

**A.1: Status report on operation of Indus accelerators**

The Indus synchrotron radiation (SR) sources, constituting a national facility, provided SR beam to the users regularly on round-the-clock (RTC) basis from the start of the year till 3<sup>rd</sup> week of April. In third week of April, the facility was shut down due to the lockdown declared by district administration in wake of sudden outburst of second wave of COVID-19 pandemic. Subsequently, the office was reopened in June and Indus facility was normalized with start of operation with effect from June 16, 2021.

In the said period, both the machines were operated following the prescribed safety procedures. Apart from the shutdown for 56 days due to lockdown and system restoration activities as mentioned above, only 2 days of shutdown was taken for planned maintenance activities. Taking this into account, the machine was operated in round-the-clock mode for 123 days during the period January to June 2021. The beam availability for users was 2642 hours (~ 21.5 hours/day) in Indus-1 and 1777 hours (~14.4 hours/day) in Indus-2. The performance of Indus-1 is in line with previous years, whereas the beam availability in Indus-2 is slightly less than previous years due to breakdown maintenance of 12 days in January, 2021 as a result of vacuum leak in the power coupler of RF cavity-5 in Indus-2.

In view of travel restrictions due to COVID-19, usage of SR beam at Indus beamlines was mostly limited to in-house users. The external users were requested to send the samples by courier/post. After performing experiment, the data was mailed to the users by Synchrotron Utilisation Section. The total number of user experiments carried out at Indus beamlines was 112.

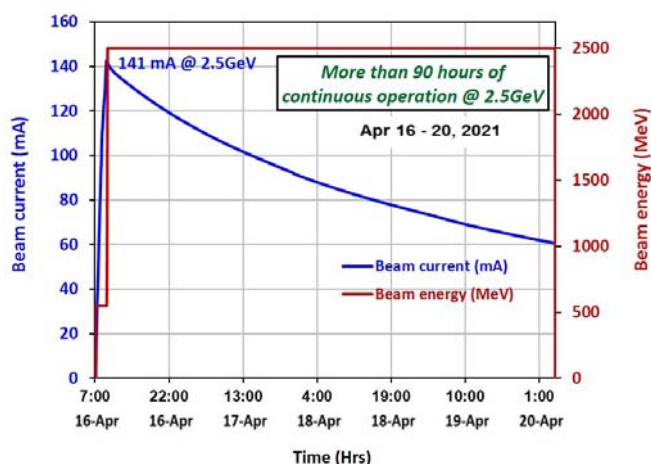


Fig. A.1.1: Ninety hours of continuous beam operation in Indus-2.

An important operational feat was achieved in April this year when Indus-2 was continuously operated with beam circulating at 2.5 GeV for more than 90 hours.

A beam with initial current of 141 mA @ 2.5 GeV filled at 09:40 AM on 16<sup>th</sup> April continued interrupted till 04:15 AM on 20<sup>th</sup> April. (Figure A.1.1). Indus-2 attained another major milestone on 17<sup>th</sup> April in which a beam lifetime of ~ 104 hours was recorded at beam current of 100 mA @ 2.5 GeV. This increase in beam lifetime with respect to previously reported number of 93 hours may be attributed to re-optimization of user orbit. Further, the exercise for orbit and tune correction during energy ramping was also carried out. Both these exercises were carried out in the month of April.

Typical user mode operation of Indus-1 is shown below in Figure A.1.2

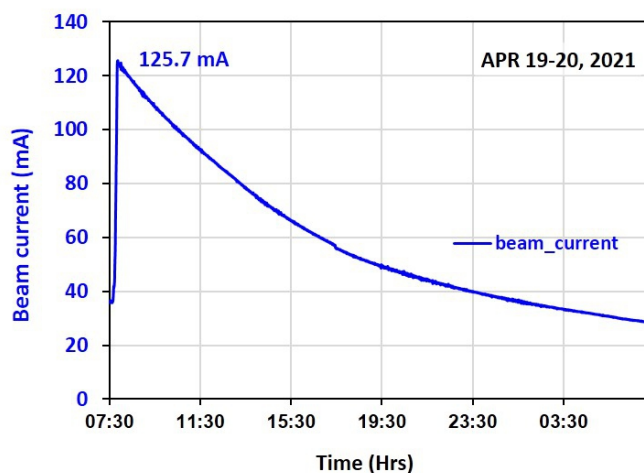


Fig. A.1.2: Typical user mode operation of Indus-1.

**Beamlines:** The Angle Resolved Photoelectron Spectroscopy (ARPES) beamline (BL-10) in Indus-2 was opened to user for experiments earlier this year in March 2021. This is the first commissioned beamline with an insertion device as its source. With this, the total number of commissioned beamlines in Indus-2 has increased to 17 whereas 3 beamlines are under trial operation.

**Normalisation of Indus facility after lock-down:** As mentioned above, Indus facility was shut down in 3<sup>rd</sup> week of April due to lock-down declared by the government on account of sudden outbreak of 2<sup>nd</sup> wave of COVID-19. During lockdown, the safety systems and the essential systems of Indus facility like vacuum, HVAC, fire alarm, CCTV, etc. were kept in running condition and regular visits to Indus complex were made for monitoring the health of the machines and safety systems. Post lockdown, the facility was normalised in similar fashion as last year. Operation of Indus-1 was restarted with effect from 16<sup>th</sup> June whereas operation of Indus-2 was restored with effect from 24<sup>th</sup> June, 2021.

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