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# Status of Diamond RF system

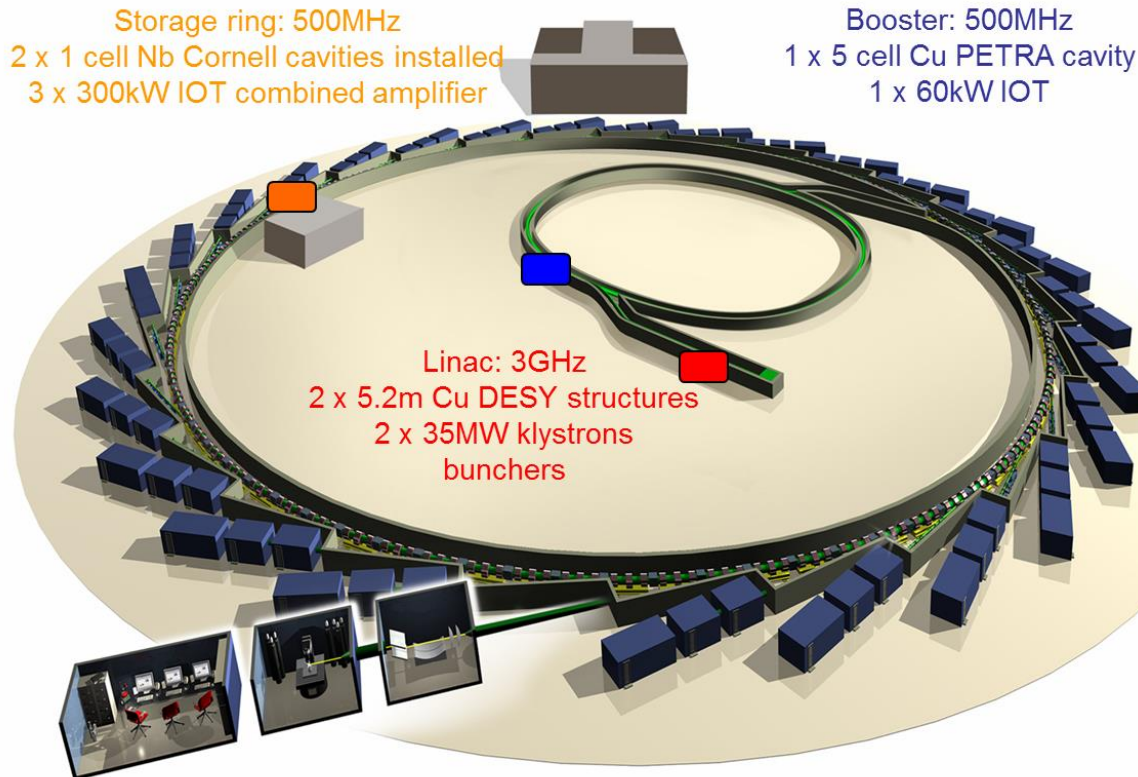
**Shivaji Pande**

**On behalf of DLS RF Group**

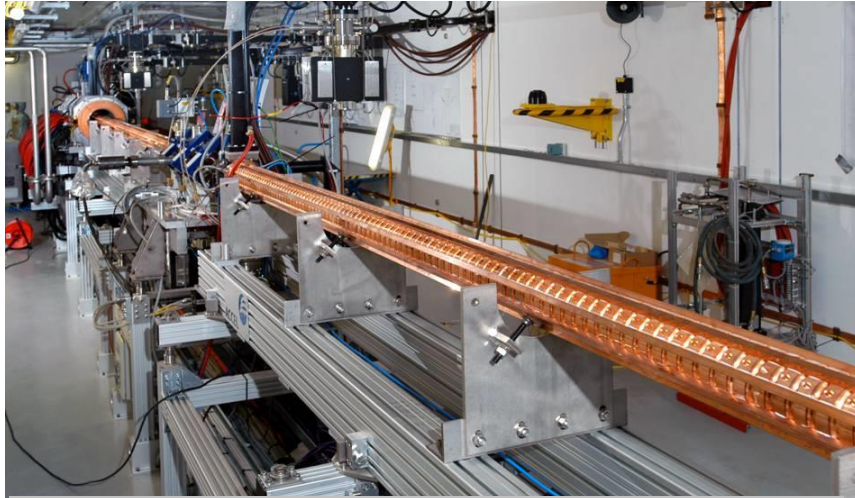


# RF at Diamond Light Source

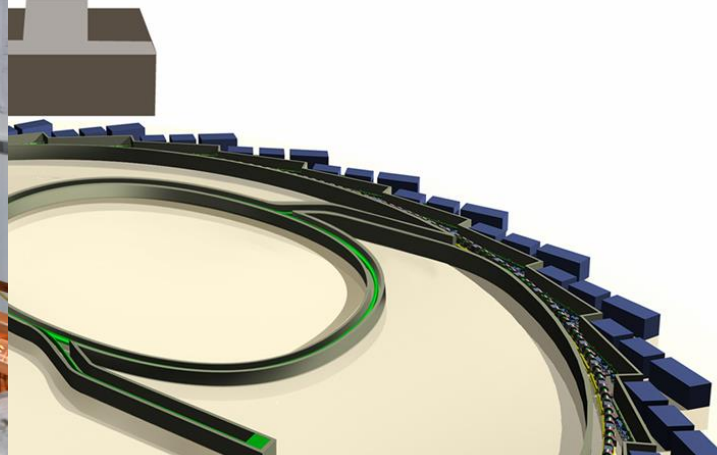
3GeV 300mA third generation synchrotron light source  
In user operation since January 2007



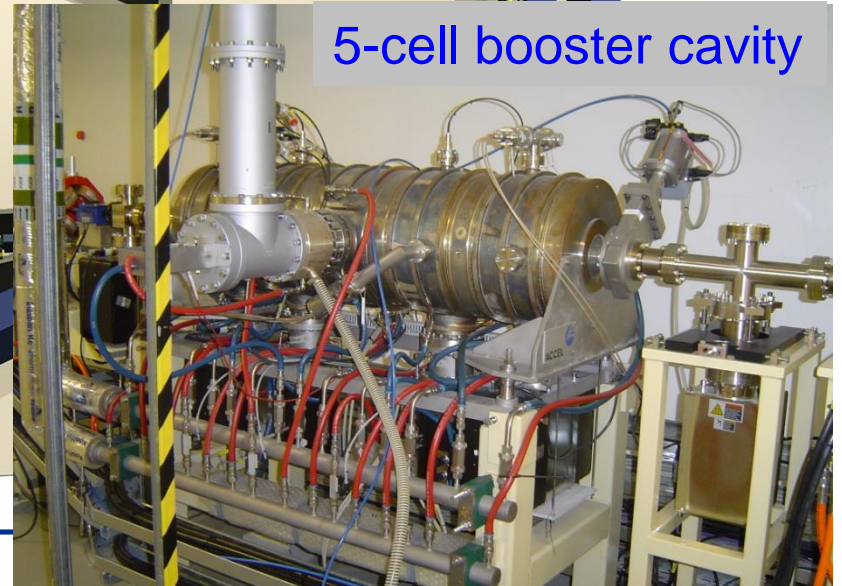
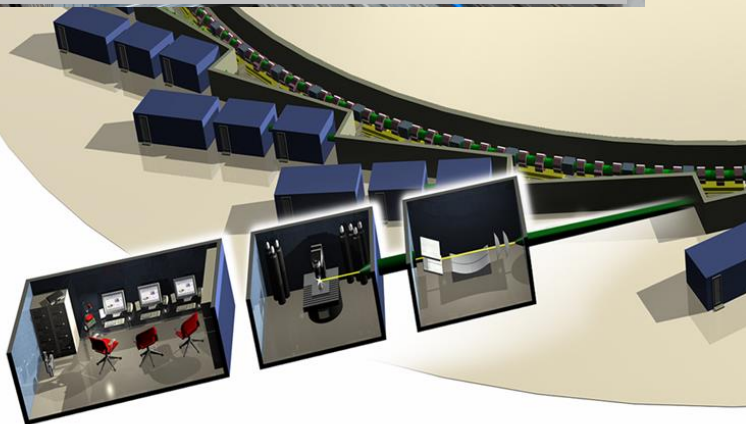
# Injector Linac & Booster cavity



100 MeV normal conducting linac

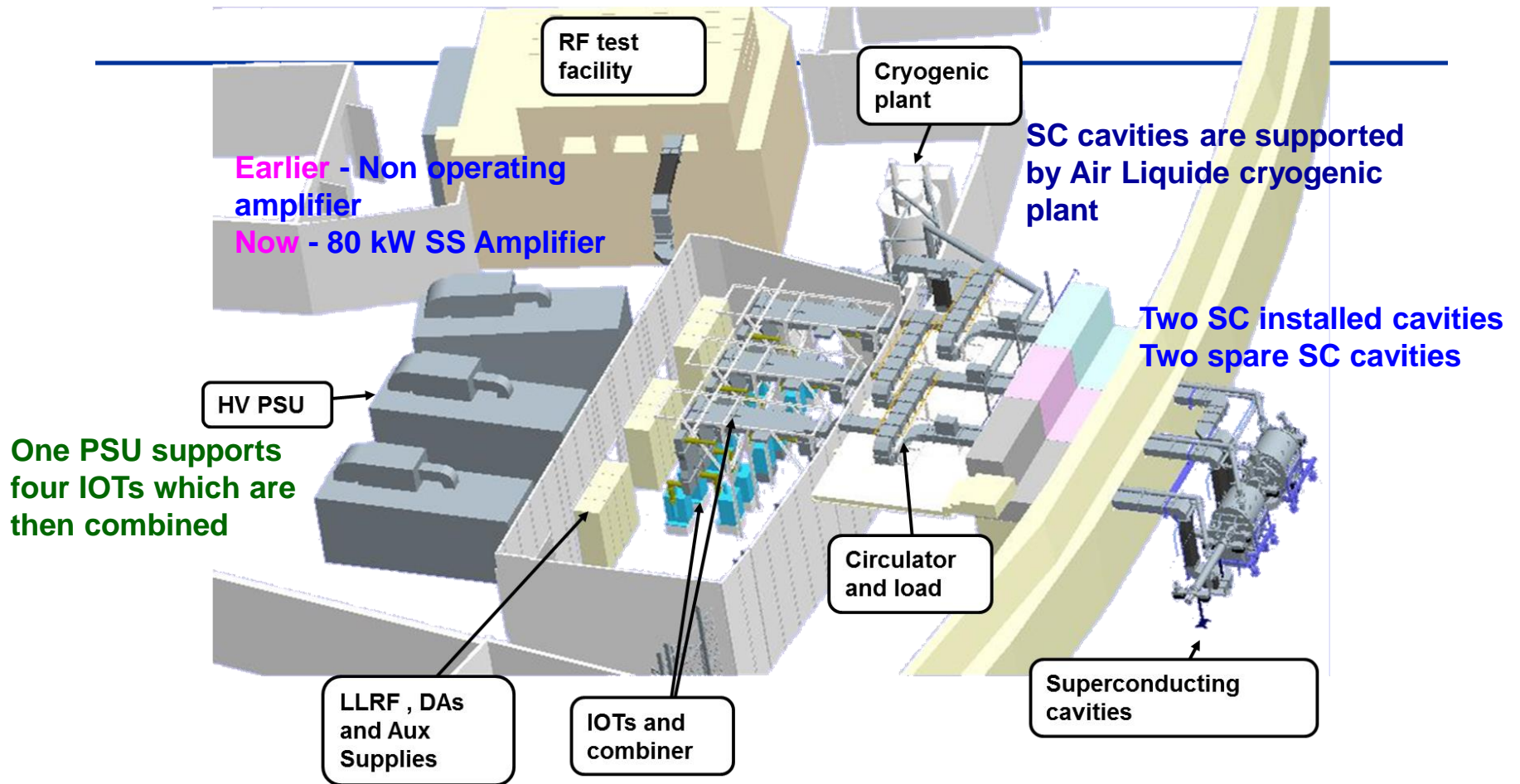


5-cell booster cavity



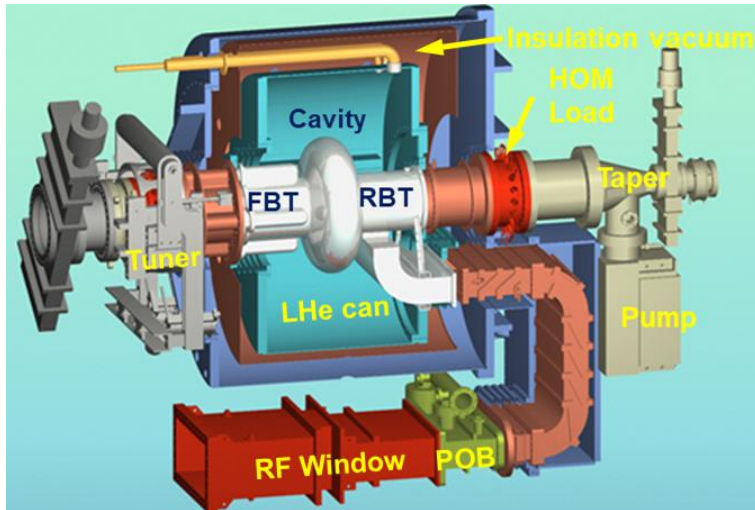


# Storage Ring RF



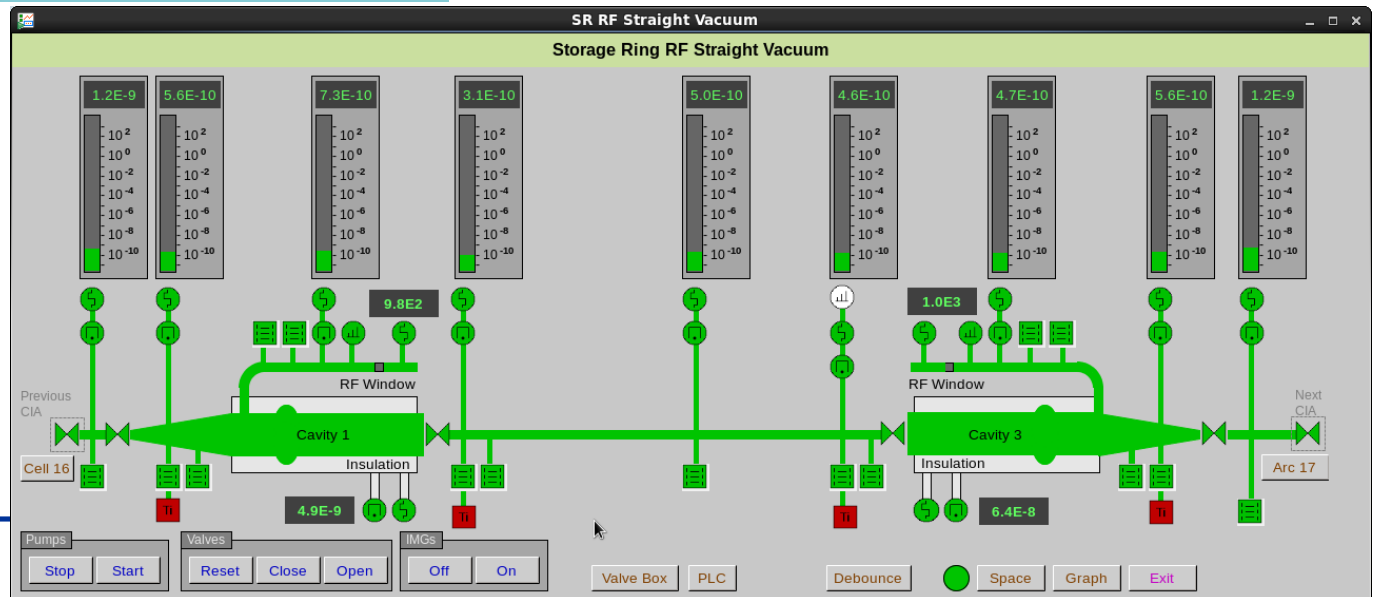
**Two extra EU HOM damped cavities already installed in 2017-18**  
**One more purchased this year**

# The Storage Ring CESR-B cavity



Operating Parameters of DLS – CESR Cavities	
Resonant frequency (MHz)	499.654 / 499.682 MHz
Acceleration voltage (MV)	1.1, 1.4
$R/Q$ ( $R = V^2/P$ )	89
$Q_{\text{ext}}$ measured	$2.35 \times 10^5$
$Q_{\text{ext}}$ with 3 stub tuners	$1.0 \times 10^5$ , $1.4 \times 10^5$
Beam power (kW)	200, 220

RF Straight  
Present Layout

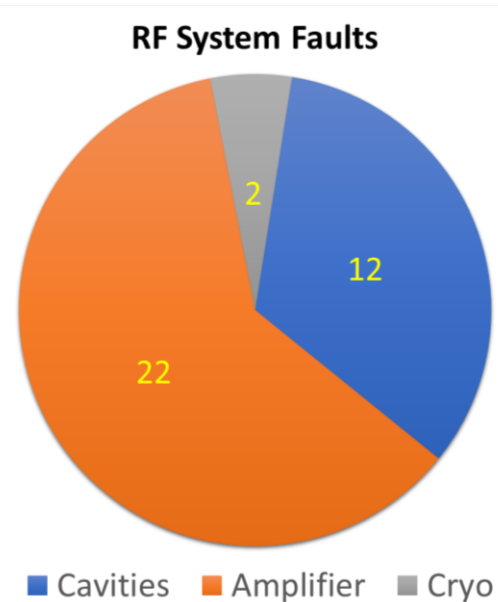


ESLS-RF 2019, 24 Oct. 2019,  
Diamond Light Source Ltd., UK



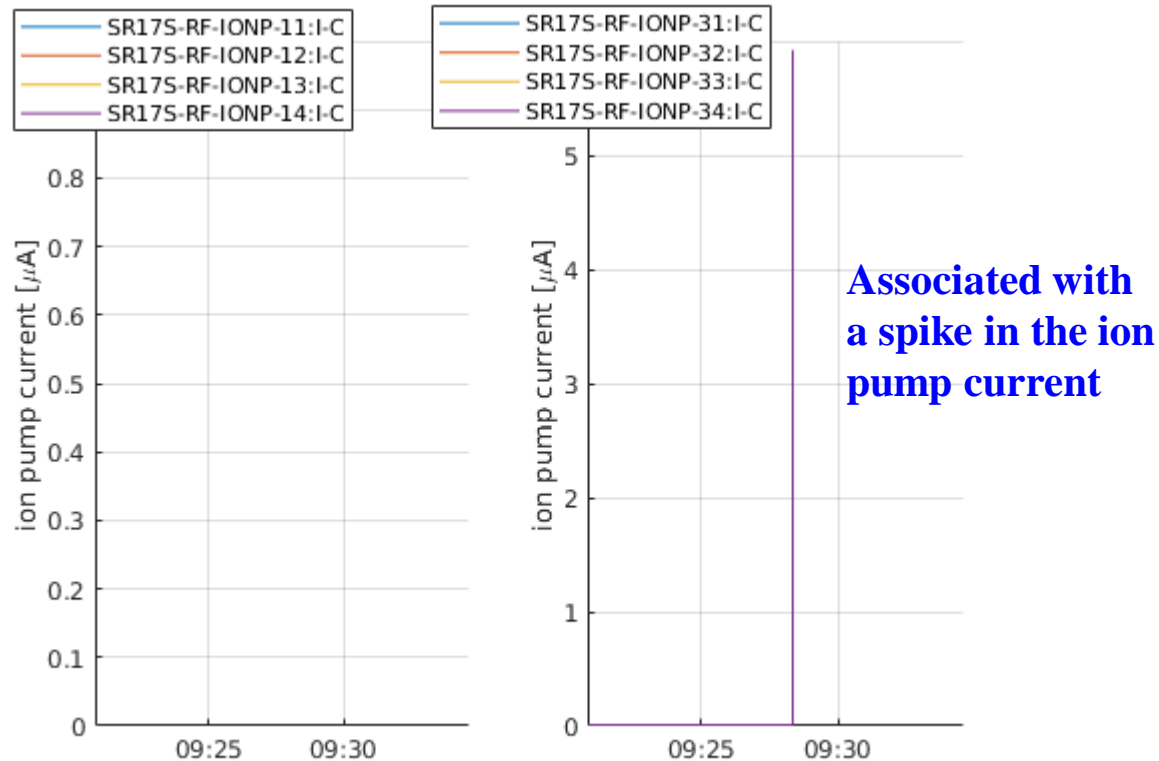
# Reliability: year to date - RF

	Run Hours	Faults	MTBF	MTTR	Downtime
Diamond	4272	52	82.15 hours	1.88 hours	97.94 hours
Storage ring RF	4272	36	118.67 hours	1.91 hours	68.64 hours

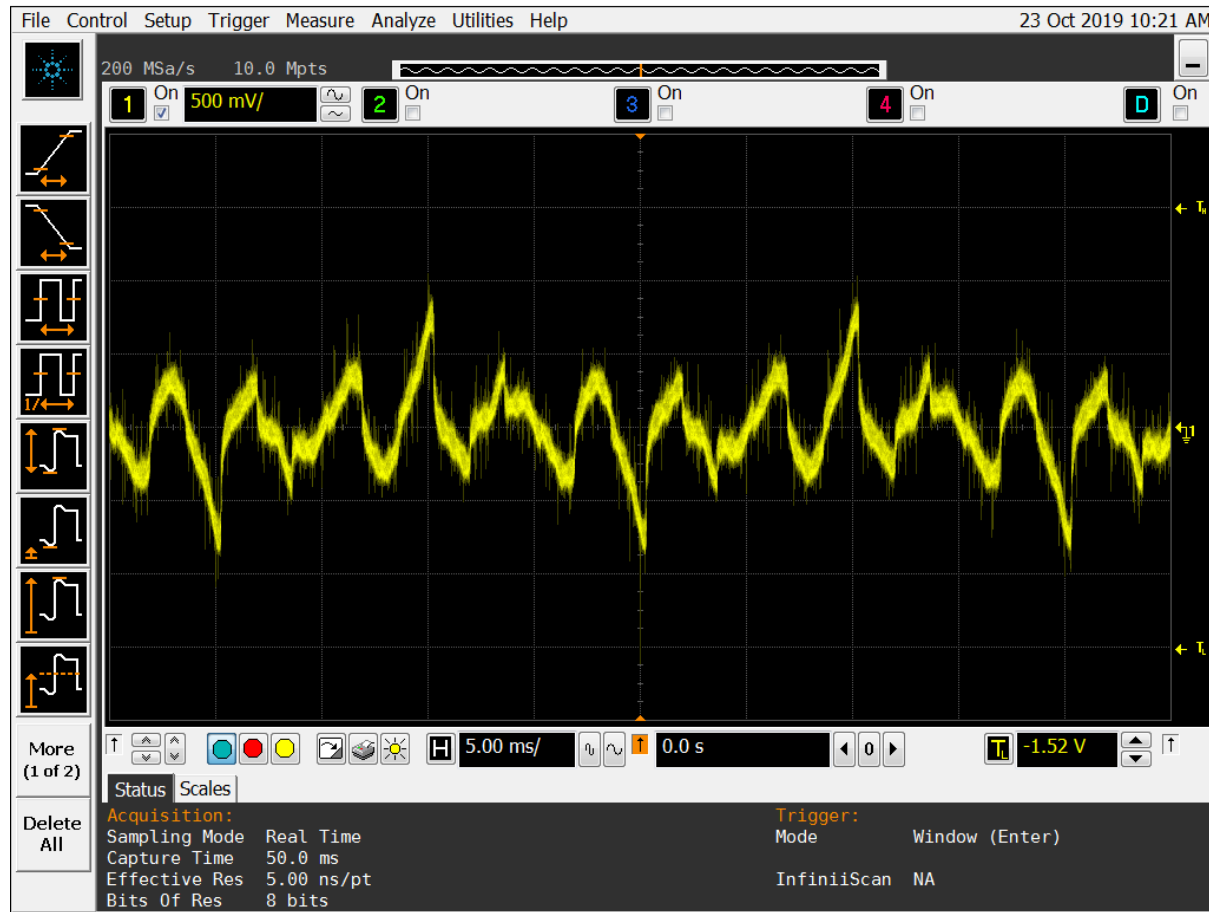


	Amplifier	Cavities	Cryogenics
IOT Short Circuit	6	RBT & Taper Vacuum	8
Grid ILM	2	POB Vacuum	2
IOT Arc	3	Ins Vacuum	1
FOC Coil	1	Taper water	1
FWD Pow	2		
Directional Coupler	5		
Mains switch Q2	1		
Trans O/heat	1		
Unknown	1		

# True IOT Short Circuit Event

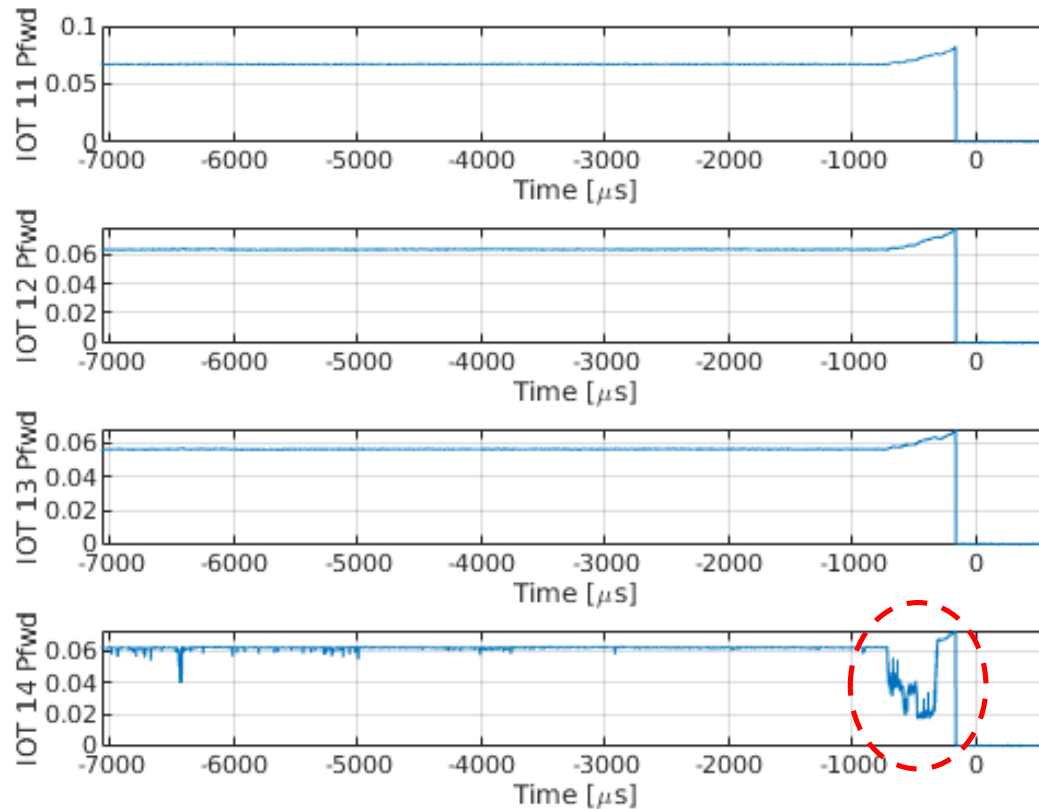


# A False IOT Short Circuit Event





# Sudden Drop in Power from IOT – 1(4)

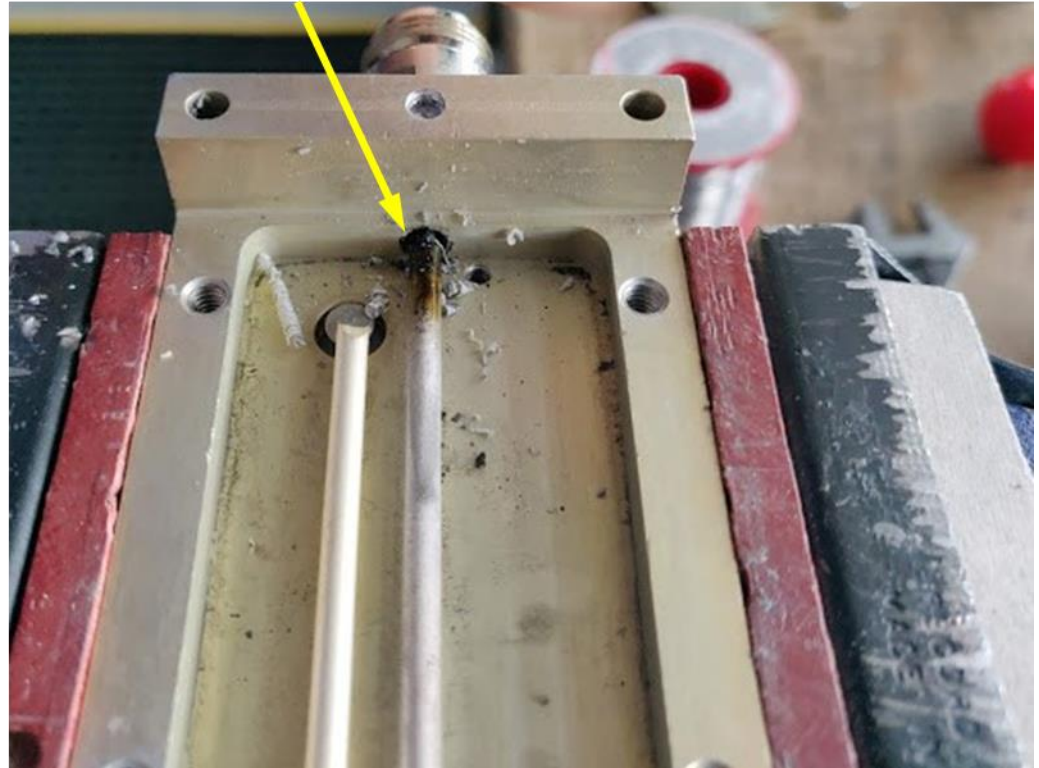


# Sudden Drop in Power from IOT – 1(4)

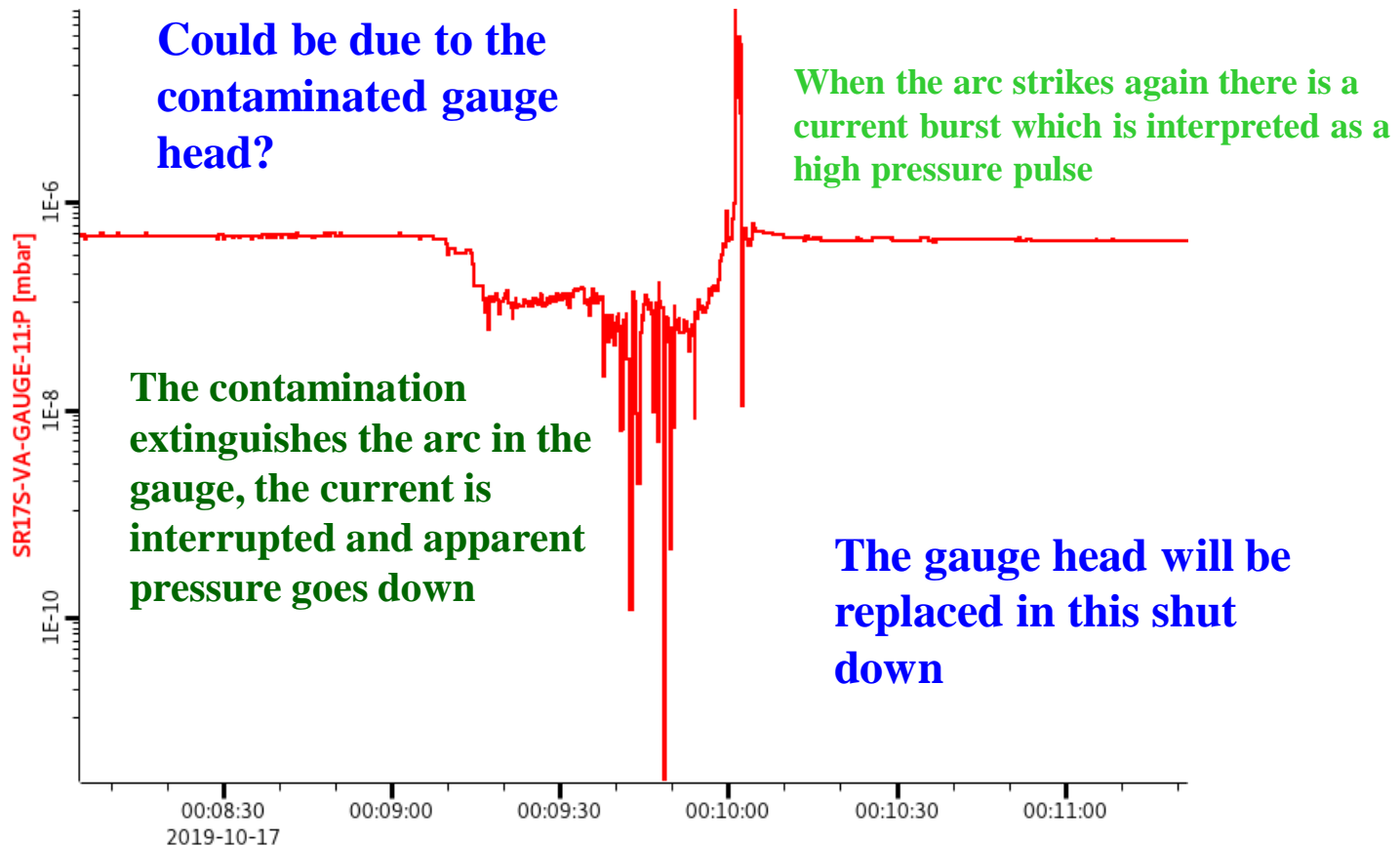
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- The Drive Amp and IOT were OK.
- The suspicion was on the Connection between DA and the IOT – cable and DC
- Operated with new cable without DC for some time
- Found burnt connection inside the directional coupler

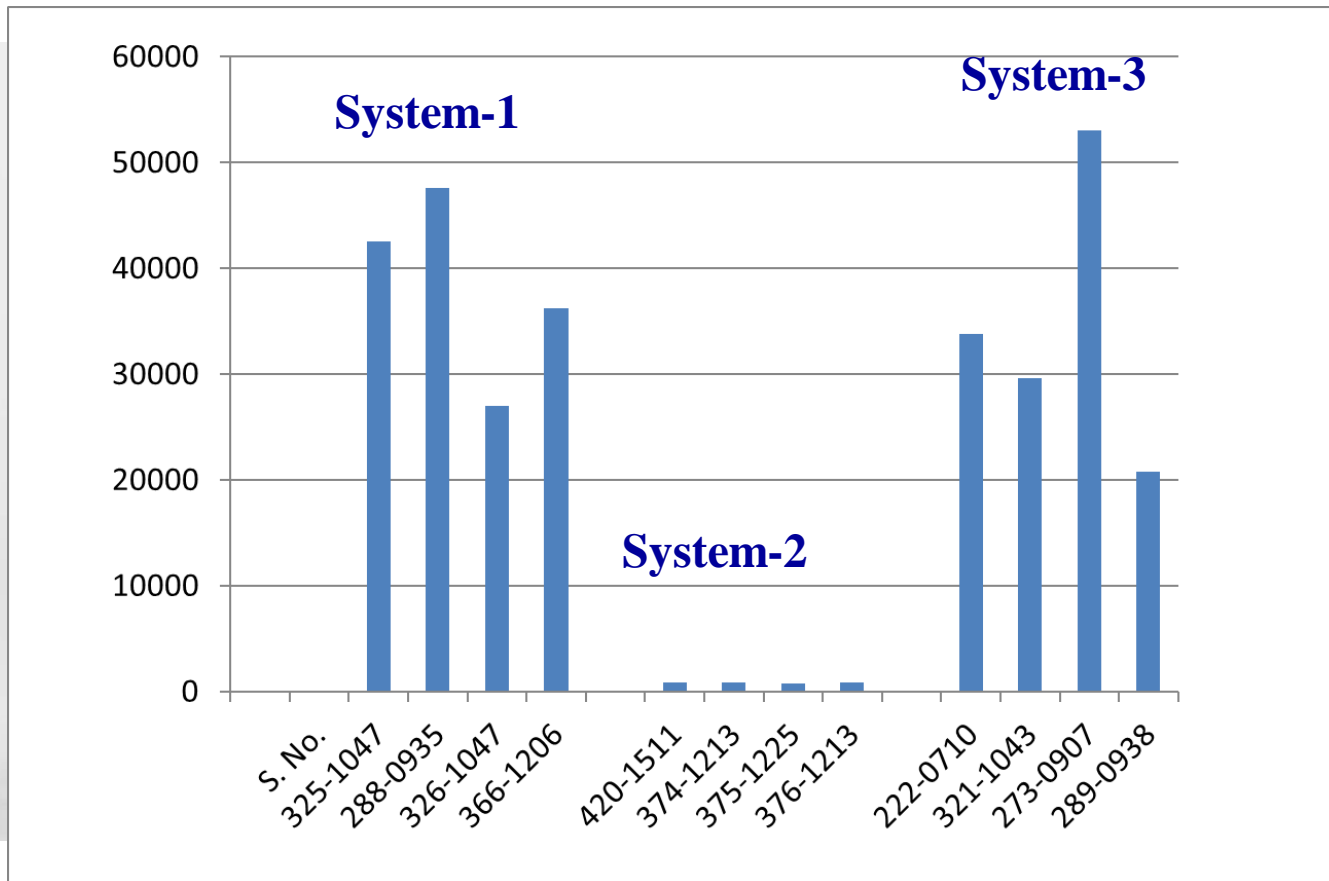
Burnt Directional Coupler Pin



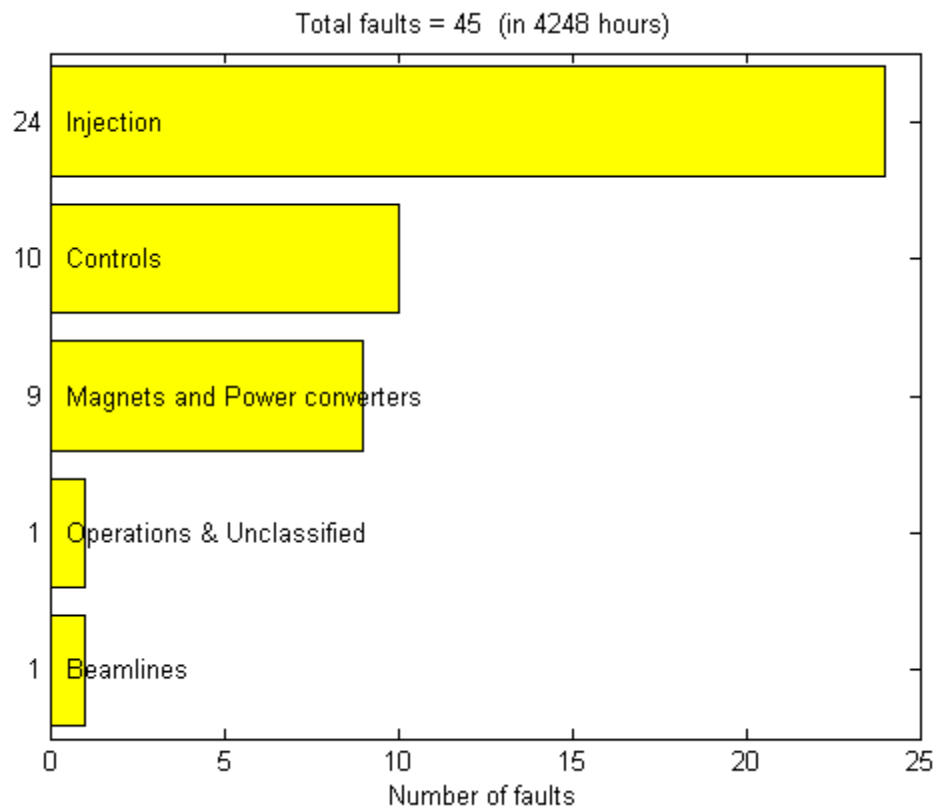
# The Insulation Vacuum Trip



# IOT Operation hours - SR



# Injector system faults – TopUp failures



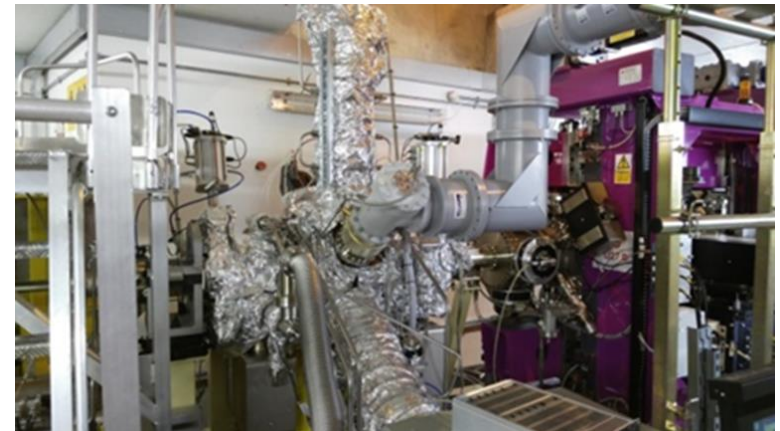
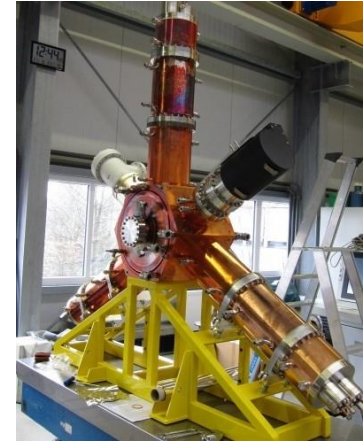
Linac faults	
Amp 1	7
Amp 2	3
Linac	5
TopUp HW	2
Gun Vac	1
BR RF	1
BTS TL	1
Unclassified	4



# New Developments

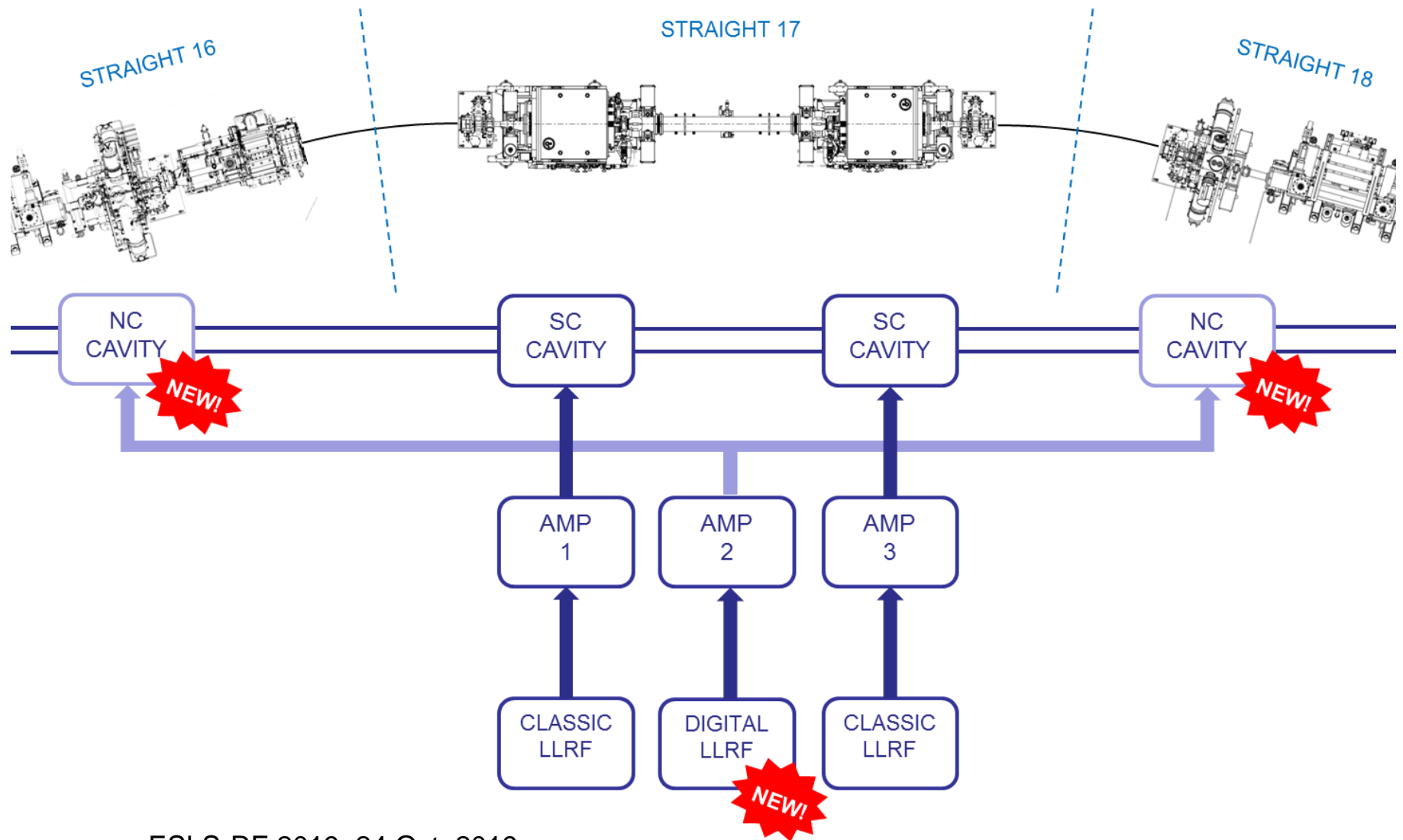
## Normal conducting cavities

- Two new NC cavities have been installed in the storage ring
- Third cavity is purchased and is under preparation for baking..
- Will be installed in straight 15
- In the normal course, two NC cavities will assist the SC cavities in terms of voltage and power
- In the event of complete failure of cryogenic system, the three NC cavities can sustain operation on their own with
- ~600 kV across each cavity
- Can support operation at ~200 mA.



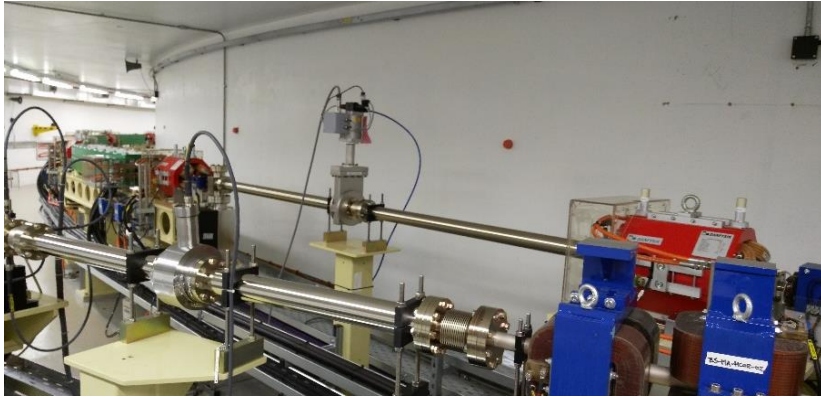
# New Developments

## New storage ring RF configuration



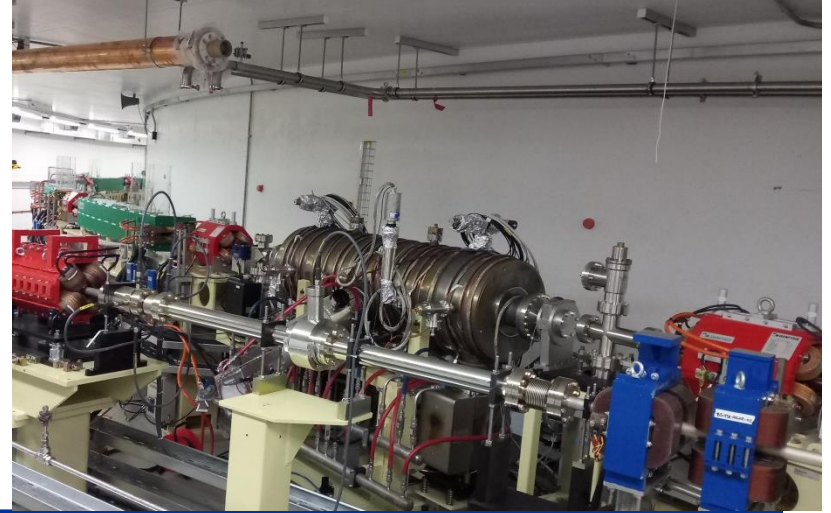
# New Developments

## Second booster cavity



Diamond booster operates with a single 5-cell copper cavity

- Cavity and amplifier are both single points of failure
- Install second cavity in vacant length of booster ring
- 5 cell Petra cavity from DESY
- Baked in tunnel in summer 2018
- Installed in November 2018
- To be powered by solid state amplifier and controlled by digital LLRF





# New Developments

## Solid state amplifiers at Diamond



### 60 kW amplifier installed on BTS roof

- Will power second booster cavity
- Using water supply for aluminium circuit
- Transmission line penetration in BTS roof is shielded by steel labyrinth
- Awaiting delivery of amplifier modules



### 80 kW amplifier installed in RF hall

- Will power RF test facility
- Using water supply for aluminium circuit
- Passed all acceptance tests
- Water cooled load rated at 150 kW but failed at 50 kW, has been repaired
- Mezzanine platform installed to support transmission line to RF test facility

# New Developments

## SLED Cavity

- Cavity, phase shifter, power divider & High Power window are delivered
- Assembly and installation in progress
- Problem with phase shifter drive mechanism
- Sent to the supplier for rectification



SLED Cavity

Window





# The Diamond RF Group

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- Chris Christou
- Pengda Gu
- Peter Marten
- Shivaji Pande
- Adam Rankin
- David Spink
- Laurence Stant
- Anton Tropp

**Thank you for your attention**

***Any questions?***