CV of Simone Dell'Agnello (INFN-LNF)

Shortlist of recent roles:

- Executive Technologist at INFN-LNF, Frascati (Rome), Italy. INFN Staff since 1995
- Coordinator of all Technology Research at INFN-LNF (2011-2019)
- Worked in Particle Physics: DoE-Fermilab (Chicago, IL, USA), INFN-LNF (1987-2003)
- Founder and Leader of INFN-LNF space research infrastructure **SCF_Lab** (≥2004)
- PI/PM of: 1 Space Science, 3 R&D Experiments of INFN (2004-2018)
- PI/PM of INFN Contracts with **Space Agencies** (ASI, ESA, ISRO, NASA) and Italian **Ministries** (Defence, Foreign Affairs, Research) for the period 2004-2017, on:
  - **Space Flagships**: Galileo, Copernicus, COSMO-SkyMed
- PI of **INFN-NASA Partnership** on Solar System Exploration and Research (≥2014)
- Member of **Scientific-Technical Council (CTS) of ASI** (2014-2018).

EARLY RESEARCH ACTIVITY IN PARTICLE PHYSICS (1987-94)

Born on 15-05-64 in Livorno, Italy. He got his Master ("Laurea") in particle physics in '89 at Univ. of Pisa, Italy (110/110; title: *Two-jet Production at CDF*). He was employed by Fermilab (US Department of Energy lab) to work on the general-purpose experiment **CDF** (Collider Detector at Fermilab), as Summer/Master Student and Guest Scientist ('87-91) under A. Tollestrup.

In '93 he got his PhD ("Dottorato") in Pisa, working mostly at Fermilab on the *discovery of the top-quark elementary particle* (INFN PI/AE 94/10). Advisor of Master and PhD thesis was G. Bellettini. His thesis was incorporated and quoted in the top-quark discovery paper, PRD 50, 2966 (1994). For his thesis he received a Prize of the Italian Physics Society ('95). In '94-95 held an INFN Postdoc fellowship at INFN-Pisa.

He worked on the Silicon Vertex Detector construction, data taking as *ACquisition Expert*, physics analysis on Quantum Chromo-Dynamics and for top-quark discovery.

RESEARCH ACTIVITY IN PARTICLE PHYSICS (1995-2003)

Since '95 he is Staff Researcher at INFN-LNF (Laboratori Nazionali di Frascati), hired with a national selection led by P. Franzini. Since then he worked mainly on the precision experiment **KLOE** (K LOng Experiment) and kept a participation in CDF. He worked on many aspects of KLOE: global construction, assembly and magnetic survey (with S. Bertolucci, now Director of Research and Scientific Computing at CERN). At KLOE he created from scratch a dedicated optical & laser-based system of precision **ground** positioning metrology in the Research Division of the LNF; tracking chamber construction; monitoring/reconstruction of DAΦNE-KLOE interaction region; run and online shift coordination; tracking analysis and physics analysis.

In '00-02 he worked on **CDF-2** as Leader for the re-commissioning of central hadron calorimeters built by INFN in the '70/'80s and was LNF Representative in the CDF2 Executive Board. After completing his CDF2 duties, he concentrated on running KLOE and optimizing its performance and data yield as KLOE Deputy Technical Manager ('03).

RESEARCH ACTIVITY IN SPACE PHYSICS & TECHNOLOGY (≥ 2004)

He won the position of "Primo Ricercatore" in '04 (formally hired in '06 due to blockage of public hiring). Since then he started from scratch a new INFN research activity in space physics and technology: **precision positioning metrology in space based on laser retroreflectors for Satellite/Lunar Laser Ranging** (SLR/LLR).

Applications: General Relativity, Galileo/GPS, Earth Observation (EO, including Copernicus & COSMO-SkyMed). He formed and leads a new research group (~20 FTE) which developed (J. Adv. Sp. Res. 47, 822–842 (2011)):

- The new **SCF_Lab** (*Satellite/lunar/gnss laser ranging/altimetry and Cube/microsatellite Characterization Facilities Laboratory*): a unique space test infrastructure with 2 Optical Ground Support Equipment (**OGSE**) facilities in a new ISO 7 Clean Room

- **SCF-Test**: interdisciplinary Industrial procedures for integrated thermal-optical-vacuum characterization of Laser Retroreflector Arrays in accurately simulated space conditions
- Thermal, optical, orbital and structural sw analysis and simulation
- Full thermal and vacuum characterization for **Cube/Micro-satellites** with the 2 OGSEs
- **ETRUSCO** ('06-09, Extra Terrestrial laser Ranging to Unified Satellite COnstellations): R&D to characterize laser reflectors of Galileo (for Satellite Navigation), LAGEOS (for Space Geodesy) and optimize laser ranging to Galileo and GPS-3
    - International effort of INFN, Italian Air Force, ILRS (International Laser Ranging Service), NASA-GSFC (inventor of SLR), Univ. Maryland (UMD, inventor of LLR).
- **ETRUSCO-2** ('10-15, ASI-INFN Contract): industry-level R&D for Galileo/GPS. Flight reflectors of GPS, GLONASS, GIOVE, Galileo have been SCF-Tested
    - Built a Retroreflector Array being proposed for Galileo V2 and, soon, for a patent
- **ETRUSCO-IRNSS** ('13-14, ISRO-INFN Contract) for the Indian navigation constellation
- **Laser Ranging to Galileo** ('15-16, ASI-INFN Project competitively awarded by the Italian Ministry of Research).

Membership of International Working Groups (WGs):

- ILRS: Core Properties and Performance Requirements for laser retroreflectors (≥'05)
- Internat. Lunar Network (ILN, of 9 Space Agencies): Core Lunar Instruments ('08-10).

ASI Studies and NASA R&Ds ('07-12):

- 2 ASI studies on precision test of General Relativity, lunar science/exploration
- 4 R&Ds with NASA: GSFC (LAGEOS, hollow reflectors); JPL (deep space laser-ranged mass to test $1/r^2$); 2 Calls by **NASA-LSSO**, Lunar Sortie Scientific Opportunities, and by **NASA-NLSI**, NASA Lunar Science Institute (lunar retroreflectors).

MoonLIGHT-ILN (INFN R&D, '10-12), **MoonLIGHT-2** (INFN Science, '13-18, approved by R. Battiston) are part of an advanced lunar research program (Moon Laser Instrumentation for General relativity High accuracy Tests) of INFN, led by SCF_Lab, and UMD (inventor of LLR and PI of Apollo laser reflectors):

- Collaborators: in US, UMD, Center for Astrophysics and APOLLO laser station; in Italy ASI-MLRO laser station in Matera and INFN/Univ. of Padua
- Work program: reflector construction/test, physics analysis (including Apollo/Lunokhod) for **precision tests of General Relativity (GR)**: weak and strong equivalence principle; PPN β; variation of gravitational constant (Gdot/G); $1/r^2$ Yukawa violations; geodetic precession; GR extensions with spacetime torsion and Non-Minimally Coupled gravity
- Mission opportunities: Luna-27 by Russia, Google Lunar X Prize, Chang'E 4/5/6 by China, NASA Resource Prospector
    - Signed international multi-mission payload agreement with Moon Express and UMD on May 15, 2015, at Frascati, which includes:
        - Single, large LLR reflector payload, dubbed MoonLIGHT
        - Retroreflector array micro-payload, dubbed INRRI, to be observed by orbiters equipped with laser altimeters, (atmospheric) lidars, and/or lasercomm (not by Earth). INRRI has been developed for the Moon, Mars, other solar system moons, asteroids and comets.

SCF_Lab work program for Earth Observation Flagships: Copernicus and COSMO-SkyMed

- **ETRUSCO-GMES** ('13-15, Global Monitoring for Environment and Security), an INFN R&D experiment for Copernicus, Galileo and COSMO-SkyMed
- **AUGUSTUS** ('14-15), a **MAE-INFN** High-Relevance Project for Copernicus and USA
- **G-CALIMES** ('13-16, Galileo-COSMO-SkyMed Absolute Laser Intercalibration with Measurements on Earth and in Space) a **Ministry of Defence-INFN** Contract
- Includes delivered and accepted devices, like:
    - **CORA**, COSMO-SkyMed Retroreflector Array, proposed for COSMO-SkyMed 2.

ISS:

- ASI-Scientific-Technical Council: consultant of ASI President for research, including ISS

- LNF Co-PI of Lazio-SiRad experiment (PI=R. Battiston) on ISS for ESA Soyuz Mission "ENEIDE" in 2007, launched from Baikonur
- Co-chairman (with R. Battiston) of INFN-Space/2 (2005) and INFN-Space/3 (2013) national workshops on astroparticle missions and space experiments on ISS.

As NASA-NLSI broadened to **SSERVI** (Solar System Exploration Research Virtual Institute, sservi.nasa.gov), he established as PI an **INFN Partnership with NASA-SSERVI** based on the research program *SPRINGLETS*: Solar system Payloads of laser Retroreflectors of INfn for General reLativity, Exploration and planeTary Science. This also includes other particle and astroparticle test facilities of the LNF (for X/UV/Vis/IR synchrotron light, DAΦNE-Light, and for electron/positron/gamma of tagged energy up to 500 MeV/c, BTF).

- PI of INFN-CSN5 R&D experiment **NEW REFLECTIONS** ('16-'18), fully synergetic with work topics of the INFN-SSERVI research and R&D program.

On 11/Sep/2014 was appointed Member of **ASI's Scientific-Technical Council** for 4 years.

He leads an Italian team of ~20 INFN employees/associates: physicists, engineers, mathematicians, technicians, students, post-docs (LNF, Rome, Padua, Naples, Trento).

Publications: >250 papers, >7800 citations, H-index (ISI)>50 (since 1987). He passed the Italian Ministry of Research selection ("Abilitazione Scientifica Nazionale"), thus enabled to the role of Full Professor ("I Fascia", Sector 02/A1, Experimental Particle Physics) for the period 23/01/2014-23/01/2018.

Languages: speaks and writes fluent English; has good French skills.

ROLES / DUTIES WITHIN INFN-LNF

- Editor of LNF Activity Reports ('02, '03)
- Secretary of LNF International Scientific Committee ('04)
- WG member: LNF Future ('04) and LNF Scientific Computing ('05)
- RUP of LNF Public Works for upgrade/extension of >300 m^2 Clean Rooms ISO 6 to 8 ('11)
- President of LNF Committee for personnel selection for a CTER technician position ('12)
- Collaborator of LNF Support Service on "High-level training and external funds" (≥'12)

ROLES / DUTIES WITH INFN & EXTERNAL FUNDING AGENCIES

- Staff Researcher, Level II ("Primo Ricercatore") at INFN-LNF (≥1995)
- Founder and Leader of **SCF_Lab** (≥2004)
- Coordinator of all Technology Research at INFN-LNF (2011-2015), re-elected for the 2nd mandate (2016-2019)
- Worked in Particle Physics (1987-2003) within INFN-National Scientific Committee 1 (**CSN1**)
- PI/PM of: 1 Space Science/INFN-**CSN2**, 3 R&D/INFN-**CSN5** Experiments (2004-2018)
- PI/PM of INFN Contracts with **Space Agencies** and Italian **Ministries** (2004-2017)
    - Contracts for **Space Flagships**: Galileo, Copernicus, COSMO-SkyMed
- PI of **INFN-NASA/SSERVI Partnership** on Solar System Exploration and Research based also on sharing of SCF_Lab, DAΦNE-Light & BTF facilities of LNF (≥2014)
    - Formal NASA-INFN partnership signed on 15-sep-2014
- Member of **Scientific-Technical Council of ASI**, appointed on 11-sep-2014
- National PI of ETRUSCO of CSN5 ('06-09), ETRUSCO-GMES of CNS5 ('13-16)
- National PI of MoonLIGHT-ILN of CSN5 ('10-12), MoonLIGHT-2 of CSN2 ('13-18).
- LNF PI of LARES of CSN2 ('04-08). Responsible for **ASI** of industrial optical acceptance test of 110 flight reflectors of LARES in air & isothermal conditions. No SCF-Test done

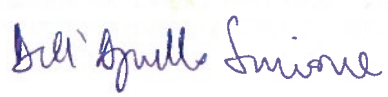
- Co-PI of MoonLIGHT-Manned ('07-09), R&D of **NASA-LSSO** and INFN; PI: D. Currie of UMD
- Co-I of **NASA-NLSI** project LUNAR, continuation of NASA-LSSO
- Co-I for **ASI** Study on "Observation of the Universe from the Moon" ('07); WP 1500 on LLR (Co-PIs: R. Battiston of INFN and R. Mandolesi of INAF)
- Co-I for **ASI** Study on Cosmology and Fundamental Physics ('07-10); WP 5200 on "Deep space gravity test"; PI: P. de Bernardis of Univ. of Rome
- Co-I of **ASI** Phase A Study for lunar orbiter MAGIA ('08); WP on "MoonLIGHT precursor and improved test of gravitational redshift with retroreflectors and atomic clock"; PI: Dr. A. Coradini of **INAF**; Prime: **Rheinmetall**
- PI/PM of R&D ETRUSCO-2
- PI of SCF-Test of laser retroreflectors of Galileo In-Orbit Validation satellites (IOV). Contract **ESA-Galileo**-INFN
- PI of ETRUSCO-IRNSS, Contract Indian Space Research Organization (**ISRO**)-**INFN** for SCF-Test of retroreflectors of the Indian Regional Navigation Satellite System (IRNSS)
- PI/PM of R&D G-CALIMES; Contract **Ministry of Defense**-INFN; approved for the "National Plan for Military Research" 2012
- PI of AUGUSTUS, Italy-USA study of INFN-Italian **Ministry of Foreign Affairs**, for satellite laser retroreflectors & ground segment geo-referencing devices for EO. Contract MAECI-INFN ('14-15). Partners: NASA-GSFC, USGS, NOAA-NIC, ASI-MLRO, ILRS
- Proposer of "Laser Ranging to Galileo", a project of the Italian **Ministry of Research**-ASI-INFN; PI: G. Bianco of ASI
- PI of **INFN-CSN5** R&D experiment NEW REFLECTIONS ('16-'18).

ORGANIZATION OF NATIONAL & INTERNATIONAL WORKSHOPS

- 2005, Co-Chairman (with R. Battiston): **INFN-Space/2**, national workshop on all INFN astroparticle and space activities, including research for ISS. LNF Frascati, http://www.lnf.infn.it/conference/2005/spazio/;
- 2006, Co-Chairman: **Fundamental Physics in Space with Small Payloads**, international workshop, LNF Frascati; http://www.lnf.infn.it/conference/fps06/
- 2007, Co-Organizer: **Observation of the Universe from the Moon**, national workshop of ASI, INFN, INAF; LNF Frascati; http://www.lnf.infn.it/conference/moon07/
- 2012, Chairman: **International Technical Laser Ranging & ETRUSCO-2 Workshop**; http://www.lnf.infn.it/conference/laser2012/
- 2013, Co-Chairman (with R. Battiston): **INFN-Space/3**, national workshop on all INFN space activities; LNF Frascati; http://agenda.infn.it/conferenceDisplay.py?confId=6535
- 2014, Co-Organizer: **Frontier Objects in Astrophysics & Particle Physics**, international workshop, Vulcano, Italy; http://www.lnf.infn.it/conference/vulcano2014/.
- 2015, Co-Chairman: **3rd European Lunar Symposium**, international workshop on lunar sciences and exploration; LNF Frascati, Italy http://els2015.arc.nasa.gov.
- 2016, Co-Organizer: **4th European Lunar Symposium**, international workshop on lunar sciences and exploration; Amsterdam, Holland, http://els2016.arc.nasa.gov.
- 2016, Co-organizer: **Frontier Objects in Astrophysics & Particle Physics**, international workshop, Vulcano, Italy; http://www.lnf.infn.it/conference/vulcano2016/.
- 2017, Co-Organizer: **5th European Lunar Symposium**, international workshop on lunar sciences and exploration; Muenster, Germany, http://els2017.arc.nasa.gov

CONTRIBUTIONS PRESENTED TO WORKSHOPS & CONFERENCES

He bas been the author and presenter of several tens of contributions for CDF, KLOE, CDF2 and the research activities of the SCF_Lab described in this CV.

Signature 

Curriculum formativo e dell'attività di ricerca di

Patrizia de Simone

- Nata: 10 Agosto 1959, Roma, Italia
  Indirizzo della sede di lavoro: I.N.F.N. - Laboratori Nazionali di Frascati,
  Via Enrico Fermi 40, 00044, Frascati, Roma, Italia
  Tel: +39 06 9403 2918, email: `patrizia.desimone@lnf.infn.it`

- Il 27 Giugno 1985 ho conseguito la laurea in Fisica presso l'Università di Roma "La Sapienza" discutendo una tesi dal titolo:
  "*Diagnostica Ottica per Plasmi Termonucleari: misure di fluttuazione di densità sul Tokamak FT mediante diffusione coerente di un laser CO_2 in continua*",
  relatori il prof. Carlo Bernardini e il dr. Leonardo Pieroni, riportando voti 110/110.

- Nell' anno accademico 1985/86 ho frequentato il corso di perfezionamento in "Ingegneria del Plasma e della Fusione Termonucleare Controllata" presso l'Istituto Gas Ionizzati di Padova.

- Il 23 Dicembre 1986 ho vinto una borsa di studio INFN, concorso n. 908/85 relativa alla linea di ricerca "Fisica delle Particelle" da usufruirsi presso i Laboratori Nazionali di Frascati, nell'ambito dell'esperimento SLD.

  Il 23 Dicembre 1987 la suddetta borsa mi è stata rinnovata per il secondo anno.

- Il 15 Aprile 1989 ho ottenuto un contratto di un anno presso i laboratori dello *Stanford Linear Accelerator Center*, dove ho continuato la mia collaborazione nell'ambito dell'esperimento SLD.

  Il 15 Aprile 1990 ho ottenuto il rinnovo del suddetto contratto per sei mesi.

  Il 15 Settembre 1990 ho ottenuto un nuovo contratto di un anno presso i laboratori dello *Stanford Linear Accelerator Center.*

- Il 23 Gennaio 1992 ho sostenuto l'esame per l'ammissione al settimo ciclo del corso di Dottorato di Ricerca in Fisica presso l'Università di Roma "La Sapienza", e sono risultata vincitrice di una borsa di studio. Ho svolto il lavoro per la tesi di Dottorato presso i Laboratori Nazionali di Frascati, nell'ambito dell'esperimento KLOE.

- Il 20 Ottobre 1995 ho sostenuto con esito positivo l'esame finale di Dottorato di Ricerca in Fisica discutendo la tesi dal titolo:
  "*Studio di tecniche sperimentali per la ricostruzione del decadimento* $K_L \to \pi^+\pi^-$ *nell'esperimento KLOE a DAΦNE*".

- Nel Maggio del 1996 ho ottenuto un contratto articolo 23 dell' Istituto Nazionale di Fisica Nucleare della durata di due anni, con sede di lavoro presso i Laboratori Nazionali di Frascati, nell'ambito dell'esperimento KLOE.

  Nel Maggio del 1998 il contratto articolo 23 dell' Istituto Nazionale di Fisica Nucleare mi e' stato rinnovato per altri tre anni.

- Dal 21 Dicembre 1999 godo di un contratto a tempo indeterminato dell' Istituto Nazionale di Fisica Nucleare, dopo essere risultata vincitrice del concorso pubblico per titoli ed esami di cui al bando n. 7434/99 per un posto per il profilo di Tecnologo - III livello professionale, con sede di lavoro presso i Laboratori Nazionali di Frascati.

- Il 24 Giugno 2005 la mia richiesta di assegnazione a profilo diverso (Ricercatore), a parità di livello (III livello professionale) - ai sensi dell'art. 65 del CCL 1998-2001 - è stata accettata.

- Il 27 Gennaio 2006 sono stata dichiarata (delibera n.9495) vincitrice del concorso INFN (bando 10669/2004) per il profilo di Primo Ricercatore - II livello Professionale.

Esperimento SLD (Slac Large Detector)

Nell'ambito dell' esperimento SLD, il gruppo italiano ha avuto la responsabilità di progettare, costruire e mantenere operativo il WIC (*Warm Iron Calorimeter*), calorimetro adronico a ferro e a tubi di plastica operanti nel regime di *streamer* limitato.

Presso i Laboratori Nazionali di Frascati ho partecipato al lavoro svolto per la preparazione dei tubi : grafitatura e test. In seguito ho seguito la costruzione e messa in opera di un telescopio per muoni, per lo studio di miscele gassose per i tubi di plastica operanti nel regime di *streamer* limitato, e per il *test* delle schede di lettura, in seguito installate sul calorimetro adronico a SLAC [1], [2].

Dal 15 Aprile 1989 la mia attività di ricerca si è svolta stabilmente presso i laboratori dello *Stanford Linear Accelerator Center*. Nell'ambito del gruppo di studio sulla spettroscopia dei *quarks* pesanti ho lavorato alla stesura del codice per l'identificazione dei vertici di decadimento. Inoltre ho studiato la fattibilità della misura delle vite medie separate dei mesoni con *beauty* carichi e neutri, utilizzando i canali di decadimento con una J/ψ nello stato finale [3].

Ho lavorato alla stesura del codice di ricostruzione delle tracce dei muoni, ed in seguito alla scrittura del codice che associa le tracce ricostruite nel WIC con quelle ricostruite nella camera a deriva centrale di SLD [4], [5].

Esperimento KLOE (K LOng Experiment)

- *Database* e gestione dei dati dell'esperimento

Durante il primo run di KLOE(2000-2006) è stato utilizzato il pacchetto *software* HEPDB (*database management package* sviluppato presso i laboratori del CERN) per raccogliere i dati riguardanti i parametri geometrici e di calibrazione del rivelatore. Il *software* HEPDB è stato da me installato e configurato sulle piattaforme DIGITAL-UNIX e SUN. Inoltre, ho scritto il codice necessario per immagazzinare/recuperare le banche dati in/dal *database*, e **la manutenzione e l'aggiornamento di tale libreria è stata una mia responsabilità.**

Ho attivamente collaborato alla progettazione, scrittura e manutenzione del codice per la gestione dei dati di KLOE al fine di ricostruire, identificare e selezionare gli eventi in modo quasi parallelo alla loro acquisizione. **In questo ambito ho coordinato il gruppo** *offline* nell'anno 2002.

- Sviluppo del codice per la calibrazione della camera a deriva di KLOE

Gran parte del mio lavoro per la tesi di dottorato è stato dedicato allo sviluppo di una procedura per parametrizzare la risposta spazio-temporale delle celle della camera a deriva di KLOE.

Gli eventi $K_L \to \pi^+\pi^-$ a DAΦNE sono caratteristici in quanto l'origine delle tracce cariche è distribuita in tutto il volume della camera, e ciò determina una perdita di correlazione tra la posizione delle celle e l'angolo di emissione azimutale ϕ delle tracce. Inoltre al fine di ottenere una efficienza di rivelazione ed una risoluzione uniforme indipendentemente da dove decade il mesone K_L , è necessario massimizzare l'omogeneità e l'isotropia del volume di tracciamento. A questo scopo la disposizione dei fili all'interno della camera di KLOE è tale da costituire una struttura a celle con filo singolo, con i fili anodo e catodo disposti ad angolo rispetto all'asse della camera. Risulta pertanto che la sezione quadrata delle celle è distorta, con il dettaglio della distorsione dipendente dall'orientazione azimutale, dal raggio e dalla coordinata z delle singole celle. Questa geometria complica notevolmente la parametrizzazione delle relazioni spazio-tempo. Infatti sembra necessario fornire tante parametrizzazioni quante sono le celle di forma diversa, dove ogni parametrizzazione deve coprire l'intera area di raccolta delle singole celle in modo da fornire una relazione spazio-tempo per tutti i possibili angoli di incidenza azimutali ϕ delle tracce.

Se si tiene conto che il numero di fili anodo della camera a deriva di KLOE è 12582, si comprende come questa situazione potrebbe rendere la parametrizzazione delle relazioni spazio-tempo estremamente macchinosa. Ho affrontato e risolto questo problema utilizzando il programma GARFIELD: ho dimostrato che solo 6 celle di forma diversa,

che ho scelto come "celle di riferimento", sono sufficienti per dare una descrizione realistica delle relazioni spazio-tempo su tutto il volume della camera, e ho definito una procedura che parametrizza 232 diverse relazioni spazio tempo [6], [7].

Ho avuto modo di verificare per la prima volta la bontà della procedura di parametrizzazione, partecipando alla presa e all'analisi dei dati raccolti alle prove su fascio presso i laboratori del CERN, di un prototipo consistente in uno spicchio *full size* della camera a deriva di KLOE (prototipo 1) [8], [9].

A seguito degli ottimi risultati ottenuti, ho lavorato allo sviluppo del codice per la calibrazione della camera a deriva. Si tratta di una procedura iterativa che ricostruisce le tracce cariche che attraversano la camera e produce un nuovo insieme di parametri ogni volta che il controllo di qualità sui residui è significativo.

Nell'estate 1998 quando è iniziata la messa in funzione del rivelatore KLOE, ho completato ed ampiamente testato il codice per la calibrazione della camera a deriva ottenendo i primi incoraggianti risultati. In seguito, durante il primo periodo di raccolta dati a DAΦNE ho studiato e monitorato la stabilità delle relazioni spazio tempo, le quali sono sensibili alle possibili variazioni della pressione del gas, della miscela gassosa, etc. [10].

Nel Marzo 2000 sono stati istituiti diversi gruppi di lavoro tra i quali il gruppo di monitoraggio e calibrazione del rivelatore; sono stata designata come coordinatrice del gruppo, insieme al Dott. Cesare Bini. Uno dei principali obiettivi è stato quello di progettare e realizzare un pacchetto *software* per il monitor e la calibrazione quasi-*online* dell'intero rivelatore.

I miei contributi al monitoring ed alla calibrazione della camera a deriva sono riportati nelle Refs. [11], [12], [13].

- Collaborazione allo sviluppo del codice di tracciamento

Lo studio della risposta temporale delle celle della camera a deriva di KLOE mi ha naturalmente portata a collaborare con il gruppo che ha sviluppato il codice per la ricostruzione delle tracce cariche.

La ricostruzione degli eventi a KLOE è ottimizzata per identificare i decadimenti dei kaoni neutri, in particolare il programma di tracciamento corregge per gli effetti dovuti al tempo di volo, alla perdita di energia $\frac{dE}{dx}$, e alla diffusione Coulombiana delle particelle cariche, assegnando loro la massa del pione. Questa premessa introduce le problematiche riguardanti la ricostruzione degli eventi $\phi \to K^- K^+$; il basso valore di β dei kaoni carichi ($\simeq 0.2$) è tale che la ricostruzione *standard* degli eventi produce una grande frazione ($\simeq 25\%$) di tracce dei kaoni spezzate e conseguentemente di vertici *fake*, uno spostamento sistematico dell'impulso dei kaoni estrapolati al vertice primario di circa 30 MeV, e un deterioramento generale della risoluzione in impulso di tutte le particelle cariche ricostruite nella camera.

Inoltre, la corretta assegnazione temporale ($T0$-globale dell'evento) tra le tracce della camera a deriva e i *clusters* nel calorimetro elettromagnetico con l'incrocio dei fasci di DAΦNE, impossibile in sede di trigger [1], viene effettuata durante la procedura di ricostruzione dell'intero evento, imponendo che il tempo del *cluster* calorimetrico più veloce sia consistente con il tempo di volo aspettato di un fotone dall'origine (γ *prompt*). Nel caso di un evento di kaoni carichi questa procedura per stimare il $T0$-globale può sbagliare fino a 7 incroci dei fasci.

Per risolvere le problematiche che ho appena descritto, ho sviluppato il codice che produce una nuova stima del $T0$-globale dell'evento selezionato come $\phi \to K^-K^+$ [2], associa le tracce che definisce "spezzate" guardando alla collinearità degli impulsi, e applica un nuovo *fit* assegnando la massa di 493.67 MeV/c^2 alle tracce identificate come kaoni.

Nell'anno 2002 l'esperimento KLOE ha iniziato a raccogliere dati con la lettura della carica rilasciata dalle particelle nella camera a deriva, tramite moduli ADC. Ho sviluppato il codice per la lettura della carica rilasciata, e che associa la carica misurata dai singoli canali ADC al rispettivo segmento di traccia.

I miei contributi all' *offline* dell'esperimento KLOE, che ho descritto, sono riportati nella pubblicazione [14].

- Analisi di fisica

Ho collaborato attivamente allo sviluppo delle analisi di fisica del gruppo dei kaoni carichi dell'esperimento KLOE: **dal febbraio 2004 fino a tutto il 2008 ho coordinato il gruppo, prima insieme al Prof. Vincenzo Patera poi alla Dott.^{ssa} Erika De Lucia.**

La ricostruzione dei decadimenti dei $K^\pm$ in due corpi, $K_{\mu 2}$ e $K_{\pi 2}$, ci permette di identificare (*tag*) gli eventi $\phi \to K^+K^-$, in altre parole siamo in grado di selezionare fasci puliti di kaoni di carica ed impulso noto, che sono il punto di partenza per tutte le analisi di fisica del gruppo (esclusa la misura di R_K).

Le misure realizzate sono:

1. la misura del *branching ratio* assoluto $K^\pm \to \pi^\pm\pi^0\pi^0(\gamma)$ [15]
2. la misura del *branching ratio* assoluto $K^+ \to \mu^+\nu(\gamma)$ [16]
3. la misura del *branching ratio* assoluto $K^+ \to \pi^+\pi^0(\gamma)$ [17]

[1] La frequenza di incrocio dei fasci è 358 MHz, mentre a causa del basso valore di β dei kaoni ($\simeq$ 0.2) provenienti dal decadimento della ϕ, i primi segnali di energia utili per la formazione del trigger possono apparire in un intervallo di tempo grande fino a $\sim$ 20 ns.

[2] La ricostruzione *standard* seleziona gli eventi di kaoni carichi guardando alla distribuzione in impulso delle tracce cariche che hanno origine dal vertice primario, $\langle p \rangle \simeq 100$ MeV.

4. la misura dei *branching ratios* assoluti semileptonici K_{e3} e $K_{\mu 3}$ [18]
5. la misura della della vita media $\tau_{\pm}$ [19]
6. la misura del rapporto $R_K = \frac{\Gamma(K \to e\nu(\gamma))}{\Gamma(K \to \mu\nu(\gamma)}$ [20] [21]
7. la misura del *branching ratio* assoluto $K^+ \to \pi^+\pi^-\pi^+(\gamma)$ [23]

I *branching ratios* assoluti in due corpi, $K_{\mu 2}$ e $K_{\pi 2}$, sono stati misurati con una precisione relativa di qualche per mille. Tutte le misure di *branching ratios* assoluti sono inclusive del contributo radiativo. Le misure delle ampiezze parziali di decadimento semileptonico (*BR*'s assoluti e vita media) sono state utilizzate per determinare l'elemento V_{us} della matrice CKM, e per testare l' universalita' degli accoppiamenti dei leptoni e e μ al bosone W. Inoltre dalla misura dell'ampiezza parziale di decadimento $K^+ \to \mu^+\nu(\gamma)$, abbiamo estratto il rapporto V_{us}/V_{ud} [Marciano hep-ph/0406324]. Abbiamo combinato le nostre misure 2, 4, e 5, con le misure effettuate con i kaoni neutri (il gruppo dei kaoni neutri ha misurato anche i parametri dei fattori di forma K_{Kl3}), per testare con elevata precisione il Modello Standard. I risultati sono ampiamente descritti nella pubblicazione [22].

Oltre al lavoro collettivo appena descritto, ho condotto individualmente la misura del *branching ratio* assoluto $K^+ \to \pi^+\pi^-\pi^+(\gamma)$ inclusivo del contributo radiativo, al fine di completare il programma di misura dei *branching ratios* dominanti dei kaoni carichi a KLOE. La misura è stata realizzata con un errore relativo di 0.72%, migliorando di un fattore circa 5 la misura più recente che, tra l'altro, non fornisce informazioni sul trattamento del contributo radiativo [I.H.Chiang, *et al.*, Phys. Rev. D **6** (1972) 1254]. Attualmente, insieme alla Dott.^{ssa} Caterina Bloise, sto lavorando alla misura della massa dei kaoni carichi. Utilizziamo i decadimenti $K^\pm \to \pi^\pm\pi^-\pi^+(\gamma)$ con l'obiettivo di misurare $m(K^\pm)$ con un errore dell' ordine di poche decine di KeV/c^2.

Esperimento LHCb

Dal 2001 faccio parte del gruppo LHCb dei Laboratori Nazionali di Frascati che ha contribuito in maniera sostanziale al progetto e alla costruzione del rivelatore dedicato all' identificazione dei muoni. Esso consiste di quattro stazioni M2-M5 disposte tra lastre di filtri di ferro, e di una stazione M1 posta di fronte ai calorimetri elettromagnetico ed adronico. Le stazioni sono equipaggiate con camere proporzionali multi-fili. [24].

Ho collaborato con il gruppo che ha proposto per la regione più interna della prima stazione M1, un rivelatore basato sulla tecnologia delle *Gas Electron Multiplier* (GEM). Le richieste per il rivelatore in termini di capacità di conteggio ($\sim$ 500 kHz/cm^2),

efficienza ($\sim$ 96% in una finestra temporale di 20 ns) e resistenza alla radiazione ($\sim$ 6 C/cm^2 in 10 anni di operazione, per un guadagno di $\sim 10^4$) sono molto stringenti.

Ho collaborato attivamente a dieci prove su fascio dei rivelatori *triple*-GEM, dedicandomi principalmente all'analisi dei dati raccolti. La risoluzione temporale ottenuta ($\simeq$ 5 ns) con miscele gassose a base di CF_4 e iso-C_4H_{10}, permette di soddisfare la richiesta di efficienza leggendo l'OR dei segnali di due rivelatori. Abbiamo svolto studi dettagliati sulla probabilità di scarica, e sugli effetti delle scariche sulla funzionalità del rivelatore, esponendo una camera *triple*-GEM a un fascio di adroni di alta intensità presso i laboratori del PSI, e ad una sorgente di ^{241}Am di particelle α [25], [26].

La miscela di gas scelta per le camere *triple*-GEM è $Ar/CO_2/CF_4$ (45/15/40) poichè permette di raggiungere le prestazioni temporali richieste da LHCb, e non presenta problemi di sicurezza (principalmente infiammabilità) tipici dell'isobutano. D'altra parte il fluoro è noto per essere corrosivo, quindi a causa dell'elevata percentuale di CF_4 (40%) presente nella miscela gassosa, al fine di verificare la compatibilità tra i materiali di costruzione (sia del rivelatore che del sistema di gas) e la miscela stessa, le camere *triple*-GEM sono state sottoposte ad un test di irraggiamento globale con un intenso flusso di raggi γ (1.25 MeV) da una sorgente di ^{60}Co, presso la *facility* Calliope dei laboratori ENEA-Casaccia. Il risultato del test ha mostrato che il rivelatore *triple*-GEM è robusto e può tollerare la dose di radiazione prevista in 10 anni di operazione a LHCb [27].

Il 25 Febbraio 2004, le camere *triple*-GEM sono state approvate dalla collaborazione LHCb per la regione più interna della prima stazione M1, dei rivelatori di μ.

Ho sviluppato una procedura per selezionare un campione pulito di muoni al fine di misurare l'efficienza delle stazioni μ. Il codice scritto è ora parte del *monitoring* della qualità dei dati raccolti durante le collisioni a LHC.

Da Maggio a Novembre 2011 ho coordinato l' operazione del rivelatore dei muoni dell' esperimento LHCb, presso i laboratori del CERN.

Per quanto riguarda il progetto di *upgrade* di fase 1 del rivelatore, che dovrà sostenere un aumento di luminosità di circa un fattore 10 previsto per il 2020: $\mathcal{L} = 2 \times 10^{33}$ cm^{-2}s^{-1}, abbiamo studiato la risposta delle stazioni di rivelazione dei muoni utilizzando i dati raccolti e il MC, sia in termini dell' efficienza di identificazione dei muoni che della percentuale di mis-identificazione [28].

In questo ambito sto lavorando allo sviluppo di una nuovo algoritmo di identificazione dei muoni in grado di recuperare le *performance* del rivelatore che vengono inevitabilmente deteriorate dall'aumento dell' *occupancy* nelle camere, ottenendo ottimi risultati.
Da gennaio 2017 coordino il gruppo che si occupa di sviluppare e mantenere il *software* di ricostruzione ed identificazione dei muoni.

A febbraio 2017 la collaborazione LHCb ha presentato una manifestazione di interesse [29] per un *upgrade* detto di fase 2; un rivelatore completamente rinnovato da installare

durante il *Long Shutdown* 4 (2030), in grado di operare ad una luminosità di $\mathcal{L} = 2{\times}10^{34}$ $\mathrm{cm}^{-2}\mathrm{s}^{-1}$. Per quanto riguarda le stazioni di rivelazione dei muoni, la collaborazione ha fatto propria la proposta del gruppo di Frascati di adottare la tecnologia delle μ-RWELL (presentazione della sottoscritta al *workshop* "*Theatre of Dreams: Beyond the LHCb Phase 1 Upgrade*": **Challenges for operation of the muon system at** $2 \times 10^{34}\mathbf{cm}^{-2}\mathbf{s}^{-1}$, aprile 2016). In questo ambito ho collaborato alla ricerca e sviluppo del rivelatore partecipando a prove su fascio e all'analisi dei dati [30].

- Analisi di fisica

Le recenti misure di LHCb del *rate* di decadimento $B \to Kl^+l^-$ [31] e del rapporto $R(D^*) = BR(\bar{B}^0 \to D^{*+}\tau^-\bar{\nu}_\tau)/BR(\bar{B}^0 \to D^{*+}\mu^-\bar{\nu}_\mu)$ [32] hanno messo in evidenza una possibile violazione dell'universaltà leptonica. La collaborazione LHCb intende approfondire questo aspetto della fisica del sapore studiando più modi di decadimento. Con il gruppo di Frascati lavoro alla misura del rapporto dei decadimenti semileptonici del B_s in D_s: $R(D_s) = BR(\bar{B}_s \to D_s^+\tau^-\bar{\nu}_\tau)/BR(\bar{B}_s \to D_s^+\mu^-\bar{\nu}_\mu)$. La misura di $R(D_s)$ non è semplice, principalmente a causa dell' elevata contaminazione che la selezione del segnale, $B_s \to D_s\tau\nu$, subisce da parte dei decadimenti semimuonici del B_s in stati eccitati del mesone D_s che avvengono con *rates* ancora sconosciute. Importante è anche il contributo di contaminazione dovuto ai decadimenti del B_s in coppie di mesoni con *charm*, ed anche in questo caso le *rates* di decadimento devono essere determinate. Per questi motivi abbiamo deciso di iniziare con la misura del rapporto $R(D_s^*)$, caratterizzata da un livello inferiore di *feed-down* dagli stati eccitati del D_s. Attualmente stiamo completando la misura del fattore di forma del $B_s \to D_s^*\mu\nu$, necessario per determinare il rapporto $R(D_s^*)$.
All'interno della collaborazione LHCb sono stata *referee* delle analisi:

- *Measurement of* Υ *production in pp collisions at* $\sqrt{s} = 2.76$ *TeV* [33]
- *Measurement of the forward W boson cross-section in pp collisions at* $\sqrt{s} = 7$ *TeV* [34]
- *Measurement of W and Z production cross sections at 8 TeV* [35]
- *Improved limit on the branching fraction of the rare decay* $K_S \to \mu^+\mu^-$ [36]

Sono attualmente impegnata con la recensione dell'analisi: *Measurement of the branching ratios of the decays* $D^+ \to K^-K^+K^+$, $D^+ \to \pi^+\pi^-K^+$ *and* $D_s^+ \to \pi^-K^+K^-$.

Altre attività

Ho fatto parte del comitato locale di organizzazione della *XVIII International Conference on Physics in Collision* che si è tenuta a Frascati dal 17 al 19 Giugno 1998. In

seguito ho fatto parte del gruppo di editori scientifici dei *proceedings* della conferenza: **XVIII Physics in Collision**, Frascati Physics Series, Volume XI.

Ho fatto parte del comitato locale di organizzazione del *First International Workshop on Frontier Science - Charm, Beauty and CP* che si è tenuto presso i Laboratori Nazionali di Frascati dal 6 al 11 Ottobre 2002.

In occasione del primo convegno di *Frontier Science* è nato il progetto di divulgazione scientifica **Scienzapertutti**. Si tratta di un sito (`scienzapertutti.lnf.infn.it`) di comunicazione scientifica rivolto ad un pubblico non specializzato. In particolare, ho sviluppato i percorsi *Le Particelle Elementari*, *Il Modello Standard* e *Le Simmetrie*.

Ho fatto parte del comitato locale di organizzazione della Conferenza *KAON 07* che si è tenuta a Frascati dal 21 al 25 Maggio 2007. In seguito sono stata uno degli editori scientifici dei *proceedings* della conferenza pubblicati su *Proceedings of Science* (`http://pos.sissa.it`).

Ho fatto parte del comitato locale di organizzazione della Conferenza *HADRON 07* che si è tenuta a Frascati dal 8 al 13 Ottobre 2007. In seguito sono stata membro del gruppo di editori scientifici dei *proceedings* della conferenza pubblicati su Frascati Phys.Ser. 46 (2007) pp.1-1601.

Nell' ambito dell' iniziativa promossa dall' Istituto Nazionale di Fisica Nucleare, *Fisica in Barca*, ho partecipato all'organizzazione dell'incontro tra studenti e fisici del nostro Istituto presso il porto di Civitavecchia, negli anni 2008 e 2009. In entrambe le occasioni, ho presentato un seminario sull'origine e la natura del vento

`https://web.infn.it/fisicainbarca`.

Dall' inizio del 2016 coordino il gruppo di lavoro sui Seminari Generali dei Laboratori Nazionali di Frascati dell' INFN.

Presentazioni a conferenze e workshop, e seminari

1. "*6^{th} Conference on the Intersections of Particle and Nuclear Physics*" Big Sky - Montana, U.S.A., dal 27 Maggio al 2 Giugno 1997, dove ho presentato **Detecting K Mesons Leptonic Decays with KLOE** nella sessione parallela *Meson and Lepton Decay*.

2. "*EURODAΦNE Working Group: how to turn results on K_{e4} decays from KLOE into measurements of $\pi\pi$ phases*" Berna, dal 29 al 30 Giugno 1998, dove ho fatto una presentazione sullo stato dell'esperimento KLOE, e sul programma di studi riguardante i decadimenti K_{l4}.

3. "*EURODAΦNE Collaboration Meeting*" Parigi, dal 19 al 21 Ottobre 1998, dove ho presentato **$K_{\mu 3}$ and K_{e4} Studies with KLOE**.

4. "*HadAtom99 Workshop on Hadronic Atoms*" Berna, 14-15 Ottobre 1999, dove ho presentato K_{l4} **Decays at DAΦNE.**

5. "*7th Conference on the Intersections of Particle and Nuclear Physics*" Quebec City, Canada, dal 22 Maggio al 28 Maggio 2000, dove ho presentato **KLOE at DAΦNE** nella sessione parallela *Accelerators, Facilities and Detectors.*

6. Seminario su invito **Status and Performance of the KLOE Detector** presso *High Energy Physics Institute* di Pechino, 13 Ottobre 2000.

7. "*The Sixth International Conference on Position Sensitive Detectors*" University of Leicester U.K., dal 9 al 13 Settembre 2002, dove ho presentato il poster **Advances in triple GEM detectors operation for high rate particle triggering**, pubblicato su **Nuclear Instruments and Methods in Physics Research** A513 (2003) 264-268.

8. Seminario su invito **Scienzapertutti: un progetto divulgativo in rete** presso l'Università degli Studi di Lecce - Dipartimento di Fisica, 4 Dicembre 2002.

9. "*XV IFAE Italian Meeting on High Energy Physics*" Lecce, 23-26 Aprile 2003, dove ho presentato **Perspectives on measuring V_{us} at KLOE.**

10. "*Hadron Structure 2004*" Smolenice Castle, Slovacchia, dal 30 Agosto al 3 Settembre 2004, dove ho presentato **Recent Results from KLOE at DaΦne.**

11. "*2004 IEEE Nuclear Science Symposium*" Rome, Italy, dal 18 al 21 Ottobre 2004, dove ho presentato **Aging measurements on triple-GEM detectors operated with CF_4-based gas mixtures.**

12. "*Kaon 2005*" Northwestern University, Chicago, U.S.A., dal 13 al 17 Giugno 2005, dove ho presentato **KLOE Measurements of the Charged Kaon Branching Fractions and Lifetime.**

13. "*9th Conference on the Intersections of Particle and Nuclear Physics*" Puerto Rico, U.S.A., dal 30 Maggio al 3 Giugno 2006, dove ho presentato **The Status of $|V_{us}|$ from Kaon Decays** nella sessione parallela *Fundamental Symmetries and CKM.*

14. "*Les Rencontres de Physique de la Vallèe d'Aoste*" La Thuile, Italia, dal 4 al 10 Marzo 2007, dove ho presentato **Recent KLOE Results.**

15. Seminario su invito **Precision Kaon and Hadronic Physics with KLOE** presso *SLAC National Accelerator Laboratory*, Stanford - California, U.S.A., 30 Ottobre 2007.

16. "*EuroFlavour 07*" Univ. Paris-Sud 11, Orsay, Francia, dal 14 al 16 Novembre 2007, dove ho presentato **Precision Test from Kaon Decays**.

17. "*Discrete 08*" IFIC, Valencia, Spagna, dal 11 al 16 Dicembre 2008, dove ho presentato V_{us} **and CP Violation from Kaon Decays with the KLOE Detector**.

18. "*The 2009 Europhysics Conference on High Energy Physics*" Krakow, Polonia, dal 16 al 22 Luglio 2009, dove ho presentato **KLOE Measurements of** K_L **lifetime and Absolute Branching Ratio of** $K^+ \to \pi^\pm\pi^\mp\pi^+(\gamma)$.

19. "*Epiphany Conference*" Krakow, Polonia, dal 10 al 12 Gennaio 2011, dove ho presentato **Operation and Performances of the LHCb Experiment**.

20. "*BEACH 2012*" Wichita - Kansas U.S.A., dal 23 al 28 Luglio 2012, dove ho presentato **Heavy flavour production and spectroscopy at LHCb**.

21. "*KAON 2013*" University of Michigan, Ann Arbor, Michigan U.S.A., dal 29 Aprile al 1 Maggio 2013, dove ho presentato **Recent KLOE results on kaon branching ratios**.

22. "*from* ϕ *to* ψ" La Sapienza University, Rome, Italy, dal 9 al 12 Settembre 2013, dove ho presentato **Recent results on BR**$(K \to \pi\pi\pi)$ **at KLOE/KLOE-2**.

23. "*MENU 2013*" Rome, Italy, dal 30 Settembre al 4 Ottobre 2013, dove ho presentato b **and** c **spectroscopy at LHCb**.

24. "*BEACH 2014*" University of Birmingham, UK, dal 21 al 26 Luglio 2014, dove ho presentato **Measurement of BR**$(K^+ \to \pi^+\pi^-\pi^+(\gamma))$ **at KLOE**.

25. Seminario su invito **Measurement of the absolute branching of the** $K^+ \to \pi^+\pi^-\pi^+(\gamma)$ **decay with the KLOE detector** presso la sezione INFN dell'Università del Salento, Lecce, Italia,1 Ottobre 2014.

26. "*Theatre of Dreams: Beyond the LHCb Phase 1 Upgrade*" Schuster Laboratory, University of Manchester, UK, dal 6 al 7 Aprile 2016, dove ho presentato **Challenges for operation of the muon system at** $2 \times 10^{34}\mathbf{cm}^{-2}\mathbf{s}^{-1}$.

27. "2^{nd} *Rare and Strange Workshop: Strange Physics at LHCb*" Santiago de Compostela, Spagna, 26-27 Aprile 2017, dove ho presentato **KLOE results on kaon physics and KLOE-2 prospects**.

28. "56^{th} *International Winter Meeting on Nuclear Physics*" Bormio, Italia, 22-26 Gennaio 2018, dove ho presentato **Flavour results at LHCb**.

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Education

- Universitá dell'Aquila (L'Aquila, Italy) - Department of Physics, Doctorate in Physics, February 16, 2001. The argument of the thesis is: "Study of leptonic decays of hadrons with heavy flavor quarks produced in $p\bar{p}$ interactions at $\sqrt{s} =$ 1.8 TeV".
- Universitá di Roma "Tor Vergata" (Rome, Italy), *Laurea* in Physics, Nuclear and Subnuclear Physics, December 19, 1996. The argument of the thesis is: "Study of W boson production in association with jets containing heavy flavor quarks and measurement of $t\bar{t}$ pairs production cross section".
- Liceo Scientifico Statale di Grottaferrata "Bruno Touschek".
  Maturità scientifica, July 1989.

Professional Experience and Charges

• Group Leader of the LNF-INFN group working on the Mu2E experiment at Fermilab

• Achieved the National Scientific Qualification (ASN) of the Education Ministry for Associate Professor, Jan 2014

• Elected Member of the Users Executive Committe at Fermilab (UEC) -Sep 2014 to date. The purpose of the Committe is to provide a forum for discussion of scientific and administrative matters relevant to the organization and functions of the Laboratory. One of the most important activity is the annual visit to Washington DC congressional offices and speak with members of the United States Senate and House of Representatives seeking support for HEP.

• Staff Research Scientist, Laboratori Nazionali di Frascati of INFN (Italy), October 2004 - to date.

→ Mu2e collaboration (Fermilab) - Currently, L3 manager for the mechanics design and integration of the calorimeter. I coordinate the Mechanichs and Electonics engineering team that is designing all the components of the calorimeter giving them all the physics inputs to achieve the best design performances. As of spring 2016, in view of the CD-3 approval review, most of the calorimeter design is final and we are building real scale prototypes of all the critical parts to optimize their design or spot critical issues.

Characterization, simulations, design and realizations and tests of small size prototypes for the crystals calorimeter readout by new generation solid state photosensors for the Mu2E experiment. Responsible for the design and assembly of the prototypes; three matrices made of different crystal types and equipped with photosensors, FEE electronics and LED/Laser calibration systems have been extensively tested in electron and photons Test Beam campaigns at the Frascati LNF Beam Test Facility and at Mainzer Microtron (Mainz) respectively.

→ KLOE-2 collaboration (LNF) - Realization and characterization of a new forward calorimeter prototype surrounding the inner quadrupoles, QCALT, devoted to the identification of photons from rare K_L decays.

→ KLOE-2 collaboration (LNF) - Responsible for the design, prototyping and realization of a small angle crystal calorimeter to improve the acceptance for tagging low energy photons coming from rare Eta and Kaon event decays ($K_s \rightarrow \gamma\gamma$, $\eta \rightarrow \pi_0\gamma\gamma$).

→ CDF II Experiment - Study of the sub-sample of dimuon events that appears to be responsible for the observed discrepancies of the b quark pairs cross section measurements, $\sigma_{b\bar{b}}$, with respect to the prediction;

→ CDF II Experiment - b-quark pairs production cross section measurement, $\sigma_{b\bar{b}}$, looking at events with muon pairs with large impact parameter originating from semileptonic b-quark decays;

→ CDF II Experiment - Study of B into J/Ψ decays, inclusive b-quark production cross section measurement via $B^+ \rightarrow J/\Psi K^+$ channel;

→ CDF II Experiment - Responsible for the energy scale calibration and maintenance of the CDF central hadron calorimeters;

→ CDF II internal referee for Z' and high mass dielectron searches.

→ KLONE collaboration (LNF) - Partecipation to the R&D project for the measurement of the neutron detection efficiency of a KLOE electromagnetic calorimeter prototype (Lead-scintillating fibers). Three test-beams are carried on at the Svedberg Laboratory neutron beam facility at Uppsala varying neutron beam energy and intensity.

• Post doctoral Researcher (*Assegno di Ricerca*), Laboratori Nazionali di Frascati of INFN (Italy), February 2002 to September 2004. The research activity is carried on at the Collider Detector at Fermilab experiment (CDF II).

→ Development of solutions to compensate for the reduced charge integration time of the CDF central calorimeter photomultipliers with 400 ns bunch spacing of the upgraded Tevatron;

→ Development of a real-time object oriented software package for CDF to analyze laser data;

→ Responsible for the installation, debug and performance monitoring of the new discriminators of the electromagnetic and hadronic calorimeters and for the calibration of the timing system;

• Physics Research Doctorate, L'Aquila University (Italy), November 1997 - March 2001. The resarch activity is carried on at the Collider Detector at Fermilab experiment (CDF).

→ Study of the heavy flavor content of events containing a low-p_T lepton plus jets; CDF Run I data show an excess of events with kinematic properties that are consistent with the production of a light scalar quark;

→ Search for narrow bound resonances in the dimuon sample with mass between the J/Ψ and the Υ;

→ Partecipation to the Stanford Linar Accelerator Laboratory Summer School: Secrets of B Mesons, August 2002.

• Fermilab - Guest Scientist at CDF.
February to September 1997 - April to December 2001.

• Tor Vergata University (Rome) and Laboratori Nazionali di Frascati of INFN, experimental *Laurea* thesis carried on at the Collider Detector at Fermilab experiment (CDF), June 1995 - December 1996.

→ Revision of the b-quark tagging efficiency measurement leading to the new and final Run I top pairs production cross section in the $W \to e\ (\mu), \nu_e\ (\nu_\mu)$+jets (lepton plus jets) channel. Development of the energy corrections for b flavoured jets to improve the top events acceptance and mass resolution.

• Pre graduate Fellow at Fermi National Accelerator Laboratory (Fermilab), July 1995 to October 1995. He works in the CDF experiment and gains the first particle physics experience during the Thesis activity.

Outreach

→ Responsible for educational experiments " Revealing particles with calorimeters" at the LNF "Incontri di Fisica: refresher/educational course for high school teachers" since year 2001.

→ Responsible for tutoring undergraduate students at the LNF Summer Stages.

→ Responsible for tutoring undergraduate students at the Fermilab Summer Student Program.

Participation at Conferences

• The Mu2e Experiment at Fermilab LASNPA -WONP-NURT 2017 (Latin-American Symposium on Nuclear Physics and Applications), La Habana (Cuba) 2017, October 23-27 • The Mu2E experimet at Fermilab
New trends in High Energy Physics, Budva, Becici, (Montenegro), 2016, October 2-8

• The Mu2E crystal calorimeter
INSTR17: Instrumentation for Colliding Beam Physics, Novosibirsk (Russia) 2016, February 27- March 3

• L'Esperimento Mu2e al Fermilab; 101° Congresso della Societá Italiana di Fisica, Rome, 2015, September 21-25.

• A Crystal Calorimeter for the Mu2e Experiment; CHEF 2013 - Calorimetry for High Energy Frontier, Paris (France) - 2013, April 22 - 25.

• CCALT: crystal calorimeter at KLOE-2; 14^{th} International Conference on Calorimetry in High Energy Physics, Beijing (China) - 2010, May 10 - 14.

• Study of Multimuons Events at CDF; Les Rencontres de Physique de la Valle d'Aoste 2009, La Thuile, Aosta Valley (Italy) - 2009, March 1-7.

• Study of Multimuons Events at CDF; XVII International Workshop on Deep-Inelastic Scattering and Related Subjects DIS 2009, Madrid (Spain) - 2009, April 26-30.

• Study of Multimuons Events at CDF; The 2009 Europhysics Conference on High Energy Physics, Krakow (Poland) - 2009, July 16-22.

• Measurement and simulation of the neutron response and detection efficiency of a Pb-scintillating fiber calorimeter; SCINT 2007, IEEE-9th International conference on Inorganig Scintillators and their Applications, Winston-Salem, NC USA - 2007, June 4-8.

• Status of the observed and predicted $b\bar{b}$ production at the Tevatron; XIV International Workshop on Deep Inelastic Scattering, Tsukuba (Japan) - 2006, April 20-24.

• High Energy Physics and its Experiments; WYP-2005, World Year of Physics dissemination program, Seminar at Liceo Serpieri - Rimini (Italy) 2005, April 15.

• Ecfa Study, First workshop on Physics and Detectors for a Linear Collider, Montpellier (France) - 2003, November 13-16.

• Properties of heavy flavour jets produced at Tevatron $\sqrt{s} = 1.8$ Tev, Incontri di

Fisica delle Alte Energie, XV (IFAE), Lecce (Italy) - 2003, April 23-26.

• Higgs searches at Tevatron, Tor Vergata University, Rome (Italy) - November 2000.

• The latest Run I result of the top cross section measurement, New Perspectives '99, Fermilab - June 1999.

Research Activity details

- Current position

Mu2e The Mu2e experiment looks for the CLFV decay $\mu \rightarrow e$. It requires a high energy and time resolution calorimeter to complement the tracking detector in the measurement of track energy to separate conversion electrons from $\mu \rightarrow e$, with 105 MeV/c momentum, from the electrons coming from the decay in orbit of orbiting muons in the Al target,$\mu \rightarrow e\ \nu$, that have a momentum spectrum with 105 MeV/c endpoint. It also needs to reject background due to reconstruction errors or cosmic ray muons. The requirements for the calorimeter are 5% energy resolution, $<1\ ns$ time resolution and $\sim$ cm spatial resolution. In the 100 MeV energy region a total absorption calorimeter employing a continuous and homogenous medium is needed. The Mu2e collaboration has chosen to consider a crystal calorimeter made of two possible type of scintillating crystals, LYSO or BAF_2. Given the experience acquired in crystal calorimetry for the KLOE-2 collaboration the Frascati group has been asked to take the responsibility of designing and realizing the calorimeter detector.

I personally followed all the stages of the Mu2e approval by the funding agencies in USA and in Italy. We showed all the phases of the R&D we have been carring on to study the performancies and to tune them with the requirements highlighted by simulation studies.

We built different crystals array prototypes ameliorating everytime the FEE electronics and the photosensors control. All these prototypes have been tested with electrons or photons beams at BTF (Frascati) and Mami (Mainz).

The calorimeter design is currently described in all its details in the Mu2e Technical Design Report **arXiv:1501.05241** prepared for the CD-3 approval expected by spring 2016. **Nucl. Instrum. Meth. A 718, 56 (2013)** describes the Mu2e calorimeter project together with the energy resolution results of the first test beam at Mami.

As L3 manager I'm currently responsible for the mechanics design an integration of the calorimeter. The electron energy and timing resolutions optimization drive the technical choices of all the components of the calorimeter: type of crystal, photosensor, FEE electronics, digitizations; all these elements need to be engineered and be housed in the calorimeter. I have the responsbility of transferring all the physics inputs to the engineer team that is designing the mechanics of the calorimenter and to play an interface role with the Muon Beamline group that is integrating all the detectors in the Detetector Solenoid.

The calorimeter consists of two identical annuli 1500 mm outer diameter, 700 mm inner diameter, composed each of an inner cylinder made of light composite material, an outer stainless steel structural ring, one light frontal plate, a stack of 800 self-standing crystals equipped with two SiPM photosensors and FEE

electronics. It is also equipped with a sophisticated cooling system to extract the electronics dissipated power and to cool down the photosensors in order to recover from deterioration of responce due to an increased leakage currents as effect of radiation damages.

CDF The measurement of $\sigma_{b\bar{b}}$ described in **Physical Review D 77 (2008) 072004** agrees with NLO predictions. A detailed investigation of the dimuon data sample indicates that the discrepancies with respect to previous measurement are related to the requirement that the two muons tracks are reconstructed with the silicon detector with hits in the two inner layer and at least two in the four outher layers; in other words, that at least one of the two muons has to decay inside the 1.5 cm radius beam pipe. When this silicon requirement is released the measurement agrees with previous measurements and does not match the theory.

This is due to a set of events with interesting properties that were unaccounted for when using looser silicon cuts. A large fraction of these events is attributed to muons arising from in flight decays and punch-throughs of hadronic prongs of K_s^0. The remaining fraction consists of events where the muons show a very long impact parameter tail and have a very high muon multiplicity in a narrow cone around the primary muons. These events cannot be explained in terms of SM events or detector failures. The analysis is published in **Eur. Phys. J. C 68, 109.**

CDF At the Tevatron the measurement of the bottom quark cross section, σ_b, and the measurement of the cross section for producing both b and $\bar{b}$ quarks centrally and above a given momentum thresholds, $\sigma_{b\bar{b}}$, is an important test of the power of QCD to predict absolute rates in hadronic collisions. In QCD calculations, the long- and short- distance dynamics of the hadronic hard-scattering cross section are factorized into nonperturbative parton distribution functions (PDF) and fragmentation functions, and perturbatively calculable hard-scattering functions.

In **Physical Review D 73 (2006) 014026** all the Tevatron measurements have been compared to the same QCD prediction and they appear to be inconsistent among themselves and higher than the expectation.

Measurements of inclusive b cross sections, σ_b, and b pairs cross sections, $\sigma_{b\bar{b}}$, are sensitive to different contributions of the perturbative level of the QCD hard scattering calculations; inclusive b productions is contributed by Next to Leading Order terms (NLO) $b\bar{b}$ pairs production is dominated by leading order terms (LO). Precise measurements can contribute to assess the role of different terms in the pertubative prediction and improve the modeling of fragmentation functions.

The analysis described in **Physical Review D 75 (2007) 012010** measures the σ_b cross section using the decay $B^{\pm} \to J/\Psi K^{\pm}$ with $J/\Psi \to \mu^+\mu^-$ reconstructing the invariant mass peak of the decay particles in different p_T bins.

Acceptancies are measured from Monte Carlo using a NLO calculation in conjunction with EVTGEN for B hadrons decays and the GEANT based simulation of the CDF detector. To rely on Monte Carlo the the most relevant efficiencies and acceptancies are cross-checked using data control sample.

A second analysis determines the production rate of muons originating from b- and $\bar{b}$-quarks semileptonic decays. A fit to the impact parameter distributions of muons allows to distinguish from muons coming from b- c-quark decays or prompt decays of quarkonia and Drell-Yan production. The fit uses heavy flavor impact parameter templates determined using the HERWIG Monte Carlo generator. Since the analysis is based on lifetime distributions, HERWIG has to reproduce the measured abundances of heavy flavor hadrons.

To have the right b- and c- hadrons composition, produced by the heavy quarks fragmentation, HERWIG has been tuned to reproduce the PDG fragmentation fractions for b-quark and the experimental results from BELLE, CLEO, HERA, LEP for c-quark. This work is documented in **Physical Review D 77 (2008) 072004.**

Both results agree with the Standard Model prediction.

CDF Responsible for the absolute energy scale calibration of the Central (CHA) and EndWall (WHA) hadron calorimeters and for the maintainance of the calorimeters hardware during the data-taking operations. The energy scale is set using a mixture of techniques: the photomultipliers gain stability is monitored by means of frequent nitrogen Laser runs. The laser light shines the light guides facing the photomultiplier photocatodes thus originating a reference pulse height monitored weekly. The scintillator output degradation is checked looking at real energy deposition in the calorimeter towers using minimum ionizing particles (muons from J/Ψ decays reconstructed using tracking information). For this pourpose a C++ based package is developed to run automatically every 50 pb^{-1} of integrated luminosity on the dimuon trigger data set. The hadronic energy response to muon of each calorimetric tower is compared to the RUN I response (when the calorimeter was calibrated using ^{137}Cs source system). The absolute energy scale is determined at the level of 1-2% precision.

A ^{137}Cs sources system determines the absolute energy scale for the WHA calorimeter; this procedure relies on the test beam of '83 - '85 that used π's with energy greater than 10 GeV.
The absolute energy scale calibration and its stability contributes to the improvement of the jet energy scale described in **Nucl. Instrum. Meth. A 566 (2006) 375**. This is very important in reducing the sistematic uncertainty in precise elettroweak measurements like the top quark mass.

KLONE The detection of neutrons is usually performed with organic scintillators where the neutrons undergo elastic scattering with proton of hydrogen atoms. Nevertheless rem counters also take advantage of medium-high Z materials to increase

the detection response through inelastic processes that produce secondary neutrons. The KLONE collaboration performed three test beams, at the neutron facility of Uppslala Svedberg Laboratory, using the KLOE electromagnetic prototype. This calorimeter is composed of 200 layers of 1 mm blue scintillating fibers glued in grooved lead layers. The trigger/DAQ system is performed with NIM/VME technology. The test beam measurements show indeed an enhancement of the neutron efficiency and are in fair agreement with the FLUKA simulation.

The detector is calibrated using cosmic ray runs. The contribution of a beam halo to the detection efficiency is determined studing the time of flight distributions. A NE-110 scintillator detector is built for reference measurements, read-out with standard photomultipliers. Design and construction of segmented WLS fibers - scintillator strips detector for determination of fthe gemetrical beam profile, read-out with multi-anode photomultipliers. This measurement is presented at the **IX IEEE Scint07 Conference**. The measured efficiency ranges between 30 to 50%, depending on energy, at the lowest trigger threshold; four times larger than expected for an equivalent scintillator thickness.

KLOE-2 The KLOE-2 proposal includes the addition of a new forward calorimeter, QCALT, to increase the photons detection acceptance in rare events decays ($K_L \rightarrow 2\pi^0$). QCALT is a high granularity calorimeter based on tungsten scintillator tiles + WLS fibers read out with silicon photodevices (SIPM). The calorimeter consists of around 2000 5x5x.5 cm^3 tiles, assembled in two barrel calorimeters 12 wedges each, for 1 m lenght and 5 cm thickness.

The R&D phase consisted on

- characterization of the SIPM response with a pulsed LED;
- study of the optical connection of the SIPM to scintillating fibers and of the response to a β source;
- construction of the first prototype cell, instrumented with Hamamatsu MPPC of 400 pixels and testing with cosmic rays and the electron beam at the Beam Test Facility of LNF.

Development of a DAQ/trigger system to read out the SIPM signals. The detector is fully operational in the KLOE2 apparatus.

KLOE-2 In the new design of the Dafne interaction region the position of the quadrupoles increases the acceptance of the central calorimeter from 21 to 18 degrees. In this volume is possible to insert few crystals to improve the acceptance for tagging low energy photons coming from rare Eta and Kaon event decays ($K_s \rightarrow \gamma\gamma, \eta \rightarrow \pi_0\gamma\gamma$).

The proposed solution is to insert an homogeneous calorimeter immersed in a 0.52 kgauss axial magnetic field, CCALT, based on the new generation of crystals, LYSO, characterized by a very high light yield (60% of NaI), 40 ns emission

time, high density and radiation lenght. These crystals match the request for a high efficiency for low energy photons and an excellent time resolution needed by the calorimeter to sustain the high level of machine background events.

CCALT needs to maximize the light collection to improve its timing performance so that we selected as photosensor the fastest APD on the market from Hamamatsu.

We built a prototype matrix of 2x2x15 cm^3 LYSO crystals read-out by 0.5x0.5 Hamamatsu avalanche photodiodes (APD) and we tested it using cosmic rays an at the electrons beam test facility of Frascati.

The measurements show a very good time resolution of around 200 ps and a light yield of 2000 photoelectrons per MeV.

We studied the energy resolution of this kind of calorimeters, that is limited by the containment of the shower and by the electronic noise. For this purpose we built aset of much larger prototypes, the first consisting of 21 crystals, 9 LYSO for an inner matrix and 12 PBWO for outer leakage recovery (3 Moliere radius in total), we measured 5% energy resolution @100 MeV.

The calorimeter is composed of four aluminum wedges per side; each wedge has three sectors with a granularity of four projective crystal. Every crystal is readout with large area Sipm.

I followed the design and the realization of the mechanical shells with a characteristic shape of truncated pyramid with a dodecagonal base manufactured using Electro Discharge Machining; the design and realization of the Sipm holder using a 3D PVC printer, the international tender for the purchase of the crystals and the photosensors. After a phase of quality assurance of all the components, all the parts were assembled and tested as a whole. The calorimeter is installed over the inner quadrupoles of Kloe and is fully operational as described in **Acta Phys. Polon. B 46, no. 1, 87 (2015)**.

- Post Doctoral Research

The LNF group is historically responsible for the building, upgrading, maintenance and calibration of the central hadronic calorimeter of the CDF experiment leading the commissioning of the central hadron calorimeters for Run II.

The hadron calorimeters underwent minor upgrades going from Run I to Run II; the front end electronics has been replaced to substain the higher luminosity acquisition rate; all the photomultipliers functionality has been restored. The shorter acquisition gate causes a loss of the charge integration of photomultipliers pulses and various techniques are developed to set back and monitor the absolute energy scale of the calorimeters using also the first collision data from the Tevatron.

An object oriented software package is developed to analyze (online) laser runs for the calibration of the electronic chain from the photomultipliers to the front-end electronics.

Involved in the installation, calibration, performance monitoring and commissioning of the new timing system for the hadronic and electromagnetic calorimeters (**Nucl. Instrum. Meth. A 565 (2006) 538**).

The timing calibrations of the detectors, the debugging of the new discriminators installation and their thresholds settings have been checked through many "engineering" runs of $p\bar{p}$ collisions that have been analyzed using software packages developed in C++ language within the AC++ framework of the CDF offline software.

- Physics Research Doctorate

Detailed study of the data set containing a low-p_T lepton plus jets with heavy flavor searching for a light scalar quark (mass in the range of $\sim$3.5 GeV/c^2) with a long lifetime and an anomalous semileptonic branching ratio. At the Tevatron energies, heavy flavor jets coming from b and c quarks adronization show a displaced vertex with rispect to the primary vertex of the event due to the effect of the long lifetime of heavy flavor hadrons ($\tau \simeq 1$ ps) together with the Lorentz boost acquired by jets. These heavy flavor jets are identified using tagging algorithms (SECVTX, Jetprobability) based on the location of the secondary vertex. The semileptonic decay rate of heavy flavor quarks is instead measured looking for soft (low momentum) leptons not isolated in the calorimeter, contained in jets with secondary vertices. These leptons are found by the Soft Lepton Tagging algorithm (SLT).

The basic results of this analysis is the observation of an excess of events containing an additional soft-lepton inside one of the jets recoiling against the jet containing the trigger lepton significantly larger that what is expected for the production and semileptonic decay of b and c hadrons. This part of the analysis has been published in **Physical Review D. D69:072004,2004**.

Also an excess of events with an additional lepton inside the jet containing the trigger lepton was observed. These events and their kinematical properties are described in the paper published in **Physical Review D72:072002,2005**.

As a working ipothesis, the excess can be interpreted (in terms of supersimmetric signal) as the pair production and decay of a spin 0 scalar quark. The best candidate is the supersimmetric partner of the b quark: $\tilde{b} \rightarrow c\tilde{\chi}^{\pm}$ and $\tilde{\chi}^{\pm} \rightarrow l\tilde{\nu}_l$, with $m_{\tilde{b}} =$ 3.65 GeV/c^2, $m_{\tilde{\nu}} = 0$ and $\tau_{\tilde{b}} \simeq 1$ ps. This process has been implemented in the Herwig Monte Carlo generator using a matrix element calculation by K. Hikasa and M. Kobayashi for SUSY models and reproduces most of the features of the observed anomalies. These results are explained in term of SUSY signal in **Physical Review D73:014025,2006**.

Based on the interpretation of a scalar quark, this analysis was extended to a search of narrow bound states of two scalar quarks by studying the dimuon invariant mass spectrum between 6 and 9 GeV/c^2. This latter study is published in **Physical Review D72:092003,2005**.

- *Laurea* Thesis

The argument of the thesis is the study of the $W+$ jet sample where $t\bar{t}$ production

events can be isolated and top production cross section measured. Each top quark in the event decays to a W boson and a b quark with a Branching Ratio of $\sim 100\%$ and there are different research channels according to the decay of the two W bosons present in the event (to hadrons or to leptons). It is used the "lepton plus jets" channel, where one of the two W decays to leptons, $W \to l\nu_l$ ($l = e,\ \mu$) and the other to two adronic jets. The event topology consists of a lepton with high momentum isolated in the calorimeter, an unbalance of transverse energy in the calorimeters ($\not\!\!E_T$) indicating the presence of an undetected neutrino and at least four jets; furthermore it is required that at least one of the jets contains a secondary vertex, reconstructed by the SECVTX algorithm, in order to enhance the presence of b quarks.

The measurement of the top production cross section at Tevatron provides the opportunity to test the Standard Model predictions comparing the data with the QCD + $t\bar{t}$ prediction of $W+$ jets events as a function of the multiplicity and transverse momentum of the jets in the event.

The highest contribution to background events for top comes from the direct QCD production of W boson associated to jets from gluons radiation that split to heavy flavor pairs. The amount of these events is estimated from Monte Carlo.

The excess over the background of events with at least three jets is attributed to top; geometrical acceptancies of the analysis cuts and tagging efficiencies are measured in a top Monte Carlo sample. With an integrated luminosity of $\int \mathcal{L}dt = 105 \pm 4\ \mathrm{pb}^{-1}$ we count 29 $W+ \geq 3$ jets events with 7.99 ± 0.98 background events, corresponding to a $\sigma_{t\bar{t}} = 5.1 \pm 1.5$ pb. This value is the official result of the CDF Run I and is published on **Physical Review D64:032002,2001** .

List of Papers

Primary Publications

- "A LYSO crystal calorimeter for the Mu2e experiment".
  Proceedings of the CHEF2013 Conference - Eds. J.-C. Brient, R. Salerno, and Y. Sirois
  ISBN number 978-2-7302-1624-1

- "Measurement of correlated b-bbar production in p-pbar collisions at s**(1/2) = 1960 GeV," Phys. Rev. D **77** (2008) 072004.

- T. Aaltonen *et al.* [CDF Collaboration], "Study of multi-muon events produced in $p\bar{p}$ interactions at $\sqrt{s} = 1.96$ TeV," Eur. Phys. J. C **68**, 109 (2010).

- "Measurement of the B^+ production cross section in $p\bar{p}$ collisions at $\sqrt{s} = 1960$ GeV", Phys. Rev. D **75** 2007012010.

- F. Happacher, "Measurement and simulation of the neutron response and detection efficiency of a Pb-scintillating fiber calorimeter", in proceedings of IX IEEE Scint07 Conference - Winston Salem, North Carolina USA, june 4-8, 2007.

- F. Happacher, "Status of the observed and predicted $b\bar{b}$ production at the Tevatron", in proceedings of XIV International Workshop on Deep Inelastic Scattering - Tsukuba (Japan), april 20-24, 2006.

- F. Happacher, "Properties of jets with heavy flavor produced in in p anti-p interactions at $\sqrt{s} = 1.8$-TeV", in proceedings of IFAE 2003 - Lecce, april 23-26, 2003.

- F. Happacher, P. Giromini and F. Ptohos, "Status of the observed and predicted b barb production at the Tevatron," Phys. Rev. D **73** (2006) 014026.

- G. Apollinari *et al.*, "Search for narrow resonances below the Upsilon mesons," Phys. Rev. D **72** (2005) 092003.

- G. Apollinari *et al.*, "Phenomenological study of the atypical heavy flavor production observed at the Fermilab Tevatron," Phys. Rev. D **73** (2006) 014025

- G. Apollinari, I. Fiori, P. Giromini, F. Happacher, S. Miscetti, A. Parri and F. Ptohos, "Study of sequential semileptonic decays of b hadrons produced at the Tevatron," Phys. Rev. D **72** (2005) 072002.

- Heavy flavor properties of jets produced in p anti-p interactions at $\sqrt{s} = 1.8$ TeV.
  Nov 2003, D. Acosta *et al.*, Published in Phys. Rev. D **69** (2004) 072004

- Study of the heavy flavor content of jets produced in association with W boson in p anti-p collisions at $\sqrt{s} = 1.8$ TeV.
  Sep 2001, D. Acosta *et al.*, Published in Phys. Rev. D **65** (2002) 052007

- Measurement of the t anti-t production cross-section in p anti-p collisions at $\sqrt{s} = 1.8$ TeV.
  Jan 2001, T. Affolder *et al.*, Published in Phys. Rev. D **64** (2001) 032002.
- Cordelli:2013mka M. Cordelli, E. Dan, S. Giovannella, M. Gatta, F. Happacher, A. Luc, S. Miscetti and A. Saputi *et al.*, "CCALT: A Crystal CALorimeter with Timing for the KLOE-2 upgrade," Nucl. Instrum. Meth. A **718**, 81 (2013).

Internal CDF Publications

1. CDF9230, PRD DRAFT: Study of multi-muon events produced in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV - 20/10/08;
2. CDF8733: Measurement of the correlated $b\bar{b}$ production - 11/6/07;
3. CDF8394: Measurement of the B+ production cross section at $\sqrt{s}$=1.96 TeV - 21/7/06;
4. CDF8507: Tuning of herwig version 6.5 - 25/9/06;
5. CDF7543, NIM Draft: Determination of the jet Energy scale at the Collider Detector at Fermilab - 11/7/05;
6. CDF7599: Cross-check of the CHA and WHA calibrations - 26/4/05;
7. CDF6891: Energy scale calibration of CDF Hadron Calorimeters - 23/2/04;
8. PRD draft: Study of the semileptonic decays of b hadrons produced at Tevatron - 2003;
9. PRD draft: Search for narrow resonances below the Υ mesons - 2003;
10. PRD draft: A possible explanation for the anomalous heavy flavor production observed at Tevatron - 2003;
11. CDF5856: Timing calibration of CDF hadron calorimeters - 14/2/02;
12. CDF4795: Observation of semileptonic decays of heavy quarks produced in $p\bar{p}$ interactions and the existence of one scalar quark - 29/3/2000;
13. CDF4257: Measurement of the data to simulation scale factor for the tagging efficiency of SECVTX and JPB - 28/3/99;
14. CDF4303: Method II measurement of the top cross section with W+3,4 jet events with SECVTX, JPB and SLT tags - 26/3/99;
15. CDF4860: Measurement of the dimuon invariant mass between the Psi and the Upsilon - 25/1/1999;
16. CDF4115: Heavy flavor content of jets in the data and in Herwig simulations - 19/3/97;

17. CDF3855: Measurement of the $t\bar{t}$ production cross section using SECVTX tags - 11/2/97;

18. CDF3861: Measurement of the $t\bar{t}$ production cross section using SLT tags - 4/9/96;

19. CDF3876: Measurement of the $t\bar{t}$ production cross section using Jetprobability tags - 11/9/96;

20. CDF3485: Evidence for a b-bbar state of mass 109 GeV - 17/1/96;

21. CDF3457: ZZJSCO: jet corrections for the study of ttbar, VV and VH production - 19/12/96;

22. CDF3602: Study of the top invariant mass distribution using $W+ \geq 4$ jet events - 11/3/96;

23. CDF3610: Study of the invariant mass distribution of the two highest E_t jets in $V+ \geq 2$ jet events with a SECVTX tag - 15/3/96.

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