





# 1 Abstract

*In this note we briefly report the beam development test conducted for ISAC-GRIFFIN beamline. Main objective is to demonstrate/develop a tune with calculated optical settings. Measured beam profiles and current readings at various locations are presented.*

# 2 Method

We have used beams from OLIS-MWS (see Table 1) for the beam development through the GRIFFIN beamline (see Fig. 1). Quadrupoles from ILE1B:Q6 to ILE1B:Q10 are used to focus the beam at the location of slit ILE1B:XYSLIT10 and the quadrupoles ILE1B:Q11 to ILE1B:Q16 images the beam spot from ILE1B:XYSLIT10 (i.e., focus-to-parallel-to-focus) to the target location (ILE1B:FC18). A detail beam optics note can be found in Ref. [1]. For an initial emittance of  $\varepsilon = 10 \mu\text{m}$  the calculated full width (horizontal and vertical) of the beam spot at the location of the slit ILE1B:XYSLIT10 is 3.0 mm (2 RMS) and at the location of slit ILE1B:XYSLIT14 is 14.0 mm (2 RMS). We begin the tune by setting all the optical elements (from IOS:Q6 to ILE1B:Q16) to the calculated values.

Ion source	OLIS-MWS
IOS:Bias	28000 V
IOS:EE	2444 V
IOS:MB Current	331.212 A
IOS:MB Field	5152.52 G
IOS:MB M/Q	40
IOS:MCOL3A	14.5769
IOS:MCOL3B	14.0846
IOS:FC6	32.18 nA
ILE:FC5	31.98 nA
ILE1:FC5	31.49 nA

Table 1: Beam from the ion source.

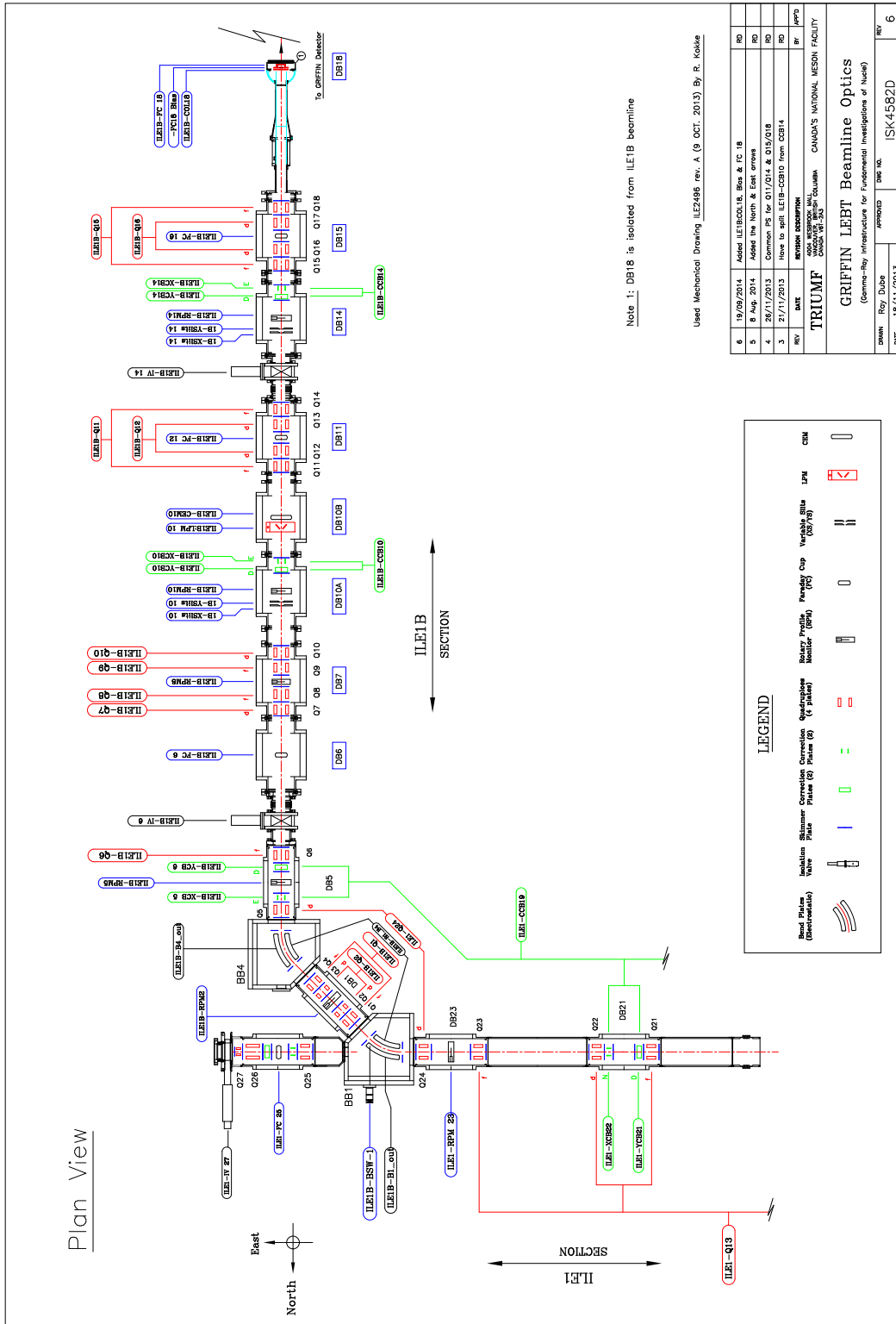
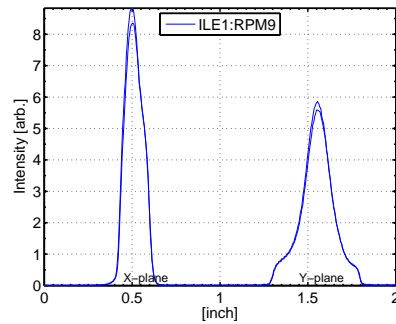
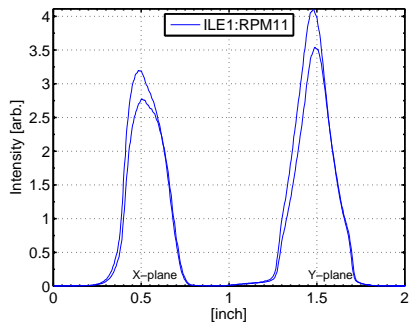


Figure 1: Layout of the GRIFFIN beamline (ILE1B) at ISAC.

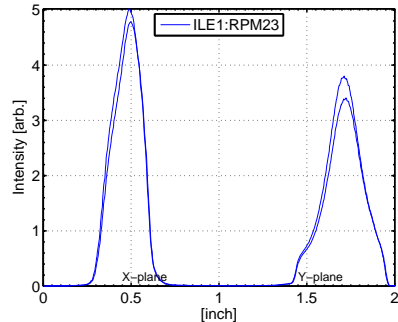
Measured beam profiles by RPM (ILE1:RPM9, ILE1:RPM11, ILE1:RPM23) in the period section (ILE1) are shown in Fig. 2. The measured beam size (2 RMS) in the periodic section was around 4.5 mm and  $\beta = 1$  m for a matched beam through the periodic section. From the beam size and  $\beta$  value the estimated beam emittance through this section was  $\varepsilon \approx 20 \mu\text{m}$ . The ILE1B section was re-optimized for the estimated emittance of  $\varepsilon \approx 20 \mu\text{m}$  and the calculated quadrupole settings were used to transport the beam through the ILE1B section (tune 150304-1820.snapiosgriffin). Calculated beam envelope and the measured beam size by the RPMs are shown in Fig. 3. Measured beam currents in the ILE1B section are shown in Table 3. The transmission from ILE1B:FC6 to ILE1B:FC18 was around 80 % with slit ILE1B:XYSLIT10 at 5 mm and slit ILE1B:XYSLIT14 at 17 mm. The ratio of current readings at collimator (ILE1B:COL18ACI) to FC (ILE1B:FC18) was less than 5 %. The measured beam profiles in the ILE1B section are shown in Fig. 4.



(a) ILE1:RPM9



(b) ILE1:RPM11



(c) ILE1:RPM23

Figure 2: Measured beam profiles (Horizontal profile left blue curve and vertical profile right blue curve) by using RPMs.

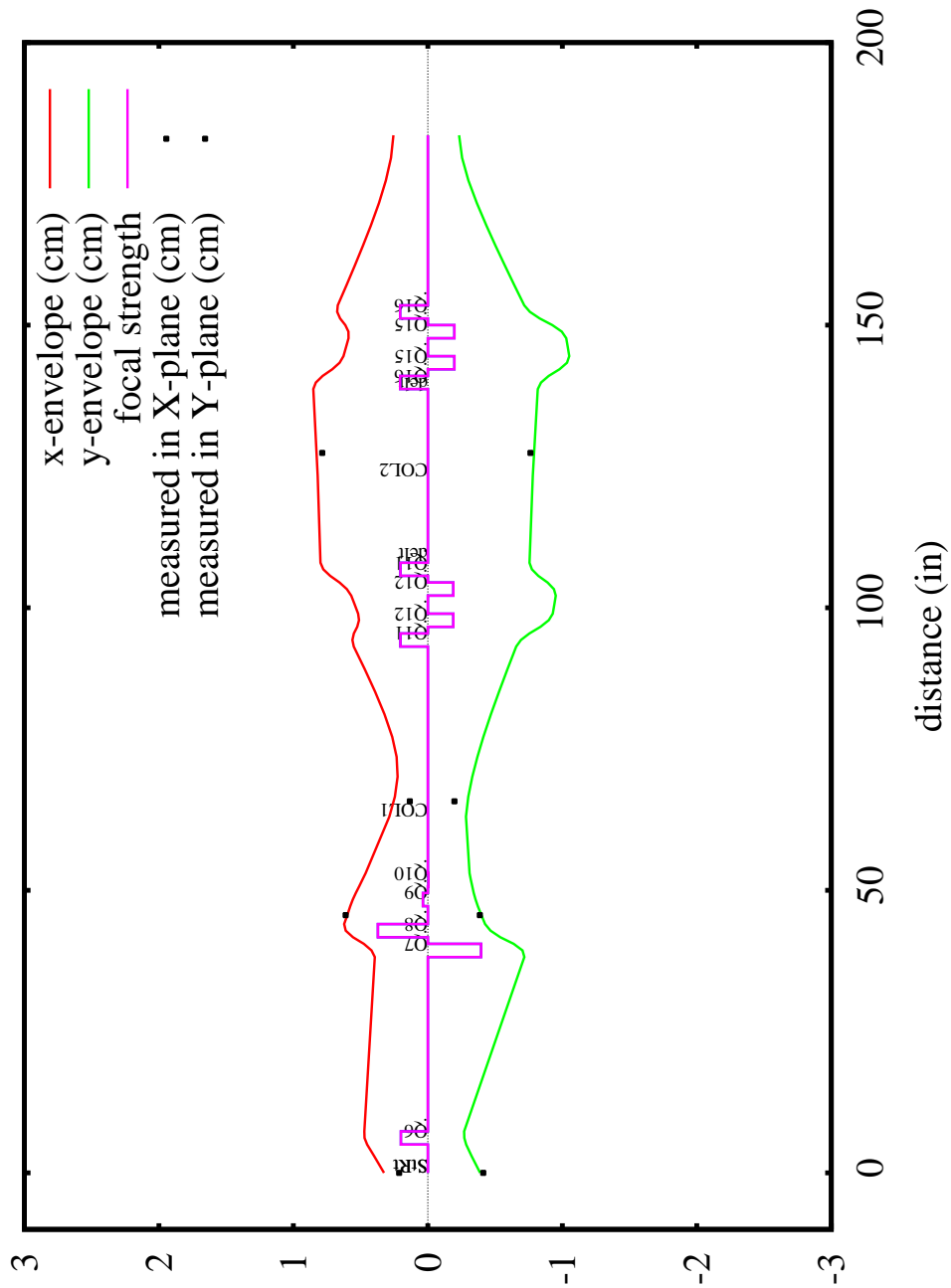


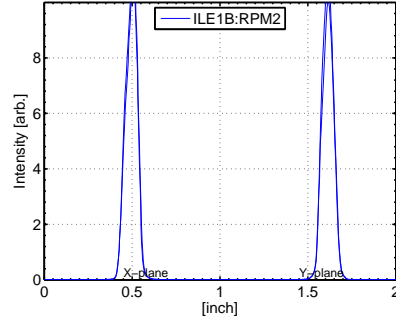
Figure 3: Calculated beam envelope for 28 keV  $^{40}\text{Ar}^+$  beam through the GRIFFIN beamline (IEL1B).

Quadrupole	Calculated [V]	Tune [V]
ILE1B:Q6	0904	0904
ILE1B:Q7	1787	1787
ILE1B:Q8	1677	1677
ILE1B:Q9	0165	0165
ILE1B:Q10	0020	0020
ILE1B:Q11	0922	0922
ILE1B:Q12	0855	0855
ILE1B:Q15	0931	0931
ILE1B:Q16	0892	0892

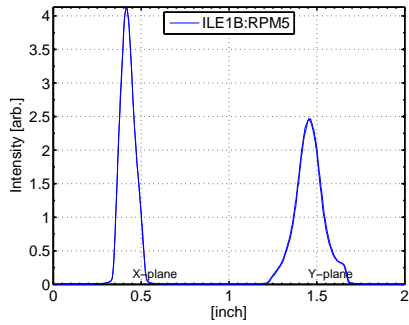
*Table 2:* Quadrupole settings used in the tune 150304-1820.snapiosgriffin

ILE1B:FC6	26.81 nA
ILE1B:FC12	23.69 nA
ILE1B:FC16	22.10 nA
ILE1B:FC18CI	21.54 nA
ILE1B:COL18ACI	0.945 nA

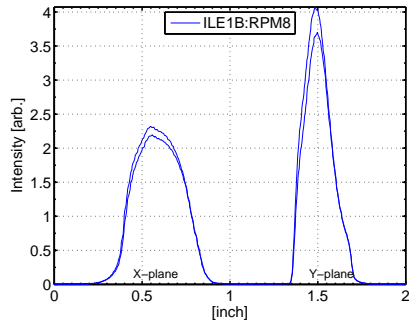
*Table 3:* Beam current measured by the Faraday cup.



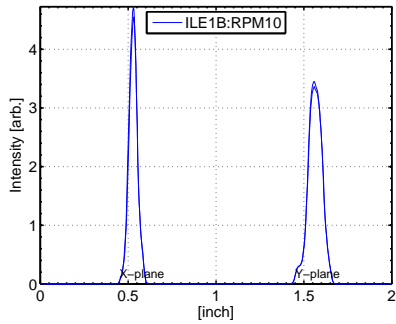
(a) ILE1B:RPM2



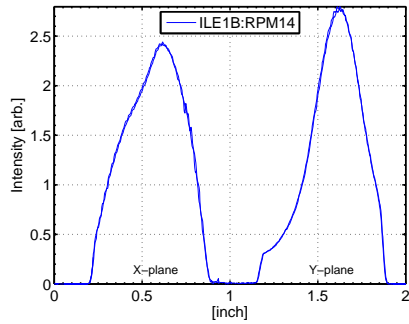
(b) ILE1B:RPM5



(c) ILE1B:RPM8



(d) ILE1B:RPM10



(e) ILE1B:RPM14

Figure 4: Measured beam profiles (Horizontal profile left blue curve and vertical profile right blue curve) by using RPMs (ILE1B:RPM2 to ILE1B:RPM14). In this measurement the steerers are tuned to align the beam on the RPMs (tune:150304-1820.snapiosgriffin).



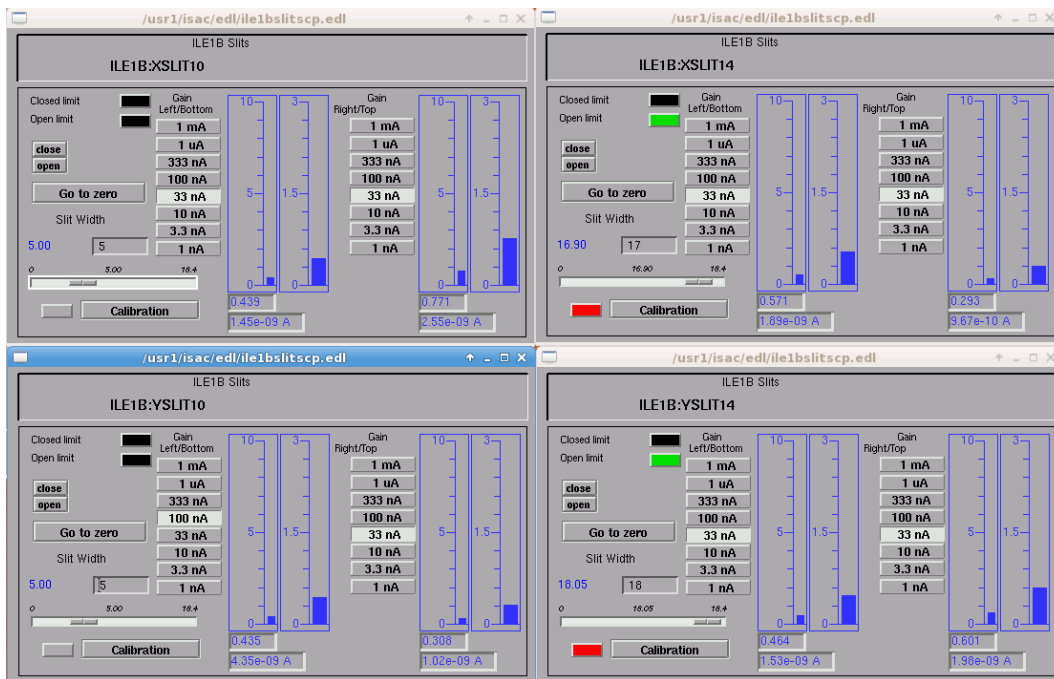


Figure 5: ILE1B slits readings (tune:150304-1820.snapiosgriffin).

## References

- [1] R. Baartman, *GRIFFIN OPTICS*, TRI-BN-11-01, TRIUMF, July, 2011.