



# AD Machine and Experimental Areas – Operation and major problems in 2006, outlook for 2007



# Contents

- AD restart and related problems
- The 2006 physics run
- What's in store for 2007?
- Consolidation



# AD startup after 18 months....

## Extremely difficult startup:

- **PS-complex schedule delayed 6 weeks due to PS rotor** 😊
- **3 weeks planned for AD startup – needed 8 weeks !!** 😞
  - **Problems in setting up electron cooler (19 days)** 😞
  - **PS injection septum failure (6 days)** 😞
  - **CERN general power distribution failure (4 days)** 😞
  - **Difficulties in finding correct trajectory for ALPHA line (8 days)** 😞
- **Physics finally started 22/8 instead of 18/7(all beamlines ok)**  
😊 .....
- **...but with lower rep. rate and somewhat lower intensity** 😞



# Startup: Electron cooling difficulties

- Many, many problems during the PS repair (power converters, ctrls etc.)
- First beam on target 28/6 – 1 week to decelerate to low energies and discover e-cooling problems
- 50% of the 19 “cooling days” spent on cooler itself. 50% on other issues (ctrls, network, OASIS, supplies etc.) – inefficient !
- Problems w. unstable residual collector voltage (cooling circuit?)
- Cathode stability verified after improvements in voltage divider
- When stable, momentum cooling rate much reduced in spite of much work on alignment, coupling compensation etc.
- Limited cooler diagnostics
- Problem “fixed” by drastically increasing cooling duration (+10s @ 300 MeV/c, +5s @ 100 MeV/c)



# H and V beam profiles at 100 MeV/c

**File**

choose scraper: Top, Int, Ext, Bot

move scraper through beam: -7.0 Xmin [mm], Measure

blow up before meas.  use scintillator

move scrapers out: move active scraper to park position, move all scrapers to park position

**Beam Blow-up**

sense: 0.390, 0.370

beam intensity: 0.0000 (update)

final intensity: 80.0 % of I<sub>0</sub>

amplitude: 13

blow-up beam: horizontal blow-up, vertical blow-up, STOP

**ZOOM**

beam intensity vs scraper position / mm

beam edge (full beam) found at 2.92e+01  
 beam edge (95 pc) found at 8.94e+00  
 beam centre found at 4.42e+00  
 ==> emittance = 4.75e+00 pi mm mrad  
 ==> acceptance = 1.43e+02 pi mm mrad

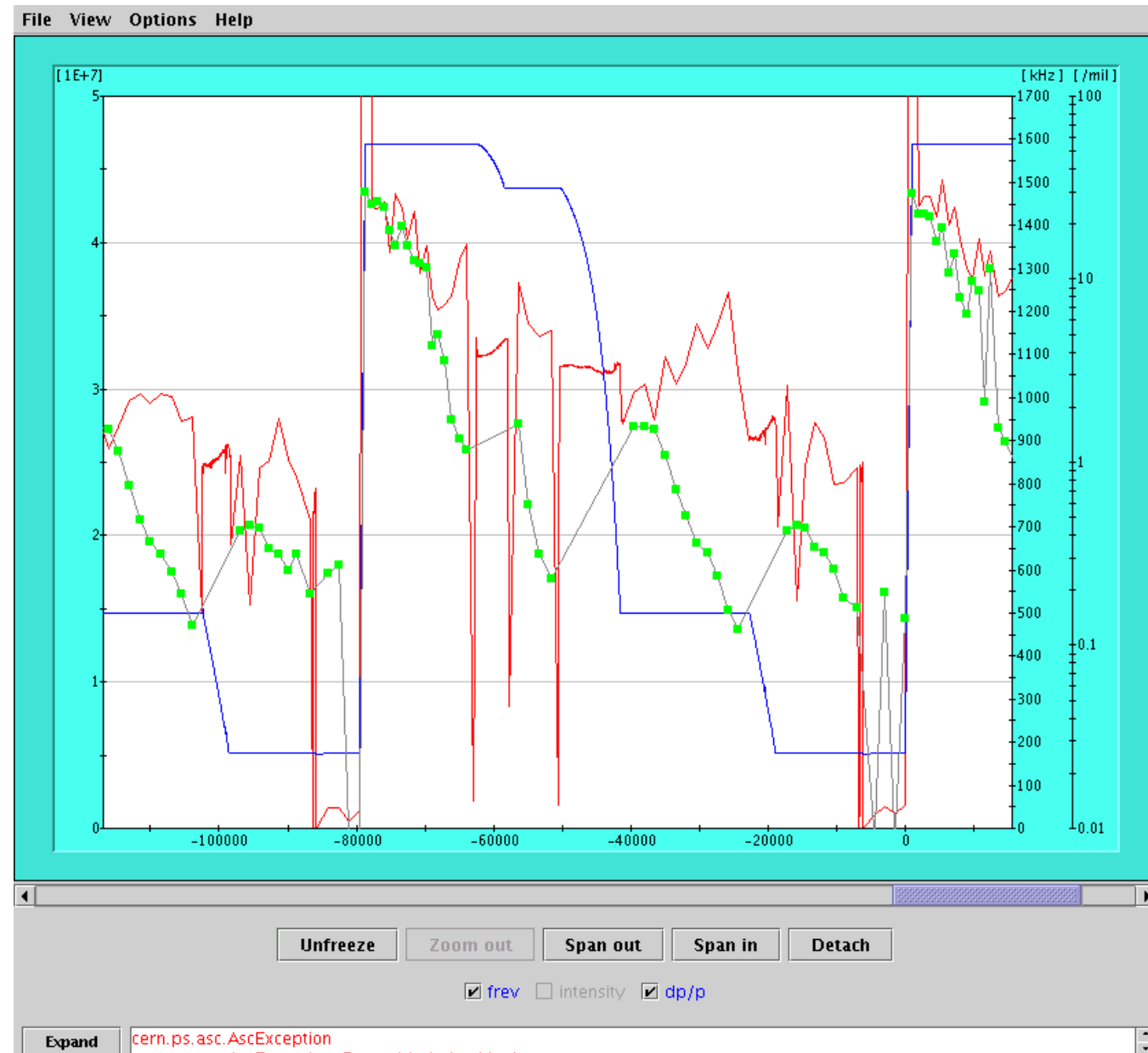
For your info:  
 beta<sub>h</sub> = 5.0 m, beta<sub>v</sub> = 4.3 m  
 at position of scrapers  
 init. intensity/10<sup>10p</sup> or total # of cou  
 6.82e+05

profile in file: /ade/data/scraper/Sun\_Aug\_13\_17:23\_2006.top

profile in file: /ade/data/scraper/Thu\_Aug\_17\_10:09:40\_2006.inner



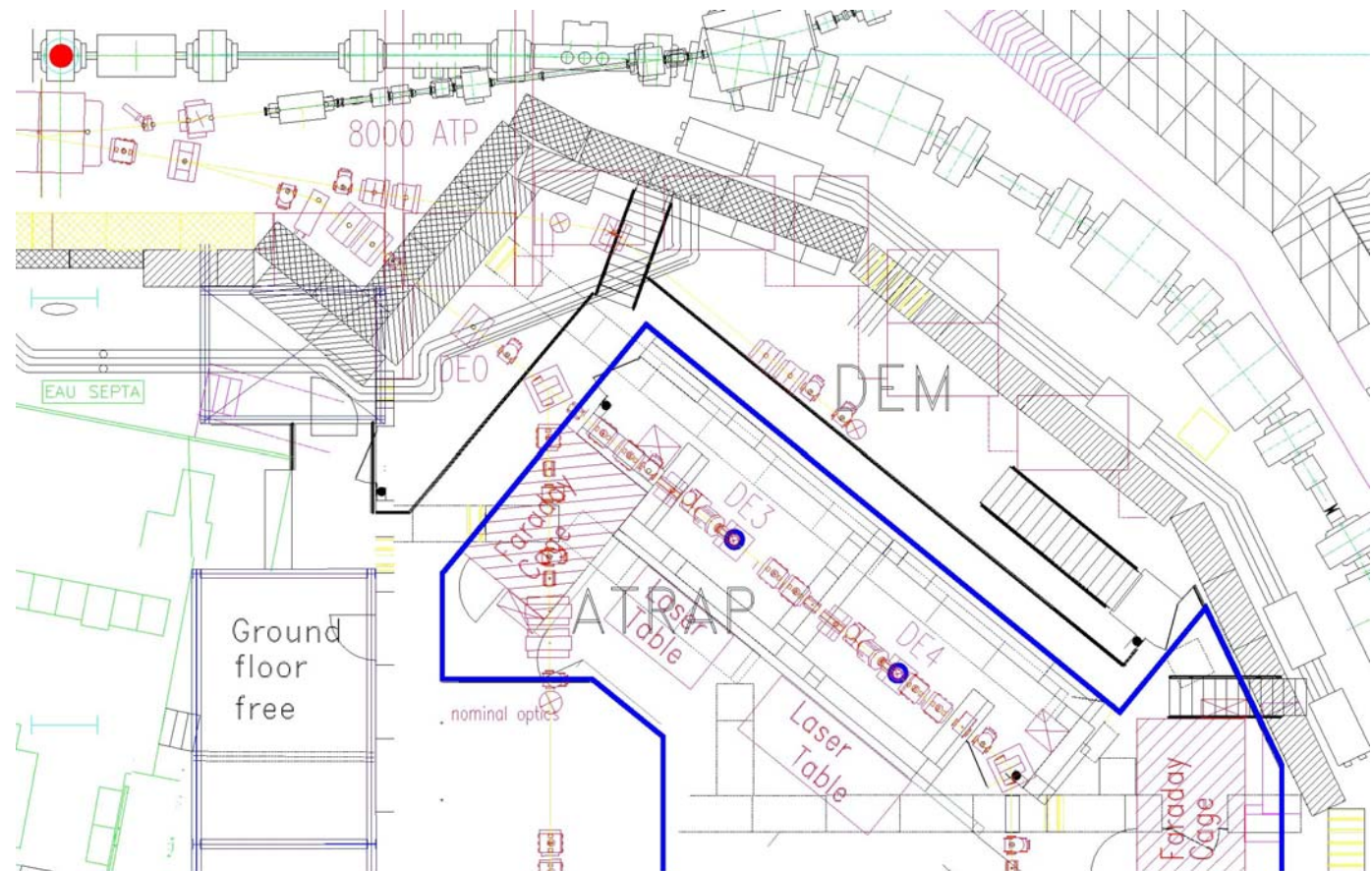
- **“2006 cycle”:**
  - Now 100s (86s in 2004)
  - Final emittances ok for reasonable deceleration and xfer efficiency
  - Rep.rate suffers also from longer PS-supercycles





# Startup: ALPHA beamline

- Beam passes through strayfields of both ATRAP solenoids





## Startup: ALPHA beamline

- New DE0.DHZ87 successfully commissioned with ATRAP2 solenoid @ 3T.
- Shortly after, transmission = 0.....??!! (solenoid off)
- Found (much later...) that despite normal beam on 5 downstream MWPC:s, a trajectory change through the septum caused the losses
- New MWPC will be installed in the sensitive region during this shutdown





# The 2006 run

- **All beamlines operational as of 22/8 (5 weeks late): Run extended until 20/11 to compensate**

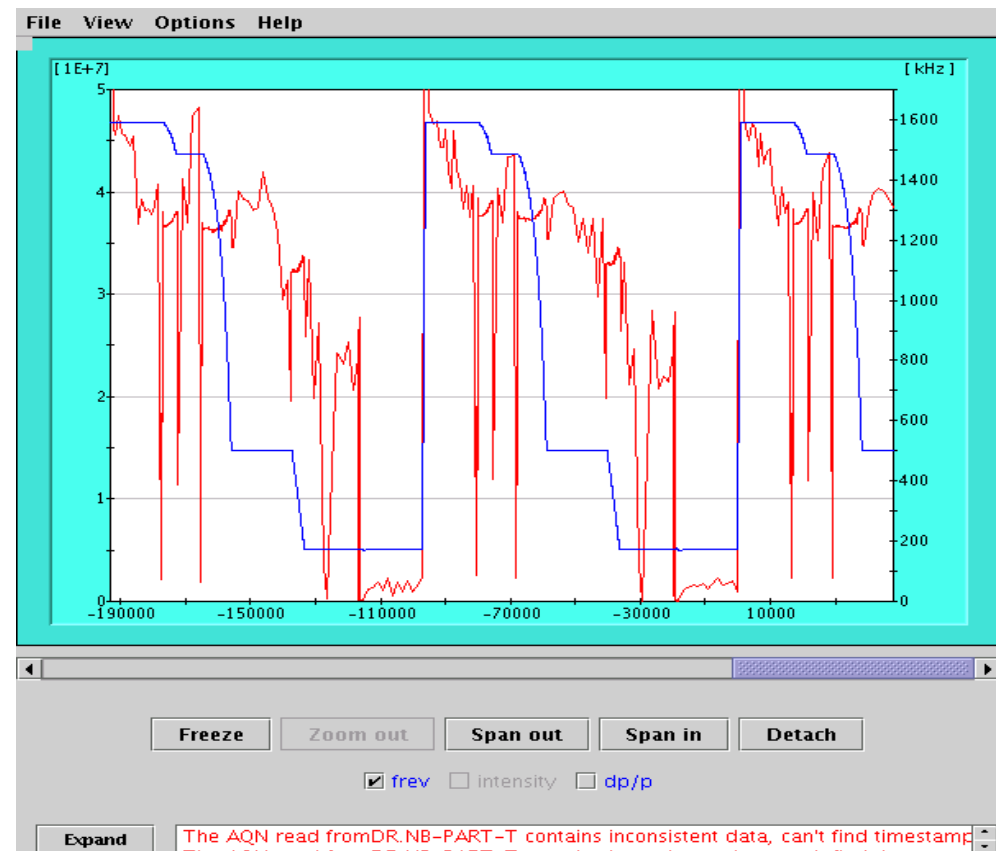
<b>Run time (h)</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2006</b>
<b>Total</b>	<b>3600</b>	<b>3050</b>	<b>2800</b>	<b>2800</b>	<b>3400</b>	<b>2925</b>
<b>Physics</b>	<b>1550</b>	<b>2250</b>	<b>2100</b>	<b>2300</b>	<b>3090</b>	<b>2765</b>
<b>md</b>	<b>2050</b>	<b>800</b>	<b>700</b>	<b>500</b>	<b>310</b>	<b>160</b>
<b>uptime</b>	<b>86%</b>	<b>89%</b>	<b>90%</b>	<b>90%</b>	<b>71%</b>	<b>65%</b>



# The 2006 run

- Typical performance

Np (3.5 GeV/c)	3.31 e7	100 %
Np (2 GeV/c)	3.26 e7	98 %
Np (300 MeV/c)	2.8 e7	84 %
Np (100 MeV/c ramp)	2.92 e7	88 %
Np (100 MeV/c end)	2.72 e7	82 %
DETFA7049	2.39 e7	72 %
dp/p (3.5 GeV/c)	33.113	0.976
dp/p (2GeV/c)	1.317	0.231
dp/p (300MeV/c)	1.33	0.048
dp/p (100 MeV/c)	0.433	0





# The 2006 run

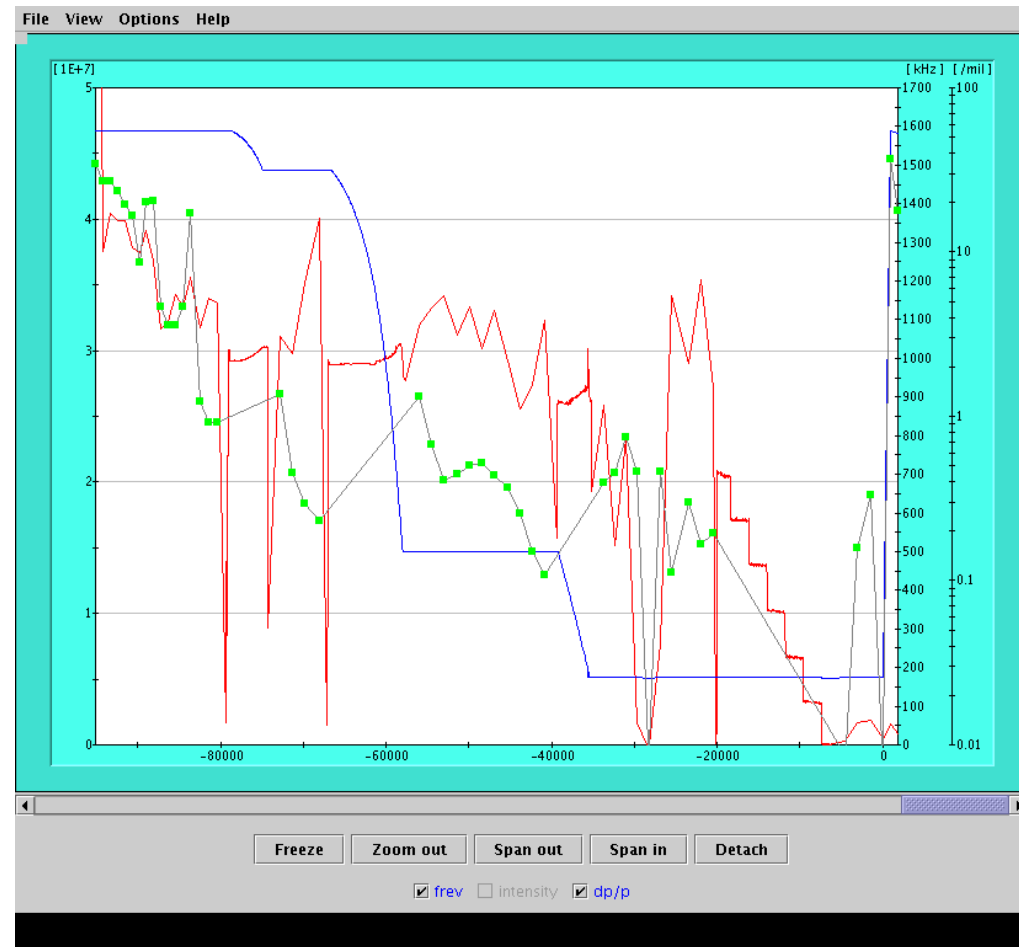
- Increased losses PS – AD target
- Increased deceleration losses
- Slower beam cooling at low energies
- Higher long. emittance

Parameter (at extraction)	Design	Achieved 2004				Achieved 2006		
		100 MeV/c	100 MeV/c	300 MeV/c	100MeV/c, multiej.	100 MeV/c	500 MeV/c	100MeV/c multiej.
Total energy spread [4s] [10 <sup>-3</sup> ]	1 – 0.1	0.8 – 0.4	0.15			>1	2	>1
Bunch length [ns]	200-500	90-200	300			120-500	500	50
Number of antiprotons [10 <sup>7</sup> ]	1.2	3.0/4.2	3.3/4.0	1.0*3	0.4*6	2.5	3.0	0.4*6
Cycle time [s]	60	84	84	89	96	100	95	112



# The 2006 run: ASACUSA

- Several subgroups including RFQD and multiejection (ej. at 2.4s interval on h=6)





# The 2006 run: ATRAP

- Commissioning of new zone (ATRAP2); new e<sup>+</sup> source →
- New trap with large-bore 3T superconducting solenoid (several quenches)
- Some handling problems with the new source
- New dipole corrects well for strayfield disturbance, but complications can arise when coupled with AD orbit trajectory drift





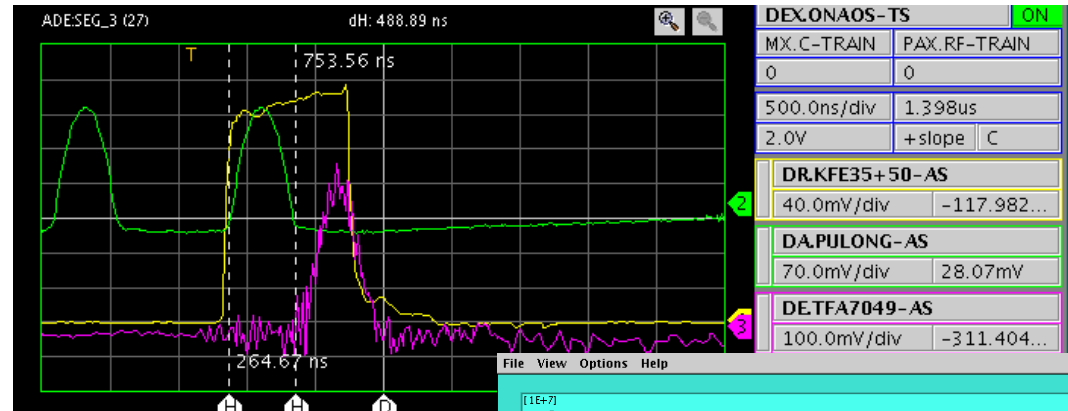
## The 2006 run: ALPHA

- Commissioning of new trap ultimately aimed at trapping Hbars

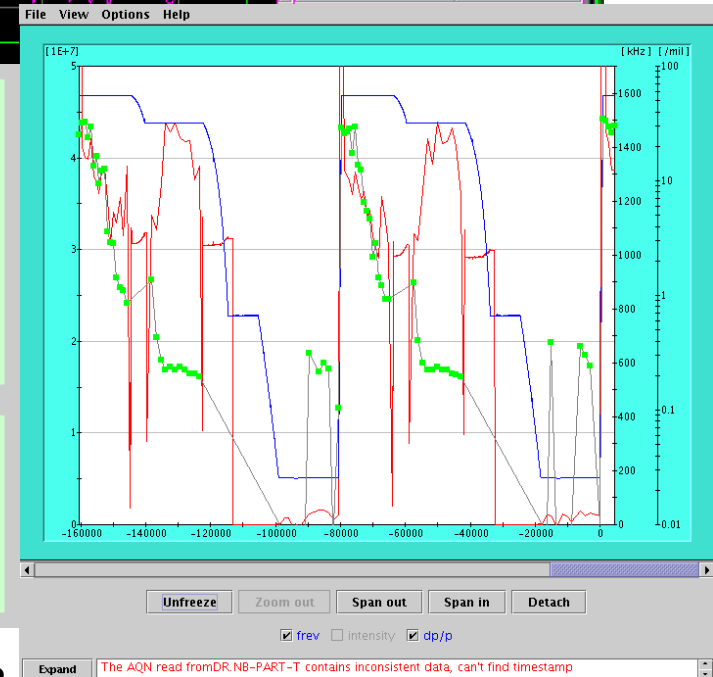


# The 2006 run: ACE

- Cell irradiation with 500MeV/c beam:
- Plans for AD cycle w. e-cooling at 300MeV/c and then acceleration for ejection at 500MeV/c abandoned.....
- Extended s-cooling at 2GeV/c
- $E_h, E_v = 8\pi$ ,  $l_{\text{bunch}}=500\text{ns}$
- Some modifications to ej. line supplies
- 1 week exclusive run (including final setting-up)



Np (3.5 GeV/c)	2.93 e7	100 %
Np (2 GeV/c)	2.91 e7	99 %
Np (300 MeV/c)	0.0 e7	0 %
Np (100 MeV/c ramp)	0.0 e7	0 %
Np (100 MeV/c end)	0.0 e7	0 %
DETFA7049	2.54 e7	86 %
dp/p (3.5 GeV/c)	28.797	0.917
dp/p (2GeV/c)	1.284	0.197
dp/p (300MeV/c)	0	0
dp/p (100 MeV/c)	28.797	0



ATC/ABOC 2007

T. Eriksson CERN AB/OP



## 2007 - shutdown work

- **E-cooler:**
  - **Renovation of collector cooling system: improve water quality (conductivity); attempt to solve stability problems**
  - **Verification of all collector HW**
  - **2005 NEG improvement was successful, BUT we are running with one less Ion pump (feedthrough broken)**
- **“New” MWPC in DE0-line:**
  - **To simplify ALPHA line setup**
  - **Mech. design done w. upstream move of 2 quadrupoles**
  - **Optics consequences checked: hope for improvements...**





## 2007 - shutdown work

- **Shielding of DE1.STP26/DE1.MWPC42: under study**
- **New experimental area access system**
- **ACE: Alignment of DEM-line**
- **ASACUSA:**
  - **1 New Ion pump + refurbish 1 existing**
  - **Turbo pumps: last spare used, no longer supported (CERN-wide problem). To be discussed**
  - **RF buncher removal (end March?)**
- **ALPHA: Re-arrangement of zone. (+ general alignment/vacuum, not yet defined)**
- **ATRAP: (General services only, not yet defined)**



## 2007 - shutdown work

- **Safety issues:**
  - **Modification of platform near D305 (after crane accident)**
  - **New ATRAP e+ source: much overhead work**
  - **Condition of catwalks**
  - **Barracks/workshops...**



## 2007 (and beyond) requests

- ACE: awaiting request
- ASACUSA: awaiting subgroup schedule (for support planning)
- PAX: Initial feasibility study for proposed experiment underway. Internal target tests soon?



## 2007 startup

- Extra HW-test time requested by AB/PO: 4 weeks in total
- Start with production beam 7/5
- 4 weeks for startup/md
  - Thorough study of e- vs. Pbar alignment for e-cooling
  - Set-up of new optics in DE0, DE3/4, DE2
- No plans for tst protons, but it might be needed
- And:
  - *Study of PS to AD line optics desirable*
  - *5-bunch production beam – is it far away?????*



## 2007 startup

- Physics run: 4/6 – 22/10
- Plan to continue running during weekends
- AD operation:
  - 2 shifts/day during startup, then:
  - 1 specialist on-call/week
  - 1 backup/week
  - ccc looks after AD during nights/weekends
- The same team also runs LEIR



CCC

- *Running AD from ccc reinforces the need for:*
- *Improved machine stability =*
  - *Electron cooler stability/performance*
  - *Need improved correction of ecool trajectories*
- *Better tools for ejection beamline tuning =*
  - *Need new monitors for fast, non-destructive measurements and corrections*



# AD Consolidation

- AD is now included in the general consolidation program....
- ....at the bottom of the list....
- Let's look at only RS...and see what can be done

Item	RS	Material budget 2007-2010 kCHF	Staff requirements 2007-2010 MY
C10/C02 Cavity upgrade	12	380	3.3
Stochastic cooling Pickup/kicker movement	12	150	1.0
Horn pulser ignitron phaseout	9	230	0.35
Stochastic cooling controls/instrumentation	8	200	2.0
Horn pulser electronics	6	175	1.30
Ej.line trajectory instrumentation	2	300	0.6
(RF low level migration to DSP)	6	150	1.0



# Conclusion

## General remarks

- AD downtime is increasing
- e-cooler is getting more and more difficult to set-up correctly
- Some equipment (eg. target area) has been operational for a very long time without intervention: know-how is disappearing
- Keen interest from users