

Beamsizes and angles under straight line trajectory assumptions

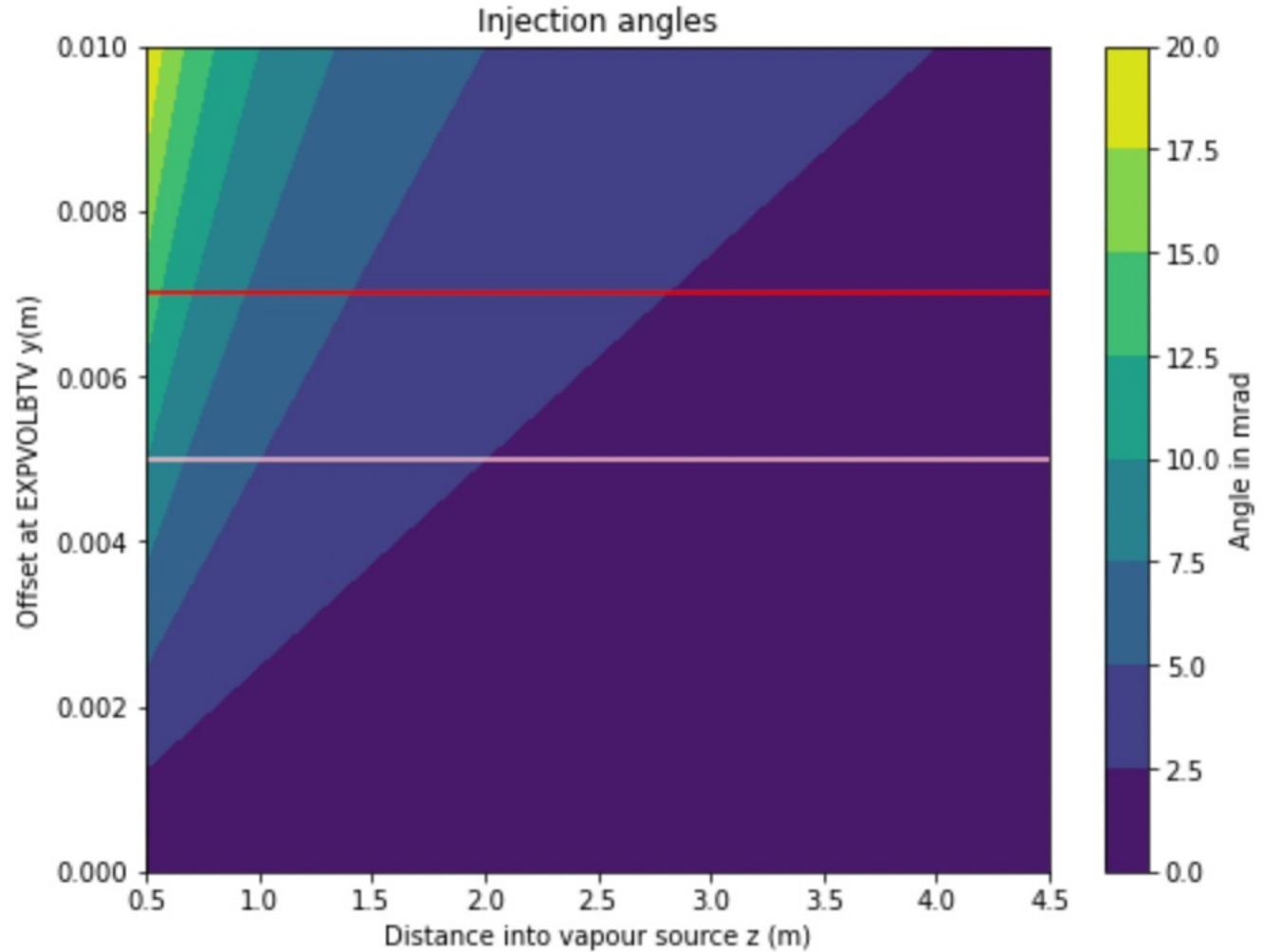
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Injection angles θ_i possible for straight trajectories:

- Take 2mm wide beam to not have cutting at entrance => max offset 7mm (red line), 5mm max offset for beams max 4mm wide (pink line)

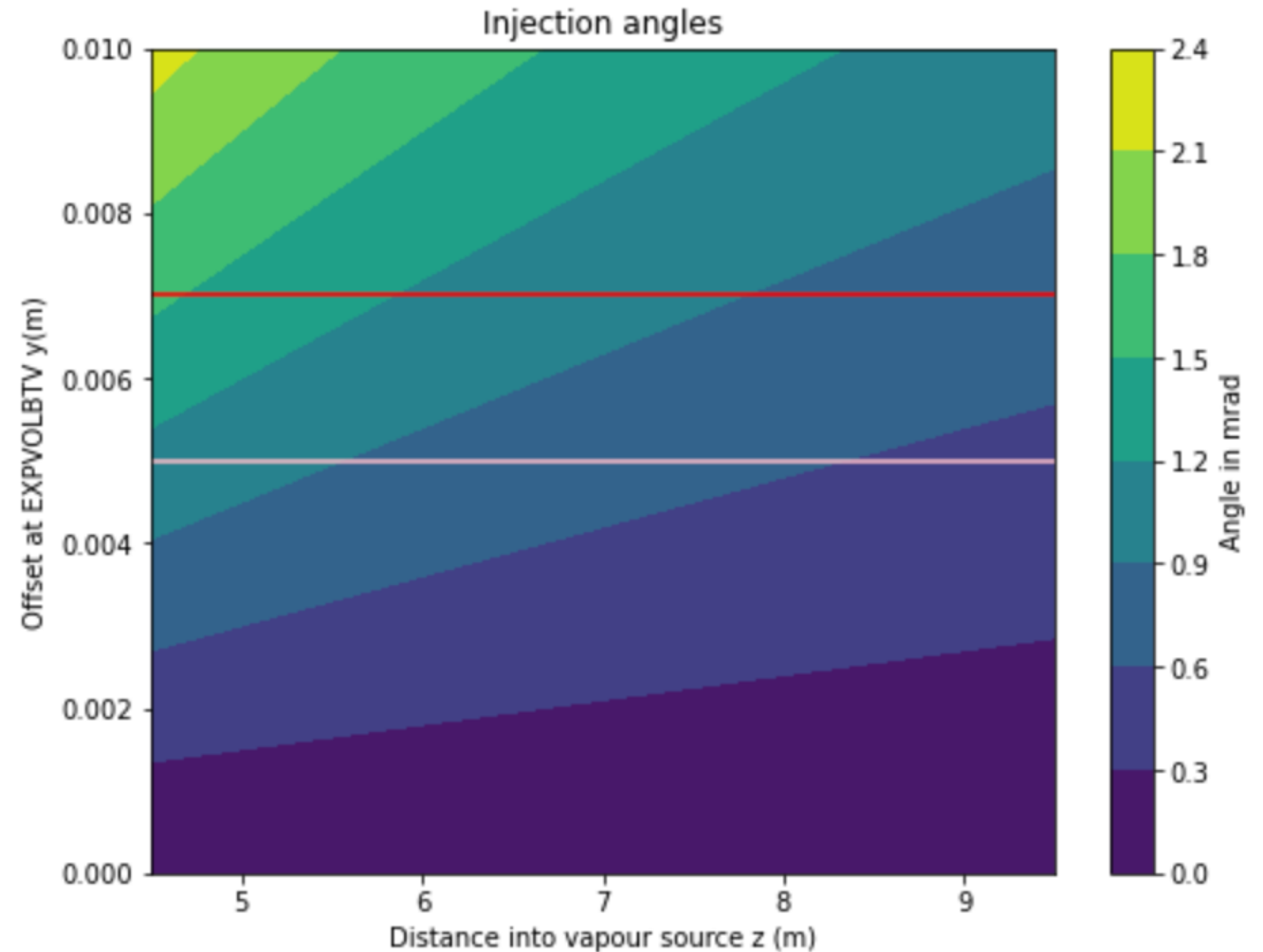
Angles assuming straight lines (0.5m-4.5m)

- Wide possibility of injection angles; can cover up to 4.5m with same angle (max up to 5mrad for $z=0.5\text{m}, 1.5\text{m}$ and 2.5m) then below 2.5mrad.



Angles assuming straight lines (4.5m-9.5m)

- Narrower choice, very flat up to possibly 1.2mrad for all; however not guaranteed.
- Also raises the problem of can we inject so far down? Given that the offset would be 1mm 1m prior.... E.g. for 9.5m.
- Worth noting, perhaps the ghost kick can save us?

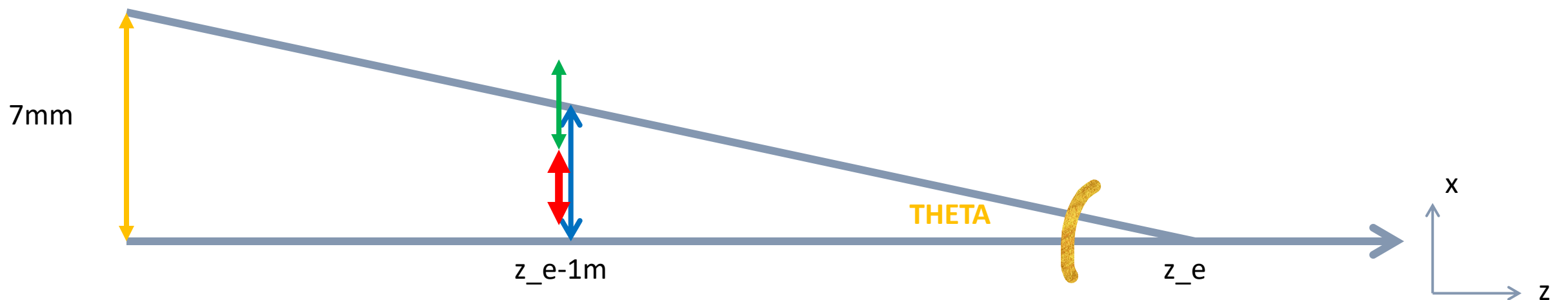


Estimated screen offsets required

- The input beam parameters used for the tracking are the one coming from tomographic reconstruction performed on the 24th October 2023:

Normalised emittance	alpha	beta
• x_plane 1.94E-06 mm*mrad	1.009158908	1.302212864
• y_plane 2.44E-06 mm*mrad	0.860641819	1.50216876

z_e injection location and focus [m]	Maximum angle possible with 2mm beamsize at entrance aperture; i.e. 7mm offset max. THETA [mrad]	Beam centroid distance from (0,0) 1m prior D [mm]	Beamsize 1m prior to focus only in x RMS [mm]	Beamsize at focus only in x RMS [mm]	Max distance (with beam sizes) from (0,0) at screen 1m prior to z_e only in x D-RMS [mm] 1 d.p.
1.5	4.6	4.6	0.52	0.12	4.1
2.5	2.8	2.8	0.41	0.14	2.4
3.5	2	2	0.27	0.20	1.7
4.5	1.5	1.5	0.46	0.22	1.0
5.5	1.3	1.3	0.47	0.23	0.8
6.5	1	1	0.44	0.27	0.6
7.5	0.9	0.9	0.45	0.29	0.5
8.5	0.8	0.8	0.21	0.27	0.6

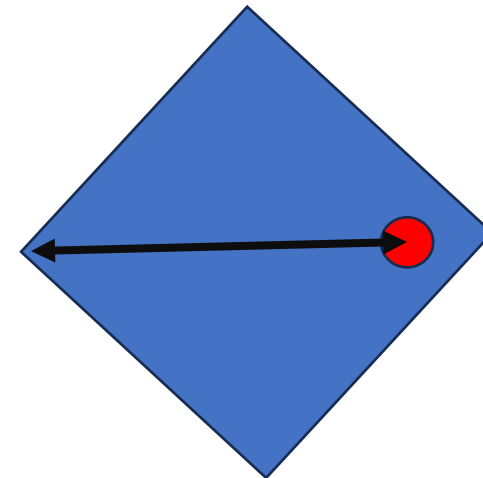
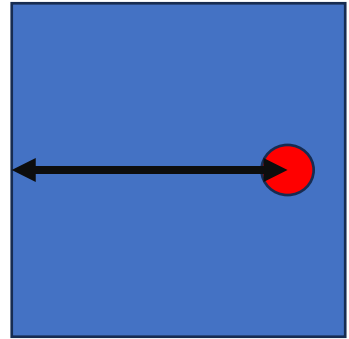


Conclusions/Comments

- Screen sizes 7mmx7mm; would be better to ensure a **5mm or 6mm** offset of screens with respect to proton beam trajectory (red); i.e. not have centre of screen be on axis.
- Screens up to 6.5m valid; later screens perhaps salvagable if trajectory is not straight.

Comments:

- Can we place screens diagonally within holder to gain +2mm horizontally? Does this work within holder? Or then will have to make the screens less tall (to ensure fit in holder-> would be ok given horizontal injection)
- Also this would provide further visibility range in case trajectory is not a straight line.
- Screens won't guarantee injection occurs there; perhaps plasma cameras prior could be used to check trajectories also (significant light increase pinning down to 1m uncertainty)



At focus



	pm_0_5m	pm_1_5m	pm_2_5m	pm_3_5m	pm_4_5m	pm_5_5m	pm_6_5m	pm_7_5m	pm_8_5m
alpha_x	-0.9334670542714620	-0.9104238168175320	0.0016046423688593800	-0.9211061464342000	0.6909466190078680	0.7688756772677340	0.6032652777621570	0.6274291428600100	-0.9575480362218120
alpha_y	0.04217595470206740	0.15272677900514200	-0.5397766272626250	-0.03704174381121700	0.17986406755499200	0.266011533119102	-0.20726953838340400	0.01882462936703820	-0.01770441796605030
beta_x [m]	0.27688194171049700	0.27175528174160200	0.3497313386349940	0.7625867403942700	0.9231886390458790	0.9735755608795520	1.376161904744980	1.6125109361205500	1.361430021009500
beta_y [m]	0.22264987969015000	0.2173145468865090	0.49979049898717900	0.6120507020916030	0.7381139865716210	0.7778960786617490	1.0830073058122000	1.2645450792112900	1.046314190807880
dx [m]	-0.00021722745585785400	-0.00029431710030574400	-0.0004943625716063150	-0.00017521338947661800	-0.0010643385167965100	-0.0007573292802007990	-0.0008978144151186370	-0.0006914279732405280	-0.0009452337507356950
dy [m]	-0.015224127794125700	-0.014378112945494100	-0.039371431878169600	-0.04639859435048740	-0.05681778374792830	-0.04230370242192230	-0.08071058234405430	-0.1112368591601090	-0.0738330250887942
sigma_x [mm]	0.12212311436490400	0.12098723515538200	0.13725173120830300	0.20267266571855500	0.22299533739703400	0.22899995002093700	0.2722609286491160	0.294714761912857	0.27079972403120700
sigma_y [mm]	0.12296525392338900	0.1214829874043590	0.18423316452734200	0.20387691159436600	0.22389126928829700	0.22984421674994100	0.2712022156617700	0.29305525936497700	0.2665677267948830

1m prior to focus



	PM_0_5M	PM_1_5M	PM_2_5M	PM_3_5M	PM_4_5M	PM_5_5M	PM_6_5M	PM_7_5M
alpha_x	5.819423399059500	2.8609497007218100	1.50279717509902	2.2912774374691000	2.4032324452790600	1.5943761279104200	1.4917130978346000	0.45045546898286300
alpha_y	4.861686596406180	2.0440236049465500	1.5990516180010000	1.5784977495862400	1.6424963427539000	0.7557532001931400	0.8099030836794280	0.9383310207229320
beta_x [m]	5.18075486398356	3.2122856817256600	1.3442777690590900	3.9054126955228500	4.145683683426340	3.5738033104175600	3.731653176815160	0.8543374537705500
beta_y [m]	5.23172792229782	2.0040374766711100	2.1740605762813800	2.4964758037128500	2.686403954534750	1.6314909676219400	2.0932727922577600	1.9669407935647600
dx [m]	- 0.001143656183899820 0	- 0.001335039081066080 0	- 0.001024294416618560 0	- 0.001773776687616500 0	- 0.001298227253082600 0	- 0.001523302495849500 0	- 0.001361870321239130 0	- 0.001381076517595620 0
dy [m]	0.029652781492046400	-0.006082597665080670	-0.02030960459344210	-0.03523795325136570	-0.01753079286214400	-0.06224314194952470	-0.09531616511894310	-0.05411821636469310
sigma_x [um]	0.5282592092848760	0.41596581107245000	0.2690884545325630	0.458652772391407	0.4725509456938370	0.4387487369925320	0.4483335012413030	0.21451876176246400
sigma_y [um]	0.5960636491076770	0.3689120067350780	0.38424295199312700	0.41175052715719900	0.4271256497811410	0.33286276864240600	0.3770407689904190	0.3654831803000320