Middle-Long Term Needs for Ion Beams

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- Plan for LHC and SPS Heavy Ion Programmes
- Plan for Medical Application Programme
- Plan from 2011 to 2021

Middle-Long Term Needs for Ion Beams: 2011

- **LHC:** - Increase the number of bunches with intermediate (200ns) or nominal (100ns) bunch spacing, energy 3.5 Z TeV, projected luminosity (=1-1.4 10^{26} cm^{-2} s^{-1})

  - In order to reduce the Pb source reloading time, a study of the cost and benefits of an extra source should be recommended.

  - Study and feasibility test of p-Pb collisions.
- **NA61**: - Physics with fragmented Pb ion beam

  - Scheme with 2(3) injections to be compatible with LHC filling.

  - Prepare tunes for all requested energies and optimize the spill structure

  - Improve the H2-Beam instrumentation (calibration of the transformer on T2?) and beam extraction
- Note: Proton and ion beams are not compatible in the North Area
- To make physics with fragmented ion beam (weeks 47-50), 2 weeks of tests and commissioning are needed (weeks 45 and 46).
- **UA9**: - Test in the North Area and in the SPS with Pb ion beam
- **ITHEMBA:** Preparation of the collaboration work started

NA61 History

- **2010:** test TEST
- **2011:** test Frag Frag
- **2012:** Ar shutd Frag
- **2013:** Frag Ar Shutd
- **2014:** Xe Xe my presentation

Middle-Long Term Needs for Ion Beams: 2012

- **LHC**: Either physics with p-Pb (and Pb-p) ion collisions (depending on the test in 2011 and physics requirements) or Pb-Pb collisions with Nominal beam.

  The matching 100 ns filling scheme needs to be set-up for the proton beam.
- **NA61**: Physics with fragmented Pb ion beam
  - Prepare tunes in advance for all requested energies (not done in 2011) (20, 40, 158 AGeV/c ?)
- **NA63**: Physics with primary Pb ion beam
  - needs debunching
  - can it be done with an LHC beam type or should it be a new beam?
  - Should be done in a Pb ion period only
- **UA9**: Test in the North Area and in the SPS with Pb ion beam
- **ITHEMBA:** Preparation of the settings for Ar and Xe ions.

CERN – NA61 – iThembaLABS

- iThembaLABS have acquired an identical ECR ion source.
- The source is being installed and connected. Testing starts now!
- **CERN – iThembaLABS collaboration**:
  - CERN provides input on operation of the source to **speed up commissioning** at iThembaLABS. A CERN staff is in Cape Town now!
  - iThembaLABS will investigate producing **argon** and **xenon** ions from this source, and investigate the long term stability of the charge states CERN needs. **This speeds up CERN's tests in 2013**.

Middle-Long Term Needs for Ion Beams: 2013

- **General Shutdown:** installation of:
  - dispersion suppressor collimators in LHC-IR3 (?) (should improve ion intensity limits)
  - the safety hardware in the SPS for the light ions programme with primary beam in the North Area

- **NA61**: Commissioning of the source+RFQ with Ar and Xe ions. A short period to run the Linac3 is requested.

  As the South Africa collaboration should already have produced Ar and Xe the year before, the CERN commissioning will have a head start and take less time.

Middle-Long Term Needs for Ion Beams: 2014

- **This year will not be a normal year of operation**

- **LHC:** Physics with Pb-Pb ion beam collision at top energy, performance depending on limits, projected luminosity (5 $10^{26} cm^{-2} s^{-1}$)
- **NA63:** Physics with primary Pb ion beam (depending of the 2012 run)

- **The SPS light ion (Ar**) could be scheduled only if LHC Pb beam is not requested (should be known by June 2014).

  The safety hardware and the debunching are needed.

Middle-Long Term Needs for Ion Beams: 2015-2016

- **2015: LHC**: - Physics with Pb-Pb ion beam collision with the nominal beam at top energy at the end of the year. Continue to integrate Pb-Pb luminosity.
- **NA63** continues(?)
- **NA61**: - Ar ion or Xe ion physics with primary beam depending whether Ar ion physics took place in 2014.

The accelerators should start in March;

- **2016: LHC**: - Physics with p-Pb (if requested) or Pb-Pb collisions at top energy with maximum luminosity, scheduled at the end of the year.
- **NA61**: - If Xe ion physics was not done in 2015, then it could be done during the first part of the year.

The accelerators should start in March;

Middle-Long Term Needs for Ion Beams: 2017-2018

- **2017: Shutdown:** installation of dispersion suppressor collimators in LHC-IR2 in order to increase the BFPP (Bound Free Pair Production) limit on luminosity.
- Installation and beam commissioning for a Medical Application programme can only start in 2017 (The light ions requested should be defined 5 years in advance for the study of new source and RFQ (Oxygen and lighter ions?).

- **2018: LHC**: Physics with Pb-Pb at full energy with higher luminosity (larger than in 2015) thanks to IR2 modifications.
- **NA61:** Primary Pb beam at 3 energies with the upgraded experiment (high statistics)
- Medical Application programme could take place.

Middle-Long Term Needs for Ion Beams: 2019-2021

- **2019: LHC**: Physics with p-Pb or, possibly, d-Pb collisions.

  The latter would need a second source to produce deuterons, a second RFQ, a LEBT and a switchyard (to be decided more than 5 years earlier if needed but decision best made at the same time as medical light ions). The commissioning of the new source, RFQ, LEBT, Linac3 should be done during the 2017 shutdown.
- Medical Application programme could take place.

- **2020: LHC**: Physics with Ar-Ar collisions.

  Already commissioned in the injectors, Ar ion beam is ready
- Medical Application programme could take place.

- **2021: Shutdown**

Conclusion

- A road-map for the ALICE heavy-ion physics programme in the LHC has been prepared for the medium term (to 2020).
- A compatible schedule for other users of ion beams has been proposed.
- The ion injectors have a very tight programme up to 2016.
- For the physics programme in 2017, some decisions are needed during 2011.
- Official projects only exist(ed) for Pb LHC and NA61.
- The LHC has priority as the principal user of ion beams from the injectors.

  However the ion injector complex must also support a diverse physics programme (NA61, NA63, possible medical applications) whose needs should not be forgotten.

Good planning and communication, for both day-to-day and longer-term scheduling, are essential.