

# Glossary

$A \subseteq B$	$A$ is a subset of $B$ (not necessarily a proper subset)
$A \subsetneq B$	$A$ is a proper subset of $B$
$A^c$	the complement of a set $A$
$\chi_E$	the characteristic function of the set $E$
$d_f$	the distribution function of a function $f$
$f^*$	the decreasing rearrangement of a function $f$
$f_n \uparrow f$	$f_n$ increases monotonically to a function $f$
$\mathbf{Z}$	the set of all integers
$\mathbf{Z}^+$	the set of all positive integers $\{1, 2, 3, \dots\}$
$\mathbf{Z}^n$	the $n$ -fold product of the integers
$\mathbf{R}$	the set of real numbers
$\mathbf{R}^+$	the set of positive real numbers
$\mathbf{R}^n$	the Euclidean $n$ -space
$\mathbf{Q}$	the set of rationals
$\mathbf{Q}^n$	the set of $n$ -tuples with rational coordinates
$\mathbf{C}$	the set of complex numbers
$\mathbf{C}^n$	the $n$ -fold product of complex numbers
$\mathbf{T}$	the unit circle identified with the interval $[0, 1]$
$\mathbf{T}^n$	the $n$ -dimensional torus $[0, 1]^n$ ,
$ x $	$\sqrt{ x_1 ^2 + \dots +  x_n ^2}$ when $x = (x_1, \dots, x_n) \in \mathbf{R}^n$
$\mathbf{S}^{n-1}$	the unit sphere $\{x \in \mathbf{R}^n :  x  = 1\}$

$e_j$	the vector $(0, \dots, 0, 1, 0, \dots, 0)$ with 1 in the $j$ th entry and 0 elsewhere
$\log t$	the logarithm to base $e$ of $t > 0$
$\log_a t$	the logarithm to base $a$ of $t > 0$ ( $1 \neq a > 0$ )
$\log^+ t$	$\max(0, \log t)$ for $t > 0$
$[t]$	the integer part of the real number $t$
$x \cdot y$	the quantity $\sum_{j=1}^n x_j y_j$ when $x = (x_1, \dots, x_n)$ and $y = (y_1, \dots, y_n)$
$B(x, R)$	the ball of radius $R$ centered at $x$ in $\mathbf{R}^n$
$\omega_{n-1}$	the surface area of the unit sphere $\mathbf{S}^{n-1}$
$v_n$	the volume of the unit ball $\{x \in \mathbf{R}^n :  x  < 1\}$
$ A $	the Lebesgue measure of the set $A \subseteq \mathbf{R}^n$
$dx$	Lebesgue measure
$\text{Avg}_B f$	the average $\frac{1}{ B } \int_B f(x) dx$ of $f$ over the set $B$
$\langle f, g \rangle$	the real inner product $\int_{\mathbf{R}^n} f(x)g(x) dx$
$\langle f   g \rangle$	the complex inner product $\int_{\mathbf{R}^n} f(x)\overline{g(x)} dx$
$\langle u, f \rangle$	the action of a distribution $u$ on a function $f$
$p'$	the number $p/(p-1)$ , whenever $0 < p \neq 1 < \infty$
$1'$	the number $\infty$
$\infty'$	the number 1
$f = O(g)$	means $ f(x)  \leq M g(x) $ for some $M$ for $x$ near $x_0$
$f = o(g)$	means $ f(x) / g(x) ^{-1} \rightarrow 0$ as $x \rightarrow x_0$
$A^t$	the transpose of the matrix $A$
$A^*$	the conjugate transpose of a complex matrix $A$
$A^{-1}$	the inverse of the matrix $A$
$O(n)$	the space of real matrices satisfying $A^{-1} = A^t$
$\ T\ _{X \rightarrow Y}$	the norm of the (bounded) operator $T : X \rightarrow Y$
$A \approx B$	means that there exists a $c > 0$ such that $c^{-1} \leq \frac{B}{A} \leq c$
$ \alpha $	indicates the size $ \alpha_1  + \dots +  \alpha_n $ of a multi-index $\alpha = (\alpha_1, \dots, \alpha_n)$
$\partial_j^m f$	the $m$ th partial derivative of $f(x_1, \dots, x_n)$ with respect to $x_j$
$\partial^\alpha f$	$\partial_1^{\alpha_1} \dots \partial_n^{\alpha_n} f$
$\mathcal{C}^k$	the space of functions $f$ with $\partial^\alpha f$ continuous for all $ \alpha  \leq k$

$\mathcal{C}_0$	space of continuous functions with compact support
$\mathcal{C}_{00}$	the space of continuous functions that vanish at infinity
$\mathcal{C}_0^\infty$	the space of smooth functions with compact support
$\mathcal{D}$	the space of smooth functions with compact support
$\mathcal{S}$	the space of Schwartz functions
$\mathcal{C}^\infty$	the space of smooth functions $\bigcap_{k=1}^\infty \mathcal{C}^k$
$\mathcal{D}'(\mathbf{R}^n)$	the space of distributions on $\mathbf{R}^n$
$\mathcal{S}'(\mathbf{R}^n)$	the space of tempered distributions on $\mathbf{R}^n$
$\mathcal{E}'(\mathbf{R}^n)$	the space of distributions with compact support on $\mathbf{R}^n$
$\mathcal{P}$	the set of all complex-valued polynomials of $n$ real variables
$\mathcal{S}'(\mathbf{R}^n)/\mathcal{P}$	the space of tempered distributions on $\mathbf{R}^n$ modulo polynomials
$\ell(Q)$	the side length of a cube $Q$ in $\mathbf{R}^n$
$\partial Q$	the boundary of a cube $Q$ in $\mathbf{R}^n$
$L^p(X, \mu)$	the Lebesgue space over the measure space $(X, \mu)$
$L^p(\mathbf{R}^n)$	the space $L^p(\mathbf{R}^n,  \cdot )$
$L^{p,q}(X, \mu)$	the Lorentz space over the measure space $(X, \mu)$
$L^p_{\text{loc}}(\mathbf{R}^n)$	the space of functions that lie in $L^p(K)$ for any compact set $K$ in $\mathbf{R}^n$
$ d\mu $	the total variation of a finite Borel measure $\mu$ on $\mathbf{R}^n$
$\mathcal{M}(\mathbf{R}^n)$	the space of all finite Borel measures on $\mathbf{R}^n$
$\mathcal{M}_p(\mathbf{R}^n)$	the space of $L^p$ Fourier multipliers, $1 \leq p \leq \infty$
$\mathcal{M}^{p,q}(\mathbf{R}^n)$	the space of translation-invariant operators that map $L^p(\mathbf{R}^n)$ to $L^q(\mathbf{R}^n)$
$\ \mu\ _{\mathcal{M}}$	$\int_{\mathbf{R}^n}  d\mu $ the norm of a finite Borel measure $\mu$ on $\mathbf{R}^n$
$\mathcal{M}$	the centered Hardy–Littlewood maximal operator with respect to balls
$M$	the uncentered Hardy–Littlewood maximal operator with respect to balls
$\mathcal{M}_c$	the centered Hardy–Littlewood maximal operator with respect to cubes
$M_c$	the uncentered Hardy–Littlewood maximal operator with respect to cubes
$\mathcal{M}_\mu$	the centered maximal operator with respect to a measure $\mu$
$M_\mu$	the uncentered maximal operator with respect to a measure $\mu$
$M_s$	the strong maximal operator
$M_d$	the dyadic maximal operator
$M^\#$	the sharp maximal operator

$\mathcal{M}$	the grand maximal operator
$L_s^p(\mathbf{R}^n)$	the inhomogeneous $L^p$ Sobolev space
$\dot{L}_s^p(\mathbf{R}^n)$	the homogeneous $L^p$ Sobolev space
$\Lambda_\alpha(\mathbf{R}^n)$	the inhomogeneous Lipschitz space
$\dot{\Lambda}_\alpha(\mathbf{R}^n)$	the homogeneous Lipschitz space
$H^p(\mathbf{R}^n)$	the real Hardy space on $\mathbf{R}^n$
$B_{s,q}^p(\mathbf{R}^n)$	the inhomogeneous Besov space on $\mathbf{R}^n$
$\dot{B}_{s,q}^p(\mathbf{R}^n)$	the homogeneous Besov space on $\mathbf{R}^n$
$\dot{B}_{s,q}^p(\mathbf{R}^n)$	the homogeneous Besov space on $\mathbf{R}^n$
$F_{s,q}^p(\mathbf{R}^n)$	the inhomogeneous Triebel–Lizorkin space on $\mathbf{R}^n$
$\dot{F}_{s,q}^p(\mathbf{R}^n)$	the homogeneous Triebel–Lizorkin space on $\mathbf{R}^n$
$BMO(\mathbf{R}^n)$	the space of functions of bounded mean oscillation on $\mathbf{R}^n$

# References

1. D. Adams, *A note on Riesz potentials*, Duke Math. J. **42** (1975), 765–778.
2. R. A. Adams, *Sobolev Spaces*, Academic Press, New York, 1975.
3. G. Alexopoulos, *La conjecture de Kato pour les opérateurs différentiels elliptiques à coefficients périodiques*, C. R. Acad. Sci. Paris **312** (1991), 263–266.
4. J. Alvarez and C. Pérez, *Estimates with  $A_\infty$  weights for various singular integral operators*, Boll. Unione Mat. Ital. **8-A** (1994), 123–133.
5. N. Y. Antonov, *Convergence of Fourier series*, Proceedings of the XXth Workshop on Function Theory (Moscow, 1995), pp. 187–196, East J. Approx. **2** (1996).
6. J. Arias de Reyna, *Pointwise Convergence of Fourier Series*, Lect. Notes in Math. 1785, Springer, Berlin–Heidelberg–New York, 2002.
7. N. Aronszajn and K. T. Smith, *Theory of Bessel potentials I*, Ann. Inst. Fourier (Grenoble) **11** (1961), 385–475.
8. P. Auscher, A. McIntosh, and A. Nahmod, *Holomorphic functional calculi of operators, quadratic estimates, and interpolation*, Indiana Univ. Math. J. **46** (1997), 375–403.
9. P. Auscher and P. Tchamitchian, *Square root problem for divergence operators and related topics*, Astérisque No. 249, Société Mathématique de France, 1998.
10. P. Auscher, S. Hofmann, J. L. Lewis, and P. Tchamitchian, *Extrapolation of Carleson measures and the analyticity of Kato’s square-root operators*, Acta Math. **187** (2001), 161–190.
11. P. Auscher, A. McIntosh, S. Hofmann, M. Lacey, and P. Tchamitchian, *The solution of the Kato Square Root Problem for Second Order Elliptic Operators on  $\mathbb{R}^n$* , Ann. of Math. **156** (2002), 633–654.
12. A. Baernstein II and E. T. Sawyer, *Embedding and multiplier theorems for  $H^p(\mathbb{R}^n)$* , Mem. Amer. Math. Soc., No. 318, 1985.
13. R. Bagby and D. Kurtz, *Covering lemmas and the sharp function*, Proc. Amer. Math. Soc. **93** (1985), 291–296.
14. R. Bagby and D. S. Kurtz, *A rearranged good- $\lambda$  inequality*, Trans. Amer. Math. Soc. **293** (1986), 71–81.
15. B. Barceló, *On the restriction of the Fourier transform to a conical surface*, Trans. Amer. Math. Soc. **292** (1985), 321–333.
16. B. Barceló, *The restriction of the Fourier transform to some curves and surfaces*, Studia Math. **84** (1986), 39–69.
17. J. Barrionuevo, *A note on the Kakeya maximal operator*, Math. Res. Lett. **3** (1995), 61–65.
18. W. Beckner, A. Carbery, S. Semmes, and F. Soria, *A note on restriction of the Fourier transform to spheres*, Bull. London Math. Soc. **21** (1989), 394–398.
19. C. Bennett, R. A. DeVore, and R. Sharpley, *Weak  $L^\infty$  and BMO*, Ann. of Math. **113** (1981), 601–611.

20. Á. Bényi, C. Demeter, A. Nahmod, C. Thiele, R. H. Torres, and P. Villaroya, *Modulation invariant bilinear  $T(1)$  theorem*, to appear.
21. Á. Bényi, D. Maldonado, A. Nahmod, and R. H. Torres, *Bilinear paraproducts revisited*, Math. Nach., to appear.
22. A. Besicovitch, *On Kakeya's problem and a similar one*, Math. Z. **27** (1928), 312–320.
23. A. Besicovitch, *A general form of the covering principle and relative differentiation of additive functions*, Proc. of Cambridge Phil. Soc. **41** (1945), 103–110.
24. O. V. Besov, *On a family of function spaces. Embedding theorems and applications* [in Russian], Dokl. Akad. Nauk SSSR **126** (1959), 1163–1165.
25. O. V. Besov, *On a family of function spaces in connection with embeddings and extensions* [in Russian], Trudy Mat. Inst. Steklov **60** (1961), 42–81.
26. Z. Birnbaum and M. W. Orlicz, *Über die Verallgemeinerung des Begriffes der Zueinander konjugierten Potenzen*, Studia Math. **3** (1931), 1–67; reprinted in W. Orlicz, “Collected Papers,” pp. 133–199, PWN, Warsaw, 1988.
27. S. Bochner, *Summation of multiple Fourier series by spherical means*, Trans. Amer. Math. Soc. **40** (1936), 175–207.
28. J. M. Bony, *Calcul symbolique et propagation des singularités pour les équations aux dérivées partielles non linéaires*, Ann. Sci. École Norm. Sup. **14** (1981), 209–246.
29. J. Bourgain, *Besicovitch type maximal operators and applications to Fourier analysis*, Geom. Funct. Anal. **1** (1991), 147–187.
30. J. Bourgain, *On the restriction and multiplier problems in  $\mathbb{R}^3$* , Geometric Aspects of functional analysis (1989–90), pp. 179–191, Lect. Notes in Math. 1469, Springer, Berlin, 1991.
31. J. Bourgain, *Some new estimates on oscillatory integrals*, Essays on Fourier Analysis in Honor of E. M. Stein, pp. 83–112, C. Fefferman, R. Fefferman, and S. Wainger (eds.), Princeton Univ. Press, Princeton, NJ, 1995.
32. J. Bourgain, *On the dimension of Kakeya sets and related maximal inequalities*, Geom. Funct. Anal. **9** (1999), 256–282.
33. M. Bownik, *Anisotropic Hardy spaces and wavelets*, Mem. Amer. Math. Soc. **164** (2003), no. 781, 122pp.
34. M. Bownik, *Boundedness of operators on Hardy spaces via atomic decompositions*, Proc. Amer. Math. Soc. **133** (2005), 3535–3542.
35. M. Bownik, B. Li, D. Yang, and Y. Zhou, *Weighted anisotropic Hardy spaces and their applications in boundedness of sublinear operators*, Indiana Univ. Math. J., to appear.
36. S. M. Buckley, *Estimates for operator norms on weighted spaces and reverse Jensen inequalities*, Trans. Amer. Math. Soc. **340** (1993), 253–272.
37. H. Q. Bui, *Some aspects of weighted and non-weighted Hardy spaces*, Kôkyûroku Res. Inst. Math. Sci. **383** (1980), 38–56.
38. D. L. Burkholder, R. F. Gundy, and M. L. Silverstein, *A maximal characterization of the class  $H^p$* , Trans. Amer. Math. Soc. **157** (1971), 137–153.
39. S. Campanato, *Proprietà di hölderianità di alcune classi di funzioni*, Ann. Scuola Norm. Sup. Pisa **17** (1963), 175–188.
40. S. Campanato, *Proprietà di una famiglia di spazi funzionali*, Ann. Scuola Norm. Sup. Pisa **18** (1964), 137–160.
41. A. P. Calderón, *Lebesgue spaces of differentiable functions and distributions*, Proc. Symp. Pure Math. **4** (1961), 33–49.
42. A. P. Calderón, *Commutators of singular integral operators*, Proc. Nat. Acad. Sci. USA **53** (1965), 1092–1099.
43. A. P. Calderón, *Cauchy integrals on Lipschitz curves and related operators*, Proc. Nat. Acad. Sci. USA **74** (1977), 1324–1327.
44. A. P. Calderón, *An atomic decomposition of distributions in parabolic  $H^p$  spaces*, Adv. in Math. **25** (1977), 216–225.
45. A. P. Calderón and A. Torchinsky, *Parabolic maximal functions associated with a distribution*, Adv. in Math. **16** (1975), 1–63.

46. A. P. Calderón and A. Torchinsky, *Parabolic maximal functions associated with a distribution*, Adv. in Math. **24** (1977), 101–171.
47. A. P. Calderón and A. Zygmund, *Singular integrals and periodic functions*, Studia Math. **14** (1954), 249–271.
48. A. P. Calderón and A. Zygmund, *Commutators, singular integrals on Lipschitz curves and applications*, Proceedings of the International Congress of Mathematicians (Helsinki, 1978), pp. 85–96, Acad. Sci. Fennica, Helsinki, 1980.
49. A. P. Calderón and R. Vaillancourt, *A class of bounded pseudo-differential operators*, Proc. Nat. Acad. Sci. USA **69** (1972), 1185–1187.
50. A. Carbery, *The boundedness of the maximal Bochner–Riesz operator on  $L^4(\mathbb{R}^2)$* , Duke Math. J. **50** (1983), 409–416.
51. A. Carbery, E. Hernández, and F. Soria, *Estimates for the Kakeya maximal operator on radial functions in  $\mathbb{R}^n$* , Harmonic Analysis, ICM 1990 Satellite Conference Proceedings, pp. 41–50, S. Igari (ed.), Springer-Verlag, Tokyo, 1991.
52. A. Carbery, J.-L. Rubio de Francia, and L. Vega, *Almost everywhere summability of Fourier integrals*, J. London Math. Soc. **38** (1988), 513–524.
53. L. Carleson, *An interpolation problem for bounded analytic functions*, Amer. J. Math. **80** (1958), 921–930.
54. L. Carleson, *Interpolation by bounded analytic functions and the corona problem*, Ann. of Math. **76** (1962), 547–559.
55. L. Carleson, *On convergence and growth of partial sums of Fourier series*, Acta Math. **116** (1966), 135–157.
56. L. Carleson, *On the Littlewood–Paley Theorem*, Mittag-Leffler Institute Report, Djursholm, Sweden 1967.
57. L. Carleson, *Two remarks on  $H^1$  and B.M.O.*, Adv. in Math. **22** (1976), 269–277.
58. L. Carleson and P. Sjölin, *Oscillatory integrals and a multiplier problem for the disc*, Studia Math. **44** (1972), 287–299.
59. D.-C. Chang, S. G. Krantz, and E. M. Stein,  *$H^p$  theory on a smooth domain in  $\mathbb{R}^N$  and elliptic boundary value problems*, J. Funct. Anal. **114** (1993), 286–347.
60. F. Chiarenza and M. Frasca, *Morrey spaces and Hardy–Littlewood maximal function*, Rend. Mat. Appl. Series 7, **7** (1981), 273–279.
61. M. Christ, *Estimates for the  $k$ -plane transform*, Indiana Univ. Math. J. **33** (1984), 891–910.
62. M. Christ, *On the restriction of the Fourier transform to curves: endpoint results and the degenerate case*, Trans. Amer. Math. Soc. **287** (1985), 223–238.
63. M. Christ, *On almost everywhere convergence of Bochner–Riesz means in higher dimensions*, Proc. Amer. Math. Soc. **95** (1985), 16–20.
64. M. Christ, *Weak type endpoint bounds for Bochner–Riesz multipliers*, Rev. Mat. Iber. **3** (1987), 25–31.
65. M. Christ, *Weak type  $(1, 1)$  bounds for rough operators I*, Ann. of Math. **128** (1988), 19–42.
66. M. Christ, *A  $T(b)$  theorem with remarks on analytic capacity and the Cauchy integral*, Colloq. Math. **60/61** (1990), 601–628.
67. M. Christ, *Lectures on singular integral operators*, CBMS Regional Conference Series in Mathematics, Vol. 77, Amer. Math. Soc., Providence, RI, 1990.
68. M. Christ, J. Duoandikoetxea and J.-L. Rubio de Francia, *Maximal operators related to the Radon transform and the Calderón–Zygmund method of rotations*, Duke Math. J. **53** (1986), 189–209.
69. M. Christ and R. Fefferman, *A note on weighted norm inequalities for the Hardy–Littlewood maximal operator*, Proc. Amer. Math. Soc. **87** (1983), 447–448.
70. M. Christ and J.-L. Journé, *Polynomial growth estimates for multilinear singular integral operators*, Acta Math. **159** (1987), 51–80.
71. R. R. Coifman, *Distribution function inequalities for singular integrals*, Proc. Nat. Acad. Sci. USA **69** (1972), 2838–2839.

72. R. R. Coifman, *A real variable characterization of  $H^p$* , *Studia Math.* **51** (1974), 269–274.
73. R. R. Coifman, D. G. Deng, and Y. Meyer, *Domaine de la racine carée de certaines opérateurs différentiels acréatifs*, *Ann. Inst. Fourier* **33** (1983), 123–134.
74. R. R. Coifman and C. Fefferman, *Weighted norm inequalities for maximal functions and singular integrals*, *Studia Math.* **51** (1974), 241–250.
75. R. R. Coifman and L. Grafakos, *Hardy space estimates for multilinear operators, I*, *Rev. Mat. Iber.* **8** (1992), 45–67.
76. R. R. Coifman, P. Jones, and J. L. Rubio de Francia, *Constructive decomposition of BMO functions and factorization of  $A_p$  weights*, *Proc. Amer. Math. Soc.* **87** (1983), 675–676.
77. R. R. Coifman, P. Jones, and S. Semmes, *Two elementary proofs of the  $L^2$  boundedness of Cauchy integrals on Lipschitz curves*, *J. Amer. Math. Soc.* **2** (1989), 553–564.
78. R. R. Coifman, P. L. Lions, Y. Meyer, and S. Semmes, *Compensated compactness and Hardy spaces*, *J. Math. Pures Appl.* **72** (1993), 247–286.
79. R. R. Coifman, A. M<sup>c</sup>Intosh, Y. Meyer,  *$L^1$  intégrale de Cauchy définit un opérateur borné sur  $L^2$  pour les courbes lipschitziennes*, *Ann. of Math.* **116** (1982), 361–387.
80. R. R. Coifman and Y. Meyer, *Commutateurs d' intégrales singulières et opérateurs multilinéaires*, *Ann. Inst. Fourier (Grenoble)* **28** (1978), 177–202.
81. R. R. Coifman and Y. Meyer, *Au delà des opérateurs pseudo-différentiels*, *Astérisque* No. 57, Société Mathématique de France, 1979.
82. R. R. Coifman and Y. Meyer, *A simple proof of a theorem by G. David and J.-L. Journé on singular integral operators*, *Probability Theory and Harmonic Analysis*, pp. 61–65, J. Chao and W. Woyczyński (eds.), Marcel Dekker, New York, 1986.
83. R. R. Coifman, Y. Meyer, and E. M. Stein, *Some new function spaces and their applications to harmonic analysis*, *J. Funct. Anal.* **62** (1985), 304–335.
84. R. R. Coifman and R. Rochberg, *Another characterization of BMO*, *Proc. Amer. Math. Soc.* **79** (1980), 249–254.
85. R. R. Coifman, R. Rochberg, and G. Weiss, *Factorization theorems for Hardy spaces in several variables*, *Ann. of Math.* **103** (1976), 611–635.
86. R. R. Coifman and G. Weiss, *Extensions of Hardy spaces and their use in analysis*, *Bull. Amer. Math. Soc.* **83** (1977), 569–645.
87. L. Colzani, G. Travaglini, and M. Vignati, *Bochner–Riesz means of functions in weak- $L^p$* , *Monatsh. Math.* **115** (1993), 35–45.
88. W. C. Connett, *Singular integrals near  $L^1$* , *Harmonic analysis in Euclidean spaces*, *Proc. Sympos. Pure Math.* (Williams Coll., Williamstown, Mass., 1978), pp. 163–165, Amer. Math. Soc., Providence, RI, 1979.
89. A. Córdoba, *The Kakeya maximal function and the spherical summation multipliers*, *Amer. J. Math.* **99** (1977), 1–22.
90. A. Córdoba, *A note on Bochner–Riesz operators*, *Duke Math. J.* **46** (1979), 505–511.
91. A. Córdoba, *Multipliers of  $F(L^p)$* , *Euclidean harmonic analysis* (Proc. Sem., Univ. Maryland, College Park, Md., 1979), pp. 162–177, *Lecture Notes in Math.* 779, Springer, Berlin, 1980.
92. A. Córdoba and C. Fefferman, *A weighted norm inequality for singular integrals*, *Studia Math.* **57** (1976), 97–101.
93. A. Córdoba and R. Fefferman, *On differentiation of integrals*, *Proc. Nat. Acad. Sci. USA* **74** (1977), 2211–2213.
94. M. Cotlar, *A combinatorial inequality and its applications to  $L^2$  spaces*, *Rev. Mat. Cuyana*, **1** (1955), 41–55.
95. D. Cruz-Uribe, *New proofs of two-weight norm inequalities for the maximal operator*, *Georgian Math. J.* **7** (2000), 33–42.
96. D. Cruz-Uribe, J. M. Martell, and C. Pérez, *Extrapolation results for  $A_\infty$  weights and applications*, *J. Funct. Anal.* **213** (2004), 412–439.
97. D. Cruz-Uribe, J. M. Martell, and C. Pérez, *Weights, Extrapolation and the Theory of Rubio de Francia*, in preparation.
98. D. Cruz-Uribe SFO and C. J. Neugebauer, *The structure of the reverse Hölder classes*, *Trans. Amer. Math. Soc.* **347** (1995), 2941–2960.



99. F. Cunningham, *The Kakeya problem for simply connected and for star-shaped sets*, Amer. Math. Monthly **78** (1971), 114–129.
100. G. Dafni, *Hardy spaces on some pseudoconvex domains*, J. Geom. Anal. **4** (1994), 273–316.
101. G. Dafni, *Local VMO and weak convergence in  $h^1$* , Can. Math. Bull. **45** (2002), 46–59.
102. G. David, *Opérateurs intégraux singuliers sur certaines courbes du plan complexe*, Ann. Sci. Ecole Norm. Sup. **17** (1984), 157–189.
103. G. David and J.-L. Journé, *A boundedness criterion for generalized Calderón–Zygmund operators*, Ann. of Math. **120** (1984), 371–397.
104. G. David, J.-L. Journé, and S. Semmes, *Opérateurs de Calderón–Zygmund, fonctions para-accrétives et interpolation*, Rev. Math. Iber. **1** (1985), 1–56.
105. G. David and S. Semmes, *Singular integrals and rectifiable sets in  $\mathbb{R}^n$ : Beyond Lipschitz graphs*, Astérisque No. 193, Société Mathématique de France, 1991.
106. K. M. Davis and Y. C. Chang, *Lectures on Bochner–Riesz Means*, London Math. Soc. Lect. Notes **114**, Cambridge Univ. Press, Cambridge, UK, 1987.
107. L. De Carli and A. Iosevich, *A restriction theorem for flat manifolds of codimension two*, Ill. J. Math. **39** (1995), 576–585.
108. L. De Carli and A. Iosevich, *Some sharp restriction theorems for homogeneous manifolds*, J. Fourier Anal. Appl. **4** (1998), 105–128.
109. M. de Guzmán, *Differentiation of Integrals in  $\mathbb{R}^n$* , Lecture Notes in Math. **481**, Springer-Verlag, Berlin, 1985.
110. O. Dragičević, L. Grafakos, C. Pereyra, and S. Petermichl, *Extrapolation and sharp norm estimates for classical operators on weighted Lebesgue spaces*, Publ. Mat. **49** (2005), 73–91.
111. S. W. Drury,  *$L^p$  estimates for the  $x$ -ray transform*, Ill. J. Math. **27** (1983), 125–129.
112. S. W. Drury, *Restrictions of Fourier transforms to curves*, Ann. Inst. Fourier (Grenoble) **35** (1985), 117–123.
113. S. W. Drury and K. Guo, *Some remarks on the restriction of the Fourier transform to surfaces*, Math. Proc. Cambridge Philos. Soc. **113** (1993), 153–159.
114. S. W. Drury and B. P. Marshall, *Fourier restriction theorems for curves with affine and Euclidean arclengths*, Math. Proc. Cambridge Philos. Soc. **97** (1985), 111–125.
115. S. W. Drury and B. P. Marshall, *Fourier restriction theorems for degenerate curves*, Math. Proc. Cambridge Philos. Soc. **101** (1987), 541–553.
116. J. Duoandikoetxea, *Fourier Analysis*, Grad. Studies in Math. **29**, Amer. Math. Soc., Providence, RI, 2000.
117. P. L. Duren, *Theory of  $H^p$  Spaces*, Dover Publications Inc., New York, 2000.
118. P. L. Duren, B. W. Romberg, and A. L. Shields, *Linear functionals on  $H^p$  spaces with  $0 < p < 1$* , J. Reine Angew. Math. **238** (1969), 32–60.
119. E. Fabes, D. Jerison, and C. Kenig, *Multilinear Littlewood–Paley estimates with applications to partial differential equations*, Proc. Nat. Acad. Sci. USA **79** (1982), 5746–5750.
120. E. Fabes, D. Jerison, and C. Kenig, *Multilinear square functions and partial differential equations*, Amer. J. Math. **107** (1985), 1325–1367.
121. E. Fabes, I. Mitrea, and M. Mitrea, *On the boundedness of singular integrals*, Pac. J. Math. **189** (1999), 21–29.
122. K. Fan, *Minimax theorems*, Proc. Nat. Acad. Sci. USA **39** (1953), 42–47.
123. C. Fefferman, *Inequalities for strongly singular convolution operators*, Acta Math. **124** (1970), 9–36.
124. C. Fefferman, *Characterizations of bounded mean oscillation*, Bull. Amer. Math. Soc. **77** (1971), 587–588.
125. C. Fefferman, *The multiplier problem for the ball*, Ann. of Math. **94** (1971), 330–336.
126. C. Fefferman, *Pointwise convergence of Fourier series*, Ann. of Math. **98** (1973), 551–571.
127. C. Fefferman, *A note on spherical summation multipliers*, Israel J. Math. **15** (1973), 44–52.

128. C. Fefferman, N. Riviere, and Y. Sagher, *Interpolation between  $H^p$  spaces: The real method*, Trans. Amer. Math. Soc. **191** (1974), 75–81.
129. C. Fefferman and E. M. Stein, *Some maximal inequalities*, Amer. J. Math. **93** (1971), 107–115.
130. C. Fefferman and E. M. Stein,  *$H^p$  spaces of several variables*, Acta Math. **129** (1972), 137–193.
131. T. M. Flett, *Lipschitz spaces of functions on the circle and the disc*, J. Math. Anal. Appl. **39** (1972), 125–158.
132. G. B. Folland and E. M. Stein, *Estimates for the  $\bar{\partial}_b$  complex and analysis on the Heisenberg group*, Comm. Pure and Appl. Math. **27** (1974), 429–522.
133. G. B. Folland and E. M. Stein, *Hardy Spaces on Homogeneous Groups*, Mathematical Notes 28, Princeton Univ. Press, Princeton, NJ, 1982.
134. J. Fourier, *Théorie Analytique de la Chaleur*, Institut de France, Paris, 1822.
135. M. Frazier and B. Jawerth, *Decomposition of Besov spaces*, Indiana Univ. Math. J. **34** (1985), 777–799.
136. M. Frazier and B. Jawerth, *A discrete transform and decompositions of distribution spaces*, J. Funct. Anal. **93** (1990), 34–170.
137. M. Frazier and B. Jawerth, *Applications of the  $\varphi$  and wavelet transforms to the theory of function spaces*, Wavelets and Their Applications, pp. 377–417, Jones and Bartlett (eds.), Boston, MA, 1992.
138. M. Frazier, B. Jawerth, and G. Weiss, *Littlewood–Paley Theory and the Study of Function Spaces*, CBMS Regional Conference Series in Mathematics, 79, Amer. Math. Soc. Providence, RI, 1991.
139. E. Gagliardo, *Proprietà di alcune classi di funzioni in più variabili*, Ricerche di Mat. Napoli **7** (1958), 102–137.
140. J. García-Cuerva, *An extrapolation theorem in the theory of  $A_p$  weights*, Proc. Amer. Math. Soc. **87** (1983), 422–426.
141. J. García-Cuerva and J.-L. Rubio de Francia, *Weighted Norm Inequalities and Related Topics*, North-Holland Math. Studies **116**, North-Holland, Amsterdam, 1985.
142. J. Garnett, *Bounded Analytic Functions*, Academic Press, New York, 1981.
143. J. Garnett and P. Jones, *The distance in  $BMO$  to  $L^\infty$* , Ann. of Math. **108** (1978), 373–393.
144. J. Garnett and P. Jones,  *$BMO$  from dyadic  $BMO$* , Pacific J. Math. **99** (1982), 351–371.
145. F. W. Gehring, *The  $L^p$ -integrability of the partial derivatives of a quasiconformal mapping*, Acta Math. **130** (1973), 265–277.
146. D. Goldberg, *A local version of real Hardy spaces*, Duke Math. J. **46** (1979), 27–42.
147. I. Gohberg and N. Krupnik, *Norm of the Hilbert transformation in the  $L_p$  space*, Funct. Anal. Appl. **2** (1968), 180–181.
148. L. Grafakos and N. Kalton, *Some remarks on multilinear maps and interpolation*, Math. Ann. **319** (2001), 151–180.
149. L. Grafakos and N. Kalton, *Multilinear Calderón–Zygmund operators on Hardy spaces*, Collect. Math. **52** (2001), 169–179.
150. L. Grafakos and X. Li, *Uniform bounds for the bilinear Hilbert transforms I*, Ann. of Math., **159** (2004), 889–933.
151. L. Grafakos and J. M. Martell, *Extrapolation of weighted norm inequalities for multivariable operators and applications* J. Geom. Anal. **14** (2004), 19–46.
152. L. Grafakos, J. M. Martell, and F. Soria, *Weighted norm inequalities for maximally modulated singular integral operators*, Math. Ann. **331** (2005), 359–394.
153. L. Grafakos, T. Tao, and E. Terwilleger,  *$L^p$  bounds for a maximal dyadic sum operator*, Math. Zeit. **246** (2004), 321–337.
154. L. Grafakos and R. H. Torres, *Multilinear Calderón–Zygmund theory*, Adv. in Math. **165** (2002), 124–164.
155. A. Greenleaf, *Principal curvature and harmonic analysis*, Indiana Univ. Math. J. **30** (1981), 519–537.
156. G. H. Hardy, *The mean value of the modulus of an analytic function*, Proc. London Math. Soc. **14** (1914), 269–277.

157. G. H. Hardy and J. E. Littlewood, *Some properties of fractional integrals I*, Math. Zeit. **27** (1927), 565–606.
158. G. H. Hardy and J. E. Littlewood, *Some properties of fractional integrals II*, Math. Zeit. **34** (1932), 403–439.
159. G. H. Hardy and J. E. Littlewood, *Some theorems on Fourier series and Fourier power series*, Duke Math. J. **2** (1936), 354–381.
160. G. H. Hardy and J. E. Littlewood, *Generalizations of a theorem of Paley*, Quarterly Jour. **8** (1937), 161–171.
161. L. Hedberg, *On certain convolution inequalities*, Proc. Amer. Math. Soc. **36** (1972), 505–510.
162. H. Helson and G. Szegő, *A problem in prediction theory*, Ann. Math. Pura Appl. **51** (1960), 107–138.
163. C. Herz, *On the mean inversion of Fourier and Hankel transforms*, Proc. Nat. Acad. Sci. USA **40** (1954), 996–999.
164. S. Hofmann and A. M<sup>c</sup>Intosh, *The solution of the Kato problem in two dimensions*, Proceedings of the 6th International Conference on Harmonic Analysis and Partial Differential Equations (El Escorial, Spain, 2000), pp. 143–160, Publ. Mat. Extra Volume, 2002.
165. S. Hofmann, M. Lacey, and A. M<sup>c</sup>Intosh, *The solution of the Kato problem for divergence form elliptic operators with Gaussian heat kernel bounds*, Ann. of Math. **156** (2002), 623–631.
166. L. Hörmander, *Linear Partial Differential Operators*, Springer-Verlag, Berlin–Göttingen–Heidelberg, 1963.
167. L. Hörmander, *Oscillatory integrals and multipliers on  $FL^p$* , Arkiv f. Mat. **11** (1973), 1–11.
168. L. Hörmander, *The Analysis of Linear Partial Differential Operators I*, 2nd ed., Springer-Verlag, Berlin–Heidelberg–New York, 1990.
169. S. V. Hrusčev, *A description of weights satisfying the  $A_\infty$  condition of Muckenhoupt*, Proc. Amer. Math. Soc. **90** (1984), 253–257.
170. R. Hunt, *On the convergence of Fourier series*, Orthogonal Expansions and Their Continuous Analogues (Edwardsville, Ill., 1967), pp. 235–255, D. T. Haimo (ed.), Southern Illinois Univ. Press, Carbondale IL, 1968.
171. R. Hunt, D. Kurtz, and C. J. Neugebauer, *A note on the equivalence of  $A_p$  and Sawyer's condition*, Conference on Harmonic Analysis in honor of Antoni Zygmund, Vol. 1, pp. 156–158, W. Beckner et al. (eds.), Wadsworth, Belmont, 1983.
172. R. Hunt, B. Muckenhoupt, and R. Wheeden, *Weighted norm inequalities for the conjugate function and the Hilbert transform*, Trans. Amer. Math. Soc. **176** (1973), 227–251.
173. R. Hunt and W.-S. Young, *A weighted norm inequality for Fourier series*, Bull. Amer. Math. Soc. **80** (1974), 274–277.
174. S. Igari, *An extension of the interpolation theorem of Marcinkiewicz II*, Tôhoku Math. J. **15** (1963), 343–358.
175. S. Igari, *On Kakeya's maximal function*, Proc. Japan Acad. Ser. A Math. Sci. **62** (1986), 292–293.
176. S. Janson, *Mean oscillation and commutators of singular integral operators*, Ark. Math. **16** (1978), 263–270.
177. F. John and L. Nirenberg, *On functions of bounded mean oscillation*, Comm. Pure and Appl. Math. **14** (1961), 415–426.
178. P. Jones, *Factorization of  $A_p$  weights*, Ann. of Math. **111** (1980), 511–530.
179. O. G. Jørsboe and L. Melbro, *The Carleson–Hunt Theorem on Fourier Series*, Lect. Notes in Math. 911, Springer-Verlag, Berlin, 1982.
180. J.-L. Journé, *Calderón–Zygmund Operators, Pseudo-Differential Operators and the Cauchy Integral of Calderón*, Lect. Notes in Math. 994, Springer-Verlag, Berlin, 1983.
181. T. Kato, *Fractional powers of dissipative operators*, J. Math. Soc. Japan **13** (1961), 246–274.
182. N. Katz, *A counterexample for maximal operators over a Cantor set of directions*, Math. Res. Lett. **3** (1996), 527–536.

183. N. Katz, *Maximal operators over arbitrary sets of directions*, Duke Math. J. **97** (1999), 67–79.
184. N. Katz, *Remarks on maximal operators over arbitrary sets of directions*, Bull. London Math. Soc. **31** (1999), 700–710.
185. N. Katz, I. Laba, and T. Tao, *An improved bound on the Minkowski dimension of Besicovitch sets in  $\mathbb{R}^3$* , Ann. of Math. **152** (2000), 383–446.
186. N. Katz and T. Tao, *Recent progress on the Kakeya conjecture*, Proceedings of the 6th International Conference on Harmonic Analysis and Partial Differential Equations (El Escorial, Spain, 2000), pp. 161–179, Publ. Mat. Extra Volume, 2002.
187. U. Keich, *On  $L^p$  bounds for Kakeya maximal functions and the Minkowski dimension in  $\mathbb{R}^2$* , Bull. London Math. Soc. **31** (1999), 213–221.
188. C. Kenig and Y. Meyer, *Kerato's square roots of accretive operators and Cauchy kernels on Lipschitz curves are the same*, Recent progress in Fourier analysis (El Escorial, Spain, 1983), pp. 123–143, North-Holland Math. Stud., 111, North-Holland, Amsterdam, 1985.
189. C. Kenig and E. M. Stein, *Multilinear estimates and fractional integration*, Math. Res. Lett. **6** (1999), 1–15.
190. A. Knapp and E. M. Stein, *Intertwining operators for semisimple groups*, Ann. of Math. **93** (1971), 489–578.
191. A. N. Kolmogorov, *Une série de Fourier–Lebesgue divergente presque partout*, Fund. Math. **4** (1923), 324–328.
192. A. N. Kolmogorov, *Une série de Fourier–Lebesgue divergente partout*, C. R. Acad. Sci. Paris **183** (1926), 1327–1328.
193. S. V. Konyagin, *On everywhere divergence of trigonometric Fourier series*, Sbornik: Mathematics **191** (2000), 97–120.
194. P. Koosis, *Sommabilité de la fonction maximale et appartenance à  $H_1$* , C. R. Acad. Sci. Paris **28** (1978), 1041–1043.
195. P. Koosis, *Introduction to  $H_p$  Spaces*, 2nd ed., Cambridge Tracts in Math. 115, Cambridge Univ. Press, Cambridge, UK, 1998.
196. A. A. Korenovskyy, A. K. Lerner, and A. M. Stokolos, *A note on the Gurov–Reshetnyak condition*, Math. Res. Lett. **9** (2002), 579–585.
197. T. Körner, *Everywhere divergent Fourier series*, Colloq. Math. **45** (1981), 103–118.
198. S. G. Krantz, *Fractional integration on Hardy spaces*, Studia Math. **63** (1982), 87–94.
199. S. G. Krantz, *Lipschitz spaces, smoothness of functions, and approximation theory*, Exposition. Math. **1** (1983), 193–260.
200. M. G. Krein, *On linear continuous operators in functional spaces with two norms*, Trudy Inst. Mat. Akad. Nauk Ukrain. SSR **9** (1947), 104–129.
201. D. Kurtz, *Operator estimates using the sharp function*, Pacific J. Math. **139** (1989), 267–277.
202. D. Kurtz and R. Wheeden, *Results on weighted norm inequalities for multipliers*, Trans. Amer. Math. Soc. **255** (1979), 343–362.
203. M. T. Lacey and C. M. Thiele,  *$L^p$  bounds for the bilinear Hilbert transform,  $p > 2$* , Ann. of Math. **146** (1997), 693–724.
204. M. Lacey and C. Thiele, *On Calderón's conjecture*, Ann. of Math. **149** (1999), 475–496.
205. M. Lacey and C. Thiele, *A proof of boundedness of the Carleson operator*, Math. Res. Lett. **7** (2000), 361–370.
206. R. H. Latter, *A decomposition of  $H^p(\mathbb{R}^n)$  in terms of atoms*, Studia Math. **62** (1977), 92–101.
207. R. H. Latter and A. Uchiyama, *The atomic decomposition for parabolic  $H^p$  spaces*, Trans. Amer. Math. Soc. **253** (1979), 391–398.
208. A. K. Lerner, *On pointwise estimates for maximal and singular integral operators*, Studia Math. **138** (2000), 285–291.
209. A. K. Lerner, *An elementary approach to several results on the Hardy–Littlewood maximal operator*, Proc. Amer. Math. Soc., **136** (2008), 2829–2833.
210. A. Lerner, S. Ombrosi, C. Pérez, R. H. Torres, and R. Trujillo-González, *New maximal functions and multiple weights for the multilinear Calderón–Zygmund theory*, to appear.

211. A. Lerner, S. Ombrosi, and C. Pérez, *Sharp  $A_1$  bounds for Calderón–Zygmund operators and the relationship with a problem of Muckenhoupt and Wheeden*, Internat. Math. Res. Notices (2008) Vol. **2008** article ID rnm161, 11 pages, doi:10.1093/imrn/rnm161.
212. X. Li, *Uniform bounds for the bilinear Hilbert transforms II*, Rev. Mat. Iber. **22** (2006), 1069–1126.
213. E. H. Lieb, *Sharp constants in the Hardy–Littlewood–Sobolev and related inequalities*, Ann. of Math. **18** (1983), 349–374.
214. E. H. Lieb and M. Loss, *Analysis*, Grad. Studies in Math. **14**, Amer. Math. Soc., Providence, RI, 1997.
215. J.-L. Lions, *Espaces d' interpolation and domaines de puissances fractionnaires*, J. Math. Soc. Japan **14** (1962), 233–241.
216. J.-L. Lions, P. I. Lizorkin, and S. M. Nikol'skij, *Integral representation and isomorphic properties of some classes of functions*, Ann. Sc. Norm. Sup. Pisa **19** (1965), 127–178.
217. L. Liu and D. Yang, *Boundedness of sublinear operators in Triebel–Lizorkin spaces via atoms*, to appear.
218. P. I. Lizorkin, *Properties of functions of the spaces  $\Lambda_{p\Theta}^r$*  [in Russian], Trudy Mat. Inst. Steklov **131** (1974), 158–181.
219. S.-Z. Lu, *Four Lectures on Real  $H^p$  Spaces*, World Scientific, Singapore, 1995.
220. A. McIntosh, *On the comparability of  $A^{1/2}$  and  $A^{*1/2}$* , Proc. Amer. Math. Soc. **32** (1972), 430–434.
221. A. McIntosh, *Square roots of elliptic operators*, J. Funct. Anal. **61** (1985), 307–327.
222. A. McIntosh, *On representing closed accretive sesquilinear forms as  $(A^{1/2}u, A^{*1/2}v)$* , Collège de France Seminar, Vol. III, pp. 252–267, H. Brezis and J.-L. Lions (eds.), Research Notes in Mathematics, No. 70, Pitman, 1982.
223. A. McIntosh, *Square roots of operators and applications to hyperbolic PDE*, Proceedings of the Miniconference on Operator Theory and PDE, CMA, The Australian National University, Canberra, 1983.
224. A. McIntosh and Y. Meyer, *Algèbres d' opérateurs définis par des intégrales singulières* C. R. Acad. Sci. Paris **301** (1985), 395–397.
225. D. Maldonado and V. Naibo, *Weighted norm inequalities for paraproducts and bilinear pseudodifferential operators with mild regularity*, to appear.
226. G. Mauzeri, M. Picardello, and F. Ricci, *A Hardy space associated with twisted convolution*, Adv. in Math. **39** (1981), 270–288.
227. P. Mattila, *Geometry of sets and measures in Euclidean spaces. Fractals and rectifiability*, Cambridge Studies in Advanced Mathematics, 44, Cambridge Univ. Press, Cambridge, UK, 1995.
228. B. Maurey, *Théorèmes de factorization pour les opérateurs linéaires à valeurs dans un espace  $L^p$* , Astérisque No. 11, Société Mathématique de France, 1974.
229. V. G. Maz'ya, *Sobolev Spaces*, Springer-Verlag, Berlin–New York, 1985.
230. S. Meda, P. Sjögren, and M. Vallarino, *On the  $H^1 - L^1$  boundedness of operators*, Proc. Amer. Math. Soc. **136** (2008), 2921–2931.
231. M. Melnikov and J. Verdera, *A geometric proof of the  $L^2$  boundedness of the Cauchy integral on Lipschitz graphs*, Internat. Math. Res. Notices **7** (1995), 325–331.
232. Y. Meyer, *Régularité des solutions des équations aux dérivées partielles non linéaires* [d'après J.-M. Bony], Séminaire Bourbaki, 1979/80, No. 560.
233. Y. Meyer, M. Taibleson, and G. Weiss, *Some functional analytic properties of the spaces  $B_q$  generated by blocks*, Indiana Univ. Math. J. **34** (1985), 493–515.
234. N. G. Meyers, *Mean oscillation over cubes and Hölder continuity*, Proc. Amer. Math. Soc. **15** (1964), 717–721.
235. A. P. Morse, *Perfect blankets*, Trans. Amer. Math. Soc. **69** (1947), 418–442.
236. C. J. Mozzochi, *On the pointwise convergence of Fourier Series*, Lect. Notes in Math. 199, Springer, Berlin 1971.
237. B. Muckenhoupt, *Weighted norm inequalities for the Hardy maximal function*, Trans. Amer. Math. Soc. **165** (1972), 207–226.

238. B. Muckenhoupt, *The equivalence of two conditions for weight functions*, Studia Math. **49** (1974), 101–106.
239. B. Muckenhoupt and R. L. Wheeden, *Two weight function norm inequalities for the Hardy–Littlewood maximal function and the Hilbert transform*, Studia Math. **55** (1976), 279–294.
240. D. Müller, *A note on the Kakeya maximal function*, Arch. Math. (Basel) **49** (1987), 66–71.
241. T. Murai, *Boundedness of singular integral operators of Calderón type*, Proc. Japan Acad. Ser. A Math. Sci. **59** (1983), 364–367.
242. T. Murai, *A real variable method for the Cauchy transform and analytic capacity*, Lect. Notes in Math. 1307, Springer-Verlag, Berlin, 1988.
243. N. I. Muskhelishvili, *Singular Integral Equations*, Wolters-Noordhoff Publishing, Groningen, the Netherlands, 1958.
244. A. Nagel, E. M. Stein, and S. Wainger, *Differentiation in lacunary directions*, Proc. Nat. Acad. Sci. USA **75** (1978), 1060–1062.
245. F. Nazarov, S. Treil, and A. Volberg, *Cauchy integral and Calderón–Zygmund operators on nonhomogeneous spaces*, Internat. Math. Res. Notices **15** (1997), 703–726.
246. F. Nazarov, S. Treil, and A. Volberg, *Weak type estimates and Cotlar inequalities for Calderón–Zygmund operators on nonhomogeneous spaces*, Internat. Math. Res. Notices **9** (1998), 463–487.
247. F. Nazarov, S. Treil, and A. Volberg, *The Bellman functions and two-weight inequalities for Haar multipliers*, J. Amer. Math. Soc. **12** (1999), 909–928.
248. F. Nazarov, S. Treil, and A. Volberg, *Bellman function in stochastic control and harmonic analysis. Systems, approximation, singular integral operators, and related topics*, Oper. Theory Adv. Appl., Vol. 129, pp. 393–423, Birkhäuser-Verlag, Basel, 2001.
249. L. Nirenberg, *On elliptic partial differential equations*, Ann. di Pisa **13** (1959), 116–162.
250. D. Oberlin, *Fourier restriction for affine arclength measures in the plane*, Proc. Amer. Math. Soc. **129** (2001), 3303–3305.
251. M. W. Orlicz, *Über eine gewisse Klasse von Räumen vom Typus B*, Bull. Int. Acad. Pol. de Science, Ser A (1932), 207–220; reprinted in W. Orlicz “Collected Papers,” pp. 217–230, PWN, Warsaw, 1988.
252. M. W. Orlicz, *Über Räume ( $L^M$ )*, Bull. Int. Acad. Pol. de Science, Ser A (1936), 93–107; reprinted in W. Orlicz “Collected Papers,” pp. 345–359, PWN, Warsaw, 1988.
253. J. Oröbitg and C. Pérez,  *$A_p$  weights for nondoubling measures in  $R^n$  and applications*, Trans. Amer. Math. Soc. **354** (2002), 2013–2033.
254. J. Peetre, *On convolution operators leaving  $L^{p,\lambda}$  spaces invariant*, Ann. Mat. Pura Appl. **72** (1966), 295–304.
255. J. Peetre, *Sur les espaces de Besov*, C. R. Acad. Sci. Paris **264** (1967), 281–283.
256. J. Peetre, *Remarques sur les espaces de Besov. Le cas  $0 < p < 1$* , C. R. Acad. Sci. Paris **277** (1973), 947–950.
257. J. Peetre,  *$H_p$  Spaces*, Lecture Notes, University of Lund and Lund Institute of Technology, Lund, Sweden 1974.
258. J. Peetre, *On spaces of Triebel–Lizorkin type*, Ark. Math. **13** (1975), 123–130.
259. C. Pérez, *Weighted norm inequalities for singular integral operators*, J. London Math. Soc. **49** (1994), 296–308.
260. C. Pérez, *Endpoint estimates for commutators of singular integral operators*, J. Funct. Anal. **128** (1995), 163–185.
261. C. Pérez, *Sharp estimates for commutators of singular integrals via iterations of the Hardy–Littlewood maximal function*, J. Fourier Anal. Appl. **3** (1997), 743–756.
262. C. Pérez, *Some topics from Calderón–Zygmund theory related to Poincaré–Sobolev inequalities, fractional integrals and singular integral operators*, Function Spaces, Nonlinear Analysis and Applications, Lecture Notes of the Spring lectures in Analysis in Paseky. Editors: Jaroslav Lukes and Lubos Pick, (1999), 31–94.
263. C. Pérez and R. Wheeden, *Uncertainty principle estimates for vector fields*, J. Funct. Anal. **181** (2001), 146–188.

264. S. Petermichl, *The sharp bound for the Hilbert transform on weighted Lebesgue spaces in terms of the classical  $A_p$  characteristic*, Amer. J. Math. **129** (2007), 1355–1375.
265. J. Plemelj, *Ein Ergänzungssatz zur Cauchyschen Integraldarstellung analytischer Funktionen, Randwerte betreffend*, Monatsh. Math. Phys. **19** (1908), 205–210.
266. M. Pramanik and E. Terwilleger, *A weak  $L^2$  estimate for a maximal dyadic sum operator on  $\mathbf{R}^n$* , Ill. J. Math. **47** (2003), 775–813
267. E. Prestini, *A restriction theorem for space curves*, Proc. Amer. Math. Soc. **70** (1978), 8–10.
268. J. Privalov, *Sur les fonctions conjuguées*, Bull. Soc. Math. France **44** (1916), 100–103.
269. M. M. Rao and Z. D. Ren, *Theory of Orlicz spaces*, Pure and Applied Mathematics, Marcel Dekker, New York–Basel–Hong Kong, 1991.
270. M. Riesz,  *$L'$  intégrale de Riemann-Liouville et le problème de Cauchy*, Acta Math. **81** (1949), 1–223.
271. N. Riviere and Y. Sagher, *Interpolation between  $L^\infty$  and  $H^1$ , the real method*, J. Funct. Anal. **14** (1973), 401–409.
272. M. Rosenblum, *Summability of Fourier series in  $L^p(\mu)$* , Trans. Amer. Math. Soc. **105** (1962), 32–42.
273. J.-L. Rubio de Francia, *Estimates for some square functions of Littlewood–Paley type*, Publ. Mat. **27** (1983), 81–108.
274. J.-L. Rubio de Francia, *Factorization theory and  $A_p$  weights*, Amer. J. Math. **106** (1984), 533–547.
275. J.-L. Rubio de Francia, *Weighted norm inequalities and vector-valued inequalities*, Harmonic Analysis, (Minneapolis, Minn., 1981), pp. 86–101, Lect. Notes in Math. 908, Springer-Verlag, Berlin–Heidelberg–New York, 1982.
276. J.-L. Rubio de Francia, F. J. Ruiz, and J. L. Torrea, *Calderón–Zygmund theory for operator-valued kernels*, Adv. in Math. **62** (1986), 7–48.
277. D. Sarason, *Functions of bounded mean oscillation*, Trans. Amer. Math. Soc. **207** (1975), 391–405.
278. E. Sawyer, *A characterization of a two-weight norm inequality for maximal operators*, Studia Math. **75** (1982), 1–11.
279. W. Schlag, *A geometric inequality with applications to the Kakeya problem in three dimensions*, Geom. Funct. Anal. **8** (1998), 606–625.
280. A. Seeger, *Endpoint inequalities for Bochner–Riesz multipliers in the plane*, Pacific J. Math. **174** (1996), 543–553.
281. S. Semmes, *Square function estimates and the  $T(b)$  theorem*, Proc. Amer. Math. Soc. **110** (1990), 721–726.
282. R. Sharpley, *Multilinear weak type interpolation of  $mn$ -tuples with applications*, Studia Math. **60** (1977), 179–194.
283. P. Sjölin, *On the convergence almost everywhere of certain singular integrals and multiple Fourier series*, Arkiv f. Math. **9** (1971), 65–90.
284. P. Sjölin and F. Soria, *Some remarks on restriction of the Fourier transform for general measures*, Publ. Mat. **43** (1999), 655–664.
285. S. L. Sobolev, *On a theorem in functional analysis* [in Russian], Mat. Sob. **46** (1938), 471–497.
286. S. Spanne, *Sur  $l'$  interpolation entre les espaces  $\mathcal{L}_k^{p,\Phi}$* , Ann. Scuola Norm. Sup. Pisa **20** (1966), 625–648.
287. E. M. Stein, *Interpolation of linear operators*, Trans. Amer. Math. Soc. **83** (1956), 482–492.
288. E. M. Stein, *Note on singular integrals*, Proc. Amer. Math. Soc. **8** (1957), 250–254.
289. E. M. Stein, *On limits of sequences of operators*, Ann. of Math. **74** (1961), 140–170.
290. E. M. Stein, *Singular integrals, harmonic functions, and differentiability properties of functions of several variables*, in Singular Integrals, Proc. Sympos. Pure Math. (Chicago, Ill., 1966), pp. 316–335, Amer. Math. Soc., Providence, RI, 1967.

291. E. M. Stein, *Oscillatory integrals in Fourier analysis*, Beijing Lectures in Harmonic Analysis, pp. 307–355, E. M. Stein (ed.), Annals of Math. Studies 112, Princeton Univ. Press, Princeton, NJ, 1986.
292. E. M. Stein, *Harmonic Analysis, Real Variable Methods, Orthogonality, and Oscillatory Integrals*, Princeton Univ. Press, Princeton, NJ, 1993.
293. E. M. Stein and G. Weiss, *On the theory of harmonic functions of several variables, I: The theory of  $H^p$  spaces*, Acta Math. **103** (1960), 25–62.
294. R. Strichartz, *Restrictions of Fourier transforms to quadratic surfaces and decay of solutions of wave equations*, Duke Math. J. **44** (1977), 705–713.
295. J.-O. Strömberg, *Maximal functions for rectangles with given directions*, Doctoral dissertation, Mittag-Leffler Institute, Djursholm, Sweden, 1976.
296. J.-O. Strömberg, *Maximal functions associated to rectangles with uniformly distributed directions*, Ann. of Math. **107** (1978), 399–402.
297. J.-O. Strömberg, *Bounded mean oscillation with Orlicz norms and duality of Hardy spaces*, Indiana Univ. Math. J. **28** (1979), 511–544.
298. J.-O. Strömberg and A. Torchinsky, *Weighted Hardy spaces*, Lect. Notes in Mathematics 1381, Springer-Verlag, Berlin–New York, 1989.
299. M. Taibleson, *The preservation of Lipschitz spaces under singular integral operators*, Studia Math. **24** (1963), 105–111.
300. M. Taibleson, *On the theory of Lipschitz spaces of distributions on Euclidean  $n$ -space, I*, J. Math. Mech. **13** (1964), 407–480.
301. M. Taibleson, *On the theory of Lipschitz spaces of distributions on Euclidean  $n$ -space, II*, J. Math. Mech. **14** (1965), 821–840.
302. M. Taibleson, *On the theory of Lipschitz spaces of distributions on Euclidean  $n$ -space, III*, J. Math. Mech. **15** (1966), 973–981.
303. T. Tao, *Weak type endpoint bounds for Riesz means*, Proc. Math. Amer. Soc. **124** (1996), 2797–2805.
304. T. Tao, *The weak-type endpoint Bochner–Riesz conjecture and related topics*, Indiana Univ. Math. J. **47** (1998), 1097–1124.
305. T. Tao, *The Bochner–Riesz conjecture implies the restriction conjecture*, Duke Math. J. **96** (1999), 363–375.
306. T. Tao, *Endpoint bilinear restriction theorems for the cone, and some sharp null form estimates*, Math. Zeit. **238** (2001), 215–268.
307. T. Tao, *On the Maximal Bochner–Riesz conjecture in the plane, for  $p < 2$* , Trans. Amer. Math. Soc. **354** (2002), 1947–1959.
308. T. Tao, A. Vargas, and L. Vega, *A bilinear approach to the restriction and Kakeya conjectures*, J. Amer. Math. Soc. **11** (1998), 967–1000.
309. M. Taylor, *Pseudodifferential Operators and Nonlinear PDE*, Progress in mathematics 100, Birkhäuser, Boston, 1991.
310. P. Tchamitchian, *Ondelettes et intégrale de Cauchy sur les courbes lipschitziennes*, Ann. of Math. **129** (1989), 641–649.
311. C. Thiele, *A uniform estimate*, Ann. of Math. **157** (2002), 1–45.
312. C. Thiele, *Multilinear singular integrals*, Proceedings of the 6th International Conference on Harmonic Analysis and Partial Differential Equations (El Escorial, Spain, 2000), pp. 229–274, Publ. Mat. Extra Volume, 2002.
313. P. A. Tomas, *A restriction theorem for the Fourier transform*, Bull. Amer. Math. Soc. **81** (1975), 477–478.
314. P. A. Tomas, *A note on restriction*, Indiana Univ. Math. J. **29** (1980), 287–292.
315. R. H. Torres, *Boundedness results for operators with singular kernels on distribution spaces*, Mem. Amer. Math. Soc., No. 442, 1991.
316. H. Triebel, *Spaces of distributions of Besov type on Euclidean  $n$ -space. Duality, interpolation*, Ark. Math. **11** (1973), 13–64.
317. H. Triebel, *Theory of function spaces*, Monographs in Math. Vol. 78, Birkhäuser-Verlag, Basel–Boston–Stuttgart, 1983.



318. A. Uchiyama, *A constructive proof of the Fefferman-Stein decomposition of  $BMO(\mathbf{R}^n)$* , Acta Math. **148** (1982), 215–241.
319. A. Uchiyama, *Characterization of  $H^p(\mathbf{R}^n)$  in terms of generalized Littlewood–Paley  $g$ -function*, Studia Math. **81** (1985), 135–158.
320. A. Uchiyama, *On the characterization of  $H^p(\mathbf{R}^n)$  in terms of Fourier multipliers*, Proc. Amer. Math. Soc. **109** (1990), 117–123.
321. A. Uchiyama, *Hardy Spaces on the Euclidean Space*, Springer Monographs in Mathematics, Springer-Verlag, Tokyo, 2001.
322. A. Vargas, *Bochner–Riesz multipliers, Maximal operators, Restriction theorems in  $\mathbf{R}^n$* , Lecture Notes given at MSRI, August 1997.
323. N. Varopoulos,  *$BMO$  functions and the  $\bar{\partial}$ -equation*, Pacific J. Math. **71** (1977), 221–273.
324. I. E. Verbitsky, *Weighted norm inequalities for maximal operators and Pisier’s theorem on factorization through  $L^{p,\infty}$* , Integral Equations Operator Theory **15** (1992), 124–153.
325. I. E. Verbitsky, *A dimension-free Carleson measure inequality*, Operator Theory: Advances and Applications, Vol. 113, pp. 393–398, Birkhäuser-Verlag, Basel, Switzerland, 2000.
326. J. Verdera,  *$L^2$  boundedness of the Cauchy Integral and Menger curvature*, Contemp. Math. **277** (2001), 139–158.
327. T. Walsh, *The dual of  $H^p(\mathbb{R}^{n+1})$  for  $p < 1$* , Can. J. Math. **25** (1973), 567–577.
328. G. Weiss, *An interpolation theorem for sublinear operators on  $H^p$  spaces*, Proc. Amer. Math. Soc. **8** (1957), 92–99.
329. G. V. Welland, *Weighted norm inequalities for fractional integrals*, Proc. Amer. Math. Soc. **51** (1975), 143–148.
330. H. Weyl, *Bemerkungen zum Begriff der Differentialquotient gebrochener Ordnung*, Viertel Natur. Gesellschaft Zürich **62** (1917), 296–302.
331. H. Whitney, *Analytic extensions of differentiable functions defined in closed sets*, Trans. Amer. Math. Soc. **36** (1934), 63–89.
332. J. M. Wilson, *On the atomic decomposition for Hardy spaces*, Pacific J. Math. **116** (1985), 201–207.
333. J. M. Wilson, *Weighted norm inequalities for the continuous square function*, Trans. Amer. Math. Soc. **314** (1989), 661–692.
334. M. Wilson, *Weighted Littlewood–Paley Theory and Exponential-Square Function Integrability*, Lec. Notes in Math. 1924 Springer-Verlag, Berlin, Heidelberg, 2008.
335. T. H. Wolff, *An improved bound for Keakeya type maximal functions*, Rev. Mat. Iber. **11** (1995), 651–674.
336. T. H. Wolff, *Recent work connected with the Keakeya problem*, Prospects in Mathematics, pp. 129–162, H. Rossi (ed.), Amer. Math. Soc., Providence, RI, 1998.
337. T. H. Wolff, *A sharp bilinear cone restriction estimate*, Ann. of Math. **153** (2001), 661–698.
338. D. Yang and Y. Zhou, *A boundedness criterion via atoms for linear operators in Hardy spaces*, Constr. Approx., to appear.
339. A. Zygmund, *On a theorem of Marcinkiewicz concerning interpolation of operators*, Jour. de Math. Pures et Appliquées **35** (1956), 223–248.
340. A. Zygmund, *On Fourier coefficients and transforms of functions of two variables*, Studia Math. **50** (1974), 198–201.

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