Luminosity monitor and experimental detectors integration at IR2 (IR8/1)

D. Macina (TS/LEA)

30.LTC 1/9/2004

OUTLINE

- Luminosity monitor and ALICE ZDC
  - Integration issues
  - Operational issues
  - Conclusions

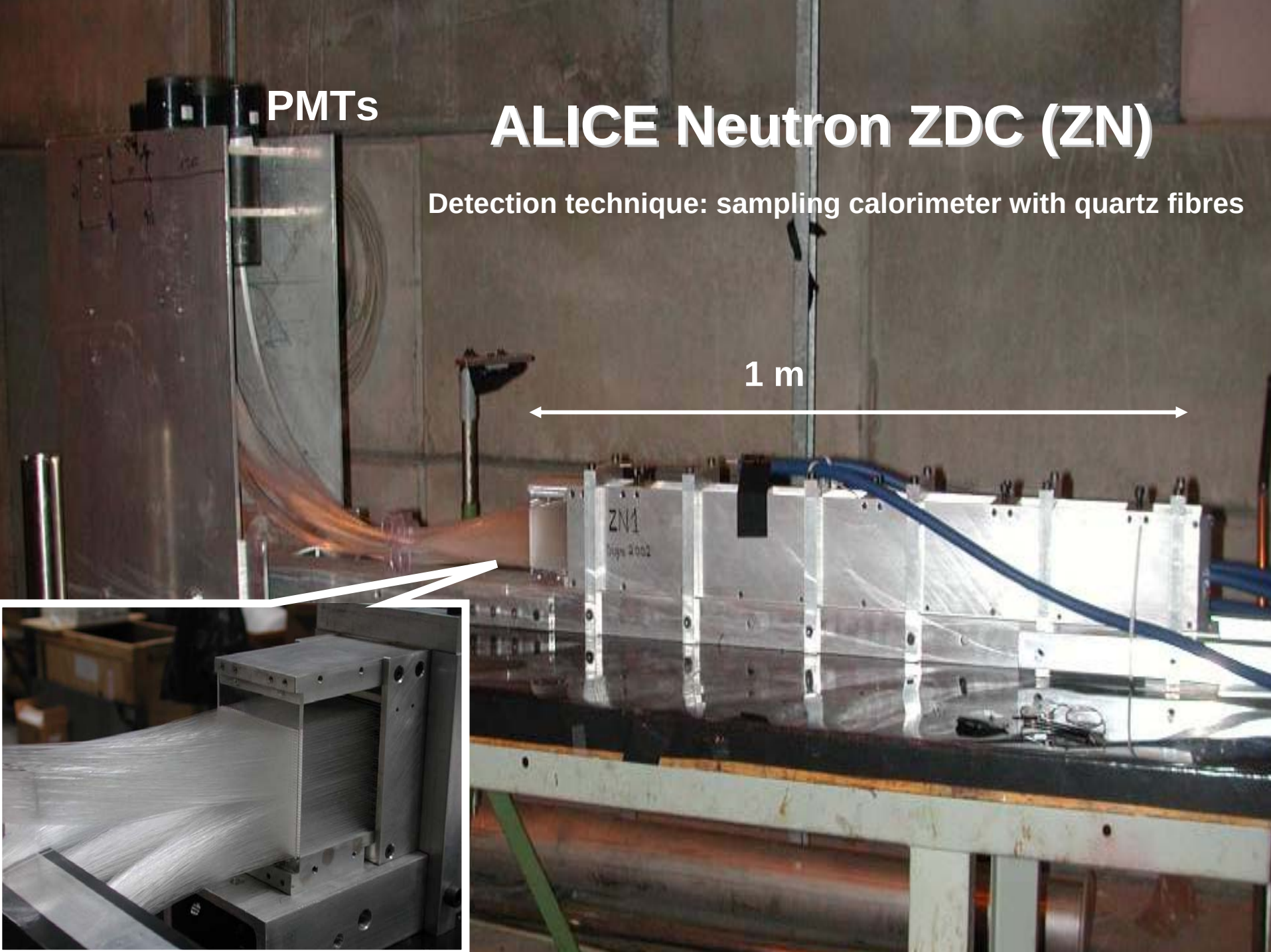
- Few words on the LHCf calorimeter
  - LoI submitted; LHCC (May 2004) encouraged LHCf to continue developing their experimental design
  - Proposed locations at IR8 (behind the recombination chamber) or at IR1 (in the TAN)

Meeting held on 3 October 2003

(Present: R. Assmann, E. Bravin, M. Gallio, M. Lamont, D. Macina, C. Oppedisano, K. Potter, C. Rathjen)

ZDC

- Measures the centrality of the heavy ion collisions via the measurement of the number of spectator nucleons
- Technology: quartz fibres calorimetry
- Two types of ZDCs placed behind the recombination chamber (~ 116 m from IP2)
  - W alloy ZN placed between the beam pipes behind the recombination chamber: 82 mm (H) x 107 mm (V) x 1000 m (Z).
  - Brass ZP placed externally to the outgoing beam: 240 mm (H) x 150 mm (V) x 1500 mm (Z)
- Placed on a movable support: lowered during injection, raised during heavy ions collisions
- **Conflict with the luminosity monitor only during the heavy ion operation and only with the ZN**


PMTs
ALICE Neutron ZDC (ZN)
Detection technique: sampling calorimeter with quartz fibres
1 m
ZN1

Meeting held on 3 October 2003

- Luminometer

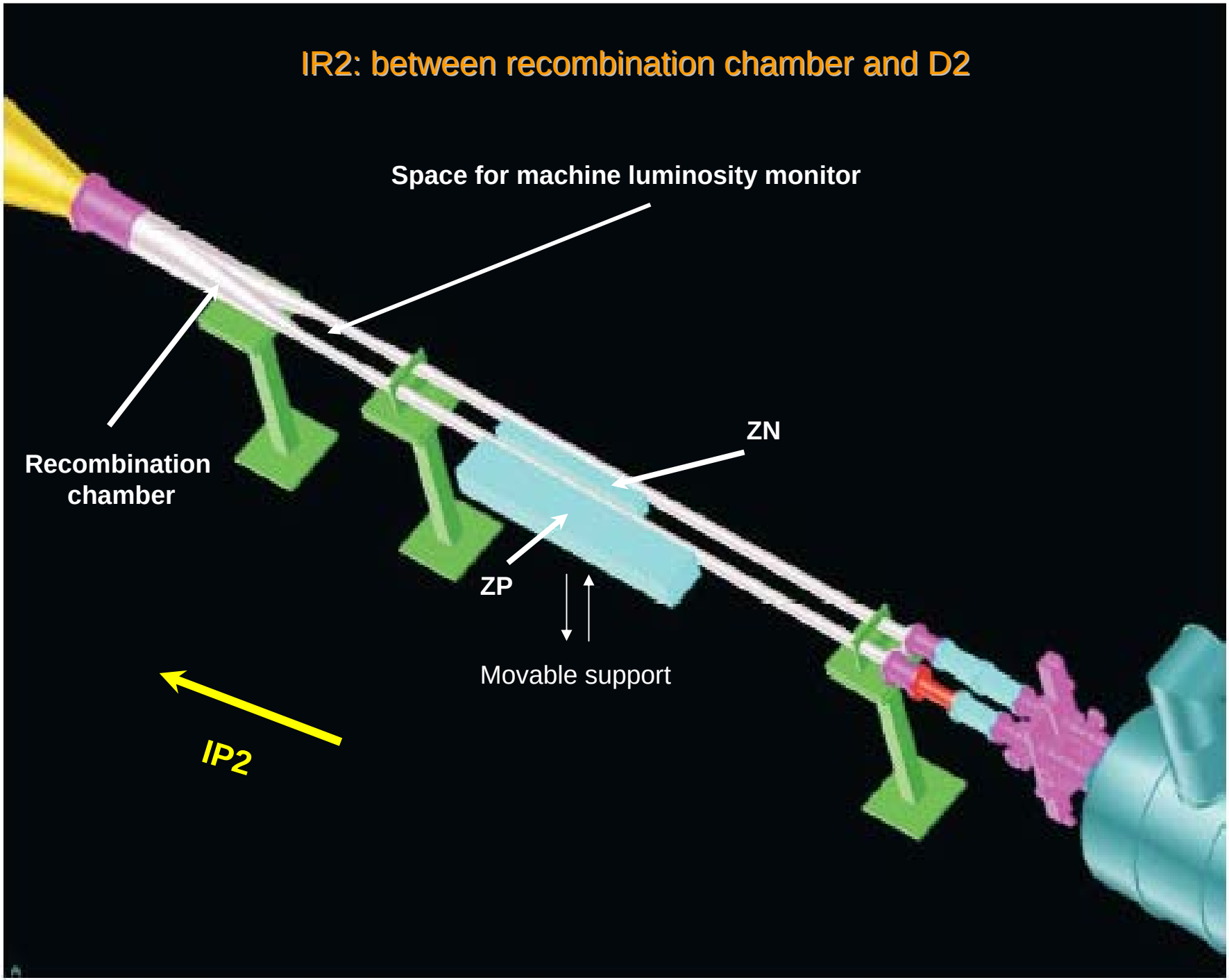
  Two technologies under evaluation:

  - Fast Ionization Chamber : 93 mm (H) x 269 mm (V) x 98 mm (Z) and ~ 30 cm Cu absorber in front (shower maximum). Not compatible with ZN
  - CdTe detectors: 94 mm (H) x 66.3 mm (V) x 36.5 mm (Z) and ~ 3 cm Cu absorber in front (high sensitivity). Compatible with ZN
  - N.B. available space between beam pipes 100 mm => non standard solution for bakeout and special care for the alignment and fabrication tolerances

- MiniTAN

  Preliminary results based on basic considerations on the heavy ion physics (D. Macina) and cascade simulations in D2 (B. Jeanneret, I. Baichev) suggest that minitan during heavy ion runs is not needed for vertical crossing angle (or no crossing angle).

  N.B. The ZDCs act as minitan when in the data taking position

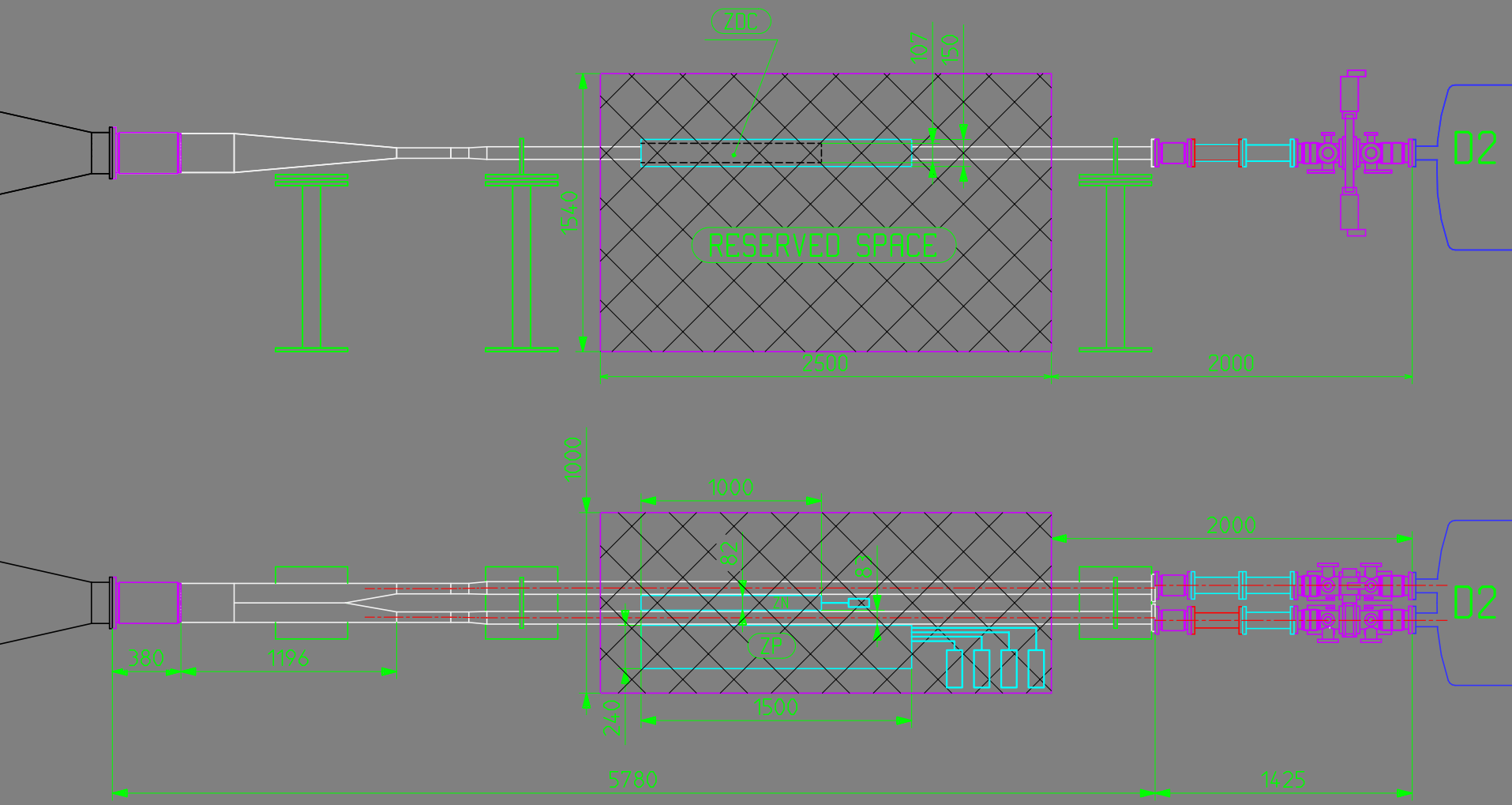

IR2: between recombination chamber and D2
Space for machine luminosity monitor
Recombination chamber
ZN
ZP
Movable support
IP2

Conclusions on the ZDC-Luminosity monitor integration and subsequent actions

- The luminosity monitor (both technologies) can be integrated in front of the ZN although its dimensions are barely fitting into the available space. Few minor details remains to be studied (missing information on mechanical details of the luminosity monitor)
- ZDC ECR, based on the vacuum layout agreed on 3 October 2003, approved on 22 April 2004
- Warning: the TCTh location as proposed at LTC on 2 June 2004 implies a redesign of the zone

  (a new “working” proposal is available but it needs a validation from the aperture point of view. In particular the required lateral space for the luminosity monitor might be in conflict with the required machine aperture)

Luminosity monitor – ZDC integration according to the ECR 459357



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ZDC-Luminosity monitor: mode of operation

- If CdTe option: ZDC-Lumi parallel operation possible (3 cm Cu absorber do not spoil the ZN energy resolution) => Lumi positioned on a fixed support and always operational
- If FIC solution: ZDC-Lumi parallel operation not possible (30 cm Cu absorber spoil the ZN energy resolution) => Lumi positioned on a movable support and operational only during the proton runs (lowered during the heavy ion run)

Can the ZDC be used as machine luminosity monitor
(as done at RHIC)
and would ALICE agree to this proposal?

Can the ZDC be used as luminosity monitor?

- The ZDC fulfills most of the luminosity monitor functional specifications:
  - It is able to measure the flux of the neutral particles produced at the IP (it contains 80% of the shower generated by 2.7 TeV spectators neutrons)
  - It should be able to measure the crossing angle since the optical readout is divided, in the transverse plane, into four independent towers (precision of the measurement to be checked)
  - It should be able to measure the bunch by bunch luminosity being the duration of the analog signal at the base ~ 20 ns at maximum (feasibility of the measurement to be checked)
  - It can be used for the initial beam finding and overlap maximization if positioned at the end of the squeeze

- In addition to the measurement of the centrality of the collision, ALICE plans to use the ZN to monitor and measure the absolute luminosity (via the mutual electromagnetic dissociation in the neutron channel)

Discussion with ALICE on 15/6/2004

Present: C. Fabjan, M. Gallio, L. Leistam, D. Macina, A. Morsch

ALICE has no objections to the possible use of the ZN as machine luminosity monitor provided:

- Initial beam finding and overlap maximization is a safe operation (no additional risks compared to the physics run)
- The machine takes full responsibility for the work (both hardware and software) to be done to bring the signal to the PCR and to adapt it to the machine operation requirements

CONCLUSIONS for IR2

- According to the actual LHC layout, both luminosity monitor technologies can be integrated with the ALICE ZDCs. However the recent request of a TCTh integration requires a new study and the compatibility needs to be reconfirmed
- No operational incompatibility during the proton run
- If CdTe option => no operational incompatibility during the heavy ion run
- If FIC option => operational incompatibility during the heavy ion run BUT ZN can be used as machine luminosity monitor

LHCf calorimeter and lumonisity monitor at IR1 or IR8

(preliminary discussion with LHCf and personal considerations)

- The LHCf calorimeter has 18.8 cm of tungsten which is roughly similar to the Cu and then can serve as absorber for the luminosity monitor (FIC option but probably compatible also with the CdTe option)
- When LHCf not in data taking position => the calorimeter will need to be replaced with an absorber
- Both integration and mode of operation need to be studied in detail. However it looks (to me) that a solution can be found