CSN5

INFN-LNF/Cs
R&D Projects

Open Lab Council (“Preventivi 2019”)

S. Dell’Agnello, CSN5 LNF/Cs Coordinator

INFN-LNF, 2 July 2018

CSN5 News

- CSN5 “Calls”, 6th edition
  - Open to all themes. Deadlines: Step 1 = June 11, 2018
    - Step 2 = ordinary DB “Preventivi” CSN5, July 20
  - Two proposals, SLEM (RN), FLAGS (RL)
- Six CSN5 “Grants Young Researchers” 6th edition
  - Deadline = July 21 (see CSN5 website)
- Next CSN5 meetings
  - Rome “Sapienza” July 25-27; Pisa Sep. 24-28

R&D experiments

Name	R&D Area	Resp (Nat, Loc)	FTE
SL-COMB2FEL	Accelerat	E. Chiadroni (N)	>7.3
MICA	Accelerat	R. Cimino (N)	~7
NUCLEAAR	Accelerat	C. Marcelli (N)	1.4
GLARE-X	Interdiscipl	S. Dell'Agnello (N)	5.7
SIMP2	Detec/Elec	C. Gatti (N)	2.1*
ANET	Detec/Elec	R. Bedogni (L)	2.3
SLEM	"CALL"	M. Biagini (N)	2.6 + 12yr AR
FLAGS	"CALL"	A. Clozza (L)	1.0 + 1 yr AR

* C. Gatti: *"FTE potrebbero cambiare se si dovesse aprire la sigla per Klash"*

MICA (THIRD & LAST YEAR)
MITIGATE INSTABILITIES IN CIRCULAR ACCELERATORS

- Predict the behaviour of future circular accelerators in terms of beam stability, given the increase of beam intensity leading to undesirable collective effects, triggered by self-induced e.m. fields, which may play an important role in the machine performance.
- Put together several INFN competences to fully qualify materials to be compliant with operational parameters of such future accelerators.
- Create an INFN network able to completely perform theoretical and experimental studies on collective effects.

R. Cimino (Local And National Responsible) **R. Larciprete** (WP leader), **C. Milardi** (WP leader), **A. Drago** (WP leader)**, D.Alesini, M. Angelucci, S. Caschera, A. Di Trolio, L.A. Gonzalez** (Eurocircol)**, E. La Francesca, L. Spallino**(Eurocircol), **M. Zobov**.

People involved @ LNF: a total of ~ 7 FTE.

Maria Rosaria Masullo (Infn-Na, 1.5-2. FTE): Local Responsible

Mauro Migliorati (INFN Rm1 2-2.5 FTE): Local Responsible

MICA @ LNF:

WP	TITLE	UNITS INVOLVED	RESPONSIBLE
WP1	Surface properties of Carbon and Cu Surfaces for HL-LHC	LNF-INFN CERN	R. Larciprete
WP2	Vacuum stability at FCC-hh	LNF-INFN CERN	R. Cimino
WP3	Synchrotron radiation material studies	LNF-INFN CERN	R. Cimino
WP4	Impedance simulations and beam dynamics studies	Rome1-INFN Na-INFN CERN	M. Migliorati
WP5	Impedance Study and measurements of materials in real condition	Na-INFN Salerno-INFN Rome1-INFN	M.R. Masullo
WP6	Feedbacks for FCC-ee	LNF-INFN CERN	A. Drago
WP7	Feasibility study on potential use of DAΦNE for advanced R&D accelerator studies	LNF-INFN CERN, RM1	C. Milardi

WP1	Surface properties of Carbon and Cu Surfaces for HL-LHC	LNF-INFN CERN	R. Larciprete

Activity 2017 - 2018

- Test and first measurements with the LT - Manipulator to study a-C and Cu surfaces of relevance to HL-LHC at T between 5 and 20 K.
- Validate a-C and Cu surfaces to be compatible with the higher luminosity of the upgraded machine and study their properties as a function of cryosorbed gas, ion, electron and photon bombardment.
- Exploiting SR From DAΦNE, within the approved MoU with CERN (June-17 to June 21).
- Dissemination & publication (RC Chairman of e-cloud18; CAS, Various presentations; Work in preparation; Publications (LA Gonzalez, M Angelucci, R Larciprete, R Cimino: "The secondary electron yield of noble metal surfaces" AIP Advances 7 (2017), 115203)

Proposed Activity 2019

- Experiments with the new Low Temperature (LT) setup
- Tests and Experiments exploiting Synchrotron Radiation from DAΦNE as an investigation tool and a photon irradiation facility.
- Support to the CERN-LNF MoU activity.

Requests 2019 (as foreseen)

- Mobility: 6 k€
- Consumables: 20 k€
- Contribution to New Laser for Raman 7 k€

WP2	Vacuum stability at FCC-hh	LNF-INFN CERN	R. Cimino

Activity 2017 - 2018

- **WP symbiotic with LNF activity within EuroCirCol** (L. Spallino on this full time)
- Experiments on vacuum stability in the temperature range between 20 and 60 K, on condensed gases (Ar, Co, etc) on test samples.
- Experimental validation on the ability of SEY and LE-SEY to monitor adsorbate thermal stability versus temperature and versus irradiation.
- Study Desorption and SEY properties of Laser treated surfaces
- Dissemination & publication (RC Chairman of e-cloud18; CAS, Various presentations; Work in preparation; Pubblication (R. Dupuy, ... R. Cimino, and J.-H. Fillion: "The efficient photodesorption of nitric oxide (NO) ices: A laboratory astrophysics study" Astronomy and Astrophysics A&A 606, L9 (2017))

Proposed Activity 2019

- Tests and Experiments with the new LT set-up
- Tests/Experiments adding the use of Synchrotron Radiation from DAΦNE as investigation tool & photon irradiation facility.
- Contribution to EuroCirCol final CDR.
- Exploitation of our studies on LT Ices in other research fields, such as Astrophysics.

Requests 2019 (as foreseen)

- Mobility: 6 k€
- Consumable: 20 k€
- Contrib to New Laser for Raman 7k€

WP3	Synchrotron radiation material studies	LNF-INFN CERN	R. Cimino

Activity 2017 - 2018

- WP symbiotic with LNF activity within EuroCirCol (L. Gonzalez, L.G., on this full time)
- At **ANKA** a set-up to study photo induced desorption has been installed and tested. (L.G.)
- At **Bessy2** we are measuring **R and PY** by SR at-wavelength reflectometry.
- Experiments on highly reflecting a-C surfaces are supporting our proposal (PRL 2015) to deal with the very high SR induced heat load in FCC-hh.
- Dissemination & publication (RC Chairman of e-cloud18; CAS, Various presentations; Work in preparation)

Proposed Activity 2019

- Continue Experimental campaign on new samples
- Continue data taking at **ANKA** setup (L. Gonzalez)
- Install (within INFN/CERN MoU) a new test line to irradiate with white light photons from DAΦNE long beam pipes.

Requests 2019 (as foreseen)

- Mobility: 15 k€
- Consumable: 15 k€

WP6	Feedbacks for FCC-ee	LNF-INFN CERN	A.Drago

Activity 2017 - 2018

- To develop a faster tool (hardware and software) to timing the double modulation (AM and QPSK) backend for the longitudinal feedbacks.
- To put the new software and hardware AM/ QPSK timing tool in operation for DAFNE runs.
- Revision of the low noise front end for the vertical feedback systems necessary to avoid beam enlargement in collision.
- Put in operation the low noise front end for DAFNE/Siddartha runs.
- To write a chapter of the FCC-ee CDR including and describing the new and innovative feedback system specifications

Proposed Activity 2019

- To double the feedback in the horizontal positron plan to better fight the e-cloud effects limiting the beam total current.
- Better control the quadrupole longitudinal oscillations.
- Intra-bunch feedback R&D for a possible test in DAFNE in 2020.
- Publish the CDR (Conceptual Design Report) including a chapter with the FCC-ee feedback specification.

Requests 2019 (as foreseen)

- Mobility: 10 k€

WP7	Feasibility study of potential use on DAΦNE for advanced R&D accelerator studies	LNF Rome I CERN	C. Milardi

Activity 2018

- Analyze the ongoing international R&D programs at the forefront of research in advanced particle accelerators
- Study the possibility of using parts of the DAFNE accelerator complex as qulified test bench facility
- identifying 'hot' topics to be investigated with dedicated experiments.
- A first already considered activity concerns the newly proposed LASER treated surface to be used as active e-cloud moderator.
- In this context vacuum chamber surface will be: laser treated and qualified in terms of: SEY coefficient, desorption properties (also stimulated), impedance etc

Proposed Activity 2019

- Continue to analyze the ongoing international R&D programs at the forefront of research in advanced particle accelerators
- Continue to study the possibility of using parts of the DAFNE accelerator complex as qualified test bench facility
- Continue to identifying 'hot' topics to be investigated with dedicated experiments.

Requests 2019

- Mobility: 10 k€
- Consumable: 10 k€

MICA: Requests to Comm.V (2019)
(No specific requests to LNF services)

WP1 and WP2: Apparata & consumable & Mobility

To replace the Laser for Raman and upgrade sample transfer mechanisms for new manipulator. Experiments in EU and coll. Meetings.

WP3: Consumable & Mobility

To machine tests samples and perform experiments in EU.

WP4: Mobility.

To perform impedance measurements and to take part to relevant meetings.

WP5: Mobility & Consumable.

To optimize impedance measurements set-up and to take part to relevant meetings.

WP6: Mobility

To take part to relevant meetings on Feedbacks systems.

WP7: Mobility & Consumable

To take part to relevant meetings and analyse new materials before testing them.

GLARE-X

Georeferencing via LAser Ranging
& LAser debris Redirection from spacE-X

New CSN5 Interdisciplinary Experiment 2019-2021

Participants:
INFN-LNF (RN)
TIFPA/Univ. Trento/FBK
Roma2?

Preventivi INFN-CSN5, July 2018

New technologies and synergisms

- INFN-LNF
  - Laser ToF, geodesy from space – interest by ASI
    - Also interactions with NASA & ESA for ISS
  - Modulated RetroReflectors (MRRs) – interest by ASI, ESA
  - Study georeferencing from space for (mini)EUSO (M. Ricci)
  - Laser debris removal from ISS; w/(mini)EUSO (Roma2?)
- TIFPA/Univ. Trento
  - University Laser ablation laboratory @TIFPA site
  - R&D goal 1: space debris removal with space lasers
  - R&D goal 2: laser ablation propulsion for redirection of asteroids
- INFN-LNF & FBK/Trento
  - Service FBK contribution of MEMS to LNF (under convention)
  - R&D for for semi-active Modulated RetroReflectors
  - To perform laser communications in addition to positioning
  - Technology Readiness Level (TRL) up to 5 (now ~3)

Innovative R&Ds ⇔ Work Packages

WP1 = Develop 1 psec laser ToF – LNF

- Develop/customize **1 psec laser ToF** capabilities
  - Option 1: highly specialized, micro-channel plate PMT
  - Option 2: single photon avalanche photodiode detector package for laser ranging, reduced jitter and reduced temperature drift
  - Option 3: (external) collaboration with INFN-Torino, N. Cartiglia, winner of ERC on Ultra Fast Silicon Detectors (UFSD)
- "GLARE-X" mission concept (orbit, platform) with **SpaceX**
  - Original idea submitted in 2016 to ESA "Call for New science ideas"
- **Inverse laser ranging** from orbit with lasers in space
  - Laser options: 1) ranging to laser retroreflectors on Ground Control Points (GCP) for Earth Observation (EO); 2) Galileo; 3) LAGEOS-2
  - **Study also UV laser for (mini)EUSO for debris removal?**

Innovative R&Ds and Work Packages

WP2 = Laser Ablation Propulsion (LAP) – Trento

- R&D for laser debris removal and for asteroid redirection
- Debris orbiting Earth: study optimal orbit (h~6600 km or EO orbit h~650 km) and corresponding laser
- 1 laser for debris removal and iterative orbit correction
- Clean Space ESA program. SSA, SST programs of H2020

WP3 = Modulated RetroReflectors – LNF (FKB)

- Both for space and ground
- Distances up to 500 km; rates up to 5 kHz or more
- Applications to Near Earth Orbit
- Interest by ASI, ESA, NASA
- Potential commercial applications if TRL reaches TRL = 5

Prelim. requests to LNF & Personnel, 2019

- Requests to LNF Support Services (man-months):
  - SPCM: 2; Automation: 2; DT: 1; Cryo: 1; Laser: ½; Electr install: ½
- LNF Personnel (FTE, %: tot = 5.7)
  - S. Dell'Agnello 40%
  - M. Ricci 30%
  - B. Spataro Associato Sr
  - L. Porcelli 40%
  - G. Delle Monache 40%
  - O. Luongo 40%
  - M. Mauro 40%
  - M. Muccino 40%
  - M. Tantalo 50%
  - M. Tibuzzi, L. Salvatori, C. Mondini: 50% / each (tot = 150%)
  - R. March 20%
  - G. Bellettini 30%
  - R. Vittori 20%
  - G. Bianco 30%
- TIFPA Personnel: 2.0 FTE (~10 people)

SIMP: single microwave photon detection

Claudio Gatti

Partenariato

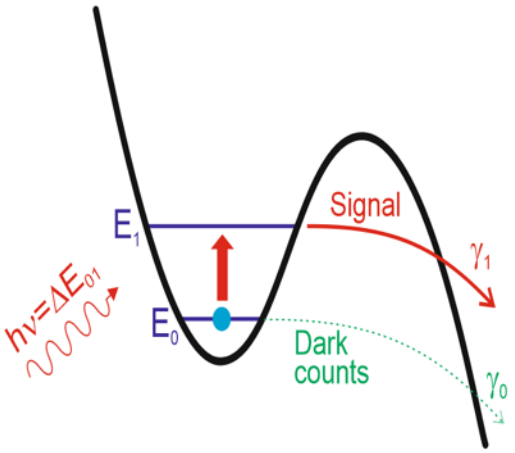
INFN LNF
INFN PISA
INFN SALERNO (new)
TIFPA
INRIM
CNR-NANO
CNR-IFN

10-30 GHz

Current Biased Josephson Junction Device

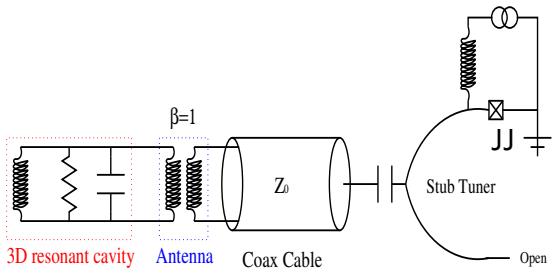
(LNF, INFN-Salerno, CNR-IFN)

Giunzione Josephson con bias in corrente



A seguito dell'assorbimento di un fotone, la tensione ai capi della giunzione Josephson passa da un valore nullo a qualche centinaio di microvolt, fino al reset della giunzione stessa.

Descrizione WP



CNR-IFN: Fabbricazione device e misure.

LNF: Setup criogenia diluizione 20 mK (da Frossati, Laiden Cryogenics), setup sperimentale e misure.

Salerno: Simulazioni giunzioni (GPU) e misure.

Fase 1: Portare il dark count a 10 kHz partendo da device esistente in letteratura.

Fase 2: Riduzione dark count al Hz con schema a 3 livelli (0→1→2).

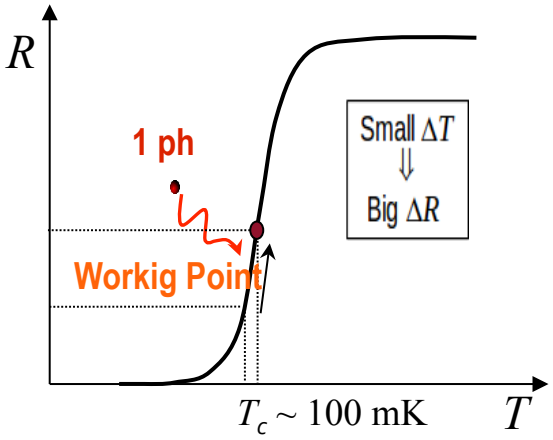
Fase 3: Puntare al mHz di dark count con nuovi schemi (overtones etc.).

30-100 GHz

Transition Edge Sensor

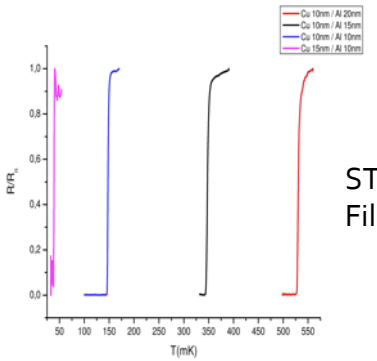
(INFN-Pi, TIFPA, INRIM, CNR-NANO)

TES



Un rivelatore TES si basa sulla ripida transizione allo stato resistivo di un film superconduttore.

Descrizione WP



STAX R&D
Film 40 mK

INRIM: Partendo da film con transizione a 40 mK (R&D Stax) fabbricazione TES su antenna.

CNR-NANO: Completamento R&D (Stax) per film con transizione a 20 mK

TIFPA: Setup criogenia per misure TES a 20-40 mK.

INFN-Pisa: Design antenna e matching in guida. Misure 20 mK e prestazioni in campo magnetico. Rumore ambientale

Fase 1: TES a 40 mK completamente testato in guida; film a 20 mK.

Fase 2: TES a 20 mK completamente testato; R&D film.

Anagrafica

	FTE*	
Claudio Gatti	0.5	R
Daniele di Gioacchino	0.5	R
Carlo Ligi	0.3	T
Bruno Buonomo	0.3	T
Luca Foggetta	0.2	T
David Alesini	0.1	PT
Giulietto Felici	0.1	DT
Alessandro Gallo	0.1	DT
TOT	2.1	

*potrebbero cambiare se si dovesse aprire la sigla per Klash

Richieste

Costo progetto 200-300 keuro

Durata 3 anni

- Laboratorio COLD nell'area Nautilus
- Liquefattore Nautilus e Tecnico (In sovrapposizione con Quax) (0.2 FTE)
- Tecnico criogenico per aiuto attivazione criogenia a diluizione (0.2 FTE). Tecnico meccanico per componenti discendenti (0.2 FTE)
- Servizio elettronica per alimentatore corrente 100 nA bassissimo rumore e sistema di reset; cablaggi e filtri criostato (0.2 FTE)

FLAGS
Fiber Links for Atomic Gravity Sensors

Resp. nazionale:
F. Sorrentino

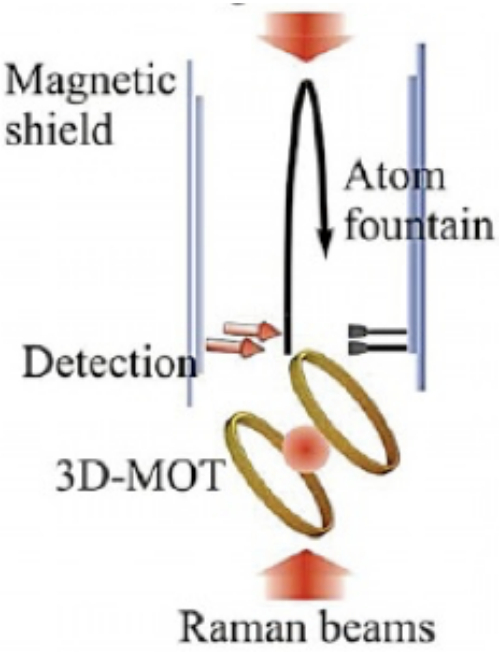
Sedi partecipanti: FI, GE, PI, RM3, LNF (RL = A. Clozza)
Enti esterni: INGV, EGO

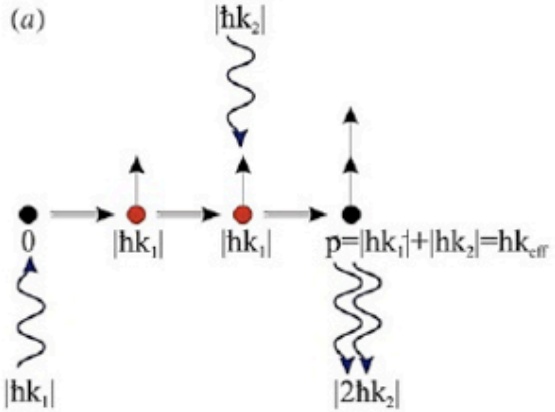
Sommario

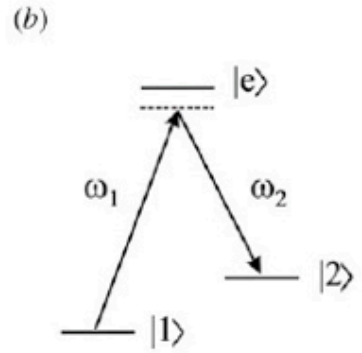
- I sensori ad interferometria atomica
- Reti di gravimetri atomici con link ottici
  - Vantaggi scientifici e tecnologici delle misure di gravità differenziali
  - Link ottici in vuoto e in fibra
  - Fattibilità tecnica, scalabilità, limiti di sensibilità
- Possibili applicazioni
  - Fisica della terra e dell'atmosfera
  - Onde gravitazionali
    - Misura del rumore Newtoniano in bassa frequenza per rivelatori di 3° generazione
    - Misura di fondo stocastico tramite modi normali della terra
  - Dark Matter (*"da campi ultraleggeri"*)

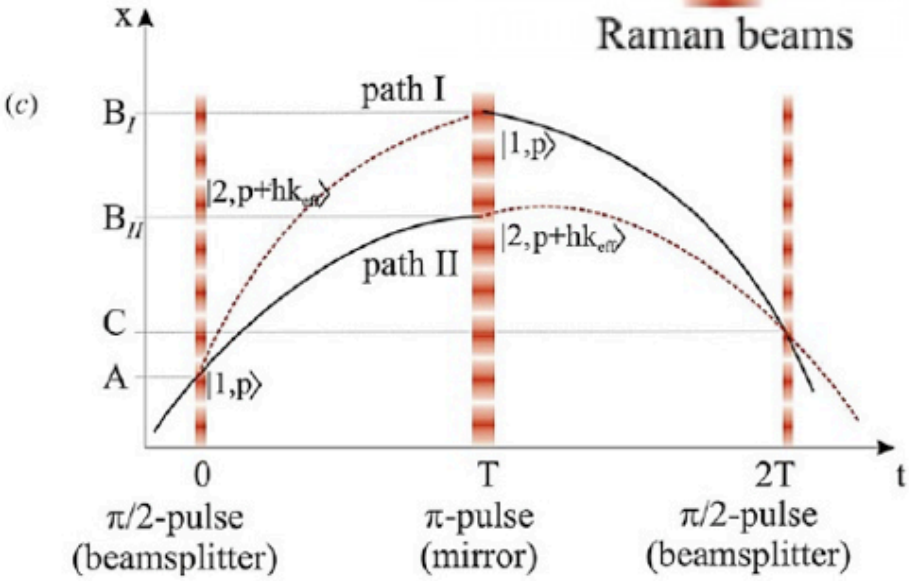
Gravimetri atomici

- Sono basati sull'interferometria atomica: laser cooling + manipolazione coerente di pacchetti d'onda atomici
- Sono i migliori gravimetri assoluti: dimostrate sensibilità dell'ordine di 10 μgal/√Hz, accuratezza ~1 μgal (1 μgal=10^{-8} m/s^2)
- Il rumore sismico è uno dei principali limiti di sensibilità









Il gruppo proponente

- Genova (1.2 FTE + 1 assegno biennale)
  - coord. Naz., link in fibra ottica, controllo di fronti d'onda laser, controllo dei campi magnetici, modelli per misure di rumore Newtoniano
- Firenze (2.6 FTE + 1 assegno biennale)
  - Interferometria atomica su riga di orologio ottico, metodi di ottica atomica, integrazione di link ottici e isolamento sismico su sistemi atomici
- Pisa (1.5 FTE + 1 assegno triennale)
  - isolamento sismico, controllo angolare, modelli per misure di rumore Newtoniano, modelli per ottica atomica con atomi intrappolati
- Roma 3 (1.6 FTE + 1 assegno triennale)
  - modelli per misure di fisica della terra e dell'atmosfera
- LNF (1 FTE + 1 assegno biennale)
  - **Sistema da vuoto, elettronica di controllo**
  - A. Clozza (resp. locale) 0.2 FTE, A. Spallone 0.2 FTE, M. Bazzi 0.2 FTE, E. Pace 0.2 FTE, L. Sperandio 0.2 FTE
- Enti esterni
  - INGV (supporto per lo studio di applicazioni geofisiche)
  - EGO (supporto per test su larga scala, confronto con reti di sismometri per monitoraggio del rumore Newtoniano)

Budget

(40+50+70 = 160 kEuro for LNF)

	Primo anno	Secondo anno	Terzo anno
Genova	65	70	90
Firenze	95	120	100
Pisa	70	80	60
LNF	40	50	70
Roma3	30	30	30
Totale	**300**	**350**	**350**

	Primo anno	Secondo anno	Terzo anno
WP1	60	65	85
WP2	110	135	115
WP3	50	60	40
WP4	50	60	80
WP5	30	30	30
Totale	**300**	**350**	**350**

CSN5 Reminders

- CSN5 “Calls”, 6th edition
  - Two proposals, SLEM (RN), FLAGS (RL)
- Six CSN5 “Grants Young Researchers” 6th edition
  - Deadline July 21 (see CSN5 website)
- Next CSN5 meetings
  - Rome “Sapienza” July 25-27; Pisa Sep. 24-28