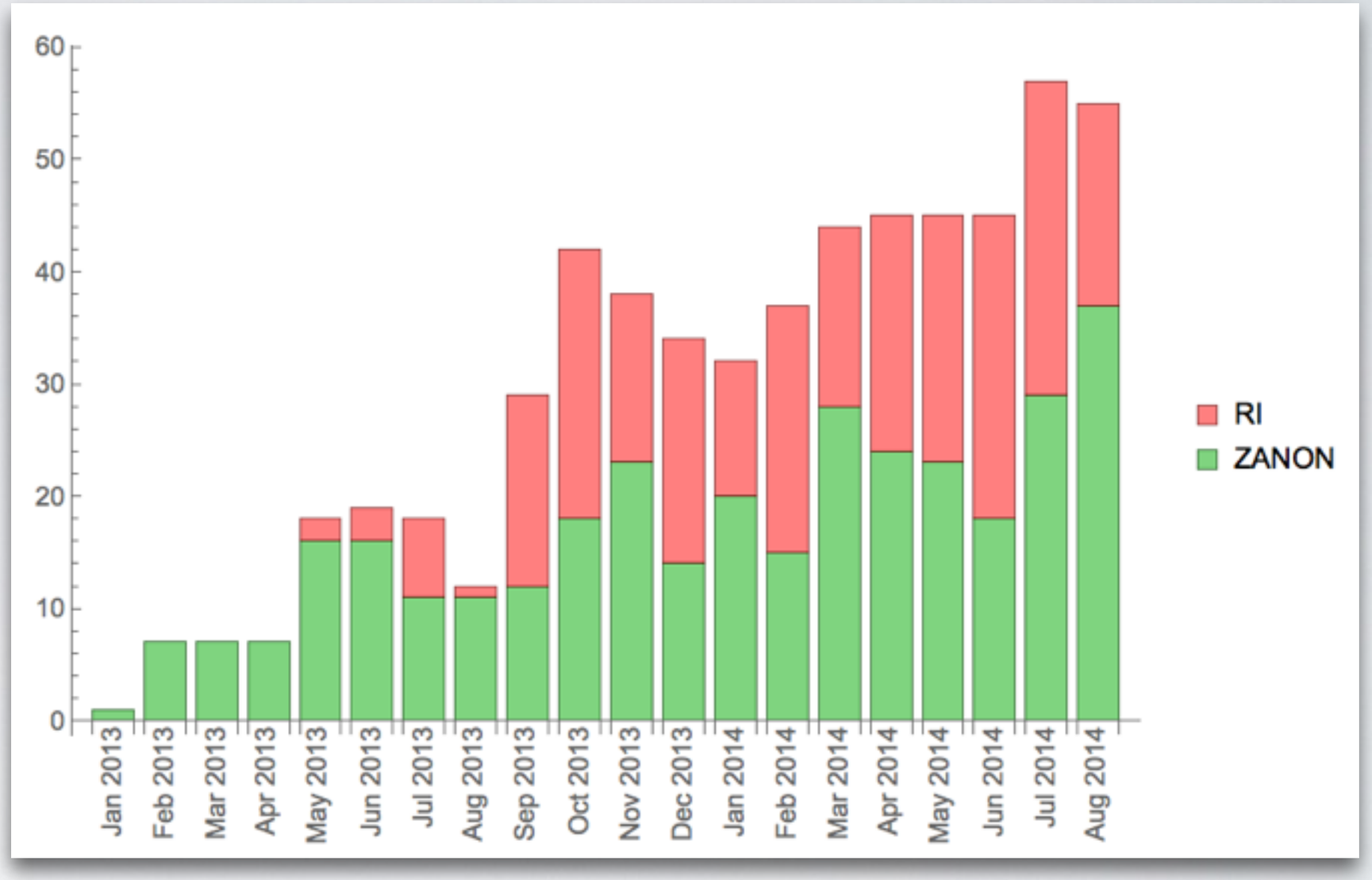
CAVITY & TEST NUMBERS

Up to 31 August 2014

	ZANON	RI	TOTAL
Number of cavities	224	183	407
Number of vertical tests	337	255	592
Tests/cavity	1.50	1.39	1.45

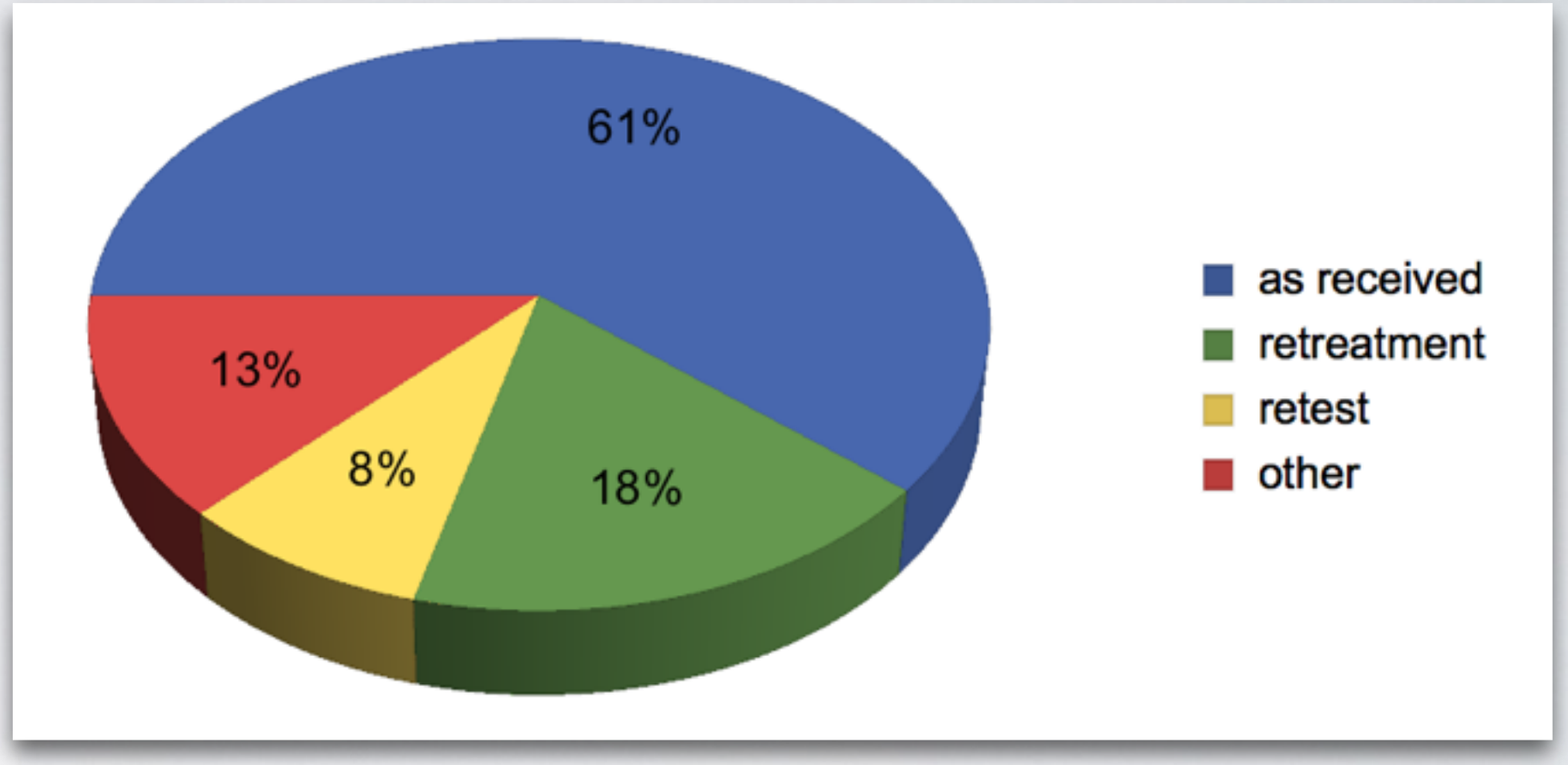
CAVITY TEST RATES

- All vertical tests shown (by test date)
- Avg. tests/week (since 10.13) **10**
- Peak tests per week **14.3**
- Average number of tests per cavity: **1.45**



CAVITY TESTS

- All vertical tests shown (by test date)
- Avg. tests/week (for 2014) **10.4**
- Peak tests per week **14.3**
- Average number of tests per cavity: **1.46**



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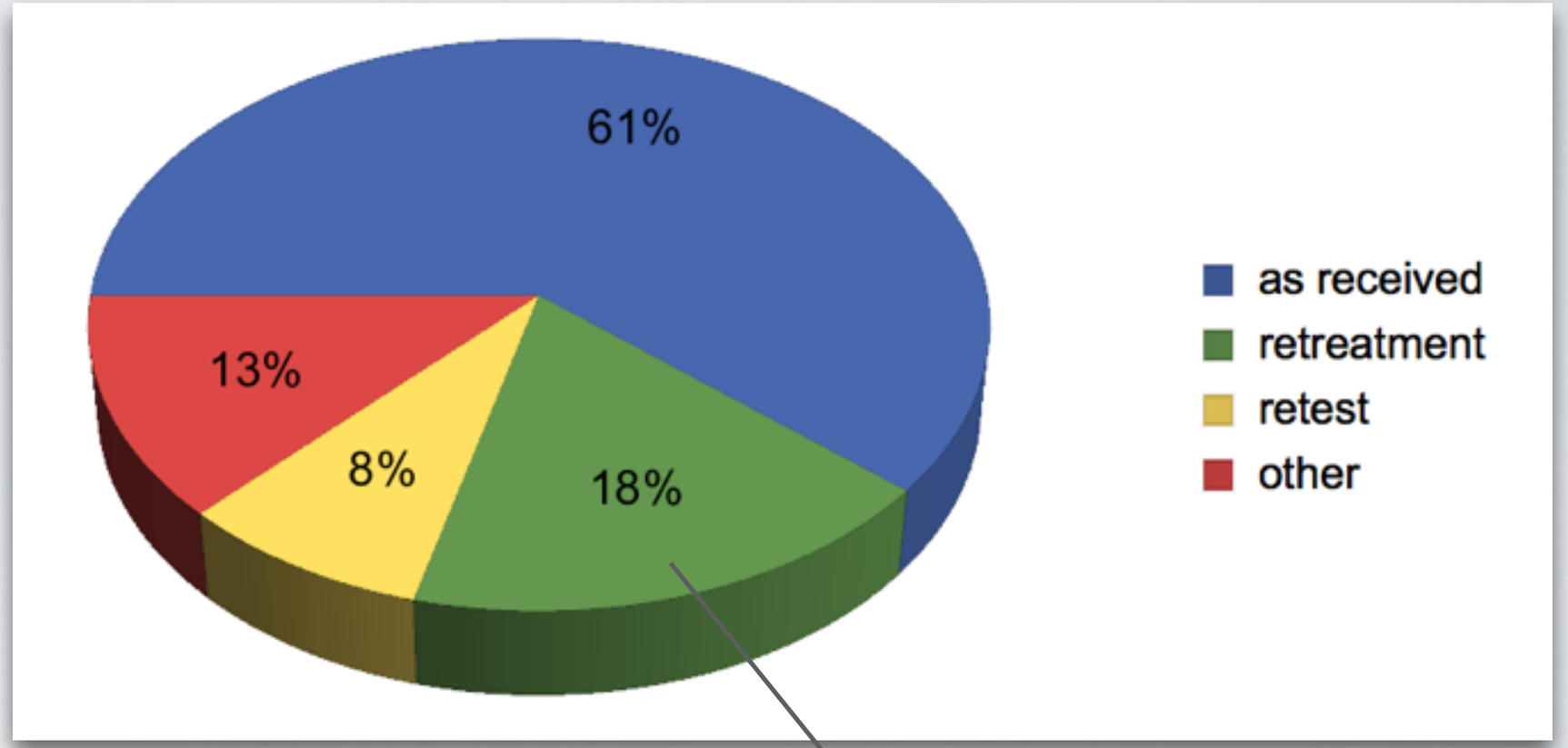
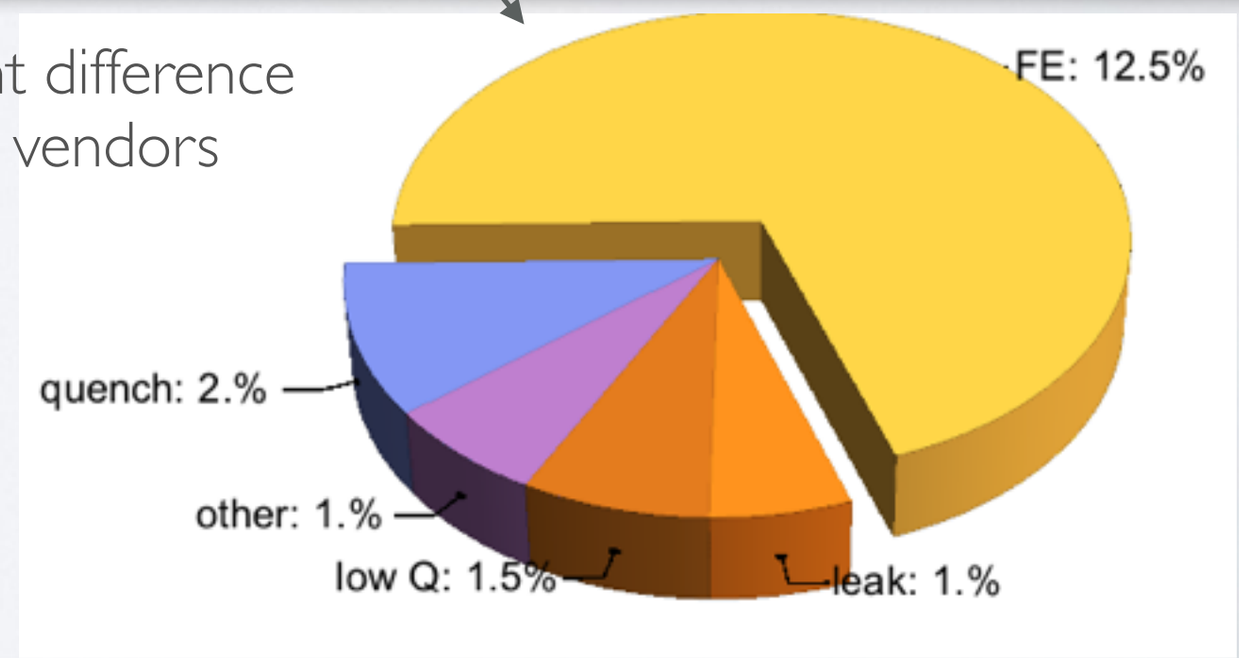


no significant difference between vendors



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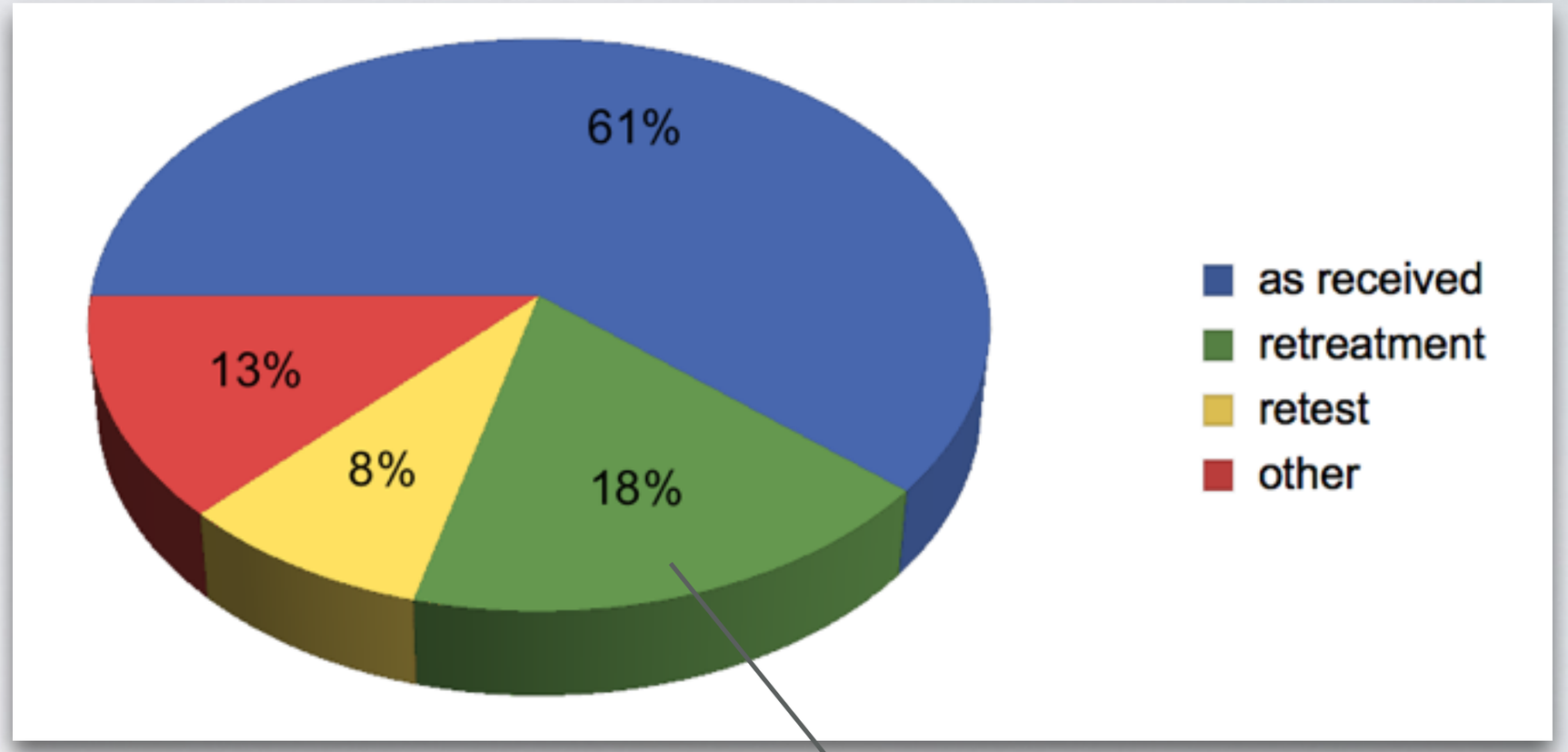
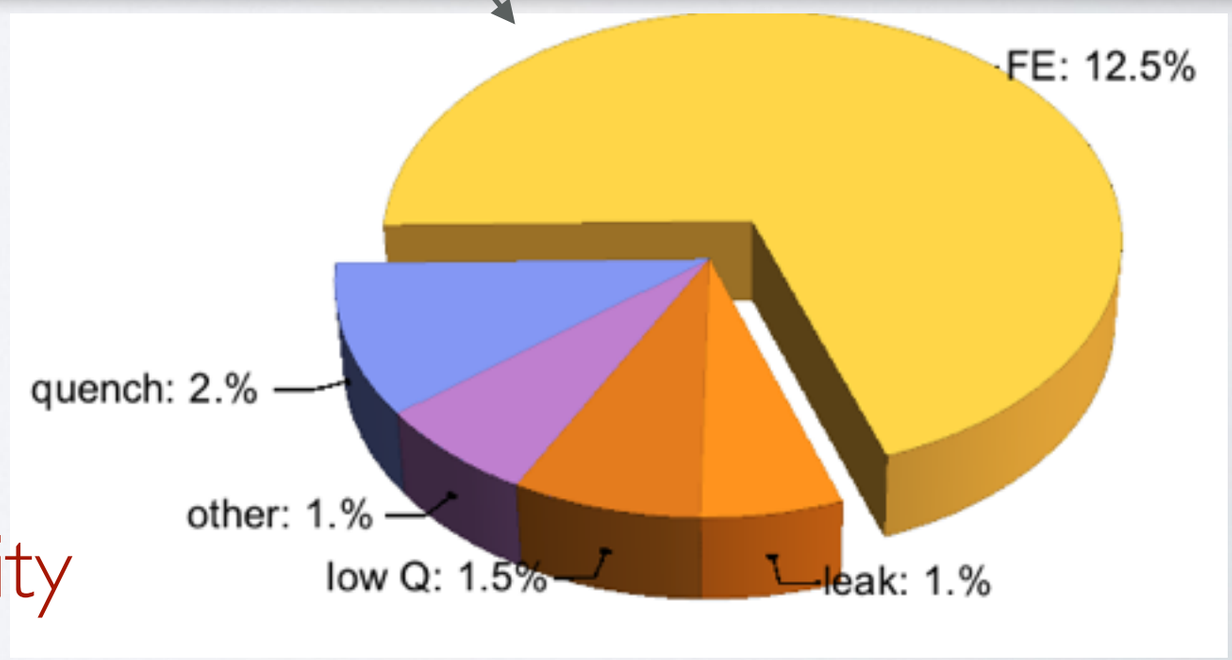
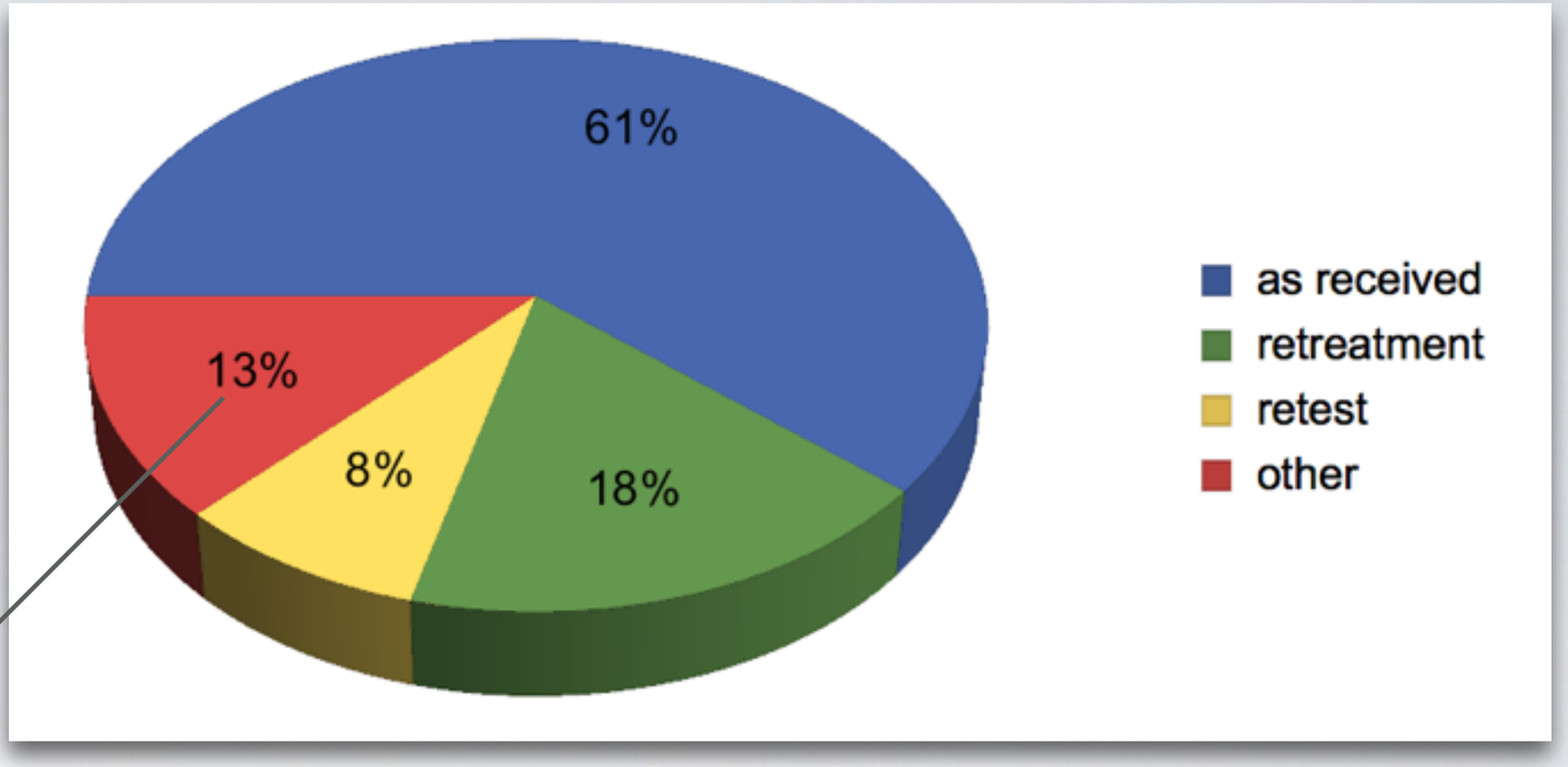
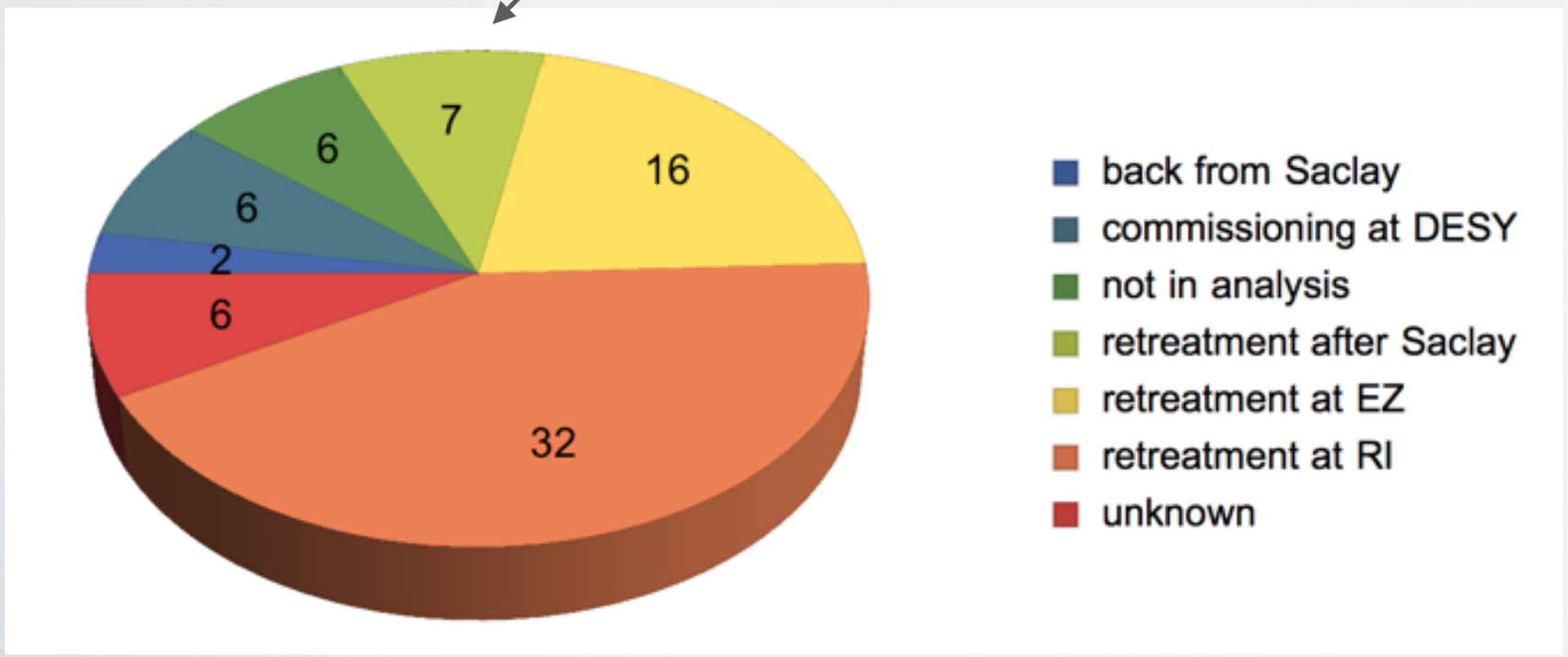




ILC TDR assumed 1.25 test/cavity

CAVITY TESTS



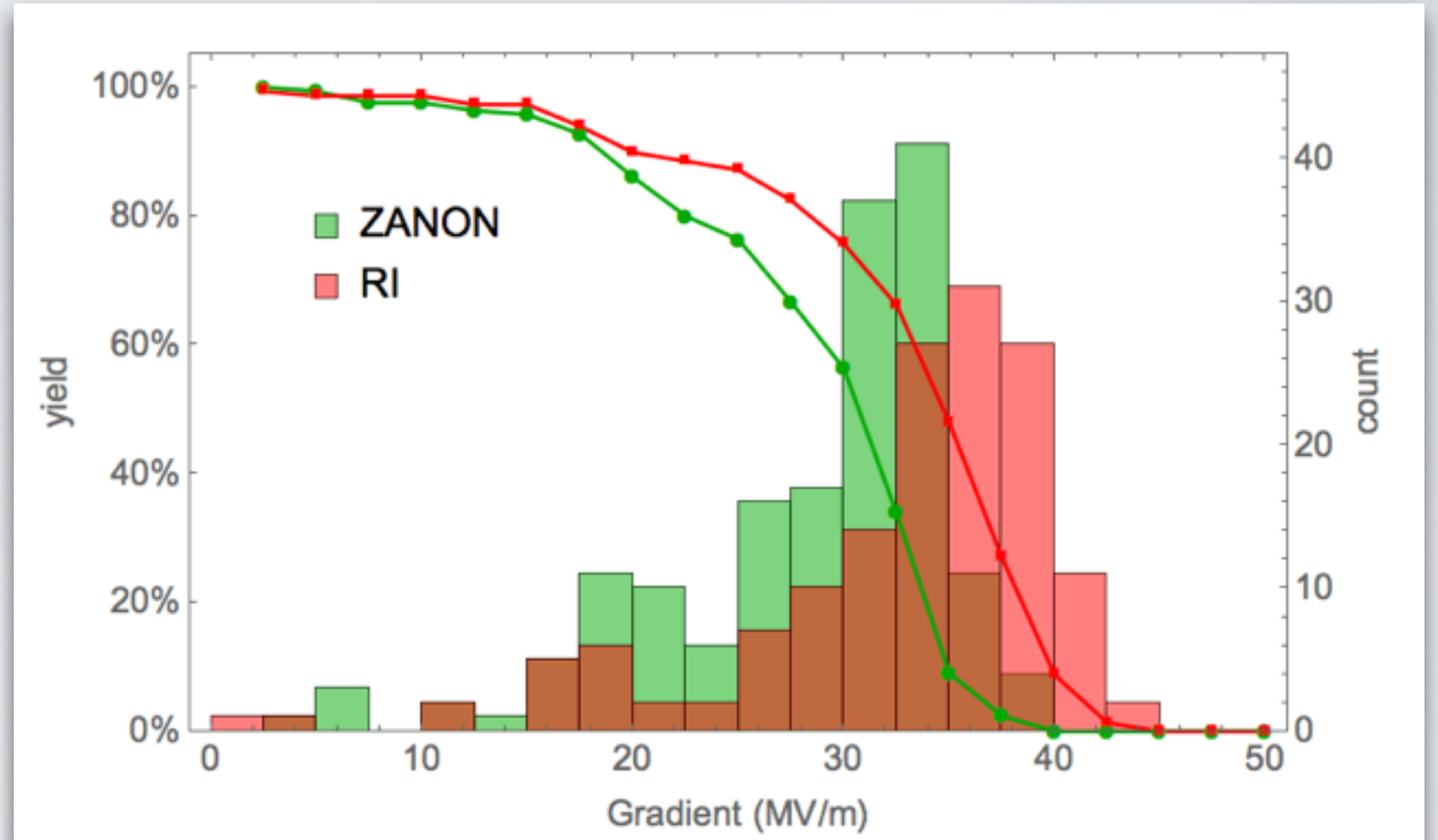


XFEL USABLE FIELD

- Usable field for XFEL is defined as <u>the lowest of</u>
  - MAX FIELD (i.e. vertical test max achieved)
  - $Q_0 < 10^{10}$ (Q-limited)
  - X-RAY monitors (F.E. limited)
    - top sensor ≤0.01 mGy/min (historical from TTF measurements)
    - bottom sensor ≤0.12 mGy/min (calibrated wrt top)

YIELD

- **MAX FIELD**
- <u>as received</u>
- Excluding bad tests (leaks, RF problems etc.)

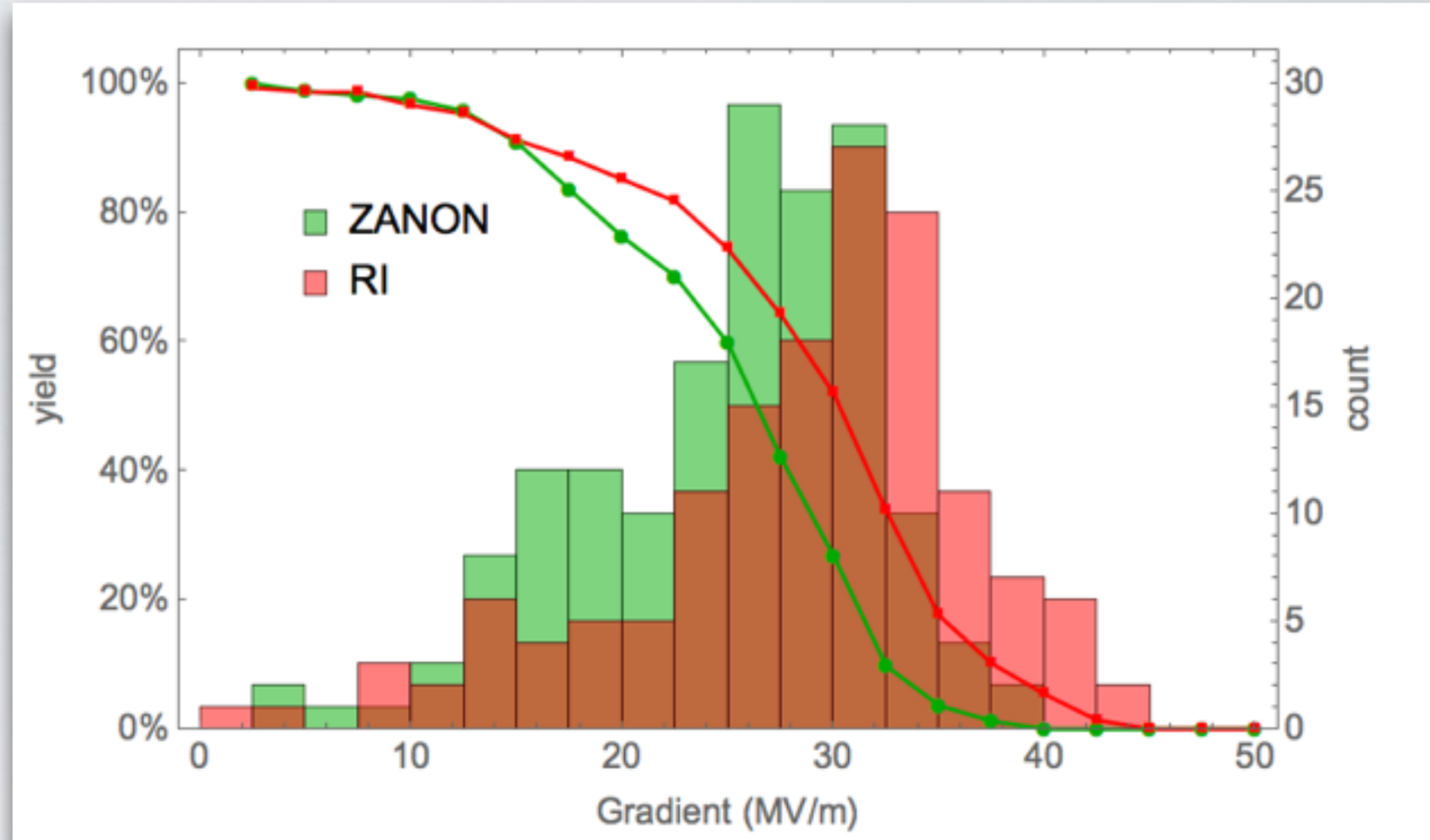


Cavities	313	(77%)
Tests	313	(52%)

	Tests	Average	RMS	Yield@20	Yield@26	Yield@28
ZANON	165	28.5	7.	86%	73%	65%
RI	148	32.8	7.6	90%	86%	82%
All	313	30.5	7.6	88%	79%	73%

YIELD

- **USABLE FIELD**
- <u>as received</u>
- Excluding "bad tests" (leaks, RF problems etc.)
- RI result is more relevant for ILC (flash EP)



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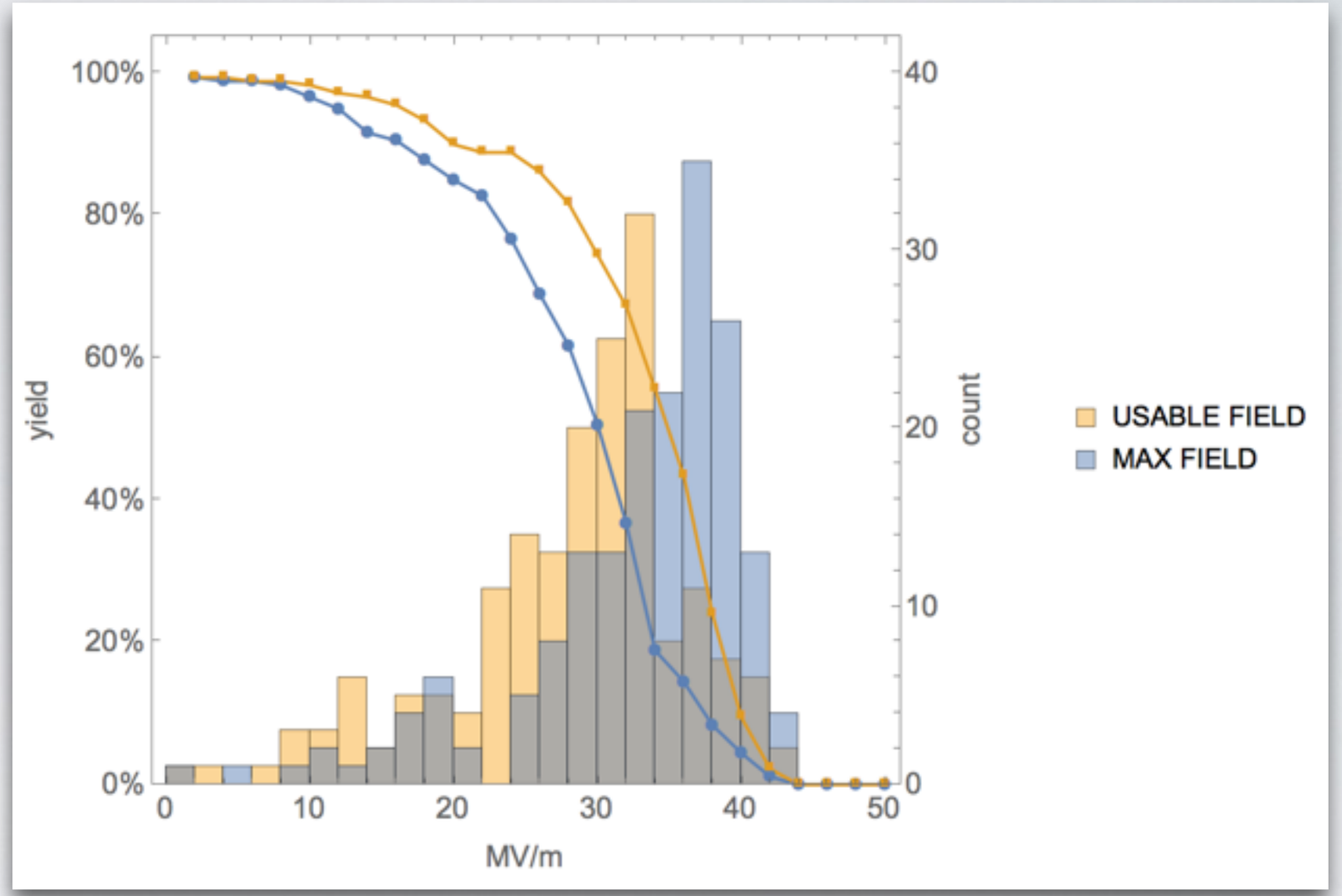
	Tests	Average	RMS	Yield@20	Yield@26	Yield@28
ZANON	164	25.	6.9	76%	52%	38%
RI	148	28.6	8.1	85%	70%	63%
All	312	26.7	7.7	80%	61%	50%

YIELD (RI)

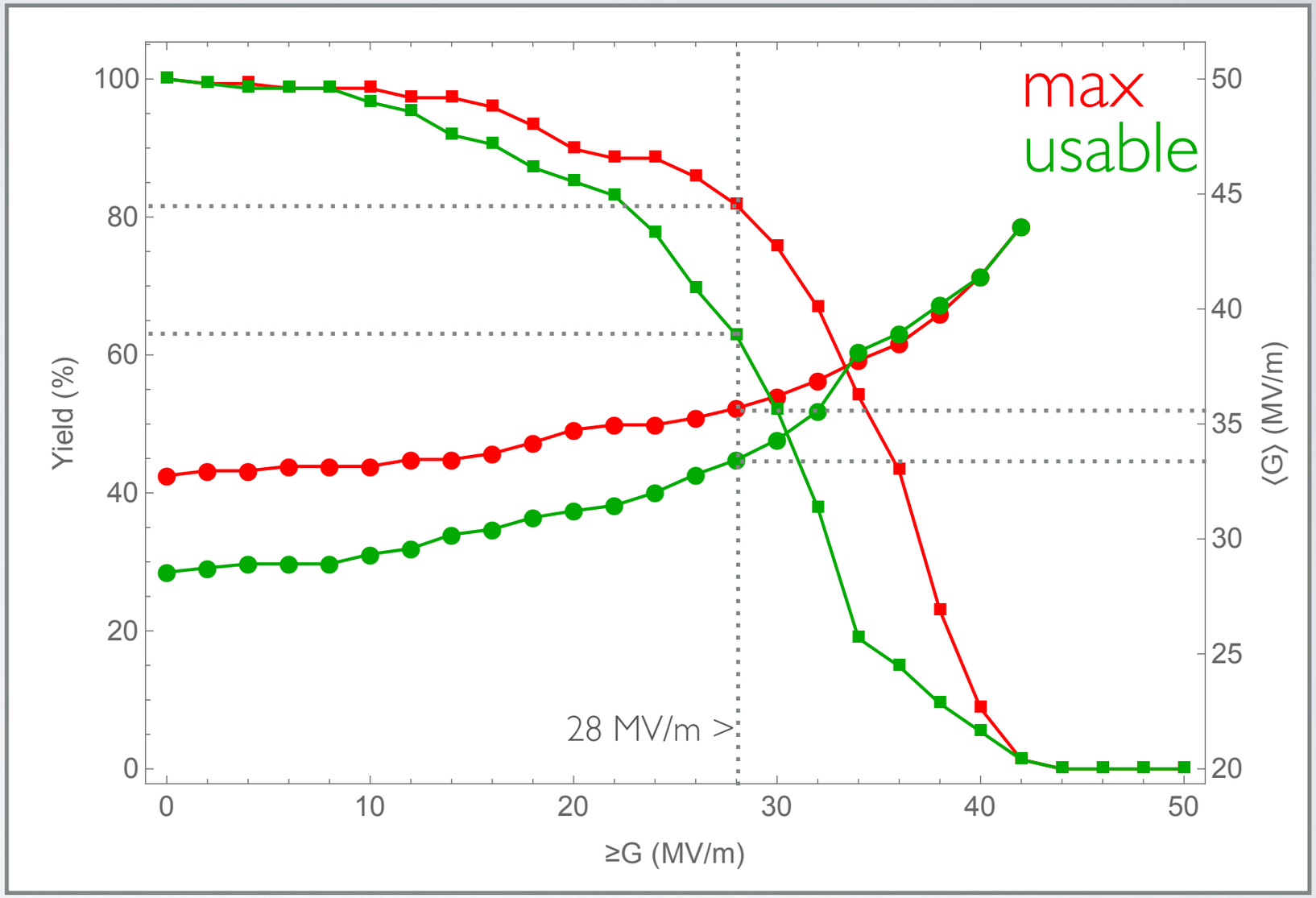
- as received
- Excluding "bad tests" (leaks, RF problems etc.)



	Tests	Average	rms	Yield@28	Yield@31.5	Yield@35
Max	148	32.8	7.6	82%	69%	48%
Usable	148	28.6	8.1	63%	41%	18%

YIELD (RI)

- as received
- Excluding "bad tests" (leaks, RF problems etc.)
- TDR assumption: 75% @ 28 MV/m with 35 MV/m avg (1st pass)



148 tests	Yield @ 28 MV/m	Average above 28 MV/m
Max gradient	82%	35.7 MV/m
Usable gradient	63%	33.4 MV/m

Note: 148/183 cavities included (81%): what happened to the missing 35 cavities?

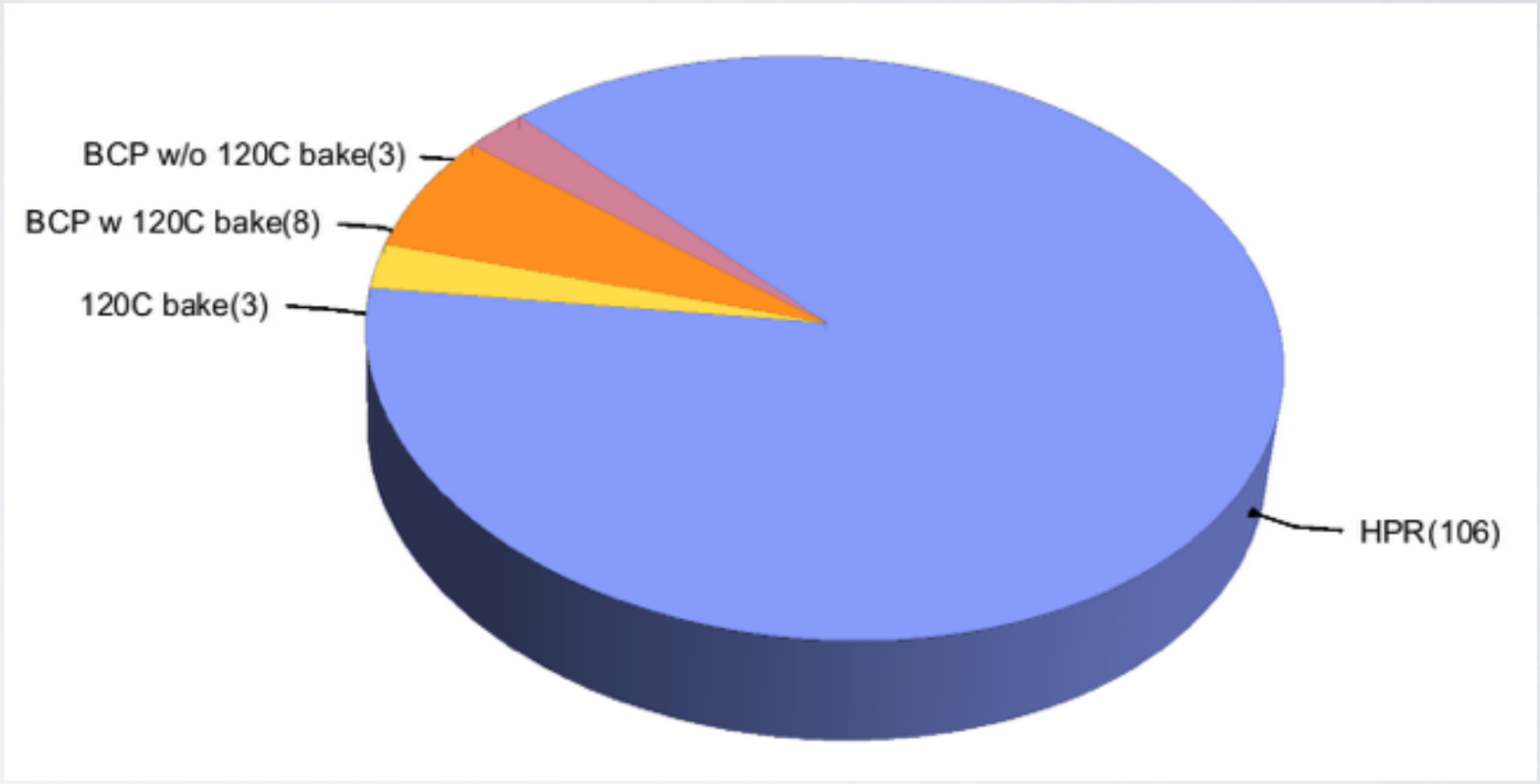
CAVITIES NOT INCLUDED

Failed or aborted "as received" tests	13
First test in DB flagged as	
retreatment at RI	20
retreatment at DESY	2

Inclusion of these tests changes statistics at the ~1% level

RETREATMENT

- Original retreatment criteria was <26 MV/m
  - ~40% of cavities
- Now <20 MV/m
  - ~20% of cavities
- FE dominated
  - mostly HPR



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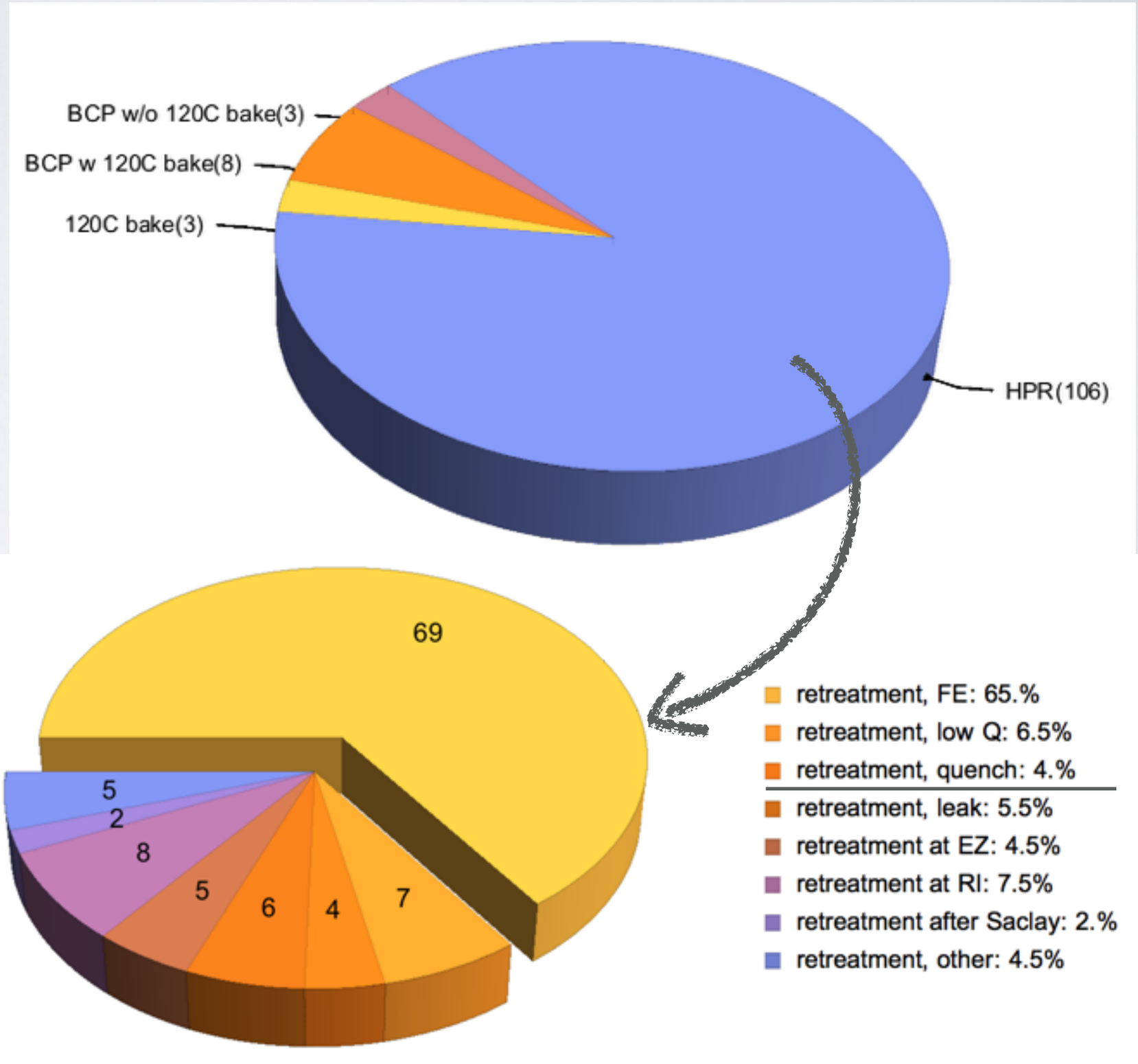
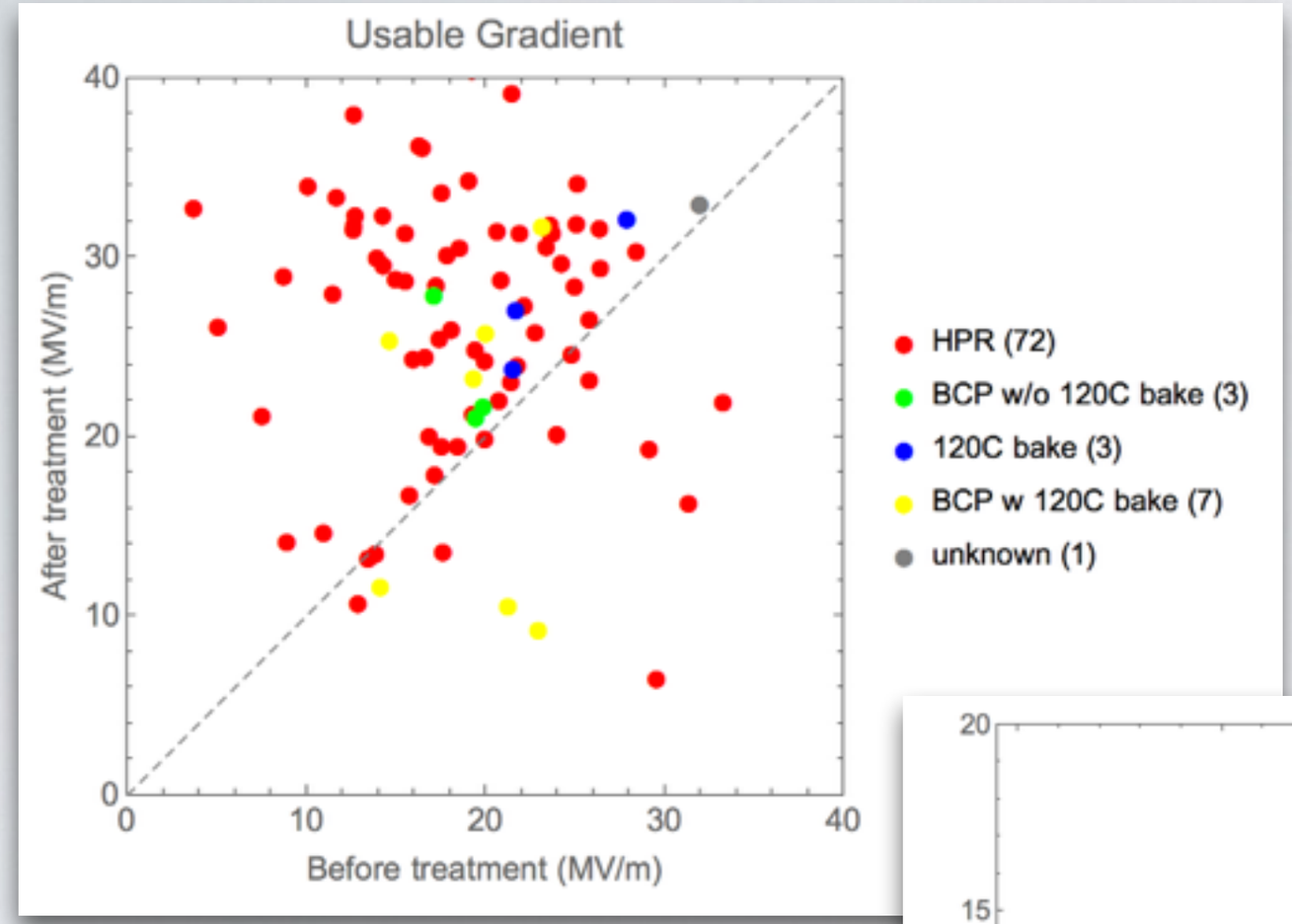
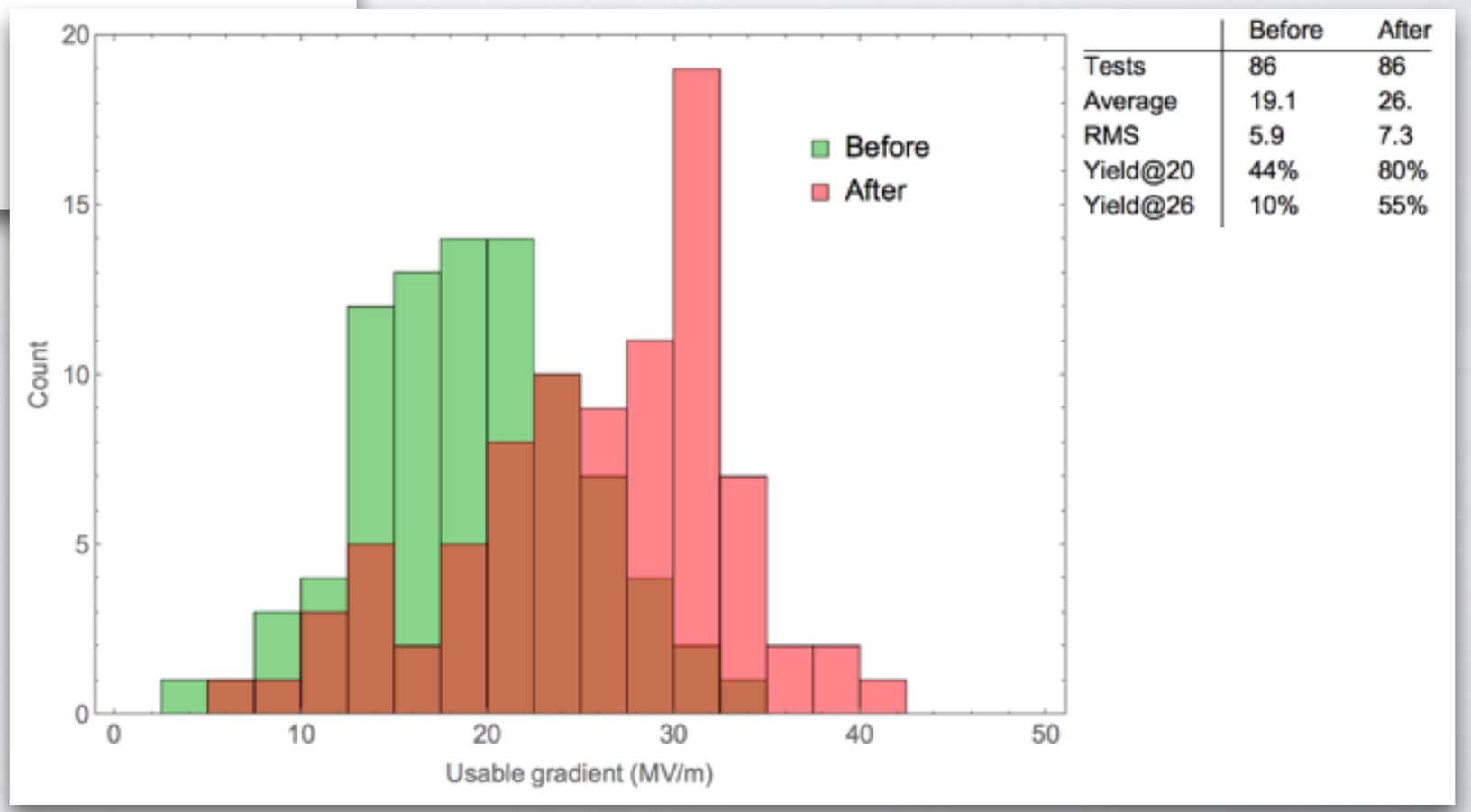


RETREATMENT: DIRECT COMPARISON

Both vendors



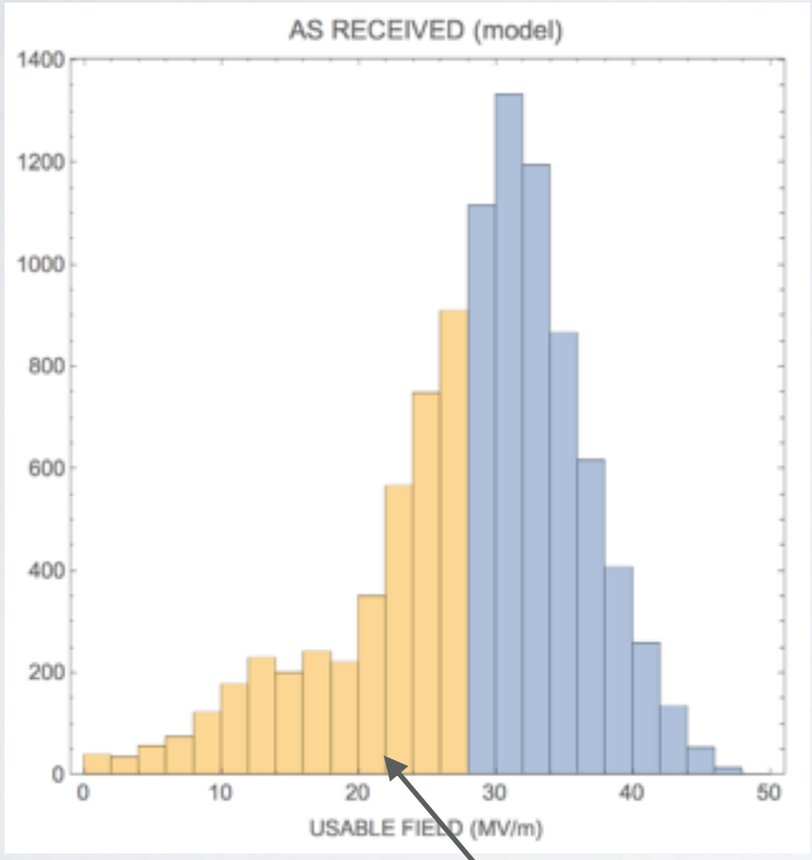


	Before	After
Tests	86	86
Average	19.1	26.
RMS	5.9	7.3
Yield@20	44%	80%
Yield@26	10%	55%

A MODEL FOR ILC

RI USABLE FIELD distribution used t generated 1st pass VT results

XFEL HPR results used to generate model for (HPR) retreatment



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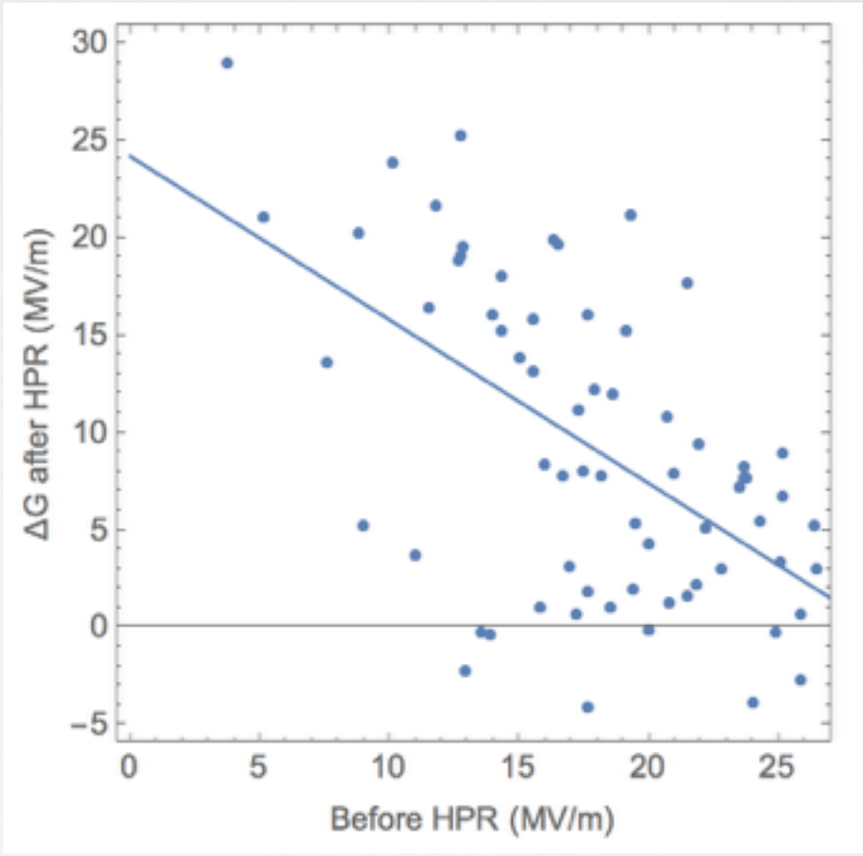
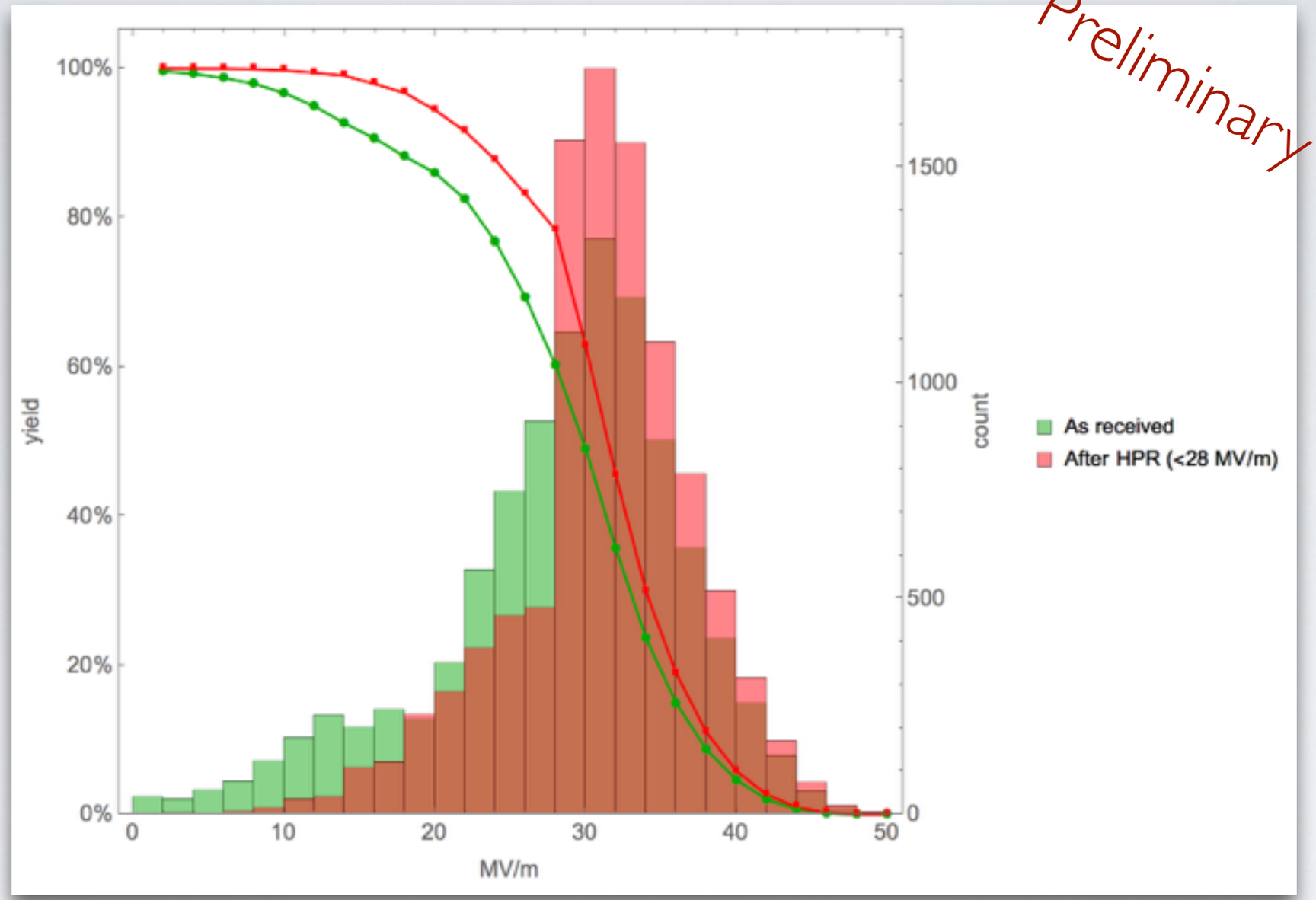


Retreatment model applied to cavities with *G*<28 MV/m

ILC MODEL - RESULT

Preliminary result!!



	Tests	Average	rms	Yield@28	Yield@31.5	Yield@35
As received	10 000	28.4	8.3	61%	40%	19%
Second Pass	10 000	30.9	6.4	77%	49%	24%

SOME INITIAL CONCLUSIONS

- RI (ILC recipe) results close to TDR assumptions
  - MAX FIELD 82% yield, <G>~35.7 MV/m
  - USABLE FIELD (XFEL) 61% yield <G>~33.4 MV/m
  - ILC TDR: 75% with <G> = 35 MV/m
- XFEL dominated by FE at low gradients for which simple HPR proves quite effective
- ILC projection of HPR retreatment increases UF yield 61% to 77%
  - 23% of cavities would still require further retreatment
  - projected tests per cavity = 1 + 0.4 (1st pass) + ~0.2 (2nd pass) + ~0.1 (other) ~ 1.7
- Next steps
  - Understand FE in XFEL production (on going)
  - Fold ILC projections into cost model (evaluate cost optimum)
  - Start looking at XFEL string assembly (too few stats right now)