

MADMAX Seed Setup: Disk Placement Algorithm

Stefan Knirck

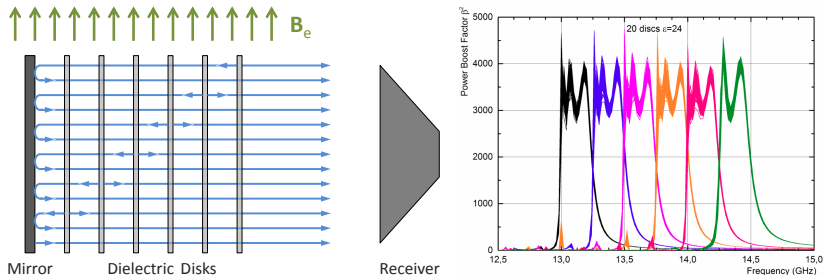
B. Majorovits, C. Moore, O. Reimann



Excellence Cluster Universe



The MADMAX Idea



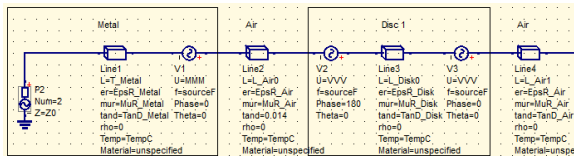
$$P/A = 2.2 \times 10^{-27} \text{ W m}^{-2} \left(\frac{B_e}{10 \text{ T}} \right)^2 C_{a\gamma}^2 \cdot \beta^2$$

β^2 : power emitted by booster / power emitted by single mirror ($\epsilon = \infty$)

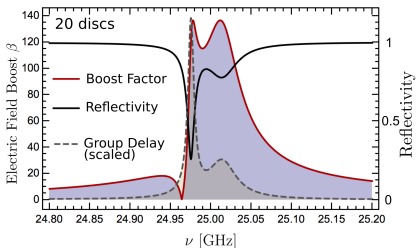
How to control Boostfactor?

Controlling the Boost Factor

Simulate it!
1D, ideal



Measure Correlated Quantities!



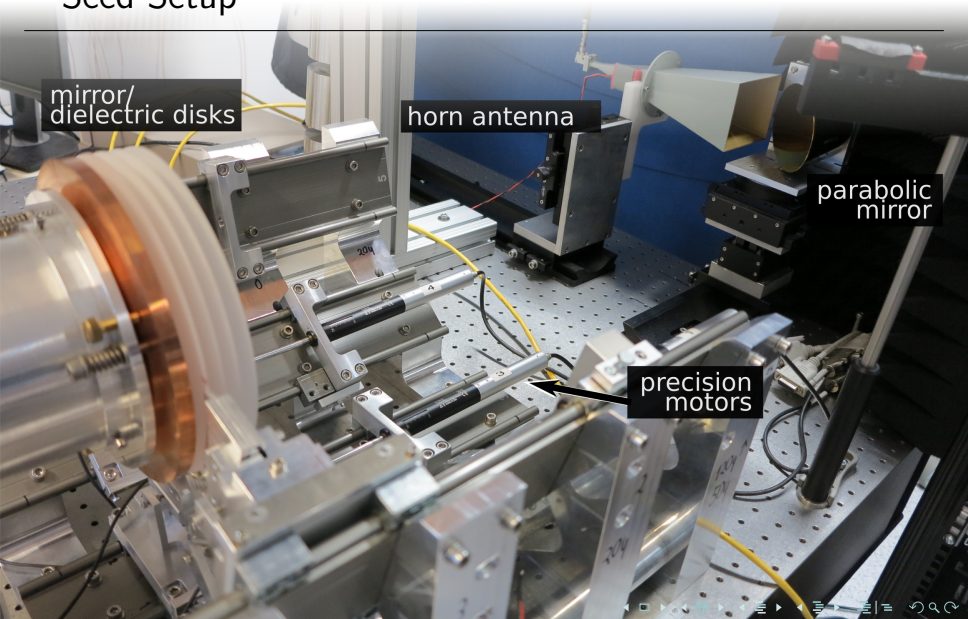
Reflectivity
(Group Delay)

$$\tau_g = -\frac{d\Phi}{d\omega}$$

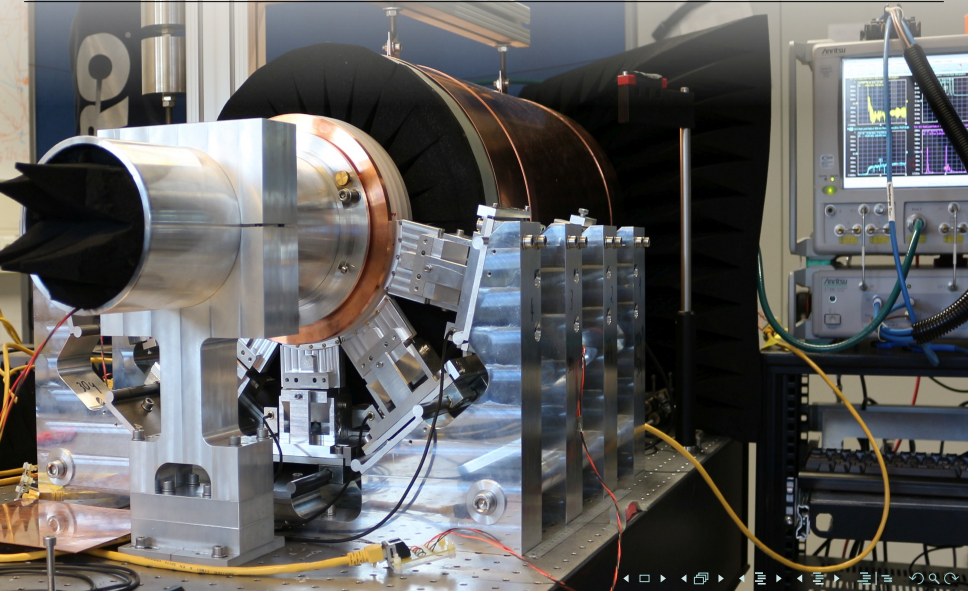
Transmission

Fit Disk Spacings

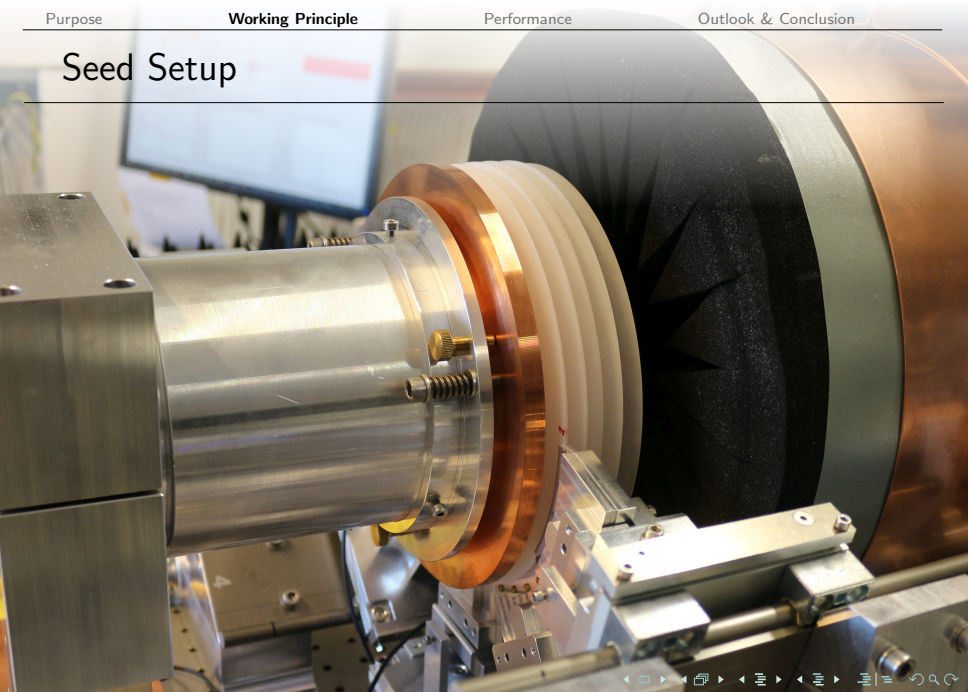
Seed Setup



Seed Setup

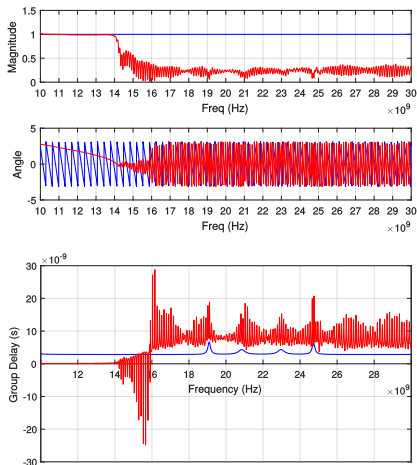


Seed Setup



Signal Processing (Basics)

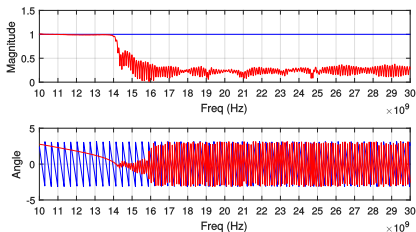
— simulation
— measurement



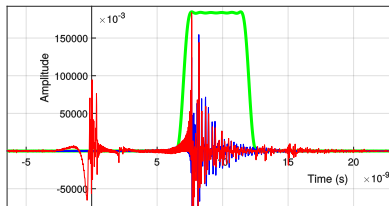
$$\tau_g = -\frac{d\Phi}{d\omega}$$

Signal Processing (Basics)

— simulation
— measurement

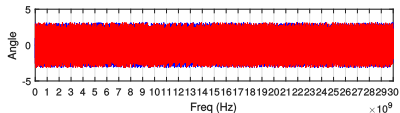
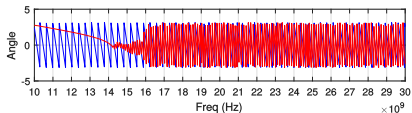
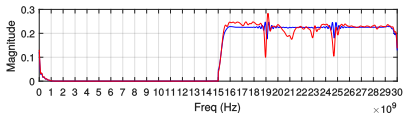
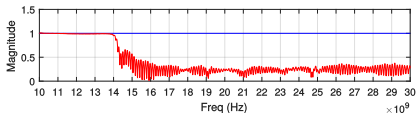


FFT⁻¹

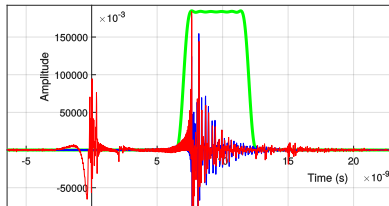


Signal Processing (Basics)

— simulation
— measurement

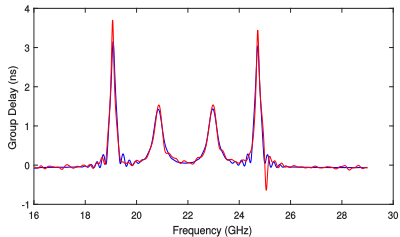
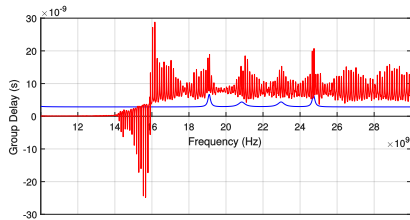
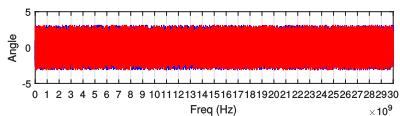
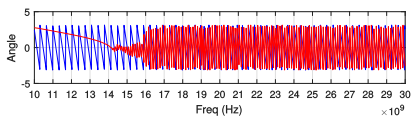
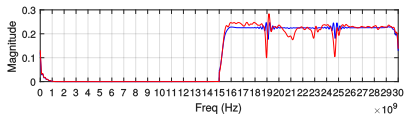
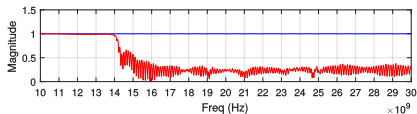


FFT⁻¹

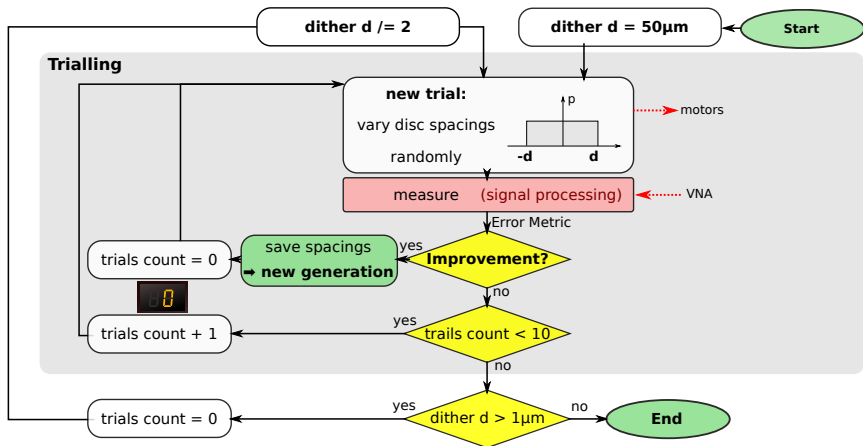


FFT

Signal Processing (Basics)

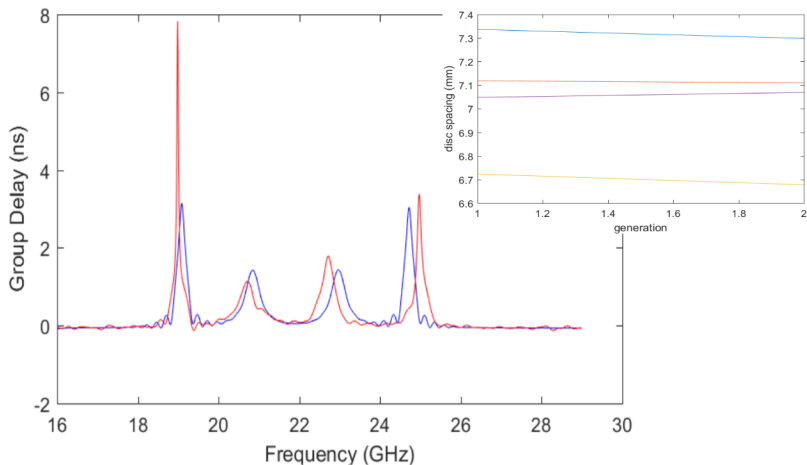


Fitting Algorithm (Basics)



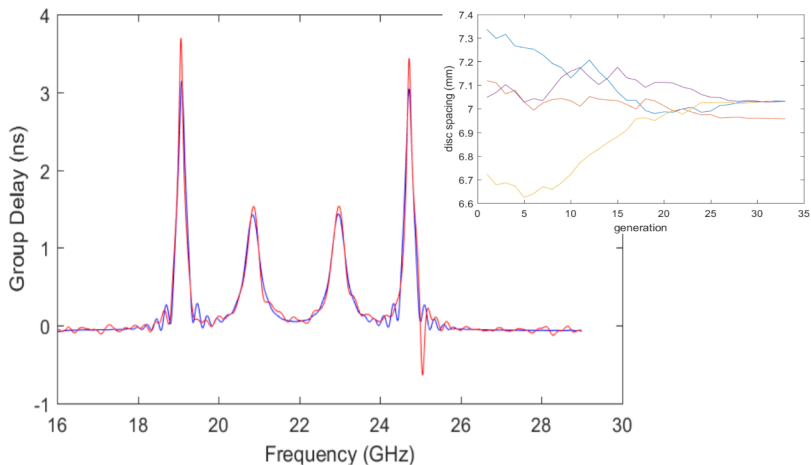
Fitting Algorithm

— simulation
— measurement



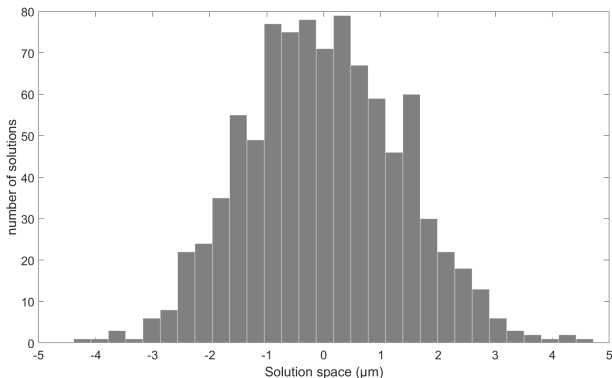
Fitting Algorithm

— simulation
— measurement



Disk Spacing Repeatability - One Disk

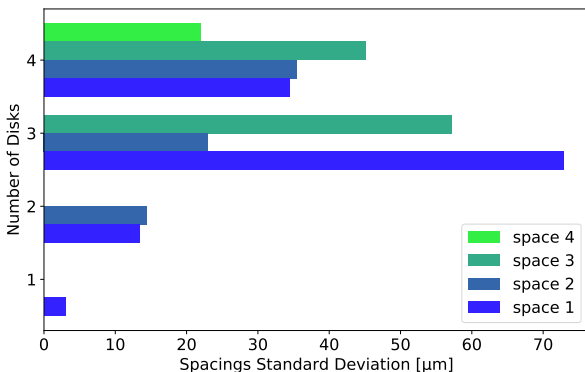
initial misplacement: $\pm 200 \mu\text{m}$ (*uniform distribution*)
distance from mirror $d_1 = 8 \text{ mm}$



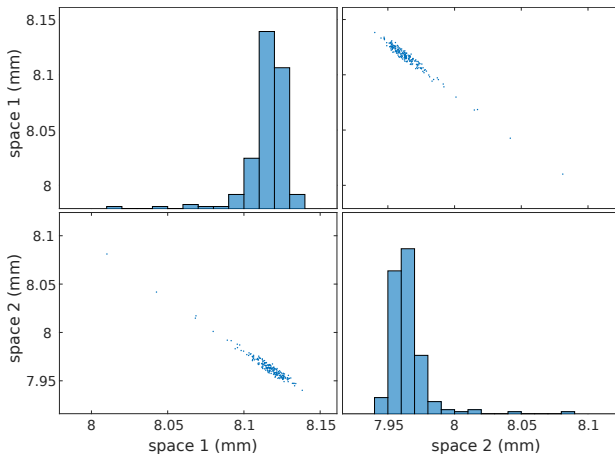
$\pm 2 \mu\text{m}$ **reproducible**

Disk Spacing Repeatability - More Disks

initial misplacement: $\pm 200 \mu\text{m}$ (*uniform distribution*)
all distances $d_i = 8 \text{ mm}$

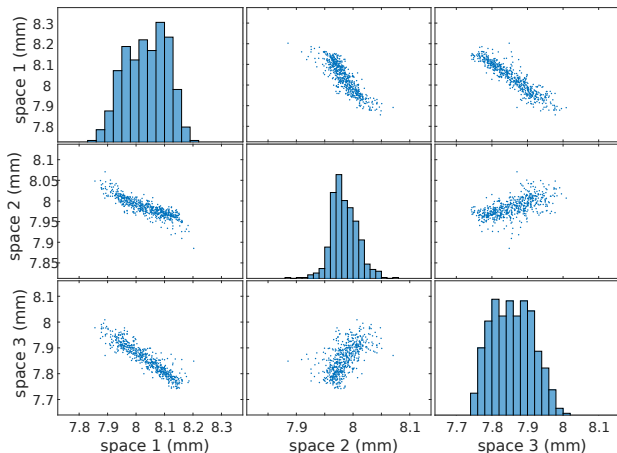


Disk Spacing Repeatability - 2 Disks



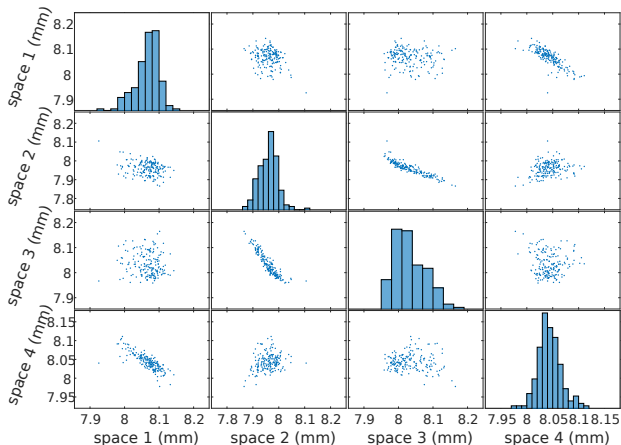
Spacings Correlated

Disk Spacing Repeatability - 3 Disks



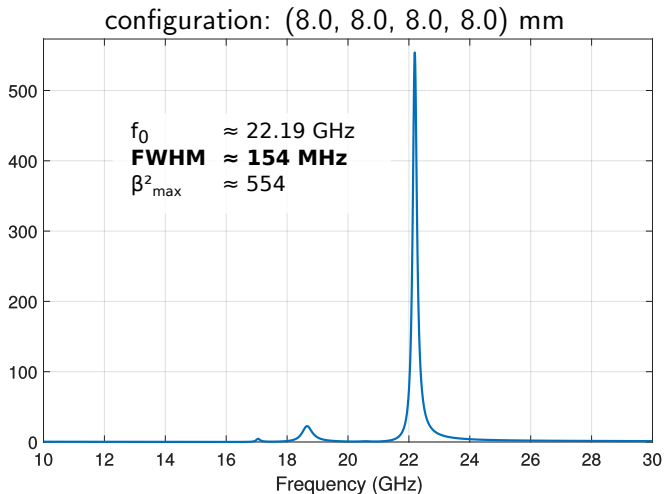
Spacings Correlated

Disk Spacing Repeatability - 4 Disks



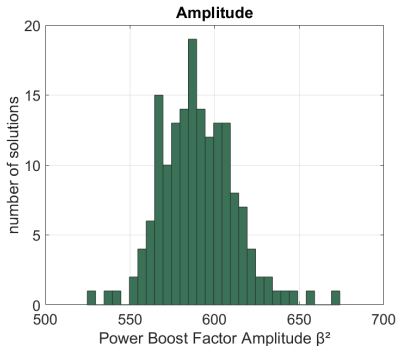
Spacings Correlated

Boost Factor

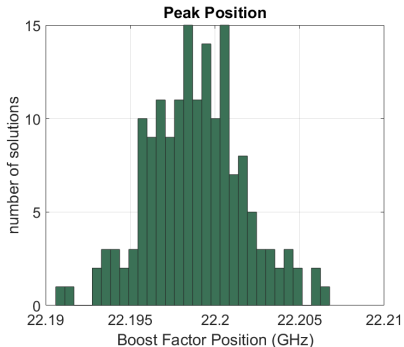


Boost Factor

fitting Model (simulation) to Measurement after alignment



± 40



± 4 MHz

reasonably under control

Next Steps

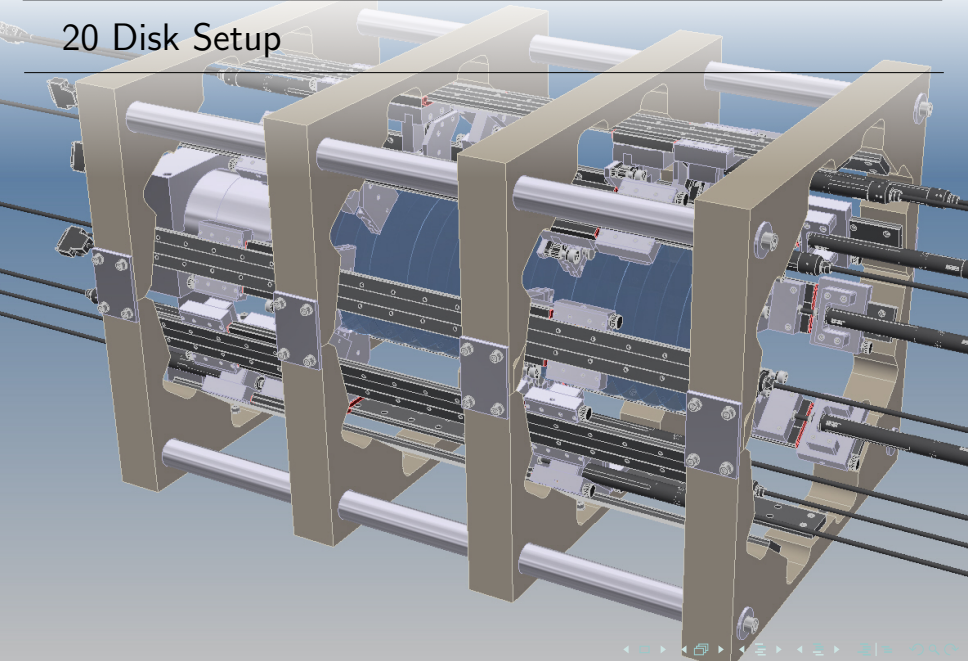
until now all spacings equal
try fitting arbitrary cases

until now up to 4 disks
extend to 20 disks

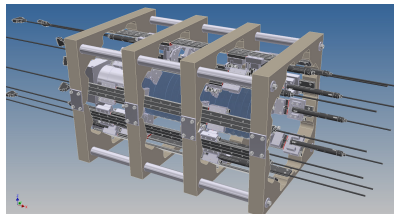
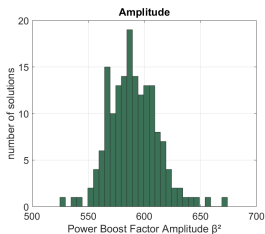
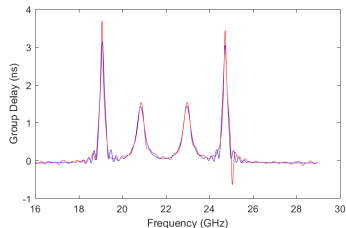
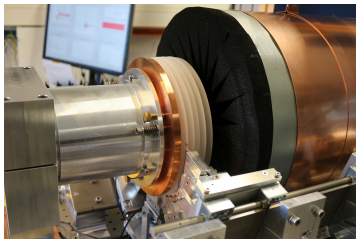
group delay & refelectivity
incorporate transmission

until now 10 GHz to 30 GHz
extend frequency range

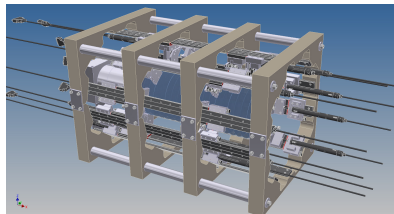
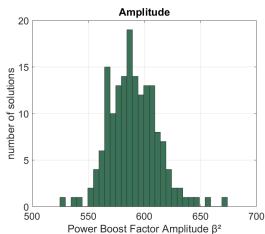
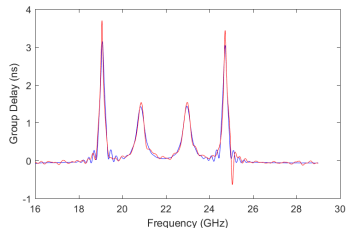
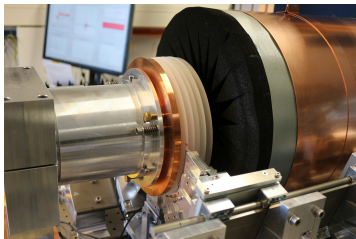
20 Disk Setup



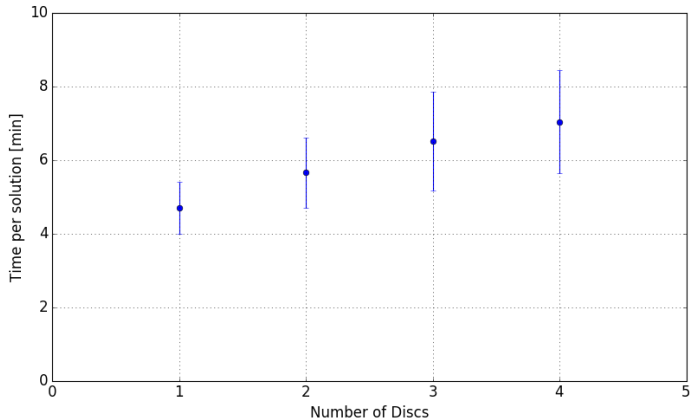
Conclusions



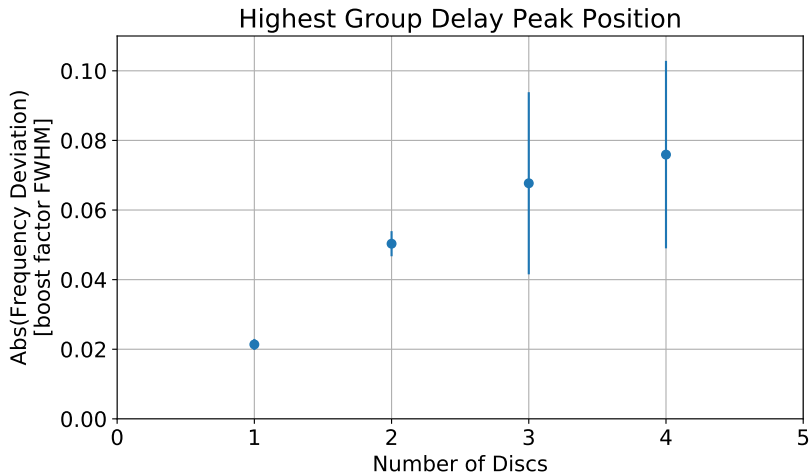
Thank You very much



Time Scaling of Algorithm

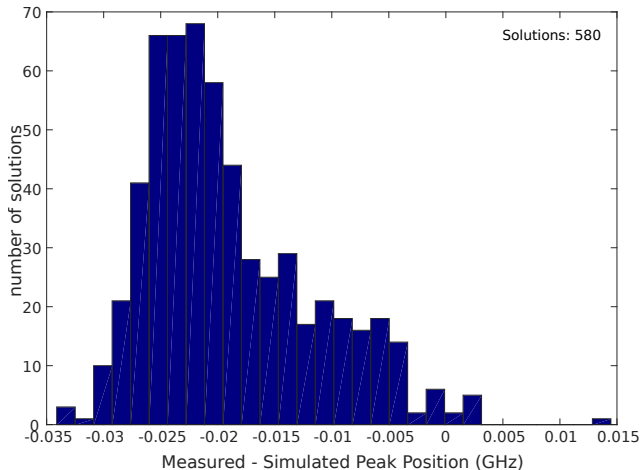


Frequency Accuracy

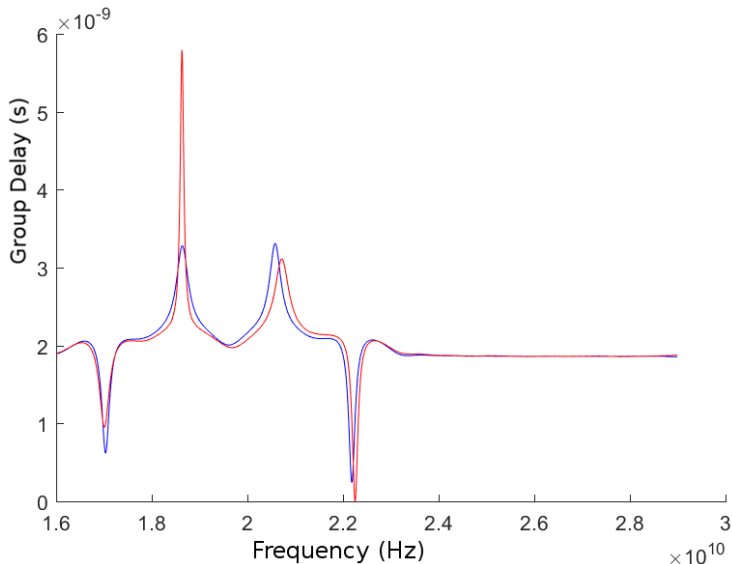


Frequency Accuracy

3 disks



Negative Group Delay



Time Window for Negative Group Delay

