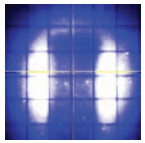
Proton Irradiation Facility at INR RAS linac

Sergei Gavrilov
on behalf of the PIF team and users



INR RAS linac in Troitsk (Moscow)

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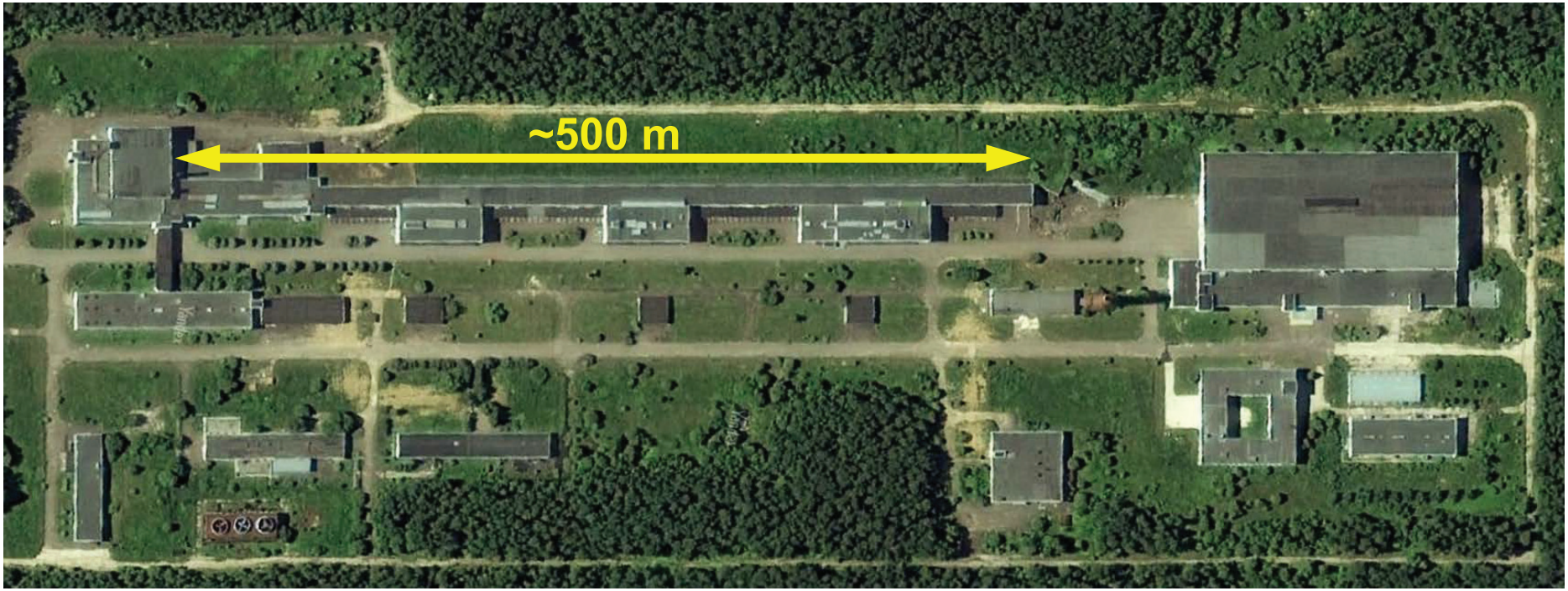

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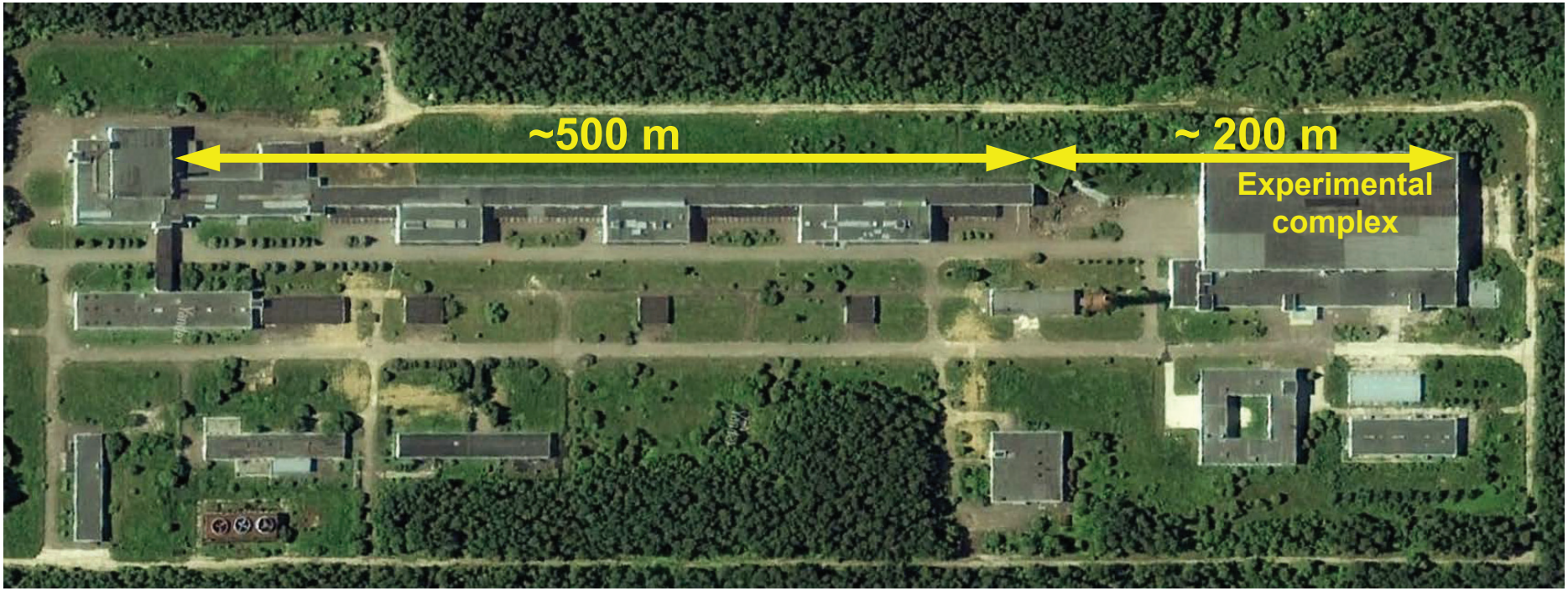

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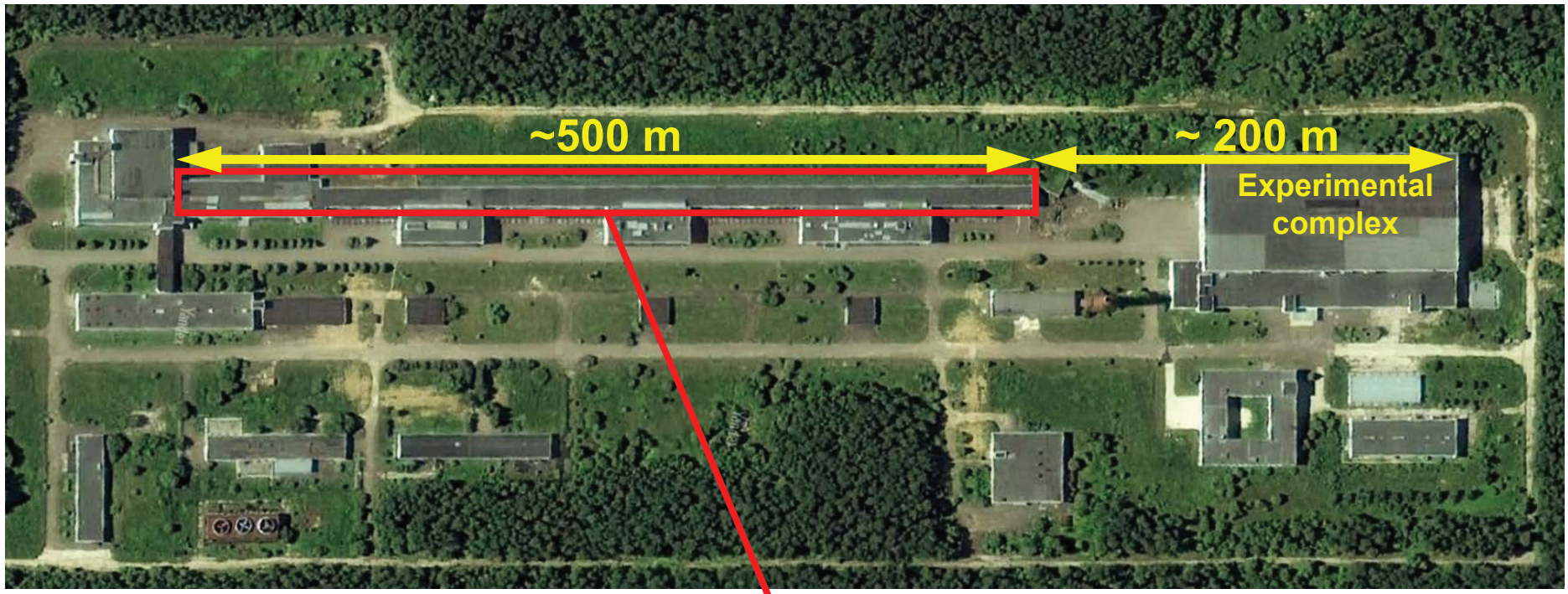

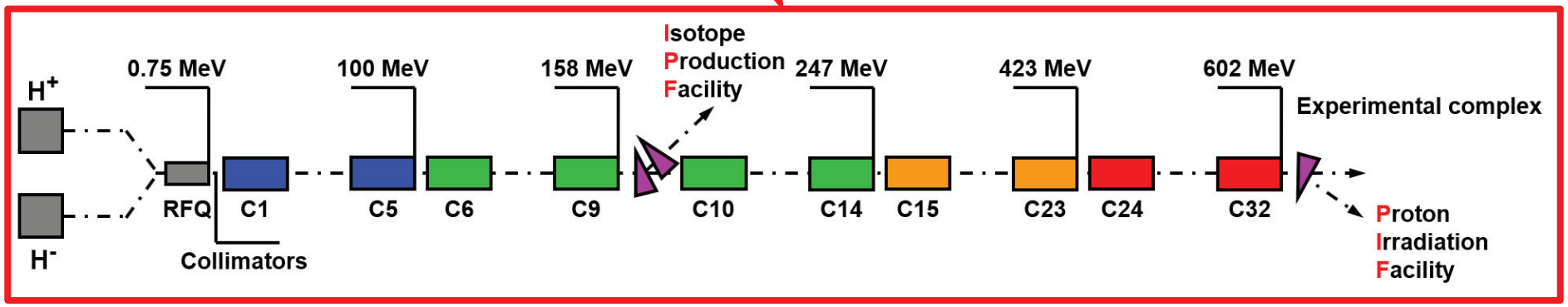

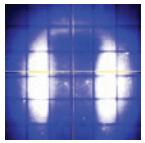

PIF design

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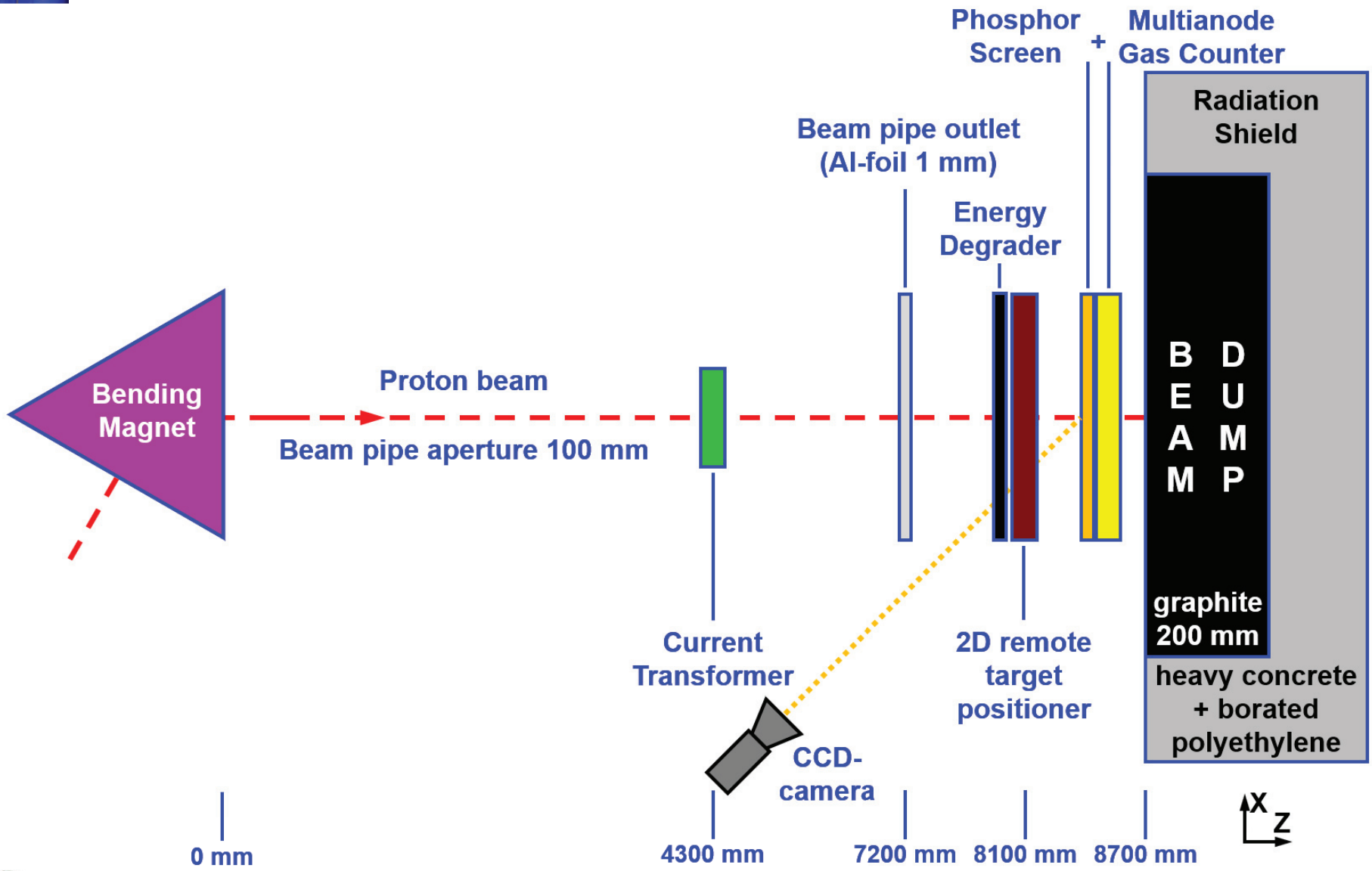
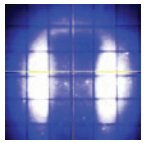

Phosphor Screen
+
Multianode Gas Counter
Radiation Shield
Beam pipe outlet (Al-foil 1 mm)
Energy Degrader
Bending Magnet
Proton beam
Beam pipe aperture 100 mm
B E A M
D U M P
graphite 200 mm
heavy concrete + borated polyethylene
Current Transformer
2D remote target positioner
CCD-camera
X
Z
0 mm
4300 mm
7200 mm
8100 mm
8700 mm



Operation parameters

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1) Beam energy: 20÷210 MeV discretely + individual degrader
2) Number of particles per pulse: 10^7÷10^{12} (10^6÷10^{11} p/(pulse*cm^2))
3) Pulse duration: 0.3÷180 μs
4) Pulse repetition rate: 1÷50 Hz discretely + single pulses

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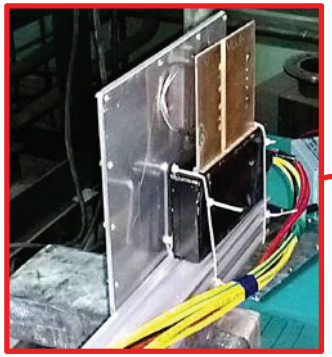

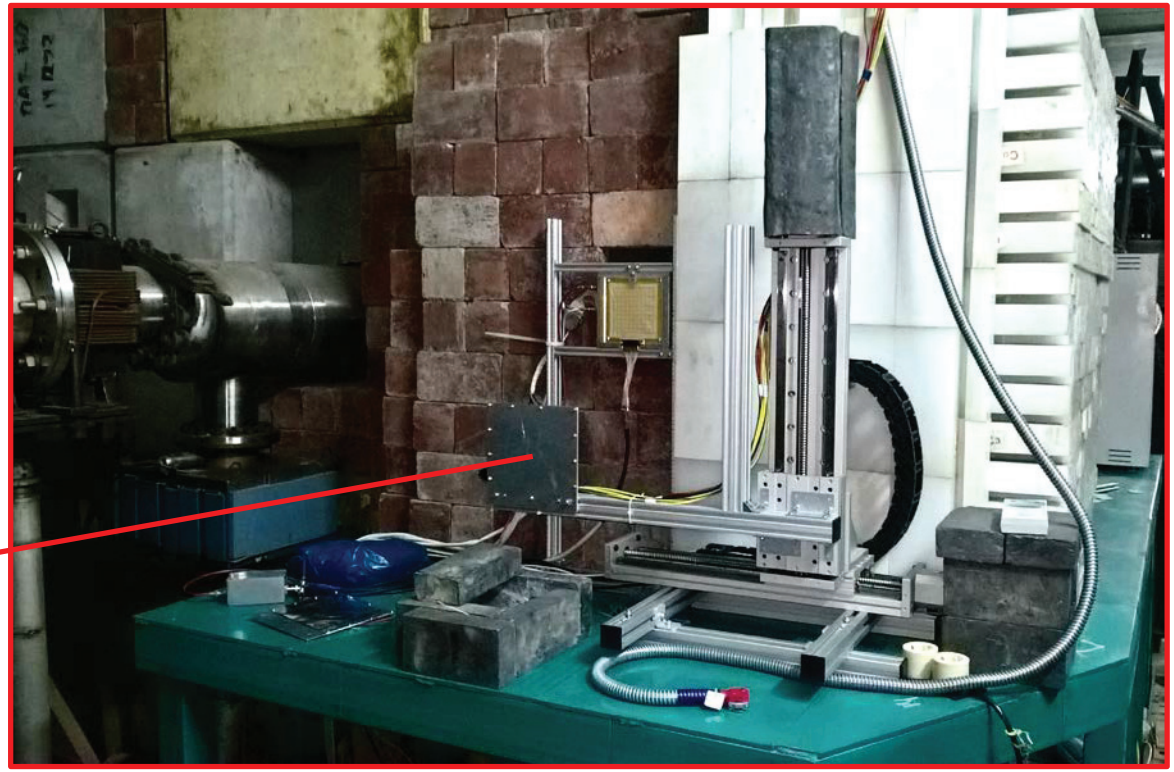

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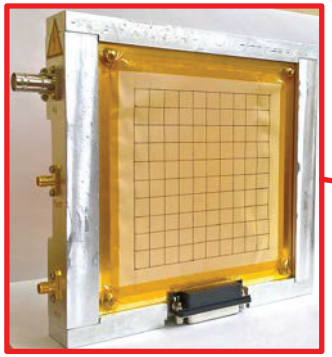

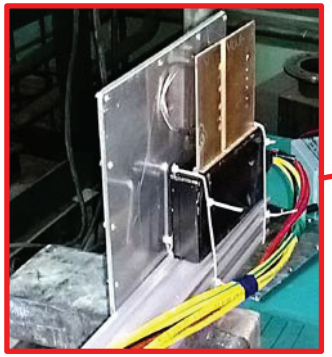

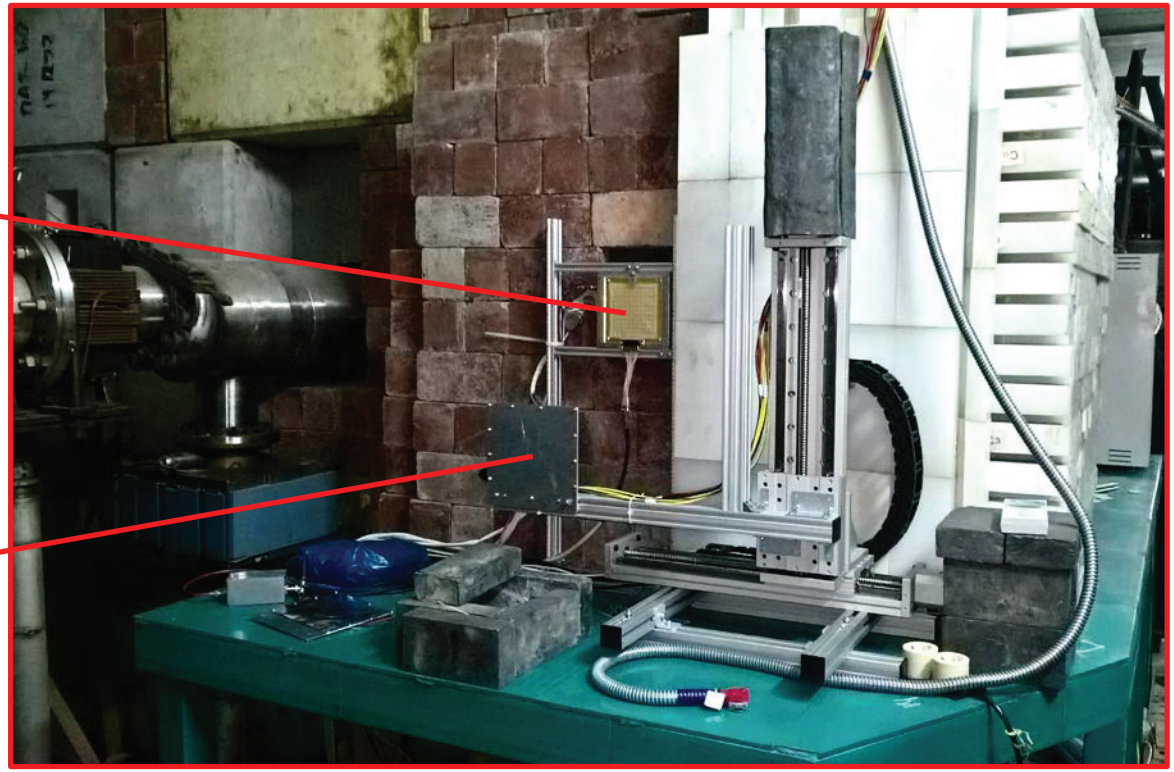

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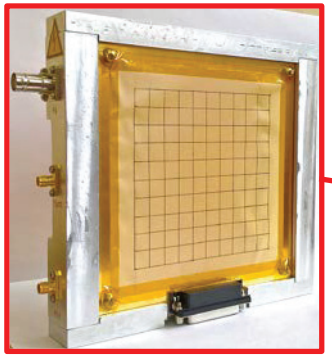

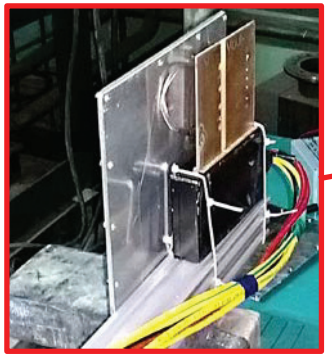

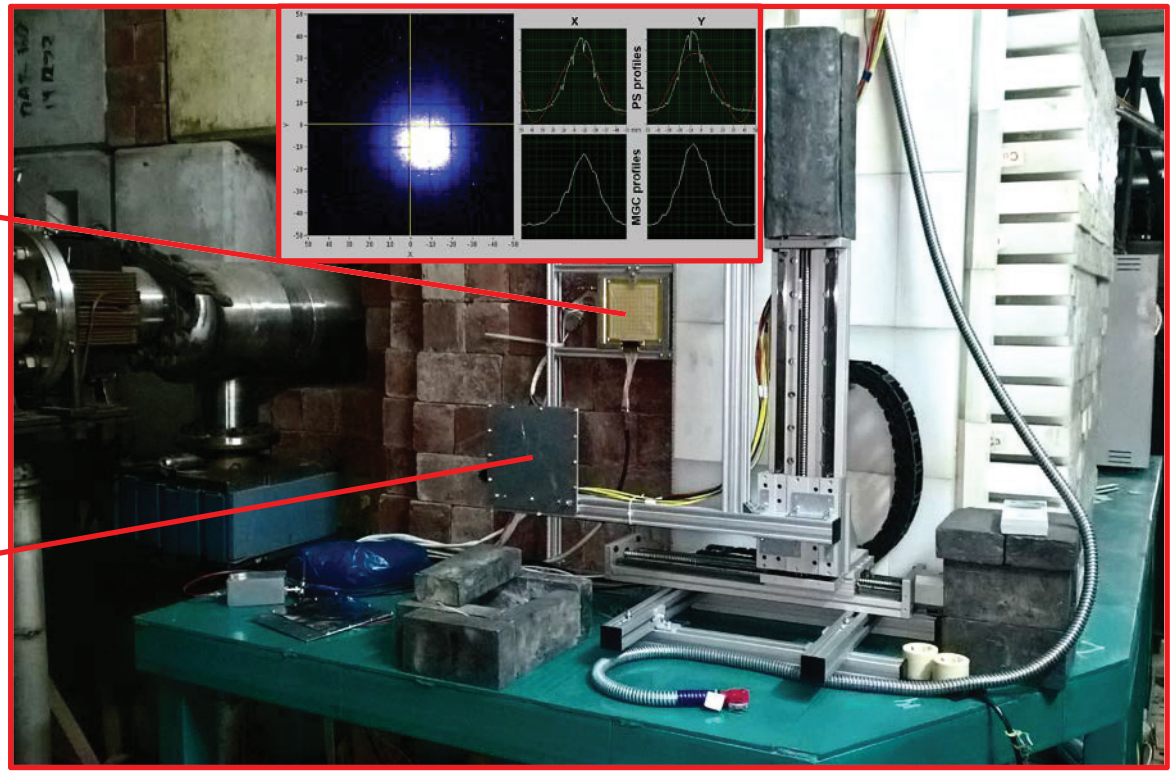

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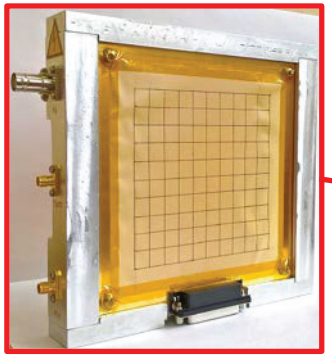
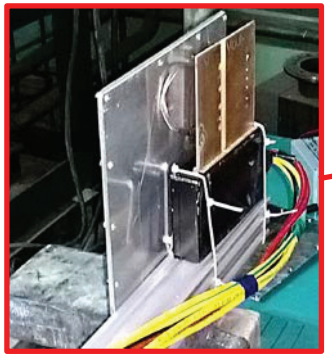
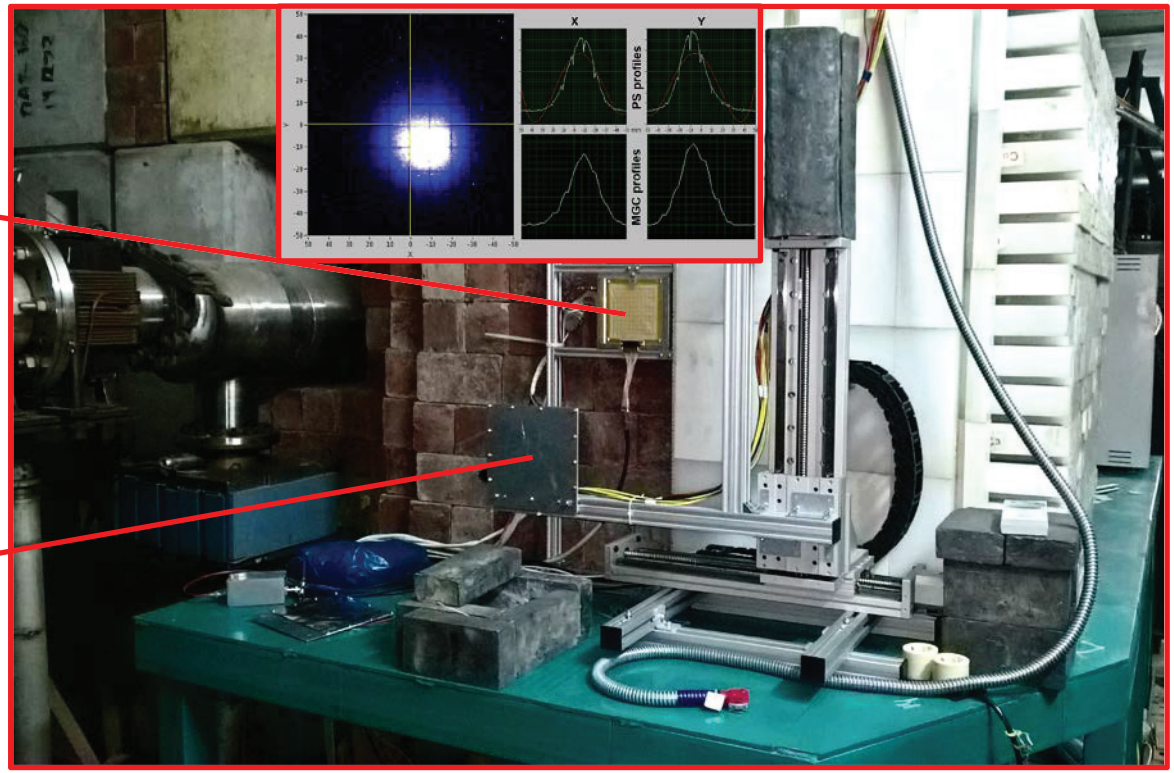
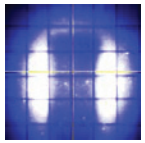


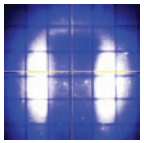




5) Average irradiation nonuniformity: < 20%
6) Irradiated area:< 300*300 mm^2
7) Target mass: < 10 kg
8) 5÷10m-long cables to front-end electronics, fiber-optic + GigE to control room



First results



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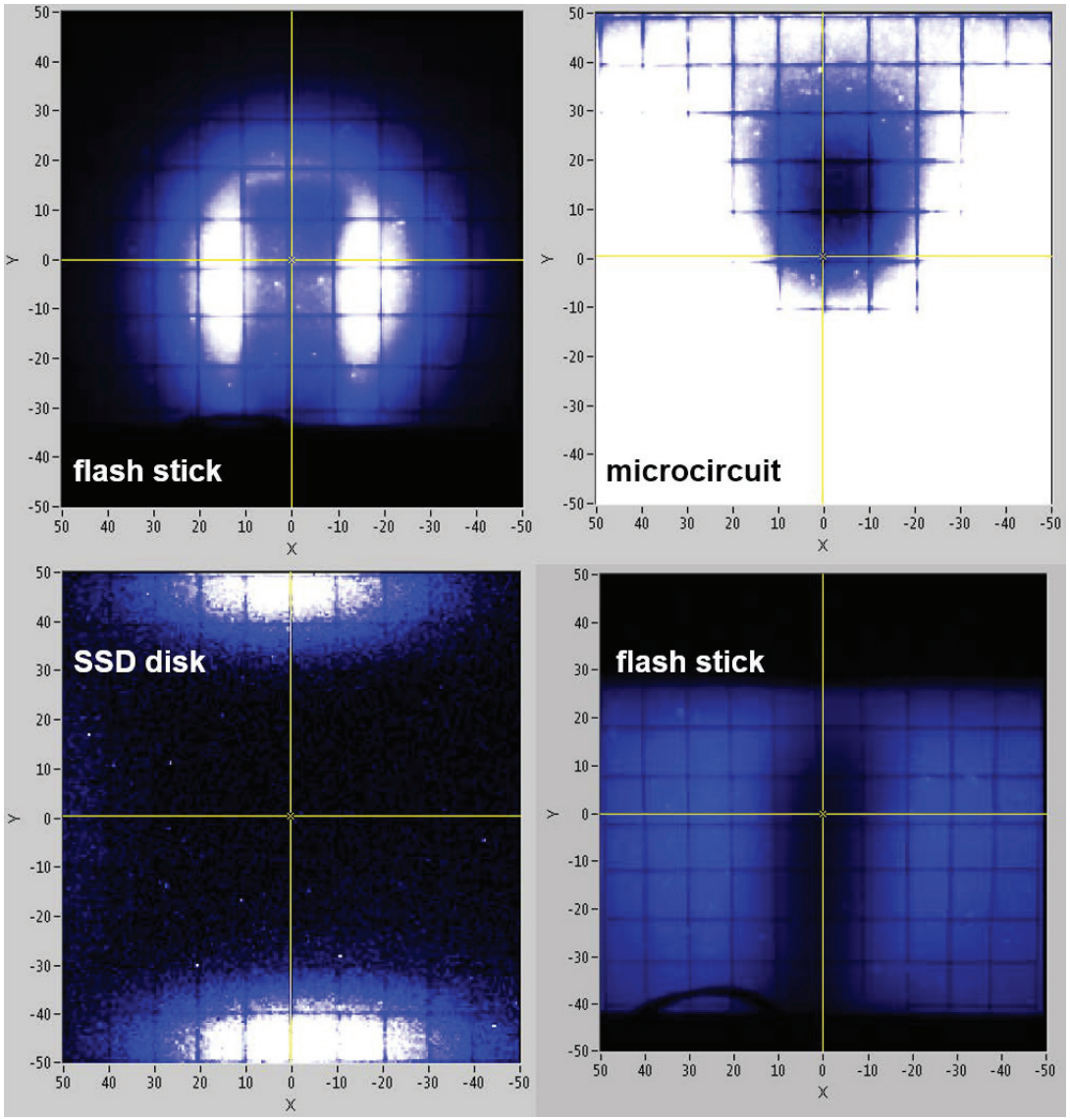
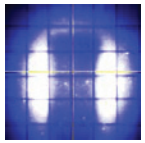
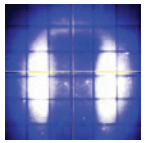


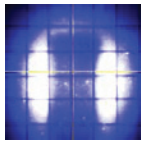


Lessons learned



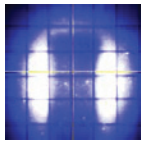
Lessons learned

- ✓ **Energy on demand**



Lessons learned

- ✓ Energy on demand
- ➢ Energy spread



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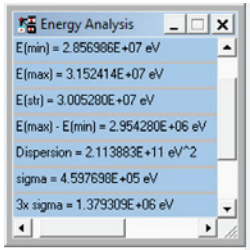
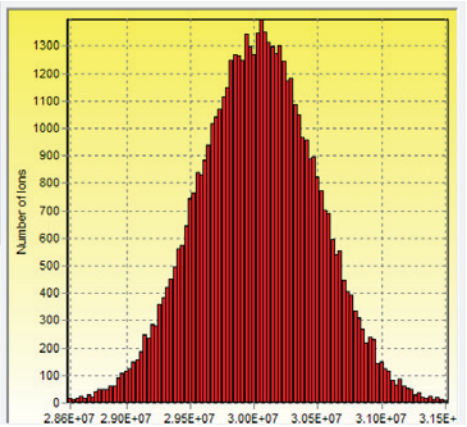
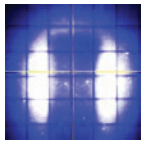


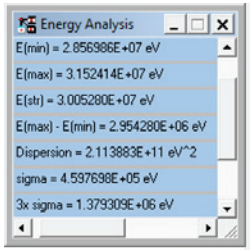
49 MeV after
1mm Al
+ 900mm Air
+ 4.6mm Al





Lessons learned

- ✓ Energy on demand
- ✓ Intensity range
- ➢ Energy spread



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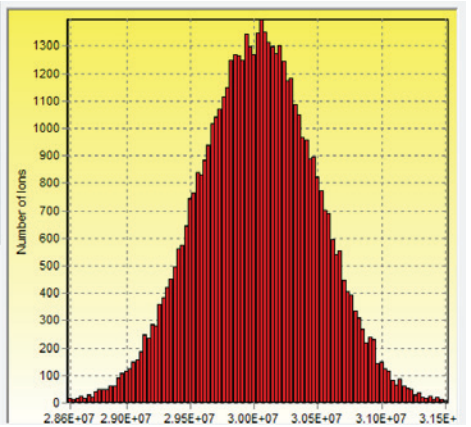

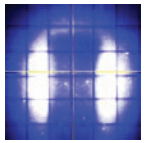

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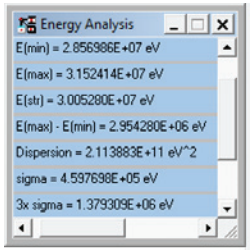
➢ **Energy spread**



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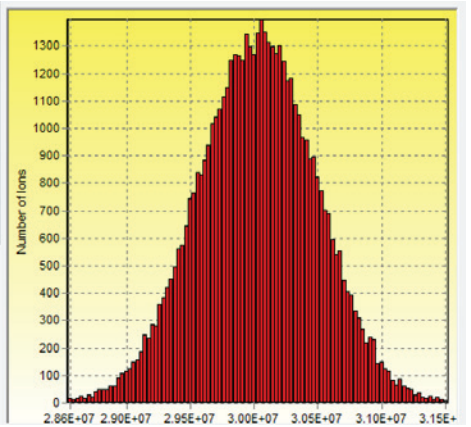
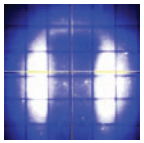


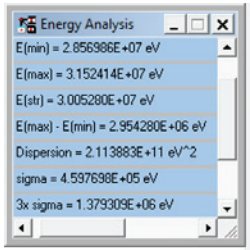
✓ **Intensity range**

➢ **Beam instrumentation zoo**



Lessons learned

- ✓ Energy on demand
- ➢ Energy spread



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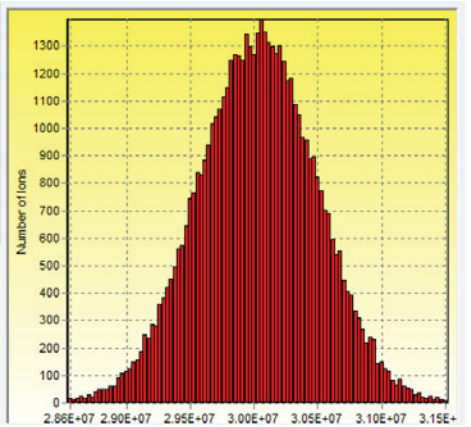

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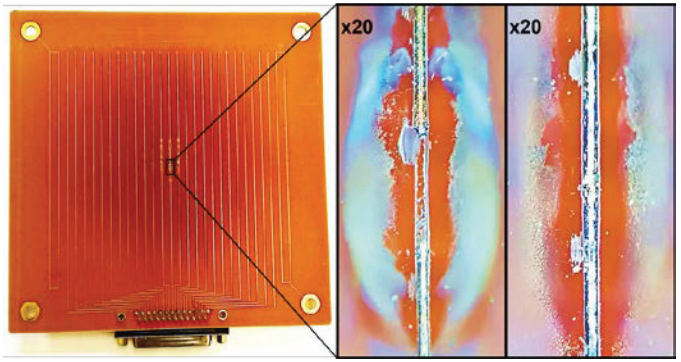

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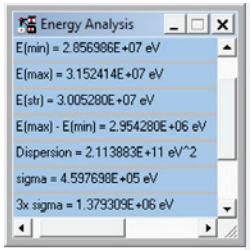

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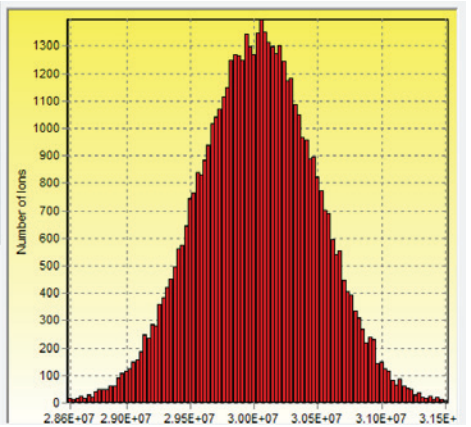

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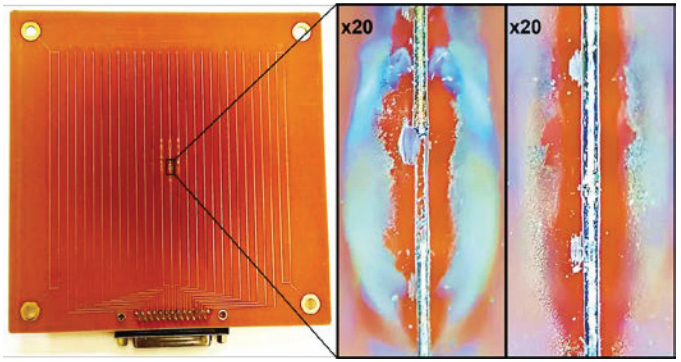
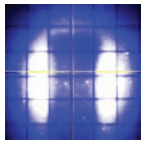
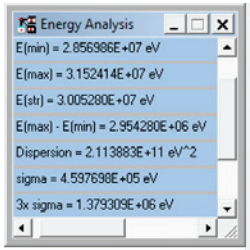


- ✓ Beam dynamics



Lessons learned

- ✓ Energy on demand
- ✓ Intensity range
- ✓ Beam dynamics
- ➢ Energy spread
- ➢ Beam instrumentation zoo
- ➢ Uniformity



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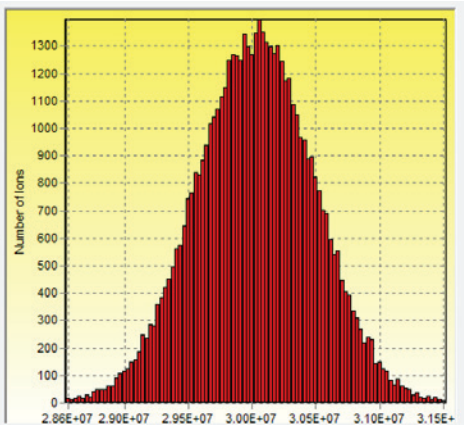

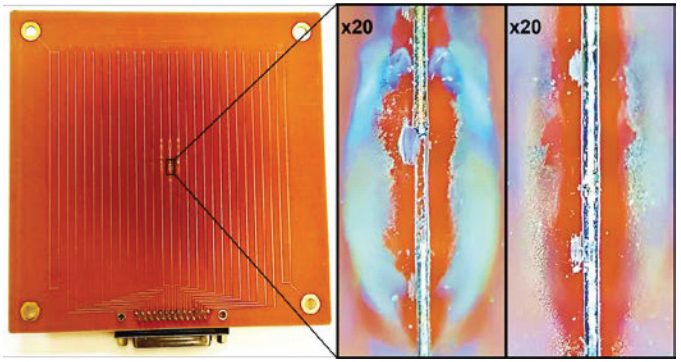

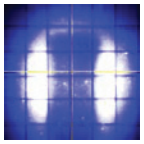

Lessons learned

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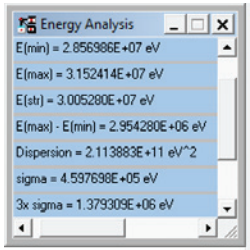

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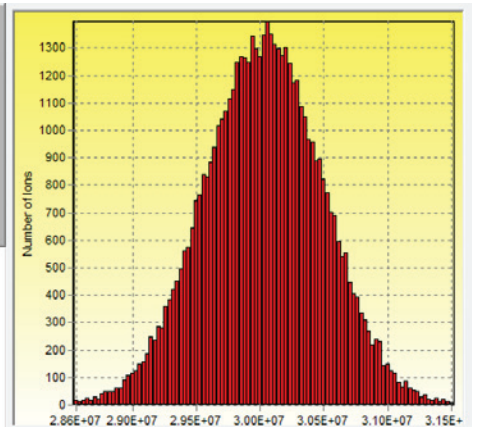

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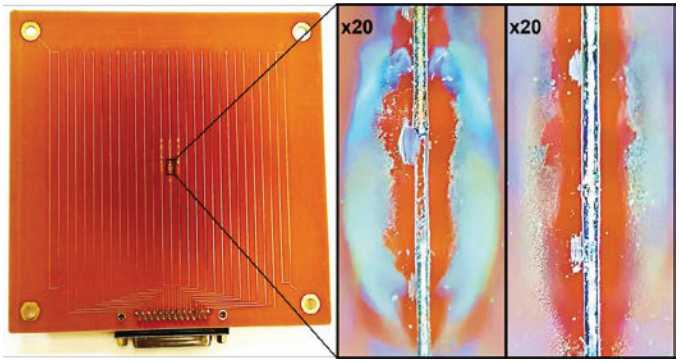

- ✓ Beam dynamics
- ➢ Uniformity