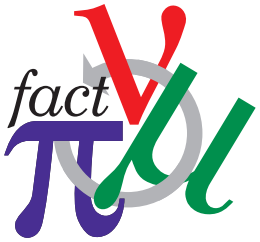
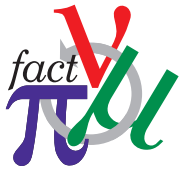


The CERN standard cooling channel sensitivity study

Peter Gruber

CERN-PS Division



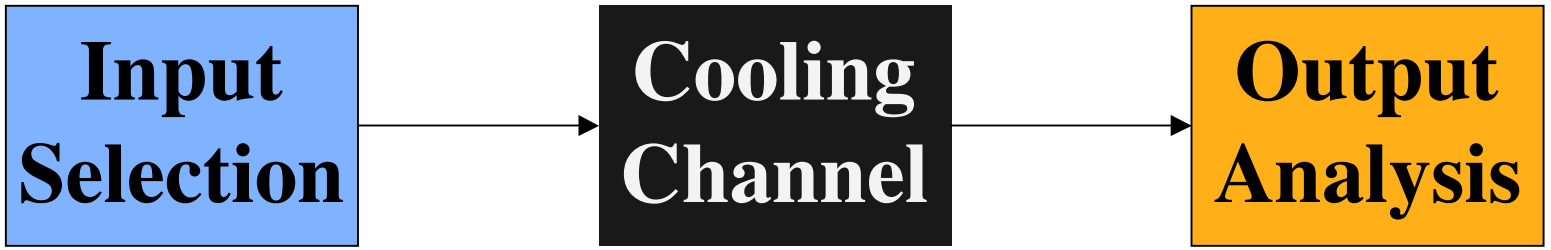
Aims

- Which input variables influence the output?
- Which channel parameters influence the output?
- What are the optimal values for the above?

PLUS

- To understand the cooling dynamics better

The cooling study



Input variables
- trans. emitance
- mean E
- delta E
- delta φ

Method

PARMILA creates 10.000 particles matched to MARS

Ch. parameters
- absorber material
- focusing
- rf

Method

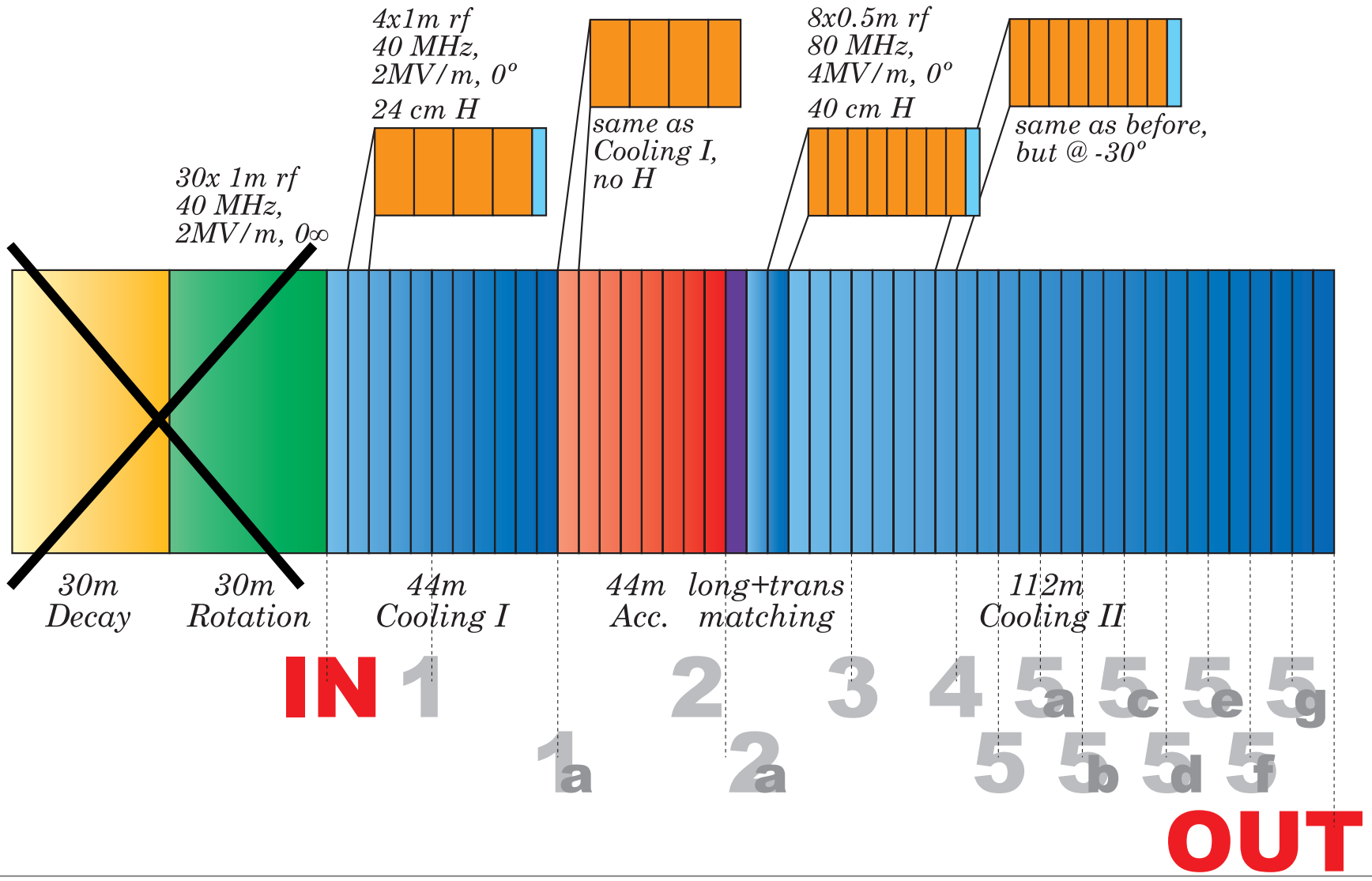
Tracking with TRAVEL

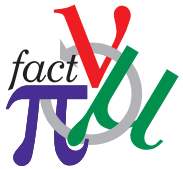
Results
- long+tr emitances
- transmission
- cooling factor
- phase space density

Methods

PARMILA emitance
PAW plots @16 locations

The 44/88MHz channel

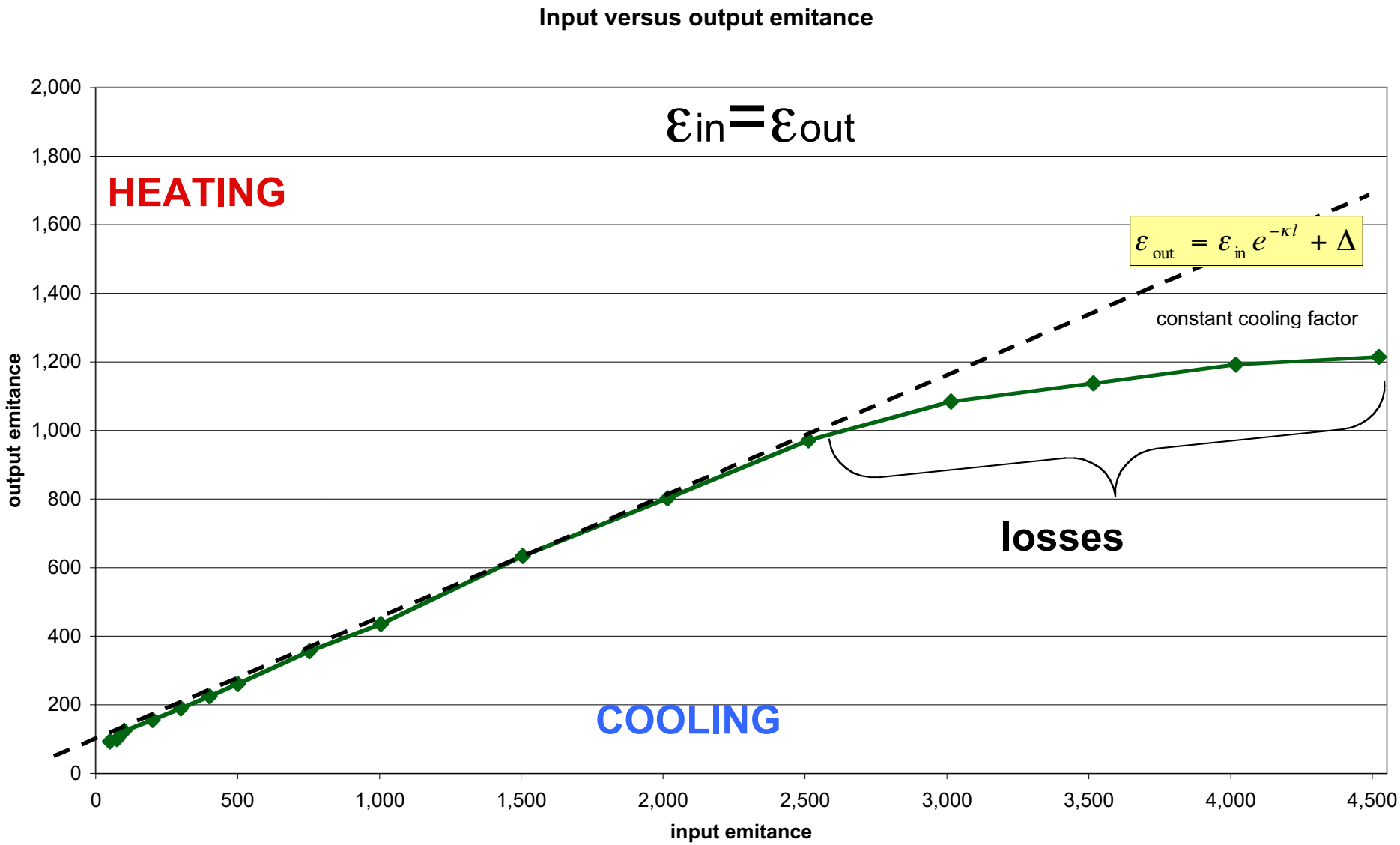


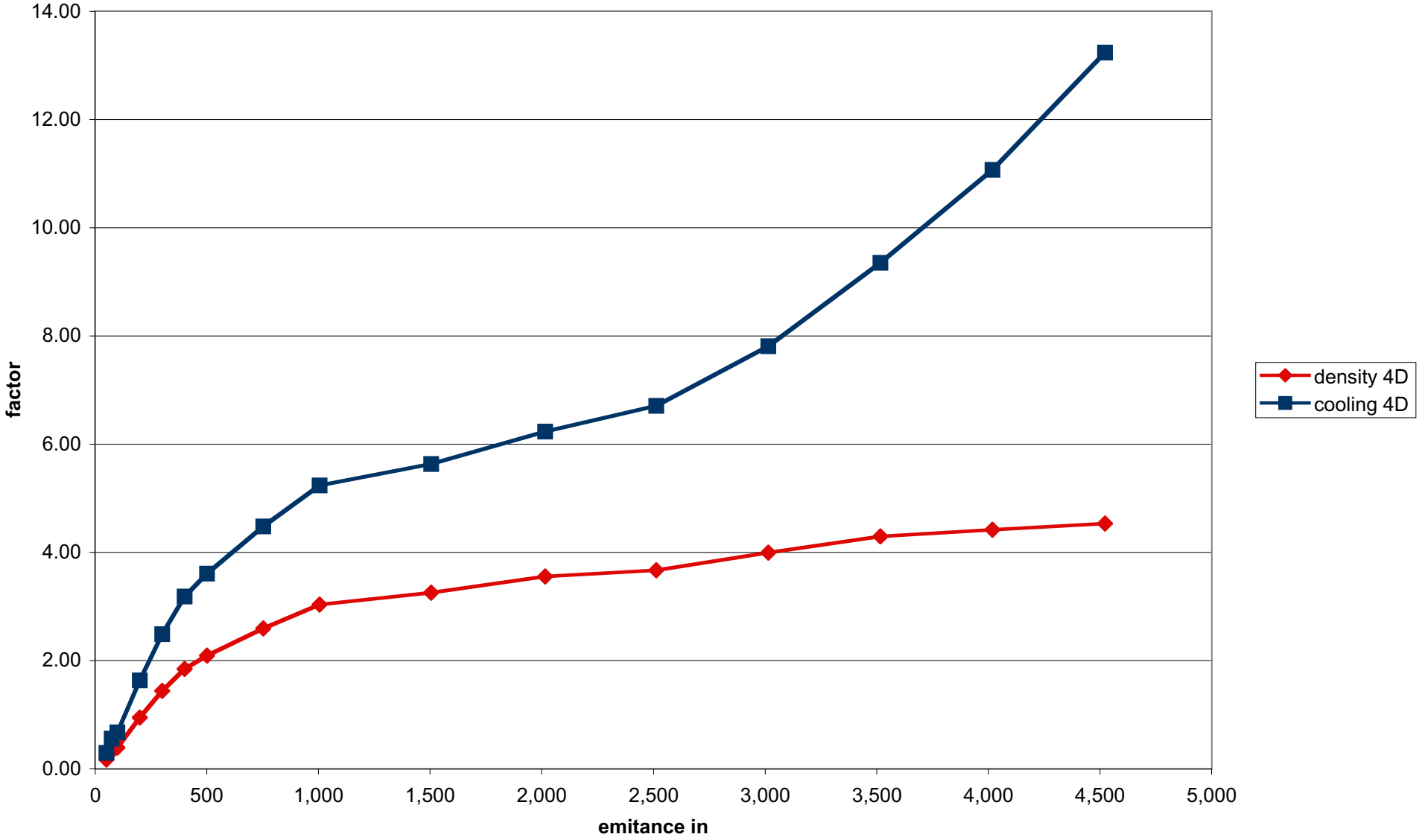


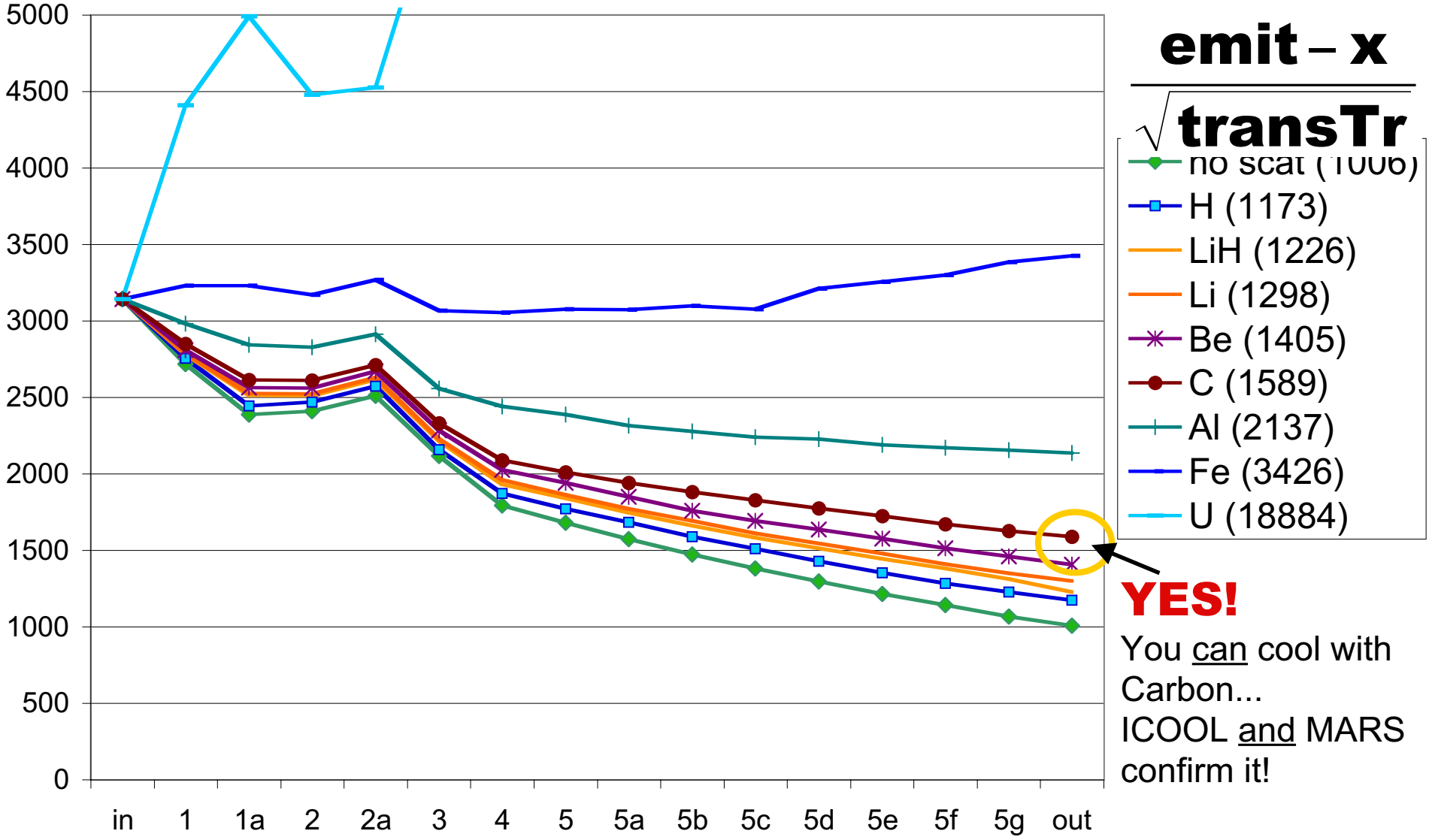
Modelling

- Beam from particle distribution, not from MARS simulation (<5% difference)
- Ideal solenoids
- Ideal rf field
- Acceptance in 2nd cooling part is 20cm instead of 15cm

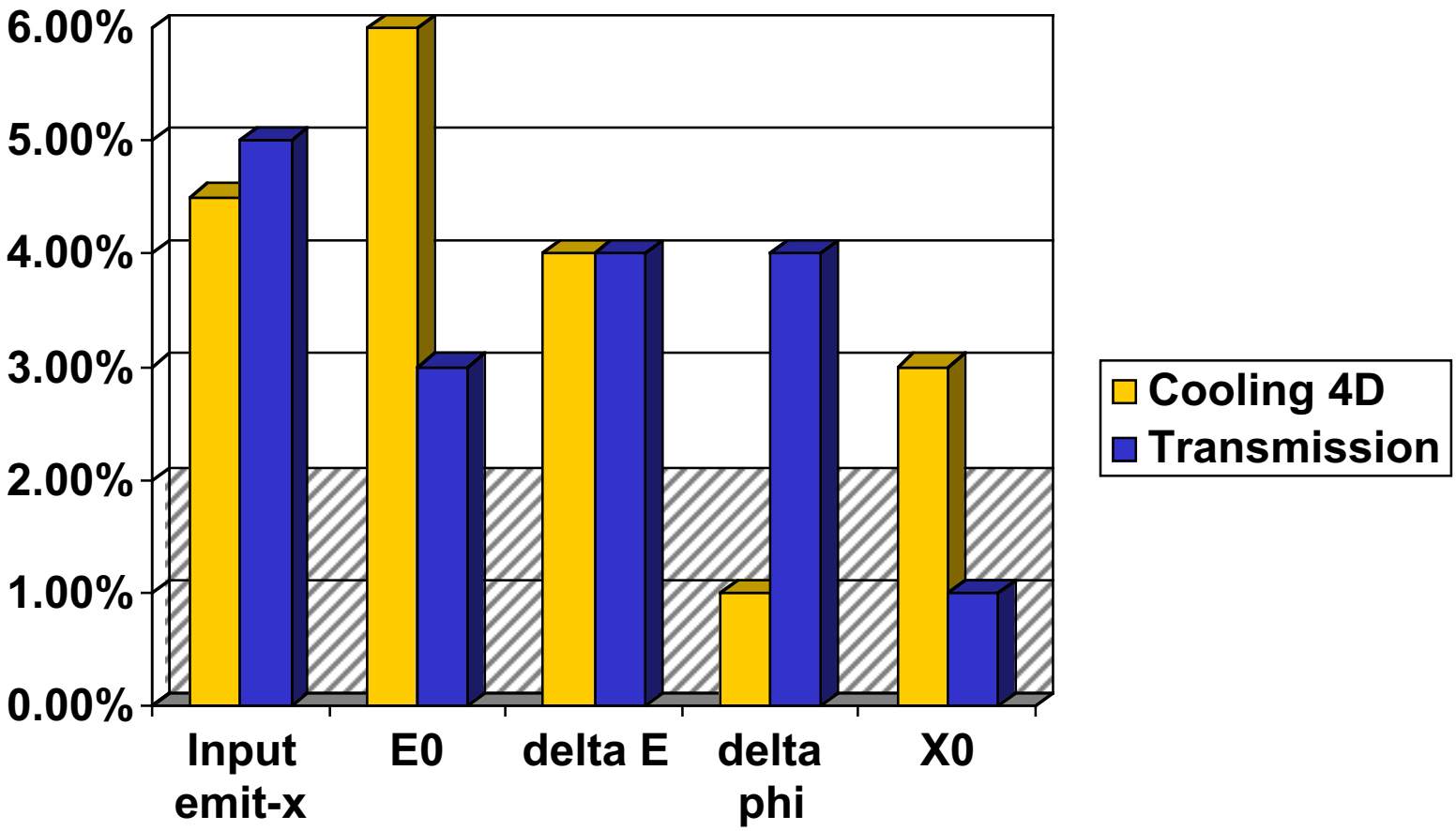
➡ Only relative statements


Input versus output emitance
εin=εout
HEATING
$\varepsilon_{out} = \varepsilon_{in} e^{-\kappa l} + \Delta$
constant cooling factor
losses
COOLING
output emitance
input emitance
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500


14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
factor
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
emitance in
density 4D
cooling 4D


5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
in
1
1a
2
2a
3
4
5
5a
5b
5c
5d
5e
5f
5g
out
emit – x
√transTr
no scat (1006)
H (1173)
LiH (1226)
Li (1298)
Be (1405)
C (1589)
Al (2137)
Fe (3426)
U (18884)
YES!
You can cool with Carbon...
ICOOL and MARS confirm it!

A 10% change ...


6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
Input emit-x
E0
delta E
delta phi
X0
Cooling 4D
Transmission

Summary

- This channel is very stable with respect to the parameters investigated
- Our biggest problem is not cooling, but beam dynamics
- Further investigation needed for sensitivity towards focusing parameters (→G. Franchetti)